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The Effect of 9 Weeks of Weight Training on Cardiovascular Endurance in Sedentary Adults

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Abstract

Sedentary lifestyles among adults represent a major risk factor for cardiovascular and metabolic diseases. Physical inactivity is associated with decreased cardiovascular endurance, elevated resting heart rate, increased blood pressure, and higher body fat percentage. Therefore, effective and structured interventions are needed to improve physiological health in this population. This study aimed to examine the effects of a 9-week resistance training program on cardiovascular endurance and selected physiological parameters in sedentary adults. This study employed an experimental design involving 30 sedentary participants, divided into an exercise group (EG, n=10) and a control group (CG, n=20). The exercise group participated in a structured resistance-training program three times per week for approximately 60 minutes per session, at an intensity of 60–75% of one-repetition maximum (1RM). Pre- and post-intervention assessments included the Cooper 12-minute run test, estimated VO_2max, resting heart rate, heart rate recovery, systolic and diastolic blood pressure, and body fat percentage. Data were analyzed using paired-sample and independent-sample t-tests with a significance level of $p < 0.05$. The findings revealed significant improvements in the exercise group across all measured variables. Cooper test distance and estimated VO_2max increased significantly, while resting heart rate decreased and heart rate recovery improved. Additionally, systolic and diastolic blood pressure, as well as body fat percentage, showed significant reductions. In contrast, no significant changes were observed in the control group. These findings suggest that resistance training is an effective strategy for enhancing cardiovascular health and reducing metabolic risk factors in sedentary adults. This program can be recommended as a preventive and promotive health intervention in broader public health contexts.

Keywords: *Cardiovascular endurance, Heart rate, Resistance training, Sedentary adults, VO_2max*

A. Introduction

A sedentary lifestyle is currently recognized as a major global public health problem. Physical inactivity has been identified as an important risk factor for the development of many chronic diseases, such as cardiovascular diseases, obesity, hypertension, and metabolic syndrome (Warburton & Bredin, 2017; World Health Organization, 2020). In particular, technological conveniences associated with modern life reduce individuals' daily energy expenditure and increase levels of physical inactivity. This situation negatively affects the cardiovascular system, leading to decreased aerobic capacity and increased cardiovascular health risks (Booth, Roberts, & Laye, 2012).

Cardiovascular endurance refers to the body's capacity to transport and utilize oxygen during prolonged physical activity and is considered one of the most important indicators of

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overall health and physical fitness (Bassett & Howley, 2000). One of the most commonly used parameters for evaluating aerobic capacity is maximal oxygen consumption (VO_2max). VO_2max is an important physiological indicator of the cardiovascular, respiratory, and muscular systems' ability to utilize oxygen (Joyner & Coyle, 2008). Previous studies have shown that VO_2max is a strong predictor of cardiovascular disease risk (Kodama et al., 2009). One practical field test used to assess cardiovascular endurance is the Cooper 12-minute run test. This test allows indirect determination of aerobic capacity by measuring the distance covered within a specific time period (Cooper, 1968). The Cooper test is widely accepted as a reliable and valid method in sports science research and physical fitness assessments (Grant et al., 1995). Other important indicators of cardiovascular function include resting heart rate and blood pressure. Regular exercise is known to reduce resting heart rate, allowing the heart to function more efficiently (Fagard, 2001). Similarly, physical activity lowers systolic and diastolic blood pressure and reduces the risk of hypertension (Cornelissen & Smart, 2013). Heart rate recovery after exercise is another important physiological indicator used to evaluate cardiovascular adaptation. A rapid return of heart rate to normal levels following exercise indicates good cardiovascular adaptation capacity (Cole et al., 1999), whereas slower recovery is associated with increased cardiovascular risk factors (Peçanha et al., 2014). Body composition is also closely related to cardiovascular health. In particular, a high body fat percentage increases the risk of cardiovascular diseases (Heyward & Wagner, 2004). Regular exercise is known to reduce body fat percentage and improve metabolic and cardiovascular health (Willis et al., 2012).

