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Biology of the Tribal Groups of Rajasthan, India: 5. Pulmonary Functions: Their Relation with Anthropometric Variables

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KEYWORDS Anthropometry. Tribals. Respiratory Function. Adaptation

ABSTRACT The present study is based on a cross-sectional investigation on 2928 samples consisting of 1503 males and 1425 females. The study was carried out on the Scheduled Tribes, namely Minas, Bhils, Sahariyas, Garasias, Damors and Kathodis of Rajasthan. Samples were collected from the place of residence and schools. For the purpose of analysis, the subjects were classified into yearly intervals. Those subjects who had completed 8 years of age but were less than 9 years even by one day were grouped under 8+ age group. Similar pattern was followed for other age groups as well. Heights and weights were collected following the internationally accepted standards and assessment of physiological functions was made using an electronic spirometer. Standard techniques were employed to measure respiratory function. The results of lung functions (FEV_1, FVC, MVV) show a gradual increase with advancing age in boys as well as among the girls. Boys, generally tend to show higher mean values as compared to girl counterparts. Positive significant correlation is observed between lung functions (FEV_1, FVC, MVV) with height and body weight, thus indicating that development of pulmonary functions and growth of physical parameters go hand in hand in children and adolescents.

INTRODUCTION

The physiological tolerance of a population to the environment stresses such as heat may be determined for their health status. The measures of biological fitness are dependent on the extent to which such environmental stresses occur in the environment of a given settlement. The physical fitness indicators, such as, lung functions are important measures in the overall evaluation of a population's biological fitness. However, the specific components, which are important, need to be viewed in the context of physical, ecological and cultural environment set-ups.

The study of lung functions provides a better understanding of pulmonary physiology in healthy individuals and pathologic physiology of abnormal individuals. Any airway obstruction or patho-physiological change in the lungs results in lowered pulmonary functions causing functional impairment (Cotes, 1978). The low pulmonary values show a high prevalence of tuberculosis, cough, phlegm production, and chronic bronchitis, which could be hazardous to human health leading to the malfunctioning of other organs as well. The impaired lung functions may cause a loss of appetite and limited food consumption, thus limiting the release of energy for metabolic processes reducing the body weight; thus reflecting a poor health status.

The physiological and patho-physiological interaction between the respiratory and cardio-vascular systems has been recognized since, the early 1900s (Peabody and Wentworth, 1917; Peters and Barr, 1920). Only in the last two or three decades, much attention has been paid to the potentially predictive role of pulmonary function in the development of cardiovascular disease (Friedman et al., 1976; Marcus et al., 1989; Keys et al., 1972; Weiss, 1991; Higgins et al., 1991). Recent studies have shown that individuals with low pulmonary function, especially decreased forced vital capacity (FVC), have a higher risk for developing coronary events (Marcus, 1989; Walker et al., 1989; Cook and Shaper, 1988), congestive heart failure (Kannel et al., 1974), stroke (Kannel et al., 1983) and hypertension (Sparrow et al., 1988; Selby et al., 1990) and a higher risk of cardiovascular death (Friedman et al., 1976; Marcus et al., 1989; Persson et al., 1986; Lange et al., 1991; Ebi-Kryston, 1988; Masaki et al., 1993).

MATERIALS AND METHODS

The present study is based on a cross-sectional investigation on 2218 samples consisting of 1131 males and 1087 females belonging to adolescent (8^+ to 18^+) age groups (Table 1). The

Table 1: Distribution of sample size in various age groups in six tribes of Rajasthan

Age (Yrs)	*Mina*		*Bhil*		*Sahariya*		*Garasia*		*Damor*		*Kathodi*	
	M	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
8+	21	26	24	20	21	24	13	13	12	12	12	12
9+	21	20	22	20	23	22	12	12	12	12	13	12
10+	21	20	21	23	22	25	14	13	12	11	12	12
11+	24	20	22	23	21	21	14	11	12	12	12	12
12+	25	20	23	23	21	21	14	12	12	12	13	11
13+	25	21	20	21	21	21	12	12	12	12	12	12
14+	21	20	22	21	24	22	12	11	12	12	11	11
15+	21	20	21	20	21	21	13	11	12	12	13	12
16+	21	19	22	20	20	23	13	11	12	11	12	12
17+	24	21	21	20	22	20	12	13	13	13	12	12
18+	22	21	22	20	22	17	12	12	12	12	11	11
> 19	89	76	66	66	50	39	81	76	41	37	43	43
Total	335	304	306	297	192	170	319	313	175	169	176	172

study was carried out on the Scheduled Tribes, namely Minas, Bhils, Sahariyas, Garasias, Damors and Kathodis, residing in the districts Sawai Madhopur, Udaipur, Baran, Sirohi, Dungarpur, respectively of Rajasthan (for details about area and people see Bhasin and Jain, 2007). Samples were collected from the place of residence and schools. For the purpose of analysis, the subjects were classified into yearly intervals. Those subjects who had completed 8 years of age but were less than 9 years even by one day were grouped under 8+ age group. Similar pattern was followed for other age groups as well (Table 1).

