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Impact of Aerobic Exercise on Resting Heart Rate and Cardiovascular Endurance in Non-Athlete Students

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ABSTRACT

Background:A positive effects of moderate level of aerobic exercise to reduce the risk factors for cardiovascular diseases is well established.

Objectives: This study aimed to compare the difference in the values of resting heart rate and cardiovascular endurance at pre and post-test,

Methodology: This study used an experimental research design with pretest & posttest randomized group. The study was conducted at COMSATS, Lahore Campus and a total number of 80 non-athletevolunteer and healthy university student participated in this study. First of all the health status of the students was checked and those with good state of health were inducted in the training program by taking their consent. Before the administration of aerobic training, the selected tests for selected physiological variables were administered to collect pretest data. After the completion of eight weeks of aerobic training again the same tests were conducted to collect post-test data. Participants' RHR was measured daily in the morning and CVE was calculated by (PE-HR-PE-RHR). Data was tabulated and analyzed with SPSS (23.0) and descriptive statistics was used to classify and summarize the data. Paired Sample t- test and ANOVA was used for hypotheses testing.

Results: Descriptive analysis showed mean age of the participants of control group (M=20.22, SD=1.30) and experimental group (M=20.22, SD=1.76), mean height of control group (171.39, SD=8.82) and experimental group (175.24, SD=6.03), and mean weight of control group (68.62, SD=8.93) and experimental group (M=66.70, SD=9.92). Average time taken to complete 1.5 mile run and walk test of control group (13.25, SD=1.29) and experimental group (M=12.63, SD=1.10) Paired Sample t-test was used to analyze the differences between pre and posttest of the dependent variables, which showed significant difference as at post (RHR, p=.000, <0.05); and cardiovascular endurance (CVE, p=.000, <0.05). A significant effect of moderate level aerobic training on RHR as (F=5.49, p=.000) and similarly, a significant effect of moderate level aerobic training on CVE was also found as (F=5.23, p=.001).

Conclusion: Thus, it was concluded thatnon-athlete students can increase their CRF and CVE levels and prevent diseases that may lead to healthier individuals in the future.

Keywords:*Aerobic, VO2 max, Cardiovascular Endurance, Non-Athletes, Students*

Introduction

A positive effects of moderate level of aerobic (OCA) to reduce the risk factors for cardiovascular

diseases(CVD) is well established. For example, practicing physical activity (PA) on regular basis helps in weight management and can also help reduce resting heart rate (RHR), which as a result reduce the risk of CVD.At long last, having low RHRis positively related to cardiovascular endurance(CVE), which implies that a person can certainly finish exercises that have a cardiovascular interest, for example, climbing, and running, jumping and swimming. Having the option to do PA without feeling tired can have a colossal effect on certainty and personal satisfaction. A decent CVE permits a person prepare and complete a training session more enthusiastically without feeling exhausted. It is exceptionally normal to perform the OCA as the only type of activity. For instance, a run of the mill long distance runner would have an extremely elevated level of cardiovascular wellness.

There are four pillars of Fitness: Strength, Cardiovascular Fitness, Flexibility, and Body Composition. The aerobic exercise identifies with the body's ability to use oxygen. The high-impact perseverance grants people to last more while looking into works out. It is important to exercise regularly to achieve CVE. Adaptability is the capacity to work through the full scope of movement permitted by a joint. Adaptability relies upon numerous components, including age, sexual orientation, and muscle versus fat/bulk proportion and activities done to upgrade adaptability. Females will in general be more adaptable than guys, due to their body synthesis (muscle to fat ratio to bulk proportion). The more seasoned individuals get, the less adaptable they become, in light of the fact that joint versatility diminishes. The more a joint is utilized, the more adaptable it will turn into. Expanding adaptability is most viably accomplished through extending, which protracts the muscles. The most significant regions wherein to keep up adaptability are the neck, shoulders, hamstring muscles, chest, and hips.

