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Effect Of Moderate Intensity Aerobic Training On The Heart Rate Recovery & Cardiorespiratory Fitness Of Nonsporting Girls

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Abstract

Sedentary lifestyle is one of the main factors putting the individual at the risk of a number of ailments including cardiorespiratory, obesity, hypertension and so on. A number of the research studies have confirmed that cardiac health in terms of heart rate recovery and muscular fitness play significant role in reducing the risk factors associated with the aforementioned health issues. This experimental research study was conducted with the objective to evaluate the effect of moderate intensity aerobic training on the heart rate recovery and cardiorespiratory fitness of the non-sporting girls' university students. Pre-test and post-test experimental research design was employed in this research study. The study was conducted at the university of Lahore where 80 volunteer non-sporting girls' students were selected for the study. Prior to the administration of eight-week moderate intensity aerobic training, the respondents were divided into two groups experimental and control group. Data in respect of Heart rate recovery and cardiorespiratory fitness level of the respondents included in both groups were taken and recorded for cross examination after completion of the intervention. After [1]completion of the treatment, the same tests were conducted again to take the post-test data with reference to the effect of moderate intensity aerobic training on the heart rate recovery and cardiorespiratory fitness of the respondents. Result of the pre and post-treatment of the investigation in respect of control and experimental group reflected significant effect of the independent variable (moderate intensity aerobic training) upon the dependent variable (heart rate recovery and cardiorespiratory fitness of the respondents. Heart rate recovery post treatment was (U=4.50, P=0.00 <0.05) and similarly cardiorespiratory fitness was (U=4.50, P=0.00 <0.05). Result of the regression analyses has confirmed positive role of the moderate aerobic training in improving the cardiorespiratory fitness.

Keywords: *Heart Rate Recovery, Cardiorespiratory Fitness, Moderate, Intensity, Training*

Introduction

A number of research studies have confirmed that avoiding inactive daily routine and leading life full of action work like a deterrent for combating the risk associated with CVD and other fatal diseases (Cabandugama et al., 2017). Health experts unanimously agree upon the positive and health promoting role of active lifestyle, enhancing fitness, longevity of life and preventing

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health affecting diseases. Physical exertion, either it is planned or spontaneous, has positive and long lasting health outcomes. Evaluation of the effect of moderate intensity aerobic activities upon different parameters of health has been the point of main focus of this research study. Eser et al. (2020) have concluded that moderate intensity aerobic exertion has twofold advantages; they increase good cholesterol level in the blood, and alternately prove to be very helpful in reducing the risk of cardiac diseases. With reference to improving performance of heart and lungs, moderate intensity aerobic training (MIAT), in collaboration of the healthy lifestyle, yield positive outcomes in perspectives of improved cardiovascular endurance (CVE).

The role of cardiorespiratory fitness in everyday life is well established as it has been one of the basic factors for leading a life full of vigor. On the other hand, following a sedentary lifestyle has been the most common preventable factor impeding the establishment of the state of cardiorespiratory fitness. Baqar et al. (2019) have concluded that oxygen consuming activities (OCA); aerobic activities of moderate intensity play significant role in avoiding pre-mature deaths from cardiorespiratory issues including diabetes, stroke and hypertension. In addition to that, physical exertion of moderate intensity also has positive role in weight-management, maintenance of good posture, improvement of muscular strength and endurance. On account of regular exertion in moderate intensity aerobic activity, cardiac muscles and blood vessels become stronger and efficient and their working capacity is enhanced which alternately reduces the risk of cardiac issues (Liu et al., 2020). In literature, intensities of the physical activities have been categorized and weighed differently in terms of the pace of the heart rate. Coswig et al. (2020) have concluded that any physical exertion causing the heart beat between 60 to 70 percent of its maximum capacity is called as the moderate intensity aerobic activity. Besides other cardiovascular organs, heart is the principal organ that gets maximum benefit of regular participation in MIAT. During performing intense physical activity, each cell requires additional amount of oxygen and nutrients to meet the accelerated amount and intensity of functioning. It alternately forces the heart to function with more pace and more promptness to meet requirement of the body. This type of working routine improves working capacity and performance of the heart which alternately reflects in the enhanced quality of cardiovascular fitness.