Heights and weights were collected following the Internationally accepted standards of Martin and Saller (1957), Tanner et al. (1969), Weiner and Lourie (1969), Singh and Bhasin (1989). Assessment of physiological functions was made using an electronic spirometer. Standard techniques were employed to measure respiratory function (Consolazio et al., 1963; Weiner and Lourie, 1969). The subjects, whilst wearing a nose clip after maximum inspiration, were asked to completely exhale as fast as possible in the mouthpiece. The best of three attempts was used for analysis.

RESULTS AND DISCUSSION

Ventilatory capacity is an indicator of the functioning of the respiratory muscles and thoracic cage. It is measured either in terms of a single respiratory effort or by voluntary hyperventilation for a short period. In the present study both the methods of measuring ventilatory capacity has been used, the former by forced vital capacity and forced expiratory volume in the 1st second, and the latter by maximal voluntary ventilation.

Studies have shown that respiratory functions are associated with stature, body surface area and weight (Ferris et al., 1952; Rao et al., 1961; Lyons and Tanner, 1962; Bhattacharya, 1963; Puzuk et al., 1967; Jain and Ramiah, 1969; Malik, 1976; Malik and Singh, 1979). The mean values of respiratory functions (FVC, FEV_1, MVV) along with the height and body weight are presented according to age groups in Table 2. The mean values of weight indicated that there are little differences during preadolescent ages in Minas and Sahariyas. In Bhil, Garasia, Damor and Kathodi, males are heavier than their female counterparts throughout from 8 to 18^+ years. At higher ages Mina males and females become heavier than other five populations, as a result of which Mina males and females have the highest weight. The poorest weight status is shown in Bhil and Kathodi females. With respect to height, males of all tribal groups are taller than the females with few exceptions during preadolescent ages. The results indicate that after 14^+ years, males start growing little taller than the females, ultimately achieving taller stature than the females. Females of both Minas and Damors comparatively show better heights and among males Minas are the tallest.

The results of lung functions (FEV_1, FVC, MVV) show a gradual increase with advancing age in boys as well as among the girls (Deshpande et al., 1983; Pande and Deshpande, 1984). In the present work, FVC ranged from as low as 0.83 l in Minas to 2.88 l in Damors among males. In females it ranged from 0.77 l in Bhils to 2.89 l in Garasias. FEV_1 was observed to increase among males from 0.75 l in Sahariyas to 2.86 l in Damors. Among females it ranged from 0.79 l in Bhils to 2.88 l in Garasias. Maximum value of both FVC and FEV_1

