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Genetic Studies of Pangwalas, Transhumant and Settled Gaddis: A Comparative Study of Age Changes in Biological Variables among Transhumant and Settled Gaddis

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ABSTRACT The present paper is on comparative study of pattern of body growth and respiratory functions among Transhumant Gaddi (Brahmans and Rajputs) of Tehsil Bharamour, District Chamba inhabting Mid-Himalayan zone and Settled Gaddi (Brahmans and Rajputs) of District Kangra inhabiting Outer-Himalayan zone. Broadly speaking, all the groups do not show statistically significant differences between each other in most of the biological variables studied, except Settled Kangra Rajputs, who have shown differences in certain biological variables, when compared with Transhumant Bharmour Brahmans and Rajputs. These differences may be attributed more to socio-economic conditions, physical environment and mode of existence and less to biological make up.

The present paper on "Age changes in biological variables among Transhumant and Settled Gaddis" is the ninth in the series of "Genetic Studies of Pangwalas, Transhumant and Settled Gaddis from Himachal Pradesh, India".

AREA AND PEOPLE

Geographical Location

Himachal Pradesh is located in Northwest India between about 31^{O} and 33^{O} northern latitude and about 75^{O} and 79^{O} 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 the mean sea level. Figure 1 demonstrates the geographical location of Himachal Pradesh in India. 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) the Kangra District (Outer Himalayan Zone); (Figs. 1 and 2.)

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^{o}10'N and 33^{o}13'N and 75^{o}5'E and 77^{o}33'E, respectively.

Tehsil Bharmour (32^{o}11'N^{-}; 32^{o}41'N^{-}; 76^{o}22'E^{-}; 76^{o}53'E) is situated south of Tehsil Pangi. Its total area is 1,818.3km^{2}, and it is inhabited by 29,944 individuals, 3,975 of them belong to Scheduled Castes, 24,639 to Scheduled Tribes. The population density was found to be 16 per sq km (Census 1981). This area is inhabited by the Gaddis, a migratory tribe. A majority of them migrate before beginning of winter to the lower hills of Kangra, Chamba, Mandi, and Gurdaspur.

Kangra District

The Kangra District (31^{o}20'N and 32^{o}58'N; 75^{o}39'E and 78^{o}35'E) is bounded in the southwest by the district to Hoshiarpur, in the northwest by the district of Gurdaspur of Punjab State, in the north by the native district of Chamba, in the east and south west by the districts of Kulu, Mandi and Bilaspur, respectively. The Kangra District is among others also inhabited by two groups of Gaddis - the Settled Gaddis and the Transhumant Gaddis, who are living here only during the winters. Samples of both these groups are reported in this study.

The Gaddis

The Gaddis are living mostly in the Chamba and Kangra Districts of Himachal Pradesh, but are administratively principally found in the Bharmour Tehsil of the Chamba District. They have migrated to these areas from plains (mostly from Punjab) at various times because of the

religious persecution. The Brahmans of the Gaddis followed the Rajput Gaddis in order to serve them as *Purohits* (priests) and they are still continuing this. The original inhabitants of the areas now occupied by the Gaddis are the Sipis, Reharas, and Halis (Scheduled Castes), who had been conquered later on by the Rajput Gaddis (Hutchinson, 1910).

The Gaddis have been declared as a tribe mainly for the purpose of development in view of their social and economic backwardness. Anthropologically, however, they can hardly be called a tribe. There is some confusion nowadays, as Brahmans and Sipis have also started calling themselves Gaddis, because the members of Scheduled Tribe and Scheduled Caste communities are entitled to financial benefits such as a free education and medical care along with other free subsidaries among other incentive as per direction of the Goverment of India.

Agriculture and allied occupations such as sheep and goat rearing, weaving and spinning of wool etc. are the main occupations of the people of Bharmour. Due to hard climate resulting in heavy snowfall every winter the population of Bharmour splits up and migrates to different places in the Outer Himalayan Zone. When the winter ceases down they again start migrating back to their respective villages in the Mid-Himalayan Zone. For this reason the population of Bharmour is called "Transhumant".

Thus, this Transhumant population of the Bharmour Tehsil, Chamba District, lives for about six months in the Mid-Himalayan Zone , and for six months in the Outer Himalayan zone of Himachal Pradesh, mainly in the Kangra District, but also to some degree in the districts of Chamba, Mandi, and Gurdaspur (Punjab State), see figure 2,

Due to this continuous migration since generations from the Mid-Himalayan Zone to the Outer Himalayan Zone some of the Gaddis have now permanently settled in the Kangra District (Outer Himalayan Zone). They are now about 15,000 in number (in year 1978). Thus, the Gaddis of Bharmour and Kangra apparently are a single population group, which split up many generation ago. These two groups diverged culturally in response to their different habitats. The historical background set limits on the degree to which they resemble each other. The common historical origin has set limits to the degree to which people can diverge culturally from each other in their adaptation to different habitats. Now, the Settled Gaddis of Kangra live in much more beneficial and congenial environment than the biologically similar Transhumant Gaddis of Bharmour Tehsil. Owing to better socio-economic status of the Kangra Gaddis, they have not been given the status of the Scheduled Tribe.

A number of studies on ecology, demography, biology, socio-cultural aspects of Gaddis have already been reported (Bhasin, M.K. et al., 1982, 1983, 1986 a, b, c; 1991, 1995; Bhasin, V., 1988, 1990 a, b, 1991; Bhasin and Bhasin, 1993, 1995; Bhasin V. et al., 1991, Singh and Bhasin, 1983; Singh et al., 1982)

In this paper results of 24 biological variables studied on Transhumant and Settled Gaddis-Brahman and Rajput boys (age 8+ to 19+ years) have been reported. An attempt has been made to compare the age changes in biological variables among Transhumant Gaddis-Brahmans and Rajputs of Bharmour Tehsil, Chamba District, (inhabit the Mid-Himalayan zone altitude 2000-2300 meters) and Settled Gaddis-Brahmans and Rajputs of Kangra district (inhabit the Outer Himalayan zone altitude 600-2000 meters) as follows:

(1) to compare the population groups characterised by identical physical environment, socio-economic conditions and mode of existence (Transhumant and Settled respectively) but different biological make up i.e., Brahmans vs Rajputs.
(2) to compare the population groups characterised by different physical environment, different socio-economic conditions, different mode of existences (Transhumant versus Settled) but similar biological make up (Brahmans x Brahmans and Rajputs x Rajputs)
(3) to compare the population groups characterised by different physical environment, different socio-economic conditions, different mode of existence (Transhumant versus Settled) and different biological make up (Brahmans x Rajputs)

The present comparative study may help to understand the growth and development pattern among Transhumant and Settled population groups.

MATERIALS AND METHODS

A cross sectioal sample of 489 healthy apparently Transhumant Gaddi Rajputs and Brahman boys of Tehsil Bharmaur, District Chamba (264

Fig. 1. Location of the Chamba and Kangra districts in Himachal Pradesh, North India.

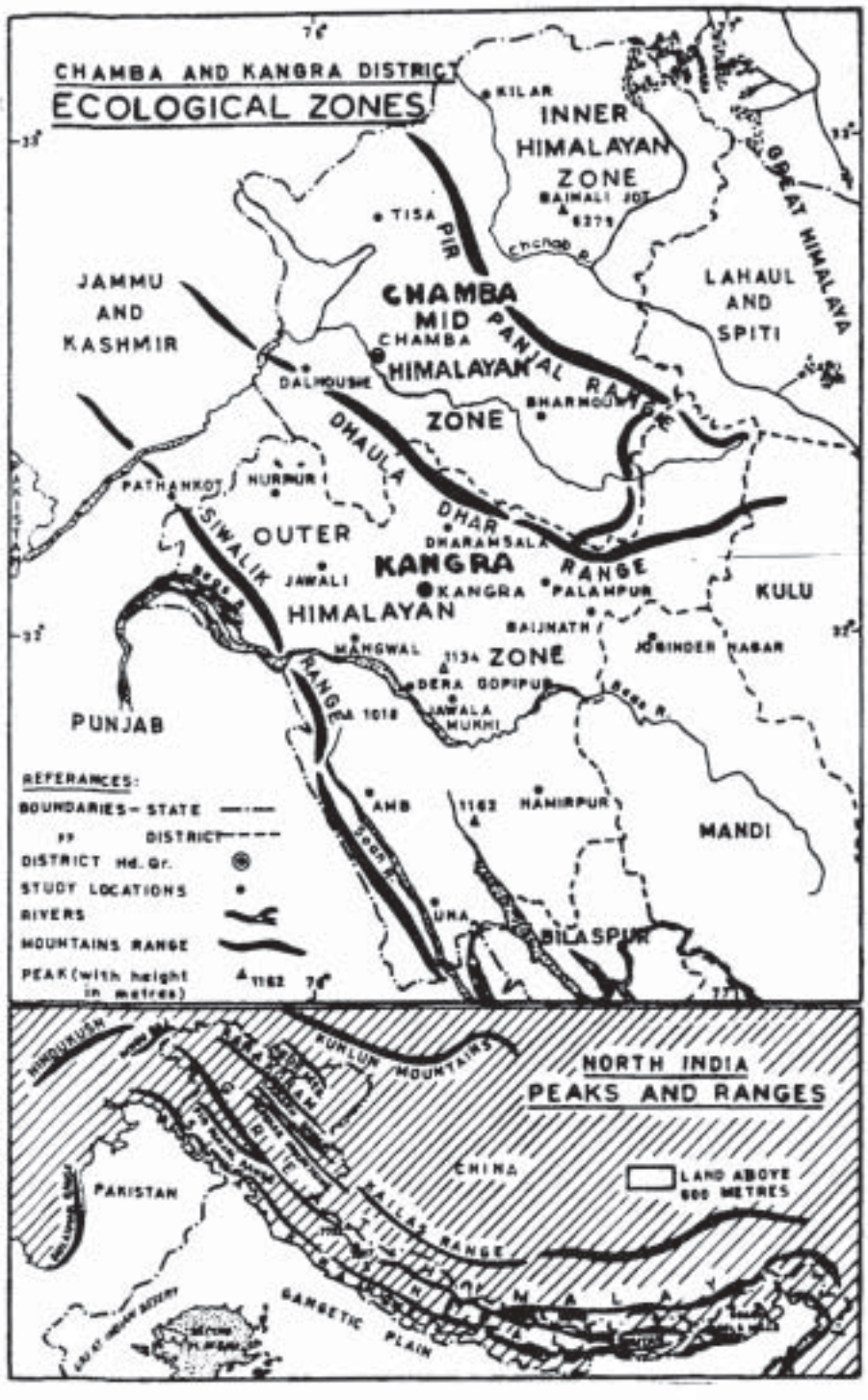

Fig. 2. Ecological zones of the Chamba and Kangra districts in Himachal Pradesh.

Rajputs and 225 Brahmans) and 501 Settled Gaddi Rajput and Brahman boys of District Kangra (289 Rajputs and 212 Brahmans) ranging in age from 8-19 years have been collected for the present study.

From Kangra district only those Settled Gaddi Brahmans and Rajputs have been considered for present investigation, who have migrated from their original place in Bharmour Tehsil and have settled in Kangra district for at least 3-4 generations. Further, neccessary precautions were taken to exclude those subjects who are marrying with the Transhumant Bharmour Gaddis, to specify or emphasize the biological and geographical isolation. Only thoseTranshumant Gaddis are taken for the present investigation, who have been in Tehsil Bharmour (Mid Himalayan Zone) for at least 2-3 months or when the return migration is completely over.

All the necessary precautions were taken to collect the data on the subjects who are not closely related in both endogamous groups from Tehsil Bharmour, District Chamba and District Kangra. The sample collection was carried out from June 1976 to June 1979.

The categorisation of age groups has been done as those subjects who have completed 8 years of age but one less than 9 years even by one day are grouped under 8+ age group. Similar pattern has been followed for each age group from 8 to 19 years.

The anthropometric measurements have been taken on each of the 990 subjects following the standard technique of Martin and Saller (1959), WHO Reports (1964); Singh and Bhasin (1968) and Weiner and Lourie (1969).

Physiological measurements have been taken following the techinques of Consolazio et al. (1963) and Weiner nad Lourie (1969). Respiratory functions have been taken on Collin's nine litre capacity respirometer. The list of biological variables is given in Table 1.

Abbrevations used for the Poputation groups under study are as follows:

TG = Transhumant Gaddis of Tehsil Bharmour, District Chamba
BB = Transhumant Gaddi Brahmans of Tehsil Bharmour, District Chamba
BR = Transhumant Gaddi Rajputs of Tehsil Bharmour, District Chamba
SG = Settled Gaddis of District Kangra
KB = Settled Gaddi Brahmans of District Kangra
KR = Settled Gaddi Rajputs of District Kangra

RESULTS AND DISCUSION

The magnitude of growth has been studied on the basis of occurrence of distance and velocity curves, adolescent spurts and growth gradients.

Analysis of the present data on various population groups i.e. Transhumant Gaddi Rajputs and Brahmans and Settled Gaddi Rajputs and Brahmans reveals that all the biological variables is from 8 to 19 years, Skinfold measurements, Pulse rate, Blood pressure are showing variation in growth.

