

**Research Article****Impact of Resistance and Endurance Exercise Training on Heart Rate Variability****Dr Rakesh Yeole<sup>1</sup>, Dr Devendra Ghodpage<sup>2</sup>**Associate Processor<sup>1,2</sup>, Dept of Physiology, AIMMMCR, Bhilai, (CG)**Corresponding Author:****Dr Devendra Ghodpage, Associate Processor, Dept of Physiology, AIMMMCR, Bhilai, CG.,  
ghodpagedevendra 48@gmail.com****Abstract:**

**Background:** The Heart rate variability (HRV) test is a non-invasive way to check the hearts and autonomic nervous system (ANS) overall health and performance. The test finds the average and standard deviation of the time between heartbeats. **Aim:** The goal of this 12-week trial is to find out how different types of exercise, including resistance and endurance training, affect people's HRV. Autonomic control and cardiovascular health will be the primary outcomes of the study. **Materials & methods:** The 100 individuals in the research were randomized to either the control group or the exercise group. Measurements were made of physical attributes such height, weight, BMI, waist circumference, body fat percentage, blood pressure, resting heart rate, and heart rate variability. Additionally, the study assessed muscle strength, leg muscle strength, maximum oxygen absorption (VO<sub>2</sub>max), and VO<sub>2</sub>max. For 12 weeks, the exercise regimen included both resistance and aerobic workouts that were done three times a week. **Results:** Measurements gathered from the exercise group showed significantly decreased weight, body fat percentage, waist circumference, and systolic and diastolic blood pressure compared to the control group. As a consequence of becoming in better shape, we saw gains in VO<sub>2</sub>max, grip strength, leg strength (both sides), and endurance. There was no discernible difference in HRV between the two groups. **Conclusion:** More research with bigger samples is needed to confirm the findings of this study, which implies that exercise modalities may enhance cardiovascular function and autonomic balance. Furthermore, it implies that personalized exercise regimens are necessary for optimal health outcomes.

**Key words:** HRV, autonomic nervous system, resistance exercise training, endurance exercise training, parasympathetic activity.

**Introduction:**

Heart rate variability (HRV), or the variation in the time between consecutive heartbeats, is a non-invasive indicator of cardiovascular health and autonomic nervous system (ANS) function. An enhanced HRV suggests a robust and flexible ANS, whereas a lower HRV is linked to a higher risk of

cardiovascular disease and a decreased capacity to tolerate stress [1,2]. Training with resistance and endurance exercises [1–3] has long been recognized to have a substantial effect on HRV, which in turn affects cardiovascular health [2].

HRV is significantly impacted by resistance exercise training (RET), which comprises

exercises that increase muscle strength and endurance [2,3]. Acute bouts of resistance exercise have been shown to worsen cardiac parasympathetic modulation in young, healthy people more than aerobic exercise [4,5], increasing the likelihood of cardiovascular dysfunction following exercise. In contrast to its capacity to enhance parasympathetic regulation in middle-aged persons with autonomic dysfunction, chronic RET does not seem to impact resting HRV in young, healthy individuals [6]. The therapeutic potential of RET was shown in a randomized controlled trial including patients with coronary artery disease. The study found that after eight weeks of high-repetition, low-load resistance exercise, the participants' physical strength, endurance, and HRV markers all significantly improved [2,3].

Numerous studies have examined the effect of endurance exercise training (EET) on HRV. EET requires an extended duration of aerobic exercise, such as swimming, cycling, or running [4-6]. Frequent participation in EET can improve cardiovascular fitness, parasympathetic activity, and HRV measurements [5]. The best method to reduce resting heart rate, a related measure of cardiovascular efficiency, is through endurance exercise, per a meta-analysis published in the Journal [6]. Improved capillary infrastructure, heart health, stroke volume,  $VO_2$  max, and endurance are also linked to the advantages of HRV. All of these are improved by prolonged steady-state exercise [5-8]. The current study compares and analyzes the effects of resistance and endurance exercise training on HRV in individuals over a 12-week period, with a focus on assessing cardiovascular health and autonomic function.

