Research Article

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COMPARISON OF TREADMILL VERSUS CYCLE ERGOMETER TRAINING ON FUNCTIONAL EXERCISE CAPACITY IN NORMAL INDIVIDUALS

Zahara K. Polen, Snehal Joshi

Deccan Education Society's Brijlal Jindal College of Physiotherapy, Pune, Maharashtra, India.

ABSTRACT

Background : There is an increasing awareness among the people about fitness and health. The bicycle ergometer and treadmill are the commonest forms of indoor aerobic exercises. Motor driven treadmill exercise is similar to walking or jogging or running depending upon the speed of the treadmill. In case of bicycle ergometer the amount of exercise can be controlled voluntarily by pedaling the cycle with predefined resistance.

Aim of Study: The study was aimed at finding out the effects of these commonly used machines in gyms and in cardiovascular rehabilitation and comparing these effects.

Methodology: type of study – experimental type.

- Subjects were randomly allotted into two groups of 10 each. One group underwent treadmill training and the second group underwent cycle ergometer training for 30min, 3days per week for four weeks. The intensity of training was within 60% to 70% of age matched target heart rate[5] which was monitored using pulse oximeter.[12]
- Shuttle walk test was admistered pre and post training and the results were recorded.
- Vo2 was calculated using the formula (0.0289 *distance)+17.46.[6]
- Results were analysed using paired t test for intra group analysis and unpaired t test for inter group analysis.

Results: According to the study conducted the increase in shuttle walk distance and Vo2 values post treadmill training and cycle ergometer training were found to be extremely significant. No significant difference was seen between the improvements in two groups.

Conclusion: Our study concludes that, treadmill and bicycle ergometer are equally effective in improving functional exercise capacity.

Key Words: Fitness, Aerobic exercises, Shuttle walk test, Vo2 values, Heart rate, Treadmill, Cycle ergometer

INTRODUCTION

Physical fitness is a state of well-being with low risk of premature health problems and energy to participate in a variety of physical activities. Physical fitness is classified into health related and skill related categories.

Health related fitness is the ability to perform activities of daily living without undue fatigue. Its components are cardiorespiratory endurance, muscular strength and endurance, flexibility and body composition. [1]

Physical fitness is generally achieved through correct nutrition, exercise, hygiene and rest. To stay healthy, it is important to engage in physical activity.

The primary recommendations from the ACSM and AHA regarding guidelines for physical activity suggest that all healthy adults aged 18 to 65 need moderate-intensity aerobic physical activity for a minimum of 30 minutes five days per week, or vigorous activity for a minimum of 20 minutes three days per week.[2]

Aerobic exercise is associated with low-intensity, repetitive exercise of large muscle groups performed over an extended period of time. Aerobic exercise depends primarily on the aerobic energy-generating process. Aerobic refers to the use of oxygen to adequately meet energy demands during exercise via aerobic metabolism. This mode of exercise primarily increases muscular and cardiopulmonary endurance. Aerobic exercises include

Corresponding Author:
Dr Snehal Joshi, Professor, D.E.Society's Brijlal Jindal College of Physiotherapy, Fergusson college campus, near Dnyaneshwar Paduka chowk, Shivaji nagar, Pune- 41100, Email: drsnehalmandke@gmail.com

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walking, cycling, jogging, running, swimming, skating, and skiing. Indoor aerobic exercises include treadmill, stationary bicycle, elliptical trainer, stair climbing, etc. [3]

The bicycle ergo meter and treadmill exercises are the commonest to perform as indoor aerobic exercises. The motor driven treadmill exercise can be similar to walking or jogging or running if the speed of the treadmill motor is changed accordingly .Bicycle ergometer is exercise is similar to cycling. The intensity of exercise can be changed by varying the amount of resistance.

There is an increasing awareness among the people about fitness and health. Healthy adults are being encouraged to exercise regularly to fight the effects of aging and avoid health problems. There has been a significant increase in the number of people joining health clubs, gyms and other fitness centers.

A study was conducted which found that Values of HR-max were significantly higher on treadmill than cycle ergometer for each testing session. The subjects had significantly higher relative VO2max on treadmill than cycle ergometer for each testing session. [9] In a study conducted, it was found that ground walk training increased endurance walking capacity more than cycle training and was similar to cycle training in improving peak walking capacity, peak and endurance cycle capacity and quality of life. [10]

This study was attempted to see whether treadmill training and cycle ergometer training improves functional exercise capacity and which of the two machines has a better effect, since both these equipments have their own advantages and disadvantages. The change in functional exercise capacity was indicated by shuttle walk distance and Vo2 consumed pre and post training.

