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Metabolic syndrome among elderly care-home residents in southern India: a cross-sectional study

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ABSTRACT

Background: The health of the elderly population and the emergence of noncommunicable diseases have become major public health issues in recent years. Metabolic syndrome is thought to be the main driving force for the global epidemic of cardiovascular diseases, as well as for type 2 diabetes. This cross-sectional study aimed to determine the prevalence of metabolic syndrome and its correlates among the residents of care homes for the elderly in Hyderabad city, India.

Methods: A total 114 elderly persons (aged ≥60 years) were evaluated in a cross-sectional study. Metabolic syndrome was defined by the 2005 criteria of the International Diabetes Federation. Data were collected on selected sociodemographic, behavioural and nutritional variables and cardiometabolic risk factors. Blood pressure and anthropometric measurements were also recorded. Fasting blood samples were collected for measurement of blood glucose and serum lipid levels. Univariable logistic regression was applied to investigate the associations between metabolic syndrome and known risk factors; adjusted analysis was then done by multivariable logistic regression for significant variables.

Results: The overall prevalence of metabolic syndrome was 42.1% (48/114) among the study population. A higher prevalence (50.9%; 27/53) was found among women. High blood pressure or taking antihypertensive medication was found to be the most common (95.8%; 46/48) cardiometabolic component. The risk of metabolic syndrome did not differ significantly by age group, sex, caste, religion, type of diet (vegetarian or non-vegetarian), educational status, behavioural factors such as tobacco use and alcohol intake, physical activity (assessed by modified Eastern Cooperative Oncology Group [ECOG] scale), or physical exercise. However, a body mass index ≥23 kg/m^2 was associated with metabolic syndrome (unadjusted odds ratio [OR]: 8.97; 95% confidence interval [CI]: 3.78–21.28); adjusted OR: 9.31; 95% CI: 4.12–22.14)

Conclusion: The overall prevalence of metabolic syndrome in this study population of elderly care-home residents in India was more than 40%. Further research on the burden of metabolic syndrome in the elderly population is warranted.

Key words: cardiometabolic risk factors, care home, elderly, metabolic syndrome, noncommunicable disease

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BACKGROUND

Rapid urbanization and lifestyle changes, coupled with nutritional transition, has led to the emergence of noncommunicable diseases in the last few decades, especially in low- and middle-income countries. Metabolic syndrome, a clustering of impaired glucose metabolism, dyslipidaemia, hypertension and central obesity, is associated with the subsequent development of cardiovascular diseases and type 2 diabetes. Individuals with metabolic syndrome are at greater risk of cardiovascular mortality and morbidities.[1,2] Previous studies have shown a high prevalence of various components of metabolic syndrome among the Indian population compared to the population of high-income countries, probably because of a higher prevalence of abdominal obesity and insulin resistance.[3–5]

Population ageing has become a major concern in the last few decades, especially in low- and middle-income countries, which are often least prepared to meet the challenges of rapidly ageing societies. The size of the elderly population (aged ≥60 years) is increasing rapidly in India: in 1991 it accounted for 6.7% of the total population, rising to 7.4% by the turn of the new millennium, and is expected to increase to around 10.7% by 2021, as a result of demographic transition.[6] For a populous country like India, this is likely to pose mounting pressures on various aspects of society, including a burden on health-care facilities and health expenditures. Studies have revealed that nearly one third of the urban population in India has metabolic syndrome,[7,8] but there is little information available on metabolic syndrome among the elderly population in the country. It is vitally important to understand the prevalence and determinants of metabolic syndrome among the elderly population, in order to apply medical and social interventions to improve the health status, and thus quality of life, for this population. Taking these considerations into account, this study aimed to investigate the prevalence of metabolic syndrome and its correlates among the residents of care homes for the elderly in Hyderabad City, India.

