J. Hum. Ecol., 8(3) : 179-183 (1997)
DOI: 10.31901/24566608.1997/08.03.06

Comparison of Somatotype of Two Oraon Occupational Groups of Jalpaiguri District, Northern West Bengal

Subrata K. Roy and Baidyanath Pal

Anthropology and Human Genetics Unit, Indian Statistical Institute, Calcutta 700 035, West Bengal, India

KEY WORDS Somatotype. Anthropometry. Occupation. Oraon. Environment.

ABSTRACT Somatotype is basically done to assess human body built. The present study tries to relate human work performance and physique. New somatotype component rating method has been used to know the somatotype component ratings. In the present study, somatotyping methods has been applied to see the difference if any, with regards to body built between Oraon agricultural labourer and Oraon tea garden labourer of the same geographical region. The findings suggest the differences exist between the two occupational groups which may be due to microenvironmental factors.

INTRODUCTION

Somatotype is a description of present morphological conformation. It is expressed in a three-numeral rating, consisting of three sequential numbers, always recorded in the same order. Each numeral represents evaluation of one of the three primary components of physique which describe individual variations in human morphology and composition (Heath and Carter, 1969). One can make a number of anthropometric measurements on an individual and compare each of these with a range of values collected from a 'standard' group of the same age and sex, but this approach does not readily help visualization of the body shape (Harrison et al., 1977). Somatotype on the other hand, gives information on individual physical constitution in an easily comprehensible form compared to an array of anthropometric measurements presented as such (Roy, 1990).

Heath and Carter (1969) suggested modifocation of an extended and readjusted universal rating scale, applicable to both sex at all ages and constructed table to obtain reliable anthropometirc somatotype rating. Anthropometric somatotyping was basically the modification and developed version of Sheldon's technique. Therefore, it uses much of the original vocabulary and employs those criteria of Sheldon's basic approach which are objective and straightforward. The important fundamental difference is that the later technique is (1) a phenotypic ratings, which allows for change over time, (2) the rating scales for the three components are open, so as to apply to the physiques of both sexes at all ages, and (3) selected anthropometric dimensions help to objectify somatotype ratings. But in such method there were so many computational difficulties, especially of the mesomorphy ratings. Therefore, there was a need for more easier rating method and further modifications were inevitable. Ultimately, Carter and Heath (1990) again suggested new somatotype rating techniques through anthropometric measurements, now the modified method is currently the most widely used.

However, anthropometric somatotype studies have been used for various purpose during the last two decades. The most extensive use of somatotying has been made in evaluating the relationship between physique and physical performance of athletes at various competitive levels in a variety of sports (Carter, 1970; Parizkova, 1970, 1972; de Garay et al., 1974; Ross et al., 1977; Withers et al., 1987). A number of factors may influence somatotype including age (Zuk, 1958; Heath and Carter, 1971; Walker, 1978), sex (Tanner, 1962; Parizkova and Carter, 1976; Carter and Parizkova, 1978), smoking habit (Prakash and Malik, 1988), nutrition (Malik et al., 1986a) and other environmental factors (Malik et al., 1986b; Singh et al., 1986), although multiple environmental and cultural

factors typically play important role (Song et al., 1993). Somatotype has also been used in studying human variability (Kraus, 1951; Danby, 1953; Damon et al., 1962; Roberts and Bainbridge, 1963; Song et al., 1994), including demonstration of similarities/differences between and within groups (Prakash and Malik, 1989) disease correlates (Spain et al., 1955; Damon et al.; 1970, Bailey, 1985), changes during growth and maturation (Zuk, 1958; Walker, 1974; Singh, 1976; Malina and Bouchard, 1991). Although phenotypic variation in somatotype among individuals and/or population is in part genetically determined but the available information on the relationship between somatotype and certain type of physical performance is still inadequate, especially when the genetic effect is controlled.

