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Age-Related Anthropometric Changes and Undernutrition among Middle Aged and Older Savar Tribal Females of Keonjhar District, Orissa, India

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ABSTRACT A cross sectional study of 113 Savar tribal women of four villages of Keonjhar District, Orissa, India, was undertaken to examine age changes in anthropometric and body composition characteristics as well as to evaluate their nutritional status. Height, weight, circumferences and skinfolds data collected from subjects aged 41-75 years, along with body mass index and seven body composition variables. Significant negative age trends were observed for all anthropometric and body composition variables and indices. Correlation studies of age with these variables and indices revealed significant negative correlations. Linear regression analyses revealed that for all variables, age had a significant negative impact. Studies on the nutritional status of Savar women revealed that 53.1% belonged to the undernutrition category. In conclusion, this study showed that among these women, age was significantly negatively related with anthropometric and body composition variables and indices. Undernutrition was a serious problem in this group.

1. INTRODUCTION

Numerous research work worldwide have investigated the anthropometric characteristics and nutritional status of middle aged and elderly persons of different ethnic groups (Bose 2002; Burr and Phillips 1984; Chandler and Bock 1991; Chiu et al. 2000; Chumlea et al. 1986; 1989; Davidson and Getz 2004; Delaure et al. 1994; Kikafunda and Lukwago 2005; Kuozmarski et al. 2000; McLorg 2005; Miccozi and Harris 1990; Perissinotto et al. 2002; Santos et al. 2004; Shimokata et al. 1989; Strickland and Ulijaszek 1993; Suzana et al. 2002; Yassin and Terry 1991).

Most studies on anthropometric and body composition parameters among middle-aged and older individuals in India tend to focus on non-tribal populations (Bagga 1997; Bose and Das Chaudhuri 2003; Ghosh et al. 2001; Ghosh 2004; Ghosh and Das Chaudhuri 2005; Manandhar et al. 1997a; 1997b; Singal and Sidhu 1983; Singal et al. 1988). Limited data are available on anthropometric and body composition characteristics and nutritional status of tribal populations of India (Bisai et al. 2008; Bose and Chakraborty 2005; Bose et al. 2006; 2007). The proportion of older people in developing countries remains smaller than in industrialized countries, but is increasing (Dandekar 1996; Zverev and Chisi 2004). A significant proportion of the Indian population is aged (Dandekar 1996; Ghosh et al. 2001; Kinsella and Suzman 1992).

The tribes of India comprise about 8% of the total population of the country having probably the largest number of tribal communities in the world (Topal and Samal 2001). They are categorized as 698 tribal populations, of which 75 are primitive tribal groups (PTGs). Savars are one such PTG whose mother tongue is Savar, an Austro-Asiatic language. They are inhabitants of four eastern provinces of India: Bihar, Jharkhand, Orissa and West Bengal. The majority of the Savars in Orissa are found in the districts of Cuttack, Dhenkanal, Ganjam and Keonjhar. They are also known as Saura, Saora and Sahara in different provinces of India (Mandal et al. 2002).

The present study was undertaken to examine patterns associated with age in anthropometric and body composition indicators as well as to evaluate the nutritional status among middle aged and older Savar tribal females of Keonjhar District, Orissa, India.

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2. MATERIALS AND METHODS

2.1 Area of Study and Subjects

This study was conducted in collaboration of Associated Social Service Agency (ASSA), a non-governmental organization based at Sailongchhak, Anandapur, Keonjhar District, Orissa, India. Prior permission and ethical approval was obtained from local community leaders as well as ethical committee of Vidyasagar University. Information on ethnicity, age, occupation and educational status were obtained from all subjects with the help of a questionnaire. The data were collected from four villages, Bonianiposi, Morabali, Panchapolli and Sailong, in Anandapur region of Keonjhar district of Orissa, India. These villages are located approximately 150 kms from Bhubaneswar, the capital city of the state of Orissa. These villages were selected because all the residents belonged to the Savar ethnic group. Middle-aged and older adult (> 40 years) residents in the four villages were contacted and a total of 113 subjects were included in the study. The response rate was 83%. The sample size was calculated using standard formula as documented by earlier study (Bisai 2008). The minimum number of study sample was estimated to be 95 based on 53.8 % prevalence of undernutrition in community-based surveys (Bisai et al. 2009), with desired precision of 10%. Only non-pregnant and non-lactating women were measured and included in the present study. The vast majority of the subjects were illiterate and very low-wage earning manual labourers. Thus, they belonged to the low socio-economic class. Subjects were grouped into three age groups: Group I: 41-50 years (n = 47); Group II: 51-60 years (n= 44) and Group III: > 60 years (n= 22).

