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Original Research Article

# Anthropometry, Body Composition, Metabolic Profiles and Blood Pressure in Elderly of Asian Indian Origin: The Santiniketan Longitudinal Study on Aging

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## Abstract

**Objective:** The present study was aimed to investigate the changes and interaction of metabolic and body fat distribution variables in a gap of one year.

**Methods:** A total of 254 participants aged 55 to 70 years took part in the longitudinal study. Anthropometric measures were collected and body fat distributions were subsequently calculated. Metabolic variables and blood pressure were also recorded. All measures were taken twice in a gap of one year.

**Results:** There were significant changes on height, waist circumference mid upper arm circumference, sum of four skinfold, arm muscle circumference, arm muscle area, arm fat area, waist-height ratio, conicity index, total cholesterol, triglycerides, high and very low density lipoprotein as well as insulin and HOMA-IR. Partial correlation (adjusted for sex) revealed no significant negative association between changes in metabolic and body fat distribution.

**Conclusion:** Increasing age didn't warrant decrease in cardiovascular risk by means of metabolic and body fat distribution measures.

**Keywords:** Ageing, longitudinal study, body composition, metabolic syndrome, Asian Indians

## 1. Introduction

Older people are becoming an increasing important proportion of the population of the developing countries. [1] According to 2001 census, the total aged (55 years and above) population of India is approximately 112 million or 13.2% of the total population. This population will be increased to 14.8% by the year 2020. [2] Although the population of older people is increasing in India (109 million in 1991 to 112millions in 2001) the biological problems of aging have not been viewed as a critical issue. [1] Yet little information exists on their nutritional status or body composition. [3,4] Only few studies are so far undertaken to deal with the age trends in anthropometric characteristics among the elderly individuals from India. [5] There have been a few studies from India. [6-9] which have dealt with age trends in anthropometric characteristics among elderly individuals. [4] Changes in body composition occur with increasing age, but these changes are also affected by numerous covariate factors.[1] The present longitudinal study was aimed to investigate the changes and interaction of metabolic and body fat distribution variables in a gap of one year among the Asian Indians elderly in India.

## 2. Materials and Methods

### 2.1 Study population

The present community passed longitudinal study was conducted between October 2012 and October 2014. Initially a total of 300 individuals aged 55 years and above (male: female = 1:1) was selected randomly using local voter's registration list. However, a total of 30 individuals (male=12, female= 18) were excluded because of their prolong illness (under medication for hyper tension, blood sugar or hormone therapy). A further 16 individuals were excluded because of their unwillingness to provide blood sample for the study. Therefore a total of 254 individual were finally participated in the present longitudinal study. The study was divided into two phase with a gape of exact one year. In the first phase anthropometry, metabolic profile, blood pressure and socioeconomic data were obtained from all 254 individuals. In a gape of exact one year information on anthropometry, metabolic profile, blood pressure and socioeconomic characteristics were again obtained from some 254 participants. All participants were 55 years and above and were inhabitants of Bolpur, Santiniketan area (lies in between

$23^0$40' north latitude and $87^0$43' east longitude); West Bengal, India. All participants were reported freedom from any serious disabilities or illness. The subjects were visited in their respective homes, and age was ascertained and then crosschecked with horoscope. The written consent from participants was also obtained prior to actual commencement of the study. The institutional ethics comity had approved the study.

### 2.2 Measurements

***Anthropometric variables***

Anthropometric measure namely height (nearest to 0.1 cm), weight (nearest to 0.5 kg) minimum waist circumference (MWC) (nearest to 0.1 cm), maximum hip (MHC) circumference (nearest to 0.1cm), mid upper arm circumference (MUAC) (nearest to 0.1 cm) and skinfolds (nearest to 0.2 mm) at biceps, triceps, subscapular and suprailiac were collected using standard techniques. [10] Percentage of body fat (% BF), sum of four skinfold ($SF_4$), fat mass (FM), fat free mass (FFM), arm muscle circumference (AMC) , arm muscle area (AMA), arm fat area (AFA), basal metabolic rate (BMR), body mass index (BMI), as well as trunk- extremity ratio (TER), waist-hip ratio (WHR), waist height ratio (WHtR), conicity index (CI), intrabdominal visceral fat (IVF) were subsequently calculated using standard equations [5].

