

Genetic Studies of Pangwalas, Transhumant and Settled Gaddis: Age Changes in Biological Variables among Pangwalas of Pangi Tehsil, Chamba District, Himachal Pradesh

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ABSTRACT In the present paper 37 biological variables (26 anthropometric; 2 physiological and 8 physical fitness tests) have been reported among Pangwala boys with their age ranging from 8+ to 18+ years. The anthropometric and physiological variables show gradual rise from 8+ to 18+ year generally, where as for physical fitness tests, in general, a uniform trend of growth is not observed. When compared for anthropometric variables with Transhumant and Settled Gaddis, Pangwalas are showing similar results, in general, whereas for physiological and physical fitness tests variables variation has been observed with Gaduliya Lohars, which may be attributed to their different physical, biological and social environment.

The present paper is the eight in the series of Genetic Studies of Pangwalas, Transhumant and Settled Gaddis from Himachal Pradesh, North India. A number of studies on ecology, biology and socio-cultural aspects of the Pangwalas have been reported (Bhasin, M.K. et al., 1982, 1983, 1986 a,b,c, 1991; Bhasin, V. et al., 1991; Singh et al., 1982).

In the present paper the results of the 37 biological variables (26 anthropometric, 3 physiological and 8 physical fitness tests) among Pangwala boys, their age ranging from 8+ to 18+ years has been reported. An attempt has been made to formulate simple, multilinear and stepwise multilinear regression equations for the prediction of physiological and physical fitness tests from anthropometric variables. Further, the results of the present study has been compared with Transhumant and Settled Gaddis for anthropometric variables and with Gaduliya Lohar boys for physiological variables and physical fitness tests.

AREA AND PEOPLE

Himachal Pradesh is located in Northwest India between about 31° and 33° northern latitude and about 75° and 70° eastern longitude. It is bordered by Jammu and Kashmir in the north, Punjab in the west and southwest, Haryana in the south, Uttar Pradesh in the southwest, and Tibet in the east. The altitude of Himachal Pradesh varies between 350 and 6100m above mean sea level.

This area is subdivided in various field areas,

which are Pangi Tehsil in the Chamba District (Inner Himalayan Zone), Bharmour Tehsil in the Chamba District (Mid-Himalayan Zone) and the Kangra District (Outer Himalayan Zone).

Chamba District

The Chamba District lies astride the Mid-Himalayas, the touch on the fringe at one corner and a bit of Siwalik range before the plains commence on the other side of the border. The geographical location of this district is between 32°10' N and 33°13' N and 75°45' E and 77°33' E, respectively.

Tehsil Pangi (32°33' N - 33°19' N and 76°15' E - 77°21' E) is situated north of Chamba District. The total area of Tehsil Pangi is 1,6537 sq. km, and it has a population of 12,256 individuals, (919 belonging to Scheduled Castes and 11,237 to Scheduled Tribes). Three main tribes - Pangwalas, Bhots and Lahaulis - inhabit Tehsil Pangi; the majority of the local population are Pangwalas. They are professing Hindu religion and reported in the present study. According to the District Census Hand Book (1981) the population density is 6 per sq. km.

MATERIALS AND METHODS

This study is based on a cross-sectional sample of apparently healthy Pangwala boys of Tehsil Pangi, District Chamba, their ages ranging from 8 to 18 years. The categorisation of age was done as those subjects who have completed 8

years of age but are less than 9 years even by one day were grouped under 8+ age groups. Similar pattern has been followed for each age group from 8 to 18 years.

Following the standard techniques of Martin and Saller (1959); WHO (1964); Singh and Bhasin (1968); Weiner and Lourie (1969) and Wolanski and Pyzuk (1973), a total of 37 biological variables (27 anthropometric measurements, 3 physiological variables and 8 physical fitness tests) have been taken. The anthropometric measurements have been taken on every subject, whereas physiological measurements and physical fitness tests have not been done for all individuals. The measurements and samples studied have been listed in Table 1. The data for present study have been analysed statistically in order to interpret in numerical terms.

RESULTS AND DISCUSSION

The magnitude of the growth has been studied on the basis of occurrence of distance and velocity curves, adolescent spurts, coefficient of correlation and regression equations.

