Variation in Measures of Circumference and Skinfold by Age and Gender Among the Elderly Bengalee Hindus of Kolkata, India

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INTRODUCTION

According to the 2001 census, the total aged (55 years and above) population of India is approximately 112 millions, or 13.2% of the total population. According to Kinsella and Suzman (1992) this percentage will be increased to 14.8% by the year 2020. Although the population of older people is increasing in India (109 millions in 1991 to 112 millions in 2001), the biological problems of ageing have not been viewed as a critical issue. Most studies in India have investigated social aspect involved in the ageing process (Ghosh et al., 2001). The non-invasive technique of anthropometry could be used to provide information on health, body composition and nutritional status in epidemiological and clinical studies related to ageing process. The fat (both subcutaneous and visceral) content of the human body has physiological and medical importance and may influence mortality and morbidity. Genetic and environmental factors such as life-style, Scio-economic status access to health facilities, health conditions and differences in mortality of older people bring about differences in anthropometric characteristics between populations (Ghosh et al., 2001).

There have been very few studies from India (Singal and Sidhu, 1983; Singal et al., 1988; Manandhar et al., 1997a; Ghosh et al., 2001), which have dealt with age trends in anthropometric characteristic among the elderly individuals. However, to date, there is no detailed study on variation of circumference and skinfold measure by age and gender simultaneously in the elderly Bengalee Hindus. Considering the above fact, the present investigation studied age and sex variation simultaneously on circumference (Chest, Waist, Abdomen, Hip and Mid upper arm) and skinfold (Biceps, Triceps, Fore arm, Subscapular, Suprailiac, Chest, Abdomen, Midaxillary, Anterior thigh, Medial calf) measures among 282 (82 men and 200 women) elderly (=55 years) Bengalee Hindus resident in Calcutta (South Calcutta) and its suburb, West Bengal, India.

MATERIALS AND METHODS

Study Population: The present study was conducted in between October 1999 and March 2001. A cut-off point of 55 years was taken to define elderly people as recommended by several authors (Yasssin and Terry, 1991; Chilima and Ismail, 1998; Ghosh et al., 2001). The detailed sampling procedure has already been mentioned elsewhere (Ghosh et al., 2001). All subjects were requested to complete a three-page questioner, which included a specific question on age. Prior to measurement, verbal information was sent to all selected individuals. All women subjects were selected from ward 88 at Kalighat, South Calcutta and all men participants were part of a 'health examination programme' (HEP) initiated at the 'out patient department' (OPD), B.R.Singh Hospital, Calcutta during this period. The study population consisted of 82 men and 200 women aged 55 years and above belonging to the Bengalee Hindu population.

Anthropometric Measurements: Trained investigators using standard anthropometric techniques (Lohman et al., 1988) made all anthropometric measurements. The circum-ference measures of Chest, Waist, Abdomen, Hip, and Mid-upper arm (MUAC) were taken to the nearest 0.1cm using a tape measure (Triced, Shanghai, China). Skinfolds at Biceps, Triceps, Forearm, Anterior thigh, Medial calf, Chest, Subscapular, Midaxillary, and Suprailiac and Abdomen were measured to the nearest 0.2mm on the left side using a Harpenden skinfold caliper.

Statistical Analysis: The distribution of the variables/indices was not significantly skewed. Technical error of measurements (TEM) was calculated and the result was found to be within reference values as cited by Lohman et al. (1988) and Ulijaszek and Lourie (1994). Therefore, TEM was not incorporated in statistical analyses. Student's t test was under taken on total samples (men=82 vs. women=200) to test whether there existed any sex differences in anthropometric characteristics. Pearson's correlation co-efficient (r) was under taken

separately for both the sexes. Finally, gender specific simple linear regression analysis was under taken to find out the effect of age on circumference and skinfold measure. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS/PC + Version 10). A *p* value of <0.05 (two tailed) was considered as significant.

