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Original Research Article

Effect of aerobic training on cardiorespiratory fitness using chester treadmill walk test in physiotherapy students

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ABSTRACT

Background: The aim of the study was to study the effect of aerobic training on cardiorespiratory fitness in physiotherapy students. This was an analytical type of study in which the participants were tested both pre and post the intervention to carry out the results accordingly.

Context and Purpose of the study: Physiotherapist as trainers of fitness are themselves expected to have a good amount of fitness. There are many studies done on evaluation of cardiorespiratory fitness in physiotherapy students. There is limited literature to check the effect of aerobic training using Chester Treadmill Walk Test specifically on cardiorespiratory fitness in physiotherapy students. 25 Participants were selected by Convenient Sampling who were Physiotherapy students. The participants included were between age group of 18-25 years who were not able to complete the Chester Treadmill Walk test for 12 minutes. After which those who were included were given a 8 weeks treadmill training intervention and post the testing was conclusion was carried out accordingly.

Results: The student paired "t" test value of heartrate prior to intervention was 33.81 and post intervention was 8.34 and the student paired "t" test value for systolic blood pressure was 2.16 and diastolic blood pressure was 2.22. The student paired "t" test value of VO_{2max} was 4.03. Based on the readings of the "t" test values mentioned above, proves that there is significant increase in VO_{2max} post the aerobic training intervention

Conclusion: The result shows that there is a significant increase in VO_{2max} which was calculated using the formula for Chester Treadmill Walk Test after the aerobic training intervention was given for 8 weeks based on the ACSM's Guidelines.

KEY WORDS: Chester Treadmill Walk Test, Cardiorespiratory fitness, Treadmill training, Physiotherapy students.

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INTRODUCTION

Physical fitness as a whole is the basis of all activities of our society. And on the other side cardiorespiratory fitness reflects the overall

capacity of the cardiovascular and respiratory systems and its ability to carry out exercise for a prolonged period of time. Therefore the cardiorespiratory fitness is considered as a direct and accurate measure of the physiologic status of an individual [1].

A sedentary lifestyle and low physical fitness, these two are the most prevalent modifiable risk factor and predictor of both cardiovascular disease and all causes of morbidity and mortality. It has been tested and found that high levels of cardio respiratory fitness provides strong and independent prognostic information about the overall risk of illness and death, related to cardiovascular causes [1].

Now a days, demands of Physiotherapy profession is increasing day by day. For this, the Physiotherapists are required to be engaged in various activities. They work in hospitals and in rehabilitation centres with varieties of patients. Their work involves giving various exercises to patient, transferring of patients and various other activities, for which they need good amount of strength, endurance and flexibility. Therefore the therapists need to maintain a good physical fitness level to meet their demands of increasing strength and endurance [1].

But due to poor attention given to the physical fitness by the physiotherapists, it has been reported that there is an increased prevalence of musculoskeletal disorder among the Physiotherapists as well as the students who are trainers. As trainers of fitness, they themselves are expected to have good fitness levels [1]. Exercise, in general, is one of the best preventive actions to fight illness and maintain health. There is an increasing evidence of ardiovascular problems in present era, due to which importance of exercise for development of fitness is on rise [2].

There is a slow decline in cardiovascular function with advancing age that is significantly accentuated by a sedentary lifestyle. ACSM has released a physical activity guideline to improve physical fitness. Hence it was recommended that there should be accumulation of at least 30 minutes of moderate activity on most preferably all days of week [2].

Low fitness levels are responsible for the highest proportion of deaths, followed by smoking had amongst the four cardiovascular lifestyle factors. Hence interventions are being made to decrease the prevalence of low physical fitness and smoking can promote reduced mortality rates [2].

Participation in aerobic exercise develops increased cardiorespiratory fitness, which protects from cardiovascular morbidity and mortality. Maximal oxygen consumption (VO2max) provides a measure of the maximal volume of oxygen that the body consumes via the respiratory system and is transported through the bloodstream to be used to release energy in the cell [3].

VO2max is currently the best indicator to assess cardiorespiratory fitness and it is directly related to cardiovascular health, and its improvement has been linked to decreases in risk of death from cardiovascular disease [3].

