ORIGINAL RESEARCH PAPER

Anthropology

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

CHANGES IN SKINFOLD THICKNESS THROUGHOUT CHILDHOOD: AN INTER-TRIBAL STUDY

KEYWORDS

SFT, Konda Reddi, Koya, Tribal offspring.

Appalanaidu Pappala

Senior Research Fellow (SRF), Department of Anthropology, Andhra University, Visakhapatnam - 530003

ABSTRACT *The present study examines inter-tribal offspring's variations with a special reference to age and gender differences as measured using skinfold thickness (SFT). The main aim of this work is to examine the correlations of body fat content among the Koya (vulnerable) and the Konda Reddi (most vulnerable) tribal groups of West Godavari district in Andhra Pradesh. For the study, tribal offspring between the ages of 6+ to 16+ years available at the time of visit attending the schools were used. The outcomes indicate that majority of offspring are in normal category of skinfold followed by a few individuals with thicker skinfold and a very few are under thin skinfold category. A slightly higher proportion of Koya girls (7.4%) have thinner skinfolds than Koya boys (1.7%). Among Konda Reddi also as high as 22.6% of girls possess higher fat compared to only 5.5 per cent of boys. No tribal household have reported shortage of food or starvation deaths in this region.*

INTRODUCTION

Variation among studies probably reflects the different skinfolds used and in the criteria of maturation and cut-offs for defining groups of contrasting maturity status (Malina et al. 2004). Age and gender difference in body size and shape is a common phenomenon in human populations. Skinfold thickness provides a good measure of subcutaneous fat at all ages, including school aged offspring; it therefore seemed worthwhile to see whether they could be used to provide some estimate of total body fat. Because there is a relationship between subcutaneous fat and total fat, the sum of several skinfold measures can be used to estimate total body fat (Appalanaidu, 2012). Skinfold measurement is used to predict the body composition. While these can be used for individuals who are very lean or obese, the results may be less accurate and specific; more accurate they have been established for these special populations.

Anthropometric appraisal has always been an essential feature of nutritional evaluation for determining malnutrition, overweight, obese, muscular mass loss, and adipose tissue redistribution (Sanchez-Garcia et al., 2007). Hence, the objective of our research is to understand the role of skinfold thickness as indicators, to infer the nutritional status of undernourished tribal males of India and to find the best prognosticator skinfold for assessing under nutrition. Per cent of body fat is strongly associated with the risk of chronic diseases such as hypertension, diabetes mellitus, and coronary heart disease (Merchant et al., 2005).

In these following studies, surrogate measures of body fatness such as body mass index (BMI), waist circumference, waist-hip ratio and skinfold thickness have been used extensively. However, these techniques do not precisely characterize persons by body composition (percentage of body fat or muscle mass), and there is substantial variation across age, gender and ethnic groups (Dagenais G. R., 2005). The regression co-efficient values indicate a positive influence of triceps and sub-scapular skinfold thickness on both systolic and diastolic blood pressure among Manzai Mali an agricultural tribe of Andhra Pradesh (Babu et al., 1996). Familial correlations for five measures of adiposity were assessed using data from 473 nuclear families residing in the Chittoor district of Andhra Pradesh, India. Fat patterning, measured as the ratio of trunk to extremity subcutaneous fat, and the ratio of the sub-scapular to the sum of the sub-scapular and supra iliac skinfolds, and three measures of generalized fatness: body mass index, the sum of six skinfolds and the sum of three trunk skinfolds were analyzed. Maximum likelihood estimates of the familial correlations were obtained for each phenotype, after adjusting for the effects of age within gender, and current levels of energy intake and expenditure, and age within Gender (Nirmala et al., 1993).

This global epidemic stalks India's tribal residents the most as they are socially and economically vulnerable. As per 2011 census, India has more than 104 million tribals who constitute 8.6 per cent of the total population (Census of India, 2011). India probably has the largest number of tribal communities in the world. The tribal populations of Andhra Pradesh offer an excellent opportunity for studies on growth and nutrition. The state of Andhra Pradesh is the habitation for 33 tribes with more than 5 per cent of a population.

In general, tribal populations of India are recognized as socially and economically vulnerable (Appalanaidu, 2015). Traditionally, some of them were forest dwellers but now they have started cultivation either as owner or as agricultural labourers and are also engaged in hunting and fishing (Ghosh and Bharati, 2006).

