Association of Conicity Index with Different Cardiovascular Disease Risk Factors among Rural Elderly Women of West Bengal, India

Joyeta Ghosh[1,2], Debnath Chaudhuri[3], Indranil Saha[4], Aditi Nag Chaudhuri[2]

[1]Department of Dietetics and Nutrition, NSHM Knowledge Campus, [2]Department of Microbiology, Lady Brabourne College, University of Calcutta, Kolkata, [4]Scientist E, ICMR-Centre for Ageing and Mental Health (I-CAM), Indian Council of Medical Research, Kolkata, West Bengal, [3]Society for Nutrition and Dietetics, India

Abstract

Introduction: In menopause, changes in body fat distribution lead to increasing risk of cardiovascular and metabolic diseases. Therefore, the prediction of cardiovascular disease (CVD) by the presence of risk factors is of importance in elderly women. **Objective:** To find out the conicity index (CI) and its association with different CVD risk factors among rural elderly women of West Bengal. **Materials and Methods:** The study was conducted among 236 rural elderly women, selected randomly from 30 villages of Amdanga block, West Bengal. Components of metabolic syndrome (MS), body fat percentage, different lipid profile fractions, CI, and body mass index (BMI) were measured. Statistical tests were calculated using SPSS software version 20.0. $P \leq 0.05$ was considered statistically significant. **Results:** High CI (median 1.25 and interquartile range 1.05–1.45) was found. The proportion of participants with high CI were significantly higher among those with MS (87.95%), waist circumference having 80 cm or more (99.09%), blood pressure having $\geq$ 130/85 mm of Hg (75.66%), body fat percentage $\geq$25% (80.14%), and BMI $\geq$23 (93.18%). **Conclusion:** High prevalence of CI existed among rural elderly women. Significant correlation existed between CI and different CVD risk factors as well as some of the components of MS indicating a possible coexistence of different CVD risks.

Keywords: Conicity index, cardiovascular disease risks, elderly, hypertension, waist circumference, women

Introduction

Progressive increase in the prevalence of cardiovascular disease (CVD) risk factors (dyslipidemia, elevated blood pressure [BP], disturbances in glycemic index) with increasing body fatness has been observed in many epidemiological studies.[1-3] Various anthropometric measures have been undertaken in recent decades to understand the relationship between obesity and cardiovascular risk factors.[1-3] Considering various obesity measures, such as body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) were implemented and investigated thoroughly. However, the best and ideal obesity measure to use as a predictor of cardiovascular risk factors remains elusive.[4,5]

The simplest and commonly used method is BMI, especially for estimating the frequency of obesity in large epidemiological studies.[6] However intra-abdominal fat has a stronger relationship with the risk of obesity-related morbidity and cannot be measured by BMI.[7] Thus WHR and WC measurements and conicity index (CI) are becoming important indicators for abdominal adipose tissue distribution.[8] Above all the CI has been shown to correlate decently with various cardiovascular risk factors associated with visceral fat accumulation in some population.[8-10] CI is a theoretical range that includes a built-in adjustment of WCs for height and weight and does not require the hip circumference to assess fat distribution.[9,10]

In menopause, changes in body fat distribution lead to increasing risk of cardiovascular and metabolic diseases.[7] Altogether rise in abdominal obesity with the acceleration

Address for correspondence: Prof. Joyeta Ghosh,
3D Madhukunja, Swami Vivekananda School,
Kolkata - 700 0157, West Bengal, India.
E-mail: joyetaghosh01@gmail.com

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of the breakdown of lean body mass leads to no significant changes in the bodyweight of postmenopausal women.[7,8] Therefore, the prediction of CVD by the presence of risk factors is of such importance, especially for elderly women.[11,12,13] In this background, the present study was conducted to find out the CI and its association with different CVD risk factors among rural elderly women of West Bengal, India.

MATERIALS AND METHODS

This community-based study with a cross-sectional design was conducted among 236 elderly women, aged between 60 and 70 years, selected randomly by multistage probability sampling from 80 villages of Amdanga block, North 24 Parganas district, West Bengal, India, from April 2014 to August 2018.

Ethical clearance was obtained from the Institutional Ethics Committee. Informed written consent was obtained from the study participants. Women with severe liver, renal and cardiovascular disorders, and those who were on medication or on hormone replacement or lipid-reducing therapy, antihypertensive drugs, and nonsteroidal anti-inflammatory drugs were excluded. Physically or mentally challenged subjects and non-cooperative in nature were also excluded from the study.