## Materials & methods:

Fifty people were randomly allocated to the exercise group and fifty to the control group out of a total of one hundred. After providing the participants with a comprehensive explanation of the objectives, methods, and anticipated results of the exercise program, we were able to obtain their consent to take part in the study. We took care to adhere to the Declaration of Helsinki's ethical standards at every stage. The physical characteristics of the people were detailed in the documents.

We had our weight and height measured. The weight in kilograms was divided by the square of the height in meters squared to get the body mass index, or BMI. The subject's waist was measured to within 0.1 cm of the halfway between the top portion of the bilateral crista iliac and the bottom ribs as they stood with their back straight. The percentage of body fat was determined using a body composition analyzer. Before taking the patient's vitals while they were at rest, we gave them 10 minutes to unwind. To find the resting heart rate, we employed a wireless heart rate meter. The diastolic and systolic blood pressure were measured using an automated blood pressure monitor.

At ten in the morning, we conducted a five-minute HRV test using an HRV analyzer following a brief twenty-minute break. To investigate HRV, we used both frequency domain and temporal domain techniques. For the temporal domain analysis, we computed the root mean square successive differences (rMSSD) and the standard deviation of all normal R-R intervals (SDNN). While rMSSD shows brain activity associated to the parasympathetic nervous system, SDNN is used as a sign of overall variability. We were able to determine the low frequency (LF), high frequency (HF), and LF/HF ratio by doing research in the frequency domain. A low LF/HF ratio indicates a balanced

sympathetic-parasympathetic nervous system. Whereas "HF" is only used for parasympathetic activity, "LF" stands for sympathetic and, to a lesser extent, parasympathetic activity.

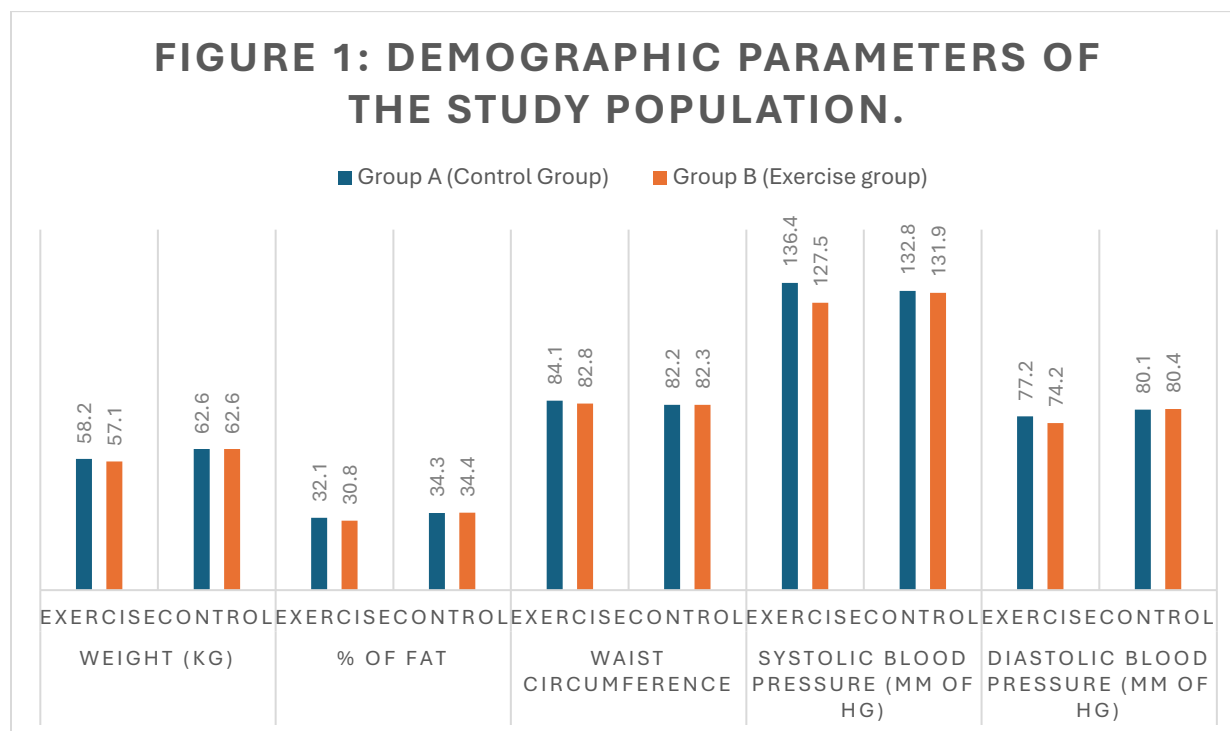
By doing a submaximal exercise test on a cycle ergometer, we were able to calculate VO<sub>2</sub>max in a cardiorespiratory test. By measuring the highest heart rate (HR) at which a participant could maintain an increasingly demanding exercise regimen, we were able to calculate VO<sub>2</sub>max. The second finger joint width was adjusted using the dynamometer until it was almost straight. This was done to determine the strength of the muscles. The force generated by forcefully pushing the right and left feet together while the thighs and upper torso were restrained in a sitting position was measured using a leg muscle strength measuring device. The number of sit-ups a person could do on a sit-up measuring board after 30 seconds of sit-up motions was used to gauge their level of muscular endurance. These movements involve pulling up the knees, holding hands behind the neck, and bending and elevating the upper body forward.

