

Comparative Evaluation of Metabolic Syndrome in Premenopausal and Postmenopausal Women

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Abstract:

Background: The prevalence of the Metabolic Syndrome is increasing tremendously due to increase in obesity around the World. Metabolic Syndrome doubles the risk of Atherosclerotic Cardiovascular diseases and approximately four fold increases the risk of developing type II diabetes mellitus. It has been seen that Metabolic Syndrome is on the rising trend especially in post-menopausal women. Metabolic Syndrome is widely increasing especially in the transition phase in every woman's life from premenopausal to menopausal phase. The aim of this study is to compare presence of metabolic syndrome and its components in premenopausal and post-menopausal women.

Material and Methods: The study was conducted in 300 pre-menopausal and 300 post-menopausal women attending Medicine OPD and admitted in ward of Dr. B.R.A.M. Hospital, Raipur C.G. from March 2015 to August 2016. The objective of the study was explained and informed to women and data of each woman was recorded in identical pre designed proforma after informed and written consent. Participants were categorized into two groups Pre-menopausal age group and Post-menopausal age group. Investigations including Fasting blood sugar, Lipid Profile and Anthropometric measurements including height, weight, waist circumference (WC) and hip circumference (HC) was recorded. A modified definition by the Adult Treatment Panel III guideline of the National Cholesterol Education Program was used to categorize the subjects according to presence of metabolic syndrome.

Results: In the present study the mean age of pre-menopausal and postmenopausal group was 42.8 yrs and 54.5 yrs respectively in a study group of 300 women in each. The mean age of attaining menopause in present study was 46 ± 3.1 yrs. Mean systolic BP in pre-menopausal and post-menopausal study group was 117.13 ± 10.87 mmHg and 118.23 ± 13.15 mmHg respectively. Mean Diastolic BP in pre-menopausal and post-menopausal study group was 78.55 ± 8.19 mmHg and 77.70 ± 9.24 mmHg respectively. No significant difference was observed between two groups regarding systolic BP ($p=0.265$) and diastolic BP. ($p=0.234$) The mean Waist Circumference (WC) was 78.96 ± 8.84 cms and 80.11 ± 10.82 cms in pre and post menopausal group respectively with no significant difference. Waist Hip Ratio was found to be significantly higher in post-menopausal subjects compare to pre-menopausal subjects. ($p=0.001$). BMI was found to be significantly higher in post-menopausal subjects as compared to pre-menopausal subjects. ($p=0.003$). TG was found to be significantly higher in Post-menopausal subjects compared to pre-menopausal subjects ($p<0.0001$). HDL was found to be significantly lower in Post-menopausal subjects compared to pre-menopausal subjects ($p=0.071$). FBS and PPBS were found to be significantly higher in Post-menopausal subjects as compared to pre-menopausal subjects. Raised FBS levels in post-menopausal subjects was statistically significant ($p<0.0001$) in the study. The overall prevalence of Metabolic Syndrome as per NCEP ATP III and IDF criteria was 38% and 50.7% respectively in our study. The prevalence of Metabolic Syndrome in post-menopausal women as per NCEP ATP III and IDF criteria was 48.6% and 56.8% respectively. Prevalence of Metabolic Syndrome in pre-menopausal women as per NCEP ATP III criteria is 27.4% and 44.6% as per IDF criteria.

In pre-menopausal group – Among this study subjects 1.47% had five risk factors of Metabolic Syndrome, 15.3% had four, 10.43% had three, 45.9% had two risk factors while 26.9% had only one risk factor of Metabolic Syndrome. **In post-menopausal group** 10.2% had five risk factors of Metabolic Syndrome and 40.32% had four risk factors while 49.4% had three and 50.9% had two and 36.9% had one risk factor of Metabolic Syndrome in the study. **Conclusion:** In present study there was high prevalence of Metabolic Syndrome (48.6%) among post-menopausal women than pre-menopausal women (27.4%) The incidence of Metabolic Syndrome increases with age, peak is seen in fourth to sixth decade. Dyslipidemia and abdominal obesity were the most prevalent components of Metabolic Syndrome among these women.