Table 2: Anthropometric measurements of the tribal groups of Rajasthan

Age (yrs)	Mina				Bhil				Sahariya			
	Male		Female		Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Height (cm)												
8+	118.39	4.79	118.84	5.29	117.72	5.27	116.72	7.05	120.24	4.98	122.37	4.17
9+	127.31	4.62	126.06	3.86	122.19	3.68	123.98	4.52	128.34	3.88	129.92	4.31
10+	130.68	5.81	132.22	4.10	131.11	5.38	128.41	5.44	132.73	6.79	130.57	6.51
11+	136.10	4.54	138.49	3.77	138.11	3.34	132.79	5.56	139.18	5.37	143.98	6.08
12+	124.37	3.69	142.35	4.15	141.48	4.53	139.05	4.52	145.63	8.29	144.10	5.67
13+	145.98	8.12	146.88	5.13	147.68	5.34	145.96	5.36	149.92	8.85	145.62	5.87
14+	155.92	7.77	151.05	4.34	155.53	4.63	147.81	6.57	154.33	7.37	150.53	5.06
15+	159.99	4.30	152.71	4.89	154.48	4.89	151.22	3.83	161.71	4.63	153.36	4.36
16+	165.68	4.09	154.96	4.48	160.39	4.79	151.45	5.71	163.79	4.90	154.46	4.06
17+	167.21	4.05	153.34	3.84	160.59	4.56	150.04	5.21	164.93	5.88	156.63	5.49
18+	169.35	4.25	154.45	4.87	164.22	4.47	151.37	4.32	164.94	6.26	153.92	5.87
>19+	169.26	4.59	155.04	4.95	163.19	3.52	151.93	4.06	164.20	5.68	153.35	5.31
Weight (kg)												
8+	17.21	2.07	17.67	2.18	16.94	2.09	15.80	1.4	19.19	2.91	19.48	2.84
9+	20.00	2.64	21.23	1.81	17.41	1.84	18.50	3.43	21.96	2.49	21.95	4.05
10+	23.50	2.85	22.37	2.45	21.64	4.52	20.22	3.65	24.09	4.18	23.20	4.21
11+	25.69	3.86	25.23	6.73	24.95	2.94	22.76	3.68	28.02	3.71	31.58	5.40
12+	28.23	2.95	28.60	3.17	27.46	3.62	27.46	3.70	32.28	6.44	31.05	4.24
13+	30.68	4.73	32.76	3.78	33.35	3.51	31.17	3.26	34.64	5.12	36.12	6.75
14+	37.45	5.59	35.53	4.76	36.36	2.68	33.69	4.40	36.63	5.68	39.68	4.62
15+	40.31	4.72	39.38	4.86	35.87	4.13	37.90	4.06	41.67	5.99	42.47	4.77
16+	44.19	4.22	42.21	3.92	40.00	4.38	36.85	4.56	45.23	3.82	42.07	5.04
17+	48.25	3.98	41.02	3.60	41.83	2.88	35.50	3.42	46.06	4.44	43.88	4.52
18+	50.16	4.69	43.71	4.46	44.04	2.91	38.88	3.20	48.23	5.72	42.88	5.51
>19+	51.85	4.81	45.88	3.18	44.21	3.67	38.48	6.79	47.31	6.15	41.86	6.30
FVC												
8+	0.83	0.38	0.84	0.18	0.96	0.27	0.77	0.26	0.83	0.27	0.83	0.37
9+	1.09	0.24	0.89	0.27	1.07	0.20	1.01	0.71	1.01	0.21	0.93	0.41
10+	1.20	0.31	0.88	0.30	1.27	0.27	1.05	0.32	1.12	0.43	0.98	0.37
11+	1.39	0.35	1.22	0.29	1.43	0.39	1.04	0.38	1.24	0.34	1.04	0.41
