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1 author:

Sandip Hulke
LNCT Group of Colleges

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Short report

Effect of endurance training on lung function: a longitudinal study

Sandip Meghnad Hulke[a]*, Mrunal S. Phatak[b]

[a]**Assistant professor, LN Medical College, Department of Physiology, Bhopal*
Professor and Head Department of Physiology, Indira Gandhi Govt Medical College, Nagpuri.

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ABSTRACT

Physical activity is known to improve physical fitness and reduce morbidity and mortality from numerous chronic conditions and lung function is not an exception to this. Also, the sports activities have put the athletes at risk of exercise-induced bronchoconstriction. to see the changes in pulmonary function over the duration of 12 weeks. material and methods: This study was a longitudinal study which was done on the students of Physical Education College. Hundred subjects (51 male, 20.18 yrs 1.147, 49 female, 19.91 yrs ± 1.89) were assessed using MIR Spirolab within 7 days of admission to their college and reexamined after 12 weeks. results: significant change was seen in PEFR in male however no significant change was found other lung function parameters studied in male as well as females. There was very significant improvement in aerobic fitness as assessed by VO2max in both male and female. Conclusion: physical activity does improve some of lung function and also there is no deterioration in lung function with 12 weeks of exercise but we recommend multiple longitudinal study.

1. Introduction

It is essential to be involved in physical activity or sports which help in achieving better lung function. Involvement in certain physical activities or sports could help in respiratory muscle strengthening and improvement in pulmonary function. Change in physical activity is associated with change in cardio respiratory fitness [1]. Over past few decades sports activities especially winter sport activity put athletes at risk of asthma and exercise induced bronchoconstriction. This is believed to be result from the repetitive dehydration of the small airways when large volume of cold air inhaled [2]. Exercise-induced bronchospasm (EIB) is defined as a decrease in lung function, usually characterized by a 10% decrement in forced expiratory volume in 1s (FEV1), or a decrease of 20% in mid-forced expiratory flow (FEF25%–75%), which occurs after vigorous exercise. EIB can be triggered by intense exercise, cold dry environments, chronic asthma, or by a variety of air pollutants [3]. In our country, specially in this part of world, central India, only few studies have been carried out and we have not come across a reference of longitudinal study hence we endeavored to undertake a longitudinal study to investigate and report pulmonary function changes at rest (improvement or deterioration) in healthy students involved in sports over a period twelve week.

* Corresponding Author : Dr Sandip Meghnad Hulke
M.D. Physiology, Assistant professor, Department of Physiology
LN Medical College, Bhopal, R-135, Gurudeo Nagar, New Nandanvan, Nagpur, Maharashtra 440009, Mo. No. 9039769805
Email: smh555@rediffmail.com, sandip_hulke@yahoo.co.in

2. Materials and method

This was a longitudinal study in which hundred subjects (51 male, 20.18 yrs ±1.147; 49 female, 19.91 yrs ±1.89) were evaluated within 7days of admission to college and after 12 weeks of exercise and these findings were compared with previous findings. All the subjects had to undergo physical training and their F.I.T.T. (i.e. frequency, intensity, time and type of physical activity) was: ten session /wk, 30min / session, somewhat hard intensity (RPE scale[4]. twelve weeks duration, and dynamic exercise in form of running. Theses exercise per session were distributed as warm up for ten min fairly light intensity (RPE scale), followed by running somewhat hard intensity (RPE scale), for 30 min.

Inclusion criteria were mainly healthy volunteer, age group between 17 – 22 yrs, and non smokers. Smokers, subjects with history cardiac, respiratory and diabetics and subjects whose clinical finding were abnormal were excluded from the study.

For pulmonary function test, MIR Spirolab was used. Pulmonary function test was recorded in Physical Education College, in the morning session at around 6.30am. On the previous day students were told to avoid exercise till the same test is over.

All the subjects were made familiar with the instrument and the procedure for performing the test. The data of the subject as regards to name, age, height, weight, sex, date of performing the test, atmospheric temperature was fed to the computerized Medspiror.

The tests were performed in sitting position. The subject was asked to take full inspiration which was followed by as much rapid and forceful expiration as possible in the mouthpiece of Medspiror. Three consecutive reading were taken and the best reading among three was selected and noted.

For Maximal oxygen consumption:-Queen's College Step test [4] was used. Subjects were instructed to step at the rate of 22 steps per min (females) or 24 steps per min (male) for 3 minute. The bench or stool height is 16.25 inches. After exercise, the subjects remain standing, waits for 5 second, and 15-second heart rate count is taken. The VO_{2max} (ml/kg/min) is predicted using this equation.

MALES : - PREDICTED VO_{2max} = 111.33 – (0.42*HEART RATE)
FEMALES : -PREDICTED VO_{2max} = 65.81 – (0.1847*HEART RATE)
Approval for the above study was taken from institutional ethics committee.

Then the data of the observation for all parameters were statistically analyzed by calculating mean and standard deviation. The data was analyzed using Graph pad prism 5 software. Statistical difference between the data obtained in various groups was evaluated by paired t test and p value <0.05 was considered as statistically significant.