METHODS

Study design, setting and participants

A cross-sectional study was conducted among the residents of two care homes for the elderly situated in the greater Hyderabad Municipal Corporation, around 8 km and 5 km respectively away from Hyderabad City, in the state of Andhra Pradesh, India. The study was carried out between January and March 2013 and included all the residents of the two care homes who were willing to participate voluntarily.

Sample size and sampling technique:

A total 127 elderly persons (aged ≥60 years) lived in the two care homes. Of these, 96.9% (123/127) voluntarily participated in the study. A total of nine individuals were excluded from the study, for various reasons (six were seriously ill and confined to bed owing to the presence of comorbidities during the data collection and another three were not willing to fast overnight). Thus, a total 114 elderly persons were included in the study.

Ethical issues approval

The study was approved by the institutional ethical committee of the National Institute of Nutrition, Hyderabad, India. The purpose and outcome, as well as the methods of study were explained to the management authority of the residential care homes, to ensure sustained cooperation. Informed written consent was obtained from each of the study participants. Those who were found to have either metabolic syndrome or modifiable risk factors for development of chronic lifestyle disorders were taken to the nearest Gandhi Hospital for further management.

Data collection and measurements

After obtaining the necessary permission from the management authorities of the care homes, and informed written consent from the study participants, a trained person interviewed the elderly residents using a pretested and predesigned structured questionnaire to collect information on individual characteristics (e.g. age, sex, educational level, history of cardiovascular diseases, diabetes or hypertension, etc.) and personal habits (e.g. type of diet [vegetarian or non-vegetarian], tobacco use and alcohol intake). The types of tobacco used considered in the present study included smoked (cigarettes, beedis and cigars), oral (chewed tobacco, pan masala, etc.) and inhaled forms (snuff) of tobacco. For tobacco use and alcohol consumption, current users were considered to be those who had been using for least one year continuously (smoking one small [ten-cigarette] pack or more per day; chewing betel nut/pan masala 3–4 times or more per day; inhaling snuff 3–4 times or more per day; consuming alcohol 3 times or more per week, irrespective of the quantity of alcohol) without interruption. Former users were those who had ever used previously (total lifetime consumption of >100 packs; chewing betel nut/pan masala 3–4 times or more per day; inhaling snuff 3–4 times or more per day; consuming alcohol 3 times or more per week, irrespective of the quantity of alcohol) but had stopped using more than one year ago. A never user was an individual who had never used, apart from occasional social intake.

The physical activity or performance status of the subjects was assessed by modified ECOG (Eastern Cooperative Oncology Group) scale, as reported by Lin et al.[9] The initial ECOG was defined in in five categories:

- ECOG 0: fully active, able to carry on all pre-disease performance without restriction
- ECOG 1: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc.
- ECOG 2: ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours
- ECOG 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours
- ECOG 4: completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

The modified ECOG grading used was as follows:

- ECOG Grade 1: ECOG 0
- ECOG Grade 2: ECOG 1 or 2
- ECOG Grade 3: ECOG 3 or 4.

Subjects' pattern of physical exercise was assessed by means of the total time spent each day walking and/or engaging in regular exercise, such as yoga or pranayama, or any other forms of exercise (for at least 30 minutes per day for a minimum of 5 days per week).

Anthropometric measurements like weight and height were obtained using a digital weighing scale and portable stadiometer (both manufactured by SECA, Germany), using standard techniques to measure to the nearest 0.1 kg and 0.1 cm respectively. Waist circumference was also measured to the nearest 0.1 cm, at the end of normal expiration, on subjects with a bare belly, using a flexible fibreglass measuring tape positioned midway between the lowermost infracostal margin and the highest point of the iliac crest at the level of the mid-axillary line.[10] For interpretation of anthropometric measurements, body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). For cut-off values of BMI, the World Health Organization (WHO) recommendations for defining moderate to high health risks associated with BMI amongst Asians were used.[11] Blood pressure was recorded three times (to the nearest 2 mmHg), using a mercury sphygmomanometer (Diamond Co, India) on the right arm, with subjects in a sitting position and a 10-minute rest before each recording. The mean of the lowest two readings of systolic and diastolic blood pressures was recorded.