12+	1.36	0.34	1.30	0.30	1.46	0.36	1.27	0.44	1.51	0.61	1.12	0.39
13+	1.66	0.32	1.39	0.35	1.87	1.52	1.54	0.36	1.65	0.45	1.29	0.51
14+	1.71	0.38	1.63	0.44	1.93	0.51	1.52	0.41	1.81	0.13	1.33	0.52
15+	2.11	0.57	1.54	0.42	2.00	0.53	1.68	0.52	2.02	0.52	1.40	0.56
16+	2.08	0.66	1.72	0.55	2.34	0.43	2.05	0.78	2.19	0.57	1.72	0.47
17+	2.69	0.42	1.82	0.45	2.45	0.53	1.77	0.79	2.54	0.58	1.66	0.45
18+	2.61	0.67	2.01	0.62	2.54	0.82	2.21	0.91	2.34	0.74	1.52	0.50
>19+	2.65	0.61	1.69	0.33	2.26	0.64	1.54	0.53	2.28	0.71	1.59	0.62
FEV_1												
8+	0.83	0.38	0.83	0.18	0.95	0.26	0.79	0.26	0.75	0.08	0.82	0.36
9+	1.08	0.24	0.87	0.21	1.07	0.20	0.96	0.28	1.01	0.21	0.92	0.41
10+	1.23	0.32	0.87	0.31	1.26	0.27	1.03	0.32	1.11	0.42	0.97	0.37
11+	1.36	0.30	1.20	0.29	1.43	0.40	1.04	0.38	1.24	0.34	1.05	0.41
12+	1.34	0.33	1.29	0.30	1.46	0.35	1.31	0.36	1.45	0.54	1.12	0.39
13+	1.64	0.31	1.37	0.34	1.88	0.54	1.51	0.34	1.66	0.45	1.27	0.48
14+	1.66	0.41	1.58	0.38	1.93	0.51	1.52	0.41	1.78	0.31	1.31	0.49
15+	2.03	0.53	1.52	0.37	1.99	0.53	1.66	0.53	2.01	0.51	1.39	0.57
16+	2.13	0.62	1.72	0.55	2.34	0.43	1.74	0.55	2.18	0.55	1.71	0.47
17+	2.62	0.36	1.79	0.45	2.45	0.53	1.76	0.78	2.53	0.56	1.66	0.45
18+	2.57	0.64	1.95	0.54	2.53	0.83	2.14	0.84	2.31	0.14	1.45	0.44
>19+	2.55	0.56	1.66	0.32	2.23	0.65	1.52	0.59	2.18	0.71	1.54	0.62
MVV												
8+	127.43	42.32	121.35	41.35	160.96	45.00	132.40	32.93	126.32	42.73	109.46	46.59
9+	141.67	33.47	136.45	39.88	159.54	40.71	145.00	43.37	154.60	52.38	138.24	60.68
10+	180.91	44.05	134.30	40.32	181.43	43.67	161.91	52.22	160.53	65.86	138.79	51.09
11+	198.88	47.22	152.55	56.47	212.04	69.99	157.46	52.09	195.75	61.43	159.32	29.91
12+	200.60	56.03	183.10	58.29	245.60	65.81	198.56	75.15	204.57	79.35	198.48	80.39
13+	238.80	50.28	200.81	66.80	250.35	74.83	222.38	57.43	267.89	67.11	198.48	80.39
14+	266.81	36.64	201.60	62.15	298.45	76.57	239.95	65.23	264.65	86.79	223.12	32.23
15+	264.33	57.43	185.30	60.31	317.43	72.67	228.45	99.61	308.38	87.11	221.71	70.45
16+	303.38	56.09	261.95	87.55	364.72	87.52	265.25	90.56	347.90	98.09	207.52	59.58
17+	330.75	110.70	216.14	61.04	371.33	78.59	225.40	90.50	380.68	105.60	248.20	82.53
18+	324.45	106.30	290.76	65.68	406.54	122.30	286.10	80.30	362.81	117.50	287.06	59.78
>19+	344.09	95.44	264.37	43.79	313.91	101.80	201.44	76.48	357.51	101.70	175.54	71.17