Keywords: NCEP ATP III=National cholesterol Education Programme Adult Treatment Panel III, IDF=International Diabetes Federation, EGSIR= European Group for the Study of Insulin Resistance.

I. Introduction

Metabolic Syndrome (Syndrome X, Insulin resistance syndrome) is widely increasing especially in the transition phase in every woman's life from premenopausal to menopausal phase. The existence of Metabolic Syndrome was first described by Kylin in 1923 when he described metabolic syndrome as clustering of hypertension, hyperglycemia and gout. [1]Gerald Reaven in 1988 gave pathophysiological arguments for the existence of Syndrome X, in which he included insulin resistance, hyperinsulinaemia, hyperglycemia, dyslipidemia and arterial hypertension and found that insulin resistance was present in 25% of adult population.[2] Besides insulin resistance with resulting hyperinsulinemia, the other identified features of the Metabolic syndrome include impaired glucose tolerance/type 2 diabetes, hypertension, lipid triad [increased triglycerides, decreased high-density lipoprotein cholesterol (HDL-C), increased low-density lipoprotein cholesterol (LDL-C)], obesity/visceral adiposity, elevation of inflammatory markers.[3]

The World Health Organization (WHO) was the first to specify the diagnostic criteria for metabolic syndrome in 1998. [4] The WHO definition emphasized insulin resistance and therefore required the individual to be insulin resistant or having type 2 diabetes, or impaired glucose tolerance (indicated by oral glucose tolerance test). The practical difficulties in meeting the insulin criteria limited the use of the WHO definition. In addition to this absolute requirement of insulin resistance, two additional criteria have to be met. These included obesity (measured as elevated waist-hip ratio or body mass index (BMI), dyslipidemia [high triglycerides or low high density lipoprotein (HDL) cholesterol], hypertension and microalbuminuria. In 1999, the European Group for the Study of Insulin Resistance (EGIR) proposed a modification of the WHO definition.[5] The WHO criteria was modified for better practical approach and the EGIR proposed their own definition relying on fasting insulin instead of the euglycaemic clamp to measure insulin resistance. Therefore, participants with type 2 diabetes were excluded since fasting insulin may not be a useful measure of insulin resistance in such persons. The obesity criteria were simplified to waist circumference. Moreover, micro albuminuria was eliminated from the criteria of metabolic Syndrome.

In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) introduced an alternative clinical definition for metabolic syndrome. The purpose of the NCEP definition was to identify people at higher long-term risk for CVD who would need clinical lifestyle intervention to reduce risk. An updated NCEP definition was proposed by the American Heart Association (AHA) and the National Heart Lung and Blood Institute (NHLBI) in 2005. [6] This definition retained most of the NCEP ATP III criteria but suggested a lower threshold for elevated fasting glucose. The NCEP definitions one of the most widely used metabolic syndrome definition because it is practical and easy to apply. However, it does not include the measurement of insulin and therefore it may fail to take insulin resistance into account.

In 2005, the International Diabetes Federation (IDF) proposed a new definition for metabolic syndrome, which was quite similar to the NCEP definition except that central obesity was required. [4] Following are definitions of metabolic syndrome according to IDF, ATP III, WHO

I. International Diabetes Federation definition of the metabolic syndrome:-

In order for a person to have a diagnosis of metabolic syndrome, he or she must have. Central obesity (defined as a waist circumference >94 cm for European men and >80 cm for European women, with ethnicity-specific values for other groups.) - If BMI is >30 kg/m², central obesity can be assumed and waist circumference does not need to be measured.

Plus any 2 of the following 4 factors

1. High triglyceride concentration: ≥ 150 mg/dL (1.7 mmol/L), or specific treatment for this abnormality.
2. Low HDL-cholesterol concentration: <40 mg/dL (1.03 mmol/L) in males and <50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality.
3. High blood pressure (BP): systolic ≥ 130 mm Hg or diastolic ≥ 85 mm Hg, or treatment of previously diagnosed hypertension.
4. High fasting plasma glucose (FPG) concentration ≥ 100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes.