Biological Variables

Anthropometric Variables

(a) 1. Body Weight

The mean value of body weight shows a continuous increase from 18.6±0.72 kg among Bharmour Brahmans of age 8 years to a maximum of 55.6±0.84 kg among Kangra Brahmans of age 19 years (Table 1). The distance curve shows that Kangra Rajputs remain ahead of the other groups from 8 to 12, 13 to 15 and 17 to 19 years of age. The velocity curve shows multiple peaks for all the four population groups. The adolescent spurt ranges between 13 to 18 years. Maximum amount of growth between 8 to 18 years is achieved by Bharmour Brahmans (61.67 percent) and minimum by Bharmour Rajputs (57.42 percent).

(b) Projective Height Measurements of the Body

Projective height measurements are showing gradual rise from 8 to 19 years. Among the Gaddis, the mean values of Stature, Height acromion, Total lower extremity length and Sitting height show a continuous increase from 116.0±1.45 cm among Bharmour Brahmans, 91.3±1.33 cm among Bharmour Brahmans, 61.9±0.95 cm among Kangra Rajputs, 62.0±0.91 cm among Bharmour Brahmans, respectively of the 8 years age group to a maximum of 168.0±1.26 cm among Kangra Rajputs, 136.0±1.24 Kangra Rajputs, 92.3±0.75 cm among Bharmour Brahmans, 88.9±0.59 Kangra Rajputs, repectively of the 19 years age group. The distance curves show that Kangra Rajputs are much ahead than other groups except for total lower extremity length where Brharmour Rajputs and Bharmour Brahmans surpass the other groups. The velocity curves show multiple peaks for all

the measurements in all the four groups. The adolescent spurt ranges between 9+ and 18+ years. The maximum and minimum growth achieved between 8 and 18 years are Bharmour Brahmans 27.92 percent and Kangra Rajputs 26.79 percent for Stature; Bharmour Brahmans 30.33 percent and Kangra Rajputs 26.79 percent for Height acromion; Kangra Rajputs 29.40 percent and Bharmour Rajputs 25.74 percent for Total lower extremity length and Bharmour Brahmans 24.80 percent and Bharmour Rajputs 22.87 percent for Sitting height vertex, respectively.

(c) Breadth and Depth of Trunks

Breadth and depth measurements exhibit gradual rise from 8 to 19 years and it has been observed that the mean values varies between 8+ and 19+ years for Biacromial breadth is 24.3 ± 0.33 cm (Bharmour Brahmans) to 37.4 ± 0.38 cm (Kangra Rajputs); for Bicristal breadth is 17.2 ± 0.27 cm (Bharmour Brahmans) to 27.2 ± 0.31 cm (Bharmour Brahmans); for Transverse diameter of chest is 17.2 ± 0.22 cm (Bharmour Brahmans) to 26.7 ± 0.28 cm (Kangra Rajputs) for Antero-posterior depth of chest is 13.2 ± 0.25 cm (Bharmour Brahmans) to 21.1 ± 0.38 cm (Kangra Rajputs); for Height strenum is 10.5 ± 0.18 cm (Kangra Brahmans) to 16.6 ± 0.19 cm (Bharmour Rajputs), respectively. The distance curves show that Kangra Rajputs remain much ahead of the other groups, in general, except the Height strenum, where Bharmour Brahmans remain ahead of the other groups from 9 to 13 years. The velocity curves show multiple peaks for all the measurements in the four population groups. The highest peak (adolescent spurt) ranges between 13+ and 18 years. The maximum and minimum growth between 8 and 18 years is achieved for Biacromial breadth by Bharmour Brahmans (31.95 percent) and Kangra Rajputs (27.81 percent); for Bicristal breadth by Bharmour Rajputs (33.34 percent); for Transverse diameter of chest by Bharmour Brahmans (30.04 percent) and Bharmour Rajputs (26.08 percent); for Antero-posterior depth of chest by Kangra Rajputs (30.33 percent) and Bharmour Brahmans (27.50) and for Height strenum by Kangra Rajputs (32.71 percent) and Bharmour Brahmans (31.10 percent), respectively.

(d) Girths

Girth measuremtns show a rise upto 19 years. The minimum (at the age of 8 years) and the maximum (at the age of 19 years) observed for varous girths are: for Head circumference from 50.8 ± 0.36 cm (Bharmour Brahmans) to 55.5 ± 0.36 cm (Bharmour Brahmans); for Chest circumference at normal respiration from 56.0 ± 0.78 cm (Bharmour Brahmans); for chest circumference at normal respiration from 56.0 ± 0.78 cm (Bharmour Brahmans) to 86.3 ± 0.83 cm (Kangra Rajputs); for Chest circumference at maximum inspiration from 60.7 ± 0.73 cm (Bharmour Brahmans) to 89.5 ± 0.75 cm (Kangra Rajputs); for Chest circumference at maximum expiration from 54.8 ± 0.70 (Bharmour Brahmans) to 84.3 ± 0.69 cm (Kangra Rajputs); for Upper arm girth from 14.2 ± 0.27 cm (Bharmour Brahmans) to 25.3 ± 0.21 cm (Kangra Rajputs) and for Calf girth from 20.5 ± 0.76 cm (Bharmour Brahmans) to 32.9 ± 0.26 cm (Kangra Rajputs), respectively. The distance curves show that, in general, in all the age groups, Kangra Rajputs remain ahead of the other groups of the present study, whereas velocity curves plotted for all the four population groups exhibit multiple peaks. Mostly adolescent spurts are observed between 16 and 17 years. The maximum and minimum amount of growth achieved between 8 and 18 years for Head circumference is by Bharmour Brahmans (5.94 percents) and Kangra Rajputs (3.49 percent); for Chest circumference at normal respiration is by Kangra Rajputs (29.67 percent) and Bharmour Rajputs (28.39 percent); for Chest circumference at maximum inspiration is by Kangra Rajputs (27.94 percent) and Bharmour Rajputs (24.09 percent); for Chest circumference at maximum expiration is by Kangra Rajputs (29.77 percent) and Bharmour Rajputs (25.89 percent); for Upper arm girth is by Bharmour Brahmans (36.10 percent) and for Calf girth is by Bharmour Brahmans (31.45 percent) and Bharmour Rajputs (29.55 percent), respectively.

(***e) Skinfold Measurements***

Skinfold measurements at Biceps and Triceps are showing variation in growth among all the four population groups studied. Skinfold at biceps and triceps show, in general, 100 percent growth at 8+ years. The adolescent spurt ranges from 10+ to 18+ years, in general.

B. Physiological Measurements

(a) Pulse Rate and Blood Pressure

Pulse rate shows almost stationary values i.e., it is showing minimum changes with age from 8

to 19 years. Systolic blood pressure shows gradual rise from 8 to 19 years, where as dystolic blood pressure is showing variation in growth. Pulse rate and blood pressures show occurrence of adolescent spurt between 9 to 19 years and are showing wide range.

(b) Respiratory Functions

The respiratory functions show a continuous increase from 8 years age group to 19 years age group as follows: for Forced vital capacity from 1380±44.06 ml (Kangra Rajputs) to 4504±121.03 ml (Bharmour Brahmans); for Forced expiratory volume Ist second from 1315±52.91 ml (Kangra Brahmans) to 4054±89.83 ml (Bharmour Brahmans); for Maximum voluntary ventilation from 50.2±2.28 lit/min (Kangra Brahmans) to 142.0±3.60 lit/min (Bharmour Rajputs). The distance curves show that Bharmour Brahmans remain ahead of other groups for Foced vital capacity and Forced expiratory volume Ist second whereas for Maximum voluntary ventilation, Bharmour Rajputs are ahead. The velocity curves exhibit multiple peaks. The adolescent spurts are observed between 13 and 17 years. The maximum and minimum growth achieved between 8 and 18 years for Forced vital capacity is by Kangra Brahmans (64.93 percent) and Bharmour Brahmans (58.97 percent); for Forced expiratory volume Ist second by Kangra Brahmans (63.27 percent) and Maximum voluntary ventilation by Kangra Brahmans (60.88 percent) and Kangra Rajputs (54.40 percent), respectively.

Group Differences among Transhumant and Settled Gaddis

The results of the comparison, using students 't' test in all the 24 biological variables of boys at each age, within the two population groups of Transhumant and Settled Gaddis of Tehsil Bharmour, District Chamba and District Kangra, indicate that in most cases the differences are statistically non significant except in a few age groups where statistically significant differences within and between the two Gaddi groups have been observed (Table 2).

(1) Transhumant Gaddi - Brahmans x Rajputs

Transhumant Bharmour Rajputs who share a common physical environment, socio-economic condition and mode of existance with Bharmour Brahmans share statistically significant higher values of Transverse diameter of chest at 8 years, chest inspired at 8 and 9 years; M.V.V. at 8, 11 and 13 years age group. Skinfold at biceps and triceps at 15 years; Pulse rate at 10, 14 and 15 years age group. On the other hand, Bharmour Brahmans, when compared with Bharmour Rajputs indicate statistically higher values of Height strenum at the age of 11, 16 and 17 years; FVC at the age of 12 years; FEV_1 at the age of 12, 16 and 19 years, Height acromion and Chest inspired at the age of 16 years, Weight, Sitting height, Stature, Bicristal breadth, Antero-posterior depth of chest at the age of 17 years and Calf girth at the age of 19 years; Systolic blood pressure at 11, 12, 14 and 15 years and Dystolic blood pressure at 8, 11, 12, 14 and 15 years age group.

(2) Settled Gaddi - Brahmans x Rajputs

Analysis of comparison between Settled Gaddi-Rajputs and Settled Gaddi-Brahmans of Kangra reveal statistically significant higher values in a number of measurements like Bicristal breadth at 9, 12, 14 and 17 years age group; Head circumference, Upper arm girth, Calf girth at 14 years age group; Height acromoin at 9, 12, 14, 15 and 19 years age group; Stature at 14, 15 and 19 year; Chest expired at 14, 18 and 19 years; Antero-posterior depth of chest, chest normal at 14, 15 and 19 years; Skinfold at triceps at 10, 13 and 14 years age group whereas Kangra Brahmans, in turn, indicate statistically significant ($P<0.05$) higher value that of Kangra Rajputs for Respiratory functions i.e., FEV 1see at 13 years and FVC at 13 and 18 years age group, and Systolic blood pressure at 8, 12, and 18 years age group.

(3) Transhumant Gaddis with Settled Gaddis

Analysis of comparison between Transhumant Bharmour Gaddis inhabiting Mid Himalayan Zone and Settled Kangra Gaddis inhabiting Outer Himalayan Zone show significant differences for most of the biological variables as will be discussed below:

(a) Transhumant Brahmans with Settled Brahmans: Comparing Brahmans of both the areas, it has been observed that Settled Kangra Brahmans possess statistically significant higher values than biologically similar Transhumant Bharmour Brahmans in biological variables like Chest normal, Chest expired and Transverse

diameter of chest at 8, 9, 11 and 13 years; Calf girth at 7 years; Bicristal breadth at 8 and 9 years; Upper arm girth at 8, 9, 11and 12 years and Head circumference at 13 years of age; Skinfold biceps at 8, 12 and 15 years and triceps at 10, 17 and 18 years of age group. In contrast Transhumant Bharmour Brahmans show statistically significant higher values than Settled Kangra Brahmans in the following biological variables: MVV at 9 years; Height sternum at 11 and 12 years; Total lower extremity length at 12, 15 and 19 years; Height acromion at 14 years, Weight and Biacromial breadth at 15 years and Bicristal breadth at 17 years.

(b) Transhumant Brahmans with Settled Rajputs: Transhumant Bharmour Brahmans show statistically significant higher values than Settled Kangra Rajputs with regard to Height sternum at 9 years, Total lower extremity length at 8, 10, 12, 14 and 18 years of age; FVC at 12, 13, and 19 years of age; FEV_1 at 12, 13, 15 and 19 years of age; MVV at 15 and 16 years of age; Systolic blood pressure at 14 years of age. Settled Rajputs also exhibit statistically significant differences with Bharmour Brahmans mainly in Bicristal breadth from 8 to 12 and 14 years; in Transverse diameter of chest from 8 to 14 and 19 years; in Head circumference at 8 and from 10 to 15 years; in Chest normal from 9 to 14, 18 and 19 years of age; in Chest expired 9, 11 to 14, 18 and 19 years; in Upper arm girth from 8 to 14, 18 and 19 years; in Calf girth at 8 to 11, 13, 18 and 19 years of age; in Skinfold biceps at 8 to 12, 15 and 19 years and triceps at 8 to 12, 14, 15, 17 and 18 years of age; in Pulse rate at 8, 13 and 16 years and Dystolic blood pressure at 19 years of age.

(c) Transhumant Rajputs x Settled Brahmans: Transhumant Bharmour Rajputs, when compared with Settled Kangra Brahmans reveal few differences. Bharmour Rajputs have statistically significant higher values than Kangra Brahmans for Total lower extremity length at 9, 12, and 13 years; Height sternum at 8 years; Stature and Height acromion at 15 year, Skinfold at triceps at 14 years of age and MVV at 8, 9, 10, 13 and 15 years of age. In contrast, Settled Kangra Brahmans, when matched with Transhumant Bharmour Rajputs show statistically increase in values of Bicristal breadth at 8 years; Chest (expired) at 8 and 9 years; Chest normal at 9 and 11 years; Upper arm girth at 11, 12 and 18 years; Height strenum at 16 years; Calf girth at 18 years; Skinfold at biceps at 12 and 17 years and triceps at 12, 17 and 18 years; Pulse rate at 14 years, Systolic blood pressure at 11, 12, 14 to 17 and 19 years and Dystolic blood pressure at 8, 11, 12, 14 and 15 years of age.