The mean values of Body weight range from 19.29 to 45.69 kg; Stature from 1162.46 to 1582.63 mm; Height ilioispinale from 672.58 to 947.00 mm; Sitting height vertex from 632.00 to 837.88 mm; Biacromial breadth 242.77 to 339.13 mm; Antero-posterior depth of chest from 134.85 to 174.88 mm; Chest circumference at normal respiration 569.00 to 760.38 mm; Wrist circumference 118.54 to 158.88 mm and Calf circumference 204.23 to 293.13 mm in which least value has been observed at 8+ years and the maximum value at 18+ years (Table 1). The skinfold measurements are showing generally variation in growth. In the physiological measurements the Pulse rate at rest and Blood pressure show almost gradual rise from 8+ to 18+ years. In the Physical fitness tests, it has been observed that in Step test, a uniform trend of growth is not observed; for the Sargent vertical jump, Burfee Squat thrust test (agility), there is an increase from 8+ to 18+ years (with small fluctuations). For the Shuttle run test, Pangwalas are showing a decrease in time taken for completing one cycle from 8+ to 18+ years and hence a corresponding increase in agility (with minor fluctuations). For Turning balance test (No. of full circles) and Turning balance test (No. of circles/10 sec.), no uniform trend is observed among Pangwala boys. The rest two test i.e., Hand eye coordination tests - (1) cm. and (2) milliseconds

show a decrease in the mean values and hence a corresponding increase in coordination (Table 1).

Distance and Velocity Curves

An analysis of the distance curves plotted for the 37 biological variables included in the present study reveals largely a mixed trend in the advancement of growth from 8+ to 18+ years. The velocity curve plotted for each biological variable reveal more than one peak indicating a high degree of multimodality which could be attributed to the cross sectional nature of the data or to poor nutrition habits, has been emphasised by Tanner (1962). However, Frisancho (1969) and Baker (1971) show a high degree of multimodality revealing poor defined adolescent spurt in high altitude Peruvian Quechua boys.

Adolescent Spurt

The highest peak velocity (HPV), corresponding to occurrence of adolescent spurt among Pangwalas has been observed between 10+ and 11+ years for Stature, Height acromion, Height ilioispinale, Antero-posterior depth of chest and Systolic blood pressure. Six biological variables- Medial calf skinfold, Burfee squat thrust test, Shuttle run tests, Turning balance test measured in terms of no. of circles/10sec, Hand eye coordination test in milliseconds are showing highest peak velocity between 8+ and 9+ years. Systolic blood pressure and Turning balance test (no. of full circles) are showing growth spurt between 12+ and 13+ years age group. Wrist circumference and Pulse rate at rest are showing HPV between 13+ and 14+ years and among the variables Sitting height vertex, Biacromial breadth, Abdomen circumference and Step test, HPV is observed between 14+ and 15+ years. One variable each i.e., Chest skinfold is showing HPV between 15+ and 16+ years and Knee skinfold between 17+ and 18+ years whereas out of the rest sixteen variables fifteen variables are showing adolescent growth spurt between 16+ and 17+ years and in the case of Fore arm skinfold, it was not possible to observe the highest peak velocity as this variable was showing fluctuations.

Coefficient of Correlation Between Different Biological Variables Along with Age

The Pearson product of correlation coefficient has been applied to all biological variables and ages

Table 1: The mean values and standard deviation (S.D) values of various biological variables in different age groups among Pangwalas Boys of Pangri Tehsil Chamba District, Himachal Pradesh.