Biochemical analysis

About 10 mL of blood was taken from each participant after overnight fasting. Fasting blood glucose was measured by the glucose oxidase–peroxidise method.[12] Serum triglyceride was measured by the GPO-PAP (glycerol phosphate oxidase-*p*-aminophenazone) method,[13] and high-density lipoprotein (HDL) cholesterol by an enzymatic colorimetric test, using a Hitachi 747 auto analyser.[14]

Definition of metabolic syndrome

The 2005 criteria of the International Diabetes Federation (IDF) were used to define metabolic syndrome.[15] To diagnose central obesity, the ethnic-specific (for south Asians) cut-off value of waist circumference was used.[15] Thus, metabolic syndrome was defined as:

1. the presence of central obesity (waist circumference ≥90 cm in men and ≥80 cm in women), *plus ≥2 of the following following criteria:*
2. blood pressure ≥130/85 mmHg or taking drug treatment for hypertension;
3. serum triglyceride ≥150 mg/dL or taking specific treatment for this lipid abnormality;
4. serum HDL cholesterol (HDLc) <40 mg/dL in men and <50 mg/dL in women, or taking specific treatment for this lipid abnormality;
5. fasting blood glucose ≥100 mg/dL, or previously diagnosed type 2 diabetes and taking specific drug treatment.

Statistical analysis

Statistical analysis was done using the SPSS 12.0.1 software package (SPSS for windows, version 12.0.1.2001.Chicago: SPSS Inc.). The continuous variables were presented by mean and standard deviation and categorical variables expressed in percentages. The chi squared test was applied to test for associations between two categorical variables. Univariable logistic regression was applied to investigate associations between metabolic syndrome and known risk factors. An adjusted analysis was performed using a multivariable logistic regression for any factor that was found to be significant on unadjusted analysis. For all statistical tests, $P < 0.05$ was considered as statistically significant.

RESULTS

Study subjects

The baseline characteristics of the study participants are given in Table 1. Regarding modifiable factors, most participants (66.7%; 76/114) were primarily non-vegetarian. Among the study participants, 13.2% (15/114) gave a history of any form of current tobacco use, while another 26.3% (30/114) gave a past history of use. Regarding alcohol intake, 5.3% (6/114) of participants gave a history of current alcohol consumption and another 21.9% (25/114) were former drinkers. Nearly half of the study participants (48.2%; 55/114) had BMI cut-off values (≥23 kg/m^2) associated with mild to moderate health risks as per WHO recommendations for Asian populations.[11] While considering physical activity, one quarter (25.4%; 29/114) of the study participants were found to be fully active and able to carry out all work without any restriction (modified ECOG Grade 1). Another one third (32.5%; 37/114) were found to be ambulatory but mainly sedentary, restricted in strenuous physical activities and able to carry out light work, including all self-care needs (modified ECOG Grade 2), and the remaining 42.1% (48/114) were either capable of performing only limited self-care, confined to bed or a chair for >50% of their working hours or completely disabled (modified ECOG Grade 3). Among the study participants, 30.7% (35/114) never engaged in any form of exercise (see Table 1).

Cardiometabolic characteristics

Among the 114 study participants, 49.1% (56/114) had been previously diagnosed with hypertension and were taking antihypertensive drugs; 29.8% (34/114) were taking antidiabetes drugs for type 2 diabetes; 14.0% (16/114) were taking antidyslipidaemic drugs; and 42.1% (48/114) fulfilled the criteria for metabolic syndrome. The participants' cardiometabolic parameters are summarized in Table 2.

