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Bilateral Variations in Adipose Tissue Distribution, Segmental Lengths and Body Breadths in Relation to Physical Activity Status

A.P. Singh* and S.P. Singh**

**Department of Human Anatomy, Desh Bhagat Dental College and Hospital, Muktsar Punjab, India*
E-mail: drpal78@yahoo.com
*** Department of Human Biology, Punjabi University, Patiala, Punjab, India*
E-mail: singhsps2000@rediffmail.com

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ABSTRACT The purpose of the study was to find out the level and range of bilateral asymmetry in the body morphology of adult men 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 19 anthropometric parameters (seven skinfolds, five circumferences, three segmental lengths and four body breadths) on both right and left sides of the body irrespective of handedness. Crossectional data has been collected from the different areas of Punjab during April 2003 and January 2004.Percentage distribution of asymmetry in the different regions of the body has been calculated using relative index of asymmetry (RIA) given by Wolanski, (1965). Results indicate that maximum effect of habitual work status on the body proportions of right and left side has been found in Blacksmiths who shows overall maximum bodily asymmetry in comparison to all the four occupational groups. Direction of asymmetry is generally towards right side of the body whereas the body of Farmers is found to be more symmetrical. Otherwise maximum percentage distribution of bilateral variations out of all the skinfolds, body circumferences, segmental lengths and body breadths has been found in biceps (Carpenters), thigh circumference (Blacksmiths), hand length (Blacksmiths) and femur bicondylar diameter (Blacksmiths) respectively.

INTRODUCTION

Ability to changes is one of the important property of a living organism which is well visible in the course of individual life. Degree of asymmetry as a constant property in the process of ontogenesis where changes in functional, dynamic and morphological asymmetry appearing with age. (Wolanski, 1972).During childhood, the shape of the body continuously changes because of the different rates of growth of different parts. The gross changes in bodily proportions during growth in the human have been analyzed. (Medawar, 1944). Body proportion differences between populations and ethnic groups are well known and are often used to exemplify the concept of genetic potential. The largest the differences between ethnic groups, when all are growing up in good environments are those of shape rather than size. (Norgan, 1998). Growth in diameter is dependent on periosteal ossification while growth in length is depends upon endochondral ossification of epiphyseal plate and the factors affecting are both general (genetic factors, influence of availability of vitamins and minerals and hormonal regulation) as well as localized (an adequate and uninterrupted blood flow and mechanical work stress). The degree of asymmetry reflects the degree of force exerted onto the right or left limb whereas the particular bone site showing the asymmetry indicates the kind of force exerted (Cuk et al., 2001).

Present study has been done using the anthropometric methods to find out the level and range of bilateral asymmetry of upper limb in relation to habitual physical activity.

MATERIAL AND METHODS

The Sample: The sample consists of 800 adult males (200 each group) involved in four different traditional occupational groups viz., Tailors, Farmers, Carpenters and Blacksmiths. Data has been collected from the different rural and urban areas of Punjab during April, 2002- January, 2004.

*Anthropometric Parameters (*Following techniques given by Lohman et al., 1988)

Skinfolds: triceps, biceps, forearm, subscapular, suprailiac, thigh, calf

Circumferences: Upper arm, forearm, wrist, thigh, calf

Segmental lengths: Upper arm forearm, hand length

Body Breadths: humerus bicondylar, femur bicondylar, hand breadth.

Methods: Bilateral asymmetry has been calculated from the right and left side body measurements irrespective of handedness as also of the fact that whatever be the higher value. It is likely that in some persons the measurements on the right side would be more as compared to those on the left side whereas in some other cases the measurement on left side would be greater than those on the right side. Keeping in mind this fact there are great chances of the bilateral differences being annulled or minimizing the differences. This problem has been tackled on the basis of first obtaining the actual bilateral differences and then calculated their mean values.

Percentage distribution of asymmetry or relative index of asymmetry (RIA) has been estimated using the formula given by Wolanski (1965)

Relative Index of Asymmetry (RIA): $(2\,D / X1 + X2) \times 100$

Where D is mean of individual differences between right and left side body measurement. Individual differences are calculated as higher value minus lower value.

X1 is the mean for the right side measurement of the body

X2 is the mean for the left side measurement of the body

Statistical Analysis: Statistic analysis was performed for the individual person and then mean was calculated. Results were checked by using students t-test (test of significance).Whole procedure of data analysis has been carried out on Excel for Windows Xp version.

RESULTS AND DISCUSSION

Findings of the present study (Table 1and 2) indicate that Blacksmiths possess maximum bilateral differences for all the skinfold thicknesses (except for suprailiac and thigh skinfolds) among all the four occupational groups. Thus indicate uneven distribution of subcutaneous tissue over the various sites of the body when left and right sides are considered. Bilateral asymmetry in Blacksmiths has been found mostly in the upper region of the body. Out of all the skinfolds, Blacksmiths possess maximum bilateral differences between right and left side triceps skinfold and direction of asymmetry is towards right side (57%). This might be due to the fact that right hand in Blacksmiths does the maximum work as compared to the left hand. Tempering the red-hot iron with a heavy hammer is done with right hand whereas left hand is used for

Table 1: Mean values of individual differences (D) and relative index of asymmetry (RIA)