MATERIALS AND METHODOLOGY

The project was sent to Ethical committee for approval and clearance was obtained. Healthy subjects between 18 to 24 years of age were selected. PAR-Q was administered to the subjects. The subjects were informed about the project and written consent was obtained.

Study Type: Experimental Type.

Inclusion Criteria: Healthy individuals of age group 18 to 24 years.

Exclusion Criteria: Person with

1. Normal individual training in a gym or exercising regularly
2. A known Cardiac and Respiratory disorder
3. Any systemic Illness at the time of training and
4. Lower limb orthopaedic problems

Materials used: Treadmill, bicycle ergometer, pulse oximeters to monitor heart rate during exercise, 10m track for shuttle walk test, shuttle walk test, audio CD, CD player, calculator, book and a pen.

METHODOLOGY

- Shuttle walk test was administered to each healthy subject and results were recorded.
- Subjects were randomly allotted into two groups. One group underwent treadmill training and the second group underwent cycle ergometer training for 30min, 3days per week for four weeks. The intensity of training was within 60% to 70% of age matched target heart rate[5] which was monitored using pulse oximeter.[12]
- At the end of four weeks, subjects were reassessed using shuttle walk test and the results were recorded.
- Vo2 was calculated using the formula (0.0289 *distance)+17.46.[6]
- The Shuttle Walk Test (SWT) is a submaximal, standardized, incremental walking test that measures functional capacity by exercising an individual to a symptom limited maximal performance. This incremental exercise test requires patients to walk at increasing speeds back and forth a 10-m course. [6]

STATISTICAL TESTS

Results were analysed using paired t test for intra group analysis (i.e for pre and post effect of each) and unpaired t test for inter group analysis (i.e for pre and post effect of each).

RESULTS

On observational analysis it was seen that there was a significant increase in exercise capacity brought about by treadmill training protocol and cycle ergometer training indicated by the increase in shuttle walk test distance and Vo2 values post training protocol. There was no significant difference between the improvements in exercise capacity in treadmill as compared to bicycle ergometer.

DISCUSSION

The increase in shuttle walk distance and Vo2 values post training protocol on treadmill as well as cycle ergometer is due to the adaptations in skeletal muscle and bone, metabolic changes and cardiovascular adaptations that

take place in the body following aerobic exercise and training. (7)

Skeletal muscle adapts to endurance training chiefly through a small increase in the cross-sectional area of slow-twitch fibers, because aerobic activity primarily recruits these fibers. Endurance training also increases number of capillaries in skeletal muscle, thereby allowing a greater capacity of blood flow in the exercised muscle. (7)

Significant metabolic adaptations occur in skeletal muscle in response to endurance training. Both the size and number of mitochondria increase substantially as does the activity of oxidative enzymes. Myoglobin content in the muscle is also augmented. Such adaptations combined with increase in capillary and muscle blood flow in the trained muscle, greatly enhance the oxidative capacity of endurance trained muscle. (7)

After training, stroke volume is increased at rest, during submaximal exercise, and during maximal exercise; conversely, post training heart rate is decreased at rest and during submaximal exercise and is usually unchanged at maximal rates of work. The increase in stroke volume appears to be the dominant change and explains most of the changes observed in cardiac output. Arterial blood pressure at rest, blood pressure during submaximal exercise, and peak blood pressure all show a slight decline as a result of endurance training. (7)

Body response to exercise depends on the type of exercise. Cardiovascular changes again depend on the type of exercise and severity of exercises. Cardiovascular responses differ in bicycle ergometer exercise and treadmill exercise as the method of exercise differs. Studies have shown that increase in heart rate was more in treadmill exercise compared to bicycle ergometer exercise. Systolic blood pressure increases more in treadmill exercise compared to bicycle ergometer exercise due to more sympathetic activation. (8)

The study conducted also shows no significant difference between improvements in between the two groups that is treadmill and bicycle trained individuals. This is due to the fact that both types of exercises primarily focus on large muscles of the lower limb. Responses in the exercised muscle produce an effect on central circulation and leg blood flow. In both cases similar muscular and cardiovascular adaptations are produced responsible for the increase in shuttle walk distance and increased V02 value in both groups. Hence treadmill and bicycle ergometer can be interchangeably used for training.