***Metabolic Profiles***

A fasting blood sample (7ml) was collected from 254 subjects for the determination of fasting blood glucose (FBG in mg %) and lipid profile ( mg%) namely total cholesterol (TC), Triglyceride (TG), High (HDL), low (LDL) and very low density lipoprotein (VLDL), insulin and uric acid. All subjects maintained an overnight fast of ≥ 12 hours prior to blood collection. The plasma was separated within 2h of blood collection using a micro centrifuge at 1000 rpm for about 20 min at room temperature. Estimation of FBG, TC, TG and HDL were carried out using an ERBA microscan ELISA Reader (Trans Asia Biomedical Limited, Mumbai, India). Low-density Lipoprotein (LDL) and very low-density lipoprotein (VLDL) were then calculated by using the standard formula: LDL= TC-(HDL+TG/5) and VLDL=TG/5. Homeo stasis model assessment-insulin resistance (HOMA-IR) was calculated using standard equation:

$$\text{HOMA-IR} = \frac{\text{fasting insulin } [\mu U/mL] \times \text{fasting glucose } [mg\ \%]}{22.5}$$

***Blood pressure***

Left arm systolic (SBP) and diastolic (DBP) blood pressure was taken from the participants with the help of an Omron MI digital electronic blood/ pulse monitor (Omron Corporation, Tokyo, Japan). Two BP measurements were taken after 5 minutes interval and averaged for analysis. Mean arterial pressure (MAP) was then calculated accordingly:

MAP = DBP + 1/3 (SBP-DBP)

### 2.3 Statistical analyses

Descriptive statistics such as mean, standard deviation (SD) were undertaken separately for each phase (viz. phase I and Phase II) and was compared using paired *t* test. Pearson's partial correlation coefficient (adjusted for sex) between changes (Δ) in metabolic profiles and changes in body fat distribution were also computed. All statistical analysis was performed using the SPSS (PC+ version 17). A p value of <0.05 (two tailed) was considered as significant.

## 3. Results

Mean and standard deviation (SD) of anthropometry, body composition and metabolic profiles, blood pressure for both the phases are presented in **Table 1**. The 't' test revealed significant phase differences for height, MWC, MHC, MUAC, AMC, AMA, AFA, WHtR, CI % BF, $SF_4$, VFL, TC, TG, HDL, VLDL, Insulin and HOMA-IR.

Partial correlation coefficient (adjusted for sex) between changes in metabolic profiles and changes in body fat distribution is presented in **Table 2**. It was revealed that there existed significant associations between ΔTER-ΔTC, ΔTER-ΔHOMA IR, ΔTER-ΔHDL, ΔCI –ΔTG, ΔCI-ΔDLDL.

**Table 1: Baseline characteristic of the study population (n = 254)**

| Variables | Survey 1 | | Survey 2 | | *p value* |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Age (year) | 64.16 | 6.28 | 65.20 | 6.33 | 0.000 |
| Height (cm) | 160.32 | 8.29 | 159.87 | 8.44 | 0.000 |
| Weight (kg) | 59.21 | 12.00 | 59.01 | 12.29 | 0.197 |
| MWC (cm) | 82.28 | 10.81 | 83.19 | 11.42 | 0.001 |
| MHC (cm) | 93.18 | 10.28 | 92.03 | 10.14 | 0.009 |
| MUAC (cm) | 26.03 | 3.02 | 25.28 | 3.05 | 0.000 |
| BMI ($kg/m^2$) | 23.00 | 4.14 | 23.01 | 4.24 | 0.835 |
| WHR | 0.88 | 0.19 | 0.90 | 0.06 | 0.269 |
| WHtR | 0.51 | 0.06 | 0.52 | 0.07 | 0.000 |
| CI | 1.24 | 0.07 | 1.25 | 0.07 | 0.000 |
| TER | 1.93 | 1.17 | 2.16 | 1.55 | 0.012 |