The program included three sessions each week for 12 weeks of resistance and aerobic training. These routines were based on the American College of Sciences and Medicine's workout guidelines. Karvonen [9] calculated the degree of aerobic exercise using the following formula: By adding the resting heart rate to the exercise intensity and then deducting the maximum heart rate from

the resting heart rate, one may get the goal heart rate. We employed Fleck and Kramer's 1-repetition maximum (RM) indirect measurement approach to ascertain and establish the resistance workouts' intensity [10].  $W_o + W_1$ , where  $W_1$  is  $W_o$  multiplied by 0.025 times R and  $W_o$  is a weight that may be contracted seven or eight times, equals one repetition, or RM. We stretched for ten minutes each time to warm up and cool down before starting the strength and cardio training regimens. Walking on a treadmill for 30 minutes at 60% heart rate was part of the aerobic workout. It was feasible to precisely ascertain if the aerobic activity was carried out within the intended heart rate range by using a Polar Heart Rate Analyzer. We were able to do this by maintaining a consistent level of training intensity. The resistance training, which consisted of two sets of nine weight machine exercises—curl-ups, leg presses, leg extensions, leg curls, calf raises, and lateral pulldowns—came after the aerobic session. You would perform one set of eight to twelve repeats for thirty minutes. The repetitions ranged from 60% to 80% of one's maximum.