Cardiorespiratory fitness (CRF) as a whole is a health-related component of physical fitness which is defined as the ability of the circulatory, respiratory, and muscular systems to supply oxygen at the time of sustained physical activity. Cardiorespiratory fitness or endurance is an indication of a person's overall physical heath. The primary measure of cardiorespiratory fitness is VO_2 max. It is a measure of how well your muscles are able to absorb and use the oxygen. Essentially, your cardiorespiratory fitness level is a measure of strength of your aerobic system.[4]

The first component of the cardiorespiratory fitness is the ability of your body to transport oxygen to your muscles during prolonged exercise. The second component of cardiorespiratory fitness is the ability of the muscles to absorb and make use of the oxygen while you are exercising [4].

Physical Therapy is a basic necessity to improve health of the individuals these days. It helps maintaining the working of the bodily systems which includes nervous system, cardiovascular system, respiratory system, musculoskeletal system, gastrointestinal system, etc. Physical Therapy consists of

specially designed exercises to improve and maintain the physical abilities of an individual to perform specific tasks [5].

Physiotherapy itself suggests physical activity. Being a physiotherapist, one needs to be physically fit as it requires a lot of manual strength to give various treatments to the patients. Hence regular physical activity might help maintaining fitness and muscular strength and also improve the cardiovascular health, which overall states that it helps in improving and increasing the physiological processes of the body [5].

Cardiorespiratory endurance training indicates the subject's level of aerobic health and physical fitness. Physical fitness training includes jogging, walking, treadmill training, swimming, cycling, sprinting etc. Cardiorespiratory endurance training can be given at three levels that is mild, moderate and high intensity exercise.

The aim of the study was to study the effect of aerobic training on cardiorespiratory fitness in physiotherapy students. This was an analytical type of study using Chester's treadmill walk test as an outcome measure. This test consists of 6 levels and had been carried out before and after the intervention which consists of treadmill training for 8 weeks after which the pre and post fitness levels of physiotherapists was assessed.

MATERIALS AND METHODS

Study Setting: OPD, Department of Cardiorespiratory Physiotherapy, Dr. A.P.J Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences, Loni BK, Maharashtra.

Sample Size: 25 Subjects

Sampling Method: Convenient Sampling

Study Duration: 6 months

Study Design: Analytical Study

Materials to be used:

1. Data collection sheet
2. Stepper
3. Informed consent form

Equipment's Used: Treadmill (NEXCUS TREADMILL; EURO FITNESS POLAR)

Type of analysis: Statistical analysis used: student paired "t" test value, "p" value and significance.

Inclusion Criteria:

1. Male and Female Physiotherapy Students.
2. Age group 18-25 years.
3. Students who are not able to reach VO_{2max} value of 42 ml/kg/min.
4. Participants who sign the informed consent form.

Exclusion Criteria:

1. Students suffering from any medical or physical abnormalities like cardiovascular disorders, metabolic disorders, endocrine disorders.
2. Students already involved in any physical activity.
3. Students with recent surgical history.
4. Students with history of trauma.

Procedure: Ethical clearance was obtained from the Institutional Ethical Committee (IEC No: . PIMS/DR.APJAKCOPT/IEC/2019/467).The study was an Analytical Study which involved Convenient Sampling. The samples were the students of Dr. A.P.J. Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences, Loni. A sample size of 25 within the age group of 18 years to 25 years who were not able to complete Chester Treadmill Walk Test for 12 minutes were included. After which those who were included were given an 8 weeks treadmill training intervention according to the ACSM's Guidelines and then post testing was carried out again using the same test and then conclusion was carried out accordingly.

Cardiorespiratory Fitness was assessed pre and post the intervention. The participants were assessed using the Chester Treadmill Walk Test. This test is a 12 minute treadmill walk test consisting of 6 levels. After each level the gradient of the treadmill was increased by 3% and each level was of 2 minutes each. Before starting the test, participant were asked to walk on treadmill at 0% gradient for 2 minutes as warm up session and also at the end of 6 levels the gradient was at 0% and the participant was asked to walk for 2 minutes as a part of cool down period. At the end of each level heartrate and rate of perceived exertion was noted. At the end of the test VO_2 max was

to be predicted and the participants were included based on the inclusion criteria.