| Table 1 Continue………… | | | | | |
|---|---|---|---|---|---|
| %BF | 29.62 | 7.16 | 30.27 | 7.03 | 0.030 |
| FM (kg) | 17.65 | 5.93 | 17.97 | 5.94 | 0.084 |
| FFM (kg) | 41.56 | 8.75 | 41.04 | 8.85 | 0.008 |
| AMC (cm) | 23.72 | 2.75 | 23.40 | 2.58 | 0.001 |
| AMA ($cm^2$) | 45.40 | 10.40 | 44.15 | 9.52 | 0.000 |
| AFA ($cm^2$) | 9.29 | 4.43 | 7.49 | 4.50 | 0.000 |
| SF4 (mm) | 30.13 | 13.17 | 24.33 | 12.89 | 0.000 |
| BMR (kcal) | 1274.90 | 517.54 | 1237.89 | 163.33 | 0.247 |
| IVF ($cm^2$) | 92.40 | 51.53 | 94.91 | 51.93 | 0.073 |
| VFL | 9.24 | 5.15 | 9.51 | 5.16 | 0.041 |
| TC (mg %) | 178.07 | 23.31 | 169.73 | 22.02 | 0.000 |
| TG (mg %) | 133.88 | 40.63 | 123.93 | 46.00 | 0.000 |
| HDL (mg %) | 37.01 | 5.71 | 33.77 | 4.7 | 0.000 |
| LDL (mg %) | 114.62 | 18.24 | 112.04 | 14.18 | 0.034 |
| VLDL (mg %) | 26.66 | 8.05 | 24.80 | 9.26 | 0.001 |
| FBG (mg %) | 91.71 | 20.50 | 91.15 | 23.17 | 0.639 |
| Insulin (nU/mL) | 4.40 | 2.83 | 2.75 | 1.59 | 0.000 |
| HOMA-IR | 18.49 | 13.75 | 12.21 | 13.28 | 0.000 |
| Uric acid (mg %) | 5.84 | 3.06 | 5.48 | 1.19 | 0.058 |
| SBP (mm Hg) | 138.14 | 18.74 | 140.26 | 20.10 | 0.067 |
| DBP (mm Hg) | 81.86 | 10.93 | 81.17 | 10.99 | 0.334 |
| MAP | 100.62 | 11.96 | 100.87 | 12.99 | 0.749 |

MWC- minimum waist circumference, MHC-maximum heap circumference, MUAC-mid upper arm circumference, BMI- body mass index, , WHR-waist-hip ratio, WHtR-waist height ratio, CI-conicity index, TER-trunk extremity ratio, %BF-percentage of body fat, FM-fat mass, FFM-fat free mass, AMC-arm muscle circumference, AMA-arm muscle area, AFA-arm fat area, $SF_4$-sum of four (biceps, triceps, subscapular suprailliac) skinfold, BMR-basal metabolic rate, IVF- intra-abdominal visceral fat, VFL-visceral fat level TC-total cholesterol, TG-triglyceride, HDL-high density lipid, LDL-low density lipid, VLDL-very low density lipid, FBG-fasting blood glucose, SBP-systolic blood pressure, DBP-diastolic blood pressure, MAP-mean arterial pressure

**Table 2: Partial correlation coefficient (adjusted for sex) between changes in body fat distribution and changes in metabolic variables**

| | **ΔTC** | **ΔTG** | **ΔVLDL** | **ΔHDL** | **ΔInsulin** | **ΔHOMA-IR** |
|---|---|---|---|---|---|---|
| **ΔAGE** | -0.047 | -0.071 | -0.078 | -0.030 | -0.003 | 0.000 |
| **ΔMHC** | 0.026 | 0.054 | 0.054 | 0.129 | 0.024 | -0.011 |
| **ΔMWC** | 0.092 | 0.081 | 0.090 | 0.102 | -0.055 | -0.057 |
| **Δ$SF_4$** | 0.016 | -0.025 | 0.003 | -0.043 | 0.113 | 0.075 |
| **ΔTER** | -0.039 | -0.039 | -0.073 | -0.039 | -0.005 | -.0015 |
| **ΔWHR** | 0.101 | 0.081 | 0.091 | 0.111 | -0.053 | -0.053 |
| **ΔWHtR** | 0.096 | 0.081 | 0.090 | 0.109 | -0.052 | -0.053 |
| **ΔCI** | 0.052 | 0.035 | 0.048 | 0.092 | -0.087 | -0.080 |