If FPG is above the values stated above, an oral-glucose-tolerance test is strongly recommended but is not necessary to define presence of the syndrome.

II. Adult Treatment Panel III definition of the metabolic syndrome: (NCEP /ATP III) guidelines:- Patient may have three or more of the following:

1. Fasting plasma glucose level ≥ 100 mg/dl OR specific medication OR previously diagnosed type 2 diabetes.
2. Central obesity
Waist circumference : Men: >102 cm (40 in), Women: > 88 cm (35 in)

3. Triacylglyceridemia
≥150 mg/dL (>1.7 mmol/L) OR specific medication
4. Low HDL cholesterol
Men: < 40 mg/dL(<1.036 mmol/L), Women: <50 mg/dL (< 1.295 mmol/L) OR specific medication
5. Hypertension
Blood pressure ≥130 mm Hg systolic OR ≥85 mm Hg diastolic OR specific medication

III. World Health Organization definition of the metabolic syndrome:-

The patient must have 1of the following

1. Diabetes mellitus
Fasting plasma glucose ≥126 mg/dL ≥7 mmol/L OR
2 hour post glucose load ≥ 200 mg/dL ≥11.1 mmol/L
2. Impaired glucose tolerance –
Fasting plasma glucose <126 mg/dL (<7 mmol/L) and
2 hour post glucose load >140 mg/dL(7.8 mmol/L) and <200 mg/dL (11.1 mmol/L)
3. Impaired fasting glucose –
Fasting plasma glucose>110 mg/dL(6.1 mmol/L) and <126 mg/dL(<7 mmol/L) and.(If measured 2hour post glucose load <140 mg/dL(7.8 mmol/L)
- 4.Insulin resistance:
Glucose uptake below lowest quartile for background population under investigation under hyperinsulinemic, euglycemic conditions.
Plus any 2 of the following:
 1. Waist-to-hip ratio>0.9 in men, > 0.85 in women; BMI > 30; OR both
 2. Triacylglycerols>150 mg/dL(> 1.7 mmol/L)
 3. HDL cholesterol<35 mg/dL(0.9 mmol/L) in men,
< 39 mg/dL (1.0 mmol/L) in women; or both
 4. Blood pressure >140/90 mm Hg (revised from >160/90 mm Hg)
 5. Microalbuminuria (urinary albumin excretion rate > 20 microg/min OR albumin-to-creatinine ratio > 30 mg/g. (AlbertiKG ,Zimmet PZ 1998)[4]

IV. European Group for the Study of Insulin Resistance,(EGIR) 1999:-

Insulin resistance hyperinsulinaemia,

Plus 2 or more of the following

1. Central obesity: waist –hip ratio for men >0.9, for women >0.85 and/orBMI is >30 kg/m²
2. Dyslipidaemia: raised plasma triglycerides >1.7 mmol/L or low HDL cholesterol <1.0mmol/L for women and < 0.9 mmol/L for men or treated for dyslipidemia .
3. Hypertension: blood pressure >140/90 mm Hg and/or on antihypertensive medication.
4. Fasting plasma glucose: >6.1 mmol/L(Balkau B, Charles MA 1999)[5]

V. American Association of Clinical Endocrinologists (AACE)

Identifying abnormalities of Insulin Resistance Syndrome

1. Triglycerides:>150 mg/dl
2. HDL:<40 mg/dl for men, <50 mg/dl for women
3. BP:>130/85mm Hg (Bloomgarden ZT 2003)[27]
4. Glucose :
Fasting 110-125 mg/dl
120 min post glucose challenge 140-200 mg/dl