The present study falls under Coastal Andhra conducted mostly from 25 schools in the district of West Godavari. In Andhra Pradesh, from North to south scattered hill ranges running irregularly down the middle of the India dividing it into western and Coastal Andhra. West Godavari district, as its name indicates, is a part of the Godavari Delta in Andhra Pradesh. It lies between 16^{0} 15'-17^{0} 30' northern latitudes and 80^{0} 55' and 81^{0} 55' eastern longitudes. The Koya tribe mainly inhabit the hilly areas of West Godavari and East Godavari districts. The Konda Reddi inhabit on the either side of river Godavari in the hilly and forest tracts.

METHODOLOGY

The sample population is composed of Koya and Konda Reddi tribal children. A total number 829 (230 Koya boys, 273 Koya girls, 127 Konda Reddi boys and 199 Konda Reddi girls) were measured (Table-1). The ages of the subjects were recorded based on school admission registers. The information on age was cross-checked with the elders of the village and school teachers.

Table-1: Sample composition of the present study

Age (in year)	Sample Composition (N=829)			
	Koya (N=503)		Konda Reddi (N=326)	
	Male (N=230)	Female (N=273)	Male (N=127)	Female (N=199)
6+	34 (14.8)	29 (10.6)	17 (13.4)	17 (8.6)
7+	16 (7.0)	32 (11.7)	11 (8.7)	17 (8.6)

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

8+	27 (11.7)	18 (6.6)	22 (17.3)	25 (12.7)
9+	39 (17.0)	23 (8.4)	30 (23.6)	25 (12.7)
10+	19 (8.3)	17 (6.2)	15 (11.8)	22 (11.2)
11+	11 (4.8)	18 (6.6)	3 (2.4)	13 (6.6)
12+	17 (7.4)	22 (8.1)	11 (8.7)	22 (11.2)
13+	17 (7.4)	32 (11.7)	6 (4.7)	25 (12.)
14+	22 (9.6)	35 (12.8)	3 (2.4)	18 (9.1)
15+	18 (7.8)	35 (12.8)	6 (4.7)	14 (7.1)
16+	10 (4.3)	12 (4.4)	3 (2.4)	1 (0.5)

Skinfold Thickness (SFT) was measured with a range skinfold caliper (Herpendon) using the techniques described by Weiner and Lourie (1969) at five different sites namely, biceps, triceps, sub-scapular, supra-iliac and abdomen on the right side of the body. Skinfold caliper is then used to measure the skinfold thickness in millimeters. These measurements are recorded and averaged. This test estimates the percentage of body fat by measuring skinfold thickness at specific locations on the body. The thickness of these folds is a measure of the fat under the skin, also called subcutaneous adipose tissue. Skinfold thickness results rely on formulas that convert these numbers into an estimate of a person's percentage of body fat according to a person's age and gender.

In order to take a skin-fold measurement the proper site must be identified. The skin is then pinched between the thumb and forefinger half an inch from the measurement site. The skin is lifted from the muscle and calipers are applied. Four seconds should pass between reading the calipers in order to account for the compressibility of fat.

Statistical analyses of the data collected were carried out using M.S. Excel sheets and SPSS 18.0. Each skinfold thickness was measured three times. The Mean and Standard Deviation values for each skinfold characteristic were used in all analyses.

RESULTS

The results of biceps skinfold mean values at a glance indicate that girls always record higher fat at this region than boys. The information about mean biceps skinfold for age and gender presented in the Table-2 and 3. Skinfold fat at biceps region among Koya boys ranges from 3.0 mm to 4.2 mm only, while among Koya girls it ranges from 3.5 mm to 5.6 mm. Similarly, the Konda Reddi boys record a minimum mean biceps skinfold of 2.8 mm to a maximum of 3.6 mm.

However, Konda Reddi girls recorded a minimum of 4.3 mm to 5.9 mm of biceps fat. Furthermore Konda Reddi girls, report higher fat than their age matched Koya girls. It is evident that more Konda Reddi girls are heavier in their weight measurement than Koya girls. The adolescent spurt is recorded during 13th year among girls, while no specific trend is observed among boys.