In view of these, the objective of the present study is to (1) compare the anthropometric traits of two occupational groups, (2) compare the somatotype scores of the two occupational groups, and (3) find out the possible reasons behind the difference between the groups, if any.

METHODOLOGY

Data were collected as a part of an on going project on 525 adult (20 years and above) agricultural labourers and on 182 tea garden labourers. Out of the 525 agricultural labourers 233 were females and 292 were males, and 94 males and 88 females - out of a total of 182 tea garden labourers. Both agricultural and tea garden labourers belonged to the Oraon tribe in the village areas of Shishubari Anchal under Madarihat police station, and Tea garden labourers were from Birpara and Dalgaon tea gardens under Birpara police station of Jalpaiguri district, respectively. Both Oraon groups were purposively chosen, in order to minimize the possible ethic/genetic effect and both groups belonged to the same geographical area so as to eliminate the possible environmental effect, if any.

The Oraons are a Dravidian speaking population with its major concentration in the Chotanagpur plateau in Bihar. They are believed to have migrated to northern West Bengal about the end of the last century (Choudhury, 1978). Some of the Oraon populations are working as tea garden labourers but the majority are still sticking to their traditional agricultural occupation and living in the adjacent villages of the tea gardens. Anthropometric measurements were made using standard instruments and techniques (Weiner and Lourie, 1981). Anthropometric somatotype of Carter and Heath (1990) method have been used for obtaining somatotype rating.

The following measurements were taken from subjects wearing light apparal:

1. Height (cm)
2. Weight (kg)
3. Biepicondylar diameter of humerous (cm)
4. Upper arm circumference (cm)
5. Bicondylar diameter of femur (cm)
6. Calf circumference (cm)
7. Skinfold thickness, triceps, left (mm)
8. Skinfold thickness, subscapular, left (mm)
9. Skinfold thickness, suprailiac, left (mm)
10. Skinfold thickness, calf, left (mm)

The Following Somatotype Rating Techniques Have Been Followed

Endomorphy was determined by using the following formula:

$$-0.7182 + 0.1451\ (X) - 0.00068(X^2) + 0.0000014\ (X^3) \quad \ldots\ldots (1)$$

Where X is the sum of the triceps, subscapular and suprailiac skinfold thickness, adjusted for stature [*i.e.* X = Sum of skinfold thickness (170.18/stature)].

Mesomorphy was determined using the following formula:

$$[(0.858 \times \text{biepicondylar}) + (0.601 \times \text{bicondylar}) + \{0.188 \times (\text{upper arm circumference} - \text{triceps skinfold})\} + \{0.161 \times (\text{calf circumference} - \text{calf skinfold})\}] - (\text{stature} \times 0.131) + 4.50 \quad \ldots\ldots (2)$$

A note of caution is that both triceps and calf

skinfold thickness are measured in millimeter scale and at the time of subtraction this unit should be converted into centimeter scale.

Ectomorphy was obtained by using the reciprocals of the Ponderal Index, and formula is

HWR (Height Weight Ratio) × 0.732 -28.58 ..... (3)

Where HWR = Stature / Weight $^{1/3}$. If HWR is less than 40.75 but greater than 38.25, ectomorphy is determined by using HWR × 0.463 - 17.63 ..... (4)

If HWR is less than 38.25, a rating of 0.1 is assigned to the ectomorphic rating (Carter and Heath, 1990).

All anthropometric measurements were made by a single investigator. The somatotype rating was done in the personal computer using standard Minitab Package, version 6.1.1.

Initially it was thought that there may be some age effect in some of the variables and therefore, age^2 and age^3 were computed and made stepwise regression analysis for each group of both male and female and found no age effect in any of the groups studied. Therefore, further analysis of residuals were not done.