(d) Transhumant Rajputs x Settled Rajputs: The comparison between Transhumant Bharmour Rajputs and Settled Kangra Rajputs shows significant differences for most of the biological variables at each age group. Kangra Rajputs show statistically significant higher values than Bharmour Rajputs mainly in Total lower entermity length from 8 to 12 years and at 15 years; in Bicristal breadth at 9, 11, 12 and 14 to 17 years; in Transverse diameter of Chest from 9 to 12 and 15 and 19 years; in Chest normal from 9 to 12, 14 and from 16 to 19 years; in chest expired from 9 to 12 and 14 to 19 years; in Upper arm girth from 8 to 19 years except at 13 years; in Calf girth from 8, 9, 11, 14 and 16 to 19 years of age; Skinfold at biceps at 11 to 13, 15, 17 and 18 years and triceps at 9, 10, 12, 13, 17 and 18 years; Systolic blood pressure at 11 and 14 to 16 years and Dystolic blood pressure at 8, 11, 12, 14 and 15 years of age. On the contrary, Transhumant Bharmour Rajputs show significantly higher values in some of the biological variables when compared with Settled Kangra Rajputs. They show higher values of Height sternum at 8, 9, 13 and 17 years of age; Total lower extremity length at 8 to 12 and 15 years of age; MVV at 9 and 13 to 16 years of age; Stature and Height acromion at 13 years of age and Pulse rate at 14 years.

Thus, it can be inferred from the present study on pattern of body growth and physiological variables, among Transhumant Gaddi - Brahmans and Rajputs of Bharmour Tehsil, Chamba District inhabiting Mid Himalayan Zone and Settled Gaddi - Brahmans and Rajputs of District Kangra inhabiting outer Himalayan zone, that broadly speaking, the groups do not show statistically significant differences betweeen each other in most of the biological variables studied. However, differences in regard to the various biological variables studied, observed between Transhumant Bharmour Brahmans and Transhumant Bharmour Rajputs on the one hand and the Settled Kangra Brahmans and Settled Kangra Rajputs on the other, may be attributed to the differences in their biological make up. Whereas the differences between Transhumant Bharmour Brahmans and the Settled Kangra Brahmans on the one hand and between Transhumant Bharmour Rajputs and the Settled Kangra Rajputs,

may be attributed largely to better socio-economic condition of the Kangra based poputlation groups. The differences could also be partly due to differences in physical environment and mode of living (Transhumant versus Sedantary or Settled). Singh (1964), Madhavan et al. (1967), Berry (1971), Rao et al. (1976), Kwon (1978) among others have suggested that better socio- economic status leads to better health status among children.

The statistically significant differences between Transhumant Bharmour Brahmans with Settled Kangra Rajputs and between Transhumant Bharmour Rajputs with Settled Kangra Brahamans may be due to the differences in their biological make up, as well as due to their socio-economic conditions, mode of existence and physical environment.

Rao (1956), Spurgeon et al. (1959), McDowell et al. (1970), ICMR (1972), Heirnaux et al. (1975), Johnston et al. (1976), Eveleth and Tanner (1976), Nofely (1978), Eveleth (1978) have shown that the physical environments viz. geographical demaraction, climate and socio-economic conditions have definite effect on growth status of children. However Ashcroft and Lovell (1964) have suggested that the differences observed could be genetic in origin observed among Jamaican children and youth of African, Chinese and European ancestory.

In contrast, the Transhumant Bharmour Rajputs and Bharmour Brahmans exhibit statistically significant differences when compared with the Settled Kangra Rajputs, in Respiratory functions mainly from 13 to 16 years of age. This differences could be due to the differences in mode of existence i.e., Transhumant versus Sedentary or Settled. However, Kangra Rajputs also practice high level of habitual activity due to mountaneous terrain of the outer or Himalayan Zone, but not as high as that of Transhumant groups.

Cotes et al. (1973), Jones et al. (1977), Millller et al. (1978), Anderson et al. (1978) have suggested that higher lung volume may be the effect of high level of habitual activity rather than altitude or genetic in origin.

The other probable population pairs of Bharmour Rajputs x Bharmour Brahmans; Bharmour Rajputs x Kangra Brahmans; Bharmour Brahmans x Kangra Brahmans; and Kangra Rajputs x Kangra Brahmans show statistically significant differences only in a few of the biological variables at different age points, irrespective of differences in biological make up or physical environment or socio-economic condition or mode of existence (Transhumant versus Sedantary or Settled).

It has been observed that the differences between Transhumant Brahmans and Settled Brahmans and among Transhumant Rajputs with Settled Rajputs, in regard to biological variables are statiscally significant only in case of a few variables. They may be attributed to the fact that the Settled population groups of Kangra District originally belonged to Bharmour Tehsil and that they separated only a few generations in the not too distant past. From this fact, it may be reasonably assumed that these groups had not changed biologically to an extent where they would show significant differences. However, whatever differences have been observed may be attributed more to socio-economic conditions, physical environment and mode of existence and less to the biological make up.

Cofficient of Correlation Between Different Biological Variables Along with age

The Person product-moment-correlation-coefficient has been applied to all biological vairables and ages for all the four population groups studied to assess linear relationship between two concerned variables. It has been observed that values of "r" are positive throughout, 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, does not experience even a single value of "r", whereas category "B" exhibiting moderate degree of positive relationship, includes many values of "r" of head circumference when correlated with other variables and age among all the four population groups studied, Category "C" showing a higher degree of positive relationship includes all biological variable and age except head circumference.

All the anthropometric variables and age exhibit significant positive values of "r" with FVC, FEV_1 and MVV for all the four population groups studied. It has been observed that FVC and FEV_1 are best correlated with body weight among Bharmour Rajputs, Bharmour Brahmans and Kangra Rajputs, and least correlated with head circumference, whereas FVC, FEV_1 and MVV show better association with age and weak correlation with head circumferecne in case of Kangra Brahmans.

Table 1: The means, standard deviations and absolute growth values of 24 biological variables among different groups of Transhumant and Settled Gaddis of Himachal Pradesh.

Age groups	*Transhumant Gaddi*								*Settled Gaddi*							
	Brahmans				*Raputs*				*Brahmans*				*Rajputs*			
	No.	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*
A. ANTHROPOMETRIC VARIABLES																
(a) 1. Body Weight (kg)																
8+	20	18.6	3.26	1.9	22	20.4	2.81	0.8	20	19.5	3.53	1.9	23	19.2	2.20	3.1
9+	15	20.5	2.40	2.8	24	21.2	2.95	1.3	16	21.4	2.19	1.8	22	22.3	2.17	1.2
10+	20	23.3	2.57	1.6	20	22.5	3.01	2.4	17	23.2	6.71	2.3	27	23.5	2.90	3.2
11 +	20	24.9	4.51	1.6	23	24.9	3.50	2.5	17	25.5	3.69	0.7	22	26.7	5.52	1.5
12+	22	26.5	3.12	4.0	22	27.4	4.71	3.9	21	26.2	3.71	3.2	27	28.2	4.20	0.7
13+	21	30.5	8.41	1.9	26	31.3	5.64	2.4	21	29.4	4.31	1.3	29	28.9	5.36	8.1
14+	21	32.4	4.69	6.4	22	33.7	5.23	2.9	16	30.7	5.94	3.1	32	37.0	5.46	0.1
15+	20	38.8	8.34	1.5	21	36.6	7.30	1.7	20	33.8	6.65	5.4	25	37.1	7.31	2.7
16+	15	40.3	5.64	7.3	22	38.3	5.30	3.9	17	39.2	6.10	5.2	20	39.8	5.90	7.6
17+	17	47.9	6.27	2.7	20	42.2	5.94	7.6	16	44.4	6.94	4.5	21	47.4	7.07	4.8
18+	19	50.3	6.13	1.1	21	49.8	3.50	1.4	16	48.9	4.46	1.5	20	52.2	5.57	3.4
19+	15	51.4	4.52		21	51.2	5.41		15	50.4	6.54		21	55.6	3.87	
(b) Projective Height Measurements																
2. Stature (cm)																
8+	20	116.0	6.50	4.0	22	118.0	6.47	4.0	20	117.2	8.84	4.1	23	118.0	6.48	7.0
9+	15	120.0	5.99	7.0	24	122.0	6.78	3.0	16	121.3	6.19	5.1	22	125.0	5.65	4.0
10+	20	127.0	5.79	3.0	20	125.0	5.70	5.0	17	126.4	11.4	5.1	27	129.0	6.68	5.0
11 +	20	130.0	6.56	4.0	23	130.0	6.47	6.0	17	131.5	8.25	1.9	22	134.0	8.30	3.0
12+	20	134.0	5.81	5.0	22	136.0	7.47	7.0	21	133.4	7.52	6.9	27	137.0	7.85	1.0
13+	21	139.0	8.52	6.0	26	143.0	7.27	2.0	21	140.3	8.17	2.3	29	138.0	8.64	13.2
14+	21	145.0	10.08	6.0	22	145.0	6.65	6.0	16	142.6	12.90	2.6	32	151.2	7.33	0.1
15+	20	151.0	10.30	5.0	21	151.0	7.73	1.0	20	145.2	8.91	7.9	25	151.3	10.1	3.1
16+	15	156.0	5.15	5.0	22	152.0	6.97	3.0	17	153.1	8.06	5.4	20	156.0	9.94	5.0
17+	17	161.0	5.84	0.4	20	155.0	6.32	8.0	16	158.5	7.29	3.5	21	161.0	7.68	2.0
18+	19	161.4	5.29	1.8	21	163.0	2.85	0.0	16	162.0	3.97	0.8	20	163.0	5.19	5.0
19+	15	163.2	5.40		21	163.0	5.92		15	162.8	4.41		21	168.0	5.80	
3. Height Acromion (cm)																
8+	20	91.3	5.96	2.3	22	92.7	5.04	4.2	20	92.3	8.17	2.5	23	92.6	5.62	6.1
9+	15	93.6	4.98	7.6	24	96.9	6.31	3.1	16	94.8	5.61	5.8	22	98.7	5.21	4.3
10+	20	101.2	5.19	4.1	20	100.0	4.99	4.0	17	100.6	9.88	4.5	27	103.0	5.29	5.0
11+	20	105.0	8.24	1.8	23	104.0	7.45	5.6	17	105.1	7.52	0.7	22	108.0	7.18	3.0
12+	22	107.1	5.96	5.3	22	109.0	7.42	7.0	21	105.8	7.20	7.6	27	111.0	7.37	0.6
13+	21	112.4	8.38	4.9	26	116.0	6.60	0.5	21	113.4	7.15	0.9	29	111.6	7.42	10.4
14+	21	117.3	8.35	5.2	22	116.5	7.35	4.5	16	114.3	9.90	4.0	32	122.0	8.48	2.0
15+	20	122.5	8.84	3.8	21	121.0	7.02	2.0	20	118.3	8.16	5.8	25	123.0	6.11	1.0
16+	15	126.3	4.18	3.8	22	123.0	5.53	3.0	17	124.1	6.55	4.5	20	125.0	6.30	5.0
17+	17	130.1	9.12	2.2	20	126.0	5.04	7.0	16	128.6	6.04	2.6	21	130.0	6.79	2.0
18+	19	132.3	6.73	2.9	21	133.0	3.00	0.4	16	131.2	3.92	1.1	20	132.0	6.11	4.0
19+	15	135.2	4.48		21	133.4	5.40		15	132.3	4.01		21	136.0	5.71	

Table 1: Contd....