CONCLUSION

The study shows that there is an extremely significant increase in exercise capacity brought about by treadmill training protocol indicated by the increase in shuttle walk test distance and Vo2 values post training protocol.

The increase in exercise capacity post cycle ergometer training protocol was very significant as indicated by the increase in shuttle walk distance and Vo2 values.

There was no significant difference between the improvements in exercise capacity in treadmill as compared to bicycle ergometer.

Thus, it is concluded that, treadmill and bicycle ergometer are equally effective in improving functional exercise capacity.

CLINICAL IMPLICATION:

Since both treadmill and cycle ergometer are equally effective in improving functional exercise capacity, they can be used interchangeably or as per convenience.

Treadmill can be used by younger individuals as it brings about higher energy expenditure as compared to bicycle. (11) Also walking is a familiar movement pattern as opposed to cycling. Since treadmill walking or running is in the weight bearing position it puts more stress on the joints especially the knees and may not be suitable in individuals with arthritis or injuries. Also it involves exercising on an unstable surface and can be hazardous for individuals with poor balance.

Bicycle ergometer is a non weight bearing exercise and can be used in older individuals. Also it is a stable exercise. The increase in heart rate is also comparatively lesser than treadmill hence it is better for patients with cardiac conditions. However, it has a lower energy and caloric expenditure as compared to treadmill. (11)

The advantages of Bicycle ergometer are that is more economic, occupies less space compared to treadmill and does not require electricity to run whereas treadmill does require electricity(8)

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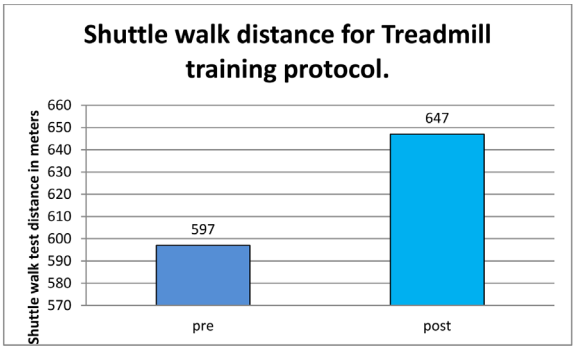
Graph 1:

Graph 1 shows the shuttle walk test distance covered by the individuals.

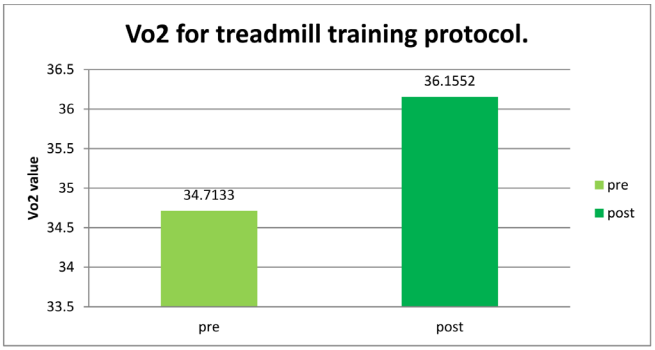


Shuttle walk distance in meters	
Pre Value (avg)	597 meters
Post Value (avg)	647 meters
Standard Deviation (pre)	78.323
Standard Deviation (post)	66.508
P value	<0.0001

Inference: The increase in the shuttle walk distance post treadmill training protocol was extremely significant indicated by the p value obtained by using paired t test which is extremely significant.

Graph 2:

Graph 2 shows the changes in Vo2 values post treadmill training protocol.

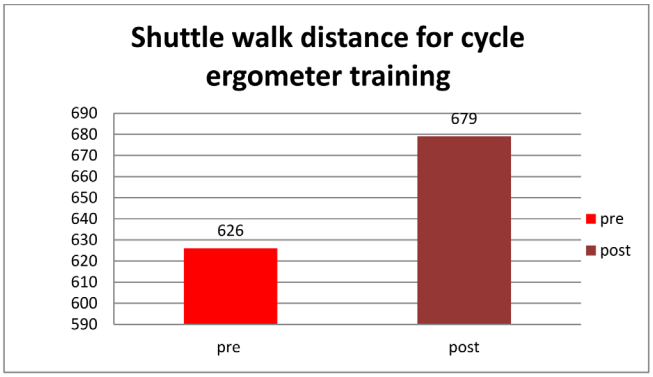


Vo2	
Pre Value (avg)	34.7133
Post Value (avg)	36.1583
Standard Deviation (pre)	1.922
Standard Deviation (post)	2.264
P value	<0.0001

Inference: The increase in the Vo2 values post treadmill training protocol was extremely significant indicated by the p value obtained using paired t test which is extremely significant.