The Concept of Aerobic Training

Literally, the term aerobic stands for the availability or presence of oxygen. Aerobics is a type of exercise that causes rise in the bodily need for oxygen. Aerobics refers to the strenuous workout increasing breathing and heart beat and alternately enhancing cardiovascular efficiency. Aerobic training refers to all those properly planned physical activities which are repetitive in nature produced by the skeletal muscles as a result of consumption of additional amount of oxygen through metabolic process. Aerobic training composes of the physical activities of different intensities requiring aerobic energy production system (Lin et al., 2018). Aerobic training and physical fitness are closely related to each other. Aerobic training has widely been used as most effective way of improving the level and quality of fitness. Aerobic training is very effective in tuning the main components of physical fitness like cardiovascular endurance, body composition and cardiorespiratory endurance of the person. In addition to that, aerobics improves gait, posture, physical structure and enhances cardiovascular output and establishes physical fitness (Araujo et al., 2019). Aerobic training improves efficiency of the cardiovascular system to carry and transports additional amount of oxygen. Aerobic metabolism is the primary source of fueling the muscles engaged in aerobic exercises extracting the basic currency unit adenosine triphosphate (ATP) from glucose, amino acids and fatty acids (Liu et al., 2020).

Effects of Aerobics on Heart

The first and foremost effect of aerobics is associated with the performance of heart; the heart rate and output of heart. During hard physical exertion, significant increase occurs in the heart rate and output of the heart known as the stroke-volume (the volume of blood the heart supplies to the body performance stroke). Regular participation in aerobics have long lasting positive effects upon the cardiac output and overall performance of heart.

Effects of Aerobics on Lungs

Secondly, aerobics affects normal functioning of the lungs, the harder is the activity the faster the lungs work. To meet the additional requirement of the working muscles for oxygen, increase occurs in the workload on part of the lungs. Regular participation in sports and other activities of physical exertion improves the working capacity of lungs in terms of supplying oxygen to the working muscles of the body.

Heart Rate Recovery (HRR)

Decrease in the heart rate after doing exercises or performing physical activities in the first minute is termed as the Heart Rate Recovery (HRR) (Del Rosso et al., 2017). The term heart rate recovery or recovery heart rate refers to the pulse rate getting down towards the normal pulse after strenuous physical activity. Rieck and Lundin (2021) have concluded that RHR means the pulse rate of a person after hard physical exertion. According to fitness experts, it is the post-training heart rate which is used to determine the level of physical fitness in terms of performance of heart. As a matter of fact, measurement of the recovery heart rate is meant for the subjects related to sports settings, and, experts suggest that the yard stick of recovery heart rate may not be used as a fitness tool for those having cardiac issues or using medications. Heart rate recovery denotes the difference between the highest rate of heart beat while performing strenuous physical activity and the heart rate just after the end of the activity. In addition to physical performance and fitness level of the person, heart rate recovery also clarifies the health and fitness level of the heart with reference to cardiac issues likely to occur in the days to come. Heart beat is the basic scale for measuring the performance of heart in terms of heart rate recovery which is measured by counting the heart rate for 15 seconds just after exercise and after one minute of the end of the exercise.

Cardiorespiratory Fitness

The term cardiorespiratory fitness (CRF) is associated with the working ability of the circulatory and respiratory systems for transportation of the nutrients and oxygen to the muscles (Eser et al., 2020). This attribute deals with the overall working capacity and efficiency of the body. It enables the working organs of the body particularly skeletal muscles, lungs and cardio-circulatory organs to promptly perform their duties for a longer period of time without being fatigued (Gillaspy, 2018). Cardiorespiratory fitness does two-way work; on one hand it supplies energy to the organs and in return it picks up the wastes from removal from the body for a prolong period. In physiological perspectives, prompt consumption of oxygen is regarded as the aerobic capacity; the higher is the aerobic capacity the better is the functioning of lungs, heart and allied blood vessels. As a whole it is called as the CRF. Cardiorespiratory fitness (CRF) has been used as an index of aerobic fitness for decades. However, direct measurement of CRF using gas analyzers can be expensive and sometimes unsafe. Thus, the use of cycle math and treadmill on indirect measurement has been considered.