The triceps skinfold for age and gender among vulnerable tribal offspring is reported in the Table- 2 and 3. The mean triceps fat fold ranges from 5.3 mm to 7.1 mm among Koya boys, while it is 6.2 mm to 12.4 mm among Koya girls. Always Koya girls recorded higher triceps skinfold than their age matched Koya boys. The maximum adolescent spurt is during 13th – 14th year among Koya girls and it is 14th year in Koya boys which is a delay by one year. The Koya boys show adolescent spurt during 14th year while Konda Reddi boys show adolescent spurt in 15th year.

Table- 2: Mean and Standard Deviation values among Koya tribal offspring.

Age (in years)	Site of Skin-fold Thickness				
	Biceps	Triceps	Sub-scapular	Supra-iliac	Abdomen
a) Boys					
6+	3.08±0.63	5.31±0.84	4.19±0.46	4.72±1.13	4.35±0.97
7+	3.64±1.43	6.26±1.66	4.86±1.38	5.54±1.83	5.46±1.78
8+	3.05±0.52	5.34±1.36	4.34±0.73	5.15±1.46	4.94±1.38
9+	3.38±1.28	5.86±2.18	4.49±1.46	5.87±2.26	5.45±2.68
10+	3.45±0.87	5.82±1.44	4.92±1.14	5.93±1.38	5.81±1.78
11+	3.05±0.69	5.33±1.41	4.49±0.84	5.73±1.72	5.40±2.39
12+	3.52±1.07	6.57±1.69	4.92±1.34	6.18±1.45	6.18±2.67
13+	3.53±0.83	6.00±1.66	5.01±0.72	6.18±1.37	5.38±1.19
14+	4.29±2.39	7.17±3.28	5.56±1.27	6.64±1.59	6.15±1.50
15+	3.98±0.98	6.86±2.20	6.66±2.01	7.26±2.16	7.96±3.89
16+	3.90±0.39	6.07±0.95	8.03±1.56	8.12±2.42	7.60±1.34
b) Girls					
6+	3.80±1.20	6.27±1.90	4.97±1.26	5.51±1.43	4.98±1.66
7+	3.67±1.01	6.57±1.61	4.86±0.89	5.75±1.80	5.42±1.79
8+	3.62±1.16	6.78±2.61	5.51±1.97	5.93±2.18	6.05±3.13
9+	3.54±1.02	6.97±1.85	5.54±1.47	6.64±1.99	5.79±2.51
10+	4.18±1.57	7.51±2.99	6.03±2.16	6.99±2.47	6.78±2.94
11+	4.34±0.88	8.29±1.73	6.63±1.90	8.56±2.66	7.80±2.65
12+	3.88±0.93	7.87±2.13	6.71±2.07	7.32±1.92	7.43±2.63
13+	4.68±1.40	10.1±3.36	8.26±2.38	10.07±4.15	9.87±3.90
14+	4.97±1.13	11.4±3.15	11.62±3.11	11.57±3.45	11.02±3.77
15+	5.69±1.54	12.4±3.84	12.79±2.84	12.38±3.78	11.88±5.00
16+	5.42±0.89	11.7±2.60	12.55±2.59	12.14±2.92	10.31±3.89

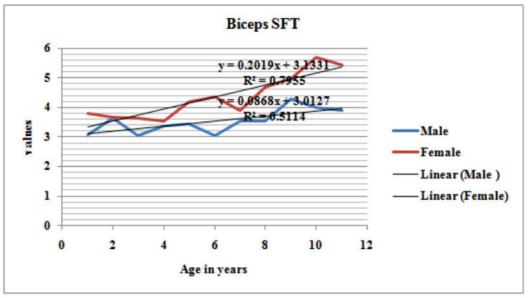

Figure-1: Changes in Bicep Skinfold

Table - 3: Mean and Standard Deviation values among Konda Reddi tribal offspring.

