PRINT: ISSN 0970-9274 ONLINE: 2456-6608 DOI: 10.31901/24566608.1990/01.03.08

JOURNAL OF HUMAN ECOLOGY J. Hum. Ecol., 1(3): 287-290 (1990)
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Lung Functions and their Correlation with Height and Weight Among Dogras of Jammu and Kashmir, India

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KEY WORDS Age Changes. Physiological Adaptation. Lung Functions. Dogras. Jammu and Kashmir.

ABSTRACT Cross-sectional data on height vertex, body weight and three lung functions FVC, $FEV_{1.0}$ and PEF were obtained on 724 Dogra boys of Jammu district of Jammu and Kashmir in 1989. Height vertex, body weight and lung functions recorded continuous increments, though time of occurrence of highest peak value corresponding to adolescent growth spurt varies for various measurements. The lung functions are showing significant correlation with body weight followed by height vertex.

In a number of studies, the functional dimensions of the lungs of selected inhabitants of the Indian sub-continent, have been compared with those for people of European descent. After standardization of common age and stature, the lung volume have usually been found smaller for Indian than for European descent (Cotes and Malhotra, 1975). Similar difference probably exists within the Indian sub-continent (Cotes and Ward, 1966; Goyle et al., 1971). On account of the people varying in their genetic constitution and in environmental exposures (which include altitude and level of habitual activity), both of which contribute to a large size of lungs (Cotes et al., 1973). Some other studies in Indian region show that lung functions are positively correlated with body measurement (Bhattacharya, 1963; Malik, 1975, 1979). In the present study an attempt has been made to study the correlation between body measurements and lung functions of various Dogra groups of low altitude, outer Himalayan region with special reference to adolescent years.

MATERIAL AND METHODS

For the present investigation, 724 normal healthy, Dogra boys (226 Dogra Brahmans, 236 Dogra Rajputs and 262 Dogra Scheduled Castes), were studied cross-sectionally from Jammu district of Jammu and Kashmir state of India in 1989. The data have been classified into yearly age groups. The age of each subject was taken from their respective educational institutes records. The boys between age group 8+ through 18+ have been incorporated in the study. All those subjects between age 8.00 to 8.99 years were included in age group 8+. Standard techniques given by Weiner and Lourie (1969) and Singh and Bhasin (1989) were followed. The lung functions were studied by Morgan's portable spirometer.

RESULTS AND DISCUSSION

It has been observed that height vertex increase from 8+ to 18+ years in Dogra population groups. In the given age range, growth in height vertex is fastest in Dogra Brahmans, followed by Dogra Rajputs and Dogra Scheduled Castes (Table 1). For body weight also, there is continuous increase from 8+ to 18+ years in Dogra population groups, however growth is fastest in Dogra Scheduled Castes followed by Dogra Rajputs and Brahmans (Table 1). The different pattern of growth observed for height vertex and body weight observed in the present study may be due to 'localized morphological adaptations'. Since the Dogra population groups are living in the same physical environment for a quite long time; these differences may be due to their genetic make-up. For both height vertex and body weight, the highest increments occurs between 11+ and 15+ years for both the measurements. From the studies, it has been established that period of accelerated growth varies from individual to individual but every individual

Table 1: Height vertex (cm) body weight (kg) and lung functions among Dogra-Brahmans, Dogra-Rajputs and Dogra-Scheduled Castes of Jammu district, Jammu and Kashmir

