

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

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(Received on April 20, 1996)

Abstract: Lung functions were studied in contemporary healthy Indian female athletes of Ladakhi, Delhi, Vanvasi and Siddi origin training for running events of varying distances. The aim of the study was to compare the lung function in females belonging to these four groups to examine lung function in relation to ethnic and environmental factors. 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 by collecting expired air during deep and rapid breathing in a 100 liters meteorological balloon for a period of 15 seconds and measuring its volume. It was found that Ladakhi females were having significantly higher VC, FVC and FEV_1 values than their counterparts. However, there was no significant difference in MVV amongst Delhi, Siddi and Vanvasi young females. The average MVV of Ladakhi females was only significantly higher than Siddi females ($P < 0.05$).

Key words : female athletes
lung functions

ethnic factors

INTRODUCTION

It has been observed that adolescents habituated to high levels of physical activity have on an average greater lung volumes than their sedentary counterparts of comparable age and body sizes (1, 2). 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 (3, 4). However, recently a number of studies have failed to find the effects of endurance exercise training on most aspects of lung function (5). Thus, the effects of training during adolescence are not yet well understood (6) as they are in adulthood (7). The present comparative study was undertaken to assess the

lung functions in Indian adolescent female athletes of Ladakhi, Delhi, Vanvasi and Siddi origin.

METHODS

Studies were conducted on female athletes who were undergoing training under the Sports Authority of India, Jawahar Lal Nehru Stadium, New Delhi for track events. The subjects were fully acclimatized to the temperature and humidity of Delhi. Brief descriptions of the females studied here are given below:

1. Ladakhi athletes: These athletes were high altitude natives (range: 3200 m to 3800 m) from Ladakh, India's biggest district with the smallest

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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). Their parents were lowlanders from North India and were settled in Delhi for 20 years or more. The children from Delhi represent a healthy and well-nourished segment of Indian society.

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

4. *Siddi athletes*: These athletes were of Siddi community from Gujarat State (India), residing at sea level areas. According to Indian history, the British brought these Siddies with their army units to India from parts of Mombassa and Angola in Africa as labourers in the 18th or 19th Century. They are unfiltered by other racial or ethnic groups.

The subjects were made familiar with the instruments and the techniques used. The lung functions were recorded in a laboratory with the temperature maintained at 24-26°C.

Tests were carried out in the mornings during the postabsorptive phase. Subjects were asked to report to each testing session at least 3 hours postprandial and dressed in the same light weight track suit to be used during the training.

Lung function studies were carried out as given below:-

VC, FVC, FEV₁, ERV and IC were recorded with subject sitting on a wooden stool by closed circuit spirometry using a calibrated Toshniwal Expirograph (8). Each subject was given two trials and three test runs for each test and best of three test readings was taken. The criteria for inclusion were that the plateau value had been reached and that reproducible maximal efforts had been made.

Maximum voluntary ventilation (MVV) was estimated collecting deep and rapid breathing expired air in a 100 litres meteorological balloon for a period of 15 sec at a frequency above 60 breaths per min with maximum tidal volume (Vt) maintained at that frequency. They were encouraged throughout the test.

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.

TABLE 1: Physical characteristics of female athletes

Sr. No.	Variables	Groups				Error variance	LSD at		
		Ladakhi (n-9)	Delhi (n-10)	Vanvasi (n-9)	Siddi (n=8)		5%	1%	0.1%
1.	Age (yr)	14.3 ±0.6	13.8 ±0.2	13.7 ±0.2	13.6 ±0.5	1.2961	NS	NS	NS
2.	Height (cm)	149.24 ±2.03	153.50 ±1.90	149.78 ±2.20	147.18 ±2.49	41.2048	NS	NS	NS
3.	Weight (kg)	40.00 ±1.86	43.45 ±1.53	43.06 ±2.00	39.58 ±1.48	27.2051	NS	NS	NS

n, Sample size. Results are means ± SEM. NS = not significant.

TABLE II : Lung function in female athletes.