Age groups	*Transhumant Gaddi*								*Settled Gaddi*							
	Brahmans				*Raputs*				*Brahmans*				*Rajputs*			
	No.	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*
4. Total Lower Extremity Length (cm)																
8+	20	65.6	3.89	2.6	22	67.3	4.37	2.8	20	63.2	7.66	3.2	23	61.9	4.59	4.6
9+	15	68.2	4.20	5.2	24	70.1	5.50	2.4	16	66.4	4.85	3.6	22	66.5	3.85	3.0
10+	20	73.4	4.57	1.6	20	72.5	3.82	3.5	17	70.0	6.54	3.6	27	69.5	3.57	3.3
11+	20	75.0	4.81	2.6	23	76.0	4.92	3.5	17	73.6	6.12	0.3	22	72.8	4.69	1.9
12+	22	77.6	4.38	5.3	22	79.5	5.46	5.0	21	73.9	5.12	6.0	27	74.7	5.50	4.8
13+	21	82.9	5.68	2.4	26	84.5	5.15	0.4	21	79.9	5.88	1.9	29	79.5	19.30	3.4
14+	21	85.3	6.32	3.7	22	84.9	4.98	3.1	16	81.8	5.79	1.2	32	82.9	4.89	0.8
15+	20	89.0	6.69	0.9	21	88.0	6.02	0.1	20	83.0	5.79	4.6	25	83.7	4.03	3.8
16+	15	89.9	4.01	1.2	22	88.1	3.92	0.5	17	87.6	3.55	1.4	20	87.5	4.43	0.9
17+	17	91.1	4.50	0.6	20	88.6	3.97	2.1	16	89.0	3.57	0.3	21	88.4	5.00	0.2
18+	19	91.7	3.07	0.6	21	90.7	4.54	0.2	16	89.3	4.06	0.2	20	88.6	3.15	2.2
19+	15	92.3	3.10		21	90.9	2.70		15	89.5	4.66		21	90.8	4.40	
5. Sitting Height (cm)																
8+	20	62.9	4.11	2.7	22	64.8	2.89	1.5	20	64.4	3.68	1.8	23	64.9	2.81	3.0
9+	15	65.6	2.59	2.3	24	66.3	3.12	1.2	16	66.2	2.55	1.5	22	67.9	2.94	1.0
10+	20	67.9	2.54	1.7	20	67.5	3.28	1.5	17	67.7	5.48	2.4	27	68.9	2.72	2.4
11+	20	69.6	3.42	1.1	23	69.0	3.06	2.1	17	70.1	5.48	2.4	27	68.9	4.29	1.2
12+	22	70.7	2.67	1.1	22	71.1	3.92	3.0	21	70.3	3.01	2.4	27	71.3	3.17	0.3
13+	21	71.8	4.20	3.0	26	74.1	3.45	1.2	21	72.7	3.71	0.3	29	72.8	3.93	6.0
14+	21	74.8	4.19	3.7	22	75.3	3.78	2.3	16	73.0	4.92	3.0	21	78.8	8.43	0.2
15+	20	78.5	5.93	1.7	21	77.6	4.28	1.5	20	76.0	4.68	2.9	25	79.0	4.14	0.0
16+	15	80.2	5.08	3.8	22	79.1	4.38	2.3	17	78.9	5.93	3.4	20	79.0	5.33	6.0
17+	17	84.0	3.71	0.3	20	81.4	4.17	3.0	16	82.3	5.11	2.2	21	85.0	4.54	1.0
18+	19	84.3	3.64	2.0	21	84.4	2.10	1.3	16	84.5	2.07	1.1	20	86.0	3.16	2.9
19+	15	86.3	1.83		21	85.7	2.86		15	85.6	2.25		21	88.9	2.74	
(c) Breadth and Depth of Trunk																
6. Biacromial Breadth (cm)																
8+	20	24.3	1.51	0.9	22	25.0	1.65	1.0	20	25.0	1.97	0.9	23	25.6	2.73	1.1
9+	15	25.2	1.21	1.7	24	26.0	2.08	0.6	16	25.9	1.38	0.9	22	26.7	1.49	0.9
10+	20	26.9	1.24	0.2	20	26.6	1.72	0.9	17	26.8	2.48	0.8	27	27.6	1.33	0.9
11 +	20	27.1	1.90	1.4	23	27.5	1.13	0.5	17	27.6	3.22	0.8	22	28.5	1.86	0.3
12+	22	28.5	1.23	0.4	22	28.0	1.38	1.7	21	28.4	2.04	1.3	27	28.8	1.82	0.8
13+	21	28.9	2.06	1.3	26	29.7	1.99	0.4	21	29.7	2.08	0.1	29	29.6	1.98	1.9
14+	21	30.2	1.93	2.4	22	30.1	1.84	1.1	16	29.8	2.49	0.0	32	31.5	3.09	0.3
15+	20	32.6	2.66	0.6	21	31.2	2.06	1.0	20	29.8	3.40	3.1	25	31.8	3.13	1.2
16+	15	33.2	1.79	1.1	22	32.2	1.74	1.1	17	32.9	2.35	1.4	20	33.0	2.11	2.2
17+	17	34.3	2.61	1.6	20	33.3	2.15	2.2	16	34.3	2.28	1.5	21	35.2	2.28	0.8
18+	19	35.9	1.51	0.4	21	35.5	1.74	0.7	16	35.8	1.24	0.7	20	36.0	1.16	1.4
19+	15	36.3	1.91		21	36.2	2.23		15	36.5	1.58		21	37.4	1.78	

Table 1: Contd....

Age groups	Transhumant Gaddi								Settled Gaddi							
	Brahmans				Raputs				Brahmans				Rajputs			
	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth
7. Bicristal Breadth (cm.)																
8+	20	17.2	1.25	1.0	22	17.9	1.36	0.6	20	18.7	0.96	0.2	23	19.0	0.96	0.8
9+	15	18.2	0.85	0.8	24	18.5	1.18	1.2	16	18.9	1.25	0.9	22	19.8	0.70	0.7
10+	20	19.0	1.13	0.8	20	19.7	2.61	0.1	17	19.8	2.35	0.7	27	20.5	2.38	0.6
11+	20	19.8	1.38	0.2	23	19.8	1.57	0.4	17	20.5	1.52	0.1	22	21.1	1.47	0.3
12+	22	20.0	1.24	1.2	22	20.2	1.57	0.9	21	20.6	1.39	0.9	27	21.4	1.39	0.3
13+	21	21.2	1.96	0.3	26	21.1	2.04	0.3	21	21.5	1.29	0.0	29	21.7	1.45	2.1
14+	21	21.5	1.58	2.0	22	21.4	1.97	1.1	16	21.5	1.93	1.3	32	23.8	1.49	0.1
15+	20	23.5	2.51	0.2	21	22.5	2.66	0.3	20	22.8	2.07	0.9	25	23.9	1.60	0.0
16+	15	23.7	1.69	2.4	22	22.8	1.57	0.5	17	23.7	2.15	0.8	20	23.9	2.00	1.7
17+	17	26.1	2.08	0.1	20	23.3	1.80	2.9	16	24.5	1.86	1.2	21	25.6	1.34	0.7
18+	19	26.2	1.61	1.0	21	26.2	2.62	0.2	16	25.7	1.48	0.8	20	26.3	1.61	0.3
19+	15	27.2	1.21		21	26.4	2.13		15	26.5	1.62		21	26.6	1.17	
8. Transverse Diameter of Chest (cm)																
8+	20	17.2	1.02	0.6	22	17.9	1.12	0.3	20	18.5	1.38	0.1	23	18.2	0.72	0.8
9+	15	17.8	0.83	0.8	24	18.2	1.20	0.3	16	18.6	0.81	0.2	22	19.0	0.86	0.5
10+	20	18.6	0.98	0.1	20	18.5	0.85	0.7	17	18.8	1.52	0.9	27	19.5	0.98	0.8
11+	20	18.7	1.13	0.6	23	19.2	1.21	0.2	17	19.7	0.99	0.3	22	20.3	1.35	0.2
12+	22	19.3	1.05	0.7	22	19.4	1.03	1.0	21	20.0	1.29	0.8	27	20.5	1.18	0.3
13+	21	20.0	1.28	0.5	26	20.4	1.53	0.8	21	20.8	1.20	0.0	29	20.8	1.24	1.1
14+	21	20.5	1.26	1.3	22	21.2	2.09	0.1	16	20.8	1.27	0.5	32	21.9	1.76	0.4
15+	20	21.8	1.88	0.5	21	21.3	1.94	0.4	20	21.3	1.34	0.9	25	22.3	1.33	0.2
16+	15	22.3	1.56	1.3	22	21.7	1.02	1.2	17	22.2	2.07	1.5	20	22.5	1.51	2.3
17+	17	23.6	2.24	1.2	20	22.9	1.91	1.6	16	23.7	2.03	1.6	21	24.5	1.59	0.7
18+	19	24.8	1.81	0.5	21	24.5	1.38	0.8	16	25.3	1.50	0.3	20	25.5	1.28	1.2
19+	15	25.3	1.42		21	25.3	1.68		15	25.6	1.85		21	26.7	1.32	
9. Antero-posterior Depth of Chest (cm)																
8+	20	13.2	1.16	0.4	22	13.6	0.90	0.2	20	13.7	0.64	0.3	23	13.6	0.90	0.1
9+	15	13.6	0.67	0.4	24	13.8	1.17	0.1	16	14.0	0.66	0.1	22	13.7	1.04	0.2
10+	20	14.0	0.80	0.2	20	13.9	0.89	0.7	17	14.1	1.45	0.5	27	13.9	1.01	1.1
11+	20	14.2	1.20	0.4	23	14.6	1.20	0.1	17	14.6	0.93	0.3	22	15.0	1.27	0.2
12+	22	14.6	0.85	0.4	22	14.7	1.28	0.5	21	14.9	1.41	0.4	27	15.2	1.02	0.1
13+	21	15.0	1.54	0.3	26	15.2	1.37	0.2	21	15.3	0.96	0.1	29	15.3	1.05	1.4
14+	21	15.3	1.07	1.1	22	15.4	1.11	0.6	16	15.4	1.41	0.3	32	16.7	1.20	0.2
15+	20	16.4	1.52	0.5	21	16.0	1.44	0.4	20	15.7	1.44	1.7	25	16.9	0.90	0.1
16+	15	16.9	1.32	1.1	22	16.4	1.07	0.2	17	17.4	2.22	0.1	20	17.0	1.24	1.6
17+	17	18.0	1.34	0.7	20	16.6	1.28	2.2	16	17.5	1.60	1.5	21	18.6	1.77	1.4
18+	19	18.7	1.53	1.3	21	18.8	0.96	0.1	16	19.0	1.41	0.2	20	20.0	1.30	1.1
19+	15	20.0	2.64		21	18.9	1.46		15	19.2	1.36		21	21.1	1.76	

Table 1: Contd....

Age groups	*Transhumant Gaddi*								*Settled Gaddi*							
	Brahmans				*Raputs*				*Brahmans*				*Rajputs*			
	No.	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*
10. Height Sternum (cm)																
8+	20	10.9	0.64	0.8	22	11.1	1.07	0.6	20	10.5	0.83	0.8	23	10.6	0.51	0.5
9+	15	11.7	0.61	0.2	24	11.7	0.90	0.1	16	11.3	0.61	0.1	22	11.1	0.73	1.0
10+	20	11.9	0.73	0.8	20	11.8	1.08	0.1	17	11.4	1.31	0.6	27	12.1	1.67	0.1
11+	20	12.7	1.08	0.1	23	11.9	0.93	0.5	17	12.0	0.85	0.3	22	12.2	1.02	0.1
12+	22	12.8	0.92	0.3	22	12.4	1.07	0.8	21	12.3	0.67	0.5	27	12.3	0.98	0.0
13+	21	13.1	1.75	0.4	26	13.2	0.85	0.1	21	12.8	1.17	0.3	29	12.3	0.92	1.5
14+	21	13.5	0.86	0.5	22	13.3	1.13	0.8	16	13.1	0.94	0.6	32	13.8	1.11	0.0
15+	20	14.0	1.57	1.1	21	14.1	0.96	0.1	20	13.7	0.81	1.5	25	13.8	1.53	0.8
16+	15	15.1	1.36	0.6	20	14.2	1.16	0.4	16	15.2	1.46	0.4	21	14.6	1.75	0.8
17+	17	15.7	1.65	0.3	20	14.6	1.08	1.9	16	15.6	1.87	0.4	21	15.4	1.46	0.5
18+	19	16.0	1.72	0.4	21	16.5	1.27	0.1	16	16.0	1.06	0.4	20	15.9	1.62	0.3
19+	15	16.4	1.59		21	16.6	0.90		15	16.4	1.65		21	16.2	1.53	
(d) Girths																
11. Head Circumference (cm)																
8+	20	50.8	1.62	0.4	22	51.2	2.00	0.4	20	51.4	1.30	0.6	23	51.8	1.56	0.5
9+	15	51.2	2.56	0.2	24	51.6	2.16	0.3	16	52.0	1.12	0.2	22	52.3	1.21	0.4
10+	20	51.4	1.34	0.4	20	51.9	1.28	0.4	17	52.2	1.82	0.1	27	52.7	1.89	0.2
11+	20	51.8	1.01	0.1	23	52.3	1.38	0.3	17	52.3	1.69	0.3	22	52.9	1.42	0.0
12+	22	51.9	1.83	0.1	22	52.6	1.71	0.0	21	52.6	1.07	0.2	27	52.9	1.28	0.5
13+	21	52.0	1.19	0.5	26	52.6	1.48	0.1	21	52.8	1.13	0.0	29	53.4	1.37	0.5
14+	21	52.5	1.44	0.2	22	52.7	1.37	0.1	16	52.8	1.41	0.1	32	53.9	1.17	0.2
15+	20	52.7	2.39	0.5	21	52.8	1.96	0.5	20	52.9	1.70	0.0	25	54.1	1.33	-0.6
16+	15	53.2	1.52	0.8	22	53.3	1.19	0.1	17	52.9	1.52	0.4	20	53.5	1.59	0.6
17+	17	54.0	1.38	0.1	20	53.4	1.07	0.5	16	53.3	1.25	0.8	21	54.1	1.54	-0.4
18+	19	54.1	1.69	1.4	21	53.9	1.49	0.5	16	54.1	1.34	0.4	20	53.7	1.64	0.7
19+	15	55.5	1.43		21	54.4	2.58		15	54.5	2.21		21	54.4	2.14	
12. Chest Circumference at Normal Respiration (cm)																
8+	20	56.0	3.49	1.6	22	57.0	2.87	0.8	20	58.3	3.70	1.2	23	57,5	2.50	2.7
9+	15	57.6	2.35	1.9	24	57.8	3.33	0.7	16	59.5	2.02	1.4	22	60.2	2.25	0.9
10+	20	59.5	2.37	0.4	20	58.5	2.85	1.8	17	60.9	4.62	2.3	27	61.1	2.96	3.1
11 +	20	59.9	3.69	2.0	23	60.3	2.85	1.0	17	63.2	3.64	0.2	22	64.2	4.50	0.8
12+	22	61.9	2.42	1.5	22	61.3	3.75	4.0	21	63.4	3.63	3.1	27	65.0	3.78	0.8
13+	21	63.4	4.06	2.8	26	65.3	4.05	0.4	21	66.5	3.00	0.1	29	65.8	3.81	5.1
14+	21	66.2	3.04	4.1	22	65.7	4.11	3.4	16	66.6	4.46	1.8	32	70.9	5.06	1.1
15+	20	70.3	5.74	2.0	21	69.1	6.32	0.6	20	68.4	4.61	3.9	25	72.0	4.20	0.9
16+	15	72.3	4.75	3.4	22	69.7	3.15	4.2	17	72.3	6.31	3.9	20	72.9	4.49	6.1
17+	17	76.7	5.21	2.7	20	73.9	6.02	4.4	16	76.2	5.46	4.6	21	79.0	5.21	4.1
18+	19	79.4	4.86	2.2	21	78.3	2.95	2.4	16	80.8	5.71	0.7	20	83.1	4.89	3.2
19+	15	81.6	3.52		21	80.7	3.11		15	81.5	4.47		21	86.3	3.84	

Table 1: Contd....