RESULTS

Table 1 shows the descriptive statistics of eleven anthropometric and other traits of the male labourers. The mean values of height, weight, upper arm circumference, calf girth, subscapular skinfold and calf skinfold are higher in case of tea garden labourers compared to agricultural labourers. Results of t-test value show that there are significant differences exist in case of height, epicondylar diameter of humerus, bicondylar diameter of femur, upper arm circumference, calf girth and suprailiac skinfold thickness between the two occupational groups.

Table 2 shows descriptive statistics of anthropometric traits of female labourers. The mean values of height, weight and most of the skinfold thickness measurements except subscapular are higher in case of agricultural female labourers compared to the tea garden labourers. Girth measurements and diameter measurements are higher in case of tea garden females compared to agricultural female labourers. t-test values show signficant difference exists in regard to epicondylar diameter of humerus, calf girth, triceps and suprailiac skinfold thickness between the two occupational groups.

In table 3, the mean somatotype scores of both males and females have been presented. Tea garden male labourers show higher mesomorphy mean values compared to agricultural labourers, where endomorphy and ectomorphy values are higher than tea garden labourers. t-test values show significant difference between the groups. Female labourers show analogous results as those of males, but the only significant difference exist in endomorphy. None of

Table 1 : Basic statistics pertaining to anthropometric measurements of Oraon male labourers

Variables	*Tea Garden (n=94)*		*Agriculture (n=292)*		*t-values*
	mean	*sd*	*mean*	*sd*	
Age (year)	30.31	8.74	35.20	13.65	4.06*
Height (cm)	163.43	6.44	162.31	6.20	2.50*
Weight (kg)	48.42	5.59	47.56	5.13	1.32
Epi. diam. of humerus (cm)	5.99	0.51	6.52	0.34	10.03*
Biep. diam. of femur (cm)	8.73	0.44	8.85	0.37	2.04*
Upper arm circum. (cm)	23.43	1.46	22.26	1.61	6.69*
Calf girth (cm)	29.35	1.84	28.57	2.01	3.52*
Skinfold triceps (mm)	4.82	1.25	5.08	1.49	1.77
Skinfold subscapular (mm)	8.82	2.13	8.76	1.81	0.28
Skinfold suprailiac (mm)	4.68	1.13	6.02	1.58	9.43*
Skinfold calf (mm)	5.10	1.79	4.79	1.41	1.57

* Significant of 5 % level

Table 2 : Basic statistics pertaining to anthropometric measurements of Oraon female labourers

Variables	*Tea Garden (n=88)*		*Agriculture (n=233)*		*t-values*
	mean	*sd*	*mean*	*sd*	
Age (year)	34.25	10.52	33.43	12.22	0.60
Height (cm)	149.71	4.88	150.39	6.20	1.03
Weight (kg)	40.04	4.43	40.15	5.55	0.19
Epi. diam. of humerus (cm)	5.28	0.34	5.70	0.28	9.39*
Biep. diam. of femur (cm)	7.96	0.36	7.92	0.37	1.12
Upper arm circum. (cm)	20.81	1.61	20.63	1.80	0.87
Calf girth (cm)	27.45	2.03	26.72	2.05	2.86*
Skinfold triceps (mm)	7.64	3.03	8.42	3.21	2.04*
Skinfold subscapular (mm)	9.89	3.49	9.49	3.59	0.92
Skinfold suprailiac (mm)	5.15	2.20	6.99	3.45	5.57*
Skinfold calf (mm)	6.95	2.44	7.40	2.55	1.45

* Significant of 5 % level

Table 3 : Basic statistics pertaining to anthropometric somatotype rating of Oraon male labourers

Variables	*Tea Garden (n=94)*		*Agriculture (n=292)*		*t-values*	*F-values*
	mean	*sd*	*mean*	*sd*		
Male						
Endomorphy	1.54	0.49	1.87	0.57	6.31*	0.86
Mesomorphy	2.88	0.77	2.67	1.00	2.10*	0.77
Ectomorphy	3.69	0.88	4.27	0.92	5.63*	0.95
Female						
Endomorphy	1.85	0.88	2.42	0.99	5.36*	0.89
Mesomorphy	2.35	0.83	2.30	1.01	0.46	0.82
Ectomorphy	3.54	1.02	3.66	0.99	0.96	1.03

* Significant at 5 % level

the F-values are significant.