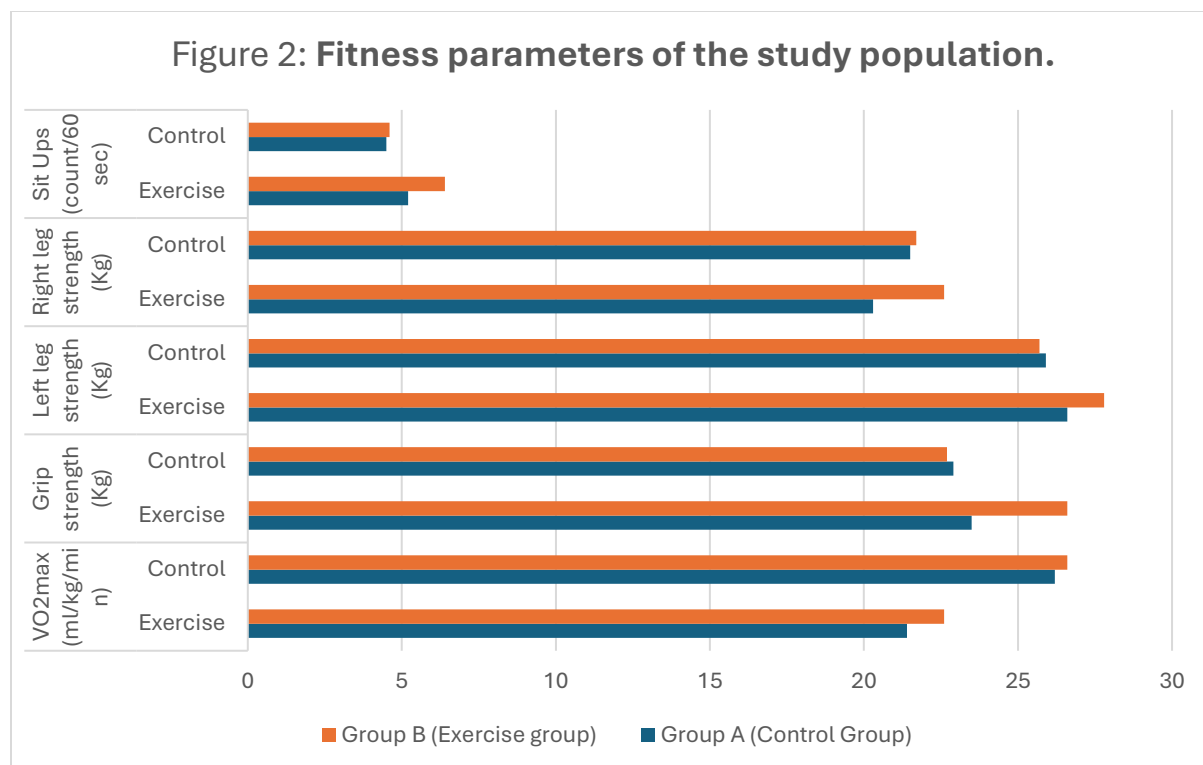
### **Statistical analysis:**

In order to analyze the data, SPSS was utilized. A two-way analysis of variance (ANOVA) with repeated measurements was carried out in order to investigate the influence that group and measurement time interactions had on the variables that were being examined. The criterion for statistical significance ( $\alpha$ ) was determined to be determined to be 0.05.

**Results:**

In terms of body composition, the exercise group's weight, body fat percentage, and waist circumference were all considerably lower than their pre-exercise values ( $p < 0.001$ ,  $p < 0.001$ , and  $p < 0.001$ , respectively). Furthermore, the exercise group's systolic and diastolic blood pressures were considerably lower after the program than they were before ( $p < 0.001$  and  $p < 0.01$ , respectively). Between the pre- and post-periods, none of the anthropometric index variables for the control group changed (Figure 1).

When compared to before the training program, the exercise group's VO<sub>2</sub>max ( $p < 0.05$ ), grip strength ( $p < 0.05$ ), left leg strength ( $p < 0.01$ ), right leg strength ( $p < 0.01$ ), and muscular endurance ( $p < 0.01$ ) all shown substantial gains in physical fitness. Figure 2 illustrates that there were no changes in the physical fitness of the control group between the pre- and post-partum periods. Regarding HRV, neither group's pre- and post-periods showed any appreciable changes in SDNN, rMSSD, LF, HF, or LF/HF.



## Discussion:

The results of this study show that those who engage in structured exercise programs significantly improve the number of anthropometric and cardiovascular characteristics. Following the intervention, the exercise group saw substantial decreases in body weight, body fat percentage, and waist circumference ( $p < 0.001$ ,  $p < 0.001$ , and  $p < 0.001$ , respectively). Furthermore, systolic and diastolic blood pressure were significantly lowered ( $p < 0.001$  and  $p < 0.01$ , respectively) in response to physical exercise. All of the characteristics that were assessed, however, showed no discernible changes in the control group.

The observed reduction in body weight and adiposity-related indicators is positive and consistent with other research showing the ability of well-planned exercise to control metabolic diseases and obesity. Regular exercise, for example, has been demonstrated to be essential for enhancing metabolic

health; in patients with type 2 diabetes, for example, a combination of aerobic and strength training dramatically decreased waist circumference and body fat percentage [11,12]. Additionally, a meta-analysis conducted by Wewege et al. [13] shown that strength training successfully lowers adiposity markers in diabetics, whether it is performed alone or in conjunction with aerobic exercise.