Age groups	Transhumant Gaddi								Settled Gaddi							
	Brahmans				Raputs				Brahmans				Rajputs			
	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth
13. Chest Circumference at Minimum Inspiration (cm)																
8+	20	60.7	3.31	1.3	22	62.6	2.72	1.3	20	61.9	3.94	1.3	23	61.2	2.79	2.8
9+	15	62.0	2.63	3.2	24	63.9	2.93	0.6	16	63.2	2.34	1.8	22	64.0	2.05	1.0
10+	20	65.2	3.05	0.9	20	64.5	2.74	2.0	17	65.0	4.89	2.0	27	65.0	3.01	2.8
11+	20	66.1	4.32	2.0	23	66.5	3.33	0.6	17	67.0	3.77	0.8	22	67.8	4.56	0.9
12+	22	68.1	2.53	0.8	22	67.1	3.95	3.6	21	67.8	4.81	2.5	27	68.7	3.76	0.8
13+	21	68.9	4.15	3.1	26	70.7	4.57	0.3	21	70.3	3.00	0.1	29	69.5	4.50	5.1
14+	21	72.0	3.09	3.4	22	71.0	4.20	3.8	16	70.4	5.00	1.8	32	74.6	5.04	1.6
15+	20	75.4	7.01	2.7	21	74.8	6.28	0.1	20	72.2	4.69	5.3	25	76.2	4.12	0.4
16+	15	78.1	4.63	3.8	22	74.9	3.03	4.2	17	77.5	5.80	3.9	20	76.6	4.82	6.2
17+	IT	81.9	4.20	2.4	20	79.1	5.82	3.9	16	81.4	5.45	3.1	21	82.2	4.66	3.4
18+	19	84.3	5.39	1.9	21	83.0	3.20	1.7	16	84.5	4.70	1.4	20	86.2	4.72	3.3
19+	15	86.2	3.15		21	84.7	3.54		15	85.9	4.64		21	89.5	3.46	
14. Chest Circumference at Maximum Expiration (cm)																
8+	20	54.8	3.56	1.7	22	55.3	2.97	1.2	20	57.2	3.19	1.2	23	56.5	2.27	2.3
9+	15	56.5	2.37	1.6	24	56.5	3.00	0.6	16	58.4	2.21	0.3	22	58.8	2.21	0.8
10+	20	58.1	2.54	0.3	20	57.1	2.63	1.9	17	58.7	4.60	2.3	27	59.6	2.78	2.7
11+	20	58.4	3.75	1.8	23	59.0	2.53	0.7	17	61.0	3.25	0.7	22	62.3	4.10	1.1
12+	22	60.2	2.12	1.5	22	59.7	3.45	3.5	21	61.7	3.24	2.7	27	63.4	3.35	0.7
13+	21	61.7	3.83	2.1	26	63.2	3.67	0.3	21	64.4	3.47	0.3	29	64.1	3.77	4.9
14+	21	63.8	3.01	3.4	22	63.5	4.17	2.9	16	64.7	3.97	1.9	32	69.0	4.91	0.6
15+	20	67.2	6.48	2.4	21	66.4	5.01	1.0	20	66.6	4.41	3.5	25	69.6	4.14	1.1
16+	15	69.6	4.25	4.2	22	67.4	3.25	4.0	17	70.1	5.64	3.8	20	70.7	4.56	6.4
17+	17	73.8	5.17	3.4	20	71.4	5.47	4.3	16	73.9	5.22	4.4	21	77.1	5.39	4.5
18+	19	77.2	4.47	2.0	21	75.7	3.11	3.1	16	78.3	4.95	0.4	20	81.6	4.42	2.7
19+	15	79.2	4.35		21	78.8	3.19		15	78.7	5.57		21	84.3	3.16	
15. Upper Arm Girth (cm)																
8+	20	14.2	1.22	0.6	22	14.6	0.84	0.6	20	15.8	1.22	0.1	23	15.7	0.63	0.5
9+	15	14.8	0.94	0.9	24	15.2	1.20	0.1	16	15.9	1.33	0.1	22	16.2	1.32	0.5
10+	20	15.7	0.82	0.0	20	15.3	1.13	0.6	17	16.0	1.73	0.8	27	16.7	0.95	0.7
11 +	20	15.7	1.40	0.3	23	15.9	1.19	0.2	17	16.8	1.07	0.4	22	17.4	1.80	0.6
12+	22	16.0	1.07	0.5	22	16.1	1.04	1.2	21	17.2	1.31	0.4	27	18.0	1.41	0.0
13+	21	16.5	1.48	1.0	26	17.3	1.51	0.6	21	17.6	2.05	0.2	29	18.0	1.29	2.3
14+	21	17.5	1.20	1.9	22	17.9	1.51	0.8	16	17.8	1.40	1.4	32	20.3	1.37	0.1
15+	20	19.4	2.02	0.1	21	18.7	2.17	0.6	20	19.2	2.31	0.5	25	20.4	1.93	0.1
16+	15	19.5	1.42	2.3	22	19.3	1.76	1.1	17	19.7	2.23	2.0	20	20.5	1.90	2.4
17+	17	21.8	2.26	1.1	20	20.4	2.14	1.9	16	21.7	2.48	1.8	21	22.9	2.05	1.8
18+	19	22.9	1.78	1.2	21	22.3	1.30	1.2	16	23.5	1.64	0.6	20	24.7	1.69	0.6
19+	15	24.1	2.17		21	23.5	1.24		15	24.1	1.66		21	25.3	0.97	

Table 1: Contd....

Age groups	*Transhumant Gaddi*								*Settled Gaddi*							
	Brahmans				*Raputs*				*Brahmans*				*Rajputs*			
	No.	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*	*No.*	*Mean*	*S.D.*	*Absolute growth*
16. Calf Girth (cm)																
8+	20	20.5	1.62	1.0	22	21.1	1.52	0.8	20	21.6	1.61	0.6	23	22.1	1.58	0.6
9+	15	21.5	1.41	1.0	24	21.9	1.57	0.5	16	22.2	1.94	0.3	22	22.7	1.12	0.5
10+	20	22.5	1.11	0.7	20	22.4	1.58	0.3	17	22.5	1.25	1.0	27	23.2	1.31	1.0
11 +	20	23.2	2.17	0.5	23	22.7	1.88	1.3	17	23.5	1.30	0.0	22	24.2	1.94	0.8
12+	22	23.7	1.48	1.1	22	24.0	1.96	1.3	21	23.5	2.46	1.2	27	25.0	2.05	0.3
13+	21	24.8	1.96	0.4	26	25.3	2.24	0.8	21	24.7	1.70	0.2	29	25.3	1.50	1.9
14+	21	25.2	1.58	2.5	22	26.1	1.97	0.6	16	24.9	2.07	1.7	32	27.2	1.78	0.2
15+	20	27.7	2.62	0.2	21	26.7	2.72	0.4	20	26.6	2.26	1.2	25	27.4	2.48	0.7
16+	15	27.9	1.88	1.5	22	27.1	1.86	1.1	17	27.8	2.25	1.2	20	28.1	1.43	2.8
17+	17	29.4	2.63	1.1	20	28.2	1.97	2.0	16	29.0	2.14	2.4	21	30.9	2.48	1.3
18+	19	30.5	2.44	1.3	21	30.2	1.48	0.6	16	31.4	1.82	0.2	20	32.2	1.52	0.7
19+	15	31.8	1.51		21	30.8	1.07		15	31.6	2.34		21	32.9	1.19	
(e) Skinfold Measurements																
17. Skinfold at Biceps																
8+	20	1.97	0.66		22	2.48	0.89		20	2.97	1.16		23	2.85	0.94	
9+	15	1.77	0.51		24	2.13	0.67		16	2.31	0.97		22	2.73	1.63	
10+	20	2.00	0.78		20	2.10	0.70		17	2.21	0.82		27	2.57	1.09	
11+	20	1.92	0.55		23	1.93	0.43		17	2.15	0.72		22	2.48	0.76	
12+	22	1.95	0.50		22	1.98	0.44		21	2.45	0.53		27	2.43	0.70	
13+	21	2.40	1.10		26	2.06	0.56		21	2.40	1.00		29	2.53	0.71	
14+	21	1.98	0.45		22	2.23	0.67		16	2.16	0.66		32	2.48	0.52	
15+	20	1.97	0.33		21	2.33	0.54		20	2.52	0.68		25	2.78	0.81	
16+	15	2.20	0.47		22	2.16	0.61		17	2.32	0.57		20	2.25	0.49	
17+	17	2.59	1.05		20	2.52	0.68		16	3.16	0.81		21	3.10	0.83	
18+	19	3.11	1.51		21	2.52	1.03		16	3.22	1.16		20	3.32	1.11	
19+	15	2.40	0.49		21	3.00	1.65		15	2.90	1.04		21	3.19	1.03	
18. Skinfold at Triceps																
8+	20	4.07	1.89		22	4.77	2.26		20	5.52	1.54		23	5.63	1.16	
9+	15	3.80	1.14		24	4.40	1.58		16	4.69	1.98		22	5.66	2.30	
10+	20	4.02	1.54		20	3.85	1.35		17	4.09	1.90		27	5.26	1.58	
11+	20	3.95	1.42		23	4.78	1.40		17	4.32	1.59		22	5.34	1.57	
12+	22	3.93	1.05		22	4.11	1.30		21	5.97	1.62		27	5.67	2.05	
13+	21	4.86	2.33		26	4.81	1.63		21	4.71	1.30		29	5.88	1.72	
14+	21	4.21	1.86		22	4.91	1.56		16	3.88	1.29		32	5.28	1.54	
15+	20	4.27	1.51		21	6.07	2.31		20	5.55	2.50		25	6.42	1.55	
16+	15	4.27	1.12		22	4.75	1.57		17	4.21	1.33		20	4.80	2.11	
17+	17	5.03	1.59		20	4.35	1.72		16	6.00	2.21		21	6.64	2.18	
18+	19	5.45	1.79		21	4.67	1.49		16	6.88	2.67		20	7.15	2.46	
19+	15	5.63	2.26		21	5.31	1.77		15	5.70	1.80		21	6.12	1.98	

Table 1: Contd....