Body composition alludes to the level of muscle versus fat, which is stored in the body. The amount of pounds one weighs isn't as noteworthy as muscle versus fat proportion. The recommended muscle versus fat proportion reaches out for females is 19-26 percent fat; for men, its 15-19 percent fat. Females normally have an increasingly unmistakable degree of muscle versus fat as a result of the extra essentialness demands put upon their bodies during pregnancy. The advantages of the moderate level of exercise leads to the improvement for myocardial constriction and its electrical strength, and an expansion in "stroke volume" while at rest and during exercise, prompting a higher maximal cardiovascular endurance. At the same time the heart rate (HR) is reduced and at some random degree of submaximal CVE. Endothelial capacity is improved, prompting better stream interceded dilatation. The distance across and late limit of coronary corridors are expanded, as is guarantee arrangement. Customary exercise likewise has impacts on the inclination of blood to clump. Changes incorporate an optimal level of platelet accumulation and expanded fibrinolytic movement, potentially coming about because of lower levels of plasminogen activator restraint. Moreover, standard PA brings down provocative factors, for example, plasma fibrinogen fixations, C-reactive protein and white cell count.

Exercise brings positive physical changes for instance, urging the heart to quicken its adaptable course. Each vein conveys blood from the heart to different organs of the body. This is on the grounds that oil stores on the interior dispersion of the flexible course cause atherosclerosis and an unusual event of atherosclerosis can totally obstruct the circulatory framework in the vein. What's more, solidified stores can help improve blood coagulating, which is a genuine boundary to the circulatory framework. In the two cases, the heart muscle doesn't get enough oxygen, and there is the brevity of breath. Thus, standard physical action gives the heart different spots of intrigue. Researchers have discovered that individuals who practice all the more frequently create direct in the heart on the grounds that the heart muscle has its own pathways (coronary), which permit it to move all the more effectively through blood and oxygen. Individuals who follow the run of the mill PA build up extra coronary abilities courses. Each vein draws blood alongside the muscle cells and different tissues of the body just as the waste items that amass in the heart. Valves with a similar impact in the veins keep the blood from withdrawing. Muscles contract the veins to convey blood to the heart. Pack the muscles and veins skillfully with ordinary exercise. Nonappearance of PA can cause valves, particularly in the legs, to quit working

appropriately, for example, diminished flow in the legs.

Muscle is one of the four essential tissues of the body, and there are three kinds of muscle tissue in the body. These include skeletal muscle, heart muscle, and smooth muscle. Cardiovascular muscle tissue is effectively found in the heart. The irregular impacts of siphon blood clusters in the heart muscles in the vessels of the framework is settled. It is important to note that the muscles of the heart are different from the muscles of the arms and legs. At the point when the muscles in the arms and legs contract, the nerves in them react to the message sent by the brain. Therefore, the heart isn't controlled intentionally. It as a rule includes doing everything without deduction. Or then again perhaps, the beat is somewhat restricting called a pacemaker, which passes an electric flow and advises you to hit with certainty. Individuals who do most standard activities have a quicker heartbeat, which is the reason it is felt that the heart drains more with each beat, which implies it is quicker. The harness is the volume of the stroke and would thus be able to be beaten with less progression. Along these lines, with customary exercise, the heart works much more considering the way that every heartbeat gives more blood and oxygen to the body than it does.

Standard level ofPA underlines the body's capacity to utilize oxygen and waste items. Physical action makes the body's muscles use glucose, a hormone called insulin, which is fundamental. This breaking point is significant for acceptable success. Mostly,RHR is viewed to be one of the best ways of evaluating the wellbeing of the heart and respiratory framework.

