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COMPARISON OF PULMONARY FUNCTION AMONGST LADAKHI, DELHI, VANVASI AND SIDDI BOY ATHLETES

S. C. LAKHERA* AND T. C. KAIN

Defence Institute of Physiology and Allied Sciences,
Lucknow Road,
Delhi - 110 054

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Abstract: Lung functions were studied in contemporary healthy boy athletes of Ladakhi, Delhi, Vanvasi and Siddi origin. As lung function are related to ethnic and environmental factors, the aim of the study was to compare the lung function in boys belonging to these four groups. Vital Capacity (VC), Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV_1), Expiratory Reserve Volume (ERV) and Inspiratory Capacity (IC) were recorded using conventional closed circuit spirometry. Maximum Voluntary Ventilation (MVV) was estimated collecting expired air during deep and rapid breathing in a 100 litres metereological balloon for a period of 15 seconds and measuring its volume. It was found that Ladakhi boys were having significantly higher VC, FVC and FEV_1 values than their counterparts. However, there was no significant difference in MVV amongst Ladakhi, Delhi, Vanvasi and Siddi boys. Our results suggest that size of the lung is governed by genetic, environmental and nutritional factors and confirm that physical training during growth may help in developing a greater endurance in respiratory muscles.

Key words: athletes ethnic and environmental factors lung functions

INTRODUCTION

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 athletes genetic endowment is controversial (2). As regards the Indian athletes, no comparative lung function study in the past has been carried out, especially on adolescent athletes of different ethnic origins. The present investigation was undertaken to assess the lung functions in adolescent boy athletes of Ladakhi, Delhi, Vanvasi and Siddi (Negro) origin.

METHODS

1. Ladakhi athletes: These athletes were high altitude natives (range : 3200 m to 3800 m) from Ladakh, India's biggest district with the smallest population. It is one of the most elevated regions of the world. Its economy is primarily agrarian and rural in character with 79% of its population engaged in agriculture and 92.5% dwelling in rural areas.

2. Delhi athletes: These athletes were born and brought up at Delhi (altitude 200 m), capital of India. Their parents were lowlanders north Indians and were settled in Delhi since last 20 years or more.

3. Vanvasi athletes: These athletes wer from the tribal communities residing in the sea level tribal areas of Rajasthan, Bihar and Madhya Pradesh.

4. Siddi athletes: These athletes were of Siddi community residing in near sea level areas of Gujarat state, India. According to Indian history, the British brought these Siddies with their army units to India from the wild parts of Mombasa and Angola of Africa as labourers in the 14th or 15th century. Still at present the African culture and social life with physique are preserved.

*Corresponding Author

These athletes were selected by the Sport Authority of India under Special Area Games (SAG) scheme by holding Athletic talent contests. They were undergoing training for running events of varying distances at Jawahar Lal Nehru Stadium, New Delhi during the tenure of this study. The subjects were made familiar with the instruments and the techniques used. The lung functions were recorded in a laboratory, maintained at 24 to 26°C. Tests were carried out 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 track suit used during the training.

Lung function studies were carried out as given below:-

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 closed circuit spirometry using a Toshniwal Expirograph (3).

Maximum voluntary ventilation (MVV) was estimated collecting deep and rapid breathing expired air in a 100 litres metereological balloon for a period of 15 seconds at a frequency above 60 breaths per min (2).

The data was statistically analysed using one-way Analysis of Variance (ANOVA). In the interpretation of the results, 5% level of probability was accepted as significant.

RESULTS

The physical characteristics of the subjects are given in Table I. The mean age (yr), height (cm) and weight (kg) for Ladakhi, Delhi, Vanvasi and Siddi boys are 16.3±0.4, 160.55±1.42, 47.00±2.09; 16.3±0.4, 169.91±1.77, 52.27±2.15; 16.0±0.4, 158.72±1.94, 49.67±2.15; and 16.3±0.6, 158.99±2.51, 50.56±2.30 respectively.

The mean values ± SEM for VC, FVC, FEV_1, $FEV_{1\%}$, ERV, IC and MVV for boy athletes are depicted in Table II. Among boy athletes the VC, FVC, FEV_1, ERV and IC were found to be highest in Ladakhi with a mean value of 4.38,4.35, 3.77, 1.63, 2.75 litres and 144.86 litres/min respectively. There were no significant differences between Vanvasi and Siddi athletes in their lung volumes and capacities. The Siddi boys were having lowest mean VC, FVC and FEV_1 values of 3.33, 3.36 and 2.95 litres respectively. The mean MVV values among these four groups were not significantly different.

The Table III shows FVC and FEV_1 values of these athletic groups for standardised height of 165 cms. Ladakhi boy athletes were still having highest mean values whereas FVC and FEV_1 values in Delhi, Vanvasi and Siddi athletes became comparable.

DISCUSSION

It is known that pulmonary function values in health are influenced by race, age, sex, height, weight and some other unknown variables, and there are wide ranges of normal values (4-8).