Furthermore, due of its significant correlation with insulin resistance and cardiovascular risk, the decrease in waist circumference, a crucial measure of visceral fat is especially pertinent [14]. Consistent with earlier findings, the exercise group's statistically significant decrease in waist circumference raises the possibility that the intervention may improve glycemic management and lower cardiometabolic risk [15].

The results support previous studies showing that exercise routines dramatically reduce

both systolic and diastolic blood pressure measurements. Although resistance and aerobic training both dramatically reduce blood pressure, research [16] found that the effects of aerobic exercise are stronger. These decreases are the result of increased autonomic regulation, decreased arterial stiffness, and enhanced endothelial function, all of which help to return blood pressure to normal [17].

Exercise is crucial for managing cardiovascular health and body composition, as evidenced by the fact that the control group did not exhibit any notable changes. The results are consistent with the study [18], which showed that those who are sedentary or do not exercise frequently do not see appreciable changes in their anthropometric or hemodynamic parameters over time. These results suggest that one of the most significant non-pharmacological strategies for managing diabetes and lowering the risks to cardiovascular health is regular exercise. Future studies should evaluate the effectiveness of various exercise regimens and examine how these benefits persist over time in populations with diabetes.

This research monitored the impact of an exercise program on participants' HRV and fitness levels over a 12-week period.

Physical fitness metrics such as VO<sub>2</sub>max ( $p < 0.05$ ), grip strength ( $p < 0.05$ ), left leg strength ( $p < 0.01$ ), right leg strength ( $p < 0.01$ ), and muscular endurance ( $p < 0.01$ ) significantly improved in the exercise group after the intervention. Neither the exercise group nor the control group exhibited any appreciable changes in HRV indicators including SDNN, rMSSD, LF, HF, and LF/HF.

The increases in physical fitness metrics support other studies showing the advantages of organized exercise regimens for people.

Combining aerobic and resistance exercise can improve cardiovascular fitness, muscle strength, and endurance [19,20]. The exercise group's notable increase in VO<sub>2</sub>max indicates that aerobic training raises oxygen consumption and cardiorespiratory efficiency [21]. Resistance training is essential for improving neuromuscular function and mobility, as evidenced by gains in grip strength and lower extremity strength [22, 23].

For type 2 diabetics, exercise intervention was required to provide quantifiable gains in fitness when compared to the control group, which shown no change in their physical fitness markers. According to this study, structured exercise programs are essential for the physical well-being of people with metabolic diseases [24].

It's interesting to see that HRV levels did not significantly alter after the workout program. This result contradicts earlier research showing that organized exercise regimens improved autonomic function [25, 26]. However, a number of studies have demonstrated that in order to induce detectable autonomic changes in HRV, longer intervention durations or more intense exercise are required [27, 28]. The reported results may also have been impacted by inter-individual heterogeneity, medication use, and baseline autonomic dysfunction in type 2 diabetic patients [29].

The brief duration of the intervention is one of the study's limitations, since it is clearly insufficient to make any definitive conclusions on its effect on autonomic regulation. Furthermore, unrelated variables like nutrition, sleep patterns, and mental stress may have an impact on HRV readings; these were not examined in this study. To further evaluate their effects on HRV, future studies should examine longer-lasting and

more intense exercise regimens.

### Conclusion:

The findings suggest that the two types of exercise may enhance cardiovascular and autonomic balance since they had different impacts on HRV measurements. Given these results, it seems sense to believe that regular exercise may improve autonomic function, which may reduce the risk of cardiovascular disease. These findings clearly demonstrate the need of tailored exercise regimens in achieving optimal cardiovascular and autonomic health. To validate and build on these findings, more research with larger sample sizes and longer follow-up times is required.

### Conflict of interest:

There is no conflict of interest among the present study authors.

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