2. 2 Anthropometric Measurements

All anthropometric measurements were made by trained investigators (AK and HB) using internationally accepted standard protocol (Lohman et al. 1988). Height (Harpenden anthropometer) and weight (Libra weighing scale) were recorded to the nearest 0.1cm and 0.5kg, respectively. Technical errors of measurements (TEM) were computed and they were found to be within acceptable limits (Ulijaszek and Kerr 1999). Body mass index (BMI) was computed using the following standard equation:

BMI = Weight (kg) / Height (m^2).

It is now universally accepted (Bose and Das Chaudhuri 2003; Corish and Kennedy 2003; Davidson and Getz 2004; Pirlich and Lochs 2001; Suzana et al. 2002) that BMI is a suitable tool for evaluating nutritional status among older and elderly individuals. Thus, nutritional status was evaluated using internationally accepted World Health Organization (1995) BMI guidelines.

2.3 Body Composition

Percent body fat (PBF) was calculated using Siri's (1956) equation. The equation is:

$$PBF = (4.95/density - 4.50) \times 100.$$

Density was derived following Durnin and Womersley's (1974) equation using the sum of biceps, triceps, subscapular and suprailiac skinfold thickness.

Mid-upper arm muscle area (MUAMA) and mid-upper arm fat area (MUAFA) were calculated using the following equations (Gibson 1990):

$$MUAMA = \frac{(MUAC - (\pi \times TSK))^2}{4p}$$

$$MUAFA = \frac{TSK \times MUAC}{2} - \frac{\pi \times (TSK)^2}{4}$$

where TSK and MUAC are triceps skinfold and mid-upper arm circumference, respectively.

The distributions of anthropometric and body composition variables were not significantly skewed. ONEWAY (Scheffes' Procedure) ANOVA was performed to test for age group differences in mean anthropometric and body composition characteristics. Pearson correlation coefficients (r) and regression analyses were used to study the interrelationship between age and anthropometric and body composition characteristics. Odds ratio (OR) was employed to measure the risk between the groups. All statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS) Package. Statistical significance was set at $p < 0.05$.

3. RESULTS

The mean age of the subjects was 53.3 (sd = 8.5 years) years. The age range was 41-75 years. Table 1 presents the age group differences in mean anthropometric and body composition characteristics. There were significant age group differences in means of all variables. In all cases, age group I had the highest mean. There was a

Table 1.: Age differences of anthropometric characteristics of middle-aged and older Savar females

Variables	*Age Group-I (n= 47)*	*Age Group-II (n=44)*	*Age Group-III (n=22)*	*F*
Height (cm)	148.0 ± 5.3	147.7 ± 5.7	143.7 ± 6.7	4.583*
Weight (kg)	43.2 ± 6.4	38.5 ± 6.6	36.1 ± 7.2	10.166***
BMI (kg/m^2)	19.7 ± 3.0	17.6 ± 2.8	17.4 ± 2.9	7.694***
Sitting height (cm)	73.5 ± 3.0	72.1 ± 3.81	68.6 ± 4.6	13.362***
Circumference (cm)				
Mid Arm	23.3 ± 2.0	22.0 ± 2.8	20.8 ± 3.3	7.528***
Maximum hip	81.3 ± 5.6	77.6 ± 5.8	77.4 ± 6.1	6.058**
Mid thigh	36.5 ± 3.8	33.9 ± 4.2	32.4 ± 4.1	8.718***
Maximum calf	27.7 ± 2.5	26.1 ± 2.3	24.9 ± 2.6	10.124***
Skinfold Thickness (mm)				
Biceps	5.7 ± 2.1	4.5 ± 1.6	4.4 ± 1.8	5.951**
Triceps	10.0 ± 2.4	8.7 ± 2.2	8.3 ± 1.8	5.616**
Subscapular	11.5 ± 2.7	10.2 ± 3.0	9.2 ± 2.1	5.825**
Suprailiac	10.4 ± 3.2	8.8 ± 3.0	8.2 ± 2.7	5.357**
Medial calf	8.5 ± 2.6	7.2 ± 2.4	7.4 ± 2.1	3.288*
Body Composition				
PBF (%)	23.7 ± 3.5	21.7 ± 3.6	20.7 ± 3.5	6.622**
FFM (kg)	32.5 ± 3.7	29.9 ± 4.3	28.4 ± 4.5	8.803***
FFMI (kg/m^2)	14.9 ± 1.7	13.7 ± 1.7	13.7 ± 1.9	5.887**
FM (kg)	10.4 ± 2.9	8.5 ± 2.6	7.7 ± 2.8	8.382***
FMI (kg/m^2)	4.7 ± 1.4	3.9 ± 1.2	3.7 ± 1.2	7.140**
MUAMA (cm^2)	32.6 ± 5.7	29.9 ± 8.7	26.8 ± 8.7	4.370*
MUAFA (cm^2)	10.8 ± 3.1	9.0 ± 2.7	8.3 ± 2.8	7.365***

