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Impact of Habitual Physical Activity on the Human Body Proportions: A Comparative Study of Some Traditional Occupational Groups

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ABSTRACT Physical efficiency, body movement and performance in many daily activities can be determined through the study of human body proportions. The purpose of the present study is to analyze the effect of habitual activities on the body proportions of the adult males involved in four different traditional occupational groups i.e. Tailors, Farmers, Carpenters and Blacksmiths. A total of 800 adult men (200 each group) ranging in age from 30 to 40 years were examined for 27 anthropometric parameters (height, weight, seven skinfolds, eight circumferences, three segmental lengths and seven body breadths) following the techniques given by Lohman et al. (1988).Crossectional data has been collected from the different areas of Punjab during April 2003 and January 2004. Proportionality assessment is done by adjusting anthropometric measurement to a standard height or size and comparing them with the specified values and standard deviation values. Gross phantom specifications are used as given by Ross and Ward (1982)**.**Results indicates that proportionally Farmers have less and Tailors have more weight in relation to height. Out of all the skinfolds maximum proportional development has been observed for biceps, subscapular and calf skinfold in Farmers whereas in case of circumferences maximum proportional development has been observed for chest circumference in Tailors followed by waist circumference in Blacksmiths and hip circumference in Farmers. Proportional development of segmental lengths do not show any definite trend that can reflect inter group differences. Maximum proportional development out of all the body breadths has been observed in antero-posterior chest breadth in both Tailors and Blacksmiths.

INTRODUCTION

'Traditional Occupation' is the one, which a person acquires or inherits from his parents and passes it on to the next generation. Gross body size and other morphological characteristics of a person involved in such type of occupations provide clues regarding the developmental adaptations these people have undergone in response to variety of work factors or stresses. Habitual physical activity shows its great impact on body morphology of a person involved in it. Heavy physical work makes the body muscular whereas light and sedentary type of activities makes the body fatter. Due to increase in mechanization, manual work is decreasing whereas mental labor is increasing. Adaptability to the working environmental conditions and genetic factors also brings out differences in the body proportions, body composition and body morphology and highlight the importance of specific advantage of typical physical characters in any occupation. Relationship of one measurement to another is useful in comparing individuals who otherwise differ in size or various other body measurements. Phantom stratagem for proportionality growth assessment is essentially based on the concept of a theoretical reference human, which is named as phantom. The phantom is a conceptual unisex bilaterally symmetrical model derived from reference male and female data (Ross and Wilson, 1974).Thus present study is conducted with a view to find out the impact of different habitual physical activities on the body proportions.

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MATERIAL AND METHODS

Study has been conducted on four traditional occupational groups of Punjab viz., Tailors, Farmers, Carpenters and Blacksmiths. A total of

800 adult males (200 each group) ranging in age from 30 to 40 years were examined anthropometrically using the techniques given by Lohman et al. (1988) for gross body measurements (Height and Weight), skinfolds (biceps,triceps, thigh,calf, subscapular, suprailiac and abdominal), body circumferences (Upper arm, forearm, wrist, waist, hip, thigh, calf) segmental lengths (Upper arm length, Forearm length and Hand length) and body breadths (Humerus bicondylar, Femur bicondylar, hand breadth, antero-posterior chest depth (AP-Chest), Transverse chest (T-Chest),biacromial and bi-iliac breadth). Data for the present research work has been collected from different areas of Punjab (Amitsar, Bathinda, Kapurthala, Ludhiana, Moga, Muktsar and Patiala) during 2002 to 2004.

Proportionality assessment is done by adjusting anthropometric measurement to a standard height or size and comparing them with the specified values and standard deviation values as given below:

$$Z = (1/s)\,(v\,(170.18/h)^{d} - p$$

Where Z – proportionality value of z - score

s = Phantom standard deviation for the given variable

v = any variable

170.18 =constant height of phantom (cm)

h = Subjects height in cm

d = Dimensional constant

(d = 1 for height, widths, lengths, girths and skinfolds

d = 2 for all areas

d = 3 for all masses and volumes

p = is the phantom value of the variable.)

Gross phantom specifications are used as given by Ross and Ward (1982).

Whole procedure of data analysis has been carried out on Excel for Windows Xp version.

RESULTS AND DISCUSSION

Height of an individual is also influenced by economic activity and left a permanent imprint on human biological outcomes (Komlos and Coclanis, 1997; A'Hearn, 1998 and Komlos, 1998). Nutritional status, incidence of various diseases and its treatment and environmental variations stunts the expression of genetic potential for adult height. Economic status is equally relevant to both genotype and phenotype of height (Faulkner and Tanner, 1986; Komlos, 1989, 1994a, b and Arora, 2001). However, according to Tanner (1978) the final size of an individual is a product of the complex interactions of genetics and environmental factors. As the Tailors of the present study are found to be shortest (Table 1) in comparison to Farmers, Carpenters and Blacksmiths, it is not clear that their short stature has any overall advantage in their profession. Trends in body weight indicate that Farmers (64.08 kg) as well as Blacksmiths (64.00 kg) are the heaviest followed by Tailors (61.75 kg) and Carpenters (61.36 kg). Height varies from person to person and so does body weight, therefore simple comparison of actual weight and height does not present a clear picture about the proportionate differences. In order to find out the relationship

Table 1: Gross body measurements of occupational groups.

