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Original article

Assessment of lung functions and the role of gender in Peak Expiratory Flow Rates (PEFR) of adolescent swimmers in Chennai

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ABSTRACT

Background: Swimmers have better skeletal muscle power, endurance and improved cardio-respiratory functions. Lung functions, especially Peak expiratory flow rate (PEFR) can be assessed by simple, non-invasive, and easily reproducible techniques. There is lack of data on South Indian adolescent swimmers regarding their lung functions and also the role of gender. Aim: To estimate the chest expansion and Peak Expiratory Flow Rate in adolescent male and female swimmers and compare with age- matched controls. Materials and Methods: The cross- sectional study was conducted among 35 swimmers each in male and female categories and 35 non-swimmers (age matched controls) selected randomly from swimming pool academy. A detailed history of the respiratory functions was taken. Peak expiratory flow was measured after proper demonstration of the technique to all the subjects. Swimmers were categorized into 3 groups. The mean PEFR was calculated based on their years of swimming experience Less than 2 yrs, 2-5 years , than 5 years were the three groups. 35 healthy non-swimmers from Government school also underwent the same procedure and the results were analyzed. Results: Swimmers were categorized into 3 groups. The mean PEFR was calculated based on their years of swimming experience – Less than 2 yrs-386.33 L/min, 2-5 yrs 418.44 L/min and more than 5yrs =453L/min. Pearson's correlation analysis showed statistically significant correlation between PEFR and age, sex, height and weight among all categories of swimmers. Independent "t" test showed significant correlation of PEFR and chest expansion among swimmers and non-swimmers. Conclusion: In our pilot study, it was evident that the peak flow and chest expansion of the swimmers were better than the control group. It was also found that these parameters were significantly higher in males than females in late adolescence, whereas in early adolescence the PEFR values were almost similar to those of boy swimmers which may be due to early increased pubertal growth spurts in girls than boys. Schools therefore should be encouraged to provide facilities to promote swimming among all age groups to improve the lung functions.

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1. Introduction

Swimming is an excellent aerobic activity, which not only increases physical strength but also relieves mental stress. People initially take up swimming as a hobby, later become professionals considering the overall improvement in health. It is a well established fact that competitive swimmers have better skeletal muscle power, endurance and improved cardio-respiratory functions. They also have significant increase in lung volumes and capacities and improved pulmonary functions, depending on the number of hours of swim training and associated inspiratory and expiratory muscle training which is usually a part of the training programmes.

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Lung functions are affected by unmodifiable variables like age, stature, gender and other modifiable variables like body weight, physical activity and environmental conditions [1,2] .The lung functions gradually increase from childhood, reaches a peak during thirties and later plateaus, and slowly starts declining in old age. Adolescent phase is marked by the onset of physiological, biological and psychological changes due to increase in the level of sex hormones in both the sexes.

Measurement of pulmonary functions using latest portable instruments is simple, non-invasive and easily reproducible. Peak expiratory flow emerges from large airways within 100 – 102 ms from the start of forced expiration, and remains in peak for 10 ms [1].There is a lack of comparative data on peak expiratory flow rates among male and female swimmers with that of non-swimmers of adolescent age group in Chennai.

Aim and Objectives

- To estimate the PEFR and chest expansion in the swimmers and non-swimmers.
- To assess the correlation between anthropometric indices and PEFR in non- swimmers (control).
- To assess the correlation between anthropometric indices and PEFR in swimmers.
- A comparative study on PEFR between male and female adolescent swimmers.
- To estimate the chest expansion and Peak Expiratory Flow Rate in the adolescent male swimmers and compare with age and height matched controls.

2. Material and Methods

The cross- sectional study was conducted among 35 swimmers each in male and female categories and 35 non-swimmers (age matched controls) selected randomly from swimming pool academy (acquatic complex, Velachery) and schools (Govt High School, Kundrathur, Chennai)

Detailed respiratory history was taken and complete clinical examination was done. Anthropometric measurements like height, weight, BMI, chest expansion was measured. Smokers, asthmatics and students with H/O allergy and Tuberculosis were excluded from the study.