Components of metabolic syndrome

The prevalence of central obesity in the study participants was 59.6% (68/114). Also, 72.2% (88/114) either had raised blood pressure or were taking drug treatment for hypertension. Serum triglyceride levels were raised among 28.1% (32/114) of the elderly subjects, while 23.7% (27/114) either had lower serum HDLc levels than cut-off values or were taking antidyslipidaemic medication. Raised fasting blood glucose or previously diagnosed type 2 diabetes was present in 47.4% (54/114) (see Table 3).

Table 1. Baseline characteristics of the study participants

Baseline characteristics	Number (n = 114)	Percentage	Baseline characteristics	Number (n = 114)	Percentage
Age group, years			Type of diet		
60–69	32	28.1	Vegetarian	38	33.3
70–79	43	37.7	Non-vegetarian	76	66.7
≥80	39	34.2	Physical activity (modified ECOG grade)[a]		
Sex			Grade 1	29	25.4
Male	61	53.5	Grade 2	37	32.5
Female	53	46.5	Grade 3	48	42.1
Caste			Physical exercise		
General	58	50.9	≥30 min/day, ≥5 days/week	30	26.3
Other backward caste	48	42.1	<30 min/day	49	43.0
Scheduled caste/scheduled tribe	8	7.0	Never	35	30.7
Religion			Tobacco use		
Christian	75	65.8	Current	15	13.2
Other	39	34.2	Ex-tobacco user	30	26.3
Reason for living in a care home for the elderly			Never	69	60.5
No children	12	10.5	Alcohol consumption		
Children not taken responsibility for care	49	43.0	Current	6	5.3
Destitute	8	7.0	Ex-drinker	25	21.9
Other	45	39.5	Never	83	72.8
Education			BMI, kg/m^2		
Illiterate	38	33.3	<23	59	51.8
Up to secondary	64	56.1	≥23	55	48.2
More than secondary	12	10.5	Waist circumference, cm		
Previous occupation			≥90 (men); ≥80 (women)	66	57.9
Unemployed/housework	21	18.4	<90 (men); <80 (women)	48	42.1
Skilled worker	17	15.0			
Agriculture (land owner)	21	18.4			
Unskilled worker	25	21.9			
Service and business	30	26.3			

BMI: body mass index; ECOG: Eastern Cooperative Oncology Group.

[a]Modified ECOG scale:

- ECOG Grade 1: fully active, able to carry on all pre-disease performance without restriction
- ECOG Grade 2: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc., or ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours.
- ECOG Grade 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours, or completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

Table 2. Mean values of cardiometabolic parameters of the study participants

Cardiometabolic parameters	Mean (SD)		
	Metabolic syndrome (*n* = 48)	No metabolic syndrome (*n* = 66)	Total (*n* = 114)
Systolic blood pressure (mmHg)	146.0 (6.3)	130.0 (9.7)	138.0 (11.6)
Diastolic blood pressure (mmHg)	96.2 (3.8)	88.0 (3.8)	92.0 (5.5)
Waist circumference (cm)	91.7 (2.7)	78.4 (5.6)	85.2 (8.0)
Body mass index (kg/m^2)	25.2 (2.8)	22.0 (3.8)	23.6 (3.8)
Serum triglyceride (mg/dL)	155.4 (10.2)	123.4 (7.7)	139.4 (18.1)
Serum HDL cholesterol (mg/dL)	38.4 (3.2)	46.4 (3.6)	32.4 (5.2)
Fasting blood glucose (mg/dL)	114.6 (10.9)	74.6 (3.4)	94.6 (21.3)

HDL: high-density lipoprotein; SD: standard deviation.

