PHYSICAL FITNESS INDEX AS A MEASURE OF CARDIOVASCULAR ENDURANCE IN SWIMMERS AND NONSWIMMERS

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Abstract

Background and Objective: Recreational swimming is a good way to relax, while enjoying a full-body workout and is recommended for the prevention and treatment of hypertension and cardiovascular disease. The present study compares the physical fitness in young freestyle swimmers practicing regularly and non-swimmers to measure the cardiovascular endurance.

Materials and Methods: This Study was carried out at tertiary health centre of Municipal Corporation of Greater Mumbai on medical students after the informed and written consent. Sixty male medical students of age group 18 – 25 years fulfilling the inclusion criteria were included. Their Physical Fitness Index was calculated. The data was analysed using student’s ‘t’ test. P less than 0.05 were considered the level of significance.

Result: In this study we found that, the Physical Fitness Index (PFI) in swimmers is significantly higher than in non-swimmers and is statistically significant. (p = 0.000).

Discussion and Conclusion: Swimming as a recreational aerobic exercise performed can be recommended for use in everyday activities in fitness clubs. In addition, it can serve as a basis for the development of new aerobic programs aimed at the future.

Keywords: Cardiovascular Endurance; Physical Fitness Index; Swimmers and Non-Swimmers

1. Introduction

Swimming is an effective exercise activity to develop cardiovascular endurance, because it causes body to use the aerobic energy system to fuel the movements. Cardiovascular endurance is the ability of the heart, blood vessels, and lungs to supply oxygen to working muscles. When exercise activities are sub maximal and done over a period of time, the aerobic energy system is effective at providing body with the oxygen it needs. However, swimming at high speeds can require using the anaerobic energy system. According to Health Guidance, cardiovascular endurance is the body's ability to exert itself over a period of time while efficiently providing the tissues with fuel and getting rid of aerobic waste. It requires heart, lungs and blood circulatory system - known collectively as cardio respiratory system - work together effectively to develop cardiovascular endurance with consistent aerobic exercises. Activities that require and develop cardiovascular endurance include aerobic exercise, such as running, biking, rollerblading and swimming.

Swimming is an excellent all-around activity that exercises most of the major muscle groups and the cardio respiratory system. Swimming is a sport which is suitable for people of many different ages and fitness levels. Swimming places very little stress on the joints compared to many activities. Swimming is a form of exercise that is good for cardiovascular endurance. It stimulates blood circulation and easily increases the heart rate. As the muscles begin working out they require more and more oxygen which requires a faster heart rate for the additional oxygen to be delivered to the muscles. Swimming is another great choice because, like cross-country skiing, it’s a full body exercise. The more body parts involve in
workout, the more calories will burn. When swimming, as with any cardiovascular activity, including high-intensity intervals increases endurance.

Swimming has long been considered one of the most “perfect” sports because of its low injury rate and the amazing benefits of swimming, regardless of one’s age or ability. While injuries do occur in the sport, they tend to be associated with the very highest levels of competition or are due to a swimmer not performing the strokes correctly. Swimming is better because of buoyancy, Water Temperature, Water Resistance, Cardiovascular Endurance, Muscular Strength and Endurance, Flexibility and Weight Management. Hence the present study was undertaken to understand and compare the Cardiovascular Endurance in Swimmers and Nonswimmers by measuring the Physical Fitness Index.

2. Materials and Methods:
The present Study was carried out at tertiary health centre of Municipal Corporation of Greater Mumbai on medical students after the informed and written consent. In the present study, sixty male medical students of age group 18 – 25 years fulfilling all the inclusion criteria were divided into two groups comprising of 30 students who are swimmers, practicing for at least 3 months regularly with one session of 30-60 minutes duration per day and minimum three days in a week and a control group comprising of 30 students who are non-swimmers. In this study we found that, the Physical Fitness Index (PFI) in swimmers is significantly higher than in non-swimmers and is statistically significant. (p = 0.000, Table-1, 2 and 3). Physical Fitness Index in two groups is compared in terms of excellent, good, average and poor by using "Chi-square test". There is statistically significant difference between Physical Fitness Index of the two groups (Table-3 and 4, Fig-1).

### Table 1: Comparison of Physical Fitness Index (PFI) in Swimmers and Non-Swimmers. n=30 in each group.

|       | N  | MEAN | S.D. | MINIMUM | MAXIMUM |
|-------|----|------|------|---------|---------|
| SWIMMERS | 30 | 100.8 | 4.5  | 92      | 110     |
| NON-SWIMMERS | 30 | 69.2  | 7.7  | 52      | 82      |

S.D. = Standard Deviation.

### Table 2: Independent t-test for the Comparison of Physical Fitness Index (PFI) in Swimmers and Non-Swimmers

| GROUP       | N  | MEAN  | S.D. | t   | DF  | Sig. | Mean Difference | 95 % CI LOWER | 95 % CI UPPER |
|-------------|----|-------|------|-----|-----|------|-----------------|---------------|---------------|
| SWIMMERS    | 30 | 100.8 | 4.5  | 19.477 | 46.8 | 0.000 | 31.633          | 28.365        | 34.901        |
| NON-SWIMMERS | 30 | 69.2  | 7.7  |       |     |      |                 |               |               |
Note: The Physical Fitness Index (PFI) in swimmers is significantly higher than in non-swimmers and is statistically significant. (p = 0.000).