RESULTS

The mean and standard deviations for the circumference and skinfold measure of the elderly men and women were presented in Table 1. The mean age of the elderly men and women was 61.32 years (SD= 4.83 years) and 64.4 years (SD= 7.00 years) respectively. Elderly women had significantly greater mean values for circumference measures than elderly men. So far as skinfolds are concerned, elderly women also had significantly greater mean values than elderly men for all skinfolds except forearm skinfold.

Pearson's correlation coefficient (r) of age with circumference and skinfold measure for both the genders was presented in the Table 2. Correlation studies revealed that age had significant inverse relation with all circum-ference and skinfolds measures. However, inverse age trend was much stronger for skinfolds in both sexes than circumference measures. Among elderly men age had significant (p<0.001) inverse age trend on forearm (r= -0.51), medial calf (r= -0.67), chest (r= -0.61), subscapular (r = -0.42), and midaxillary (r= -0.53).

Simple linear regression analyses of age with circumference and skinfold measure were presented in the Table 3 (men) and Table 4 (women). Regression analyses revealed that percent of variance explained by age was much greater for skinfolds than circumference in both sexes. At the same time percent of variance explained by age was much stronger and explicit in elderly men than women.

Table 1: Mean and standard deviation of circumference and skinfold measurements in the study population (n= 282).

	Men (n = 82)		*Women (n = 200)*	
Variable	*Mean*	*SD*	*Mean*	*SD*
Age***	61.32	4.83	64.43	7.00
Circumferences (cm)				
Chest***	80.76	5.71	84.20	7.85
Waist**	80.04	6.65	82.02	10.62
Abdomen**	79.83	5.18	82.83	11.61
Hip*	83.20	7.07	84.82	9.47
Mid-upper Arm**	21.75	2.64	23.91	2.90
Skinfolds (mm)				
Biceps***	12.78	2.54	16.27	5.53
Triceps**	16.08	2.73	18.95	5.21
Forearm*	5.75	1.27	4.60	1.39
Anterior thigh***	19.13	2.05	23.59	5.99
Medial calf**	17.62	2.50	19.38	5.29
Chest**	23.20	3.29	25.46	4.78
Subscapular***	24.90	3.40	27.29	6.30
Midaxillary**	22.19	3.66	24.77	6.11
Suprailiac*	23.50	3.80	25.24	7.34
Abdomen**	26.17	3.79	28.87	8.32

Significant sex difference; *p<0.05; **p<0.01; ***p<0.001

Table 2: Pearson correlation coefficient of age with circumference and skinfold measurements in the study population (n = 282)

Correlates	*Men (n =82)*	*Women (n-200)*
Circumferences		
Chest	-0.26*	-0.24*
Waist	-0.41**	-0.17*
Abdomen	-0.29**	-0.15*
Hip	-0.26*	-0.19**
Mid-upper arm	-0.30**	-0.20**
Skinfolds		
Biceps	-0.21**	-0.38**
Triceps	-0.60***	-0.34**
Forearm	-0.51***	-0.039**
Anterior thigh	-0.56**	-0.46**
Medial calf	-0.67***	-0.49**
Chest	-0.61***	-0.41**
Subscapular	-0.42***	-0.17*
Midaxillary	-0.53***	-0.32**
Suprailiac	-0.39**	-0.19*
Abdomen	-0.41**	-0.28**

Significant at *p<0.05; **<0.01; ***p<0.001

DISCUSSION

Older people are becoming an increasingly important proportion of the populations of developing countries, yet little information exists on their anthropometric and nutritional status (Chilima and Ismail, 1998; Oguntona and Kuku, 2000; Ghosh et al., 2001). It is important to assess the nutritional condition as well as body composition of older people because of its role in ensuring a better quality of life and its association of functional ability (Galanos et al., 1994; Manandhar et al., 1997b). Both circumferences and skinfolds could play a very vital role to meet these challenges. Furthermore, anthropometric technique has also been useful in identifying changes in body size and proportion that occur with increasing age (Chumlea et al., 1989; Lipschitz, 1992; Manandhar, 1995; Chilima and Ismail, 1998; Guo

Table 3: Linear regression analyses of age with circumference and skinfold measurements in men (n= 82)

