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ASSOCIATING CARDIOVASCULAR DISEASES WITH BODY FAT MASS INDICES AND BARORECEPTOR SENSITIVITY IN POSTMENOPAUSAL WOMEN WITH HIGH BODY MASS INDEX

Dr. R. Meena*[1], Dr. Pravati Pal[2] and Dr. Dasari Papa[3]

[1]Department of Physiology, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry- 605102.
[2]Department of Physiology, JIPMER, Puducherry- 605006.
[3]Department of Obstetrics and Gynaecology, Sri Venkateshwaraa Medical College hospital and Research Centre, Puducherry- 605102.

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***Corresponding Author: Dr. R. Meena**
Department of Physiology, Sri Venkateshwaraa Medical College hospital and Research Centre, Puducherry- 605102.
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ABSTRACT

Body fat accumulation can vary baroreceptor sensitivity and that finally will have effect on body as altered blood pressure, glucose levels, and cardiovascular disorders, making it a significant public health concern among postmenopausal women with reduction in their average lifespan. High body mass index can impair baroreflex function and lower BRS, mostly via increasing sympathetic nervous system activity. Aims and Objectives: The aim of the study is to Associate cardiovascular diseases with body fat mass indices and Baroreceptor sensitivity in normal and high body mass index (BMI) postmenopausal women. Materials and Methods: This research was directed on 104 postmenopausal women of age group 45–60 years grouped them into two. Group 1 having normal BMI (18.50–24.99) and Group 2 having high BMI >25.00 based on Asian's classification for BMI. Approval from the Institutional Ethical Committee was obtained before beginning the study. The continuous beat to beat blood pressure variability is measured using a noninvasive continuous hemodynamic monitor Finapres and Body fat composition was measured using an equipment named Bodystat that uses the technique of bioelectrical impedence analysis. Statistical analysis: Unpaired t-test was used to analyze all parameters of the study (control and study group). The result showed a lower level of parasympathetic and a higher sympathetic activity in the high BMI postmenopausal women when matched against the control group. Conclusion: Body fat mass indices and BRS are inversely proportional in high BMI postmenopausal women and they more likely to suffer from cardiometabolic disorders in early when compared to normal BMI postmenopausal women.

KEYWORDS: Postmenopausal Women, Baroreflex Sensitivity, Body Mass Index, Body fat mass indices, Cardiovascular diseases.

INTRODUCTION

Over a third of women's lives are spent in a post-menopausal state. Menopause is the final cessation of menstruation as a result of ovarian activity decline[1] Menstrual abnormalities start during the menopause transition, sometimes referred to as the perimenopause, when symptoms of female sex hormone insufficiency appear. Menopausal shift is linked to changes in mood, sleep patterns, food, and other aspects of lifestyle, as well as an increased prevalence of metabolic syndrome and cardiovascular risk factors.[2,3,4] However, whether the reported changes associated with menopause are due to hormonal alterations, psychological changes associated with the transition, natural ageing, social and behavioural factors of midlife or genetic vulnerability is less clear and warrants further exploration. Numerous studies demonstrate that menopause causes changes in body composition, such as a reduction in lean body mass, an increase in fat mass, and a redistribution of adipose tissue in the abdominal region.[5] Eating packaged food with low nutritional content was revealed to be a major role in weight increase, while sitting and not doing exercises were found to be minor factors.[6] Interestingly, it has been demonstrated that patients with higher visceral abdominal fat had lower BRS than those with lower total and abdominal fat.[7] In addition to significantly lowering BRS, obesity can cause sympathovagal imbalance by raising Sympathetic nervous system and decreasing parasympathetic activity.[8] It has been shown that a small increase in body weight can increase the risk of heart failure.[9] The major cause of death for women over 65 is cardiovascular disease, which is on the rise globally.[10] The incidence of CV disorders rises significantly as women reach menopause, although the risk of developing them increases with age.[11,12] Given that 450,000 women die from cardiac disease each year and become victims of CAD, it is concerning that approximately 250,000 of these women.[13] pass away as a result of hormonal or metabolic changes brought on by excess body fat.[14]

Our study's goal is to establish a connection between body fat mass indices and baroreceptor reflex sensitivity which are a reliable measure of total body fat percentage, in postmenopausal women with high BMIs, who are at a significant risk of developing cardiovascular disease-related complications.