Table 3. Proportions of components of metabolic syndrome among the study participants

Component of metabolic syndrome	Number (%) with metabolic syndrome (*n* = 48)	Number (%) with no metabolic syndrome (*n* = 66)	Total number (%) (*n* = 114)
High blood pressure (≥130/85 mmHg) *or* taking drug treatment for hypertension	46 (95.8)	42 (63.6)	88 (77.2)
Central obesity (waist circumference ≥90 cm in men and ≥80 cm in women]	48 (100.0)	20 (30.3)	68 (59.6)
Raised serum triglycerides (≥150 mg/dL) *or* taking specific drug treatment for this lipid abnormality	23 (47.9)	9 (13.6)	32 (28.1)
Serum HDLc <40 mg/dL in men and <50 mg/dL in women *or* taking specific drug treatment for this	19 (39.6)	8 (12.1)	27 (23.7)
Fasting blood glucose ≥100 mg/dL *or* previously diagnosed type 2 diabetes taking specific drug treatment	38 (79.2)	16 (24.2)	54 (47.4)

HDLc: high-density lipoprotein cholesterol.

[a]As per IDF 2005 criteria.[15]

Table 4. Prevalence of and associated risk factors for metabolic syndrome

Variables	Total number (%)	Number (%) with metabolic syndrome	Crude OR (95% CI)	Adjusted OR (95% CI)
Overall[a]	114 (100)	48 (42.1)	—	
Age group, years				
60–69	32 (28.1)	13 (40.6)	1.00	NA
70–79	43 (37.7)	17 (39.5)	0.96 (0.34–2.71)	
≥80	39 (34.2)	18 (46.2)	1.25 (0.44–3.59)	
Sex				
Male	61 (53.5)	21 (34.4)	1.00	NA
Female	53 (46.5)	27 (50.9)	1.97 (0.93–4.21)	
Caste				
General	58 (50.9)	26 (44.8)	1.35 (0.24–9.50)	NA
Other backward caste	48 (42.1)	19 (39.6)	1.09 (0.19–7.85)	
Scheduled caste/scheduled tribe	8 (7.0)	03 (37.5)	1.00	
Religion				
Christian	75 (65.8)	30 (40.0)	1.00	NA
Other	39 (34.2)	18 (46.2)	1.29 (0.55–3.01)	
Education				
Illiterate	38 (33.3)	16 (42.1)	1.45 (0.32–7.73)	NA
Up to secondary	64 (56.1)	28 (43.8)	1.56 (0.37–7.75)	
More than secondary	12 (10.6)	4 (33.3)	1.00	
Type of diet				
Vegetarian	38 (33.3)	15 (39.5)	1.00	NA
Non-vegetarian	76 (66.7)	33 (43.4)	1.18 (0.50–2.83)	
Physical activity (modified ECOG grade)[b]				
Grade 1	29 (25.4)	16 (55.2)	1.00	NA
Grade 2	37 (32.5)	14 (37.8)	0.49 (0.16–1.48)	
Grade 3	48 (42.1)	18 (37.5)	0.49 (0.17–1.38)	
Physical exercise				
≥30 min/day, ≥5 days/week	30 (26.3)	14 (46.7)	1.00	NA
<30 min/day	49 (43.0)	19 (38.8)	0.72 (0.26–2.01)	
Never	35 (30.7)	15 (42.9)	0.86 (0.29–2.56)	
Tobacco use, current and ever				
Yes	45 (39.5)	17 (37.8)	0.74 (0.32–1.71)	NA
No	69 (60.5)	31 (44.9)	1.00	

Variables	Total number (%)	Number (%) with metabolic syndrome	Crude OR (95% CI)	Adjusted OR (95% CI)
Alcohol consumption, current and ever				
Yes	31 (27.2)	9 (29.0)	0.46 (0.17–1.20)	NA
No	83 (72.8)	39 (47.0)	1.00	
BMI, kg/m^2				
<23	59 (51.8)	11 (18.6)	1.00	
≥23	55 (48.2)	37 (67.3)	8.97 (3.78–21.28)	9.31[c] (4.12–22.14)

BMI: body mass index; CI: confidence interval; NA: not available; OR: odds ratio.