Sample size calculation and sampling technique

The sample size was calculated by taking the previous prevalence of central obesity (CO) among rural elderly as 92.3%[14] and using formula $n = (Z_{[1-\infty/2]})^2 pq/L^2$; where L is allowable error, which was taken as 5% of p, and $Z_{(1-\infty/2)}$ is the standard normal deviate at 95% confidence limit, which was 1.96. The calculated sample size came out to be $133.5 \approx 134$. Since multistage random sampling was adopted, it was multiplied by 1.5 (design effect), which came out to be 201. Additional 10% was added to compensate for the dropout and finally, it was calculated to be 221. Finally, 236 subjects could be covered. In the first stage, 30 villages were selected randomly from 80 total villages of Amdanga block. The sampling frame was prepared by adhering to the inclusion criteria from that selected villages. The number of participants from each village was calculated by population proportionate to size method. Following this, the required number of samples was drawn from the sampling frame from each village using the simple random sampling method. If the selected individual could not be contacted in three visits, that person was excluded from the study.

Diagnostic criteria

BP, WC, fasting blood glucose (FBG), serum triglyceride (TG) and high-density lipoprotein-cholesterol (HDL-C), low-density lipoprotein-cholesterol (LDL-C), very LDL-C (VLDL-C), body fat percentage, BMI, total cholesterol (TC), and CI were measured using standard procedure.[11,15-17] Overnight fasting (10–12 h) blood specimens were collected early in the morning from the villages for all biochemical estimations.

Operational definition

CI was constructed using the following formula:

CI = WC (m)/(0.109 ×√[body weight [kg]/height [m]]) where 0.109 is a constant which results from the conversion of units of volume and mass into units of length. Cut-offs 1.18 was used to classify CI into normal and high categories.[11] Metabolic syndrome (MS) was defined as per IDF, 2005 (for Asian-Indians) criteria.[18]

Statistical analysis

Data were put in Microsoft Excel worksheet (Microsoft, Redwoods, WA, USA) and checked for accuracy. Categorical data were expressed in numbers and percentages. Association between two categorical data was calculated using Pearson's Chi-square test. Continuous data were first checked for normality distribution by Kolmogorov–Smirnov test. Significant *P* value indicated skewed distribution. Thus, continuous data were presented in the median and interquartile range (IQR). Because of skewed distribution, nonparametric statistical tests were performed. The difference of distributions between the two groups was determined by Mann–Whitney *U*-test (*Z* value), while three different groups were compared by Kruskal–Wallis test. The relationship between two variables (correlation) was calculated by Spearman's correlation coefficient (rho). SPSS software, version 20.0 (Statistical Package for the Social Sciences Inc., Chicago, IL, USA) was used for calculation. $P \leq 0.05$ was considered to be statistically significant.

RESULTS

High CI was found in 236 elderly women with a median value of 1.25 and IQR was (1.05 [Q1-First quartile] - 1.45 [Q3-Third quartile]).

The proportion of participants high CI was significantly higher among the participants having MS (87.95%), WC having 80 cm or more (99.09%), and BP having ≥130/85 mm of Hg (75.66%). The proportion of participants with high CI was marginally higher among participants having FBG ≥100 mg/dl (78.57%) and TG level ≥150 mg/dl (72.83%), but this association was not found to be statistically significant. The proportion of participants with high CI was equally distributed among the groups having HDL-cholesterol less than and equal to or more than 50 mg/dl [Table 1].

Median CI was found to be significantly higher among the subjects having MS and WC having ≥80 cm. In both of these situations, Spearman's correlation coefficient was also found to be positively correlated with statistical significance. The median CI was found to be equally distributed among the participants having high and low FBG, TG, HDL-Cholesterol, and BP [Table 2].