Parameter	*Tailors*		*Farmers*		*Carpenters*		*Blacksmiths*	
	D	*RIA*	*D*	*RIA*	*D*	*RIA*	*D*	*RIA*
Skinfolds (mm)								
Triceps	0.82	6.80	0.74	8.99	0.93	8.25	1.22	9.61
Biceps	0.90	10.79	0.64	12.36	1.05	14.98	1.16	14.08
Forearm	0.46	8.28	0.49	12.18	0.63	10.93	0.83	13.65
Subscapular	1.12	6.65	0.75	6.46	1.05	7.11	1.15	6.75
Suprailiac	1.19	7.70	0.91	8.88	0.86	6.22	0.94	5.97
Thigh	1.03	7.62	0.83	9.31	1.10	8.53	0.93	6.41
Calf	0.85	8.84	0.81	10.28	0.90	9.53	1.07	9.40
Girths (cm)								
Upper arm	0.63	2.41	0.68	2.58	0.73	2.72	0.79	2.88
Forearm	0.70	2.85	0.64	2.52	0.72	2.80	0.73	2.78
Wrist	0.35	2.15	0.42	2.41	0.37	2.19	0.38	2.24
Thigh	0.85	1.79	1.09	2.37	1.32	2.76	1.51	3.16
Calf	0.52	1.61	0.72	2.26	0.51	1.59	0.60	1.83
Segmental Lengths (cm)								
Upper arm	0.64	1.88	0.74	2.03	0.91	2.57	0.87	2.44
Forearm	0.80	2.91	0.73	2.43	0.87	3.01	0.77	2.64
Hand	0.35	2.05	0.40	2.19	0.42	2.34	0.55	3.04
Body Breadths (cm)								
Humerus bicondylar	0.27	4.16	0.27	3.78	0.26	3.79	0.12	1.76
Femur bicondylar	0.32	3.77	0.44	4.82	0.38	4.51	0.76	8.76
Hand	0.64	7.76	0.25	2.85	0.27	2.86	0.61	6.47

Table 2: Test of significance (t-value): Comparison between right and left side skinfolds.

Parameter	*Tailors*	*Farmers*	*Carpenters*	*Blacksmiths*
Skinfolds				
Triceps	2.05*	2.17*	2.51*	2.54*
Biceps	3.21*	3.01*	4.20*	3.22*
Forearm	2.61*	5.00*	3.70*	3.95*
Subscapular	2.03*	1.82*	2.76*	2.30*
Suprailiac	4.85*	2.30*	1.91	2.08*
Thigh	2.17*	3.78*	3.33*	1.93*
Calf	2.61*	2.70*	3.10*	2.32*
Girths				
Upper arm	2.17*	2.72*	3.04*	2.72*
Forearm	2.91*	3.55*	4.50*	3.84*
Wrist	3.50*	3.00*	4.11*	4.22*
Thigh	2.02*	2.09*	3.14*	3.28*
Calf	2.00*	2.25*	1.64	1.87
Segmental lengths				
Upper arm	2.78*	3.89*	4.55*	3.34*
Forearm	3.63*	3.04*	3.78*	3.20*
Hand	2.91*	8.33*	5.25*	6.11*
Body breadths				
Humerus bicondylar	5.40*	5.40*	6.50*	3.00*
Femur bicondylar	4.00*	6.28*	4.22*	12.66*
Hand	6.40*	5.00*	3.37*	7.62*

* $P<0.05$

holding the iron. However, maximum bilateral differences between right and left side for suprailiac skinfold have been found in Tailors and for thigh skinfold in Carpenters. Maximum bilateral differences between right and left side body circumferences have been observed for thigh circumference in Blacksmiths followed by calf circumference in Farmers. Direction of asymmetry for both thigh (68%) and calf (55%) circumferences is also towards right side. In case of segmental lengths, bilateral differences are found to be maximum for upper arm and forearm lengths in Carpenters whereas bilateral differences for hand length are found to be maximum in Blacksmiths. Direction of asymmetry in Carpenters for upper arm length (60.5%) and forearm length (59%) and in Blacksmiths for hand length (59%) is towards right side. Most asymmetric trait of human body is hand muscular strength, which further depends on the mass of working muscles, degree of their development and the conditional reflexes which regulate and co-ordinate the movements (Gusieva, 1964). The maximum bilateral differences in hand occurred in mechanics, metal workers and weavers (Malinowski, 1975). Similarly, results of the present study coincide with the above findings, as Blacksmiths are also involved in such type of work. Asymmetry of muscular strength is related to type of work and mode of life as in cities, the skilled work is performed mostly with one hand whereas in villages or agricultural type of unskilled work, the loading of both extremities are similar which decrease the asymmetry (Wolanski, 1972). Maximum bilateral differences between breadths of left and right side have been observed for hand breadth in Tailors as one hand is used for running the sewing machine and other just for holding cloth that bring out differences in the left and right hand breadth dimensions. Direction of asymmetry for hand breadth is also towards right side (97%). The relative proportion and shape of various bones were mainly inherited characteristics. Second objective of the study that is directed at finding out the level and range of bilateral asymmetry in morphology of traditional occupational groups has been achieved. Vigorous training might change bone dimensions if this was undertaken before closure of the epiphyses has been completed (Tittle and Wutscherk, 1992 and Haapasalo et al., 2000).

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