DISCUSSION

The present study examined the effect of microenvironmental factors (occupation) on somatotyping in a tea garden labourer population and an agricultural labourer population of a single ethnic group. The factors standardized in the study included climate, habitual activity type and test protocol.

From the result, it appears that significant difference exist in so many anthropometric parameters especially the diameter and circumference measurements, but the female group do not show very consistent results with those of males. Even in somatotype scores both male and female tea garden labourers show higher values in mesomorphy which certainly point out the heavy musculature of the tea garden labourers compared to agricultural labourer. Tea garden labourers get better nutrition throughout the year because they have subsidized rationing and other facilities in the tea garden but the agricultural labourer have no such facilities and they get better nutrition only during harvesting time and they do not have any work for 2-3 months in a year and obviously, have no income during that time. Thirdly, the female agricultural labourers show higher endomorphic scores and higher skinfold thickness because most of the females, perhaps do not participate in the agricultural operation.

Thus, somatotyping may be useful in examining the effects of microenvironmental factors on health, pursuing different occupation/ethnic group. Further studies are necessary to test the effects of many other microenvironmental factors on health in different ethnic groups and in different geographical settings.

REFERENCES

Bailey, S.M.: Human physique and susceptibility to non-infectious disease. *Yearbook of Physical Anthropology*, **28**:149-173 (1985).

Carter, J.E.L.: The somatotypes of athletes-a review. *Hum. Biol.*, **42**:535-569 (1970).

Carter, J.E.L. and Parizkova, J.: Changes in somatotypes of European males between 17 and 24 years. *Am. J. Phys. Anthrop.*, **48**:251-254 (1978).

Carter, J.E.L. and Heath, B.H.: *Somatotyping : Development and Applications*. Cambridge University Press, Cambridge, England (1990).

Choudhury, M.R.: *The Tea Industry in India : A Diagnostic Analysis of its Geoeconomic Studies*. Oxford Book and Stationary Company, Calcutta (1978).

Damon, A., Bleibtreu, H.K., Elliot, O. and Giles, E.: Predicting somatotype from body measurements. *Am. J. Phys. Anthrop.*, **20** : 461-474 (1962).

Damon, A.: Constitutional medicine, pp. 179-205. In: *Anthropology and the Behavioral Sciences*. O. von Mering and L. Kasdan, (Eds.). University of Pittsburgh Press, Pittsburgh, PA. (1970).

Danby, P.M.: A study of the physique of some native East Africans. *J. Royal Anthrop. Inst.*, **83**:194-214 (1953).

deGaray, A.L., Levine L. and Carter J.E.L.: *Genetics and Anthropological Studies of Olympic Atheletes*. Academic Press, New York (1974).

Harrison, G.A., Weiner, J.S., Tanner, J.M. and Barnicot, N.A.: *Human Biology: An Introduction of Human Evolution, Variation, Growth, and Ecology*. Oxford University Press, London (1977).

Heath, B.H. and Carter, J.E.L.: A modified somatotype method. *Am. J. Phys. Anthrop.*, **27**:57-74 (1969).

Heath, B.H. and Carter, J.E.L.: Growth and somatotype patterns of Manus children. Territory of Papua and New Guinea: Application of a modified somatotype method to the study of growth patterns. *Am. J. Phys. Anthrop.*, **35**:49-67 (1971).

Kraus, B.S.: Male somatotypes among Japanese of northern Honshu. *Am. J. Phys. Anthrop.*, **9**:343-366 (1951).

Malik, S.L., Prakash, M. and Mookherjee, P.: Impact of nutrition on body size, body shape and muscular strength: An evolution of a food aid program. *Man and Life*, **12**:61-68 (1986a).

