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LUNG FUNCTION IN MIDDLE DISTANCE ADOLESCENT RUNNERS

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Abstract : Lung functions (FVC, FEV_1, ERV, IC AND MVV) were evaluated in 14 boys and 11 girls practising for middle distance running events in the age range of 13 to 17 years before and after one year training. The findings suggest that during adolescence, development of lung under proper nutritional and health conditions is governed by the process of growth with negligible additional effect of physical activity. However, physical exercises during growth may help in developing a reduced resistance to expiration and a greater endurance in respiratory muscles.

Key words: athletes adolescence lung function

INTRODUCTION

Some studies in the past have confirmed that adult athletes have larger lung volumes and capacities (1). To what extent these differences are consequent to athletic training, and to what extent, they may be due to the athlete's genetic endowment is controversial (2-5). As far as the Indian athletes are concerned, no study in the past has been carried out, especially on athletes during their growth spurt period to find out their lung dimensions. The present investigation was thus undertaken to assess the lung function in adolescent athletes before and after one year training.

METHODS

Studies were conducted on 14 boys and 11 girls athletes aged 13 to 17 years who were undergoing training under the Sports Authority of India, Jawahar Lal Nehru Stadium, New Delhi for middle distance running events. The boys had been training continuously for 1.8±1.0 yr (range 3-1) and were running 40±12 km/wk (range 30-60). The girl athletes had been training continuously for 1.00 ±0.5 yr (range 1.2 yr -6months) and were running 20 ±5 km/wk (range 15-25). All the subjects were clinically examined and found fit. Informed consent was obtained from all participants. These subjects were from the northern region of India having similiar nutritional back ground and food habits. These growing athletes remained actively engaged in their sports events during the tenure of this trial.

Lung function changes in both these groups were estimated twice at one year interval. They were familiarised with the instruments and the techniques used. The lung functions were recorded in a laboratory, temperature ranging 25-27°C. Tests were carried on in the mornings during the postabsorptive phase. Subjects were asked to report to each testing session atleast 3 hours postprandial and dressed in the same light weight running attire to be used during the training.

Protocol :

Each subject was given two trials and three test runs for each test and best of three test readings was taken. FVC, FEV_1, ERV and IC were recorded with subject sitting on a wooden stool by using a calibrated Toshniwal Expirograph (6).

Maximum voluntary ventilation (MVV) was also measured on Toshniwal Expirograph. Subjects were asked to breathe for 15 seconds at a frequency above 60 breaths per minute with maximum tidal volume (Vt) maintained at that frequency. They were encouraged through out the test.

The data were statistically analysed using paired 't'test. In the interpretation of the results, 5% level of probability was accepted.

RESULTS

The physical characteristics of the subjects are given in Table I. When the study was started, the mean age(yr), height(cm) and weight(kg) for boys were 16.64±0.93, 166.78±1.56 and 56.19±1.79 and for girls 13.90±0.70, 154.23±1.87 and 43.59±1.39 respectively.

The mean values ±SEM for FVC, FEV_1 and $FEV_{1\%}$ for both the groups are depicted in Table II and the mean values±SEM for IC, ERV and MVV are illustrated in Table III. The basal values for FVC, IC and ERV were well within the predicted range for these groups (7,8). The boy athletes after one year had slightly higher lung function values in comparison to their predicted values for the age while girls did not show any variation from their predicted FVC values.

TABLE I : Physical characteristics of trainee athletes (Mean±SEM).

S. No.	Group	Parameters	Year 1988	Year 1989	Statistical significance between 1988 and 1989
1.	Boys (n = 14)	Age (yr)	16.64 ±0.93	17.64 ±0.93	-
		Height (cm)	166.78 ±1.56	168.21 ±1.61	P<0.001
		Weight (kg)	56.19 ±1.79	57.18 ±1.87	NS
2.	Girls (n = 11)	Age (yr)	13.90 ±0.70	14.90 ±0.70	-
		Height (cm)	154.23 ±1.87	155.89 ±1.96	P<0.001
		Weight (kg)	43.59 ±1.39	45.00 ±1.29	P<0.01

TABLE II : FVC, FEV_1 and $FEV_{1\%}$ in trainee athletes (Mean±SEM).