Age (in years)	Site of Skin-fold Thickness				
	Biceps	Triceps	Sub-scapular	Supra-iliac	Abdomen
a) Boys					
6+	3.47±0.71	6.18±1.40	4.12±1.31	5.59±1.23	5.13±1.65
7+	2.95±0.55	5.21±0.72	4.30±1.44	4.91±0.96	4.75±1.26
8+	3.34±1.54	5.24±1.26	4.13±0.46	4.81±1.25	4.80±1.66
9+	2.85±0.61	5.57±1.72	4.61±0.9	5.25±1.47	5.24±1.66
10+	3.08±0.83	5.72±1.79	5.00±1.04	6.00±1.66	5.36±1.67
11+	3.53±0.94	5.53±1.97	4.70±0.95	5.26±1.41	5.96±1.34
12+	3.22±0.56	6.02±1.71	4.85±0.91	6.58±2.11	6.25±2.06
13+	3.35±0.75	5.26±1.42	5.23±1.46	5.76±0.88	5.76±1.46
14+	3.60±0.69	5.26±1.36	5.93±0.64	6.03±0.25	5.23±0.75
15+	3.53±0.40	6.31±0.84	7.05±1.22	6.75±1.80	7.91±2.70
16+	3.60±0.40	6.60±0.52	7.23±2.60	7.26±1.28	7.90±2.98
b) Girls					
6+	3.57±1.15	6.07±1.76	4.48±0.80	5.36±1.66	5.13±1.33
7+	3.95±1.49	6.65±1.84	5.22±1.19	6.89±2.45	6.54±1.90
8+	4.00±1.21	7.00±1.51	5.65±1.25	7.48±2.01	6.58±2.36
9+	3.52±1.19	6.52±2.01	5.21±1.08	6.41±2.43	5.99±2.31
10+	3.48±0.49	6.97±1.66	5.74±1.16	6.47±1.85	6.59±2.22
11+	4.60±1.70	8.98±3.52	6.66±2.25	9.29±3.46	8.51±3.08
12+	4.62±1.87	8.31±2.41	6.57±1.56	7.50±2.83	6.54±2.14
13+	5.94±2.49	9.92±2.71	8.65±2.16	9.22±3.12	8.83±2.68
14+	5.33±1.63	9.70±2.90	9.50±2.19	12.03±4.63	10.92±4.18
15+	5.11±1.33	10.36±2.94	11.04±1.91	11.87±3.90	11.80±2.66
16+	4.00±00	9.20±00	17.40±00	13.60±00	16.40±00

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

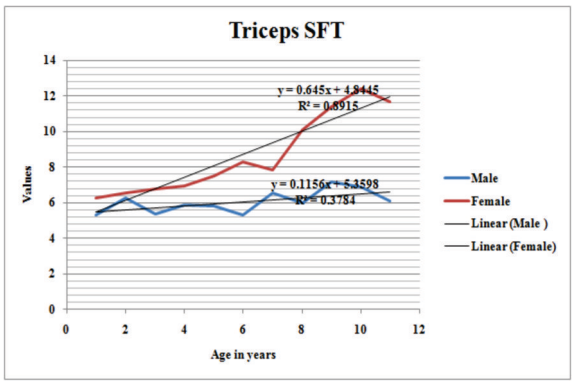

Figure-2: Changes in Tricep Skinfold

The mean sub-scapular skinfold value for age and gender are presented in the Table- 2 and 3. The fat fold ranges from 4 mm to 8 mm among Koya boys, 4.8 mm to 12.7 mm in Koya girls, 4.1 mm to 7.2 mm in Konda Reddi boys and, 4.4 mm to 11 mm in Konda Reddi girls. As observed for other two skinfold measurements such as biceps, and triceps regions the sub-scapular skinfold also, girls always exhibit higher mean skinfolds than boys and the maximum spurt recorded during 12th and 15th year, where the measurement almost doubles among Koya girls, whereas the spurt is during 16th year among Koya boys. Similar to Koya girls, Konda Reddi girls also recorded higher accumulation of fat at sub-scapular region during 13– 15 years, while among Konda Reddi boys the spurt is during 15th year.