Malik, S.L., Eiben, O.G., Prakash, M. and Mittal, M.: Impact of high altitude on body shape. *Anthrop. Kozl.*, **30**:203-208 (1986b).

Malina, R.M. and Bouchard, C.: *Growth, Maturation and Physical Activity*. Human Kinetics, Champaign, IL (1991).

Parizkova, J.: Activity, obesity and growth. *Monograph: Social Research and Child Development*, S. No. 170, **35**:28-32 (1970).

Parizkova, J.: Somatic development and body composition changes in adolescent boys differing in physical activity. *Anthropologie*, **10**:3-36 (1972).

Parizkova, J. and Carter, J.E.L.: Influence of physical activity on somatotypes in boys. *Am. J. Phys. Anthrop.*, **44**:327-340 (1976).

Prakash, M. and Malik, S.L.: Effect of smoking on anthropometric somatotype and grip strength. *Ind. J. Med. Res.*, **87**:494-499 (1988).

Prakash, M. and Malik, S.L.: Anthropometric somatotype among the Santals of district Midnapur, West India. In: *Changing Perspectives of Anthropology in India*, S.C. Tewari (Ed.). Today and Tomorrow Printers and Publishers, New Delhi (1989).

Roberts, D.F. and Bainbridge, D.R.: Nilotic physique. *Am. J. Phys. Anthrop.*, **21**:341-370 (1963).

Ross, W.D., Carter, J.E.L. Roth, K., and Willmezik, M.: Sexual dimorphism in sports. : A comparison of elite male and female atheletes by somatotype I - Index. In: *Growth and Development: Physique*. O. Eiben (Ed.). Hungarian Academc of Science, Hungary (1977).

Roy, S.K. : The concept and method of anthropometric somatotype, with an example from the Oraon tea garden labourers of Jalpaiguri District, West Bengal. *J. Ind. Anthrop. Soc.*, **25**:129-140 (1990).

Singh, S.P., Sidhu, L.S. and Malhotra. P.: Body morphology of high altitude Spitians north west Himalayas. *Z. Morph. Anthrop.*, **76**:189-195 (1986).

Singh, R.: A longitudinal study of the growth of trunk surface area measured by palnimeter on standard somatotype photographs. *Ann. Hum. Biol.*, **3**:181-186 (1976).

Song, T.M.K., Malina, R.M. and Bouchard, C.: Familial resemblance in somatotype. *Am. J. Hum. Biol.*, **6**: 265-272 (1993).

Song, T.M.K., Perusse, L., Malina, R.M. and Bouchard, C.: Twin resemblance in somatotype and comparisons with other twin studies. *Hum. Biol.*, **66**:453-464 (1994).

Spain, D.M., Bradess, V.A. and Greenblatt, I.J.: Postmortem studies on coronary atherosclerosis, serum beta lipoproteins and somatotype. *Am. J. Med. Sc.*, **229**:294-301 (1955).

Tanner, J.M.: *Growth at Adolescence*. Blackwell Scientific Publications, London (1962).

Walker, R.N.: Standards for somatotyping children: I. the prediction of young adult height from children's growth data. *Ann. Hum. Biol.*, **1**:149-158 (1974).

Walker, R.N.: Pre school physique and late adolescents somatotypes. *Ann. Hum. Biol.*, **5**:113-129 (1978).

Weiner, J.S. and Lourie A.J.: *Practical Human Biology*. Academic Press, London (1981).

Withers, R.T., Whittingham, N.O., Norton, K.I. and Dutton, M.: Somatotypes of south Australian female games player. *Hum. Biol.*, **59**:575-584 (1978).

Zuk, G.H.: The plasticity of the physique from early adolescence through adulthood. *J. Gener. Psychol.*, **92**:205-214 (cited by Withers et al. 1978) (1958).