S. No.	Biological variables	8+		9+		10+		11+		12+		13+	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Age		8.44	0.27	9.48	0.31	10.39	0.29	11.15	0.31	12.43	0.31	13.45	0.33
I. ANTHROPOMETRIC MEASUREMENTS													
2. Body Weight (kg)		19.29	3.44	20.85	2.97	21.72	2.14	25.89	3.86	26.37	3.25	29.47	3.71
<i>(a) Projective Height Measurement:</i>													
3. Height Vertex (mm)		1162.46	65.89	1203.12	63.47	1234.43	53.54	1316.72	71.79	1337.88	73.16	1397.03	59.71
4. Height Acromion (mm)		922.23	62.78	946.77	54.23	976.78	47.08	1055.31	72.95	1059.65	63.02	1128.45	55.31
5. Height Iliospinale (mm)		672.58	46.17	697.92	43.41	722.74	34.82	784.48	52.03	789.77	44.99	849.86	37.85
6. Sitting Height Vertex (mm)		632.00	38.93	655.23	28.94	667.65	28.35	697.10	29.15	702.00	29.25	724.52	29.37
<i>(b) Breadths and Depths of Trunk:</i>													
7. Biacromial Breadth (mm)		242.77	25.99	257.27	17.59	262.13	11.59	272.97	25.97	285.46	14.37	295.14	19.54
8. Bicipital Breadth (mm)		179.35	14.07	183.42	10.47	194.39	23.27	202.79	15.31	200.46	11.95	208.89	14.78
9. Transverse Diameter of chest (mm)		174.42	9.99	181.61	10.61	181.96	7.52	196.28	15.29	196.65	10.59	201.93	11.10
10. Antero-posterior Depth of chest (mm)		134.85	12.86	137.77	10.66	137.74	6.2 S	147.93	13.17	148.85	8.99	153.34	10.36
<i>(c) Girths:</i>													
11. Head Circumference (mm)		515.68	14.67	518.92	19.81	519.48	16.32	527.45	16.37	519.23	26.36	527.10	16.49
12. Chest Circumference at Normal Respiration (mm)		569.00	34.96	581.54	31.31	588.48	17.87	621.28	34.16	628.38	34.21	651.28	27.62
13. Abdomen Circumference (mm)		539.81	40.01	548.77	33.46	547.48	39.09	582.83	35.08	579.46	40.71	604.34	26.20
14. Upper arm Circumference-Relaxed (mm)		142.42	12.79	150.54	12.04	151.43	7.54	159.97	13.65	162.23	9.10	167.76	11.71
15. Upper arm Circumference 'Contracted' (mm)		158.65	15.23	167.04	14.06	166.56	10.22	178.14	14.18	179.07	18.63	186.62	12.33
16. Fore arm Circumference (mm)		161.50	12.07	166.19	10.43	168.83	7.45	179.55	10.68	181.31	9.59	186.89	11.48
17. Wrist Circumference (mm)		118.54	8.81	122.65	6.95	126.00	5.33	131.45	9.46	133.62	5.69	137.45	9.00
18. Calf Circumference (mm)		204.23	17.68	217.23	14.97	217.74	12.09	233.55	15.40	238.50	14.21	244.48	18.29
<i>(d) Skinfold Measurements</i>													
19. Skinfold at Biceps (mm)		1.83	0.39	1.98	0.64	1.71	0.42	1.79	0.41	1.79	0.49	1.96	0.87
20. Skinfold at Triceps (mm)		3.11	0.88	3.83	1.30	3.22	1.37	3.67	1.17	3.27	1.19	3.62	1.02
21. Fore arm Skinfold (mm)		2.56	0.55	2.88	0.69	2.54	0.90	2.74	0.97	2.44	0.71	2.69	0.94
22. Mid axillary Skinfold (mm)		1.75	0.47	1.88	0.43	1.93	0.59	1.96	0.38	2.15	0.66	2.24	0.59
23. Chest Skinfold (mm)		1.58	0.39	1.85	0.46	1.76	0.49	2.03	0.48	2.13	0.99	2.16	0.50
24. Abdominal Skinfold (mm)		2.25	0.47	2.71	0.87	2.52	0.87	2.52	0.97	2.87	0.94	2.98	0.69
25. Subscapular Skinfold (mm)		2.69	0.79	3.13	0.59	2.91	0.59	3.19	0.57	3.35	0.97	3.48	0.60
26. Skinfold at Knee (mm)		3.54	1.06	3.79	1.32	3.85	1.86	4.38	1.91	4.19	1.47	4.26	1.56
27. Skinfold at Medial Calf (mm)		4.04	1.30	5.13	2.15	4.67	2.00	4.97	2.06	4.81	2.40	5.05	1.68

Table 1: Contd.....

S. No.	Biological Variables	14+		15+		16+		17+		18+	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Age		14.31	0.29	15.39	0.32	16.48	0.38	17.54	0.29	18.59	0.78
I. ANTHROPOMETRIC MEASUREMENTS											
<i>(a) Projective Height Measurement:</i>											
2. Body Weight (kg)		32.55	3.87	38.03	8.54	36.86	6.07	42.88	8.39	45.69	6.71
3. Height Vertex (mm)		1434.54	123.51	1501.89	119.99	1504.27	89.15	1547.25	46.54	1582.63	69.16
4. Height Acromion (mm)		1150.10	78.63	1214.79	103.50	1216.18	75.10	1254.75	53.76	1276.75	62.01
5. Height Illiospinale (mm)		856.82	65.84	912.21	82.36	924.45	55.53	931.75	54.95	947.00	48.76
6. Sitting Height Vertex (mm)		733.55	41.58	780.21	61.08	769.27	65.69	803.50	52.88	837.88	36.89
<i>(b) Breadths and Depths of Trunk:</i>											
7. Biacromial Breadth (mm)		300.91	20.59	314.32	42.20	321.09	26.05	335.62	27.77	339.13	17.37
8. Bicristal Breadth (mm)		212.64	16.26	228.53	20.71	226.00	17.85	234.13	19.67	238.36	21.18
9. Transverse Diameter of chest (mm)		205.18	10.49	217.11	16.76	212.90	18.00	228.87	20.66	227.38	11.59
10. Antero-posterior Depth of chest (mm)		156.18	13.40	161.26	16.83	165.54	12.00	166.75	15.65	174.88	11.61
<i>(c) Girths:</i>											
11. Head Circumference (mm)		532.91	18.53	532.21	16.37	528.45	12.86	539.88	12.76	539.13	23.08
12. Chest Circumference at Normal Respiration (mm)		666.73	39.12	698.21	58.04	693.55	52.39	747.88	60.69	760.38	62.75
13. Abdomen Circumference (mm)		605.18	31.44	647.95	55.67	647.00	58.37	689.38	64.82	682.50	42.44
14. Upper arm Circumference-Relaxed (mm)		173.83	15.89	189.58	20.14	186.64	18.02	210.13	30.99	210.00	18.29
15. Upper arm Circumference 'Contracted' (mm)		184.73	14.99	211.89	24.59	207.18	23.37	236.50	33.76	234.50	22.65
16. Fore arm Circumference (mm)		195.00	14.99	207.53	19.80	204.18	14.49	230.63	41.99	222.75	16.03
17. Wrist Circumference (mm)		144.55	8.74	150.74	11.57	152.91	12.42	152.75	6.92	158.88	7.43
18. Calf Circumference (mm)		254.82	17.06	270.95	27.26	268.55	20.67	285.75	23.93	293.13	20.22
<i>(d) Skinfold Measurements</i>											
19. Skinfold at Biceps (mm)		1.95	0.41	2.03	0.39	2.18	0.51	2.63	0.64	2.19	0.59
20. Skinfold at Triceps (mm)		3.40	0.91	3.76	1.23	3.86	1.47	4.88	2.53	4.19	0.84
21. Fore arm Skinfold (mm)		2.77	0.75	2.58	0.75	2.86	0.86	2.15	0.59	2.81	0.65
22. Mid axillary Skinfold (mm)		2.04	0.42	2.28	0.69	2.64	0.74	3.13	0.99	3.00	0.59
23. Chest Skinfold (mm)		2.23	0.65	2.13	0.43	2.64	0.67	2.81	1.07	2.50	0.53
24. Abdominal Skinfold (mm)		3.14	0.92	3.34	0.96	3.77	1.42	4.69	2.66	4.63	1.19
25. Subscapular Skinfold (mm)		3.64	0.59	4.13	1.04	4.55	1.21	5.81	1.60	5.81	1.19
26. Skinfold at Knee (mm)		4.64	1.68	4.58	1.59	5.00	1.32	4.81	1.39	5.56	2.29
27. Skinfold at Medial Calf (mm)		4.82	1.40	5.68	1.81	6.41	2.52	5.75	2.39	6.25	2.36