Age groups	Transhumant Gaddi								Settled Gaddi							
	Brahmans				Raputs				Brahmans				Rajputs			
	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth
B. PHYSIOLOGICAL MEASUREMENTS																
19. Pulse Rate																
8+	20	72.2	8.69		22	76.5	6.99		20	75.2	9.09		23	79.5	7.67	
9+	15	71.6	9.72		24	76.3	7.82		16	74.5	11.00		22	75.8	13.00	
10+	20	72.2	8.02		20	79.6	9.20		17	74.0	9.15		27	76.4	9.43	
11 +	20	75.7	11.4		23	77.1	9.83		17	74.7	10.80		22	73.8	9.16	
12+	22	77.1	10.3		22	78.6	10.10		21	76.8	9.45		27	76.2	9.57	
13+	21	73.2	7.62		26	76.3	9.41		21	73.1	10.30		29	78.1	7.82	
14+	21	73.2	8.59		22	80.9	8.08		16	74.5	9.86		32	75.6	8.58	
15+	20	71.5	8.94		21	80.0	10.30		20	74.5	9.34		25	76.2	7.86	
16+	15	73.2	9.85		22	78.8	12.30		17	77.4	9.72		20	79.7	7.21	
17+	17	71.6	5.99		20	75.7	9.30		16	74.6	5.46		21	75.1	9.91	
18+	19	75.7	11.1		21	78.9	7.52		16	77.0	8.00		20	78.6	10.90	
19+	15	75.1	12.0		21	75.2	7.47		15	76.1	7.10		21	77.0	10.60	
20. Systolic Blood Pressure																
8+	20	105	5.41		22	102	11.50		20	107	5.95		23	103	8.19	
9+	15	109	7.17		24	110	10.80		16	112	8.38		22	108	7.02	
10+	20	107	4.45		20	107	14.40		17	112	9.34		27	107	7.81	
11+	20	111	7.80		23	101	17.40		17	114	8.87		22	110	8.51	
12+	22	112	6.71		22	104	15.20		21	114	7.81		27	109	7.37	
13+	21	111	8.96		26	111	18.90		21	113	9.01		29	113	8.23	
14+	21	113	6.97		22	100	6.54		16	119	12.40		32	115	9.96	
15+	20	115	7.93		21	100	8.55		20	115	7.73		25	116	7.94	
16+	15	113	9.90		22	109	10.90		17	116	9.24		20	118	7.62	
17+	17	115	7.13		20	113	11.40		16	122	5.95		21	119	7.42	
18+	19	113	8.64		21	114	8.66		16	122	5.31		20	115	8.45	
19+	15	118	7.25		21	115	8.85		15	122	5.36		21	119	5.96	
21. Dystolic Blood Pressure																
8+	20	75.6	5.99		22	66.0	15.00		20	77.4	5.44		23	75.8	6.75	
9+	15	79.7	3.26		24	76.3	13.30		16	79.4	4.40		22	77.5	6.47	
10+	20	77.4	6.18		20	72.0	14.20		17	77.3	5.27		27	78.1	6.10	
11+	20	77.0	5.42		23	66.1	16.60		17	79.2	7.13		22	77.8	4.30	
12+	22	78.5	4.43		22	71.9	12.30		21	81.4	5.48		27	78.3	6.53	
13+	21	79.0	5.11		26	74.8	14.50		21	79.0	5.78		29	80.3	5.58	
14+	21	80.8	5.03		22	67.5	11.50		16	79.5	5.45		32	77.2	4.35	
15+	20	79.2	4.66		21	69.2	11.40		20	80.4	6.12		25	81.3	4.49	
16+	15	79.3	5.09		22	77.3	9.20		17	80.7	4.70		20	79.7	4.83	
17+	17	80.1	4.52		20	82.7	6.21		16	80.8	5.91		21	80.3	5.43	
18+	19	79.4	4.40		21	80.1	6.94		16	83.1	5.66		20	79.6	5.35	
19+	15	78.7	6.01		21	81.2	6.49		15	79.2	5.92		21	82.5	3.38	

Table 1: Contd....

Age groups	Transhumant Gaddi								Settled Gaddi							
	Brahmans				Raputs				Brahmans				Rajputs			
	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth	No.	Mean	S.D.	Absolute growth
22. Forced Vital Capacity (ml)																
8+	20	1420	2140	100	22	1430	245	150	20	1381	244	142	23	1380	211	210
9+	15	1540	156	230	24	1580	240	120	16	1523	187	171	22	1590	256	120
10+	20	1770	257	164	20	1700	379	90	17	1694	173	151	27	1710	254	60
11+	20	1934	392	217	23	1790	335	80	17	1845	327	217	27	1770	369	160
12+	22	2151	340	221	22	1870	398	380	21	2062	313	289	27	1930	316	130
13+	21	2372	385	322	26	2250	392	520	21	2351	383	303	29	2060	455	620
14+	21	2694	479	448	22	2770	547	60	16	2654	553	229	32	2680	368	130
15+	20	3142	633	222	21	2830	621	320	20	2883	409	342	25	2810	609	290
16+	15	3364	426	348	22	3150	539	520	17	3225	443	459	20	3100	488	630
17+	17	3712	395	364	20	3670	830	310	16	3684	449	512	21	3730	515	160
18+	19	4076	609	428	21	3980	462	200	16	4196	270	140	20	3890	431	250
19+	15	4504	469		21	4160	578		15	4336	462		21	4140	426	
23. Forced Expiratory Volume One Second (ml)																
8+	20	1403	206	99	22	1420	246	130	20	1315	237	169	23	1350	208	170
9+	15	1502	145	221	24	1550	229	80	16	1484	176	98	22	1520	230	110
10+	20	1723	261	152	20	1630	310	40	17	1582	239	170	27	1630	225	70
11+	20	1875	391	167	23	1670	284	100	17	1752	306	230	22	1700	334	140
12+	22	2042	306	194	22	1770	385	330	21	1982	315	252	27	1840	297	100
13+	21	2236	403	371	26	2100	371	480	21	2234	389	318	29	1940	420	580
14+	21	2607	490	408	22	2580	520	80	16	2552	507	192	32	2520	371	120
15+	20	3015	629	248	21	2660	523	260	20	2744	413	402	25	2640	598	340
16+	15	3263	485	229	22	2920	469	430	17	3146	445	417	20	2980	569	440
17+	17	3492	374	269	20	3350	815	250	16	3563	456	272	21	3420	441	230
18+	19	3761	625	293	21	3600	544	70	16	3835	280	148	20	3650	410	110
19+	15	4054	348		21	3670	628		15	3983	707		21	3760	338	
24. Maximum Voluntary Ventihtion (Litre/Min.)																
8+	20	51.8	6.34	14.6	22	61.7	16.20	10.0	20	50.2	10.20	8.2	23	57.1	9.69	7.0
9+	15	66.4	9.04	1.3	24	71.8	14.30	1.8	16	58.4	7.45	4.3	22	64.1	4.78	5.2
10+	20	67.7	9.69	4.7	20	73.6	15.10	10.1	17	62.7	8.09	14.7	27	69.3	9.34	7.5
11+	20	72.4	11.10	4.1	23	83.7	19.90	2.6	17	77.4	15.70	2.5	22	76.8	12.80	3.8
12+	22	76.5	10.00	12.1	22	86.3	22.20	13.7	21	79.9	9.26	7.7	27	80.6	8.36	4.6
13+	21	88.6	11.00	11.3	26	100.0	15.10	5.0	21	87.6	15.10	12.4	29	85.2	12.10	8.3
14+	21	99.9	11.90	14.1	22	105.0	11.00	16.0	16	100.0	18.90	5.0	32	93.5	17.90	10.5
15+	20	114.0	14.20	9.0	21	121.0	15.90	5.0	20	105.0	17.70	19.0	25	104.0	17.20	13.0
16+	15	123.0	5.77	4.0	22	126.0	16.90	7.0	17	124.0	13.90	4.0	20	117.0	8.25	11.0
17+	17	127.0	8.07	7.0	20	133.0	16.40	6.0	16	128.0	10.10	5.0	21	128.0	20.70	2.0
18+	19	134.0	11.50	3.0	21	139.0	16.80	3.0	16	133.0	7.07	3.0	20	130.0	17.20	4.0
19+	15	137.0	6.41		21	142.0	16.50		15	136.0	7.04		21	134.0	13.20	

Table 2: t-test values showing intra and inter group differences among different groups of Transhumant and Settled Gaddis of Himachal Pradesh.

Age group		*Body Weight*	*Stature*	*Height Acromium*	*Total Lower Exremity Length*	*Sitting Height*	*Bicromial Breadth*	*Bicristal Breadth*	*Tarnsverse Diameter of Chest*	*Antero-posterior Depth of Chest*	*Height Strenum*	*Head Circum-ference*	*Chest Circum-ference at Normal*
8+	BRxBB	1.933	1.002	0.820	1.334	1.734	1.455	1.799	2.199*	1.272	0.767	0.723	1.009
8+	BRxKR	1.617	0.000	0.063	4.061**	0.118	0.897	3.196	1.092	0.000	2.069*	1.136	0.623
8+	BRxKB	0.920	0.333	0.189	2.106*	0.391	0.000	2.169*	1.587	0.423	2.110*	0.396	1.272
8+	BBxKR	0.706	1.009	0.733	2.872*	1.853	1.973	5.357**	3.755**	1.298	1.743	2.076*	1.600
8+	BBxKB	0.847	0.490	0.443	1.250	1.224	1.291	4.152**	3.499**	1.745	1.754	1.315	2.032*
8+	KRxKB	0.333	0.335	0.138	0.664	0.497	0.840	0.960	0.894	0.438	0.485	0.940	0.823
9+	BRxBB	0.818	0.967	1.823	1.221	0.761	1.497	0.942	1.254	0.699	0.000	0.574	0.222
9+	BRxKR	1.455	1.640	1.066	2.593*	1.810	1.341	4.734**	2.666*	0.328	2.560*	1.383	2.932*
9+	BRxKB	0.247	0.338	1.107	2.244*	0.112	0.185	1.127	1.280	0.713	1.707	0.774	2.033*
9+	BBxKR	2.356*	2.561*	3.021**	1.253	2.519*	3.312*	6.009**	4.338**	0.381	2.828*	1.848	3.411**
9+	BBxKB	1.104	0.596	0.632	1.109	0.652	1.477	2.009*	2.758*	1.713	1.885	1.325	2.432*
9+	KRxKB	1.268	1.895	2.190*	0.068	1.923	1.738	2.913*	1.486	1.171	0.942	0.815	1.020
10+	BRxBB	0.909	1.104	0.747	0.677	0.434	0.666	1.108	0.353,	0.392	0.346	1.218	1.214
10+	BRxKR	1.153	2.192*	1.999	2.756**	1.562	2.281*	1.089	3.721**	0.000	0.750	1.754	3.084**
10+	BRxKB	0.399	0.462	0.227	1.393	0.132	2.285	0.123	0.737	0.502	1.020	0.575	1.867
10+	BBxKR	0.252	1.087	1.170	3.181**	1.318	1.902	2.913*	3.178**	0.370	0.559	2.774**	2.075*
10+	BBxKB	8.058	0.197	0.225	1.807	0.139	0.152	1.285	0.479	0.257	1.433	1.502	1.129
10+	KRxKB	0.175	0.853	0.925	0.290	0.845	1.230	0.963	1.719	0.490	1.571	0.879	0.159
11+	BRxBB	0.000	0.000	0.540	0.676	0.607	0.835	0,000	1.414	1.130	2.613*	1.305	0.396
11+	BRxKR	1.305	1.808	1.836	2.240*	2.078*	2.208*	2.917*	2.930*	1.107	1.059	1.438	3.487**
11+	BRxKB	0.521	0.623	0.460	1.335	1.063	0.123	1.453	1.442	0.000	0.382	0.000	2.737**
11+	BBxKR	1.169	1.749	1.128	1.502	1.433	2.442*	3.013**	4.262**	2.134*	1.567	2.816*	3.426**
11+	BBxKB	0.448	0.605	0.077	0.766	0.447	0.564	1.493	2.885*	1.219	2.333*	1.140	2.743**
11+	KRxKB	0.816	0.938	1.219	0.447	0.979	1.032	1.263	1.627	1.490	0.723	1.280	0.772
12+	BRxBB	0.751	0.994	0.937	1.277	0.399	1.283	0.476	0.328	0.308	1.376	1.317	0.638
12+	BRxKR	0.624	0.456	0.944	3.067**	1.367	1.760	2.856*	3.616**	1.514	0.351	0.706	3.461**
12+	BRxKB	0.937	1.138	1.436	3.443**	0.758	0.759	6.896**	1.714	0.460	0.367	0.000	1.879
12+	BBxKR	1.639	1.540	2.055*	2.067*	2.193*	0.688	3.807**	3.856**	2.292*	1.910	2.143*	3.513**
12+	BBxKB	0.289	0.292	0.643	2.574*	0.466	0.195	1.511	1.965	0.779	2.012*	1.484	1.595
12+	KRxKB	1.764	1.614	2.464*	0.516	2.487*	0.711	2.015*	1.404	0.770	0.000	0.865	1.496
13+	BRxBB	0.374	1.715	1.613	1.005	2.035*	1.343	0.174	0.992	0.476	0.242	1.598	1.606
13+	BRxKR	1.621	2.337*	2.338*	1.344	1.321	0.188	1.280	1.080	0.310	3.855**	2.131*	0.473
13+	BRxKB	1.313	1.185	1.289	0.821*	1.331	0.000	0.833	1.027	0.299	1.347	0.542	1.173
13+	BBxKR	0.769	0.408	0.351	0.898	0.861	1.214	1.012	2.207*	0.789	1.921	3.959**	2.134*
13+	BBxKB	0.534	0.506	0.418	1.690	0.738	1.257	0.594	2.093*	0.767	0.659	2.308*	2.833**
13+	KRxKB	0.366	0.961	0.870	0.105	0.092	0.173	0.523	0.000	0.000	1.653	1.731	0.732

Table 2: Contd....

