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CHANGES IN METABOLIC SYNDROME PHENOTYPES IN ELDERLY OF ASIAN INDIAN ORIGIN: THE SANTINIKETAN LONGITUDINAL STUDY ON AGEING

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ABSTRACT

Objective: Virtually no studies have been undertaken to investigate the changes (longitudinal) in metabolic syndrome (MS) phenotypes in elderly people of Asian Indian origin. The present study was aimed to examine the longitudinal changes (yearly change) in MS phenotypes in elderly people of Asian Indian origin. **Methods**: A total of 254 participants aged 55 years and above took part in this longitudinal study. Anthropometric measures were collected using standard techniques. Measures and obesity and body composition were subsequently calculated. Metabolic profiles and blood pressure were also measured. All anthropometric, metabolic and blood pressure measures were twice measured in a gape of one exact year. **Results**: The ANOVA revealed significant phase differences in both sexes for BMI, TER, and LDL whereas, phase differences for TC, TG, HDL, and VLDL. It was further observed that there existed significant phase differences for WC (only for male), TG and HDL (only for male) status. **Conclusion**: This thing vindicated the fact that people of Asian Indian origin maintain a considerable level of central or abdominal obesity along with increased level of metabolic profiles and haemodynamic factors (i.e. blood pressure) notwithstanding of progressive age.

KEYWORDS: ageing, longitudinal study, body composition, metabolic syndrome, Asian Indians.

INTRODUCTION

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 percentage will be increased to 14.8% by the year 2020.[1] Most studies in India have investigated social aspects involved in the ageing process. The non-invasive technique of anthropometry could be used to provide information on health and nutritional status of all ages including elderly individuals. Genetic and environmental factors such as lifestyles, socioeconomic status access to health facilities, health conditions and differences in mortality of older people bring about differences in anthropometric characteristic between populations.[2] Changes in body composition occur with increasing age, but these changes are also affected by numerous covariate factors. These factors range from physical activity to menopausal status to nutrition and diseases.[1]

Metabolic syndrome (MS) more prevalent with increasing age, affecting half of adults aged 60 years and over. MS is a constellation of risk factors such as central obesity, hyperglycemia, decreased high density lipoprotein (HDL), increased triglyceride, and high blood pressure, which predisposes the individual to increased risk for development of diabetes mellitus and cardiovascular diseases.[3] The metabolic syndrome is a cluster of cardiovascular risk factors that is characterized by obesity, central obesity, insulin resistance, atherogenic dyslipidaemia and hypertension.[4] Obesity has become a drastic problem all over the globe. It increased with age and the highest prevalence rates of obesity was estimated in the middle age group. The obesity prevalence attained the highest value in the age range of 50 and above year's group.[5] The degree of insulin resistance also reveals an increase with increasing age, and elderly are therefore at a higher risk to develop the cardiometabolic risk factors summarized as the MS.[3] Two measures of central adiposity, waist circumference (WC) and waist-height ratio (WHtR) have been used in research and clinical contexts, out of which, WC is said to be the best simple index of fat distribution.[6,7]

Studies pertaining to physiological changes with increasing age were virtually absent on Asian Indian population. Moreover, there existed no studies on changes in MS phenotypes among the Asian Indian population. Keeping this view in mind, the present longitudinal study was aimed to examine the longitudinal changes (yearly change) in MS phenotypes in elderly people of Asian Indian origin living in and around of Santiniketan, West Bengal, India.

2. MATERIALS AND METHODS

2.1 Study population

The present community based longitudinal study was conducted between October 2012 and October 2014. Initially a total of 300 individuals 55 years and above (male: female = 1:1) was selected randomly using local voter's registration list. To avoid intra-household clustering of CVD risk factors only one subject was chosen from each house hold. However a total of 30 individuals (male = 12, female = 18) were excluded because of their prolong illness (under medication for hypertension, 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 individuals were finally participated in the present longitudinal study. The study was divided into two phase with a gape of 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 anthropometry, metabolic profile, blood pressure and socioeconomic characteristics were again obtained from same 254 participants. All participants were inhabitants of Bolpur, Santiniketan area (lies in between $23^0$40' North latitude and $87^0$43' East longitude) West Bengal, India. The age was ascertained using school leaving certificate and was also crossed checked with available horoscope. The written consent from participants was also obtained prior to actual commencement of the study.