Stage	Time (mins)	Speed (km/hr)	Gradient (%)
1	0	6.2	0
2	2	6.2	3
3	4	6.2	6
4	6	6.2	9
5	8	6.2	12
6	10	6.2	15

I. Subjects were assessed using the Chester Treadmill Walk Test and will be selected based on the inclusion and exclusion criteria.

II. As per the inclusion criteria, the patients eligible signed a consent form before commencing the intervention.

III. Than the subjects were given an aerobic training protocol for 8 weeks which includes treadmill training which will be as per the FITT principle.

According to the ACSM's guidelines the aerobic training programme was divided into 4 parts which included:

1. Warm – up period
2. Treadmill training
3. Cool down period
4. Stretching

1. Warm - up period

The warm up period was further divided into two which consisted of warm up off the treadmill and warm up on the treadmill.

a) Warm up off the treadmill

Warm up off the treadmill included basic stretches of the major muscle groups.

b) Warm up on the treadmill

Before starting the warm up on the treadmill, a heartrate monitor was attached to the participant which gave a scientific guide for maintaining specific heartrate capacities during warm up on the treadmill and also during peak treadmill training and it was given for 5 mins.

1) According to American Heart Association (AHA), the healthiest people have the target exercise heart rate ranging from 50% to 80% of their maximum capacity.

2) Maximum heart rate i.e HR max is calculated by the formula.

HR max = 220-Age

2. Treadmill training

a) Treadmill training was given based on the FITT principle i.e Frequency, Intensity, Time, and Type.

b) According to the American College of Sports Medicine (ACSM) Guidelines, FITT principle was set as follows:

Frequency: 5 days/week

Intensity: Moderate intensity i.e 40 - <60% HRR

Time: 30 minutes/day

Type: Treadmill training [7-14].

3. Cool down period

The cool-down keeps the blood flowing throughout the body. Stopping suddenly can cause light-headedness because your heart rate and blood pressure might drop rapidly. Winding down slowly allows them to fall gradually.

a. Initially in cool down period the speed gradient of the treadmill will be reduced to half of the peak training speed that was being run before and slowly the speed gradient will be reduced to 0.

b. This will help the muscles to cool down gradually and ease back to normal and vitals must also be assessed.

i. After the treadmill cool down, stretches are to be done which might help preventing muscle soreness that might occur the immediate next day.

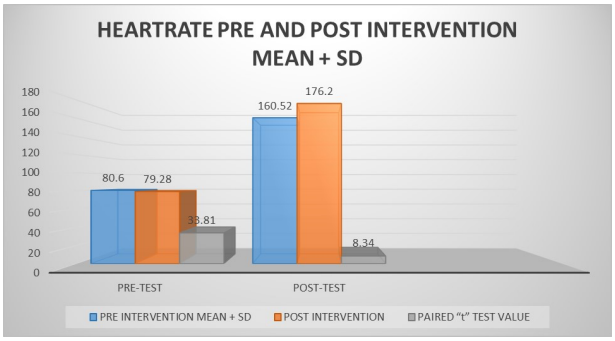
ii.After the on treadmill cool down period, major muscle stretching must be carried out.

At the end of 8 weeks after the aerobic training programme the subjects will be reassessed with the Chester Treadmill Walk Test and pre and post therapy results will be compared to find out the results i.e the effect of aerobic training on physiotherapy students [14].

Heart rate pre and post intervention Mean & SD

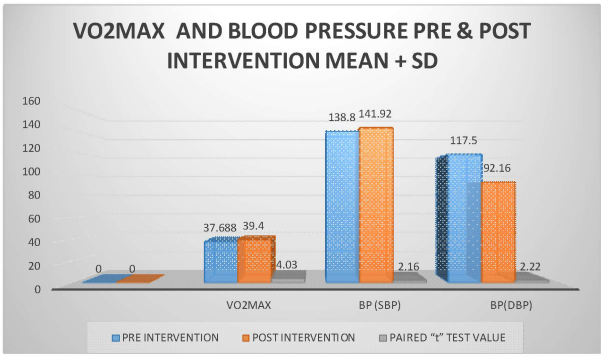
Heart rate	Pre intervention MEAN + SD	Post intervention MEAN + SD	Paired "t" test value	"p" value and significance
Pre-test	80.6 + 5.197	79.28 + 4.504	33.81	p = 0.002 significant
Post-test	160.52 + 18.5	176.2 + 8.9	8.34	p= 0.002 significant

Fig. 1: Student performing the Chester Treadmill Walk Test.