Age group		*Chest Circum-ference at Maximum Inspiration*	*Chest Circum-ference at Maximum Expiration*	*Upper Arm Circum-ference*	*Calf Circum-ference*	*Skinfold Biceps*	*Skinfold Triceps*	*Puls Rate*	*Systolic Blood Pressure*	*Dystolic Blood Pressure*	*Forced Vital Capacity*	*Forced Expiratory Volume one second*	*Maximum Voluntation Ventiala-tion*
8+	BRxBB	2.037*	0.494	1.253	1.245*	0.269	1.098	1.758	1.098	2.760*	0.142	0.243	2.656*
8+	BBxKR	1.706	1.526	5.140**	2.209*	0.332	1.462	1.372	0.361	2.795*	0.731	1.029	1.506
8+	BRxKB	0.664	2.001*	3.761**	1.038	0.257	1.263	0.516	1.794	3.320*	0.648	1.409	2.780*
8+	BBxKR	0.536	1.849	5.005**	3.321**	3.520**	2.887*	2.903*	1.131	0.103	0.620	0.839	2.151*
8+	BBxKB	1.049	2.229*	4.190**	2.160*	3.332**	2.652*	1.068	1.112	0.993	0.541	1.255	0.596
8+	KRxKB	0.664	0.822	6.333**	1.038	0.302	0.225	1.664	2.159*	0.858	0.014	0.512	2.265*
9+	BRxBB	2.036*	0.000	1.178	0.830	1.884	1.389	1.579	0.347	1.194	0.630	0.800	1.445
9+	BRxKR	0.128	2.786*	2.711*	2.030*	1.592	2.153*	0.156	0.749	0.405	0.136	0.428	2.492*
9+	BRxKB	0.803	2.313*	1.715	0.527	0.648	0.496	0.566	0.656	1.057	0.840	1.090	3.870**
9+	BBxKR	2.512*	2.986*	3.796**	2.805**	2.571*	3.267**	1.112	0.420	1.527	0.736	0.291	0.905
9+	BBxKB	1.354	2.313*	2.695*	1.182	1.978	1.563	0.779	1.072	0.217	0.275	0.380	2.683*
9+	KRxKB	1.108	0.552	0.693	0.955	0.990	1.400	0.333	1.550	1.183	0.930	0.606	2.693*
10+	BRxBB	0.800	1.240	1.298	0.235	0.428	0.369	2.712*	0.000	1.600	0.683	1.028	1.477
10+	BRxKR	0.631	3.181**	4.544**	1.860	1.780	3.323	1.167	0.000	1.805	0.102	0.000	1.290
10+	BRxKB	0.265	1.277	1.432	0.213	0.430	0.437	1.849	1.269	1.550	0.063	0.531	2.802**
10+	BBxKR	0.225	1.945	3.928**	2.109*	2.110*	2.690*	1.650	0.000	0.425	0.795	1.282	0.570*
10+	BBxKB	0.103	0.482	0.656	0.000	0.800	0.121	0.631	2.019*	0.058	1.068	1.740	1.714
10+	KRxKB	0.000	0.731	1.531	1.757	1.241	2.130	0.838	1.838	0.461	0.247	0.633	2.486*
11+	BRxBB	0.338	0.612	0.510	0.808	0.067	1.992	0.435	2.487*	2.943*	1.283	1.941	2.344*
11 +	BRxKR	1.092	3.255**	3.337**	2.650*	2.996*	1.275	1.191	2.219*	3.233*	1.190	0.324	1.391
11+	BRxKB	0.437	2.133*	2.597*	1.605	1.093	0.947	0.730	3.088**	3.355*	0.520	0.863	1.121
11+	BBxKR	1.245	3.243**	3.466**	1.584	2.800*	3.024	0.592	0.395	0.526	1.391	1.553	1.195
11+	BBxKB	0.680	2.282**	2.762	0.525	1.063	0.733	0.273	1.082	1.042	0.752	1.073	1.103
11+	KRxKB	0.601	1.112	1.319	1.361	1.370	1.997	0.275	1.417	0.715	0.671	0.506	0.128
12+	BRxBB	1.001	1.112	1.319	1.361	0.211	0.517	0.488	2.253*	2.371*	2.519*	2.593*	1.889
12+	BRxKR	1.446	3.811**	5.455**	1.810	2.704*	3.233**	0.848	1.410	2.201*	0.575	0.700	1.141
12+	BRxKB	0.523	1.977	3.089**	0.746	2.824*	4.525**	0.655	2.823*	3.375*	1.761	1.980	1.244
12+	BBxKR	0.666	4.120**	5.742**	2.693*	2.696*	3.812**	0.314	1.489	0.127	2.338*	2.331*	1.539
12+	BBxKB	0.256	1.814	3.369*	0.325	2.808*	5.367**	0.108	0.996	2.080*	0.893	0.663	1.158
12+	KRxKB	0.711	1.792	2.056*	2.320*	0.101	0.593	0.239	2.499*	1.905	1.442	1.590	0.271
13+	BRxBB	1.360	1.373	1.852	0.822	1.288	0.083	1.247	0.000	1.376	1.071	1.190	2.997**
13+	BRxKR	0.940	0.902	1.859	0.000	2.760*	2.364*	0.766	0.500	1.819	1.661	1.498	3.995**
13+	BRxKB	0.342	1.162	0.511	1.043	1.382	0.235	1.099	0.477	1.352	0.888	1.198	2.806**
13+	BBxKR	0.490	2.210*	3.750**	0.990	0.476	1.694	2.223*	0.807	0.851	2.618*	2.517*	1.035
13+	BBxKB	1.261	2.413*	1.827	0.178	0.000	0.258	0.036	0.722	0.000	0.177	0.016	0.245
13+	KRxKB	0.758	0.292	0.709	1.293	0.509	2.752*	1.868	0.000	0.796	2.447*	2.550*	0.603

Table 2: Contd....

Age group		*Body Weight*	*Stature*	*Height Acromium*	*Total Lower Exremity Length*	*Sitting Height*	*Bicromial Breadth*	*Bicristal Breadth*	*Tarnsverse Diameter of Chest*	*Antero-posterior Depth of Chest*	*Height Strenum*	*Head Circum-ference*	*Chest Circum-ference at Normal*
14+	BRxBB	0.862	0.000	0.333	0.230	0.412	0.174	0.185	1.356	0.307	0.666	0.421	0.457
14+	BRxKR	2.248*	3.244**	0.032	1.391	1.718	2.101*	4.858**	1.245	3.996**	1.633	2.913**	3.900**
14+	BRxKB	1.621	0.681	5.317**	1.856	1.576	0.409	0.156	0.743	0.000	0.604	0.199	0.538
14+	BBxKR	3.284**	2.312*	0.027	1.429	1.915	1.900	5.373**	3.167**	4.304**	1.146	3.794**	3.895**
14+	BBxKB	0.745	0.600	5.314**	1.860	1.182	0.534	0.000	0.729	0.238	1.369	0.641	0.309
14+	KRxKB	3.571*	2.472*	4.370**	0.681	2.587*	2.067*	4.213**	2.352*	3.104**	2.346*	2.728**	2.865**
15+	BRxBB	0.899	0.000	0.601	0.504	0.557	1.902	1.240	0.851	0.869	0.245	0.147	0.640
15+	BRxKR	0.231	0.114	1.067	2.791**	1.184	0.789	2.113*	2.088*	2.403*	0.819	2.631*	1.862
15+	BRxKB	1.289	2.227*	1.135	1.979	1.146	1.574	0.405	0.000	0.673	1.446	0.176	0.408
15+	BBxKR	0.718	0.098	0.222	3.125**	0.331	0.934	0.620	1.063	1.251	0.433	2.371*	1.149
15+	BBxKB	2.103*	1.911	1.566	2.286*	1.487	2.910**	0.965	0.995	1.499	0.762	0.306	1.156
15+	KRxKB	1.587	2.156*	2.220*	0.303	2.361*	2.039*	1.963	2.701*	3.135**	0.285	2.606*	2.838**
16+	BRxBB	1.088	2.017*	2.081*	0.599	0.684	1.693	1.660	1.328	1.234	2.120*	0.215	1.868
16+	BRxKR	0.867	1.499	1.096	0.467	0.070	1.337	2.000*	2.045*	1.972	0.873	0.465	2.658*
16+	BRxKB	0.483	0.449	0.559	0.401	0.117	1.030	1.461	0.922	1.742	0.356*	0.895	1.556
16+	BBxKR	0.255	0.000	0.737	0.994	0.712	0.304	0.325	0.385	0.250	0.954	0.572	0.380
16+	BBxKB	0.530	1.231	1.152	0.945	0.670	0.409	0.000	0.156	0.794	0.202	0.558	0.000
16+	KRxKB	0.303	0.981	0.426	0.075	0.056	0.135	0.293	0.500	0.701	1.145	1.178	0.328
17+	BRxBB	2.692*	3.009**	1.654	1.881	2.009*	1.262	4.372**	1.023	3.292**	2.274*	1.471	1.522
17+	BRxKR	2.563*	2.745**	2.155*	0.138	2.650*	2.770**	4.655**	3.516**	4.237**	2.040*	1.740	2.909*
17+	BRxKB	1.011	1.520	1.388	0.326	0.571	1.355	1.968	1.225	1.843	1.863	0.264	1.204
17+	BBxKR	0.092	0.000	0.037	1.723	0.747	1.127	0.865	1.880	1.217	0.574	0.214	1.359
17+	BBxKB	1.384	1.085	0.561	1.542	1.092	0.000	2.355*	0.135	0.996	0.156	1.569	0.269
17+	KRxKB	1.295	1.012	0.654	0.406	1.676	1.209	2.022*	1.819	1.993	0.350	1.773	1.583
18+	BRxBB	0.313	1.176	0.418	0.779	0.105	0.744	0.000	0.590	0.243	1.018	0.402	0.835
18+	BRxKR	1.650	0.000	0.762	1.708	1.922	1.119	0.148	2.436*	3.351**	1.357	0.415	3.930**
18+	BRxKB	0.669	0.956	1.580	0.980	0.147	0.629	0.741	1.679	0.490	1.333	0.435	1.605
18+	BBxKR	1.015	0.958	0.156	2.937**	1.555	0.215	0.193	1.409	2.860**	1.185	0.764	2.386*
18+	BBxKB	0.783	0.383	0.602	1.871	0.205	0.203	0.963	0.905	0.606	0.000	0.000	0.766
18+	KRxKB	1.982	0.659	0.532	0.569	1.731	0.512	1.178	0.431	2.200*	0.229	0.819	1.306
19+	BRxBB	0.212	0.105	1.097	1.476	0.771	0.550	1.442	0.000	1.471	0.491	1.652	0.802
19+	BRxKR	3.054**	2.772**	1.525	0.086	3.738**	1.960	0.382	3.069**	4.486**	1.027	0.000	5.250**
19+	BRxKB	0.293	0.116	0.705	1.110	0.117	0.480	0.162	0.506	0.641	0.442	0.125	0.601
19+	BBxKR	2.932**	2.558*	0.473	1.239	3.446**	1.916	1.506	3.009**	1.412	0.403	1.383	3.838**
19+	BBxKB	0.391	0.223	1.878	2.077*	0.937	0.340	1.361	0.506	1.046	0.000	1.483	0.068
19+	KRxKB	2.662	3.072**	2.295*	0.885	3.988**	1.631	0.208	2.010*	3.677**	0.375	0.136	3.384**

Table 2: Contd....