Variable	*B*	*SEB*	*Beta*	*T*	R^2
Circumferences					
Chest	-0.290	0.032	-0.376	-2.686***	0.064
Waist	-0.423	0.065	-0.407	-6.430***	0.165
Abdomen	-0.320	0.056	-0.396	-2.869**	0.079
Hip	-0.278	0.047	-0.485	-2.560*	0.064
Mid-upper arm	-0.268	0.058	-0.307	-2.887**	0.096
Skinfolds					
Biceps	-0.157	0.056	-0.298	-2.208*	0.046
Triceps	-0.270	0.060	-0.301	-10.827***	0.351
Forearm	-0.213	0.029	-0.251	-8.452***	0.264
Anterior thigh	-0.260	0.027	-0.364	-10.262***	0.320
Medial calf	-0.631	0.021	-0.594	-14.600***	0.440
Chest	0.610	0.024	-0.599	10.769***	0.370
Subscapular	-0.151	0.077	-0.214	-3.961*	0.174
Midaxillary	-0.379	0.067	-0.316	-8.965***	0.175
Suprailiac	-0.189	0.085	-0.240	-2.213**	0.164
Abdomen	-0.246	0.034	-0.310	-3.520***	0.160

Significant at *p<0.05; ** P<0.01; *** p<0.001

Table 4: Linear regression analyses of age with circumference and skinfold measurements in Women (n = 200)

Variable	*B*	*SEB*	*Beta*	*T*	R^2
Circumferences					
Chest	-0.296	0.077	-0.264	-3.850***	0.052
Waist	-0.272	0.106	-0.179	-2.567**	0.026
Abdomen	-0.264	0.116	-0.159	-2.270**	0.030
Hip	-0.261	0.094	-0.193	-2.763**	0.043
Mid-upper arm	-0.081	0.029	-0.196	-2.716**	0.039
Skinfolds					
Biceps	-0.252	0.036	-0.386	-3.620***	0.142
Triceps	-0.202	0.034	-0.334	-3.415***	0.116
Forearm	0.307	0.014	-0.039	-3.576***	0.162
Anterior thigh	-0.222	-0.059	-0.260	-4.784***	0.213
Medial calf	-0.219	0.050	-0.290	-6.266***	0.244
Chest	-0.215	0.046	-0.314	-3.650***	0.162
Subscapular	-0.284	0.042	-0.378	-2.786***	0.023
Midaxillary	-0.282	0.059	-0.323	-4.798***	0.102
Suprailiac	-0.334	0.047	-0.390	-2.465**	0.035
Abdomen	-0.343	0.081	-0.287	-2.907**	0.077

Significant at *p<0.05; ** p<0.01; ***p<0.001

et al., 1999). Non-invasive techniques of anthropometry provide an indirect assessment of body composition and are easy, economical to undertake particularly in field situation (Rea et al., 1997; Whitehead and Finucane 1997). Many studies (Burr and Phillips, 1984; Chumlea et al., 1986; Shimokata et al., 1989; Micozzi and Harris, 1990; Yassin and Terry, 1991; Delaure et al., 1994; Chilima and Ismail, 1998; Oguntona and Kuku, 2000; Ghosh et al., 2001) have already provided information related to elderly individuals utilizing the techniques of anthropometry. However, only a few studies have dealt with age trends of anthropometric characteristics in elderly individuals from India (Singal and Sidhu, 1983; Singal et al., 1988; Manandhar et al. 1997a; Ghosh et al., 2001). Moreover, to date, no detailed investigation has been undertaken on elderly Bengalee Hindus of both sexes to study in details the age trends in circumference and skinfold measure. The present study therefore, provides a unique data on age trends of circumference and skinfold measure in the elderly urban Bengalee Hindus of both sexes.