Table 2: Contd.....

Age (yrs)	Garasia				Damor				Kathodi			
	Male		Female		Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Height (cm)												
8+	120.06	3.64	118.00	2.53	119.75	5.73	119.40	3.68	117.27	3.38	117.81	1.96
9+	124.40	3.56	122.15	2.46	125.02	3.81	123.73	3.87	124.25	2.95	122.20	6.49
10+	130.62	2.55	124.43	2.11	130.20	3.45	130.29	3.30	129.88	2.92	131.13	3.34
11+	137.05	3.89	131.05	4.25	138.97	3.45	135.73	3.72	134.20	4.66	139.27	3.87
12+	141.09	5.27	140.70	2.36	143.29	3.32	141.28	4.13	139.92	2.98	142.20	2.89
13+	149.55	7.18	142.04	5.28	148.27	5.08	146.72	3.66	146.57	3.77	146.76	4.05
14+	157.29	2.74	147.81	4.32	154.64	4.09	150.57	2.64	151.62	3.48	150.70	4.23
15+	159.00	3.29	150.69	3.28	157.97	4.10	151.61	2.50	156.66	4.39	148.39	4.49
16+	161.69	3.53	151.82	3.25	163.26	5.76	152.98	3.31	159.72	3.72	154.61	5.90
17+	168.15	3.72	153.66	3.23	167.63	4.21	155.03	3.56	162.46	4.42	155.49	6.33
18+	166.71	4.41	152.24	4.10	166.43	6.64	154.64	4.59	165.69	4.41	152.00	5.46
>19+	164.70	5.15	153.62	4.32	164.90	5.24	133.29	4.84	164.95	3.97	152.21	5.26
Weight (Kg)												
8+	18.23	2.68	17.10	1.35	16.71	2.32	15.71	1.43	17.58	1.69	16.21	1.45
9+	20.37	2.03	19.87	3.93	19.58	1.36	18.96	3.22	19.65	1.61	17.83	1.68
10+	23.43	1.89	20.31	2.14	20.50	3.09	22.59	2.98	22.67	2.75	21.50	2.37
11+	25.68	2.60	23.96	3.01	24.69	2.62	25.92	3.38	23.38	4.07	26.04	3.62
12+	28.00	2.91	29.17	2.25	28.25	3.92	28.88	1.94	30.07	2.38	27.04	2.29
13+	32.69	5.01	30.75	2.30	32.95	3.24	31.79	4.27	32.67	2.79	33.38	3.09
14+	41.12	2.10	32.68	2.96	34.95	3.73	38.75	4.45	35.36	3.35	35.82	3.07
15+	42.15	2.96	35.50	2.28	39.20	3.25	38.54	3.11	39.27	3.49	35.54	2.97
16+	43.53	2.60	38.46	3.18	42.04	4.52	40.68	2.69	41.04	2.93	36.75	3.23
17+	44.45	2.39	37.42	3.22	44.92	3.38	40.96	3.53	45.63	4.48	37.45	2.68
18+	43.37	2.71	39.5	2.45	45.41	3.58	40.63	3.34	47.73	3.71	37.00	3.07
>19+	43.02	3.35	38.33	3.52	43.85	4.42	40.65	3.70	44.07	4.23	36.95	4.26
FVC												
8+	1.00	0.45	0.92	0.3	0.94	0.22	0.92	0.26	1.09	0.44	0.86	0.35
9+	1.22	0.56	1.09	0.33	1.13	0.31	1.11	0.27	1.13	0.29	0.89	0.38
10+	1.38	0.38	1.12	0.42	1.23	0.46	1.17	0.28	1.75	0.29	1.06	0.36
11+	1.51	0.42	1.20	0.33	1.47	0.32	1.26	0.35	1.99	0.55	0.19	0.43
12+	1.58	0.23	1.46	0.31	1.69	0.48	1.72	0.52	1.81	0.54	1.73	0.53
13+	1.82	0.33	1.58	0.26	1.83	0.47	1.78	0.41	2.17	0.67	1.70	0.53
14+	2.63	0.74	1.97	0.53	1.95	0.53	1.94	0.32	2.59	0.60	2.00	0.42
15+	2.32	0.65	2.29	0.67	2.09	0.52	1.99	0.43	2.67	0.73	2.15	0.44
16+	2.61	0.76	2.26	0.52	2.17	0.54	2.21	0.80	2.59	0.69	1.83	0.32
17+	2.75	0.69	2.44	0.54	2.66	0.77	2.21	0.80	2.82	0.54	1.83	0.32
18+	2.85	0.55	2.89	0.71	2.88	0.56	2.43	0.74	2.59	0.66	2.02	0.46
>19+	3.06	0.82	2.38	0.49	2.70	0.59	2.04	0.56	2.24	0.60	1.89	0.58
FEV_1												
8+	0.99	0.45	0.92	0.30	0.92	0.23	0.92	0.27	0.9	0.29	0.86	0.35
9+	1.11	0.38	1.08	0.32	1.12	0.42	1.10	0.26	1.11	0.29	0.88	0.37
10+	1.38	0.38	1.18	0.42	1.22	0.46	1.16	0.28	1.69	0.33	1.05	0.35
11+	1.50	0.42	1.19	0.33	1.47	0.32	1.25	0.33	1.96	0.54	1.17	0.45
12+	1.58	0.23	1.46	0.31	1.68	0.47	1.72	0.50	1.79	0.53	1.73	0.53
13+	1.82	0.34	1.58	0.26	1.82	0.46	1.78	0.40	2.12	0.74	1.68	0.56
14+	2.62	0.73	1.97	0.54	1.94	0.52	1.92	0.31	2.57	0.61	1.99	0.41
15+	2.32	0.65	2.27	0.67	2.05	0.53	1.98	0.43	2.65	0.75	2.14	0.44
16+	2.61	0.76	2.26	0.52	2.16	0.54	2.20	0.79	2.57	0.70	1.82	0.33
17+	2.75	0.69	2.43	0.54	2.64	0.77	2.27	0.55	2.80	0.54	1.82	0.53
18+	2.83	0.55	2.88	0.71	2.86	0.56	2.42	0.73	2.58	0.65	2.01	0.45
>19+	2.99	0.80	2.36	0.51	2.65	0.57	2.00	0.55	2.20	0.58	1.86	0.57
MVV												
8+	141.84	32.88	133.53	30.99	139.91	34.60	134.42	26.76	125.00	30.76	132.16	46.60
9+	174.91	43.18	134.00	29.25	173.58	48.65	153.50	22.85	147.39	31.46	138.00	39.46
10+	190.42	51.16	150.62	35.11	167.00	49.35	163.72	48.91	206.58	31.95	152.75	35.70
11+	214.42	65.37	187.46	60.81	199.07	39.84	151.31	40.51	241.17	40.95	165.00	39.74
12+	246.28	52.55	206.75	59.75	229.41	53.07	194.67	31.83	216.85	44.49	200.64	35.60
13+	305.38	81.87	231.42	47.75	272.08	73.28	218.41	31.83	262.75	34.27	209.76	35.60
14+	320.91	59.48	232.82	48.56	322.16	89.10	256.58	53.91	310.18	70.72	240.00	45.37
15+	311.84	69.60	293.36	55.77	289.75	66.86	286.41	42.42	328.54	83.51	272.41	39.16
16+	343.92	76.79	299.72	37.59	411.75	88.42	237.54	95.40	324.75	84.63	240.66	37.32
17+	347.16	88.69	285.23	55.41	390.61	64.18	298.69	42.69	390.41	47.06	229.83	53.47
18+	439.91	73.40	323.66	67.98	440.00	73.59	290.08	73.53	381.27	100.40	273.54	42.81
>19+	381.28	101.40	302.38	56.67	384.90	82.32	260.72	65.13	344.72	95.10	261.88	74.79