PEFR was recorded using Clement Clarke's mini peak flow meter (100 -700 L / min). Mean of 3 readings taken according to American Thoracic Society recommended criteria. Swimmers were categorized into 3 groups based on the numbers of years of swimming experience.

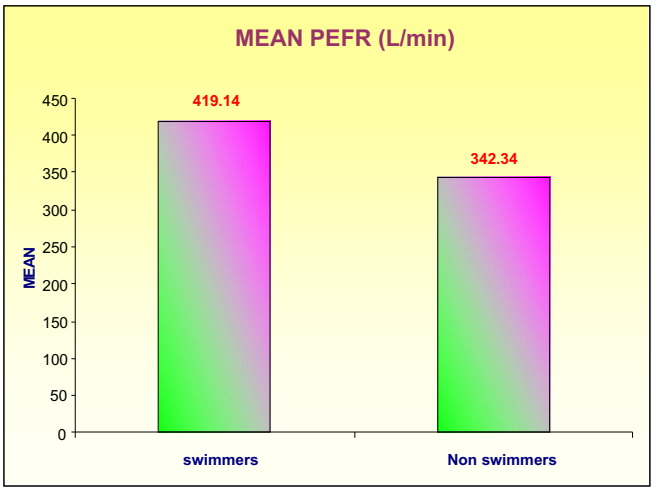
2.1. Statistical Analysis

Data is represented as Mean+SD. Independent "t' test, and one-way ANOVA was used for comparison between groups. Pearson's correlation analysis was used to assess the association of PEFR with anthropometric indices. The level of significance was taken at 5% level.

3.Results

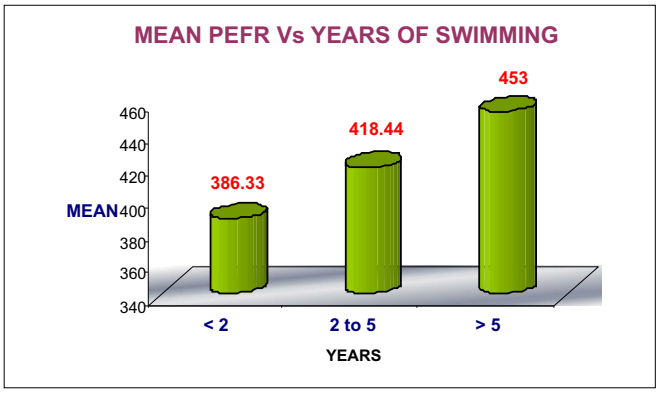
Out of 48 competitive swimmers, 35 adolescent males were recruited for the study after excluding inconsistent efforts. Swimmers had better mean chest expansion (4.38 cms) than non-swimmers (3.08 cms) and there was a positive correlation between chest expansion and PEFR in both swimmers and non-swimmers.

Graph 1: Comparison of PEFR among swimmers and non-swimmers



Mean PEFR of swimmers 419.44 L/min was better than non –swimmers 342.34L/min.

Graph 2: Mean PEFR Vs Years of swimming



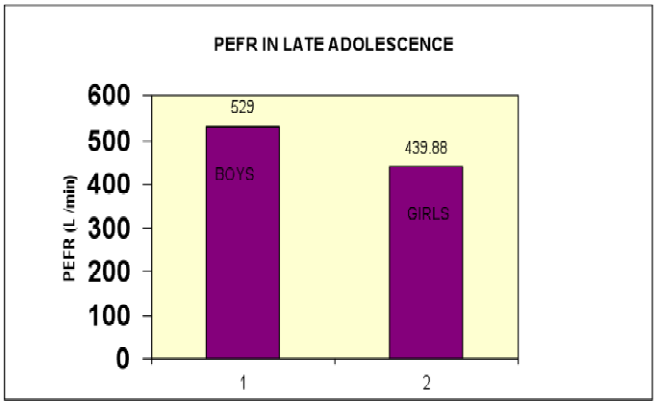
The competitive swimmers spent an average of 6hrs / day on the pool and 5 days a week. (~30hrs a week). The swimmers were categorized into 3 groups based on their years of swimming exposure. Group I – Training < 2yrs, Group II- 2 to 5yrs, Group III - >5 yrs. The PEFR increased progressively as the duration of swimming increased