Although the effects of aerobic exercise on improving cardiovascular endurance have long been known, recent studies have also demonstrated that resistance (weight) training can have important effects on cardiovascular health (Hurley, Hanson, & Sheaff, 2011). In addition to increasing muscular strength and mass, resistance training has been reported to improve metabolic and cardiovascular parameters (Westcott, 2012). Several studies have shown that regular resistance training in sedentary individuals can improve aerobic capacity and cardiovascular function (Ozaki et al., 2013). However, some research suggests that the effects of resistance training on cardiovascular endurance may be limited (Garber et al., 2011). Therefore, examining the effects of resistance training on cardiovascular endurance using different physiological parameters is important. In the literature, weight-training studies have generally focused on muscle strength and hypertrophy, while relatively few have examined its effects on cardiovascular endurance. Furthermore, the number of studies that comprehensively evaluate the effects of resistance training on cardiovascular parameters in sedentary individuals remains limited.

In this context, the aim of the present study was to investigate the effects of regular resistance training on cardiovascular endurance in sedentary individuals, using physiological and performance parameters such as the Cooper 12-minute run test, VO_2max, resting heart rate, blood pressure, body fat percentage, and heart rate recovery. The findings of this study are expected to contribute to the planning of exercise programs for sedentary individuals and to provide a better understanding of their effects on cardiovascular health.

B. Methods

This study used a quasi-experimental design with a pretest–posttest control group to examine the effects of resistance training on cardiovascular endurance in sedentary individuals. Participants were divided into two groups: an exercise group and a control group. While the exercise group participated in a regular resistance training program for 9 weeks, the control group continued their normal daily activities without participating in any structured exercise program. The same measurements were applied to all participants at the beginning and end of the study, and the resulting data were compared.

This study involved 30 sedentary individuals who voluntarily participated and were randomly assigned to two groups: an exercise group (n = 10) and a control group (n = 20). Participants met several inclusion criteria, including not having engaged in regular exercise within the past 6 months, being aged 18-30 years, having no diagnosed cardiovascular, metabolic, or orthopedic conditions, and providing informed consent to participate. All participants were informed of the study's purpose and procedures, and written consent was obtained prior to data collection. The research adhered to established ethical standards, and the confidentiality of participants' personal information was strictly maintained.

The research procedure began with pre-test measurements to assess cardiovascular endurance and physiological parameters. These included the Cooper 12-minute run test, estimated VO_2max, resting heart rate, heart rate recovery following exercise, systolic and diastolic blood pressure, and body fat percentage. Following the baseline assessments, participants in the exercise group underwent a structured resistance training program for 9 weeks, conducted 3 times per week, with each session lasting approximately 60 minutes at an intensity of 60–75% of one-repetition maximum (1RM). Meanwhile, the control group did not participate in any structured exercise program and continued their normal daily routines. At the end of the intervention period, all measurements were repeated to obtain post-test data.

Measurement protocols were implemented systematically. Cardiovascular endurance was assessed using the Cooper 12-minute run test conducted on a 400-meter track, in which participants were instructed to cover the maximum possible distance within 12 minutes. VO_2max was estimated using a standard formula based on the distance covered. Resting heart rate was measured in the morning after a 10-minute seated rest using a heart rate monitor. Heart rate recovery was calculated as the difference between heart rate immediately after exercise and one minute post-exercise. Blood pressure was measured using an automatic sphygmomanometer after a resting period, with the average of two readings recorded. Body fat percentage was assessed by bioelectrical impedance analysis (BIA) in the morning, after fasting. Overall, these procedures ensured reliable and consistent data collection to evaluate the effects of the resistance training intervention.

