

Age Changes and Altitudinal Differences in Blood Pressure in Bod Girls of North-West Himalayas

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ABSTRACT Based on 154 high altitude and 163 low altitude Bod girls, it has been observed that blood pressure is lower in highlander Bod girls than their coeval lowland girls in the age range of 11 to 18 yrs. In body weight girls below 14 yrs. don't differ significantly, but after 14 yrs, low altitude girls are significantly heavier. Low altitude girls are generally taller, but the differences are statistically non-significant

Previous investigations have delineated that blood pressure rises with increase in age, nutritional intake, body size and socio-economic status, but generally decreases with increase in the altitude of residence (Huizinga, 1972; Clegg et al., 1976; Weitz, 1982). It has been observed that highlanders exhibit a moderate degree of pulmonary hypertension, but have lower level of blood pressure than their coeval lowlanders (Rotta et al., 1956; Sime et al., 1963; Makela et al., 1978). Altitudinal differences are more consistent in systolic than in diastolic blood pressure. Of various body measurements, weight seems to be most highly correlated with blood pressure, once adjustments are made for age and sex (Pickering, 1968; Makela et al., 1978). Many of the earlier investigators have felt the need to study altitudinal differences in blood pressure by comparing ethnically similar high and low altitude populations to minimise genetical influence (Rotta, 1947; Hurtado et al., 1956; Buck et al., 1968; Harrison et al., 1969).

The present investigation aims to study:

- Age changes in blood pressure in high and low altitude Bod girls in the age range of 11 to 18 years; and
- Altitudinal differences in blood pressure in high and low altitude Bod girls in the age range of 11 to 18 years.

MATERIAL AND METHODS

Cross-sectional samples of 154 high altitude and 163 low altitude Bod girls were collected. The girls ranged in age from 11 to 18 years. Although a survey establishing genetical affinity between high and low altitude Bods has not been conducted so far, there are evidences suggesting their close bio-cultural affinity (Cunningham, 1970; Pandey and Malik, 1990).

The high altitude sample was collected from Leh and surrounding villages. Leh, the district headquarters of Ladakh, is situated at an altitude of 3514 m, having an annual temperature ranging between 30°C and -28°C. The area is classified as cold Tundra having features such as low atmospheric pressure, difficult terrain, low relative humidity, intense ultra-violet radiation and poor vegetation. These stresses have not only affected the biology of the natives, but have forced them to innovate appropriate cultural means for survival. Also due to lack of communication and limited resources, specially during winters, the district population density has been as low as two persons/km². These factors have also resulted in low socio-economic standard and poor nutritional level in high altitude Bods.

Low altitude sample was collected from Kullu valley ranging in altitude from 1000 to 2000 m above sea level. Genial climate, pleasant weather,

gentle breeze, good rainfall and comfortable temperature gradient are the salient features of this lush green valley. The valley, full of orchards, is a well known tourist resort.

Height and weight were taken following the techniques of Tanner et al. (1969). Blood pressure was taken using indirect auscultation method. Systolic pressure level was determined by the first preception of sound when the mercury column was made to run down at a rate of 2 mm/second and diastolic pressure (level of 4th phase) was recorded when the sound ceased to be tapping in quality and was fully muffled. Blood pressure was taken on right upper limb when the subject was sitting in a relaxed state for at least five minutes, and had not taken meal in last half an hour prior to recording.

Each subject was asked about her age which was confirmed from the school records. Following international method of age grouping, subjects were grouped in age groups such as 11+, 12+, 13+ and so on. A subject, for example, was grouped under 11+ year, if she had completed her 11th birthday but not the 12th. Analysis of variance test was carried out for examining the altitudinal differences.

RESULTS AND DISCUSSION

Low altitude girls are generally taller (except in 11 and 16 year age group) than the high altitude girls; but the differences in different age groups are non-significant at 5% probability level. While low altitude girls are heavier than the high altitude girls (except in 11 years age group); the differences are statistically significant at 5% probability level only in age group above 14 years. The result shows that high altitude girls have, for comparable heights, lighter body weight than low altitude girls. Since energy requirement depends on body mass, the lower body mass per unit of height in high altitude girls has a distinct advantage.