Table 1: Contd.....

S. No.	Biological Variables	8+		9+		10+		11+		12+		13+	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
II. PHYSIOLOGICAL VARIABLES													
28.	Pulse Rate at Rest (PRR)	80.22	4.06	74.00	2.19	78.55	4.82	79.75	4.25	76.95	5.20	77.64	5.74
29.	Dystolic Blood Pressure (DBP)	70.89	8.67	72.00	10.35	73.64	6.62	78.87	6.23	76.86	6.22	77.18	6.86
30.	Systolic Blood Pressure (SBP)	100.00	5.74	99.67	1.97	101.27	4.49	104.63	5.69	102.76	4.75	108.18	5.16
III. PHYSICAL FITNESS TESTS													
31.	Step Test (ST)	52.00	7.04	61.00	12.82	56.73	12.14	51.88	11.99	47.81	10.89	43.45	9.80
32.	Sargent Vertical Jump (SVJ)	20.56	5.29	19.00	7.54	22.00	3.09	24.69	3.99	24.86	3.94	28.32	4.94
33.	Burfee Squat Thrust Test (BSTT)	17.36	2.31	22.50	4.69	21.11	3.79	21.65	3.77	21.23	3.27	23.39	3.27
34.	Shuttle Run Test (SRT)	5.40	0.44	5.00	0.21	5.10	0.41	5.03	0.52	5.12	0.39	5.09	0.31
35.	Turning Balance Test (No. of Full Circles/10 Sec.) TBT ^a	8.44	11.41	4.50	2.34	3.72	2.61	4.81	3.03	2.61	1.91	5.86	6.17
36.	Turning Balance Test (No. of Circles/10 Sec.) TBT ^b	1.51	0.54	2.41	0.73	1.46	0.59	1.60	0.61	1.15	0.64	1.08	0.66
37.	Hand Eye Co-ordination Test (cm) HECT ^a	43.22	9.04	30.50	10.77	35.18	9.34	36.88	9.26	34.76	10.31	34.64	10.41
38.	Hand Eye Co-ordination Test (milliseconds) HECT ^b	295.33	31.18	245.83	47.17	265.55	37.21	272.13	35.57	263.19	40.72	262.91	39.27

Table 1: Contd.....