***p<0.001, **p<0.01, *p<0.05

trend of decreasing mean from group I to group III. The largest difference was observed for sitting height (F = 13.362) while medial calf skinfold had the smallest (F = 3.288) difference. Correlation studies of age with anthropometric and body composition variables (results not presented) revealed that age was significantly negatively correlated with all variables.

Linear regression analyses were undertaken with age as the independent variable. Results

Table 2: Linear regression between age and anthropometric characteristics.

Variables	*B*	*SeB*	*Beta*	*Adj R^2*	*t*
Height (cm)	-0.183	0.065	-0.260	0.059	-2.838**
Weight (kg)	-0.314	0.074	-0.374	0.132	-4.254***
BMI (kg/m^2)	-0.103	0.033	-0.287	0.074	-3.161**
Sitting height (cm)	-0.221	0.040	-0.462	0.207	-5.495***
Circumference (cm)					
Mid Upper Arm	-0.111	0.029	-0.341	0.109	-3.827***
Maximum hip	-0.206	0.065	-0.290	0.076	-3.188**
Mid thigh	-0.185	0.044	-0.368	0.128	-4.172***
Maximum calf	-0.137	0.027	-0.436	0.183	-5.103***
Skinfold Thickness (mm)					
Biceps	-6.990	0.020	-0.309	0.088	-3.428***
Triceps	-6.940	0.025	-0.255	0.056	-2.773**
Subscapular	-9.650	0.030	-0.289	0.075	-3.182**
Suprailiac	-0.104	0.033	-0.283	0.072	-3.112**
Medial calf	-6.120	0.027	-0.209	0.035	-2.253*
Body Composition					
PBF (%)	-0.145	0.039	-0.333	0.103	-3.715***
FFM (kg)	-0.189	0.046	-0.367	0.127	-4.157***
FFMI (kg/cm^2)	-5.340	0.020	-0.250	0.054	-2.722**
FM (kg)	-0.125	0.031	-0.354	0.117	-3.983***
FMI (kg/cm^2)	-4.980	0.014	-0.312	0.089	-3.462***
MUAMA (cm^2)	-25.021	8.435	-0.271	0.065	-2.968**
MUAFA (cm^2)	-11.376	3.286	-0.312	0.089	-3.462***

***p<0.001, **p<0.01, *p<0.05

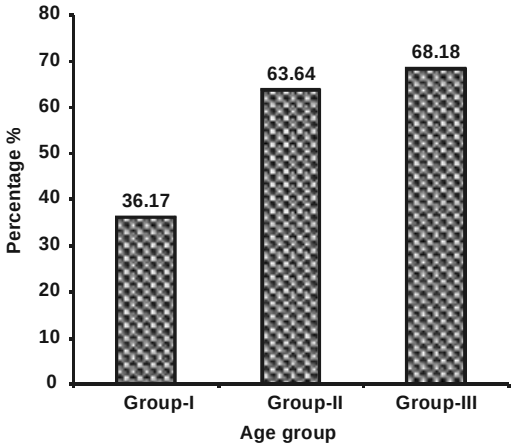

Fig. 1. Prevalence of undernutrition by age group.

revealed that (Table 2), for all variables, age had a significant negative impact. The amount of variation explained by age ranged from 3.5% (medial calf skinfold) to sitting height (20.7%).

Studies on the nutritional status of Savar women revealed that (Table 3) 53.1% of all women (n = 60) belonged to the undernutrition category. There was an increasing trend (Chi-square = 7.971, p=0.00475) in the prevalence of undernutrition (BMI<18.5) with increasing age group (Fig.1). Moreover, women with age group-I had 3.09 (OR = 3.09; confidence interval (CI): 1.21-7.99) fold and 3.78 (CI: 1.15- 12.85) fold lower chance to be undernourished compared to age group-II and age group-III, respectively.

Table 3: Nutritional status of the subjects.

Nutritional status	*BMI*	*Percentage*
CED Grade III	< 16.0	23.0 (26)
CED Grade II	16.0 – 16.9	14.2 (16)
CED Grade I	17.0 – 18.4	15.9 (18)
Normal	18.5 – 24.9	17.7 (52)
Overweight	³ 25.0	0.9 (1)

Numbers are given in parentheses.