Table No 1 : Different Criteria of Metabolic Syndrome

	WHO,1998	NCEP ATP III,2004	IDF,2005	SOUTH ASIANS	ASIAN INDIANS
AC(cm) in women	WHR >0.85 OR BMI>30	>88	>/=80	>82	≥ 72
BP(mm/Hg)	Sys.>140 Dias.>90	Sys.>130 Dias.>85	Sys.>130 Dias.>85	Sys.>130 Dias.>85	Sys.>130 Dias.>85
Serum TG(mg/dl)	>150	>150	>150	>150	>150
HDL(mg/dl)	<39	<50	<50	<50	<50
Fasting Bl. sugar(mg/dl)	>110	≥100	≥100	≥100	≥100
Microalbumi-nuria	U.alb.excretion> 20 micro/min or alb. creatinine ratio >30 mg/g				

A hallmark of the menopausal transition is the dramatic reduction in estradiol levels. With this reduction, there is a progressive shift toward androgen dominance in the hormonal milieu. Although little is known about how this hormonal shift influences CVD risk, available studies suggest a link between androgenicity and CVD risk factors. The metabolic syndrome is a summary measure of important CVD risk factors that frequently coexist. The syndrome is evident in 20% to 30% of middle-aged women and has been linked to the development of CVD and diabetes.

II. Material And Methods

The study was conducted in 300 pre-menopausal and 300 post-menopausal women attending Medicine OPD and admitted in Medicine ward of Dr. B.R.A.M. Hospital, Raipur C.G. from March 2015 to August 2016. The objective of the study was explained and informed to women and data of each woman was recorded in identical pre designed pro forma after informed and written consent. Participants were categorized into two groups

1. Pre-menopausal age group
2. Post-menopausal age group

Study Design:- Observational & Cross sectional

Inclusion criteria for study group:-

Menopause or Post-menopause - Period that starts one year after the last menstruation. It is subdivided into early (up to five years after the last menstruation) or late (more than five years after the last menstruation).

Peri-menopause or menopausal transition - Period that extends from two years before the last menstruation and until one year later. Women have irregular menstrual cycles and endocrine changes.

Pre-menopause – Period during which women still have menstrual cycles, whether such cycles are regular or not. By definition peri-menopause will not fulfill the criteria for post-menopause, hence included in pre-menopausal group. Pre-menopausal and post-menopausal women taking specific medications for hypertension, diabetes and dyslipidemia were also included in study group.

Exclusion criteria for study group:-

Acute recent illness and/or history of any overt chronic inflammatory disease.

Patients with liver disease

Patients with renal disease

Pregnant women.

After obtaining informed consent, all participants had undergone complete general and systemic examination and investigations. Initially a questionnaire was completed containing information regarding the physical activity, leisure time, addiction, menopausal status, consumption of relevant medication specially anti-diabetic, anti-hypertensive and hormone replacement therapy.

Anthropometric measurements including height, weight, waist circumference (WC) and hip circumference (HC) was taken with participants wearing light clothes and without shoes.

Weight

Weight was recorded to the nearest 0.1 kg using electronic digital liquid-crystal display weighing machines placed on a flat surface.

Height

Height was measured with the participant standing erect against a wall looking straight ahead with the occiput, back, hip and heels in contact with the wall.

Body mass index

Body mass index (BMI) was calculated as the weight (kg) divided by square of the height (m^2).

Body mass index (BMI) = $\text{Weight(kg)}/\text{Height}(m^2)$

Waist circumference

WC was measured by placing a tape horizontally midway between the lower border of the ribs and iliac crest on the mid-axillary line.

Hip circumference

Measured at the level of iliac crest

Waist- Hip Ratio

Systolic and diastolic blood pressure

Blood pressure was measured twice in the right arm in both a sitting and standing position. Measurements were taken 5 min apart, and the mean of the two measurements was taken as the final blood pressure reading.

Biochemical analysis:-

Blood for biochemical analysis was obtained from the participants after 10–12 hours of an overnight fast. Blood sample was taken in morning with all usual precaution in plain vial without any additives and anticoagulants , serum sample was collected after centrifugation.

Fasting blood sugar & Postprandial blood sugar were determined by GOD / POD method.

Fasting lipid profile : Triglyceride & HDL levels were estimated.

