p- ISSN: 2708-2113 e-ISSN: 2708-3608 URL: http://dx.doi.org/10.31703/gesr.2022(VII-I).15
Vol. VII, No. I (Winter 2022) Pages: 139 – 146 DOI: 10.31703/gesr.2022(VII-I).15

Effect Of Moderate Level Aerobic Training On Maximum Oxygen Consumption And Cardiovascular Fitness Of Non-Athlete Students

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Abstract: *This study aimed to compare the difference in VO2 max values pre and post-test, compare the difference in cardiovascular endurance pre and post-test, and determine the association between VO2 max and cardiovascular endurance. This study used an experimental research design with pretest & post-test randomized groups. The study was conducted at COMSATS, Lahore Campus and a total number of 80 non-athlete volunteers and healthy university students participated in this study. The "Cooper's 12-minute Run Test" was used to measure VO2 max and CVE. Before the administration of aerobic training, pretest data was collected. After the completion of eight weeks of aerobic training, again, the same tests were conducted to collect post-test data. Data were tabulated and analyzed with SPSS (23.0) and descriptive statistics were used to classify and summarize the data. Paired Sample t-test and "Pearson Correlation Coefficient" were used to test the stated hypotheses. VO2 max is the predictor of aerobic power and CVE, so the conclusion is that regular aerobic exercise may enhance VO2 max CVE (Falk, 2019). Therefore, it is suggested that adequate PA programs be included in the curriculum of educational institutes.*

Key Words: Aerobic, VO2 max, Cardiovascular Endurance, Non-Athletes, Students

Introduction

An inactive way of living put people at risk for developing metabolic disorders (MD), which may cause cardiovascular diseases (CVD) in the long run. Various scientific investigations have shown that reducing these risk factors can reduce the risk of CVD and can prevent respiratory failure, for example, a stroke and cardiac, pulmonary bypass (CPB). The positive effects of moderate activity on reducing the risk factors for CVD are well established. For example, practicing physical activity (PA) on a regular basis helps in weight management and can also help reduce heart rate (HR), which as a result, reduces the risk of CVD. The effect of PA can generally be very beneficial and, when combined with other lifestyle changes, is considered good for cardiovascular endurance (CVE). Therefore, joining PA at an early age can help develop a healthy lifestyle and prevent CVD at a later age. Studies have shown that reducing risk factors can help reduce morbidity and mortality and can also reduce the burden of CVD. Therefore, joining PA at an early age can help develop a healthy lifestyle and prevent CVD at a later age.

Citation: Yousaf, R., & Marwat, M. K. (2022). Effect Of Moderate Level Aerobic Training On Maximum Oxygen Consumption And Cardiovascular Fitness Of Non-Athlete Students. *Global Educational Studies Review*, *VII*(I), 139-146. https://doi.org/10.31703/gesr.2022(VII-I).15

Aerobic (OCA), additionally called endurance training, is characterized as an activity intended to improve CVE, frequently alluded to as expanding the most extreme measure of oxygen. It includes the mood, redundancy, and steady development of similar huge muscle bunches for at any rate for 10 minutes or more than that at once. When performed at high power and recurrence, this kind of activity improves CVE. The oxygen-consuming activity builds pulse and respiratory rate by invigorating the heart and lungs to keep up the body during exercise. This sort of activity necessitates that oxygen conveys blood to the muscles that work through the heart. Oxygen, once inside the muscle, is utilized to consume fat.

The CVE is viewed as the most significant part of wellness since it lessens the danger of coronary illness and advances ideal execution. Different names given to cardiovascular endurance are cardiovascular fitness, cardiovascular wellness, or high-impact wellness. Cardio Breathing Fitness is named in light of the fact that it requires the conveyance and utilization of oxygen, which is conceivable just if the circulatory and respiratory frameworks can play out these capacities. The expression "oxygen consuming wellness" is utilized in light of the fact that a high-impact exercise limit is viewed as the best pointer to cardiovascular wellness, and vigorous physical movement is the best way to accomplish it. Cardiovascular strength is as significant as cardiovascular security since it is the capacity to practice enthusiastically over expanded periods without a lot of exhaustion.