S. No.	Biological Variables	14+		15+		16+		17+		18+	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
II. PHYSIOLOGICAL VARIABLES											
28.	Pulse Rate at Rest (PRR)	84.00	6.32	77.50	5.25	77.81	4.51	78.73	7.71	80.00	6.93
29.	Dystolic Blood Pressure (DBP)	76.89	6.17	78.13	6.83	77.27	5.67	78.23	7.44	80.29	5.21
30.	Systolic Blood Pressure (SBP)	109.33	6.48	110.75	8.09	110.90	9.09	112.18	9.01	112.86	8.55
III. PHYSICAL FITNESS TESTS											
31.	Step Test (ST)	44.00	9.38	58.25	9.49	56.73	10.01	56.36	9.07	52.86	9.01
32.	Sargent Vertical Jump (SVJ)	29.22	5.54	33.25	6.44	27.82	3.09	37.73	8.09	40.14	8.21
33.	Burjee Squat Thrust Test (BSTT)	21.86	2.25	22.69	2.93	24.48	3.31	23.18	4.43	26.46	2.20
34.	Shuttle Run Test (SRT)	4.76	0.36	4.80	0.41	4.64	0.39	4.56	0.43	4.60	0.33
35.	Turning Balance Test	4.44	2.92	4.56	4.89	4.91	5.75	5.27	5.55	6.43	4.35
	(No. of Full Circles/10 Sec.) TBT ^a										
36.	Turning Balance Test	1.25	0.49	1.12	0.60	1.12	0.82	1.33	1.07	1.56	1.21
	(No. of Circles/10 Sec.) TBT ^b										
37.	Hand Eye Co-ordination Test (cm) HECT ^a	27.33	8.87	31.06	8.41	26.18	5.99	26.55	7.46	27.43	9.81
38.	Hand Eye Co-ordination Test	233.77	35.65	249.56	32.97	229.73	26.88	230.91	29.42	233.43	40.42
	(milliseconds) HECT ^b										

to assess linear relationship between two concerned variables. The range of coefficient of correlation is between -1 (which mean a perfect negative relationship) through zero (which means no relationship) to +1 (which refers to a positive relationship). It has been observed that values of 'r' are positive for anthropometric variables indicating the direct relationship between two variables for the sake of convenience, the values of 'r' have been divided into three categories, viz., A, B and C. Category 'A' showing almost independent or no relationship between two variables (close to 0 and upto +0.149) does not observe in the anthropometric variables, whereas category 'B' exhibiting moderate degree of relationship (± 0.15 to ± 0.499) include many values of 'r' and category 'C' showing a higher degree of positive relationship (± 0.50 to ± 1.00) includes most of the anthropometric variables, Systolic blood pressure (physiological variable) and Sargent vertical jump (Physical Fitness tests).

Among most of the Physical fitness tests: Shuttle run test, Turning balance test (no. of full circles/10 sec.), Hand-eye coordination test (milliseconds) and physiological variable (Pulse rate at rest) are showing negative correlation with other biological variables included in the present study.

Regression Equations

Simple Linear Regression of Different Biological Variables and Age: New Simple linear regression equations have been formulated for the prediction of various biological variables from age among Pangwalas of Pangi Tehsil. The regression has been computed by keeping age as an independent variables and all others variables as dependent. Among the anthropometric variables higher values of 'r' have been observed as follows:

	Value of 'r'
1. Height Illiospinale = 436.69 ± 29.53 Age	0.86
2. Height Vertex = 814.68 ± 42.85 Age	0.85
3. Height Acromion = 613.39 ± 37.43 Age	0.85
4. Body Weight = -5.49 ± 2.71 Age	0.84
5. Sitting Height Vertex = 487.56 ± 18.02 Age	0.82
6. Wrist Circumference = 86.24 ± 3.96 Age	0.81
7. Calf Circumference = 129.45 ± 8.87 Age	0.81
8. Chest Circumference = 587.79 ± 19.79 Age at Normal Respiration	0.80

For Physiological and Physical fitness tests variables, highest values of 'r' were observed for the following:

1. Systolic blood pressure = 86.22 ± 1.53 Age 0.54
2. Sargent vertical jump = 1.49 ± 1.96 Age 0.69

Simple Linear Regressions of Physiological Variables and Physical Fitness Tests from the Anthropometric Variables and Age: The best simple linear regression equations showing maximum regression coefficient among Pangwalas of Pangi Tehsil are shown in Table 2.

Multilinear Regressions of Physiological Variables and Physical Fitness Tests on Anthropometric Variables with Age (Taken as Forced Variable): New multilinear regression equations have been formulated in order to facilitate greater accuracy in the predication of Physiological variables and Physical fitness tests. The best multilinear regression equations for Pangwalas of Pangi Tehsil, District Chamba are represented in Table 3.

Stepwise Multilinear Regression on Anthropometric Variable and Age (Taken as Forced Variable): New Stepwise multilinear regression equations have been formulated in which variable add stepwise in order of their correlation coefficient value in the regression equations. Further adding of variable as soon as there is no further increase in value of multiple coefficient of correlation. Analysis of stepwise multilinear regression has been done at 0.05 percent level of significance. The best regression equations computed stepwise showing maximum value of multiple regression are shown in Table 4.