Results: This graph shows mean and standard deviation of the heartrate pre intervention pre testing was 80.6 ± 5.197 and post inter vention pre testing was 79.28 ± 4.504 which is decreased. And pre intervention post testing heartrate is 160 ± 18.5 and post intervention post testing is 176.2 ± 8.9.

	Pre Intervention MEAN + SD	Post Intervention MEAN + SD	Student paired "t" test value	"p" value and significance
VO_{2MAX}	37.688 ± 2.3	39.4 ± 2.0478	4.03	P =0.002 Significant
BP (SBP)	138.8 ± 5.7735	141.92 ± 6.6452	2.16	P = 0.002 Significant
BP (DBP)	117.5 ± 5.350	92.16 ± 5.5051	2.22	P = 0.002 Significant



VO_{2MAX} and blood pressure pre & post intervention MEAN & SD

Results: This graph shows the mean and standard deviation of VO_{2max} in which pre intervention values are 37.688 ± 2.3 and post intervention values are 39.4 ± 2.0478. And the systolic blood pressure pre intervention values are 138.8 ± 5.7735 and post intervention values are 141.92 ± 6.6452. Diastolic blood pressure values pre intervention are 117.5 ± 5.350 and post intervention values are 92.16 ± 5.5051. All the values are significant.

RESULTS AND DISCUSSION

The mean and standard deviation readings of heartrate pre and post testing, pre and post intervention which are 79.28 + 4.504 and 176.2 + 8.9 respectively. And the student paired "t" test value pre intervention pre testing was 33.81 and post intervention post testing was 8.34 which shows that there is a significant decrease in heartrate post the intervention given which suggests that the vitals were much more stable post the intervention.

When exercising, heart needs to work really hard to pump blood to your lungs and muscles. When you let it to this stress regularly over time, it slowly adjusts (by growing stronger) and ultimately is able to pump enough blood with fewer beats. The activity of exercising end up being less stressful, since your cardiovascular system gets prepared to handle them. This is why, when you do something like working out at higher intensity, over time you'll eventually be able to work at a higher intensity for longer than when you first started [15-17].

The more you exercise, the better your body gets at activating the parasympathetic nervous system. Exercise stimulates your sympathetic nervous system, or the "flight or fight" response, i.e parasympathetic nervous system counters it. At this time, the recovery and regeneration system that calms down the body. It relaxes lungs, heart, blood vessels, digestion, and more. When training and put the body is put under stress it stimulates the sympathetic system, the body gets better at flipping on the parasympathetic system to restore balance post-exercise. A more activated parasympathetic system contributes to a lower heart rate [17].

The mean and standard deviation of VO_{2max} and blood pressure pre and post intervention in which VO_{2max} pre intervention mean and standard deviation was 37.688+2.3 and post intervention was 39.4 + 2.0478 and the student paired "t" test value was 4.03. Systolic blood pressure pre intervention mean and standard deviation was 138.8 + 5.7735 and post intervention was 141.92 + 6.6452 and diastolic blood pressure pre intervention mean and standard deviation was 117.5 + 5.350 and post intervention was 92.16 + 5.5051. The student paired "t" test value of systolic blood pressure was 2.16 and diastolic blood pressure was 2.22. The "p" value for heartrate as well as VO_{2max} and blood pressure is 0.002 which is significant.

Training marks in an increase in the efficiency of oxygen transport within the body. By lowering the resting heart rate (HR), and the HR at sub maximal loads, the heart pumps extra blood with every heartbeat. In addition to other physiological changes, there is an increase in the oxygen extraction capability. When the subject is tested before and after training while performing exercise at the same load, a lower heartrate is shown after training because more blood and oxygen is delivered in each time the heart beats. Such heartrate differences during exercise can be used to calculate aerobic fitness. More the increase in heartrate, more increase in VO_{2max} [18].

Systolic blood pressure increases with increases in exercise intensity. As a bigger quantity of blood gets pumped from the heart the pressure rises in the blood vessels that transport the blood with each heartbeat. Same goes for the diastolic blood pressure. The higher the intensity of exercise, the greater the rise in heart rate will be, and consequently the larger the increase in systolic blood pressure [19].