Literature Review

Any increase in energy expenditure during PA requires rapid adjustment in blood flow, which affects the entire CVS. In contrast to the formation of blood vessels in inactive tissues, exercise improves vascular function of active muscles. A level of rest during exercise can increase blood flow to the muscles by 250 to 400 ml (Hearon Jr, 2016), which increases peripheral vascular circles. Furthermore, the production of temperature, carbon dioxide, adenosine, magnesium and potassium ions, and nitric oxide factors are known to be relaxing factors to maintain a normal CVS (Reimers, 2018). Arterial blood pressure reflects the blood flow or cardiac output per minute of the blast and the combined effects and resistance to the flow that is presented by the peripheral vascular capacity (Tomoto, 2018). In healthy individuals, systolic and diastolic BP is approximately 120 mm Hg and 80 mm Hg, respectively, indicating a calculated postural arterial pressure of 90 mm Hg. During dynamic exercise, systolic blood pressure rises significantly to around 220 mm Hg in the presence of V̇O2 max. Regular PA strengthens the heart, which can pump more blood with less effort. If the heart can do less work to pump, the force on the arteries decreases, which will help lower blood pressure (Carbone, 2020).

Regular exercise particularly OCA makes significant adjustments to the various dimensional and functional abilities of the cardiovascular and respiratory systems, which increase the supply of oxygen to the active muscles. These changes include a decrease in relaxed HR and PE-RHR, an increase in stroke volume and cardiac output, and arteriovenous oxygen differentiation, and a decrease in psychological stress during submaximal exercise. With the encouragement of proper training, most of these responses are independent of gender and age (Reimers, 2018). The average improvement in maximum aerobic strength is usually about 15 to 25% of baseline values during the first 2 to 3 months of aerobic training. However, changes in the V̇O2 max have observed a significant conflict in the response to aerobic training, even in high-quality training programs. The average improvement of V̇O2 max has been about 25% with an increase range from 0% to 40% in VO2 max. (Sbardelotto et al., 2019).

It is important to be clear about two different terms, these are cardiovascular endurance and cardiorespiratory endurance. Although they cite similar meanings, there is still some differences. Cardiovascular endurance (CVE) measures the ability of blood vessels to carry blood to transport during exercise. As the intensity of the exercise increases, the muscles need more fuel because they produce more waste. To keep everything nourished and clean, then the heart has to be sharpened, which puts more pressure on the veins, arteries and capillaries. Benefits related to CVE include improved heart health and overall lower risk of CVD. On the other

hand, cardiorespiratory endurance (CRE) involves both the heart and the lungs because a large part of the blood that carries these working muscles is oxygen. And part of the waste is carbon dioxide, which is brought to the lungs for respiration (Cheng, 2019). Simply put, CVE means the ability of the heart, lungs, and muscles to work together in a long way. In short, the benefits of CVE and CRE are basically the same. It is worth noting that CVE is measured by VO2 max and how it's used during intense exercise. Inactive individuals have higher levels of body fat and are at higher risk for CVD compared to regularly active persons (WHO, 2010).

Hattori (2019) revealed that over a 27-year follow-up, the occurrence of any CVD in the high-hazard populace, their kin, and okay people was 10.5, 8.4, and 6.9 per 1,000, individually. Included. The vast majority experience mental pressure for the duration of their lives, for example, the passing of a friend or family member, the conclusion of a hazardous ailment, catastrophic events or brutality. Proof assembled proposes that such difficulties may expand the danger of many significant illnesses, including CVD (Kessler, 2018).

The American Heart Association (AHA) presented the idea of perfect CV wellbeing in 2010. The perfect CV wellbeing develop rose up out of many years of information demonstrating that grown-ups who arrive at middle age without conventional CVD hazard elements have strikingly low dismalness and mortality from CVD. The seven factors that contain perfect CV wellbeing are: keeping up normal weight record, holding a sound eating regimen, remaining physically active, avoiding smoking, having circulatory strain leveled out, complete cholesterol under normal range, and fasting blood glucose levels in the normal range without pharmacologic treatment (Blomqvist, 2017). In any case, epidemiologic information reliably demonstrates that not many adolescents but approximately 20% arrive at middle age with at least five of the perfect CVE (Hozawa, 2015). Youngsters and teenagers may prefer CVE over grown-ups, however in the US just half of adolescents have at least five cardiovascular wellbeing measurements at the perfect levels; pervasiveness of individual perfect measurements differs from under 1% to 88% (Francis, 2016). Indeed, even in adolescence, having every one of the seven perfect CVE measurements is amazingly uncommon (Evaristo, 2019), to a great extent because of undesirable dietary patterns. The general account is one of right on time and dynamic loss of CV wellbeing resources leading to considerable danger of future CVD results after arriving at youthful adulthood (Polanczyk, 2016).