Difference in the Pattern of Growth-Comparision of Pangwalas with other Population Groups

An attempt has been made to compare the present population group with the Transhumant and Settled Gaddis of Chamba and Kangra districts, respectively (Singh, 1980; Bhasin et al., 2008) for anthropometric variables, like Body weight, Stature and Chest circumference at normal respiration, whereas for physiological variables and physical fitness tests, the present population is compared with Gaduliya Lohar Boys of Rajasthan among whom the results on these variables are available from India (Sagar and Bhasin, 1999).

Pangwalas are showing higher values for Body weight at the age group 11+ and less at the age group 18+ when compared to other population groups and they show significant differences with Transhumant Gaddis-Rajputs and Brahmans, Settled Gaddis-Brahmans at the age of 11+ years, whereas with Settled Gaddis-Rajputs, the differences are observed statistically at the age groups of 14+ and 18+ years.

Table 2: Simple linear regressions of physiological variables and physical tests from the anthropometric variables and age

Variables	Value of 'R'
<i>Physiological Variables</i>	
1. Pulse Rate of Rest (PRR)	= 73.02+0.03 Forearm Circumference 0.12
2. Dystolic Blood Pressure (DBP)	= 53.57+0.15 Antero-posterior depth of chest 0.36
3. Systolic Blood Pressure (SBP)	= 90.78+0.52 Body weight 0.61
<i>Physical Fitness Tests</i>	
1. Step Test (ST)	= 40.21+6.03 Skinfold at biceps 0.27
2. Sargent Vertical Jump (SVJ)	= 8.66+0.62 Body weight 0.72
3. Burfee Squat Thrust Test (BSTT)	= 5.55+0.62 Sitting height vertex 0.38
	= 10.26+0.05 Calf circumference 0.38
4. Shuttle Run Test (SRT)	= 7.16+0.001 Height Vertex -0.49
5. Turning Balance Test (No. of Full Circles) TBT ^a	= -29.25+0.06 Head Circumference 0.25
6. Turning Balance Test (No. of Circles/10sec) TBT ^b	= 3.20-0.002 Height Illisopinale -0.29
	= 3.64-0.02 Wrist circumference -0.29
7. Hand eye coordination test (cm) HECT ^a	= 71.92-0.03 Height Vertex -0.40
	59.69-0.16 Upper Arm circumference 'Relaxed' -0.39
	57.95-0.13 Upper Arm circumference 'Contracted' -0.38
8. Hand Eye coordination test (milliseconds) HECT ^b	= 408.88-0.11 Height vertex -0.39
	= 363.01-0.62 Upper arm circumference 'Relaxed' -0.39
	= 355.86 -0.52 Upper arm circumference 'Contracted' -0.38

Table 3: Multilinear regressions of physiological variables and physical fitness tests on anthropometric variables with age (Taken as forced variable)

	Value of 'R'
<i>Physiological Variables</i>	
1. Pulse Rate at Rest (PRR) = 84.63+0.06 Transverse Diameter of Chest + 0.47 Age	0.17
2. Dystolic Blood Pressure (DBP) = 53.86+0.14 Antero-posterior Depth + 0.07 Age	0.36
3. Systolic Blood Pressure (SBP) = 88.52 = 0.42 Weight = 0.39 Age	0.62
<i>Physical Fitness Tests</i>	
1. Step Test (ST) = 42.44+3.34 Skinfold at Biceps - 0.21 Age	0.27
2. Sargent Vertical Jump (SUJ) = 3.69+0.40 Body weight +0.87 Age	0.74
3. Burfee Squat Thrust Test (BSTT) = 13.48+ 0.68 Skinfold at Triceps + 0.47 Age	0.45
4. Shuttle Run Test (SRT) = 6.80-0.0009 Height vertex - 0.04 Age	0.51
	= 6.97-0.002 Sitting Height vertex - 0.04 Age 0.51
5. Turning Balance Test (No. of Full Circles) TBT ^a = -30.55+0.07 Head Circumference -0.17 Age	0.26
6. Turning Balance Test (No. of Circles/10 Sec) TBT ^b = 3.84-0.004 Height Illiospinale+0.08 Age	0.34
7. Hand Eye Co-ordination Test (cm) HECT ^b = 57.79-4.21 Skinfold at Biceps-1.23 Age	0.45
8. Hand Eye Co-ordination Test (milli seconds) HECT ^b = 355.08-17.03 Skinfold at Biceps+4.83 Age	0.46

Table 4: Stepwise multilinear regression on anthropometric variables and age (Taken as forced variable)