From the results of the present study, it is found that Ladakhi athletes have larger lung volumes and capacities in comparison to all other athletic groups studied. Higher values for lung functions for high altitude natives have been reported in the literature by the previous

TABLE I : Physical characteristics of boy athletes (Mean + SEM).

Variables	*Groups*				*Error variance*	*LSD at*		
	Ladakhi n = 11	*Delhi n = 11*	*Vanvasi n = 9*	*Siddi n = 9*		*5%*	*1%*	*0.1%*
Age (yr)	16.3 ± 0.4	16.3 ± 0.4	16.0 ± 0.4	16.3 ± 0.6	2.0101	NS	NS	NS
Height (cm)	160.55 ± 1.42	169.91 ± 1.77	158.72 ± 1.94	158.99 ± 2.51	35.7678	5.72	7.68	10.12
Weight (kg)	47.00 ± 2.09	52.27 ± 2.15	49.67 ± 2.15	50.56 ± 2.30	47.2890	NS	NS	NS

TABLE II : VC, FVC, FEV_1, FEV_1%, ERV, IC and MVV in boy athletes (Mean ± SEM).

Variables	Groups				Error variance	LSD at		
	Ladakhi n = 11	Delhi n = 11	Vanvasi n = 9	Siddi n = 9		5%	1%	0.1%
VC (l)	4.38 ± 0.22	3.82 ± 0.15	3.42 ± 0.24	3.33 ± 0.20	0.4324	0.623	0.835	1.101
FVC (l)	4.35 ± 0.21	3.80 ± 0.14	3.49 ± 0.25	3.36 ± 0.21	0.4231	0.622	0.835	1.100
FEV_1 (l)	3.77 ± 0.19	3.27 ± 0.12	3.05 ± 0.21	2.95 ± 0.15	0.3105	0.533	0.715	0.943
FEV_1 (%)	86.72 ± 1.77	86.39 ± 2.19	87.60 ± 1.67	88.33 ± 1.54	34.6672	NS	NS	NS
ERV (l)	1.63 ± 0.09	1.26 ± 0.06	1.19 ± 0.12	1.26 ± 0.12	0.1019	0.305	0.409	0.539
IC (l)	2.75 ± 0.16	2.55 ± 0.08	2.22 ± 0.14	2.07 ± 0.11	0.1784	0.404	0.542	0.714
MVV (l/min)	144.86 ± 12.06	136.35 ± 03.13	150.24 ± 10.15	122.84 ± 10.94	919.4427	NS	NS	NS

All the values are Mean ± SEM

TABLE III : FVC and FEV_1 in boy athletes standardized to a height of 165 cms (Mean ± SD).

Groups	FVC (l)	FEV_1 (l)
Ladakhi	4.58 ± 0.63	3.96 ± 0.59
Delhi	3.58 ± 0.34	3.08 ± 0.35
Vanvasi	3.74 ± 0.62	3.27 ± 0.52
Siddi	3.59 ± 0.40	3.16 ± 0.28

workers (9, 10). It may therefore, be concluded that there is a real difference in certain lung functions between Ladakhis and others (11).

The superior lung functions of the present highland boys compared with other lowlander groups may be explained in terms of genetic adaptation due to environmental factors (4, 12). It is also of interest that Vanvasi (tribal origin) and Siddi (African native origin) athletes have comparatively lower FVC and FEV_1 values than Delhi athletes. The low vital capacity of Negro children has been reported previously (13, 14). There is a genetic difference in lung size between the Negros and people of other ethnic groups. For a given height, the descendants of Europe have a 13.2% larger chest volume at full inspiration than the African descendants and this accounts almost completely for the differences in VC, FVC, FEV_1 between blacks and whites (15).

Alternatively, this could be due to the differences in food intake and health facilities in early life (16). The nutrition in young age influences the body size and hence the size of the lung. The poor nutritional level leads to poor development and growth (17, 18).

Tribal (Vanvasi) and Siddi children differ from urban children in their nutritional status, and their level of activity. Nutritional status is clearly associated with growth differences among groups of genetically related children. It seems that the higher level of physical activity with insufficient food intake during early adolescence and childhood affects the body growth. Taller individuals irrespective of age have larger vital capacity indicating thereby that they have larger lung volumes compared to the shorter individuals (19-22).

The insignificant differences in MVV amongst Ladakhi, Delhi, Vanvasi and Siddi athletes show that adolescent athletes have superior expiratory power irrespective of the genetic and environmental factors. The higher MVV is advantageous for physical work capacity (23). Robinson and Kjeldgaard also have reported increased MVV with running training (24). Actually, a large vital capacity is not in itself an indication of superior ability, nor may it be used

as a prognosticator of physical ability. Rather, it is effectiveness and the efficiency with which the vital capacity is used that determines these qualities. Our results suggest that size of the lung is governed by genetic, environmental and nutritional factors and confirm our earlier findings that physical training during growth may help in developing a greater endurance in respiratory muscles (2).

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