Table 3: Relationship between respiratory functions and anthropometric variables (values of 'r')

Tribal Group	*Anthropometric Variable*	*Respiratory Functions*		
		FVC	*FEV*	*MVV*
Mina Male	Height	0.784	0.777	0.692
	Body Weight	0.793	0.791	0.680
Mina Female	Height	0.756	0.749	0.721
	Body Weight	0.766	0.760	0.702
Bhil Male	Height	0.750	0.750	0.736
	Body Weight	0.772	0.771	0.759
Bhil Female	Height	0.610	0.560	0.552
	Body Weight	0.619	0.601	0.562
Sahariya Male	Height	0.713	0.712	0.707
	Body Weight	0.746	0.743	0.755
Sahariya Female	Height	0.514	0.510	0.529
	Body Weight	0.519	0.519	0.558
Garasia Male	Height	0.758	0.768	0.796
	Body Weight	0.777	0.760	0.760
Garasia Female	Height	0.731	0.731	0.747
	Body Weight	0.764	0.765	0.784
Damor Male	Height	0.765	0.767	0.818
	Body Weight	0.783	0.784	0.833
Damor Female	Height	0.705	0.701	0.720
	Body Weight	0.711	0.708	0.729
Kathodi Male	Height	0.681	0.678	0.771
	Body Weight	0.663	0.654	0.759
Kathodi Female	Height	0.622	0.627	0.651
	Body Weight	0.693	0.700	0.708

is exhibited by Damors among males and Garasias among females. Whereas for both, Bhil females show the minimum values. MVV attained its maximum of 125.0 in Kathodi males to a minimum of 440.0 among Damor males. In females minimum value was observed at 109.46 among Sahariyas and maximum of 323.66 among Garasia males. Minimum value for all the lung functions was observed at 8 years and maximum value at 18 years in both the sexes. Boys, generally tend to show higher mean values as compared to girl counterparts. This has also been reported by Deshpande et al. (1983), Pande and Deshpande (1984).

In the present study it was observed that there was a positive significant correlation (Table 3) between lung functions (FEV_1, FVC, MVV) with height and body weight (Deshpande et al., 1983; Pande and Deshpande, 1984; Strang, 1959; Singh et al., 1971; Zapletal et al., 1969; Cook and Hamann, 1961). This shows that development of pulmonary functions and growth of physical parameters go hand in hand in children and adolescents as also reported in other studies by Deshpande et al. (1983).

When compared with the mean values of lowlander and highlander Bods of Ladakh (Malik and Singh, 1979) it was found that the present study tribal groups are far below them with respect to FVC, FEV_1. Highland populations tend to have greater ventilatory capacity than the lowland populations. Major factors like low oxygen pressure, increased work-load and minimal air pollution are responsible for the development of higher ventilatory capacity at high altitude (Malik and Singh, 1979); also high nicotine consumption in the present study tribal groups also result in reduced lung functions (Zhang et al., 1999). Smoking has been associated as a common risk factor for impaired lung functions (Wu et al., 1991; Benfante et al., 1985). Limited food consumption along with reduced body weight limits the release of energy and also results in lowered respiratory functions (Swami and Malik, 1990).

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