	Value of 'R'
<i>Physiological Variables</i>	
1. Pulse Rate at Rest (PRR) = No variable met the 0.05 significance level for entry with into the equation	
2. Dystolic Blood Pressure (DBP) = 53.57+0.15 Antero-posterior depth of chest	0.36
3. Systolic Blood Pressure (SBP) = 93.88+0.53 Body weight + 0.07 Biacromial Breadth -0.04 Abdomen circumference	0.65
<i>Physical Fitness Tests</i>	
1. Step Test (ST) = 40.21+6.03 Skinfold at Biceps	0.27
2. Sargent Vertical Jump (SVJ) = 25.89 + 0.71 Age + 0.51 Body weight -0.11 Antero-posterior Depth of Chest -0.04 Abdomen circumference +0.13 Upper Arm circumference 'contracted' -1.48 Fore arm skinfold	0.78
3. Burfee Squat Thrust Test (BSTT) = 13.79+0.51 Age +1.03 Skinfold at triceps-0.43 Skinfold at +1.03	0.49
4. Shuttle Run Test (SRT) = 7.16 - 0.001 Height vertex	0.49
5. Turning Balance Test (No. of Full Circles) TBT ^a = -31.52+0.10 Head circumference -0.09 Wrist circumference -1.27 Fore arm	0.37
6. Turning Balance Test (No. of Circles / 10 sec.) TBT ^b = 3.93 - 0.003 Height illiospinale -0.26 Chest skinfold + 0.27 Abdominal skinfold	0.42
7. Hand Eye Co-ordination Test (cm) HECT ^a = 57.79-1.23 Age - 4.21 Skinfold at Biceps	0.45
8. Hand Eye Co-ordination Test (milli seconds) HECT ^b = 335.08-4.83 Age -17.03 Skinfold at Biceps	0.45

When compared for Stature, higher values have been observed among Transhumant and Settled Gaddis Groups as compared to Pangwalas, but statistically (t-test) not significant differences among them. The mean values for Chest circumference at 'Normal' Respiration varies from 600 at the age 8+ years (Transhumant Gaddis-Brahmans) to 831 at the age 18+ years (Settled Gaddis-Rajputs) and about similar results have been observed among different age groups in the various population groups, however, statistically significant differences have been observed at the age group of 11+ years with the Transhumant Gaddis-Rajputs and Brahmans and at the age group 13+ years with Brahmans whereas Settled Gaddis-Rajputs show significant differences at age groups 12+ and 14+ and no significant differences have been observed with Settled Gaddis-Brahmans.

When compared with Gaduliya Lohar boys for physiological variables, higher mean values are observed among Pangwalas for Pulse rate at rest and Dystolic blood pressure where significant differences are observed at the age group 8+, 9+, 10+, 11+, 13+ and 14+ for pulse rate at rest and at the age groups 11+ and 12+ years for Dystolic blood pressure, whereas for Systolic blood pressure, generally higher mean values have been observed among Gaduliya Lohar boys and they show significant differences with Pangwalas at the age groups of 9+, 10+, 11+, 12+, 13+, 15+ and 16+.

In the physical fitness tests, it has been observed that Pangwalas are showing quite high values for Step test in age groups 8+ to 13+ and they also show statistically significant differences. For the Sargent vertical jump, the population group of the present study is showing less values as compared Gaduliya Lohars in all the age groups and significant differences are observed at the age group of 10+, 11+, 12+, 13+ and 16+. The mean values of Burfee Squant thrust test (agility) show almost similar mean values and no significant differences are observed for all the age groups except for 18+ age groups. In the Shuttle run test the mean values are showing a decrease in time taken for one cycle from 8+ to 18+ years and hence a corresponding increasing in agility and these are high in Pangwalas (4.56 to 5.40) than Gaduliya Lohars (3.76 to 5.16) and significant differences have been observed for the age groups 10+, 11+, 13+, 15+, 16+, 17+ and 18+ between them. For both the measurements

i.e., Turning balance test - (1) No. of full circles and (2) No. of circles/10 sec. the higher values are observed for Gaduliya Lohars (4.75 to 11.25 and 3.43 to 5.09, respectively) as compared to Pangwalas (2.6 to 6.43 and 1.12 to 2.41, respectively) and statistically, the differences are observed significant for all the age groups in these two measurements except at the age groups 8+ and 9+ for No. of full circles. The measurements-Hand eye coordination test (1) in cm and (2) in milliseconds show decrease in mean values and hence a corresponding increase in coordination and higher values are observed among Pangwalas (26.18 to 43.22 and 229.73 to 295.33, respectively) than Gaduliya Lohars (19.80 to 39.90 and 200.10 to 264.65, respectively) and significant differences have been found for the age group 8+, 11+, 12+, 13+, 15+, 17+ for cm. as well as milliseconds.

Thus, it can be evaluated from the present study on pattern of body growth and physical fitness tests among Pangwalas of Pangi Tehsil, Chamba District that they do not show statistically significant differences between Transhumant and Settled Gaddis for Body weight, Stature and Chest circumference at Normal inspiration. Whereas when compared with Gaduliya Lohars of Rajasthan for physiological variables and physical fitness tests, significant differences have been observed among them in most of these measurements, which may be attributed to their different ecological settlements and mode of living as Pangwalas are settled in Pangi Tehsil of Chamba District at the height of about 2300 metres above mean sea level, whereas Gaduliya Lohars are nomads who are roaming on the plains and desert. However, it is rather difficult to do evaluation on the basis of available material at present.