Sr. No.	Variables	Groups				Error variance	LSD at		
		Ladakhi (n=9)	Delhi (n=10)	Vanvasi (n=9)	Siddi (n=8)		5%	1%	0.1%
1.	VC(1)	3.14 ± 0.13	2.54 ± 0.11	2.52 ± 0.17	2.15 ± 0.12	0.1737	0.425	0.571	0.75
2.	FVC(1)	3.14 ± 0.13	2.55 ± 0.11	2.56 ± 0.18	2.16 ± 0.15	0.1883	0.442	0.595	0.78
3.	FEV ₁ (1)	2.73 ± 0.11	2.12 ± 0.10	2.25 ± 0.13	1.93 ± 0.15	0.1433	0.386	0.519	0.68
4.	FEV ₁ (%)	87.30 ± 1.76	83.25 ± 2.30	82.95 ± 5.52	88.83 ± 3.43	111.2419	NS	NS	NS
5.	ERV(1)	1.27 ± 0.06	0.91 ± 0.06	0.81 ± 0.07	0.72 ± 0.08	0.0408	0.206	0.277	0.36
6.	IC(1)	1.86 ± 0.09	1.54 ± 0.08	1.70 ± 0.11	1.43 ± 0.08	0.0793	0.287	0.387	0.51
7.	MVV	116.11 ± 6.59	111.42 ± 6.53	105.15 ± 4.91	92.55 ± 5.39	323.2012	18.318	24.637	32.60

n, Sample size. Results are means ± SEM. NS = not significant.

RESULTS

The physical characteristics of the subjects are given in Table I. The mean age (yr) for Ladakhi, Delhi, Vanvasi and Siddi females are 14.3; 13.8; 13.7; and 13.6 respectively.

The mean values ± SEM for VC, FVC, FEV₁, ERV, IC and MVV for females athletes are depicted in Table II. The VC, FVC, FEV₁, ERV, IC and MVV were found to be highest in Ladakhi females. There were no significant differences among Delhi, Vanvasi and Siddi athletes as far as their lung volumes and capacities are concerned. The Siddi females had the lowest mean VC, FVC and FEV₁ values of 2.15, 2.16 and 1.93 litres respectively.

The table III shows FVC and FEV₁ values of the groups standardised to a height of 150 cm. Ladakhi female athletes still had the highest mean values for the various lung volumes and capacities whereas lung function values in

Delhi, Vanvasi and Siddi athletes became comparable.

DISCUSSION

Measurement of the pulmonary function is important in sports physiology because of the broad relation between the ventilatory capacity of populations and their physical working capacity. 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 normalcy. A few studies on the influence of ethnic differences in lung function among children have been reported (9-11). Indian children have been compared with European children directly (12).

In the present study, the Ladakhi female athletes have larger lung volumes and capacities in comparison to all other athletic groups studied. Higher values for pulmonary functions for Ladakhi subjects have been reported by the

TABLE III : FVC and FEV₁ in female athletes standardized to a height of 150 cm.

Sr. No.	Groups	FVC(1)	FEV ₁ (1)
1.	Ladakhi	3.16 ± 0.27	2.75 ± 0.17
2.	Delhi	2.44 ± 0.31	2.02 ± 0.33
3.	Vanvasi	2.54 ± 0.35	2.24 ± 0.26
4.	Siddi	2.25 ± 0.48	2.01 ± 0.49

Results are means ± SEM.

previous workers (13-15). The superior lung functions of the present high land young females compared with other lowlander groups may be explained in terms of genetic and environmental factors. The genetic influences on ventilatory capacity have been demonstrated by many authors (10,16,17). The relatively high lung volume difference implies that Ladakhis as a whole can be regarded as highlanders exposed for many generations to such natural selection as high altitude living imposes (15, 18). Of course the Ladakhi female athletes and others did not differ significantly in $FEV_1\%$, since both numerator and denominator were equally decreased among others.

It is also of interest that Siddi (African native origin) female athletes have comparatively lower FVC and FEV_1 values than Delhi and Vanvasi female athletes while Delhi and Vanvasi female athletes have indistinguishable values for ventilatory capacity. It appears that lung volumes in these young female athletes are related to body size except for Ladakhis. Taller individuals irrespective of age have larger vital capacity thereby indicating that they have larger lung volumes compared to the shorter individuals (7, 19, 20). Delhi female were taller and heavier than Siddi females. This difference in overall size was almost certainly the result of a superior diet and other advantages of a higher

socio-economic status.

Indirect comparison suggests that there is no difference in FVC between the Delhi females in the present study and the Indian females living in Nottingham, UK (12). There is anthropometric evidence that, for a given height, descendants of Europe have a 13.2% larger chest volume at full inspiration than the African descendants (21).

Thus our data suggest that during adolescence, lung volumes and capacities are genetically determined under normal environmental and dietary conditions (22, 23). The insignificant differences in MVV among these athletes show that adolescent athletes have superior expiratory power and this higher MVV is advantageous for physical work capacity (24).

ACKNOWLEDGMENTS

The authors are grateful to Dr. W. Selvamurthy, Director, DIPAS and Shri K. Sridharan, Departmental Head for valuable guidance. Sincere thanks to the athletes and coaches for extending cooperation for this study. Authors thank to Sh. Ashok Ghadiok for statistical analysis of the data and to Miss Bina Butani for technical assistance.

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