A modified definition by the Adult Treatment Panel III guideline of the National Cholesterol Education Program was used to categorize the subjects, which is given below
Diagnostic criteria for Metabolic Syndrome

Table No 2 : NCEP-ATP III (2005)

PARAMETER	NCEP-ATP III (2005)
Abdominal circumference	> 88 cm
Triglyceride	≥ 150 mg/dl
HDL level	< 50 mg/dl
Blood Pressure	Systolic ≥/≠ 130 mmHg Diastolic ≥/≠ 85 mmHg
Fasting blood glucose	≥ 100 mg/dl
Diagnosis of Metabolic Syndrome	Three criteria

The NCEP-ATP III (2005) criteria is the most frequently used criteria. But there are other criteria also which deserves to be discussed. The IDF (2005) criteria, which is almost similar to NCEP ATP III criteria is also widely accepted. The parameters are as follows-

Table No 03 : IDF (2005)

PARAMETER	IDF (2005)
Abdominal circumference	≥ 80 cm
Triglyceride	≥150mg/dl
HDL	<50 mg/dl
Blood Pressure	Systolic > 130 mmHg Diastolic >85 mmHg
Fasting blood glucose	≥ 100 mg/dl
Diagnosis of Metabolic Syndrome	AC + two criteria

III. Observation And Results

The study was conducted in 300 premenopausal and 300 post menopausal women in the Department of Medicine, Dr. B.R.A.M. Hospital, Raipur and following observations were obtained.

Table No 4 : Comparison of Lipd profile parameters in pre-menopausal and post-menopausal study subjects.

Characteristics	Study group	N	Mean	S Deviation	Std. Error Mean	T	Sig. (2-tailed)
TG (mg/dl)	Pre-menopausal	300	123.21	31.28185	1.80606	-4.626	<0.0001
	Post-menopausal	300	137.08	41.45458	2.39338		
HDL (mg/dl)	Pre-menopausal	300	38.7167	13.32723	0.76945		
	Post-menopausal	300	37.1000	7.82864	0.45199	1.812	0.071

Table No 5: Comparison of BP in Pre-menopausal and post-menopausal study subjects

Characteristics	Study group	N	Mean	Std. Deviation	Error Mean	t	Sig.(2-tailed)
Systolic BP (mm Hg)	Pre-menopausal	300	117.13	10.87089	0.62763		0.265
	Post-menopausal	300	118.23	13.15761			
Diastolic BP (mm Hg)	Pre-menopausal	300	78.5500	8.19786	0.47330	1.191	0.234
	Post-menopausal	300	77.7000	9.24635	0.53384		

Table No 6: Comparison of waist and hip circumference in Pre- menopausal and post-menopausal study subjects

Characteristics	Study group	N	Mean	Std. Deviation	Std Error Mean	t	Sig. (2-tailed)
Waist circumference (cm)	Pre-menopausal	300	78.9667	8.84721	0.51079	1.420	0.156
	Post-menopausal	300	80.1133	10.82703	0.62510		
Hip circumference (cm)	Pre-menopausal	300	89.6900	8.45056	0.48789	0.380	0.704
	Post-menopausal	300	89.3933	10.57915	0.61079		

Table No 7 : Association of Metabolic syndrome with Menopause

Metabolic Syndrome		Study Group			p value
		Pre-menopausal	Post-menopausal	Total	
Absent %		281	245	526	<0.0001
		93.7%	81.7%	87.7 %	
Present %		19	55	74	
		6.3%	18.3%	12.3%	
Total	N	300	300	600	
	%	100%	100%	100%	