An absence of PA is the most significant hazard identified as a cause for CVD (Willians, 2016). Moreover, there is strong evidence that proposes a strong relationship between stress and inactive lifestyle (Mewton, 2019). To date it is notable that an active life and improved physical wellness assumed to have a significant job in diminishing the high mortality rate due to CVD (Kondo 2017). Regular participation in PA improves the wellbeing of individuals by improving their circulatory system (Nystoriak, 2018), hemodynamic action (Joyner, 2015), neuroendocrine system (Li &Kundu, 2019), inflammatory conditions (Tsoupras, 2018) and hemostatic reactions. Experts have recommended that lack of PA causes harmful impacts on every day stressors (Masini, 2017). Since physiological health and high levels of stress have been attributed as markers for developing CVD, it is fascinating to know whether a moderate intensity OCA can possibly impact these reactions in a positive way (Miele, E. 2017).

Ziskoven, (2018) revealed OCA to be valuable from multiple points of view like to strengthen the respiratory muscles, reinforcing the muscles of the heart, improving its siphoning, to improve blood flow and, decreasing weight, lowering stress, expanding stamina and perseverance (Young, et al., 2016). In short it is reported to be an extraordinary tool to diminish the danger of cardiovascular failures (Raimondi 2017). The HR mirrors the quantity of compressions of the ventricles per unit time and changes generously with varieties in foundational interest for oxygen checking is a basic and noninvasive clinical strategy identified with wellbeing visualization (Logan, 2016) as RHR rise in young people is legitimately connected with markers of CVD, for example, expanded pulse levels, raised blood glucose, higher all out cholesterol and raised triglycerides due to unhealthy eating habits (Kerkadi, 2019).

Considering the proof in regards to the negative wellbeing impacts related with raised RHR in youths, it is pertinent to think about this issue and to recognize elements identified with high RHR, for example, wellbeing related physical wellness parts (Nicholson, 2016). It is essential to check the connection between wellbeing related physical wellness segments and RHR, since it is conceivable to distinguish modifiable factors in the youthful populace by methods for ease, effectively regulated instruments and to propose systems with the target of avoiding medical issues related with high RHR (Matos, 2018).

The wellbeing related physical wellness parts have naturally conceivable connects to changes in RHR. Higher or improved CVE is related with progressively proficient myocardial capacity and lower RHR. (Yamashita, 2016). At the same time, improved muscle quality and adaptability levels were related with neural and solid adjustments which outcomes in more noteworthy parasympathetic sensory system (PNS) movement reflected in sound RHR (Reboul, 2018). Furthermore, muscle to fat ratio is related with the arrival of fiery adiposities into the circulation system (Fletcher, 2017), which are related with expanded thoughtful sensory system action that outcomes in more noteworthy RHR. In any case, the greater part of this evidence originates from concentrates with the grown-up populace, which makes it unsure whether these affiliations are affirmed with youths.

Methodology

This study used an experimental research design with pretest & posttest randomized group. This paper is a part of a doctoral thesis in which the effect of aerobic training was investigated on different variables.The study was conducted at COMSATS, Lahore Campus and a total number of 80 non-athletevolunteer and healthy university student participated in this study. First of all the health status of the students was checked and those with good state of health were inducted in the training program by taking their consent. "Cooper's 1.5 mile run and walk test was used to measure CVE". Before the administration of aerobic training, the selected tests for selected physiological variables were administered to collect pretest data. After the completion of eight weeks of aerobic training again the same tests were conducted to collect post-test data. RHR was measured daily in the morning and CVE was calculated by (PE-HR-PE-RHR). Data was tabulated and analyzed with SPSS (23.0) and descriptive statistics was used to classify and summarize the data. Paired Sample t- test and ANOVA was used to test the followinghypotheses:

