

Original Article

Different anthropometric adiposity measures and their association with cardiovascular disease risk factors in middle aged women

**Pallavi S. Kanthe, Shrilaxmi Bagali, Gouhar Banu Shaikh,
Sumangala M. Patil, Bheemshetty S. Patil and
Manjunatha R. Aithala***

Department of Physiology,
Shri B. M. Patil Medical College, BLDE University,
Bangamma Sajjan Campus, Solapur Road,
Bijapur – 586 103, Karnataka

Abstract

A cross sectional study of 136 women age group 40-55 years was conducted to study which anthropometric measure had the strongest association with cardiovascular disease risk factors in middle aged women. In accordance with their BMI measurement subjects were divided into three groups namely: Normal weight (Group1) BMI 18.5-24.9 kg/m², Overweight (Group2) – 25 kg/m² – 29.9 kg/m², Obese (Group3) – BMI > 30 kg/m². Each group was further divided into premenopausal and postmenopausal women BMI, WHR, WHtR, SBP, DBP were recorded. TG, TC, HDL and FBS values were estimated.

Results showed that both pre and post menopausal middle aged obese women with higher BMI, WHR and WHtR have more chances of having cardiovascular diseases. BMI, WHR and WHtR are the easy and practical methods to diagnose obesity and together can be used as simple measures to predict cardiovascular risk factors in middle aged women.

Introduction

Obesity is now so common within the world's population that it is beginning to overcome under nutrition and infectious diseases as the most important hand to ill health (1).

The World Health Organization has recently defined obesity as a disease (2). Obesity is the result of imbalance between food intake and energy expenditure (3). Obese individuals with excess fat in the abdominal depots are at risk of adverse health results, carrying higher levels of risk for CHD, Type II diabetes and hypertension (4). However, the relative importance of overall and abdominal obesity is still debatable. Abdominal or central adiposity is considered the most important determinant of cardiovascular disease and Type 2 diabetes mellitus (2). CT and MRI are precise techniques available to measure body fat distribution and body composition and to diagnose obesity at the earliest. Anthropometric measures are the easy and practical

***Corresponding author :**

Dr. Manjunatha R. Aithala, Professor and Head, Department of Physiology, Shri B. M. Patil Medical College, Hospital and Research Centre, BLDE University, Bijapur, Karnataka, Email: manjunathaiithala@gmail.com

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methods to diagnose obesity. (5). Therefore in the present study we have relied on anthropometric parameters like BMI, WHR and WHtR to show correlation between obesity and cardiovascular risk factors. WHR, BMI and WHtR are the important variables of obesity. BMI provides the most useful population level measure of obesity, despite of its being crude measure (6). A recent pilot study indicates that cut-points derived from waist to height ratio (WHtR) is more accurate measurement of central obesity than WC (7).

SBP, DBP, HDL and fasting glucose are primary cardiovascular risk factors (8). We restricted our study population to women because obesity is more common in women than in men and the parallel risk of cardiovascular diseases is higher in obese women than in obese men (9).

The reasons for these differences are probably biological & related to more ability of men to deposit excess lean tissue than fat tissue (10).

In Indians, studies have reported the risk levels of various adiposity indices but none have measured all indices in the middle aged women to assess the relative risk of cardiovascular diseases. Therefore, aim of present study was to assess which anthropometric adiposity measures have the strongest association with Cardiovascular disease risk factors in middle aged south Indian women.

Materials & Methods

This is a comparative and cross sectional study assessing relation between anthropometry parameters and cardiovascular disease risk factors in middle aged women. The study was conducted in the Department of Physiology Shri B M Patil Medical College, from October to December 2013. Ethical clearance was obtained from institution. After explaining details of the study, Informed consent was obtained from each of the subject. 136 (Normal weight = 70, study group= 66) apparently healthy women of age group 40-55 years who were attending the OPD of Shri BM Patil Medical College, Bijapur were randomly selected for the study. Depending upon body mass index these

subjects were divided into three groups: Normal weight (Group1) BMI 18.5-24.9 kg/m², Overweight (Group2) – 25 kg/m² – 29.9 kg/m², Obese (Group3) - BMI ≥ 30 kg/m² (11). Each group was further divided into premenopausal and postmenopausal women depending upon attainment of menopause.

Inclusion criteria

Women with BMI between 18.5 kg/m² – ≤40 kg/m² aged between 40-55 years were included in the study.

Exclusion criteria

Subjects with Diabetes mellitus, any cardiovascular diseases or endocrine disorders, taking medications interfering with vascular reactivity.