The partial pressure of oxygen in ambient air falls to about 98 mm of Hg at an altitude of 4000 m as compared to 160 mm of Hg. at sea level. Despite this, among native highlanders the oxygen delivered to tissues is sufficient to allow normal growth and unhindered functioning. This is possible because the reduction in tissue oxygen is not as great as the decrease in ambient partial pressures. Hyperventilation and the ability to dissociate oxygen from haemoglobin help in main-

Table 1: Altitudinal variation in stature, weight and blood pressure in Bod females in age range of 11+ to 18+ years

Age (yrs)	Number		Stature (cm)		Weight (kg)		Blood Pressure (mmHg)			
	HA	LA	HA	LA	HA	LA	Systolic		Diastolic	
							HA	LA	HA	LA
11+	22	20	141.9 (6.36)	131.8 (7.33)	32.2 (5.01)	27.6 (3.95)	108 (10.63)	104 (12.36)	68 (12.11)	65 (8.69)
12+	14	26	137.9 (2.41)	141.0 (6.58)	33.5 (5.02)	34.5 (6.27)	108 (9.28)	105 (15.84)	70 (8.63)	70 (9.89)
13+	13	21	143.0 (5.50)	144.0 (6.65)	35.5 (4.70)	42.9 (4.71)	111 (7.45)	114 (10.76)	71 (9.39)	72 (7.82)
14+	19	27	147.6 (3.77)	149.4 (7.35)	36.5 (3.87)	40.4 (6.70)	109 (14.29)	113 (12.05)	72 (16.46)	75 (8.02)
15+	19	27	149.8 (4.47)	150.6 (4.96)	39.3 (4.46)	44.2 (6.01)	110 (11.22)	120 (10.61)	67 (13.03)	75 (6.84)
16+	24	10	151.4 (5.41)	150.4 (6.09)	41.5 (4.26)	45.1 (6.68)	113 (8.66)	114 (9.40)	76 (10.18)	80 (4.69)
17+	23	15	150.8 (4.80)	154.2 (5.33)	41.3 (4.09)	48.9 (4.82)	109 (9.09)	119 (17.85)	75 (8.54)	82 (12.54)
18+	20	17	156.0 (5.49)	156.7 (7.23)	44.8 (2.85)	52.2 (8.16)	112 (7.99)	121 (14.53)	74 (15.21)	81 (8.73)

HA = High Altitude; LA = Low Altitude; Values are Mean with Standard Deviation in Paranthesis

taining the desired tissue oxygen level (Mazess, 1970).

Table 2: Altitudinal difference in stature, weight and blood pressure using analysis of variances test

Age (Yrs)	Analysis of Variances			
	Stature	Weight	Blood Pressure	
			Systolic	Diastolic
11+	21.8688*	10.7545*	1.1991	0.5925
12+	2.9874	0.2435	0.4428	0.0669
13+	0.2794	2.4060	0.6778	0.3096
14+	0.9335	5.9458*	0.6711	0.5472
15+	0.2626	8.3365	9.9509*	11.0287*
16+	0.2084	4.8680	0.0956	0.5913
17+	3.8281	29.7901*	5.0094*	4.5857*
18+	0.2390	15.3340	4.8367*	2.7292

* Significant at 5% probability level

Blood pressure rises with age in both high and low altitude Bod girls. Increase in systolic and diastolic blood pressure with age has also been reported by a number of researcher (Baker, 1969; Cruz-Coke et al., 1973). Systolic blood pressure is lower in high altitude girls than in the low altitude girls. Analysis of variance shows that the differences are significant only in the later age groups, i.e. 15, 17 and 18 years. Diastolic blood pressure is also lower in high altitude girls than in the low altitude girls, except in 11 years and 12 years age groups. The differences in diastolic blood pressures are significant only in 15 and 17 years age groups. The trend of having lower systolic and diastolic blood pressure is in agreement with earlier researches conducted at high altitude (Monge, 1934; Alvarez, 1951; Macedo, 1951; Penalzoza et al., 1963; Buck et al., 1968; Makela et al., 1978). Since body weight is known to be associated with blood pressure (Makela et al., 1978), it is likely that lower blood pressure in high altitude Bod girls is, at least, partially due to their relatively lighter body weight. It can be concluded that blood pressure rises with age in Bod girls in the age range of 11 to 18 yrs and it is lower in highlander Bod girls than their coeval lowlander girls.

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