1. There will be significantdecrease in resting heart rate at posttest as compared to pretest
2. There will be significantly greater increase in cardiovascular endurance at posttest as compared to pretest
3. There will be asignificant impact of aerobic training on resting heart rate and cardiovascular endurance

Results

The demographic data of control and experimental groups is shown in Table-2. Age of the participants of control group (M=20.22, SD=1.30), Weight (M=67.72, SD=8.78) and Height (M=171.39, SD=8.82) andfor the participants of experimental group Age (M=20.60, SD=1.55), Weight (M=66.70, SD=9.92) and Height (M=173.31, SD=7.77). Average time taken to complete 1.5 mile run test for control group was (M=13.25 with SD=1.29) and for experimental group, it was (M=12.63 with SD=1.10). Whereas, average time taken to complete 1.5 mile run test at pre-test was (M=13.08 with SD=1.24) and for post-test, it was (M=12.80 with SD=1.24)

Table-1

Pre and Post-test Comparison for Resting Heart Rate and Cardiovascular Endurance

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Test - RHR	-74.70000	3.49807	.27655	-75.24618	-74.15382	-270.117	159	.000
Pair 2	Test - CVE	-33.86250	7.12555	.56332	-34.97506	-32.74994	-60.112	159	.000

Paired Sample t-test was used to analyze the differences between pre and posttest ofthe dependent variables, which showed significant difference as at post (RHR, p=.000, <0.05); and cardiovascular endurance (CVE, p=.000, <0.05).

Figure-1

Mean Differences at Pre and Post-Test

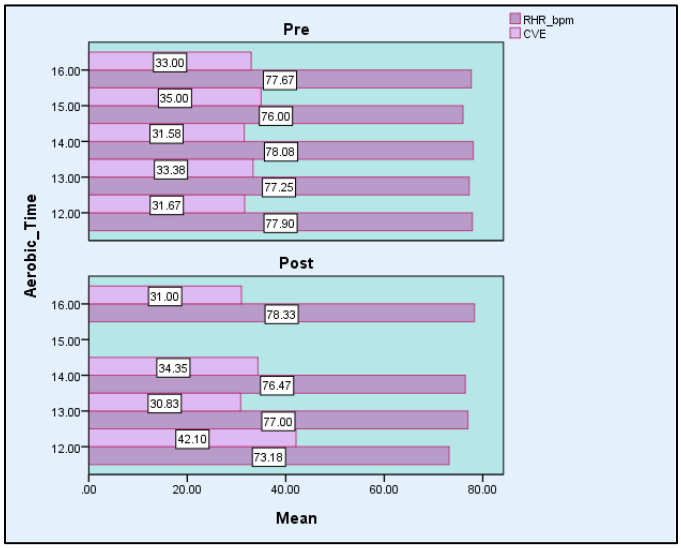

Figure-1 shows less time taken to complete 1.5 mile run and walk test decreased RHR at post-test (M=73.18) as compared to pre-test (M=77.90) and similarly less time taken at posttest improved CVE at post-test (M=42.10) as compared to pre-test (M=37.67).

Table-2

Impact of Aerobic Training onResting Heart Rate and Cardiovascular Endurance

		Sum of Squares	df	Mean Square	F	Sig.
RHR	Between Groups	203.726	4	50.931	5.490	.000
	Within Groups	1437.874	155	9.277		
	Total	1641.600	159			
CVE	Between Groups	1020.720	4	255.180	5.233	.001
	Within Groups	7558.255	155	48.763		
	Total	8578.975	159			

Table-2 shows a significant effect of moderate level aerobic training on RHR as (F=5.49, p=.000) and similarly, a significant effect of moderate level aerobic training on CVE was also found as (F=5.23, p=.001).