All the parameters were recorded in the departmental laboratory between 8 to 10 am. Anthropometric parameters like height (cm), weight (kg), waist & hip circumferences were recorded. BMI (kg/m²), WHR & WHtR were calculated. The BMI or Quetelet Index was conventionally calculated as weight in kg/height (in meters²) for each subject. WC was measured with a tape midway between the lowest rib & the iliac crest in the upright position, (WHO 1998). Hip circumference was measured in standing erect, feet together at the level of the greater trochanters (12). WHR was calculated as waist circumference divided by hip circumference. WHtR was calculated as waist circumference divided by height.

Evaluation of primary cardiovascular risk factors: Blood pressure of all women was recorded with mercury sphygmomanometer (DIAMOND) and a stethoscope in a sitting position (13).

For lipid profile study, 3 ml of blood was collected from each subject after overnight fasting of 12 hours. Serum values of TC, HDL, TG were measured by enzymatic method using Semi Auto analyzer (Mispa Excel Chemistry Analyser). Concentration represented in mg/dl.

Estimation of FBS was done by using medical device (Easy Gluco Glucometer).

Statistical analysis

Statistical analysis was done using SPSS. The results are expressed as Mean±SD. Comparisons between Normal weight, overweight and obese groups of premenopausal and post menopausal were carried out using One-Way ANOVA and Tukey post Hoc tests. Comparison between premenopausal and postmenopausal women within each group was done by using Students t test. P≤0.05 was considered as statistically significant. Correlation was done between BMI, WHR, WHtR and cardiovascular risk factors by Pearson’s correlation. Multiple linear regression was done to predict cardiovascular risk factors from BMI, WHR, WHtR using SPSS software.

Results

Adiposity measures and cardiovascular risk factors in premenopausal women (Table I):

Adiposity measures i.e. BMI, WHR and WHtR of premenopausal women were significantly higher in

group 2 and group 3 compared to group 1 and higher values observed in group 3 compared to group 2 (p=0.00).

No significant differences were observed for SBP and DBP among three groups. TC levels were significantly higher in group 2 compared to group 1. We observed significantly (p=0.00) lower values of HDL levels in group 3 compared to group 1. TG and FBS levels were significantly (p=0.00) higher in group 3 compared in group 1.

Adiposity measures and cardiovascular risk factors in postmenopausal women (Table II):

Adiposity measures i.e. BMI, WHR and WHtR of premenopausal women were significantly higher in group 2 and group 3 compared to group 1 and higher in group 3 compared to group 2 (p=0.00).

SBP and DBP have shown statistically non significant differences in group 2 and group 3 compared to group 1.

TABLE I: Adiposity measures and cardiovascular risk factors in premenopausal women.

Parameters (n=58)	Group 1 (n=25)	Group 2 (n=15)	Group 3 (n=18)	P value
BMI kg/m ²	20.8±1.4	27.05±1.8*	32.1±2.2*#	0.000
WHR	0.7±2.5×10 ⁻²	0.81±5.3×10 ^{-2*}	0.8±6.2×10 ^{-2*#}	0.000
WHtR	0.39±5.8×10 ⁻²	0.50±9.6×10 ^{-2*}	0.64±6.8×10 ^{-2*#}	0.000
SBP mmHg	123±6.8	122±11.9	121±15	0.873
DBP mmHg	79±4.6	77±5.9	79.4±10.6	0.748
TC mg/dl	164±28	193±34*	186±37	0.017
HDL mg/dl	48.9±10	4 2.5±8.5	39.3±5.9*	0.003
TG mg/dl	110±26	147±68	188±79*	0.000
FBS mg/dl	95.3±20	122.9±57	131.3±36.1*	0.007

Data presented are Mean±SD. Analysis of data was done by one-way ANOVA and post-hoc by Hochberg test. The * depicts comparison with Group 1 and the # depicts comparison with Group 2. *P<0.05; # P<0.05. Group 1 (Normal weight), Group 2 (Overweight), Group 3 (Obese).

TABLE II: Adiposity measures and cardiovascular risk factors in postmenopausal women.