Table 1. Resistance training program

Exercise	Sets	Repetitions	Rest
Squat	3	12	60 sec
Bench Press	3	12	60 sec
Lat Pulldown	3	12	60 sec
Leg Press	3	12	60 sec
Shoulder Press	3	12	60 sec
Leg Curl	3	12	60 sec
Biceps Curl	3	12	45 sec
Triceps Pushdown	3	12	45 sec
Plank	3	30 sec	45 sec

Table 2. Weekly training progression

Week	Intensity	Description
1-2	60% 1RM	Adaptation
3-4	65% 1RM	Load increase
5-6	70% 1RM	Strength development

Week	Intensity	Description
7-8	70-75% 1RM	Progressive overload
9	75% 1RM	Maximum adaptation

The data obtained in the study were analyzed using SPSS statistical software. The normality of the data distribution was assessed using the Shapiro–Wilk test. An independent-samples t-test was used to determine differences between groups, and a paired-samples t-test was used to compare pre-test and post-test results within groups. The level of statistical significance was set at $p < 0.05$.

C. Results and Discussion

A total of 30 sedentary individuals participated in the study. 10 participants were assigned to the exercise group, and 20 to the control group. Data obtained during the study were analyzed by comparing pre-test and post-test measurements.

Table 3. Descriptive characteristics of participants

Variables	Exercise Group (n=10)	Control Group (n=20)
Age (years)	22.4 ± 2.1	23.1 ± 2.5
Height (cm)	173.6 ± 6.2	172.8 ± 7.1
Body weight (kg)	72.5 ± 8.3	73.2 ± 9.1

No statistically significant differences were observed between the groups at baseline ($p > 0.05$).

Table 4. Exercise group pre-test and post-test results

Variables	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	t	p
Cooper distance (m)	2150 ± 210	2420 ± 230	-5.84	0.001
VO_2max (ml/kg/min)	36.8 ± 3.2	42.7 ± 3.6	-6.12	0.001
Resting heart rate (bpm)	78.4 ± 6.1	71.2 ± 5.5	4.67	0.002
Heart rate recovery (bpm)	18.5 ± 4.2	27.6 ± 4.8	-5.21	0.001
Systolic BP (mmHg)	124.3 ± 8.4	118.1 ± 7.2	3.12	0.013
Diastolic BP (mmHg)	79.6 ± 6.5	75.2 ± 5.8	2.76	0.022
Body fat (%)	22.8 ± 3.7	20.9 ± 3.1	3.41	0.008

Significant improvements were observed in all variables in the exercise group ($p < 0.05$).

Table 5. Exercise group pre-test and post-test results

Variables	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	t	p
Cooper distance (m)	2180 ± 240	2195 ± 235	-0.62	0.542
VO_2max (ml/kg/min)	37.1 ± 3.5	37.4 ± 3.4	-0.54	0.596
Resting heart rate (bpm)	77.6 ± 6.4	77.1 ± 6.2	0.48	0.635
Heart rate recovery (bpm)	19.2 ± 4.1	19.8 ± 4.0	-0.51	0.615
Systolic BP (mmHg)	123.8 ± 7.9	123.1 ± 8.0	0.39	0.701
Diastolic BP (mmHg)	80.1 ± 6.3	79.6 ± 6.1	0.41	0.688
Body fat (%)	23.2 ± 3.8	23.0 ± 3.6	0.33	0.745

No statistically significant differences were observed in the control group ($p > 0.05$).

Table 6. Post-Test Comparison Between Groups

Variables	Exercise Group	Control Group	t	p
Cooper distance (m)	2420 ± 230	2195 ± 235	2.73	0.011
VO_2max (ml/kg/min)	42.7 ± 3.6	37.4 ± 3.4	3.45	0.002
Resting heart rate (bpm)	71.2 ± 5.5	77.1 ± 6.2	-2.41	0.022
Heart rate recovery (bpm)	27.6 ± 4.8	19.8 ± 4.0	4.36	0.001
Systolic BP (mmHg)	118.1 ± 7.2	123.1 ± 8.0	-2.02	0.048
Diastolic BP (mmHg)	75.2 ± 5.8	79.6 ± 6.1	-2.11	0.040
Body fat (%)	20.9 ± 3.1	23.0 ± 3.6	-2.27	0.031

Post-test values of the exercise group were significantly better than those of the control group ($p < 0.05$).