Parameters	Group	Year 1988	Year 1989	Statistical Significance between 1988 and 1989
FVC(1)	Boys	3.96±0.14	4.18±0.12	P<0.01
	Girls	2.61±0.12	2.76±0.11	P<0.05
FEV_1(1)	Boys	3.26±0.10	3.56±0.11	P<0.01
	Girls	2.15±0.10	2.43±0.08	P<0.001
FEV_1(%)	Boys	82.55±1.60	85.17±1.59	NS
	Girls	82.77±2.14	88.61±2.48	P<0.01

TABLE III : IC, ERV and MVV in trainee athletes (Mean±SEM).

Parameters	Group	Year 1988	Year 1989	Statistical significance between 1988 and 1989
IC (1)	Boys	2.46±0.08	2.73±0.09	P<0.05
	Girls	1.58±0.08	1.77±0.09	P<0.001
ERV (1)	Boys	1.33±0.09	1.53±0.07	P<0.01
	Girls	0.92±0.06	1.04±0.07	P<0.05
MVV (1/min)	Boys	144.60±7.04	152.86±6.93	NS
	Girls	111.26±5.91	115.06±6.09	P<0.01

As height has a significant effect on the lung volumes and capacities, FVC and FEV_1 values for boy and girl athletes in 1988 were standardised to their after one height respectively and are given in Table IV. It is observed that standardising the FVC and FEV_1 values to the same height did not change the trend much.

TABLE IV: FVC and FEV_1 (Mean±SEM) in boy and girl athletes.

(Corrected to standard heights of 168.21 cm & 155.89 cm respectively).

Parameters	*Group*	*Year* *1988*	*1989*	*Statistical significance between 1988 and 1989*
FVC (1)	Boys	4.00±0.14	4.18±0.12	P<0.01
	Girls	2.65±0.12	2.76±0.11	NS
FEV_1(1)	Boys	3.30±0.11	3.56±0.11	P<0.01
	Girls	2.18±0.10	2.43±0.08	P<0.001

DISCUSSION

The term adolescence is defined as the period from puberty to full sexual maturation and is concerned with the physical, mental and the social growth. Growth spurt at adolecence involves every muscular and skeletal dimensions of the body. It has been observed that adolecents habituated to high level of physical activity have on an average greater lung volumes than their sedentary counterparts of comparable age and body sizes (9). Views have been expressed that training during this period, as compared with training after may be of greater importance in determining the ultimate dimensions of the lung (10,11). However, in the recent past, a number of studies have failed to find effects of endurance exercise training on most aspects of lung function. Lung volumes and capacities, Carbon monoxide diffusing capacity, pulmonary ventilation to perfusion ratio, and ventilatory responses to hypoxia, hypercapnia or exercise are all unaltered by training (12-14). Thus, effects of training during adolescence are not well understood yet.

As far as the results of the present study are concerned, average height, weight and the various lung dimensions observed are in close agreement with published reports on normal Indian boys and girls of this age group (7,8,15). The lack of differences in lung volumes between these athletes and data available for non-athletes agrees with the findings of other workers (3,10). $FEV_{1\%}$ was consistently higher in athletes which probably reflects a lower airway resistance as compared to normals.

The longitudinal studies by Lange at al (4) reveal that lung volume growth both in athletes and non-athletes, parallels growth in body height. However, others have shown that in young swimmers, lung volumes were increased above values for control subjects of similar age or height (2). It may be presumed that in the present study athletic training was not associated with detectable improvement in these lung functions, since there existed no ventilatory stress in this form of training analogous to those present in swim training (10).

Thus our data suggest that development of lung during adolescene in middle distance runners is governed by the process of growth with negligible additional effects of physical activity (13,14). However, the significant differences in FEV_1 and MVV between athletes and non-athletes show that adolescent athletes have superior expiratory power and over all low resistance to air movement in the lungs. The higher MVV is advantageous for physical work capacity (16,17). Robinson and Kjeldgaard (18) also have reported increased MVV with running training.

In conclusion, our results show that running training during growth may help in developing a reduced resistance to expiration and a greataer endurance in respiratory muscles.

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