Proportion of participants high CI was significantly higher among the participants having body fat percentage ≥25% (80.14%), BMI having ≥23 (93.18%). Proportion of subjects with high CI was marginally higher among subjects having

Table 1: Distribution of elderly women according to conicity index level in relation to metabolic syndrome, waist circumference, fasting blood glucose, triglyceride, high-density lipoprotein cholesterol, and blood pressure (n=236)

Parameter	CI		Total, n (%)	Chi-square test (P)
	High (CI ≥1.18), n (%)	Normal (CI <1.18), n (%)		
Metabolic syndrome present (IDF)				
Yes	73 (87.9)	10 (12.1)	83 (100)	17.1 (<0.05)*
No	96 (62.3)	58 (37.7)	154 (100)	
Waist circumference (cm)				
<80	60 (47.2)	67 (52.8)	127 (100)	7.6 (<0.05)*
≥80	108 (99.1)	1 (0.9)	109 (100)	
Fasting blood glucose (mg/dl)				
<100	146 (70.2)	62 (29.8)	208 (100)	0.8 (0.35)
≥100	22 (78.6)	6 (21.4)	28 (100)	
Triglyceride (mg/dl)				
<150	101 (70.1)	43 (29.9)	144 (100)	0.19 (0.6)
≥150	67 (72.8)	25 (27.2)	92 (100)	
HDL-cholesterol (mg/dl)				
<50	81 (71.1)	33 (28.9)	114 (100)	0.02 (0.9)
≥50	87 (71.3)	35 (28.7)	122 (100)	
Blood pressure (mm of Hg)				
<130/85	53 (63.1)	31 (36.9)	84 (100)	4.1 (0.04)*
≥130/85	115 (75.7)	37 (24.3)	152 (100)	

*Statistically significant. HDL: High-density lipoprotein, IDF: International diabetes federation, CI: Conicity index

Table 2: Relationship of waist circumference, fasting blood glucose, triglycerides, high-density lipoprotein-cholesterol, and blood pressure with conicity index level among rural elderly women (n=236)

Parameter	CI	Statistical test	
	Median (IQR)	Mann-Whitney U test	Spearman's correlation test
		Z (P)	ρ (P)
Metabolic syndrome (IDF)			
Yes	1.35 (0.22)	−4.1 (0.001)*	0.37 (0.00)*
No	1.22 (0.17)		
Waist circumference (cm)			
<80	1.18 (0.09)	−8.7 (<0.05)*	0.75 (<0.05)*
≥80	1.38 (0.16)		
Fasting blood glucose (mg/dl)			
<100	1.25 (0.20)	−0.91 (0.35)	0.02 (0.65)
≥100	1.25 (0.16)		
Triglyceride (mg/dl)			
<150	1.26 (0.20)	−0.44 (0.65)	0.06 (0.34)
≥150	1.28 (0.24)		
HDL cholesterol (mg/dl)			
<50	1.27 (0.20)	−0.04 (0.96)	−0.004 (0.95)
≥50	1.24 (0.20)		
Blood pressure (mm of Hg)			
<130/85	1.23 (0.21)	−2.03 (0.04)*	0.10 (0.10)
≥130/85	1.26 (0.21)		

*Statistically significant. HDL: High-density lipoprotein, IDF: International diabetes federation, IQR: Interquartile range, CI: Conicity index

LDL-C ≥100 mg/dl (69.33%), VLDL-C ≥20 mg/dl (73.49%), TC ≥200 mg/dl (70.29%) but this association was not found to be statistically significant [Table 3].

Median CI was found to be significantly higher among the subjects having body fat percentage ≥25% and BMI ≥23. In both of these situations, Spearman's correlation coefficient was also found to be statistically significant positive correlation. Median CI was found to be equally distributed among the participants having high and low LDL-Cholesterol, VLDL-C and TC [Table 4].

Table 3: Distribution of elderly women according to conicity index level in relation to body fat percentage, low-density lipoprotein cholesterol, very low-density lipoprotein cholesterol, total cholesterol, and body mass index (*n*=236)

Parameter	CI		Total, *n* (%)	Chi-square test (*P*)
	High (CI ≥1.18), *n* (%)	Normal (CI <1.18), *n* (%)		
Body fat percentage				
<25	55 (57.9)	40 (42.1)	95 (100)	11.6 (0.001)*
≥25	113 (80.1)	28 (19.9)	141 (100)	
LDL cholesterol (mg/dl)				
<100	55 (75.3)	18 (24.7)	73 (100)	1.89 (0.4)
≥100	113 (69.3)	50 (30.7)	163 (100)	
VLDL cholesterol (mg/dl)				
<20	46 (65.7)	24 (34.3)	70 (100)	1.4 (0.2)
≥20	122 (73.5)	44 (26.5)	166 (100)	
Total cholesterol (mg/dl)				
<200	71 (72.5)	27 (27.5)	98 (100)	0.13 (0.71)
≥200	97 (70.3)	41 (29.7)	138 (100)	
BMI				
<18.5	10 (18.9)	43 (81.1)	53 (100)	34.5 (<0.05)*
22.9-18.5	76 (80)	19 (20)	95 (100)	
≥23	82 (93.2)	6 (6.8)	88 (100)	