4. 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 or social conditions (Bose 2003; Ghosh et al. 2001; McLorg 2005; Oguntona and Kuku 2000). Even more scanty information is available on the anthropometric and nutritional profile of older people among the various tribal populations of India (Bose and Chakraborty 2005). It is very important to assess the nutritional status of older people because of its role in ensuring a better quality of life and its association with functional ability (Dandekar 1996; Ghosh et al. 2001; Kikafunda and Lukwago 2005; Manandhar et al. 1997b). Furthermore, anthropometry has also been extremely useful in identifying changes in body size and composition that occur with old age (Bose 2002; Bose and Das Chaudhuri 2003; Chumlea et al. 1986; 1989; McLorg 2005; Ghosh et al. 2001). Anthropometric measurements pro-vide an indirect assessment of body composition and are easy and economical to undertake making them ideally suited for field surveys (Chumlea et al. 1986, 1989, Bose 2002, Singal and Sidhu 1983, Sidhu et al 1988, Ghosh et al. 2001, Bose and Das Chaudhuri 2003, Ghosh 2004, Ghosh and Das Chaudhuri 2005). Many studies worldwide (Burr and Phillips 1984, Chumlea et al. 1986, Shimokata et al 1989, Miccozi and Harris 1990, Yassin and Terry 1991, Delaure et al. 1994, Oguntona and Kuku 2000, Chilima and Ismail 1998) have already reported on health and nutritional status among older and elderly individuals utilizing anthro-pometry from different parts of the world. However, only a few studies (Singal and Sidhu 1983, Singal et al. 1988, Bagga 1997, Manandhar et al. 1997a, Ghosh et al. 2001, Bose and Das Chaudhuri 2003, Ghosh 2004, Ghosh and Das Chaudhuri 2005) have dealt with age changes in anthropometric characteristics among older and elderly individuals from India. Moreover, to date, no detailed investigation has been undertaken to study age trends in anthropometric and body composition characteristics among any tribal population of India. The present study provides unique data on age trends of anthropometric and body composition profile of middle-aged and older female Savars, a tribal population of Eastern India.

The results of the present study show that a significant decreasing age trend exists in anthropometric and body composition variables among middle-aged and older Savar females. These results are in concordance with studies from other parts of the world on different ethnic groups (Bose 2002; Burr and Phillips 1984; Chandler and Bock 1991; 1991; Chumlea et al. 1986; 1989; Chilima and Ismail 1998; Kuozmarski et al. 2000; McLorg 2005; Miccozi and Harris 1990; Santos et al. 2004;

Strickland and Ulijaszek 1993) which have also reported a similar negative age trend in various anthropometric and body composition characteristics. In the Indian context, the significant negative age trend in anthropo-metric and body composition profile of Savars was similar to that reported among older and elderly Bengalee Hindus by two recent studies (Bose and Das Chaudhuri 2003; Ghosh 2004) from Kolkata, India.

It has been documented that malnutrition is more common in elderly persons than in younger adults (Pirlich and Lochs 2001). Older people, especially those residing in rural areas, are at a greater risk of malnutrition (Suzana et al. 2002). High prevalence of undernutrition among older Savar women is the striking feature of this study. Using WHO (1995) classification of nutritional status according to BMI values, 53.1% of older Savar women in this study were thin. The rate of undernutrition among older Savar women was much higher than those reported among other rural populations in developing countries (Chilima and Ismail 1998; Pieterse et al. 1998; Suzana et al. 2002; Zverev and Chisi 2004) including India (Bose and Das Chaudhuri 2003). However, a recent study (Kikafunda and Lukwago 2005) had reported a higher prevalence of undernutrition (68%), compared to the Savar females of this study, among elderly women from Mpigi District of central Uganda. These results indicate that undernutrition is a serious problem among middle-aged and older Savar women.

In conclusion, it can be stated that because prevention of undernutrition among Savar females is essential, the roles of nutritional screening and assessment are important. Since malnutrition in elderly people is a consequence of somatic, psychic or social problems (Pirlich and Lochs 2001), the interrelations between these factors should be further investigated among this ethnic group. Since the nutritional status of this population is very unsatisfactory, recognition of social and health factors associated with the poor nutrition status will allow appropriate intervention to enhance the quality of the life of middle-aged, older and elderly females.

The key points of this study were:

1) Among middle-aged and older Savar tribal women, age was significantly negatively related with all anthropometric and body composition variables and indices.
2) Undernutrition (BMI below 18.5 kg/m^2) was a serious problem among this ethnic group.
3) Immediate appropriate nutritional intervention programmes should be initiated among them.

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