Occupational Groups	*Height (cm)*		*Weight (kg)*	
	Mean	*S.D*	*Mean*	*S.D*
Tailors	166.5	6.32	61.75	9.97
Farmers	172.6	7.49	64.08	11.93
Carpenters	166.6	5.93	61.38	8.66
Blacksmiths	169.6	5.25	64.00	7.71

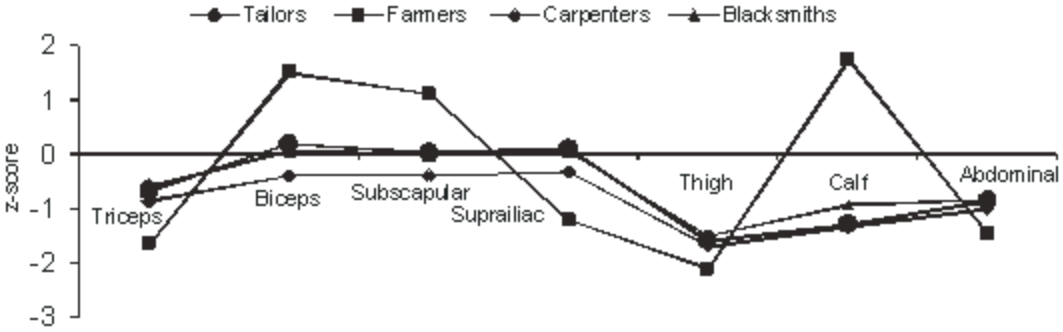

Fig. 1. Proportional development of skinfold thicknessess in traditional occupational groups.

Table 2 : Proportional development (z-values) in various body parameters of traditional occupational groups.

Parameter	*Tailors*		*Farmers*		*Carpenters*		*Blacksmiths*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Body Weight								
Skinfolds	I0.14	1.09	-0.38	1.12	0.10	1.10	0.01	0.94
Triceps	-0.67	0.92	-1.62	0.75	-0.86	0.88	-0.58	1.11
Biceps	0.20	1.49	1.51	0.96	-0.39	1.44	0.07	1.91
Subscapular	0.03	1.12	1.13	0.81	-0.39	0.83	-0.01	0.98
Suprailiac	0.11	1.14	-1.19	0.87	-0.31	1.09	0.05	1.03
Abdominal	-0.84	0.61	-1.45	0.70	-0.99	0.65	-0.83	0.69
Thigh	-1.57	0.58	-2.10	0.38	-1.68	0.42	-1.49	0.62
Calf	-1.28	0.75	1.76	0.64	-1.33	0.65	-0.93	1.07
Girths								
Upper arm	-0.01	1.33	-0.36	1.14	0.31	1.12	0.37	1.38
Forearm	0.15	1.77	-0.05	1.31	0.97	1.26	1.04	1.51
Wrist	0.49	1.61	1.10	1.98	1.19	1.26	0.95	1.54
Chest	3.62	2.30	0.21	1.35	0.76	1.38	0.76	1.44
Waist	0.87	1.44	2.61	2.24	2.92	2.31	3.13	2.24
Hip	-0.19	1.47	1.25	1.55	-0.07	1.61	0.01	1.42
Thigh	-1.68	1.06	-2.45	1.21	-1.59	1.15	-1.81	1.19
Calf	-0.96	1.21	-1.69	1.46	-1.14	1.49	-1.05	1.46
Segmental Lengths								
Upper arm	1.27	1.32	1.96	1.06	2.07	0.95	1.87	1.52
Forearm	2.69	1.66	3.63	1.60	3.54	1.54	3.41	1.75
Hand	-1.51	1.55	1.05	1.53	-0.60	1.10	-0.81	1.34
Body Breadths								
Hand	0.93	2.60	0.84	1.69	2.76	1.98	2.05	1.99
Humerus bicondylar	0.33	1.85	1.44	1.86	1.31	1.64	0.93	1.45
Femur bicondylar	-1.58	1.98	-1.04	1.58	-1.71	2.34	-1.50	1.42
Biacromial	1.91	2.08	2.15	1.55	2.20	1.56	2.03	1.50
Bi-iliac	2.72	2.32	0.74	1.80	1.36	1.51	1.91	1.30
Antero-posterior Chest	3.27	2.14	2.17	1.81	3.08	1.72	3.28	2.28
Transverse Chest	1.35	1.83	0.87	1.74	0.88	2.03	1.21	1.70

of one measurement to another proportionality values or z – values are calculated for weight **(**Table 2) using the formula given by Ross and Wilson (1974). Proportional development of body weight in relation to height for all the occupational groups indicate that Tailors have proportionally more weight in comparison to their height whereas Farmers have proportionally less weight in relation to their height. Thus in proportional terms Tailors are the heaviest and Farmers are the lightest in comparison to Blacksmiths and Carpenters. Taking stock of the global height and weight relationship, Ross et al. (1987) demonstrated from his data throughout the world that tallness is associated with relative lightness whereas smallness with relative