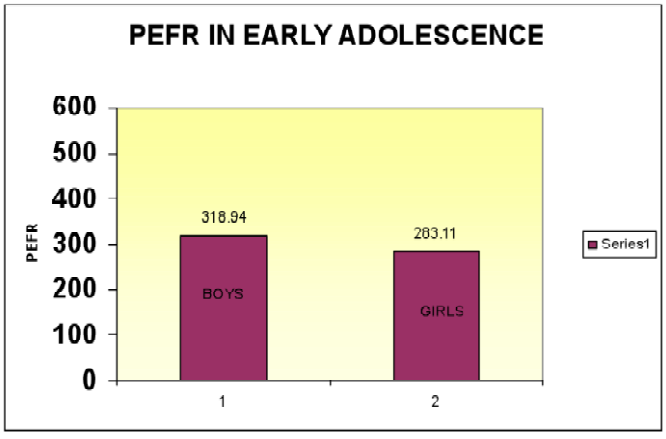
Table 1: Correlation of PEFR with age, height and chest expansion among swimmers and non-swimmers.

(n=30)	PEFR in swimmers	PFER in non-swimmers
Age	0.54	0.82
Height	0.69	0.81
Chest expansion (mean)	4.38 cm	3.08 cm

'r' values (correlation coefficient) are represented in the table. All the values were statistically significant ($p<0.05$).Height correlated the best with PEFR in swimmers and age correlated best with PEFR in non-swimmers.

Graph 3 – PEFR and gender difference in swimmers





4. Discussion

Our study clearly shows that there is a significant increase in chest expansion and PEFR amongst swimmers with an increase in age, height, and increase in duration of swimming exposure. An increase in PEFR is also observed with an increase in age, height in non-swimmers also. Older Indian studies also support these views [2,3] It was also found that these parameters were significantly higher in males than females in late adolescence. In early adolescence the PEFR values were almost similar to those of boy swimmers which are due to early increased pubertal growth spurts in girls than boys.

Schools therefore should be encouraged to provide facilities to promote swimming among all age groups to improve the lung functions.

Our study shows that PEFR is better in swimmers than non-swimmers which are also supported by other studies [4,5]. The advantages of regular physical activity are numerous. Aerobic exercise improves the overall functioning of the body as there is a drastic improvement of blood flow to most of the endogenous organs including the lungs. It is also shown that aerobic exercises are protective against age-related increases in visceral adiposity not only in adults but also in growing children and adolescents. Lung volumes are substantially reduced in obese population [6] Childhood obesity is a growing pandemic which is yet another major handicap of urbanization and sedentary lifestyle.

Variations in PEFR are well documented. PEFR shows diurnal variations (7% increase in mornings and 2 % in evenings) [7] and is well correlated with respiratory muscle strength [8,9]. Peak flow is higher in physically fit military personnel and athletes [5,10] due to high degrees of cardio –respiratory conditioning at the time of physical training.) PEFR is lower in pregnancy due to lack of proper nutrition, anemia of pregnancy, reduction in respiratory muscle strength [11] and also lower in population belonging to the lower socio-economic status. We presume that this finding is due to probably lower respiratory muscle strength, overcrowding and lack of nutrition. It is also well established that smokers have lower respiratory parameters than non-smokers. Prolonged exposure to chlorinated water in the swimming pools is well known to cause dermatitis, allergic rhinitis and sinusitis. Young and apparently healthy swimmers who do not have particularly susceptible airways when they take up competitive swimming may later develop respiratory symptoms, airway inflammation, and airway hyper responsiveness during their swimming careers. Though swimming as a career has such minimal disadvantages, it can be considered as cheap and best aerobic activity for all age groups, especially the growing adolescents.

Limitations

Small sample size is the major limitation of our study. PEFR was done randomly in the select population and it would have been better if the pulmonary parameters were measured both before and after a vigorous swimming session and compared.

5. Conclusion

Chest expansion and PEFR is better in swimmers and also increases with an increase in the duration of swimming exposure. An increase in PEFR is also observed with an increase in age, height in non-swimmers also. In late adolescence, males had better PEFR values. We suggest that children need to take up a healthy physical activity and swimming is cheap and best form of aerobic activity.

6. References

6. References

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