MATERIALS AND METHODS

Participants

The study was carried out on 104 postmenopausal women after receiving approval from the Institutional Ethics Committee for Human Studies and the JIPMER Scientific Advisory Committee (JSAC). The women were divided into two groups, with group 1 having a normal BMI (18.50–24.99) and group 2 having a high BMI >25.00 according to Asian BMI classification. Age and menopausal duration were matched equally among the subjects. Subjects were gathered from the JIPMER Obstetrics and Gynaecology OPD as well as from employees and their families who lived on campus

INCLUDION CRITERIA: During the study period, postmenopausal women aged 45–60 who were normotensive, free of serious systemic diseases, nonsmokers, and able to avoid caffeine, caffeine-containing beverages, medications, and alcohol were included.

EXCLUSION CRITERIA: Postmenopausal women of less than 45 and above 60 yrs, Tachycardia, Cardiac arrhythmias, Hypertension, Diabetes, Ischaemic heart disease, Retinopathy, Neuropathy, Any chronic disease or associated factors that may affect the autonomic reflexes, Neurological disease, Psychiatric diseases, Chronic alcoholics, Women receiving hormone replacement therapy and taking any medication that have been reported to affect BRS (like for instance autonomic blockers)

Participants were made aware of the study protocol in their mother tongue following which informed consent in written form was obtained from all postmenopausal women participating in this study before the initiation of any study procedure. History was obtained and subjects were asked to fill-up individual data sheet. Before the experiment, subjects were asked not to participate in any strenuous exercises, drinking, smoking, drinking caffeinated beverages, at least 12 hours before the recording. Subjects were advised not to take sleeping pills or tranquilizers at least 48 hours before the recordings.

ANTHROPOMETRIC INDICES: The physical and physiological parameters were recorded using weighting machine, height strands. Subjects were assessed with minimal clothing and barefoot for their height in centimetres using a stadiometer, weight in kilogram using a digital weighting machine. BMI was calculated using Quetlet index that uses body weight and height of the individual. Circumferences were measured using non- elastic steel tape (CESCORF, Brazil, South America). Waist circumference was measured (WC) which lies between lower costal border and top of the iliac crest, hip circumference at the level of greatest posterior protuberance of the buttocks. Other indices like WHtR and WHR were also calculated.

BODY FAT ANALYSIS: Body fat composition was measured using an equipment named Bodystat, (Model QuadScan 4000, Isle of Man, United Kingdom) that uses the technique of bioelectrical impedence analysis (BIA).[15,16]. Bio-electrical impedence analysis works on the principle of multi-frequency bioelectrical impedence and it measures the body composition which was accepted by National Institute of Health (NIH, U.S.A) for nutritional survey.[17,18] Determination of resistive impedence (R) was made using an electrical impedence plethysmograph with a four electrode arrangement that induces a painless alternating current of 500 to 800 micro amperes in the body. On the day prior to testing, participants were instructed not to eat or drink 2 hours prior to the test. Subjects were placed in supine position with no parts of the body touching another part for at least 10 minutes in quiet, ambience and controlled room temperature of 24- 26 degree Celsius. The electrodes were placed on the dorsal surfaces of the hand and foot proximal to metacarpal-phalangeal and metatarsal-phalangeal joints respectively. Subjects were asked to remain quiet and not to disturb the electrodes by moving the body parts. Parameters assessed by Bioelectric Impedence Analysis were 1. Body cell mass 2. Intracellular water 3. Extracellular water 4. Total body water 5. Lean body mass 6. Body fat mass and nutritional index.

BLOOD PRESSURE VARIABILITY: The continuous beat to beat blood pressure variability is measured using a noninvasive continuous hemodynamic monitor Finapres (Finometer version1.22a, Finapres Medical Systems BV, Amsterdam, The Netherlands). Finapres provides continuous hemodynamic profile by characterizing arterial circulation and its beat- to- beat variability in pressure and flow according to the volume- clamp method of Penaz and physical criteria of Wesseling.[19,20] The parameters recorded from the Finapres tachogram were: 1. Heart rate 2. Systolic blood pressure and its variability 3. Diastolic blood pressure and its variability 4. Mean arterial pressure 5. Stroke volume 6. Left- ventricular ejection time 7. Cardiac output 8. Total peripheral resistance 9. Baroreceptor- reflex sensitivity.

The subjects were made comfortable in supine posture for 10 minutes in quiet room with ambient temperature of 25 C. Based on the finger size, cuff was selected and tied tightly around middle phalanx of the middle finger. Brachial cuff was tied around the midarm above the cubital fossa for return to flow calibrations. In Finapress for level correction two sensors are used, which usually shift the finger pressure in upward direction to approach the nearest brachial artery pressure, one placed at the level of heart and the other at the level of finger. Later 5 minutes of initial recording of return to flow calibration was done and physiocal was carried out for level correction following which 10 minutes of reconstructed finger arterial pressure was recorded.