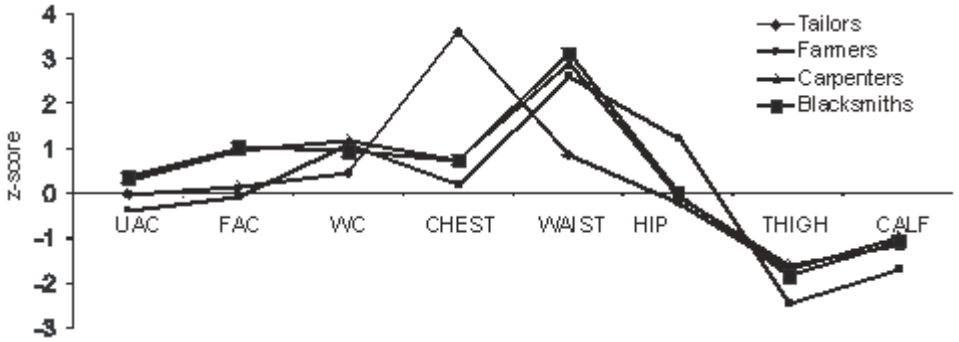

Fig. 2. Proportional development of circumferences in Tailors, Farmers, Carpenters and Blacksmiths. UAC: upper arm circumference, FAC: forearm circimfernce, WC: wrist circumference

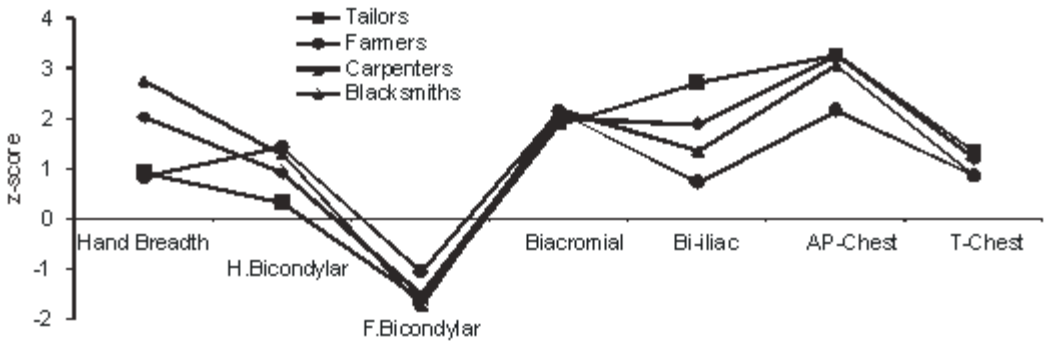

Fig. 3. Proportional development in body breadths of traditional occupational groups
H.Bicondylar – humerus bicondylar, F.Bicondylar = femur bicondylar, AP- Chest = antero-posterior chest, T- Chest = transverse chest

heaviness or ponderosity and thus explained the human architectural design with normal human biological variations. Differences in the height of an individuals within sub-populations co-habiting the same region are largely dependent on the differences in their genetic make up, whereas within an ethnically homogeneous population variations may be due to cumulative nutritional, hygienic, disease and stress experience as stated by Tanner (1994). Relative development of skinfolds (Table 2 and Fig. 1) in relation to height has been found to be maximum for biceps, subscapular and calf skinfolds in Farmers. Both Tailors and Blacksmiths almost show same trend in proportional development of all the skinfolds whereas least proportional development of all skinfolds has been found in Carpenters. Pattern of regional subcutaneous fat distribution is also influenced by age, sex, nutritional status, habitual physical activity patterns and possibly ethnic background (Garn et al., 1988 and Norgan, 1991). According to Cronk et al. (1982) reduction in the subcutaneous fat over the extremities happens, concurrent with the fat deposition over the trunk region of the body in older subjects. Maximum proportional development out of all the body circumferences **(**Table 2 and Fig. 2) has been observed for chest circumference in Tailors followed by waist circumference in Farmers. Proportional development in rest of the circumferences does not show any definite trend that can reflect inter-group differences. Z-values indicate that proportional development of upper arm length in relation to height is maximum in Carpenters whereas forearm and hand lengths are proportionally more developed in Farmers. Body breadths provide useful indication of fat free mass and are considered to be an independent estimate of relative fatness. Moreover it is the better measure of frame size (Katch and Freedson, 1982; Frisancho, 1983, 1984; Fehily et al., 1990 and Facchini et al., 2003). Maximum proportional development of body breadths in relation to height has been observed for antero-posterior breadth in both Tailors and Blacksmiths (Table 2 and Fig. 3). Inter- group differences for proportional development of body breadths have been found to be maximum for bi-iliac breadth followed by hand breadth and humerus bicondylar breadth. Rest of the body breadths shows almost similar proportional development in all the four occupational groups.

CONCLUSION

Habitual physical activity, adaptability to the working environmental conditions and genetical factors seem to play a key role in bringing out the body differences in these traditional occupational groups. It highlights the possibility of some specific advantages of typical physical characteristic in each occupational group.

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