2.2 Anthropometric and body composition measure

Height, weight, circumference of minimum waist (MWC), and maximum hip (MHC) as well as skinfold thickness at biceps, triceps, subscapular and suprailiac were taken using standard techniques.[8] Height and weight of lightly clothed subjects were measured to the nearest 0.1 cm and 0.1 kg, respectively. Circumferences were measured with an inelastic tape to the nearest 0.1 cm. in the standing position. Waist-hip ratio (WHR) and trunk-extremity ratio (TER) were computed accordingly. Body mass index (BMI) was measured using an Omron body fat analyzer (Omron Corporation, Tokyo, Japan). The validity of the analyzer was checked periodically by calculating BMI separately using the standard equation (weight in kg/height in m^2).

2.3 Metabolic profiles

A fasting blood sample (7ml) was collected from 254 subjects for the determination of fasting blood glucose (FBG in mg %) and lipids profiles (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 ERBAmicroscan ELISA Reader (Trans Asia Biomedical Limited, Mumbai, India). Low-density Lipoprotein (LDL) and very low-density lipoprotein (VLDL) were then calculated using the standard formula: LDL= TC-(HDL+TG/5) and VLDL=TG/5. Homeostasis model assessment-insulin resistance (HOMA-IR) was calculated using standard equation: fasting insulin [(µU/mL] × fasting glucose [mmol/L]/22.5.

2.4 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 blood pressure measurements were taken and averaged for analysis. A third measurement was only taken when the difference between the 2 measurements was ≥5 mmHg, and subsequently, the mean was calculated. A 5 minutes relaxation period between measurements was maintained throughout the study. The working condition of the instrument was checked periodically using a mercury sphygmomanometer and stethoscope. Mean arterial pressure (MAP) was then calculated using the standard equation:

MAP = DBP + 1/3(SBP – DBP).

2.5 Metabolic syndrome definition

In the present study, MS was defined according to consensus definition for adult Asian Indians[7] with some modifications.[9] Individuals were defined as having the MS if the individuals met three or more of the following five conditions: WC > 90 cm in male and > 80 cm in female; TG ≥150 mg %; FBG ≥ 100 mg %; BP ≥ 130/≥85 mm Hg; HDLc, 40 mg % in male and < 50 mg % in female.

2.6 Statistical analysis

Mean and standard deviation (SD) of variables were separately undertaken for two phases. Phase differences (i.e. longitudinal/yearly changes) for obesity measures, body fat distribution, metabolic profiles were undertaken using analyses of variance (ANOVA). Comparison between two phases for central obesity status (based on waist circumference), dyslipidaemia (based on TG and HDL), hypertension (based on SBP) and increased glucose level (based on FBG), chi-square test were also undertaken

All statistical analyses were carried out using the SPSS (PC + version 17). A p value of < 0.05 (two tailed) was considered as significant.

3. RESULTS

The mean and standard division (SD) of obesity measures (WC, BMI, WHR, TER) metabolic profiles (TC, TG, HDL, LDL, VLDL, FBG, Insulin and HOMA-IR) and blood pressure measures (SBP, DBP and MAP) by phases (phase I vs. phase II) sex are presented in **Table 1**. The ANOVA revealed significant phase differences in both sexes for BMI, TER, and LDL whereas, phase differences for TC, TG, HDL, and VLDL were only evident in female. Significant phase difference

for SBP was observed only in male. No significant phase differences were observed for rest of the variables.

Comparison of MS phenotypes by phases and sex (for variables having sex specific cut-offs) is presented in **Table 2**. It was observed that there existed significant phase differences for WC (only for male), TG and HDL (only for male) status (based on MS cut-offs) whereas no significant phase differences was observed for SBP and FBG.

Table 1. Baseline changes in obesity, body composition, metabolic profiles and blood pressure measures in the study (n=254)

	Phase I			Phase II		
	Mean	SD		Mean	SD	p value for ANOVA
			WC			
Male	82.18	10.48		82.87	10.93	0.806
Female	82.56	11.78		84.08	12.74	0.457
			BMI			
Male	1335.10	586.20		1284.81	144.46	0.002
Female	1106.91	139.38		1106.91	140.72	0.000
			WHR			
Male	0.89	0.22		0.90	0.06	0.339
Female	0.87	0.54		0.89	0.05	0.148
			TER			
Male	2.10	1.27		2.39	1.68	0.000
Female	1.48	0.69		1.51	0.89	0.000
			TC			
Male	176.82	22.91		167.72	20.81	0.157
Female	181.53	24.23		175.35	24.36	0.015
			TG			
Male	133.40	41.67		120.49	43.48	0.756
Female	135.20	37.85		133.53	53.42	0.049
			HDL			
Male	37.12	5.96		33.28	4.38	0.601
Female	36.70	4.98		35.13	5.56	0.006
			LDL			
Male	113.33	17.85		110.83	12.65	0.029
Female	118.23	18.96		115.41	17.44	0.023
			VLDL			
Male	26.69	8.34		24.01	8.56	0.932
Female	26.59	7.27		27.01	10.76	0.023
			FBG			
Male	91.94	20.99		90.73	24.96	0.771
Female	91.08	19.20		92.32	17.31	0.630
			Insulin			
Male	4.38	3.03		2.79	1.66	0.811
Female	4.47	2.19		2.67	1.38	0.594
			HOMA-IR			
Male	18.33	14.13		12.46	14.65	0.764
Female	18.92	12.72		11.48	8.39	0.606
			SBP			
Male	139.59	18.60		140.68	20.93	0.039
Female	134.09	18.68		139.08	17.67	0.577
			DBP			
Male	81.87	10.39		80.89	10.81	0.982
Female	81.83	12.41		81.97	11.53	0.493
			MAP			
Male	101.11	11.60		100.82	13.32	0.277
Female	99.25	12.91		101.01	12.12	0.921