Physical wellness can be improved with PA as part of the everyday schedule. A sedentary way of life and low physical wellness is the most pervasive modifiable hazard factor for non-transferable diseases. Physical movement and customary light to direct exercise may decrease the danger of way of life ailments and pass particularly from CVD and related comorbidities like hypertension, diabetes, and stoutness. The step test gives a submaximal proportion of cardiovascular problems. A moderate level of daily practice of regular PA can assist in bettering by managing weight, strengthening muscles, and growing a great stance. Customary PA additionally delivers positive changes in the body. For example, heart muscles become stronger and veins become more efficient. These progressions improve cardiovascular continuance and well-being and lessen the danger of hypokinetic maladies, particularly coronary illness and diabetes.

In the course of the most recent years, there have been a developing number of studies indicating the advantages of moderate level PA for CVE. It is important to note that moderate level PA is differently characterized as exhausting in excess of 6 meters for every min or practicing at 60–70% of most extreme pulse or at 60% of VO2 max. For all intents and purposes, this implies practice that makes the heartbeat quicker and breathing quicker. A moderate degree of PA gives advantages to CVE. The heart is one of the muscles in the body that profits by working out.

As heart is responsible to siphon blood to all the body cells. At the point when the moderate degree of PA is done, the muscle cells receive more oxygen and produce increasingly squander items. After that, the heart must look for more blood for extra oxygen and remove excess waste from the body. It is important to take care of this with an inactive way of life, and the heart can't take so much blood, as a result of which the muscles will be weakened and will become weak rapidly.

Therefore, when people do PA, especially for the allotted time, the ability of the heart to swallow blood is essential. There are two different ways for the heart to give more blood to the muscles, with the heart beating faster and sending more blood with each beat. This is called "stroke volume." An individual's resting heart rate (RHR) is controlled by calculating the amount of HR every moment when the individual is usually very high. A person with a traditional PA may have an RHR of 55 to 60 beats per second, although a person who does not exercise regularly will have an RHR of at

least 80 beats per minute or more. A fit person's heart beats about 9.5 million times less every year than normal people. The heart of a fit person works efficiently by squeezing an adequate amount of blood with less thump.

Literature Review

Physical activity (PA) is characterized as a special development produced by skeletal muscle that uses the rest of the past to use life. "Exercise is a subset of the PA in terms of planning, formulation, repetition, and purpose of improving or maintaining physical fitness" (PF) as defined by WHO (2014). Exercising is physical exertion that results in mentally and physically healthy individuals. Exercise is a sub-order of physiology kinesiology that is equivalent to a temporary natural reaction to stress and after a while, the body becomes physically resuscitated. (Altamimi, 2019).

Physical fitness (PF) is probably the most grounded indicator of people's future well-being status. Along with CVE and, the strong quality of muscles has been progressively perceived as an indication of fitness, well-being, wellness (Petriz, 2016). It is important to note that an individual's level of PA plays an important role in maintaining and promoting health. Scientific studies on children and adolescents show that PA can increase their growth and reduce their health problems. Today, due to the industrialization of societies and the incidence of inactivity in adolescents, many problems such as obesity and changes in body composition are being reported. Hence, thinking about the commonness of obesity in pre-adulthood and the adjustment in their appearance during this sensitive time of character building, numerous mental issues among them are noticeable. Today, 155 million children in the world are overweight or obese. The result of recent studies showed a greater level of obesity as compared to the past. Recently, the prevalence of obesity has been reported to be 11% in the age group of 18 years old people worldwide (Jhon, (2019).

The most explored physical change throughout the entire existence of activity science is heart stimulating exercise (Armstrong, 2019). The VO2 max is the most elevated rate at which an individual can expend oxygen during exercise, restrains the exhibition of high-impact practice and is viewed as the best single proportion of vigorous wellness perceived universally. It goes about as a biomarker for the turn of events and the seriousness of different well-being results (Armstrong N., 2017). Cardiopulmonary exercise tests, which depend altogether on VO2 max, can cover clinical bits of knowledge that can be followed to information and the connections between physiological factors. So also, in various games and in regular day-to-day existence, the capacity to participate in quick changes in practice power is at any rate as significant as VO2 max and is best depicted by the unique transient arrangement of VO2 max. Deciphering heart stimulating exercise during youth and immaturity is a test, as it is critical to consider the adjustments in development and development brought about by the development of individual natural tickers. In general, exercise scientists have ignored the status of maturity and tried to "control" the mass of the body to eliminate changes in body mass (Armstrong N., 2018).