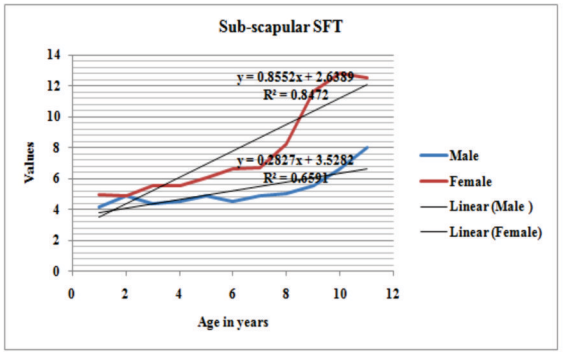

Figure-3: Changes in Sub-scapular Skinfold

The supra-iliac skinfold for age and gender among Koya and Konda Reddi children is presented in the Table – 2 and 3. Again girls record higher fat deposition than boys at supra-iliac region. The skinfold ranges from 4.5 mm to 7.9 mm among Koya boys, 4.9 mm to 11.8 mm among Koya girls, 4.7 mm to 7.9 mm in Konda Reddi boys and 5.1 mm to 11.8 mm in Konda Reddi girls. The maximum growth spurt for supra-iliac skinfold is during 13th and 14th year among Koya girls, while it is during 14th and 15th year among Konda Reddi girls.

Abdomen region is the prominent area of the body where maximum fat is deposited after attaining menopause among women and also in older men. However during younger ages specially growing period the children show relatively smaller abdomen skinfold. The mean abdomen skinfold for age and Gender among the present study tribes is listed in the Table- 1 and 2. The abdomen skinfold among Koya boys ranges from 4.7 mm to 8.1 mm while it ranges from 5.5 mm to 12.3 mm in Koya girls. Similarly, the mean abdomen skinfold ranges from 4.8 mm to 7.2 mm among Konda Reddi boys, while the abdomen fatfold ranges from (5.3 mm to 12 mm) in Konda Reddi girls.

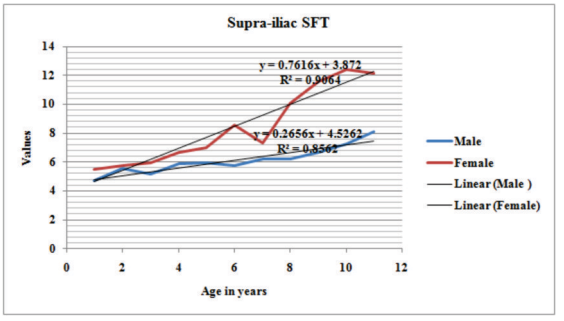

Figure-4: Changes in Supra-iliac Skinfold

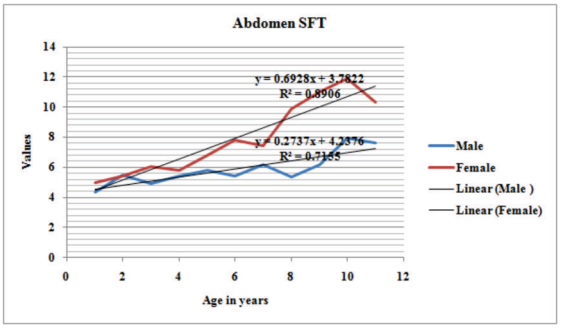

Figure-5: Changes in Abdomen Skinfold

Based on the five skinfold measurement a grand mean skinfold thickness for age and gender among Koya and Konda Reddi is calculated according to percentile distribution and presented in the Table- 4. According to usually followed classification the individuals fall in below 5th percentile are considered as thin, 6th - 95th percentile are considered as normal, while those above 95th percentile are considered as people with thick skinfold.

Table -4: Grand mean skinfold thickness percentile distribution of tribal offspring

GMI Grade	Koya (N=503)		Konda Reddi (N=326)	
	Male (N=230)	Female (N=273)	Male (N=230)	Female (N=273)
Thinness (≤ 5th percentile)	1.7	4.7	2.3	1.5
Normal (6 - 95th percentile)	95.3	70.3	92.2	75.9
Thickness (> 95th percentile)	3.0	25.0	5.5	22.6

The results indicate that majority of offspring in age group 6+ - 16+ are in normal category of skinfold followed by a few individuals with thicker skinfold and a very few are under thin skinfold category. Although Koya girls recorded higher mean values for several skinfolds, several of them up to 11th year fall in thinner skinfold category. However, in 8th, 9th, and 10th year more Koya girls show thicker skinfold than Koya boys. On the whole about 25 per cent of Koya girls' exhibit thicker grand mean skinfold compared to only 3 per cent of Koya boys. A slightly higher proportion of Koya girls (7.4%) have thinner skinfolds than Koya boys (1.7%).