3.Results and observations

The result of the present study are presented in the table I and table II. There was no significant change in anthropometric variables and body composition but there was significant improvement in aerobic power as assessed by $VO2_{max.}$ (Table I)

There was no significant change in PFT parameters but significant increase was seen in PEFR in male. (Table II)

Table I : Subjects characteristics

PARAMETERS	PRE EXERCISE male	POST EXERCISE male	*p value*	PRE EXERCISE female	POST EXERCISE female	p value
AGE(YRS)	20.18±1.147	20.18±1.147	p>0.05	19.91± 1.89	19.91±1.89	p>0.05
HEIGHT(M)	1.701 ± 0.04568	1.701 ±0.04568	p>0.05	1.581 ± 0.05442	1.581 ±0.05442	p>0.05
WEIGHT(KG)	60.85±5.873	60.63±5.516	p>0.05	52.15±6.495	52.51±5.465	p>0.05
BSA (M2)	1.70±0.081	1.70±0.077	p>0.05	1.51±0.095	1.52±0.085	p>0.05
FAT MASS%	11.04±4.72	11.00±4.57	p>0.05	20.30±4.45	20.86±3.92	p>0.05
FAT MASS(KG)	6.82±3.20	6.72±3.017	p>0.05	10.54±3.01	10.90±2.62	p>0.05
LBM (KG)	53.97±4.88	53.8±4.988	p>0.05	40.91±4.51	41.04±4.07	p>0.05
VO2MAX (ML/KG/M)	45.74±6.87	51.41±5.96 ***	p<0.001	38.47±3.38	41.50±2.57***	p<0.001

VALUES ARE MEANSD
***: p<0.001 very significant change (comparison between pre and post exercise)

Table II: Lung function parameters in subjects

PARAMETERS	PRE EXERCISE male	POST EXERCISE male	*p value*	PRE EXERCISE female	POST EXERCISE female	p value
FVC(L)	4.209±0.68	4.143±0.56	p>0.05	2.93±0.45	3.025±0.50	p>0.05
FEV1(L)	3.56±0.53	3.57±0.54	p>0.05	2.68±0.40	2.72±0.43	p>0.05
FEV1 (%)	85.91±5.38	86.67±5.00	p>0.05	91.72±6.98	91.3±5.86	p>0.05
PEFR (L/SEC)	7.46±1.64	7.91 ±1.34 *	p>0.05	5.43±0.83	5.59±0.99	p>0.05
FEF25-75%	3.383±1.184	3.291±0.9561	p>0.05	3.291±0.9561	3.275±954	p>0.05

VALUES ARE MEANSD
*:p<0.05 significant change (comparison between pre and post exercise)

4.Discussion

There was no significant change in PFT parameters but non significant increase was seen in PEFR.

FVC:-Our finding in athletes is in agreement with several studies[5-7] but contrast with some[8]. Some found similar result only in males or only in females [9,10].

FEV1 and FEV1%:-Our findings are matching with[5,6,9,10] but several studies have found contradictory results[7,8].

PEFR and mid-forced expiratory flow (FEF25%–75%), found in our study is in harmony with some studies[6,7] while significant improvement was found in some studies [8,9].

We had got significant improvement in PEFR in male, this may be because exercise of 12 weeks is enough for development of respiratory system so as to cause improvement and other parameter improvement will take longer duration.

Since there is no improvement in any of the PFT parameter studied besides PEFR, it denotes that there is lack of adaptive changes in the form of lung volume or dynamic function. It might be due to:-

- Lesser duration and moderate degree of exercise.
- Exercise training enhances ability to sustain exceptionally high level of sub maximal ventilation but exerts a little effect on maximum static and dynamic lung function[4,11].
- Type of exercise: - subjects of our study were mainly doing dynamic exercise and some static exercise; none of them were involved in swimming as exercise. Swimming training attenuates the dysanaptic development of respiratory system and improved airway conductance[12] and may lead to alveolar hyperplasia as a result of intermittent hypoxia[8,9] .

According to Qi Fu and Benjamin D. Levine[13], there are physiological and morphological gender difference exists in humans. It is likely that certain gender- specific factor such as difference in some hormonal level, menstrual cycle variability, and physical characteristics may influence the response to exercise in women. In females according to us exercise should be long duration and with hard intensity for similar improvement (as compared to male).

Histamine is one inflammatory mediator that has been shown to increase during heavy exercise, which could cause bronchoconstriction at the level of the small airways and/or increase microvascular permeability. This is believed to result from the repetitive dehydration of the small airways when large volume of cold air is inhaled.[2,14], Such decline was not shown in our study and also by Kipplen P et al who did not find significant evidence of lung function impairment in healthy Mediterranean athletes even after one year of endurance training.[15] The reason for this not significant change may be beneficial effect of exercise which is seen our study(PEFR in male) and which is overcoming the effect of different mediator responsible for bronchoconstriction and also the pleasant atmosphere in this part of the world.

Physical training carried out by the subjects in present study did not alter the status of pulmonary system except PEFR in male but it is helpful in improvement in aerobic power. We recommend higher frequency, more duration and more intensity for the improvement in lung function, and also multiple longitudinal studies are needed to perform to know the effect of exercise on respiratory function.

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