Parameters (n=78)	Group 1 (n=27)	Group 2 (n=26)	Group 3 (n=25)	P value
BMI	21.2±1.4	26.7±1.8*	34.3±3.4*#	0.000
WHR	0.77±2.3×10 ⁻²	0.8±4.1×10 ^{-2*}	0.86±5.6×10 ^{-2*#}	0.000
WHtR	0.37±3.5×10 ⁻²	0.48±8.9×10 ^{-2 *}	0.64±6.4×10 ^{-2*#}	0.000
SBP	122±8.8	121±11.3	129±12.7#	0.030
DBP	79.7±8.07	81.6±8.17	79±8.3	0.508
TC	163.9±44.8	181.1±50*	190±37	0.104
HDL	43.5±6.7	40.3±9.8	38.1±4.8*	0.035
TG	117±31	171±97.6	197.7±83*	0.001
FBS	111.1±21.6	128.8±40	170±57*	0.000

Data presented are Mean±SD. Analysis of data was done by one-way ANOVA and post-hoc by Hochberg test. The * depicts comparison with Group 1 and the # depicts comparison with Group 2. *P<0.05; # P<0.05. Group 1 (Normal weight), Group 2 (Overweight), Group 3 (Obese).

Cardiovascular risk parameters such as TG and FBS levels were significantly higher (p=0.00) in group 3 compared to group 1. TC levels were significantly higher (p=0.00) in group 2 compared to group 1. HDL levels were statistically lower (p=0.00) in group 3 compared to group 1

Comparison between premenopausal and postmenopausal women in different groups (Table III, IV, V):

We observed non significant values in premenopausal and postmenopausal women of group 1, group 2 and group 3 except for FBS, DBP and HDL. Levels of FBS was significantly higher in postmenopausal women compared to premenopausal women of group 1 and group 3 (*P<0.05) (Table III & V). DBP and FBS levels were significantly higher in

TABLE III : Comparison between premenopausal and postmenopausal women of group 1 (Normal weight).

Parameters	Premenopausal	Postmenopausal	P value
BMI kg/m ²	21.6±2.09	22.4±2.11	0.88
WHR	0.77±0.02	0.78±0.12	0.17
WHtR	0.39±0.05	0.38±0.07	0.13
SBP mmHg	122±6.9	123±21	0.88
DBP mmHg	79±4.8	80±6.8	0.37
TC mg/dl	169±34	167±55	0.8
HDL mg/dl	37±4.4	39±8.9	0.2
TG mg/dl	113±26	122±37	0.25
FBS mg/dl	93±19.26	107±27.98	0.007*

Values are expressed as (Mean±SD). *P<0.05 significant.

TABLE IV : Comparison between premenopausal and postmenopausal women of group 2 (Overweight women).

Parameters	Premenopausal	Postmenopausal	P value
BMI kg/m ²	28.5±1	27.96±1.15	0.29
WHR	0.81±0.06	0.83±0.05	0.26
WHtR	0.57±0.02	0.55±0.02	0.17
SBP mmHg	117±13.5	124±13.5	0.2
DBP mmHg	75.6±6.1	83±7.6	0.02*
TC mg/dl	190±20.12	189±36.5	0.97
HDL mg/dl	48.5±11.5	47.6±10.1	0.001*
TG mg/dl	153±72.5	232±107.5	0.1
FBS mg/dl	154±58.8	147±46.8	0.69

Values are expressed as (Mean±SD). *P<0.05 significant.

TABLE VI : Correlation between adiposity measures and cardiovascular risk factors.

Parameters	SBP	DBP	TC	TG	HDL	FBS
BMI	r = 0.178*	r = -0.018	r = 0.295**	r = 0.431**	r = -0.403**	r = 0.573**
WHR	r = 0.174*	r = -0.007	r = 0.194*	r = 0.449**	r = -0.242**	r = 0.426**
WHtR	r = 0.092	r = -0.053	r = 0.255**	r = 0.407**	r = -0.365**	r = 0.533**

*P<0.05

TABLE V : Comparison between premenopausal and postmenopausal women of group 3 (Obese Women).

Parameters	Premenopausal	Postmenopausal	P value
BMI kg/m ²	32±2.2	34±7.1	0.1
WHR	0.84±0.06	0.86±0.17	0.19
WHtR	0.64±0.06	0.64±0.14	0.79
SBP mmHg	121±15	129±14	0.06
DBP mmHg	79±10.6	70±9.2	0.89
TC mg/dl	186±37	190±37.7	0.77
HDL mg/dl	46.5±9.2	44±13.2	0.48
TG mg/dl	188±79	197±81	0.71
FBS mg/dl	131±36	170±65	0.009*

Values are expressed as (Mean±SD). *P<0.05 significant.

postmenopausal compared to premenopausal women of group 2 (*P<0.05) (Table IV).