This study examined the effects of a 9-week resistance training program on cardiovascular endurance in sedentary individuals. The findings demonstrated that regular resistance training led to significant improvements in Cooper test performance, VO_2max, resting heart rate, heart rate recovery, and blood pressure. The results indicated notable increases in Cooper test distance and VO_2max values in the exercise group, supporting previous studies suggesting that resistance training can enhance aerobic capacity. Specifically, Ozaki, Loenneke, Thiebaud, and Abe (2013) reported that resistance training can increase VO_2max in both young and older adults. Similarly, Willis et al. (2012) highlighted the positive effects of resistance training on cardiovascular fitness. Another important finding was the decrease in resting heart rate, which indicates enhanced cardiac pumping capacity and more efficient cardiovascular function. Cole, Blackstone, Pashkow, Snader, and Lauer (1999) emphasized that heart rate recovery and resting heart rate are important indicators of cardiovascular health. Improvements in heart rate recovery observed in the exercise group further reflect cardiovascular adaptations. Peçanha, Bartels, Brito, Paula-Ribeiro, Oliveira, and Goldberger (2014) noted that heart rate recovery reflects autonomic nervous system function and cardiovascular fitness.

The study also revealed significant reductions in systolic and diastolic blood pressure, consistent with literature reporting the beneficial effects of regular exercise on blood pressure. Cornelissen and Smart (2013) demonstrated in a meta-analysis that exercise programs significantly lower systolic and diastolic blood pressure, and Fagard (2001) emphasized the role of physical training in reducing hypertension risk.

The decrease in body fat percentage observed in the exercise group reflects the metabolic benefits of the training program. Booth, Roberts, and Laye (2012) noted that physical inactivity is a major risk factor for chronic diseases, and regular exercise can help mitigate these risks. Overall, the results indicate that a 9-week resistance training program significantly improves cardiovascular endurance and physiological health indicators in sedentary individuals. These findings are consistent with existing literature and suggest that resistance training positively affects not only muscular strength but also cardiovascular health parameters.

D. Conclusion

This study investigated the effects of a 9-week resistance training program on cardiovascular endurance and selected physiological parameters among sedentary individuals. The findings demonstrated that resistance training produced significant improvements in multiple cardiovascular and metabolic indicators within the exercise group, including enhanced performance in the Cooper 12-minute run test, increased estimated VO_2max, reduced resting heart rate, improved heart rate recovery, and favorable reductions in both systolic and diastolic blood pressure as well as body fat percentage. In contrast, the control group, which did not participate in structured exercise, showed no statistically significant changes across all measured variables, highlighting the intervention's specific impact. The observed increase in VO_2max and Cooper test distance indicates that resistance training contributes not only to improvements in muscular strength but also to meaningful enhancements in cardiovascular fitness and aerobic capacity. This suggests that properly structured resistance exercise can stimulate systemic physiological adaptations that extend beyond traditional strength-related outcomes. Furthermore, the reduction in resting heart rate and the improvement in heart rate recovery reflect enhanced autonomic regulation, particularly increased parasympathetic activity and more efficient cardiovascular recovery following physical exertion.

The significant decreases in blood pressure and body fat percentage indicate that resistance training has broad metabolic benefits, contributing to improved vascular function and better body composition. These changes are particularly important for sedentary individuals, who are at higher risk of developing cardiovascular and metabolic disorders. The findings of this study provide strong evidence that a 9-week resistance training program is a safe, practical, and effective intervention for improving cardiovascular endurance, autonomic function, and metabolic health in sedentary populations. Regular implementation of resistance training may therefore play an important role in reducing long-term health risks and promoting overall physical well-being.

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