Table 3: Distribution and Categorization of Swimmers and Non-Swimmers on the Basis of Physical Fitness Index.

| PFI CATEGORY | SWIMMERS | NON-SWIMMERS |
|--------------|----------|--------------|
| EXCELLENT    | 30       | 0            |
| GOOD         | 0        | 1            |
| AVERAGE      | 0        | 27           |
| POOR         | 0        | 2            |
| TOTAL        | 30       | 30           |

Table 4: Comparison of Physical Fitness Index in Swimmers and Non-Swimmers

| PFI Category | SWIMMERS | NON-SWIMMERS | Total |
|--------------|----------|--------------|-------|
| EXCELLENT    | 30 (100 %) | 0 (50 %)    | 30 (50 %) |
| GOOD         | 0 (3.3 %)  | 1 (1.7 %)    | 1 (1.7 %) |
| AVERAGE      | 0 (90 %)   | 27 (45 %)    | 27 (45 %) |
| POOR         | 0 (6.6 %)  | 2 (3.3 %)    | 2 (3.3 %) |
| Total        | 30 (100 %) | 30 (100 %)   | 60 (100 %) |

Table 5: Comparison of Physical Fitness Index in two groups in terms of excellent, good, average and poor by using "Chi-square test".

| Chi-Square Tests | Pearson Chi-Square | Degree of Freedom | P Value |
|------------------|--------------------|-------------------|---------|
| Value            | 60                 | 3                 | 0.000   |

(Note: There is statistically significant difference between Physical Fitness Index of the two groups).

4. Discussion:
According to the American Medical Association, Physical Fitness is “the general capacity to adapt and respond favourably to physical effort.” Individuals are physically fit when they meet the ordinary and unusual demands of daily life safely and effectively without being overly fatigued, and have energy left for leisure and recreational activities. The Components of Physical Fitness related to Health includes Body Composition, Cardiovascular Endurance, Muscular Strength, Muscular Endurance and Flexibility.

In the present study the Physical Fitness Index (PFI) was estimated in both the groups. Students of the swimmers group were found to be of excellent category (PFI > 90). In the non-swimmers group one student was found to have good score (PFI of 80-90), 27 students with average score (PFI of 55-79) and another two students with poor scores (PFI < 55). Out of 60 students the total number of students belonging to excellent score were 30(50%), those belonging to good score were 1(1.67%), those belonging to average score were 27(45%) and those belonging poor score were 2 (3.33%). Excellent Physical fitness index (PFI) of swimmers group indicates their active lifestyle with regular training has helped them to attain excellent condition of physical fitness.

Our study indicates that Physical fitness index of non-swimmers is poor to average (Mean PFI 69.2 ± 7.7) whereas the swimmers have excellent PFI score (Mean PFI 100.8 ± 4.5). The swimmers have a significantly higher PFI score than the non-swimmers. The results of this study have indicated statistically significant (p = 0.000) difference in physical fitness index (PFI) in the case of the swimmers group compared to the non-swimmers. Earlier studies by Keen and Sloan (1958), Sloan (1969) and Banerjee (1970) have also shown that physically active students have higher PFI scores than sedentary students. The better fitness of the study group of students is due to the regular physical activity in the form of swimming. Astrand (1956), Banerjee(1970) and Sen (1973) have shown Inverse correlation of Resting Heart Rate and Resting Blood Pressure with Physical Fitness Index(PFI). The results of the present study are suggestive that applied exercise model does have a positive effect on the transformation of the functional abilities of the
subjects of the swimmers group and thus better cardiovascular fitness. Regular aerobic exercise induces significant adaptations both at rest and during exercise in a variety of dimensional and functional capacities related to the cardiovascular and respiratory regulation system which enhances the delivery of oxygen into active muscles. These changes include decreases in resting and sub maximal exercise heart rate, enhanced stroke volume and cardiac output, an increase in arteriovenous oxygen difference and reduction in pulmonary minute ventilation during sub maximal exercise.

Physical Fitness Index (PFI) was classified as Excellent with PFI>90, as Good with PFI=80-90, Average with PFI=55-79 and Poor with PFI<55. The advantages of this test are the requirement minimal equipment and costs, and can be self-administered. The disadvantages are that the biomechanical characteristics vary between individuals. For example, considering that the step height is standard, taller people are at an advantage as it will take less energy to step up onto the step. Body weight has also been shown to be a factor. Testing large groups with this test will be time consuming.

The limitations of the present study involve the variation in the biomechanical characteristics between individuals. For example, considering that the step height is standard, taller people are at an advantage as it will take less energy to step up onto the step. Body weight has also been shown to be a factor. Testing large groups with Harvard’s step test will be time consuming. Also the present study has sample size of 60. Statistical analysis could be more conclusive with a large sample size.

Conclusion:
Swimming as a recreational aerobic exercise performed can be recommended for use in everyday activities in fitness clubs. In addition, it can serve as a basis for the development of new aerobic programs aimed at the future.

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