WC= waist circumference, BMI= body mass index, WHR= waist-hip ratio, TER= trunk-extremity ratio, TC= total cholesterol, TG= triglyceride, HDL= high density lipoprotein, LDL= low density lipoprotein, VLDL= very low density lipoprotein, FBG= fasting blood glucose, HOMA-IR= homeostasis model assessment-insulin resistance, SBP= systolic blood pressure, DBP=diastolic blood pressure, MAP= mean arterial blood pressure.

Table 2. Comparison of MS phenotypes* by phases (a gap of one year)

	Phase I	Phase II
WC in Male		
WC > 90 cm.	39	187
WC ≤ 90 cm.	148	00
$\chi^2_{(1)}$ =244.92, p < 0.0001		
WC in Female		
WC > 80 cm.	00	00
WC ≤ 80 cm.	67	67
$\chi^2_{(1)}$ =0, p < 0.50		
TG		
TG ≥ 150 mg %	71	46
TG < 150 mg %	183	208
$\chi^2_{(1)}$ = 6.84, p < 0.01		
HDL in Male		
HDL < 40 mg %	132	173
HDL ≥ 40 mg %	55	14
$\chi^2_{(1)}$ =29.86, p < 0.0001		
HDL in Female		
HDL < 50 mg %	67	67
HDL ≥ 50 mg %	00	00
$\chi^2_{(1)}$ = 0, p < 0.50		
SBP		
SBP ≥ 130	179	168
SBP < 130	75	86
$\chi^2_{(1)}$ = 1.08, p < 0.50		
FBG		
FBG ≥ 100 (mg %)	49	37
FBG < 100 (mg %)	205	217
$\chi^2_{(1)}$ = 2, p < 0.50		

*= *sex specific cut-offs were used wherever applicable*

4. DISCUSSION

This study reports on the effects of the increasing age on anthropometry, obesity measures, body composition, metabolic profiles and blood pressure in one year longitudinal study on elderly individuals (aged 55 years and above) of Asian Indian origin.

The constellation of centrally distributed obesity, decreased HDL, elevated TG, elevated blood pressure and hyperglycemia is known as the MS. Person with MS are at twice the risk for cardiovascular disease CVD compared with those without the syndrome.[9] The MS, as a principal cause for diabetes and cardiovascular disease (CVD), is considered a major challenge to public

health throughout the world.[3] Despite having lower prevalence of obesity as defined by BMI, Asian Indians tend to have greater WC and WHR, thus having a greater degree of central obesity.[10]

In our study significant phase differences were observed for BMI, TER, LDL in sexes whereas, differences for TC, TG, HDL, VLDL were observed only in female and SBP in male between the two phase (Phase I vs. Phase II). Changes (significant increasing trend) in female compared to male vindicated that Asian Indian women are no less vulnerable compared to their male counter part in MS risk factors. Moreover, no significant changes in MS phenotypes (viz. WC, WHR, FBG, insulin, HOMA-IR, SBP, DBP and MAP) with increasing age were also observed in the study. This thing further vindicated the fact that people of Asian Indian origin maintain a considerable level of central or abdominal obesity along with increased level of metabolic profiles and haemodynamic factors (i.e. blood pressure) notwithstanding of progressive age. Furthermore, significant effects of both sex on TER indicated that the aging process was more pronounced on subcutaneous fat (e.g. TER) as compared to visceral fat (e.g. WHR).[1-3,9-11]

Increased numbers of centrally obese (based on WC) and dyslipidaemic (based on HDL) males and increased TG in both sexes may be attributed to various factors including levels of physical activity, sex hormones and societal environment.[1, 9-13]

Some shortcomings however, are associated with the present study, including small sample size. Hence it is not representative of the entire Asian Indian rural elderly population. Relatively short time duration further limits the present study.

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