Discussion

The aim of the study was to determine the CVE status of non-athlete students with "1.5 mile run and walk test". The findings indicated that less time taken to complete 1.5 mile run and walk test decreased RHR at post-test (M=73.18) as compared to pre-test (M=77.90) and similarly less time taken at posttest improved CVE (M=42.10) as compared to pre-test (M=37.67). Heart rates and VO2 maxwas evaluated before the implementation of a structured training plan. At pretest, an average level of RHR; lower level of VO2 max; and lower level of CVE was recorded. Studies conducted in the past with inactive people are in accordance with the discoveries of this paper. Carbone, (2020), observed that CVE status of inactive people was lower than a group of athletes. In one more study by Mewton, (2019) aPA program was applied to non-competitors people. Because of the application, it was seen that there was a critical abatement in person's RHR. In the anther study directed by Reboul, (2018), standard PA program for a long time was applied to inactive people. Positive changes were recorded after the completion of the program. These changes included a significant reduction in RHR for a healthier heat and a significant improvement was also found in the status of CVE.

In the examinations led by Evaristo, (2019) on non-athlete individuals whopracticed a normal PA training program demonstrated changes in the RHR however no progressions were seen in BMI and BMR following 2 months of moderate level OCA training. It was seen that PA was additionally emphatically impacted when a significantchange was seen in weight practicing routinely for a considerable length of time. In another study led by Tomoto, (2018) non-athlete people who practicedOCA consistently for a longerduration of time. Different factors were estimated at pretest and toward the end of the training program. On account of RHR, a significant lessening for a healthier heart was seen at posttest (Kerkadi, 2019). Inthis study, there was a significant distinction in RHR from pretest to posttest. The current study showed that the HR increased after practice and came down in the recovery period yet the RHR couldn't be reached the normal level at post work out. This can be made sense of by the way that the CVE of inactive people is lower than the individuals who are actively involved in PA. Since with

This implies that the heart gets prepared with normal PA and it will turn out less for a similar occupation than for the inert individuals as reported by Reboul, (2018). At the point when the investigations are inspected, it is seen that normal OCA programs are applied to the people who carry on with an inert way of life will further develop their wellbeing status. In this study, the outcomes showed that HR expanded during activity to give sufficient oxygen to the functioning muscles. In view of the past investigations, it tends to be presumed that non-athlete individuals might give various reactions to a similar test assuming they participate in normal PA level. Individuals who foster CVE through moderate PA level will actually have to complete the 1.5 mile

run and walk test with lower HR as revealed by Logan, (2016).

In a study by Fletcher, (2017) who executed a 2-month OCA program. The VO2 max of the individual was estimated before the activity. At the end of the training, when the factors were analyzed, a significant impact was found to improve VO2 max in both the athletes and the non-athletes.While HR was significantly decreased in the group of athletes only. Blomqvist, (2017) carried out a training program on the inactive individuals for quite a long time and in a randomized control group. The RHR and PE-RHR of both the groups were estimated toward the start and toward the end of the training. Toward the end of 90 days, the upsides of VO2 max and RHR of the intervention groupimproved altogether, however control group didn't show significant changes. In the current study, for a 1.5 mile run and walk test significant changes at pre and posttest were estimated for RHR and CVE. In the review led by Sbardelotto, (2019) while a portion of the non-athletes were taken part in normal PA for quite some time. The factors were thought about when the activity was done. A significant change from pre to posttest was found for VO2 max; RHR and CVE. This perception shows that CVE of routinely active people is in a better status than the individuals who don't take part in PA at regular basis.

Francis, (2016) carried out a moderate level OCA program to non-athlete people for a long time. The factors were estimated at the end of the program. There was a significant expansion in VO2 max; significant reduction in RHR and CVE. In the study led by Nicholson, (2016) a normal activity program was applied to non-athlete people for a longer time period. The factors were estimated when the training ended. The outcomes demonstrated changes in VO2 max level, RHR and CVE in a positive way. Yamashita, (2016) revealed that people practicing were less inclined to foster CVD than latent or non-athlete individuals. At the point when this multitude of studies are analyzed, it has been shown that people practicing OCA consistently have an expansion in VO2 max level, diminished RHR and further developed CVE. The expansion in VO2 max level additionally implies that the CVE status is great. Subsequently, it was inferred that non-athlete people can improve their CRF and CVE levels and they can prevent serious health issues that might prompt better people from now on.

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