Age group		*Chest Circum-ference at Maximum Inspiration*	*Chest Circum-ference at Maximum Expiration*	*Upper Arm Circum-ference*	*Calf Circum-ference*	*Skinfold Biceps*	*Skinfold Triceps*	*Puls Rate*	*Systolic Blood Pressure*	*Dystolic Blood Pressure*	*Forced Vital Capacity*	*Forced Expiratory Volume one second*	*Maximum Voluntation Ventiala-tion*
14+	BRxBB	0.944	0.274	0.970	1.689	1.453	1.330	3.301*	6.360**	4.952**	0.485	0.173	1.458
14+	BRxKR	2.783**	4.175**	6.000**	2.140*	1.218	0.868	2.309*	6.733**	3.777**	0.674	0.457	2.920*
14+	BRxKB	0.401	0.905	0.228	1.833	0.329	2.241*	2.216*	5.607**	4.282**	0.641	0.164	0.949
14+	BBxKR	2.160*	4.421**	7.193**	4.346**	2.774	2.180*	0.996	0.860	2.681*	0.113	0.693	1.566
14+	BBxKB	1.128	0.759	0.755	0.489	0.954	0.635	0.420	1.733	0.743	0.230	0.331	0.018
14+	KRxKB	2.623	3.086**	6.507**	3.853**	1.459	3.344*	0.379	1.119	1.472	0.170	0.224	1.146
15+	BRxBB	0.289	0.489	1.075	1.208	2.591*	2.977*	2.824*	5.826**	3.693**	1.592	1.977	1.487
15+	BRxKR	0.909	2.439*	2.812**	0.912	2.250*	0.595	1.385	6.518**	4.554**	0.109	0.122	3.484**
15+	BRxKB	1.518	0.136	0.720	0.129	0.989	0.693	1.791	5.888**	3.929**	0.324	0.579	3.043**
15+	BBxKR	0.465	1.688	1.697	0.395	4.638**	4.673*	1.848	0.420	1.527	1.778	2.031*	2.138*
15+	BBxKB	1.706	0.383	0.294	1.436	3.323**	1.074	1.535	1.156	0.846	1.344	2.140*	0.772
15+	KRxKB	3.162**	2.455*	1.886	1.152	1.185	1.359	0.650	0.426	0.549	0.479	0.688	0.191
16+	BRxBB	2.368*	1.705	0.387	1.293	0.226	1.074	1.535	1.156	0.846	1.344	2.140*	0.772
16+	BRxKR	1.363	2.697*	2.143*	2.207*	0.529	0.086	0.293	3.120**	1.068	0.315	0.370	2.231*
16+	BRxKB	1.689	1.770	0.611	1.050	0.838	1.157	0.397	2.166*	1.500	0.476	1.536	0.406
16+	BBxKR	0.937	0.740	1.807	0.350	0.307	0.960	2.161*	1.627	0.233	1.703	1.585	2.540*
16+	BBxKB	0.326	0.286	0.308	0.138	0.651	0.139	1.211	0.881	0.803	0.904	0.708	0.221
16+	KRxKB	0.510	0.354	1.169	0.481	0.393	1.038	0.805	0.711	0.631	0.816	0.955	1.823
17+	BRxBB	1.700	1.374	1.955	1.573	0.240	1.249	1.617	0.647	1.467	0.201	0.697	1.449
17+	BRxKR	2.247*	3.372**	3.883**	3.911**	2.475*	3.741*	0.200	1.981	1.720	0.276	0.339	0.860
17+	BRxKB	1.222	1.402	1.686	1.172	2.560*	2.468*	0.442	3.038**	0.936	0.064	0.990	1.127
17+	BBxKR	0.630	1.927	1.579	1.807	1.656	2.603*	1.345	1.688	0.181	0.121	0.544	0.203
17+	BBxKB	2.295	0.055	0.122	0.485	1.780	1.439	1.504	3.066**	0.380	0.189	0.487	0.313
17+	KRxKB	0.826	1.829	1.595	2.511*	0.233	0.877	0.195	1.363	0.337	0.289	0.958	0.000
18+	BRxBB	0.921	1.229	1.228	0.465	1.427	1.482	1.058	0.365	0.385	0.557	0.864	1.107
18+	BRxKR	2.546*	4.969*	5.172**	4.350**	2.402*	3.867**	0.102	0.374	0.259	0.647	0.333	1.694
18+	BRxKB	1.104	1.810	2.457*	2.173*	1.923	2.959**	0.735	3.462**	1.452	1.778	1.704	1.474
18+	BBxKR	1.174	3.110**	3.303**	2.615*	0.488	2.478*	0.825	0.731	0.128	1.076	0.652	0.859
18+	BBxKB	0.117	0.675	1.060	1.252	0.242	1.821	0.402	3.773**	2.133*	0.773	0.463	0.316
18+	KRxKB	1.081	2.057*	2.202*	1.433	0.261	0.312	0.508	3.029*	1.890	2.601*	1.604	0.710
19+	BRxBB	1.342	0.304	0.965	2.251*	1.568	0.458	0.029	1.112	1.189	1.967	2.344*	1.262
19+	BRxKR	4.465**	5.636**	5.262**	6.049**	0.450	1.395	0.635	1.719	0.812	0.127	0.578	1.737
19+	BRxKB	0.846	0.064	0.201	1.245	0.222	0.647	0.367	2.950**	0.958	1.013	1.371	1.489
19+	BBxKR	2.989**	3.876**	2.006*	2.389*	3.092*	0.679	0.492	0.439	2.212*	2.385*	2.529*	0.906
19+	BBxKB	0.208	0.280	0.000	0.281	1.669	0.095	0.278	1.721	0.230	0.988	1.132	0.589
19+	KRxKB	2.559*	3.608**	2.555*	1.988	0.833	0.667	0.305	1.582	1.942	1.295	1.132	0.589

BR=Bharmour Rajputs; BB=Bharmour Brahamans; KR=Kangra Rajputs; KB=Kangra Brahmans
*Significant at 5% level; **Significant at 1% level

Regression Equations

Simple Linear Regression of Respiratory Functions on Anthropometric Variables and Age

Simple linear regression equations have been formulated to predict FVC, FEV_1 and MVV for all the four population groups separately (Table 3). This shows the best simple linear regression equations showing maximum regression coefficient and least standard error of estimate for Rajputs and Brahmans population groups of Tehsil Bharmour, District Chamba and District Kangra.

Multilinear Regresions of Respiratory Function and Anthropometric Variables and Age (Taken as Forced variable)

New multilinear regression equations have been formulated for the prediction of FVC, FEV_1 and MVV on the basis of age taken as forced variable and one of the 16 anthropometric variables as independent variable for all the four population groups studies (Table 4). This shows the best multilinear regression

Table 3: Simple linear regression of respiratory functions on anthropometric variables and age among Transhumant Gaddis (Brahmans and Rajputs) of Bharmour Tehsil, Chamba District, and Settled Gaddis (Brahmans and Rajputs) of Kangra District, Himachal Pradesh

	Value of "r"	*S.E. of estimate (ml)*
Bharmour Brahmans:		
PVC = .23.058 + 81.042 body weight	+0.946	335.84
FEV_1 = -97.878 + 73.252 body weight	+0.939	326.124
MVV = -18.148 + 8.160 age	+0.939	11.276 (1/min)
Bharmour Rajputs:		
PVC = .24.301 + 85.224 body weight	+0.914	420.914
FEV_1 = -34.482 + 73.333 body weight	+0.894	411.271
MVV = -3.472 + 7.187 age	+0.811	18.470 (1/min)
Kangra Brahmans:		
PVC = -1171.697 + 273.352 age	+0.919	401.452
FEV_1 = -1019.232 + 252.566 age	+0.902	415.024
MVV = -19.669 + 8.224 age	+0.908	13.019 (1/min)
Kangra Rajputs:		
PVC = -90.542 + 76.111 body weight	+0.947	313.053
FEV_1 = -20.237 + 68.431 body weight	+0.936	311.084
MVV = -8.161 + 7.336 age	+0.863	14.269 (1/min)

Table 4: Multilinear regression of respiratory function on anthropometric variables and age (taken as forced variable) among Transhumant Gaddis (Brahmans and Rajputs) of Bharmour Tehsil, Chamba District, and Settled Gaddis (Brahmans and Rajputs) of Kangra District, Himachal Pradesh

	Value of "r"	*S.E. of estimate (ml)*
Bharmour Brahmans:		
PVC = -554.637 + 92.373 age + 58.497 body weight	+0.957	302.241
FEV_1 = -323.748 + 73.226 age + 55.370 body weight	+0.947	305.005
MVV = -9.474 + 5.620 age + 0.798 body weight	+0.938	10.312 (1/min)
Bharmour Rajputs:		
PVC = -442.545 + 41.056 age + 73.868 body weight	+0.919	411.561
FEV_1 = 189.266 + 31.849 age + 64.523 body weight	+0.897	405.829
MVV = -62.448 + 3.773 age + 0.156 chest inspired	+0.881	18.627 (1/min)
Kangra Brahmans:		
PVC = -923.637 +169.027 age + 37.027 body weight	+0.942	341.072
FEV_1 = -806.280 +163.027 age + 31.785 body weight	+0.922	374.421
MVV = -46.752 + 6.695 age + 0.061 total lower extremity length	+0.916	12.478 (1/min)
Kangra Rajputs:		
PVC = -419.425 + 59.101 age + 61.800 body weight	+0.952	299.680
FEV_1 = -286.855 + 55.186 age + 55.069 body weight	+0.941	299.468
MVV = 93.320 + 4.394 age + 0.911 body weight	+0.883	13.314 (1/min)

equations with age and forced variable for Rajputs and Brahmans population groups of Tehsil Bharmour, District Chamba and District Kangra.

Stepwise Multilineaar Regresion of Anthropometric Variables with Age (Taken as Forced Variable)

It is difficult to assess which of the body measures is contributory to what extent, with age taken as forced variable in the different respiratory functions. So, stepwise multilinear regression equations have been formulated in which variables add stepwise in the order of their correlation coefficient value in the regression equation (Table 5). Further adding of variable stops as soon as there is no further increase in value of multiple coefficient of correlation.

Differences in Pattern of Growth and Respiratory Functions - Comparison with a High Altitude and Sea Level Population

Transhumant and Settled Gaddis from Bharmour Tehsil, Chamba District and Kangra District have been compared with high altitude Pangwalas of Pangi Tehsil (Bhasin et al., 2008b) Bodhs of Ladakh (Bhasin et al., 2008a), Bodhs of Lahaul Tehsil (Singh et al., 2008), Bhutias of North Sikkim (Bhasin et al., 2008c) and sea-level Indian rural boys (ICMR, 1972) to assess differences in biological variables as body weight, stature and respiratory functions. All these populations compared and studied are rural in their origin.

It has been observed that the Bodhs of Lahaul Tehsil and the Bodhs of Ladakh exhibit faster rate of growth. This is in conformity with the findings

Table 5: Stepwise multilinear regression on anthropometric variables with taken as forced variable among Transhumant Gaddis (Brahmans and Rajputs) of Bharmour Tehsil, Chamba District and Settled Gaddis (Brahmans and Rajputs) of Kangra District, Himachal Pradesh

	Value of "r"	*S.E. of estimate (ml)*
Bharmour Brahmans:		
With a set of six independent anthropometric variables and age:		
PVC = -3343.608 + 57.959 age + 21.429 Wt + 2.567 CHI + 2.360 STH + 3.853 CG - 1.071 TLEL + 2.602 BACB	+0.967	269.551
FEV_1 = -3455.655 + 28.903 age + 14.374 Wt + 1.050 CHI + 2.029 STH + 3.455 GC - 2.710 BACB + 1.718 CHN	+0.958	275.197
With a set of three independent anthropometric variables and age:		
MVV = -99.038 + 4.929 age + 0.064 CHI + 0.032 St + 0.063 HC	+0.941	10.071 (1/min)
Bharmour Rajputs:		
With a set of four independent anthropometric variables and age:		
PVC = -3650.700 + 35.355 age + 31.378 weight + 2.891 CHI + 2.520 STH + 4.724 ADPC	+0.924	397.861
With a set of six independent anthropometric variables and age:		
FEV_1 = -2791.920 + 29.633 age + 30.728 weight + 1.579 CHI + 2.432 STH + 4.246 APDC - 3.861 HTS + 3.227 TDC	+0.904	395.649
With a set of five independent anthropometric variables and age:		
MVV = -135.116 + 3.382 Age + 0.088 CHI + 0.068 TLEL + 0.124 HC - 0.136 BCRB + 0.220 APDC	+0.824	18.066 (1/min)
Kangra Brahmans:		
With a set of two independent anthrometric variables and age:		
PVC = -210.339 + 170.251 age + 48.989 Wt + 5.080 BCRB	+0.942	337.877
With a set of six independent anthrompetric variables and age:		
FEV_1 = 651.569 + 156.435 age + 56.843 Wt + 8.207 BCRB - 4.411 CHE + 0.616 HAC + 3.520 CHN - 3.887 APDC	+0.929	360.147
With a set of three independent anthrompometric variables and age:		
MVV = -2.625 + 6.026 age + 0.033 TLEL + 0.952 Wt - 0.204 TDC	+0.919	12.184 (1/min)
Kangra Rajputs:		
With a set of two independent anthropometric variables and age:		
PVC = -1327.493 + 59.742 age + 52.471 Wt + 5.516 HTS	+0.952	283.493
FEV_1 = -632.357 + 49.470 age + 49.923 Wt + 4.528 HTS	+0.942	295.034
With a set of five independent anthropometric variables and age:		
MVV = 37.694 + 4.759 age + 1.579 Wt + 0.178 HTS - 0.043 HAC + 0.209 UAG + 0.017 TLEL + 0.072 BCRB	+0.890	13.029 (1/min)

of Melcolm (1970), Garutto (1973), but in contrast with the results of Frisancho (1969, 1970, 1973, 1975), McClung (1970), Frisancho and Baker (1970), and Boyce et al. (1974) who reported a slowed and prolonged growth among high altitude natives.

The present popultion groups exhibit faster growth in body weight than Indian rural boys. This difference may be attributed to altitude rather than to geographic or genetic factors, as also reported by Rothammier and Spielman (1972).

The Bodhs of Ladakh and the Bodhs of Lahaul are characterised by possession of larger chest size, which is a pronounced characteristic of high altitude population as emphasized by Pawson (1974) and Frisancho et al. (1975).

The present population group (Transhumant Gaddis) as well as the Bodhs of Ladakh and Bodhs of Lahaul exhibit higher values of FVC, FEV_1 and MVV. Cotes et al. (1973) concluded that this may be attributed to high level of habitual activity as these populationjn groups inhabit steep terrained mountaneous regions. The same has been suggested by Jones et al. (1977), Miller et al. (1977), Anderson et al. (1978).

Thus it may be evaluated from the present study on pattern of body growth and respiratory functions among Transhumant Gaddi (Rajputs and Brahmans) of Tehsil Bharmour, District Chamba inhabiting Mid-Himalayan zone and Settled Gaddi (Rajputs and Brahmans) of District Kangra inhabiting Outer-Hinalayan zone, that boardly speaking all the groups do not show statistically significant differences between each other in most of the biological variables studied, except Settled Kangra Rajputs, who have shown differences in certain anthropometric variables, when compared with Transhumant Bharmour Rajputs and Bharmour Brahmans. In the present study the populations are intermediately placed, when compared with high altitude Bodhs of Ladakh, Bodhs of Lahaul and sea level Indian rural boys.

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