[a]As per the 2005 criteria of the International Diabetes Federation.[15]

[b]Modified ECOG scale:

- ECOG Grade 1: fully active, able to carry on all pre-disease performance without restriction
- ECOG Grade 2: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc., or ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours.
- ECOG Grade 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours, or completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

[c]Variables adjusted for: age, sex, type of diet, tobacco use, alcohol intake, physical activity status and physical exercise.

Metabolic syndrome and risk factors

The overall prevalence of metabolic syndrome among the study participants, as defined by IDF 2005 criteria,[15] was 42.1% (48/114). The proportions with metabolic syndrome did not differ significantly by age group, sex, caste, religion, type of diet (vegetarian or non-vegetarian), educational status, behavioural factors such as tobacco use and alcohol intake, physical activity (assessed by modified ECOG scale), or physical exercise (see Table 4). However, in univariable analysis, BMI was found to be strongly associated with metabolic syndrome (crude odds ratio [OR]: 8.97; 95% confidence interval [CI]: 3.78–21.28). In multivariable logistic regression, after adjustment for age, sex, caste, religion, type of diet (vegetarian or non-vegetarian), tobacco use, alcohol intake, physical activity status, and physical exercise, elderly subjects with BMI ≥23 kg/m^2 had 9.31 times (95% CI: 4.12–22.14) higher odds of metabolic syndrome as compared to those with BMI <23 kg/m^2 (see Table 4).

DISCUSSION

In the elderly population investigated in this study, the overall prevalence of metabolic syndrome was found to be 42.1%, with a higher prevalence among women (50.9%) than men (34.4%). Although a similar study among an elderly population from south India living in a care home for the elderly, which used the same IDF 2005 criteria, reported a much higher prevalence of metabolic syndrome (57%), the higher prevalence among women reported in the present study was also found in this study from South India.[16] A study from north India reported a similar prevalence (40.2%) among urban adults (≥18 years).[17] He et al. reported a prevalence of metabolic syndrome of 46.3% among an elderly population in China and also a higher prevalence (54.1%) among women, which was very similar to the present findings.[18] Another study from the United States of America reported a similar prevalence (43.5% and 42.0% in individuals aged 60–69 years and ≥70 years respectively).[19] However, a few studies from Taiwan reported a lower prevalence of metabolic syndrome in an elderly population, ranging from 21.5% to 30.2%.[20–22] The differences in prevalence were probably due to different criteria used for metabolic syndrome. All of the above studies, including the present one, found a higher prevalence among women than men. In the present study, a higher prevalence of metabolic syndrome among elderly women was probably due to hormonal effects after menopause. Lin et al. also demonstrated a higher prevalence of metabolic syndrome among postmenopausal women than among premenopausal women.[23]

The majority of Indian studies have reported a lower prevalence of metabolic syndrome than found in the present study, ranging from 9.3% to 31.4%, probably because of the lower age (<60 years) of study participants.[24–26] Many studies have evidenced that metabolic syndrome increases with age, and is more prevalent among smokers, consumers of alcohol and those who undertake less physical activity.[17,26–29] However, in the present study, metabolic syndrome was not significantly associated with age, type of diet (vegetarian versus non-vegetarian), personal habits such as intake of tobacco and alcohol, physical activity, or physical exercise. The majority of published studies have been conducted among a general adolescent and adult population; thus their findings differed from the present study, which was conducted only among an elderly population.

Conclusion

There is definite cause for concern regarding the high prevalence of metabolic syndrome among the elderly population in this study, since both this demographic segment and the prevalence of metabolic syndrome are showing a fast-rising trend in India, as a result of rapid changes in sociodemographic, lifestyle and disease-related factors. This cross-sectional study was limited to elderly care-home residents and used a small sample size, thus the findings cannot be generalized. Further cohort studies are necessary to ascertain the exact situation and possible correlates of metabolic syndrome among the general elderly population in India and elsewhere.

This issue calls for urgent attention by health-care providers and policy-makers, since awareness and identification of cardiometabolic risk factors in older persons is important for the prevention of consequent cardiovascular diseases and diabetes.

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