Fitness is very wide and comprehensive term. It encircles various aspects of life like physical, mental, emotional and social stability and wellbeing (Szabo et al., 2020a). Fitness is, in fact, an umbrella term encompassing its different components including muscular strength, muscular endurance, flexibility, body composition and CRF (Rieck & Lundin, 2021). Cardiorespiratory fitness is one of the most practical measure of the level of aerobic health and

physical fitness of a person. Cardiorespiratory fitness is the ultimate output of the corroborated functioning of blood circulatory and respiratory systems (Del Rosso et al., 2017). Strong cardiac muscles, healthy heart, arteries, veins and efficient lungs are the prerequisites for supplying required amount of oxygen and energy to the working muscles and alternately establishing cardiorespiratory fitness (Cheng et al., 2019). So for as cardiorespiratory fitness is concerned, it refers to the competency of the circulatory and respiratory systems and subsequent ability of the muscles to promptly utilize the oxygen during the execution of the strenuous physical activities (American College of Sports Medicine, 2014). Cardiorespiratory fitness reflects efficiency of the different systems of the body regarding production and consumption of the oxygen by the skeletal muscles (Liu et al., 2020). Output of the prompt performance of the cardiac and skeletal muscles appears in shape of increased energy consumption (Eser et al., 2020). Technically speaking, CRF is one of the basic predictors of physical and mental health. On account of CRF, a person is able to do any hard physical activity requiring additional amount of oxygen and energy for an extended period of time as compare to the one lacking CRF who is easily exhausted after doing an ordinary physical activity (Sopa & Pomohaci, 2021). However, CRF is not the sole determinant of the prompt aerobic performance, personal capacity, diet and training also have prominent role in this regard (Coswig et al., 2020). The attribute of CRF is also associated with heredity and its essence lies in the very nature of the person (Araujo et al., 2019). Genetic factor, age, health status and gender are commonly used for determining the level and nature of CRF.

Problem Statement

"Role of moderate intensity aerobic training in perspectives of Heart rate recovery and Cardiorespiratory fitness of the female students of the university of Lahore"

Objectives of the Study

1. To evaluate the effect of moderate intensity aerobic training on the heart rate recovery of the non-sporting girls' university students
2. To evaluate the effect of moderate intensity aerobic training on the cardiorespiratory fitness of the non-sporting girls' university students

Hypotheses of the Study

H_1: There is significant effect of moderate intensity aerobic training on the heart rate recovery of the non-sporting girls' university students

H_0: There is no significant effect of moderate intensity aerobic training on the heart rate recovery of the non-sporting girls' university students

H_1: There is significant effect of moderate intensity aerobic training on the cardiorespiratory fitness of the non-sporting girls' university students

H_0: There is no significant effect of moderate intensity aerobic training on the cardiorespiratory fitness of the non-sporting girls' university students

Results and Discussion

Table 1: H_0: There are no differences in Heart Rate Recovery and Cardiorespiratory Fitness of Group "A" (Experimental Group) and Group "B" (Control Group) Before Intervention.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Heart Rate Recovery Before Training	Experimental Group	40	26.125	1.136	.179
	Control Group	40	26.150	1.188	.187
Cardiorespiratory Fitness Before Training	Experimental Group	40	31.765	1.938	.306
	Control Group	40	31.725	1.894	.299

Descriptive statistics for physiological parameters before training are presented in Table 1 above. Heart Rate Recovery showed mean values between the experimental (M = 26.13, SD = 1.14) and control (M = 26.15, SD = 1.19) groups. Cardiorespiratory fitness, measured in units, displayed similar mean values between the experimental (M = 31.77, SD = 1.94) and control (M = 31.73, SD = 1.89) groups. These results suggest no significant baseline differences in the physiological parameters assessed between the experimental and control groups before the commencement of the training intervention.

H_A: There are positive effects of pretest and posttest in Heart Rate Recovery and Cardiorespiratory Fitness of Experimental Group

Paired Samples Statistics

		Mean	N	Std. Deviation	t-value	Sig-value
Pair 1	Heart Rate Recovery Experimental pre	26.1750	40	1.174	-30.504	.000
	Heart Rate Recovery Experimental post	31.9750	40	1.609		
Pair 2	Cardiorespiratory Fitness Experimental Pre	31.7250	40	1.894	-27.153	.000
	Cardiorespiratory Fitness Experimental Post	36.1750	40	1.550		

Paired samples t-tests were conducted to assess the effects of the training intervention on Heart Rate Recovery and cardiorespiratory fitness within the experimental group. For Heart Rate Recovery, there was a significant increase from pre- to post-training (M_{pre} = 26.1750 bpm, SD = 1.174; M_{post} = 31.9750 bpm, SD = 1.609), t (39) = -30.504, $p < .001$. This suggests that the training intervention resulted in a substantial improvement in Heart Rate Recovery. Similarly, for cardiorespiratory fitness, there was a significant increase from pre- to post-training (M_{pre} = 31.7250 units, SD = 1.894; M_{post} = 36.1750 units, SD = 1.550), t(39) = -27.153, $p < .001$. This demonstrates a notable improvement in cardiorespiratory fitness after the training intervention. Overall, these results suggest that the training intervention had a

significant positive impact on Heart Rate Recovery and cardiorespiratory fitness within the experimental group.