Statistical analysis of data: Data were analyzed using Statistical Product and Service Solutions (SPSS) (IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY). The distribution of continuous data such as age, height, weight, BMI, WC, HC, WHR, WHtR, BF (%), FFM (%), Dry lean (Kg), BCW (Kg), TBW (%), ECW (%), ICW (%), BM (Kcal/day), BM/Wt (Kcal/kg), AM (kcal/day), BFMI, FFMI, heart rate, systolic and diastolic BP, MAP , RPP (mmHg/min), SV (ml), CO (L/min), TPR (mmHg.min/L), LVET (ms), BRS (ms/mmHg) was expressed as mean ± standard deviation. Statistical analysis was done by student unpaired t-test. The p value < 0.05 was considered statistically significant.

RESULTS

Table 1: Age and Anthropometric indices in normal and high BMI postmenopausal women.

Parameters	Normal BMI (n=50)	High BMI (n=54)	P value
Age	51.68± 4.96	50.46±5.05	0.219
Weight (Kg)	52.44± 7.29	67.17±8.469	<0.000
Height (cm)	153.56± 6.23	151.98±6.00	0.190
BMI	22.16±2.08	29.06±3.18	<0.000
Waist circumference(cm)	81.19±7.91	87.94±9.35	<0.000
Hip circumference (cm)	94.80+ 7.76	100.25±10.20	0.003
Waist : hip	0.85±0.41	0.87±0.04	0.037*
Waist:height	0.52±0.57	0.57±0.06	0.000

The values are expressed as Mean±SD; Statistical analysis was done by student unpaired t-test. The P value <0.05 was considered statistically significant.

BMI: body mass index. *Mann-Whitney test was performed.

Table 2: Comparison of body composition indices in normal BMI and high BMI postmenopausal women.

Parameters	Normal BMI (n=50)	High BMI (n=54)	P value
BF (%)	20.28±3.58	29.31±4.47	<0.000
FFM (%)	79.72±3.58	70.68±4.47	<0.000
Dry lean (Kg)	11.58±1.75	19.50±4.32	<0.000
BCW (Kg)	24.00±2.46	30.83±3.58	<0.000
TBW (%)	56.09±12.13	51.37±3.04	<0.010
ECW (%)	24.34±1.99	23.79± 2.77	0.252
ICW (%)	31.62±2.86	29.92±3.26	0.006
BM (Kcal/day)	1347.64±172.37	1791.42±160.05	<0.000
BM/Wt (Kcal/kg)	26.78±1.11	23.92±1.52	<0.000
AM (kcal/day)	1989.78±192.89	2645.24±149.27	<0.000
BFMI	4.54±0.81	6.42±1.31	<0.000

The values are expressed as Mean±SD; Statistical analysis was done by student unpaired t-test. The P value <0.05 is considered statistically significant BF: body fat; FFM: free fat mass; BCM: body cell mass; TBW: total body water; ECW: extracellular water: ICW: intracellular water; BM: basal metabolism; BM/WT: basal metabolism to body weight ratio; AM: activity metabolism; BFMI: body fat mass index; FFMI: free fat mass index.

Table 3: Comparison of Blood pressure variability parameters among normal and high BMI postmenopausal women.

Parameters	Normal BMI (n=50)	High BMI (n=54)	P value
BHR (per min)	75.72± 10.13	79.85± 4.84	0.009
SBP (mmHg)	116.37± 7.18	121.41± 9.07	<0.002
DBP (mmHg)	67.90± 7.40	76.60± 6.83	<0.000
MAP	84.1± 7.84	91.5± 9.48	<0.000
RPP (mmHg/min)	88.11± 14.02	96.94±12.31	<0.000
SV (ml)	74.16± 20.18	85.90± 10.67	<0.000
CO (L/min)	5.61± 1.70	6.85± 1.00	<0.000
TPR (mmHg.min/L)	0.70± 0.27	1.22± 0.55	<0.000
LVET (ms)	255.43± 22.88	306.18± 16.37	0.000
BRS (ms/mmHg)	11.82± 4.33	9.44± 3.83	0.003

The values are expressed as Mean±SD; Statistical analysis was done by student unpaired t-test. The p value <0.05 is considered as statistically significant. BPV: blood pressure variability; BHR: basal heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; RPP: Rate pressure product; SV: stroke volume; CO: cardiac output; LVET; left ventricular ejection time; TPR: total peripheral resistance; BRS: Baroreceptor sensitivity.