Age (in years)	Dogra-Brahman			Dogra-Rajput			Dogra - Scheduled Castes		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Height Vertex (cm)									
8+	21	125.42	3.00	24	127.69	7.42	22	122.83	8.78
9+	19	127.18	5.09	20	127.03	8.60	17	128.75	4.15
10+	20	134.25	5.78	27	134.24	6.45	33	131.70	5.65
11+	20	138.87	6.74	22	138.22	9.07	32	139.33	8.83
12+	23	145.39	6.94	21	145.50	12.59	22	143.76	7.77
13+	20	148.28	7.61	20	148.78	8.52	27	152.64	9.80
14+	21	156.38	7.69	22	156.35	7.70	25	157.91	7.17
15+	22	162.92	7.11	22	163.88	7.67	25	162.32	5.09
16+	20	164.67	4.71	20	165.97	4.92	21	163.28	6.93
17+	20	165.47	6.88	20	168.02	6.88	20	165.63	6.57
18+	20	172.07	5.53	18	167.45	6.40	18	167.72	6.42
Body Weight (kg)									
8+	21	20.64	1.69	24	21.91	3.84	22	20.45	3.45
9+	19	22.23	2.52	20	22.37	2.24	17	22.52	2.55
10+	20	25.80	3.45	27	25.11	4.50	33	22.83	2.98
11+	20	27.40	3.42	22	27.70	5.47	32	27.73	5.59
12+	23	31.10	3.87	21	32.45	9.74	22	29.59	3.94
13+	20	33.27	5.52	20	34.77	6.02	27	35.12	6.48
14+	21	39.61	5.76	22	40.25	6.78	25	40.54	6.91
15+	22	46.18	6.04	22	43.11	1.22	25	46.84	1.56
16+	20	46.25	5.09	20	48.25	3.79	21	46.14	7.09
17+	20	47.25	5.04	20	52.27	6.67	20	49.00	6.26
18+	20	50.92	5.66	18	52.94	7.60	18	52.52	4.31
Forced Vital Capacity (FVC)									
8+	21	1.53	0.41	24	1.65	0.46	22	1.66	0.48
9+	19	1.65	0.46	20	1.62	0.42	17	1.43	0.38
10+	20	1.61	0.23	27	1.69	0.45	33	1.76	0.44
11+	20	1.96	0.39	22	1.82	0.40	32	1.84	0.39
12+	23	1.92	0.45	21	2.10	0.56	22	1.88	0.39
13+	20	2.06	0.54	20	2.20	0.41	27	2.09	0.65
14+	21	2.35	0.37	22	2.42	0.54	25	2.71	0.49
15+	22	2.69	0.50	22	2.92	0.54	25	2.71	0.49
16+	20	2.72	0.47	20	3.00	0.70	21	2.79	0.65
17+	20	3.17	0.48	20	2.91	0.59	20	2.99	0.70
18+	20	3.00	0.59	18	3.05	0.68	18	2.96	0.48
Forced Expiratory Volume ($FEV_{1.0}$)									
8+	21	1.53	0.30	24	1.43	0.45	22	1.49	0.47
9+	19	1.54	0.38	20	1.45	0.31	17	1.38	0.35
10+	20	1.53	0.24	27	1.56	0.39	33	1.52	0.31
11+	20	1.83	0.31	22	1.70	0.25	32	1.69	0.34
12+	23	1.74	0.36	21	2.00	0.53	22	1.71	0.42
13+	20	1.90	0.50	20	2.11	0.36	27	1.98	0.55
14+	21	2.15	0.38	22	2.27	0.46	25	2.37	0.52
15+	22	2.51	0.46	20	2.58	0.50	25	2.50	0.45
16+	20	2.62	0.43	20	2.72	0.56	21	2.74	0.65
17+	20	3.02	0.34	20	2.80	0.57	20	2.82	0.63
18+	20	2.80	0.54	18	2.89	0.67	18	2.82	0.42
Peak Expiratory Flow (PEF)									
8+	21	158.42	51.07	24	161.91	60.04	22	155.81	51.86
9+	19	171.55	39.84	20	158.55	36.41	17	152.17	34.38
10+	20	178.85	54.66	27	166.35	54.34	33	160.57	41.05
11+	20	205.70	42.62	22	193.63	58.96	32	197.12	70.40
12+	23	204.90	55.31	21	227.71	88.71	22	181.95	59.47
13+	20	223.26	85.12	20	231.20	56.11	27	228.40	67.04
14+	21	251.88	80.34	22	265.78	95.96	25	258.47	91.68
15+	22	307.28	85.95	22	300.00	88.45	25	289.50	60.45
16+	20	337.60	65.59	20	304.20	75.99	21	329.76	10.70
17+	20	340.85	59.09	20	327.20	68.00	20	346.68	80.22
18+	20	313.85	95.77	18	340.83	95.00	18	329.27	64.21

growing under normal circumstances must experience the accelerated period of growth between 12 and 17 years of age (Tanner 1962; Tanner et al., 1966a, 1966b; Miklashevskaya, 1966; Marshall, 1977).

Like height vertex and body weight, lung functions also increase during the period 8+ to 18+ years. For Forced Vital Capacity (FVC) and Forced Expiratory Volume ($FEV_{1.0}$), the fastest growth is observed in Dogra Brahmans, followed by Dogra Rajputs and Dogra Scheduled Castes (Table 1) whereas for Peak Expiratory Flow (PEF), Dogra Scheduled Castes exhibit the fastest growth, followed by Dogra Brahmans and Dogra Rajputs (Table 1). FVC and $FEV_{1.0}$ exhibit growth patterns similar to height vertex, whereas PEF's growth patterns are in line with body weight. Earlier reports show that in the populations from plains as well as from altitudes, lung functions are significantly correlated with height vertex, weight and age (Bhattacharya, 1963; Jain and Ramiah, 1969; Malik, 1975; Malik and Singh, 1979). In Dogra population groups also lung volumes show positive correlation with height vertex and body weight (Table 2). It has been observed that lung functions show higher value of co-efficient of correlation with body weight than height vertex. Similar findings have been reported on Ladakhi Bods, Gaddis of Himachal Pradesh (Malik and Singh, 1979; Singh and Bhasin, 1983).