Table 3: H_0: There are no positive effects of pretest and posttest in Heart Rate Recovery and Cardiorespiratory Fitness of Control Group

Paired Samples Statistics

		Mean	N	Std. Deviation	t-value	Sig-value
Pair 1	Heart Rate Recovery Moderate Control Pre	26.125	40	1.136	-1.052	.283
	Heart Rate Recovery Moderate Control Post	26.250	40	1.166		
Pair 2	Cardiorespiratory Fitness Control Pre	31.765	40	1.938	-1.200	.234
	Cardiorespiratory Fitness Control Post	31.750	40	1.918		

Paired samples t-tests were conducted to evaluate the effects of the intervention on Heart Rate Recovery and cardiorespiratory fitness within the control group. For Heart Rate Recovery, there was no significant difference observed from pre- to post-intervention (M_pre = 26.125 bpm, SD = 1.136; M_post = 26.250 bpm, SD = 1.166), t(39) = -1.052, p = .283. This indicates that the intervention did not result in a significant change in Heart Rate Recovery within the control group. For Cardiorespiratory Fitness, there was no significant difference observed from pre- to post-intervention (M_pre = 31.765 units, SD = 1.938; M_post = 31.750 units, SD = 1.918), t(39) = -1.200, p = .234. This result shows that the intervention didn't result in a significant change in the Cardiorespiratory Fitness with in the control group. Overall, these findings suggest that the intervention did not have a significant effect on Heart Rate Recovery and Cardiorespiratory Fitness with in the control group.

Discussion

This study aimed to investigate the differences in Heart Rate Recovery (HRR) and cardiorespiratory fitness (CRF) between an Experimental group (Group A) and a control group (Group B) before a training intervention. The null hypothesis (H_0) posited that there were no differences in the Heart Rate Recovery (HRR) and cardiorespiratory fitness (CRF) parameters between the two groups before the intervention. The current study findings align with prior research indicating that baseline physiological parameters, including Heart Rate Recovery and cardiorespiratory fitness, may not differ significantly between experimental and control groups before the implementation of an intervention (Camacho-Cardenosa et al., 2024). This supports the notion that random assignment effectively distributes participants across groups, minimizing potential confounding variables (Coswig et al., 2020). Similarly, it's essential to recognize that pre-existing individual differences in physiological fitness levels may still exist despite random assignment (Krause & Cohen Kadosh, 2014).

The alternative hypothesis (H_A) posited in this study suggested that there were differences in Heart Rate Recovery (HRR) and cardiorespiratory fitness (CRF) between an experimental group (Group A) and a control group (Group B) after training intervention. Our findings provide insight into the post-intervention differences in these physiological parameters between the two groups. Previous research study has shown that interventions targeting physical fitness can lead to significant improvements in Heart Rate Recovery and cardiorespiratory fitness (Sopa & Pomohaci, 2021). Consistent with this literature, our study observed significant differences in these physiological parameters between the experimental and control groups after the intervention. The current study findings underscore the effectiveness of the intervention in enhancing physiological fitness outcomes within the experimental group compared to the control group. The observed improvements in Heart Rate Recovery and cardiorespiratory fitness highlight the potential benefits of targeted interventions in promoting overall health and fitness (Franklin et al., 2022). However, it's essential to acknowledge that individual variability in response to the intervention may exist, influenced by factors such as baseline fitness levels, adherence to the intervention protocol, and participant characteristics (Ross et al., 2019). Future research could explore these factors in greater depth to better understand the mechanisms underlying the observed differences in physiological parameters outcomes of the post-intervention. The present study provided much evidences to supporting the alternative hypothesis, demonstrating differences in Heart Rate Recovery and cardiorespiratory fitness between the experimental and control groups after the intervention. These findings highlight the importance of targeted interventions in promoting physiological health outcomes and underscore the need for further research to elucidate individual differences in response to such interventions.

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