DISCUSSION

Anthropometric and obesity indices:

According to certain publications, there is a strong correlation between cardiovascular morbidity and mortality and anthropometric measures such as BMI, WC, WHR, and WHtR.[21-24] Compared to total obesity, indicators of abdominal obesity such as WC and WHR are proven to be more accurate predictors of CV health risk.[25,26]

When comparing postmenopausal women with high BMI to those with normal BMI, there were substantial changes in body composition measures such BFMI, TBW, ECW, and ICW. Changes in these parameters indicate a decrease in the proportion of body lean (shown by FFM) and an increase in the proportion of body fat.

This was supported by the fact that postmenopausal women with high BMI had higher BF (%) and lower FFM (%). When evaluating the clinical outcomes and mortality risk related to obesity, BF and FFM are crucial.[27] Compared to the normal BMI group, postmenopausal women with high BMI had a considerably greater BFMI.

Since each person's absolute BF readings vary greatly, BFMI has been found to be the most accurate indication of obesity and the associated metabolic dysfunctions.[28] According to reports, basal metabolism (BM) plays a significant role in maintaining energy homeostasis because it is essential for BF use and establishes the energy imbalance linked to obesity.[29,30] Furthermore, it has been shown that elevated BM is linked to higher sympathetic nervous system activity.[31] BM and activity metabolism (AM) are much higher in postmenopausal women with high BMIs than in those with normal BMIs. This suggests that these women have energy dyshomeostasis and increased sympathetic activity. This was further demonstrated by the notable increase in basal metabolism (BM) and body cell mass (BCM) in postmenopausal women with high BMI.

These women are more at risk for health problems since an increase in basal metabolic rate is a risk factor for death.[32] Their increased body weight resulted in a drop in the BM/Wt ratio.

Blood pressure variability parameters

The tone of the vasculature in the systemic circulation tell about the total peripheral resistance (TPR).[33] Adrenaline narrows the diameter of the vessel wall by vasoconstriction and allows the blood to flow at high resistance. In the present study, TPR was increased in high BMI postmenopausal women highlighting increased sympathetic activity in these subjects. This was supported by significant rise in DBP in high BMI postmenopausal women because TPR is directly proportional to diastolic blood pressure. If TPR is more, then the pressure generated by the ventricles to eject the blood out of the arteries also goes up which can be appreciated by rise in DBP.[34] In high BMI postmenopausal women the heart rate was found to be increased when compared to controls and this could be due to the vagal withdrawal influencing the rise in HR. SV is the amount of blood pumped by each ventricle per beat. Increase in sympathetic activity increases SV as the ventricles are richly innervated by sympathetic fibers, and sympathetic activity increases the force of contraction of cardiac muscle. This rise in CO is further confirmed by rise in the SBP in the high BMI postmenopausal women because CO and SBP are linearly related to each other. Rise in both CO and SBP in the present study depicts the rise in sympathetic activity in the high BMI postmenopausal women compared to controls. In the present study BRS was found to be reduced in high BMI postmenopausal women. Baroreceptors sense the fluctuation in the blood pressure based on the stretch produced on the vessel wall. Reduced sensing power of the baroreceptor could be due to persistent rise in CO and SBP in high BMI postmenopausal women when compared to controls. Also, rise in the body fat could be a factor which desensitizes the baroreceptors as fat gets deposited in the vessel wall, and makes it stiffer and less pliable. Several studies have denoted that BRS is the broadcaster of the CV risk.[35,36,37] So, postmenopausal women with reduced BRS are more prone to CV risks. Rate pressure product (RPP) is used to measure the workload or oxygen demand of the heart and it tells about the hemodynamic stress. RPP is calculated using the formula: RPP = HR (in beats per minute) × SBP (in mm/Hg). White WB et al in 1999 stated increased RPP as an established risk of cardiovascular disease.[39] In the present study, RPP was increased in high BMI postmenopausal women when compared to controls indicating that the workload by the heart was more in the high BMI group, which suggested that the chance of acquiring CV diseases was also more in this group.

CONCLUSIONS

Anthropometric indices: In our study we concluded that all the anthropometric indices such as weight, BMI, waist circumference, hip circumference, waist hip ratio and waist height ratio were significantly high (Table-1) in high BMI postmenopausal women when compared to normal BMI postmenopausal women.

Body composition indices: Among the body composition indices, BF, dry lean, BCM, BM, AM, BFMI and FFMI were significantly high and FFM, TBW, ICW and BM/ Wt. were reduced significantly in high BMI postmenopausal women when compared to normal BMI postmenopausal women (Table- 2)

Blood pressure variability parameters: Among the BPV parameters, BHR, SBP, DBP, RPP, SV, CO, LVET and TPR were significantly high (Table- 3) and the BRS was reduced significantly in high BMI postmenopausal women compared to normal BMI

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I express my gratitude to Almighty

Conflict of Interest

The authors have declared that no competing interests exist.

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