The dramatic effects on raising blood pressure occurs because the skeletal muscles are under strain from the heavy load with an increase the intra-muscular pressure, as a result the heart has to work harder to push blood into the tightly contracted muscles thus causing an increase in blood pressure [19]. After completing the statistical analysis, the results conclude that the level of VO_{2max} is increased and the aerobic training is effective to increase the level of cardiorespiratory fitness in physiotherapy students.

CONCLUSION

The results of the study supports that endurance training is effective and helps increasing cardiorespiratory fitness level in Physiotherapy students. It shows that there is a significant increase in VO2max which was calculated using the formula for Chester Treadmill Walk Test after the aerobic training intervention was given for 8 weeks based on the ACSM's Guidelines.

Conflicts of interest: **None**

REFERENCES

[1]. Pawaria S, Kalra S, Pal S. Study on cardio-respiratory fitness of physiotherapy students: A cross-sectional study. International Journal of Yoga, Physiotherapy and Physical Education. 2017;2(4):22-24.
[2]. Jourkesh M, Sadri I, Ojagi A, Sharanavard A. Determination of fitness level in male and female college aged students. Archives of Applied Science Research. 2011;3(2):326-33.
[3]. Mogharnasi M, Eslami R, Behnam B. Effects of Endurance and Circuit Resistance Trainings on Lipid Profile, Heart Rate, and Hematological Parameters in Obese Male Students. Annals of Applied Sport Science. 2014 Dec 15;2(4):11-22.
[4]. Gäbler M, Prieske O, Hortobágyi T, Granacher U. The effects of concurrent strength and endurance training on physical fitness and athletic performance in youth: a systematic review and meta-analysis. Frontiers in physiology. 2018;9.
[5]. Sykes K, Roberts A. The Chester step test—a simple yet effective tool for the prediction of aerobic capacity. Physiotherapy. 2004 Dec 1;90(4):183-8.
[6]. McGuigan RA. Reliability and validity of the Chester treadmill walk test for the prediction of aerobic capacity. University of Chester, Thesis. http://hdl.handle.net/10034/114806
[7]. Lee DC, Artero EG, Sui X, Blair SN. Mortality trends in the general population: the importance of cardiorespiratory fitness. Journal of psychopharmacology. 2010 Nov;24(4_suppl):27-35.
[8]. American College of Sports Medicine's Guidelines for exercise testing and prescription.
[9]. http://www.shapesense.com/fitness-exercise/articles/cardiorespiratory-fitness.shtml
[10]. ACSM's Guidelines for Exercise Testing and Prescription, 8th ed. Baltimore: Lippincott Williams and Wilkins, 2010.
[11]. Topp RV, Jacks DE, Moore JB. Prediction of VO 2 Peak Using Sub-Maximum Bench Step Test in Children. Clinical Kinesiology. 2011.

[12]. Ebbeling CB, Ward A, Puleo EM, Widrick JE, Rippe JM. Development of a single-stage submaximal treadmill walking test. Medicine and science in sports and exercise. 1991 Aug;23(8):966-73.
[13]. https://www.topendsports.com/testing/tests/chester-treadmill-walk.htm
[14]. http://www.cfoa.org.uk/18322
[15]. Haddock BL, Hopp HP, MASON JJ, Blix G, Blair SN. Cardiorespiratory fitness and cardiovascular disease risk factors in postmenopausal women. Medicine & Science in Sports & Exercise. 1998 Jun 1;30(6):893-8.
[16]. Saba Khan, Razia Nagarwala, Ashok Shyam, Parag Sancheti, 2019 . Effect of Continuous and Interval Training on Aerobic Capacity in healthy, Non Exercising young individuals, https://www.researchgate.net/publication/330632020_Comparison_of_Effects_of_Continuous_and_Interval_Training_on_A erobic_ Capacity_in_Healthy_ Non_Exercising_Young_Individuals
[17]. https://www.self.com/story/what-resting-heart-rate-can-tell-about-fitness
[18]. https://health.ucdavis.edu/sportsmedicine/resources/vo2description.html
[19]. https://www.ptdirect.com/training-design/anatomy-and-physiology/acute-blood-flow-pressure-and-acidity-response-to-exercise

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