## 4. Discussion

The present community based longitudinal study provides valuable information regarding age variation (changes) in anthropometry, body composition, metabolic profiles and blood pressure measures among the elderly individuals of Asian Indian origin.

No significant changes for weight, fat mass, BMI, WHR and IVF indicated that in spite of increasing age, subjects were maintaining over all (e.g. BMI or FM) as well as trunkal fat (e.g. WHR or IVF). On contrary, negative age trend on muscle mass (e.g. FFM) indicated that aging process was more prominent for FFM compared to FM. This fact is critically important for people of Indian origin (PIO) where cardiovascular disease (CVD) risk factors occurred with increasing level of trunkal fat for any given level of BMI. [11] Moreover, no consistent significant association between change in body fat distribution and metabolic measures (except for ΔTER) adjusted for sex vindicated the fact that aging process was less pronounced on trunkal fat and lipids in both the sexes.

The major limitation of the study was the small sample size and therefore is not representative of the Asian Indian population. Short time duration further limits the present study.

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## Contribution

There is no conflict of interest so far as authorship and funding is concerned. TD was responsible for data collection and preparation of the draft manuscript. AG was responsible for the study design, analyses and final version of the manuscript.

## References

[1] Ghosh A., Das Chaudhuri A.B., Explaining Body composition by some Covariate factors among the elderly Bengalee Hindu women of Calcutta, India. *The Journal of Nutrition, Health and Aging*; 2005; 9: 403-406.

[2] Kinsella K., Suzman R. Demographic dimension of population ageing in developing countries. *American Journal of Human Biology*, 1992; 4: 3-8.

[3] Chilima D.M., Ismail S.J. Anthropometric characteristic of older people in rural Malawi. *European Journal of Clinical Nutrition*, 1998; 52: 643-649.

[4] Ghosh A., Bose K., Das Chaudhuri A. B. Age and Sex variations in adiposity and central fat distribution among elderly Bengalee Hindus of Calcutta, India. *Annals of Human Biology*, 2001; 18: 616-623.

[5] Ghosh A. Age and sex variation in measures of body composition among the elderly Bengalee Hindus of Calcutta, India. *Collegium Antropollegicum* 2004: 128: 553-61.

[6] Singal, P., and Sidhu, L. S. Age changes in skinfolds, body fat and lean body mass in Jat-Sikh and Bania females during 20 to 80 years. *Anthropologischer Anzeiger*, 1983; 41: 179-189.

[7] Singal, P., Sidhu, L. S., and Bhatnagar, D. P. Estimated fat, bone mineral, total body water and cell solids in females of two communities of Punjab. *Anthropologischer Anzeiger*, 1988; 46: 51-57.

[8] Bagga, A. Normality of ageing: a cross-cultural perspective. *Journal of Human Ecology*, 1997; 9: 35-46.

[9] Manandhar, M.C., Ankelsaria, P.S., and Ismail, S. Weight, skinfolds and circumference characteristics of poor elderly people in Mumbai, India. *Asia Pacific Journal of Clinical Nutrition*, 1997; 6: 191-199.

[10] Lohman, T.G., Roche, A.F., and Martorell, R. *Anthropometric Standardization Reference Manual* (Chicago: Human Kinetics Books) 1988.

[11] Ghosh A., Bala S.K., Anthropometric, body composition, and blood pressure measures among rural elderly adults of Asian Indian origin: the Santiniketan aging study. *Journal of Nutrition in Gerentology and Geriatrics*, 2011; 30: 305-313.