As the present study deals with population groups of Jammu, inhabiting low altitude, outer Himalayan zone, it becomes necessary to establish differences with adjoining population groups. It has been observed that the three Dogra population groups show higher height vertex and greater body weight than Kangra Brahmans, Kangra Rajputs, Bharmour Rajputs and Indian rural boys (ICMR, 1972; Singh, R., 1979 and Singh, K., 1980). These differences might be due to different altitude, different nutrition level and other environmental factors besides being genetic in origin. For Forced Vital Capacity (FVC) and Forced Expiratory Volume ($FEV_{1.0}$), Dogra population groups show lower values than Bhar-

Table 2: Co-efficient of correlation 'r' between height vertex, body weight and lung functions among Dogra Brahmans, Dogra-Rajputs and Dogra-Scheduled Castes of Jammu district of Jammu and Kashmir

Age	*Dogra-Brahmans*			*Dogra-Rajputs*			*Dogra-Scheduled Castes*		
(in years)	*FVC*	*$FEV_{1.0}$*	*PEF*	*FVC*	*$FEV_{1.0}$*	*PEF*	*FVC*	*$FEV_{1.0}$*	*PEF*
Height Vertex and Lung Functions									
8+	.11	.18	$.59^{1}$	.35	.67	.30	.41	$.49^{1}$	.48
9+	.43	$.49^{1}$	$.51^{1}$	.02	.19	.37	.20	.19	.06
10+	.36	.47	$.50^{1}$	$.47^{1}$	$.47^{1}$	.33	.14	.10	.29
11+	$.76^{2}$	$.77^{2}$	$.56^{1}$	.34	.38	$.76^{2}$	$.47^{1}$	.49	$.64^{2}$
12+	$.49^{1}$	$.52^{1}$	.34	$.55^{1}$	$.60^{1}$	$.81^{2}$	.35	.43	.36
13+	$.72^{2}$	$.85^{2}$	$.68^{2}$	$.49^{1}$	$.57^{1}$	$.63^{1}$	$.64^{2}$	$.55^{1}$	.14
14+	$.57^{1}$	$.70^{1}$	$.53^{1}$	.31	.30	.46	$.55^{1}$	$.51^{1}$	$.55^{1}$
15+	.32	.35	.11	$.48^{1}$	$.51^{1}$	.32	.27	.31	.08
16+	.14	.12	.16	.16	.29	.17	$.68^{2}$	$.62^{1}$	.33
17+	.37	.29	.32	$.66^{1}$	$.56^{1}$	$.52^{1}$	$.55^{1}$	$.61^{1}$	.42
18+	.22	.17	.13	.32	.37	.27	.09	.04	.07
Body Weight and Lung Functions									
8+	.46	.42	$.71^{1}$	$.48^{1}$	$.68^{2}$	.45	.43	.43	.34
9+	.11	.34	$.69^{2}$	.42	.08	.33	.17	.15	.11
10+	.27	.40	.51	$.64^{2}$	$.61^{2}$	.35	.31	.01	.15
11+	$.57^{1}$	.38	.36	.37	.40	$.79^{2}$	.27	$.45^{1}$	$.67^{2}$
12+	$.54^{1}$	$.55^{1}$	.38	$.56^{1}$	$.62^{1}$	$.84^{2}$	.33	.44	.32
13+	$.85^{2}$	$.90^{2}$	$.76^{2}$	$.54^{1}$	$.58^{1}$	$.70^{2}$	$.74^{2}$	$.70^{2}$	.22
14+	$.58^{1}$	$.73^{1}$	.48	.28	.29	.45	$.52^{1}$	$.60^{1}$	$.54^{1}$
15+	.04	.21	.26	$.60^{1}$	$.59^{1}$	.11	.36	.34	.27
16+	$.59^{1}$	$.58^{1}$	.19	.35	.40	.26	$.51^{1}$	$.52^{1}$	.46
17+	$.71^{1}$	$.68^{1}$	.09	$.77^{2}$	$.77^{2}$	.46	$.56^{1}$	$.57^{1}$	.48
18+	.26	.39	.35	.47	.46	.26	$.53^{1}$	$.58^{1}$	.02

Significant 1. $P < 0.01$ 2. $P < 0.001$

mour Rajputs, Bharmour Brahmans, Kangra Rajputs, Kangra Brahmans, Lahauli Bodhs and Ladakhi Bods (Malik and Singh, 1979; Singh, R., 1979 and Singh, K., 1980). For lung functions, the lower values for Dogra population groups may be due to altitudinal factor besides terrain activity since all the populations under comparison live at comparatively high altitudes. As the degree of hypoxicity, increases with increase in altitude populations develop better lungs; giving higher values of lung functions than the population at low altitude. When compared with sea leveled Indian boys of a certain age groups, Dogra population groups show higher lung functions. This may be due to the fact that Dogra populations living at low altitude have higher terrain activity as compared to Indian boys (ICMR, 1961).

Several studies emphasized that higher mean values of respiratory functions are mainly governed by environmental stresses like high level of habitual activity, rather than by altitude, genetic or industrial pollution factors (Cotes et al., 1973; Jones, 1977; Anderson et al., 1978).

ACKNOWLEDGEMENT

The financial assistance is provided by the Ministry of Environment and Forests, Government of India, New Delhi for the project entitled, "Environment, Human Settlement and Human Activities in Jammu and Kashmir Himalayas with special reference to Ladakh", under MAB (Man and Biosphere Programme UNESCO). Ref. No. 14/122/84 RE MAB under the guidance of Dr. M.K. Bhasin (Principal Investigator, Department of Anthropology, University of Delhi-110 007).

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