Among Konda Reddi also as high as 22.6 per cent of girls possess higher fat compared to only 5.5 per cent of boys. Majority Koya (95.3%) and Konda Reddi boys (92.2%) following normal skinfold fat category. As well as observed for subscapular skinfolds of the maximum adolescent spurt among girls is during 13th to 15th year for abdomen skinfold among Koya as well as Konda Reddi girls. However, the increases in abdomen fat fold in not conspicuous. For abdomen skinfold also girls' recorded higher fat fold than boys.

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

CONCLUSION

The studies on skinfold thickness are useful to assess the extent of malnutrition and the present data can provide useful and reliable information needed by both planners and administrators in formulating programmes for improvement of the nutritional status and proper management of health among the children suffering from chronic malnutrition. The present study can be used as a reference material for Koya and Konda Reddi, two tribal populations of West Godavari district. Overall result indicates a relatively better nutritional status of both the tribes. Especially higher proportion of girls with normal skinfold fat category. This may be attributed to the environment with the water body in the form Godavari River, which provide fish in addition to fertile lands and the banks of Godavari River often flooded making the soil more nutrient resulting in better yields. No tribal household have reported shortage of food or starvation deaths in this region. Further, the present data may also help to suggest suitable programme for intervention and strategies to improve the nutritional status and proper management of health among the tribal populations in general.

REFERENCES

1. Appalanaidu, P. (2012). "Growth and Nutrition": A study among Konda Reddi and Koya Dora tribes of Andhra Pradesh". Lap Lambert Academic Publishing, Germany. ISBN-13: 978-3-8473-7661-3. Pages:136.
2. Appalanaidu, P. (2015). Tribes Vs. Castes. Raleigh: Lulu Press, North Carolina. ISBN 978-1-3292-7042-8. Pages:71.
3. Babu BV, Kusuma YS, Naidu JM (1996). Distribution of blood pressure and influence of subcutaneous fat on systolic and diastolic levels in a tribal population. J Indian Med Assoc. Aug; 94(8):289-91, 293.
4. Malina RM, Bouchard C, Bar-Or O. (2004). Growth, maturation, and physical activity, 2nd edn. Champaign, IL: Human Kinetics.
5. Census of India (2001). Part I of Provisional Population Totals. Govt. of India Publications New Delhi.
6. Census of India (2011). Population vital statistics. Govt. of India Publications. New Delhi.
7. Dagenais GR, Yi Q, Mann JF, Bosch J, Pogue J, Yusuf S (2005). Prognostic impact of body weight and abdominal obesity in women and men with cardiovascular disease. Am Heart J, 149:54-60.
8. Ghosh, R. and Bharati, P (2006). "Nutritional status of adults among Munda and Pod populations in a peri urban area of Kolkata City, India." Asia Pacific Journal of Public Health, 18 (2): 12-20.
9. Merchant A.T., Anand, S.S., Vuksan, V., Jacobs, R., Davis, B., Teo, K., Yusuf, S (2005). Protein intake is inversely associated with abdominal obesity in a multi-ethnic population. J Nutr, 135:1196-1201.
10. Mittal, P. C. and Srivastava, S (2006). "Diet, nutritional status and food related traditions of Oraon tribes of New Mal (West Bengal), India." Rural and Remote Health, 6 (1): 385.
11. Nirmala A, Mitchell LE, Rice T, Reddy PC, Rao DC (1993). Assessment of adiposity in an Indian population: familial correlations. Genet Epidemio, 10 (2):133-43.
12. Sanchez-Garcia S, Gacia-Pena C, Duque-Lopez MX, Juarez Cedillo T, Cortex-Nunez AR, Reyes-Beaman S (2007). Anthropometric measures and nutritional status in a healthy elderly population. BMC Public Health 7:2 doi: 10.
13. Tanner, J. M (1963). The regulation of Human Growth. Child Dev, 34: 817-847. Topal, Yeshpal S. and P.K.Samal (2001). "Causes for variation in social and economic conditions among tribes of Indian Central Himalaya. A comparative study." Man in India, 81 (I and II.): 87-88.
14. Weiner, J.S. and Lourie, J.A. (1969). Human Biology: A guide to field method, A 1 Anthropometry. IBP Handbook No.9, Blackwell, Oxford, 1-42.