Several estimation models have been developed to measure VO2 max. Some of these models have developed a low threshold exercise protocol in an attempt to overcome the limitations. All VO2 max models receive exercise-related data through a specific exercise protocol, such as the shuttle run and built-in estimation model, as well as other features. Although the VO2 max model overcomes some limitations, it still requires trained staff to perform the most tests, and exercise familiarity can affect protocol test results, making it a regular VO2 max monitoring. There are other estimating models that do not include exercise protocols. These models make estimates of VO2 max by collecting data from physical activity and HR

mainly to examine the relationship with reduced risk factors for CVE (Hughes, 2017).

There are direct and indirect methods to measure VO2 max. The immediate strategies (direct methods) incorporate treadmills, ergometers, and step tests, while circuitous techniques (indirect methods) incorporate graphs and equations and saw practice factors (Habibi, 2014). It is important that immediate techniques are progressively precise yet increasingly costly, requiring professionals who are prepared to arrange and utilize these methods. Interestingly, circuitous strategies are valuable and successful for evaluating the VO2 max on the grounds that there are no such cutoff points. Besides, VO2 max fluctuates significantly at various remaining tasks at hand. There are numerous approaches to evaluate and appraise outstanding workload, such as the perceived assessment of VO2 max. To measure the level of subjective physical workload, classification scales are considered useful (Cunha, 2011). Whereas, Gjestvang, (2019) reported that using rating scales may provide biased results, yet these measures can be used in large-scale studies.

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 for indirect measurement has been considered. At the same time, large-scale equipment such as bicycle ergometers and treadmills can be difficult to use, and at times these measures become unsafe. Thus, various step tests have been used to estimate the VO2 max and have been used in the surrogate method (Buttar, 2020). The connection between VO2 max and the different well-being markers is supported for the utilization of step tests as a proportion of well-being in both the general grown-up populace and recovery settings. The progression tests give a simple, productive, and earth substantial approach to gauge VO2 max that can be applied in an assortment of circumstances inside the general grown-up populace (Bennett, 2016).

Methodology

This study used an experimental research design with pretest & post-test randomized groups. The study was conducted at COMSATS, Lahore Campus and a total number of 80 non-athlete volunteers and healthy university students participated in this study. First of all, the health status of the students was checked and those with a good state of health were inducted into the training program by taking their consent. Cooper's 12-minute Run Test was used to measure VO2 max and 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. The VO2 max was calculated using this formula 15.3 x ((PE-HR /RHR) and CVE was calculated by (PE-HR-PE-RHR). Data were tabulated and analyzed with SPSS (23.0) and descriptive statistics were used to classify and summarize the data. Paired Sample t-test and "Pearson Correlation Coefficient" were used to test the following hypotheses:

1. There will be significantly greater increases in VO2 max at post-test as compared to pretest
2. There will be a significantly greater increase in cardiovascular endurance at post-test as compared to pretest
3. There will be a significantly positive correlation between VO2 max and cardiovascular endurance

Results

Descriptive analysis showed the mean age of the participants of the control group (M=20.22, SD=1.30) and experimental group (M=20.22, SD=1.76), mean height of the 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). The average time is taken to complete the 1.5-mile run and walk test of the control group (13.25, SD=1.29) and

experimental group (M=12.63, SD=1.10) and the mean values of VO2 max of the control group (M=43.93, SD=3.51) and experimental group (M=52.05, SD=7.89), and CVE of the control group (M=32.18, SD=3.30) and experimental group (M=38.53, SD=8.79).

Table 1. Pre and Post Training Comparisons of VO2 MAX and Cardiovascular Endurance

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Test VO2MAX	-46.49688	7.01828	.55484	-47.59269	-45.40106	-83.802	159	.000
Pair 2	Test - CVE	-33.86250	7.12555	.56332	-34.97506	-32.74994	-60.112	159	.000

Table-1 shows the results of the "Paired Sample t-test" that show a significant difference for VO2 max from pretest to post-test (p=.000) and similar results were found for CVE from pretest to post-test (p=.000).

Table 2. Association between VO2 MAX and Cardiovascular Endurance

		VO2MAX	CVE
VO2MAX	Pearson Correlation	1	.784**
	Sig. (2-tailed)		.000
	N	160	160
CVE	Pearson Correlation	.784**	1
	Sig. (2-tailed)	.000	
	N	160	160

A significant and positive association was found between VO2 max and CVE was found as shown in Table-2 (r=.784, p=.000).