Correlation between adiposity measures and cardiovascular risk factors (Table VI) :

The respective correlations between the anthropometric measures and SBP, DBP, TC, TG, HDL and FBS have been given in Table II. BMI, WHR and WHtR have showed significant positive correlations with SBP, TC, TG and FBS and significant negative correlations with HDL.

Multiple Linear Regression using BMI, WHR and WHtR as predictors for cardiovascular risk factors (Table VII) :

Shows that the independent variables BMI, WHR, WHtR statistically significantly predict the cardiovascular risk factors and the overall regression model is a good fit for the data.

TABLE VII : Multiple Linear Regression using BMI, WHR and WHtR as predictors for cardiovascular risk factors.

Parameters	R ²	F	Significance
TC	0.088	4.271	0.006
TG	0.241	13.977	0.000
HDL	0.162	8.509	0.000
FBS	0.338	22.484	0.000
SBP	0.073	3.446	0.019
DBP	0.009	0.384	0.764

Discussion

Obesity is often defined a condition of abnormal or excessive fat accumulation in adipose tissue to the extent that health may be impaired. Obesity causes increase in blood volume and cardiac output which leads to increase in venous return and intra ventricular pressure. This leads to ventricular hypertrophy which further progress to systolic and diastolic dysfunction. Characteristically obese have increased sympathetic activity, insulin resistance, abnormal lipid levels and endothelial dysfunction (14).

PL Torng et al reported obesity in women has been found to be strongly associated with elevated levels of TC, LDL-C and TG and lowered HDL-C. This correlation was strongest in women 35-54 years of age. He found significant association between BMI and TC, HDL-C, TG and LDL-C which was similarly observed in our study (15).

Ali Chehrei et al did not show any statistical relationship between WHtR and HDL. In contrast, our study has shown significant negative correlations between BMI, WHR, WHtR to HDL. Although the difference between the different measures is not great in most cases, BMI has showed the strongest negative correlations with HDL (2).

Mirel Arruda et al reported in their study that there was no correlation between anthropometric variables and DBP levels which was similarly observed in our study. On the contrary a significant but slight correlation was observed between BMI and WHR and SBP levels among females of the present study. He found no correlation between FBS to any anthropometric variables which is contrast to our study result. We found BMI, WHR and WHtR have significant positive correlations with FBS (16).

Prabhadeep Kaur et al reported in their study, WHR is the best predictor of type 2 diabetes and should be used addition to BMI for detecting high risk groups. BMI continues to be useful index for predicting hypertension (17).

SB Van et al analyzed, the weakest correlate to all

the CVD risk factors was WHtR, significantly differing from other adiposity measures for SBP, DBP, HDL, TC and FBS (8). Especially when WHR and WHtR latter holds significantly better correlations to CVD risk factors in our study.

In our study we tried to investigate which anthropometric measure had the strongest association with cardiovascular disease risk factors in middle aged women without a history of cardiovascular disease. We observed that BMI, WHR and WHtR together have shown to predict cardiovascular risk factors in middle aged women. They are the easy and practical methods to diagnose obesity and together can be used as simple measures to predict cardiovascular risk factors in middle aged women.

Regression equation to predict dependant variable (cardiovascular risk factors as SBP, DBP, TC, TG, HDL& FBS) from independent variables (BMI, WHR & WHtR) are as follows,

$$SBP = 94.02 + (BMI \times 1.019) + (WHR \times 27.262) - (WHtR \times 39.50)$$

$$TC = 104.905 + (BMI \times 2.61) + (WHR \times 21.55) (WHtR \times 27.35)$$

$$TG = -256.05 + (BMI \times 3.43) + (WHR \times 393.55) (WHtR \times 0.86)$$

$$HDL = 58.72 (BMI \times 0.64) + (WHR \times 0.71) + (WHtR \times 0.49)$$

$$FBS = -62.35 + (BMI \times 3.89) + (WHR \times 27.26) (WHtR \times 39.50)$$

We observed no significant difference in cardiovascular risk factors in premenopausal and postmenopausal women of all three groups except for FBS, DBP and HDL. Hence the reasons responsible for increase in cardiovascular risk among middle aged women are multifactorial and complex interrelated. Hence the study demonstrates that both pre and post menopausal middle aged obese women with higher BMI, WHR and WHtR have more chances of having cardiovascular diseases.

Conclusion

Both pre and post menopausal middle aged obese women with higher BMI, WHR and WHtR have more chances of having cardiovascular

diseases. BMI, WHR and WHtR are the easy and practical methods to diagnose obesity and together can be used as simple measures to predict cardiovascular risk factors in middle aged women.

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