*Statistically significant. VLDL: Very low-density lipoprotein, LDL: Low-density lipoprotein, BMI: Body mass index, CI: Conicity index

Table 4: Distribution of elderly women according to conicity index in relation to body fat percentage, low-density lipoprotein cholesterol, very low-density lipoprotein cholesterol, total cholesterol, and body mass index (*n*=236)

Parameter	CI	Statistical test	
	Median (IQR)	Mann-Whitney U test	Spearman's correlation test
		Z (*P*)	ρ (*P*)
Body fat percentage			
<25	1.20 (0.11)	−3.40 (<0.05)*	0.34 (<0.05)*
≥25	1.32 (0.20)		
LDL cholesterol (mg/dl)			
<100	1.28 (0.22)	−0.82 (0.42)	−0.08 (0.20)
≥100	1.23 (0.20)		
VLDL cholesterol (mg/dl)			
<20	1.28 (0.22)	−1.20 (0.22)	0.05 (0.41)
≥20	1.25 (0.20)		
Total cholesterol (mg/dl)			
<200	1.28 (0.20)	−0.36 (0.71)	−0.06 (0.31)
≥200	1.23 (0.20)		
BMI			
<18.5	1.20 (0.17)	21.30 (<0.05)*,#	0.37 (<0.05)*
22.9-18.5	1.20 (0.14)		
≥23	1.35 (0.20)		

*Statistically significant, #Kruskal-Wallis test conducted. VLDL: Very low-density lipoprotein, LDL: Low-density lipoprotein, BMI: Body mass index, IQR: Interquartile range

DISCUSSION

Reports estimating the CI among elderly women in India are lacking, the present result was in accordance with other studies[12-14,19] which showed a range of 40.2%–71.19%.

CO in rural elderly women may be multifactorial in etiology like nutritional, physiological, and pathological problems.[12-14]

India is phasing the epidemiological transitions, a double burden of health problems; where the country is not free of communicable diseases (e.g., various infectious diseases), while on the other hand, the occurrence of noncommunicable diseases is also increasing.[12-14] Further like many previous studies among postmenopausal and elderly participants, it has been observed that CI had a higher association with different components of CVD risk factors.[12,13,19]

Among the rural elderly women having MS, 87.95% had high CI and significant association was observed between MS (*P* < 0.05) and its different components (WC, BP) with

high CI. Significant association was also observed between CI and body fat percentage ($P < 0.05$), BMI ($P < 0.05$).

Like previous reports, the hypertensive individuals are having significantly enhanced levels of central body fat distribution which is consistent with present findings as well.[12-14,19] Considering Spearman's correlations significant positive correlation existed between CI and body fat percentage, BMI, MS, and WC, which is similar to previous reports.[12-14,19]

There may be various reasons for increasing high CI among rural elderly women in the present community. Previous reports suggest CO was closely associated with family income.[12,20] Some studies have reported that CO increased in higher-income groups,[21,22] middle-income groups,[23] while few others have reported that low-income groups had a higher CO.[24,25] One of the common reasons behind this phenomenon might be the consumption of high-calorie food which is abundantly available simultaneously with the presence of comparatively less energy expenditure.[12] Other probable factors may be poor physical activity, metabolic disorders, etc., The present study is the small part of a research project which is published elsewhere.[26]

CONCLUSION

The present study highlighted the high prevalence of CI among rural elderly women, which may have serious public health implications at the community level. Significant association with different CVD risk factors also indicating the same. Therefore, its corrections may play an important role in improving the quality of life of this population. Further studies are required to fully understand the extent of the health problems of CO among rural elderly women of India. Results of such investigations may be helpful in the formulation of appropriate ethnic and region-specific health promotion and intervention programs. Hitherto, in the Indian context, such studies, especially focused on rural elderly women are scanty.

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Conflicts of interest

There are no conflicts of interest.

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