Results had shown show that a significant decreasing age trend exists in both circumference and skinfold measure among the elderly Bengalee

Hindus of both sexes. In an earlier study Ghosh et al. (2001) have already reported similar negative age trend in adiposity and central body fat distribution among elderly Bengalee Hindus of Calcutta. The present findings are in concordance with studies pertaining to elderly individuals from other parts of the world (Burr and Phillips, 1984; Chumlea et al., 1986, 1989; Shimokata et al., 1989; Micozzi and Harris, 1990; Chilima and Ismail, 1998; Guo et al., 1999), which have also reported a similar inverse age trend of anthropometric characteristic in both sexes. The significant sex differences observed in circumference and skinfold measure was almost similar to those reported on elderly Malawians (Chilima and Ismail, 1998) and Nigerians (Oguntona and Kuku, 2000). Concomitant with ageing, changes occur in body proportion, structure as well as metabolic and physiological variables (Ghosh et al. 2001). However, the changes vary between different ethnic groups and sexes. The differences in nutritional status, diets, way of life in general, and level of physical activity etc. could be the additional causes of differential ageing process in anthropometric characteristic seen in various ethnic groups world wide. Further research is needed on both sexes from other populations in India to identify whether a negative age trend, similar to the present one, exists in other groups.

Correlation studies revealed that inverse age trend was much stronger for elderly men than women. This could be due to the fact that longevity of females, in India, on an average, is higher than that of men (Dandekar, 1996). Furthermore, percent of variance explained by age were much greater among men. It is noteworthy to mention that percent of variance explained by age was only 2-10% (vs. 16-18% in elderly men) for upper body subcutaneous fat (subscapular, suprailaic, midaxillary and abdomen) in elderly women. This vindicated the fact that in spite of increasing age, elderly women had retained their upper body fat ness or android type of fat accumulation. Fat free mass components (i.e. skeletal mass, bone minerals, fibrous or connective tissue etc.) are all very essential (at least in compare to subcutaneous fat) in maintaing body's equilibrium even in older age. This could be one reason of why circumference measures, which actually encompasses both fat and fat free mass, had lesser impact of age compared to subcutaneous fat as measured by skinfolds (Ghosh and Das Chaudhuri, 2004).

Sex differences in the age trend could be attributed to various factors like levels of physical activity and sex hormones (Guo et al., 1999). Longitudinal studies investigating the interaction between circumference and skinfold measure with hormones are needed to fully understand the sex difference observed in the dynamics of the ageing process. The clinical implications of changes in circumference and skinfolds with advancing ageing can only be investigated using the longitudinal studies (Ghosh et al., 2001). No such study has been under taken from India.

Result of the present investigation indicate that it is essential to understand the underlying factors involved in the causation of this significant negative trend which could have serious health implications particularly in geriatric nutrition and serious disability associated with increasing age. Further more, it is noteworthy to mention that an accurate evaluation of nutritional status should include an estimation of circumference and skinfolds. It has been suggested (Guo et al., 1999) that understanding the scope of the age related changes in anthropometric characteristics and the factors associated with them in healthy adults will help to improve our knowledge and understanding of these process and assist in the prevention of functional limitations and in the managements of health status into the old age. Further studies are needed to be done on other ethnic groups residing in rural as well as urban areas of India to determine whether a similar phenomenon exists among them. Results obtained from such studies could be utilized to formulate national primary health care strategies for elderly people. At present no such health policy exists in India. Physical changes during ageing process in people of different genetic origin, different life styles, including food habits, exposed to similar environmental conditions provide an unusual opportunity to examine such changes. Moreover, investigations should be undertaken among the '*Indian Diaspora*' worldwide to elucidate if they also show age trends in anthropometric characteristic similar to sedentes in India or the native population of the respective countries. Such studies would generate valuable information on the '*nature-nurture*' interaction involved in the ageing process.

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(negative impact) explained by age was only 2-10% (vs. 16-18% for elderly men) for skinfolds at subscapular, suprailaic, midaxillary and abdomen in elderly women. This indicates the retaining of upper body fatness for elderly women even with increasing age. Various factors including levels of physical activity and sex hormones could have been accounted as the probable causes for this sex difference. Longitudinal studies investigating the interaction between circumference and skinfold measure with hormones are needed to fully understand the sex difference observed in the dynamics of the ageing process.

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