Mean Comparisons of VO2 MAX and Cardiovascular Endurance

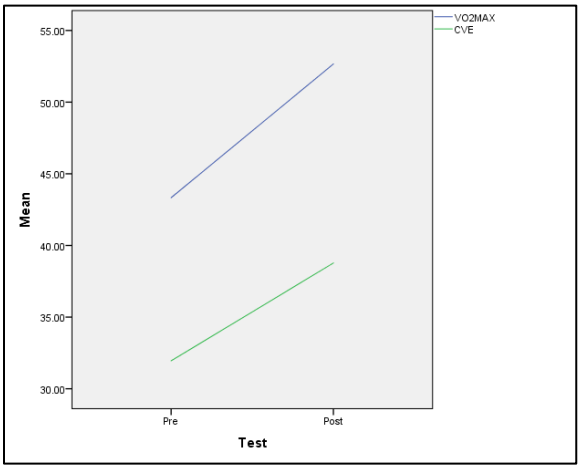

Figure 1

Figure-1 indicates that with an increase in VO2 max, CVE was also increased from pre to post-test.

Discussion

The study determined the level of VO2 max and CVE in non-athletic students after a structured aerobic training program for eight weeks. In the pretest, the participants had low VO2max, indicating low CVE. Similar results were reported in another study (Shiraishi, 2018), which indicated that most students engaged in low levels of PA, resulting in low VO2 max. The current findings showed that the mean value of VO2 max was excellent in the post-test. VO2 max is an internationally accepted parameter to assess CVE, which reflects the amount of oxygen used by working muscles during exercise (Cheng, 2019). It is the best index of aerobic capacity and CVE. Therefore, the measurement of the maximum VO2 consumption offers information on the capacity of the CVE and the muscular system to supply and use oxygen (Petriz, 2016). During exercise, up to the point of increase in OCA is proportional to the energy expended and all the energy needs of the aerobic process are met (Ertaş, 2017). So in a person, the higher the VO2 max consumption, the better their CVE level will be.

Therefore, the decrease in VO2 max is an indicator of reduced exercise capacity. It is the product of the maximum cardiac output (Armstrong, 2017). As the direct estimate of VO2 max is a thorough, laborious, and difficult experimental protocol, thus present study used a method known as the "1.5-mile run-walk test", which was reported to be reliable (Buttar, 2020) in predicting VO2 max level. The purpose of this study was to evaluate and compare the level of VO2 max and CVE among non-athletic students. The result of the present study showed that the mean value of VO2 max in the post-test was 52.66, which was found to be significantly higher than in the pretest (43.33). In the comparison of the VO2 max value with the standard VO2 max classification, the participants fit into the good CVE level in the post-test.

Studies have suggested that achieving 30 minutes or more of a moderate level of physical activity per day is associated with healthier CVE in adolescents, regardless of their adiposity status (Gjestvang, 2019). Improvements in CVE have been reported by many researchers to have positive effects on mental health and improve the ability to manage depression, anxiety, mood, and self-esteem (Gilani, S., 2019), and are also positively associated with higher academic performance (Álvarez, 2020). In this study, the association between VO2 max and CVE was confirmed, which is supported by data presented in the literature (Hughes, 2017). However, other studies have reported contrasting results (Danyang, 2019). The conflicting data is believed to be the result of methodological differences and the wide diversity of factors that affect the level of VO2 max and CVE (Kim, 2017). In addition, there is a wide variety in the methods used in clinical research to identify fitness levels, such as direct and indirect measurements of VO2 max and recovery HR (Durmić, 2019), which may cause results to differ between studies.

The findings showed a significant positive relationship between VO2 max and CVE, showing that diminished time taken to finish the 1.5-mile run test builds the degree of VO2 max. The connection between VO2 max and CVE was additionally seen in various investigations, as revealed by (Zeiher, 2019). One of the potential clarifications for a positive relationship may be that during any PA or exercise, variations happen in the human body to build the metabolic rate, coming about in a large portion of the transformations in the cardiopulmonary framework as detailed by Nystoriak (2018). Specialists have demonstrated that perhaps the main element impacted during PA is VO2 max and it is a decent indicator of vigorous power and CVE, so the end is that normal high-impact exercise might improve VO2 max CVE (Falk, 2019). Therefore, it is suggested that adequate PA programs to be included in the curriculum of educational institutes.

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