Graph 3:

Graph 3 shows the changes in shuttle walk distance post ergometer training protocol.

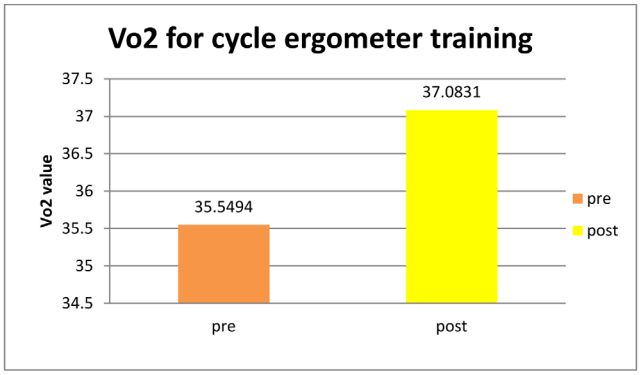


Shuttle walk distance in meters	
Pre Value (avg)	626 meters
Post Value (avg)	679 meters
Standard Deviation (pre)	106.17
Standard Deviation (post)	116.09
P value	0.0036

Inference: The increase in the Vo2 values post cycle ergometer training protocol was very significant indicated by the p value obtained using paired t test which is very significant.

Graph 4:

Graph 4 shows the changes in Vo2 values post cycle ergometer training protocol.

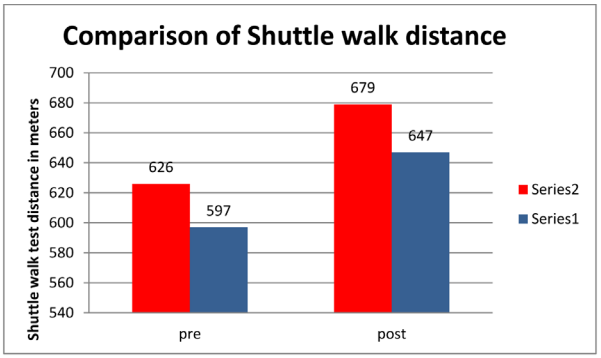


Vo2	
Pre Value (avg)	35.5494
Post Value (avg)	37.0831
Standard Deviation (pre)	3.063
Standard Deviation (post)	3.355
P value	0.0036

Inference: The increase in the Vo2 values post cycle ergometer training protocol was very significant indicated by the p value obtained using paired t test which is very significant.

Graph 5:

Graph 5 shows the comparison of shuttle walk distance in cycle ergometer training and treadmill training protocol.



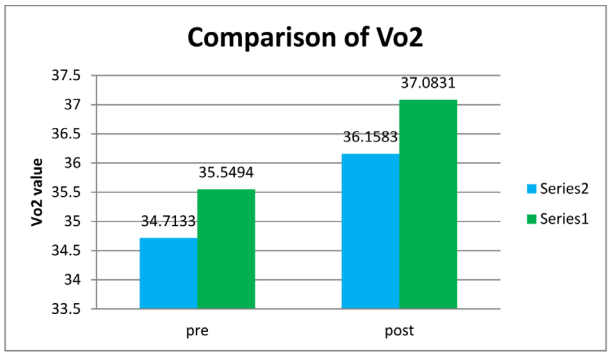
Series 1	Treadmill
Series 2	Cycle ergometer

Shuttle walk distance in meters	
Treadmill (avg)	50 meters
Cycle ergometer (avg)	54 meters
Standard Deviation (treadmill)	26.885
Standard Deviation (cycle ergometer)	47.889
P value	0.4091

Inference: There is no significant difference in shuttle walk distance post treadmill training and cycle ergometer training protocol as indicated by the p value of the unpaired t test which is not significant.

Graph 6:

Graph 6 shows the comparison of Vo2 in cycle ergometer training and treadmill training protocol.



Series 1	Cycle ergometer
Series 2	Treadmill

Vo2	
Treadmill (avg)	1.445
Cycle ergometer (avg)	1.5606
Standard Deviation (treadmill)	0.7337
Standard Deviation (cycle ergometer)	1.384
P value	0.4091

Inference: There is no significant difference in Vo2 post treadmill training and cycle ergometer training protocol as indicated by the p value of the unpaired t test which is not significant