REFERENCES

- Baker, P.T.: Adaptation problems in Andean human populations. In: *Opening Evaluation of Latin American Populations*. P. Salzano. (Ed.). Charles C. Thomas, Springfield (1971).
- Bhasin, M.K., Walter, H., Singh, Indera P., Bhasin, V., Singh, S.M. and Singh, R.: Genetic Studies of Pangwalas, Transhumant and Settled Gaddis. 1. Blood group polymorphisms and Saliva Sector system. *Z. Morph. Anthropol.*, **73**: 79-96 (1982).
- Bhasin, M.K., Walter, H., Singh, Indera P. and Kshatriya, G.: Genetic Studies of Pangwalas, Transhumant and settled Gddis. 3. Genetic differentiation processes. *Z. Morph. Anthropol.*, **43**: 333-342 (1983).
- Bhasin, M.K., Singh, Indera P., Walter, H., Bhasin, V., Chahal, S.M.S. and Singh, R.: Genetics Studies of

- Pangwalas. Transhumant and Settled Gaddis 4 Colour blindness, mid-phalangeal hair, ear lobe attachment and behavioural traits. *Anthrop. Anz.*, **44**: 45-53 (1986a).
- Bhasin, M.K., Singh, Indera P., Walter, H., Chahal, S.M.S., Bhasin, V., Singh, R. and Sudarshan, K.: Genetic Studies of Pangwalas, Transhumant and Settled Gaddis. 5 Finger Dermatoglyphics. *J. Indian Anthropol. Soc.*, **21**: 78-86 (1986b).
- Bhasin, M.K., Singh, Indera P., Walter, H., Chahal, S.M.S., Bhasin, V., Singh, R. and Sudarshan, K.: Genetic Studies of Pangwalas, Transhumant and Settled Gaddis 6. Palmar dermatoglyphics. *Ind. J. Phys. Anthropol. Hum. Genet.*, **12**: 9-28 (1986c).
- Bhasin, M.K., Walter, H., Singh, Indera P., Sudarshan, K.J., Chahal, S.M.S., Bhasin, V. and Singh, R.: Palmar dermatoglyphic creases among eleven population groups of Himalayas. *J. Hum. Ecol.*, **2**: 103-106 (1991).
- Bhasin, M.K. Singh, Ratanjit, Singh, I.P., Bhasin, V. and Chahal, S.M.S.: Genetic Studies of Pangwalas, Transhumant and Settled Gaddis: A comparative study of age changes in biological variables among Transhumant and Settled Gaddis. *J. Hum. Ecol.*, **24**(3): 149-174 (2008).
- Bhasin, Veena, Bhasin, M.K. and Singh, Indera P.: Ecology, culture and development Gaddis and Pangwalas of Himachal Pradesh. *J. Hum. Ecol.*, **2**: 253-302 (1991).
- Frisancho, A.R.: Human growth and pulmonary function of a high altitude Peruvian Quechua population. *Hum. Biol.*, **41**: 365 (1969).
- Himachal Pradesh: *District Census Handbook, District Chamba, Town and Village Directory 1981*. Printing and Stationery, Himachal Pradesh, Shimla (1985).
- Sagar, Anu Prabha and Bhasin, M.K.: Physical fitness and morphological growth among nomads of Rajasthan. *Human Ecology Special Issue No. 7*: 149-159 (1999).
- Singh, Indera P., Bhasin, M.K., Walter, H., Hilling, M., Bhasin, V. and Singh, R.: Genetic Studies of Pangwalas, Transhumant and Settled Gaddis. 2. Serum protein and red cell enzyme polymorphisms. *Z. Morph. Anthropol.*, **73**: 175-195 (1982).
- Singh, Ratanjeet: *Age Changes in Biological Variables in Transhumant and Settled Populations. A Comparative Study of Gaddis Rajputs and Brahmans of Sub-Tehsil Bharmour. District Chamba and District Kangra, Himachal Pradesh*. Ph.D. Thesis. University of Delhi, Delhi (1980).
- Tanner, J.M.: *Growth at Adolescence*, Blackwell Scient. Publ., Oxford (1962).
- W.H.O.: *Research in Population Genetics of Primitive Groups. Tech. Report Series No. 279* (1964).
- Weiner, J.S. and Lourie, J.A.: *Human Biology: A Guide to Field Methods IBP Hand Book No. 9*. Blackwell Scient. Publ., Oxford (1969).
- Wolanski, N. and Pyzdek, M.L.: *Studies in Human Ecology*. Vol. 1. Polish Scientific Publishers, Warsaw (1973).