Results

The study comprised of 600 women subjects with 300 candidates in both premenopausal and post-menopausal study group each. Out of 300 pre-menopausal study group most of the women were of 36 to 45 yrs age group with mean age of 42.8 yrs and in 300 post-menopausal study group mean age was 54.5 yrs in the study. The age of attaining menopause in present study lies in between 41 to 50 yrs. with mean of 46 ± 3.1 yrs. Although 6.7% of women attained menopause in the age group of 51 to 60 yrs. Mean systolic BP in pre-menopausal and post-menopausal study group is 117.13 ± 10.87 and 118.23 ± 13.15 respectively. Mean Diastolic BP in pre-menopausal and post-menopausal study group is 78.55 ± 8.19 and 77.70 ± 9.24 respectively. No significant difference was observed between two groups regarding systolic BP ($p=0.265$) and diastolic BP. ($p=0.234$) The mean Waist Circumference (WC) in pre-menopausal and postmenopausal study group was 78.96 ± 8.84 cms and 80.11 ± 10.82 cms respectively. No significant difference was observed between two groups regarding waist circumference ($p=0.156$)

Waist Hip Ratio was found to be significantly higher in post menopausal subjects compare to pre-menopausal subjects. ($p=0.001$). BMI was found to be significantly higher in post-menopausal subjects as compared to pre-menopausal subjects. ($p=0.003$) TG was found to be significantly higher in Post- menopausal subjects compared to pre -menopausal subjects ($p<0.0001$). HDL was found to be significantly lower in Post -menopausal subjects compared to pre- menopausal subjects ($p=0.071$). FBS and PPBS were found to be significantly higher in Post- menopausal subjects as compared to pre-menopausal subjects. We found raised FBS levels in post-menopausal subjects which was statistically significant ($p<0.0001$) in our study. The overall prevalence of Metabolic Syndrome as per NCEP ATP III and IDF criteria was 38% and 50.7%. respectively in our study. The prevalence of Metabolic Syndrome in post-menopausal women as per NCEP ATP III and IDF criteria was 48.6% and 56.8% respectively.

Prevalence of Metabolic Syndrome in pre-menopausal women as per NCEP ATP III criteria is 27.4%. and 44.6% as per IDF criteria. In pre-menopausal group – Among this study subjects 1.47% had five risk factors for Metabolic Syndrome, 15.3% had four, 10.43% had three, 45.9% had two risk factors while 26.9% had only one risk factor for Metabolic Syndrome. In post-menopausal group 10.2% had five risk factors for Metabolic Syndrome and 40.32% had four risk factors while 49.4% had three and 50.9% had two and 36.9% had one risk factor for Metabolic Syndrome in our study. The results of our study suggest that the prevalence of Metabolic Syndrome in post-menopausal women was significantly higher than pre-menopausal women. Dyslipidemia and abdominal obesity were the most prevalent components of Metabolic Syndrome among post-menopausal women in the present study.

IV. Discussion

Metabolic Syndrome increases the risk of Cardiovascular disease as well as morbidity and mortality due to it. On the other hand, menopause with its incidental hormonal changes appears to increase the risk of CVD independently of normal aging, and premenopausal women may be protected against CVD compared with men and postmenopausal women of a similar age. The present study was intended to determine the prevalence of Metabolic Syndrome and its components in premenopausal and postmenopausal women, as well as the association between the menopausal status and Metabolic Syndrome.

The mean age of pre-menopausal and post menopausal women in study group is 42.83 ± 3.7 yrs and 54.50 ± 6.36 yrs respectively. In a study done by M Nakhjavani et al 2014 the mean ages of pre-menopausal and post-menopausal were 43.33 ± 0.47 yrs and 60.35 ± 0.38 yrs respectively which is similar to our study.[7] In a study done by Miller et al 1998 where age group were 40 – 70 yrs. and 60% of them were post-menopausal. They found that 68% post- menopausal women had Metabolic Syndrome and 13% pre-menopausal women had Metabolic Syndrome. This increased prevalence in post- menopausal group may have occurred because the average age was higher (57.3 yrs.) in their study. [8] These findings indicate age as a participating factor when the relationship of menopausal status and the occurrence of Metabolic Syndrome are studied. Although the risk of Metabolic Syndrome increases with age, studies have shown that post-menopausal women are at greater risk of having Metabolic Syndrome, regardless of age.

Waist hip ratio was found to be significantly higher in post- menopausal subjects compared to pre-menopausal subjects ($p=0.001$) in our study. In a study by A Marjani et al 2012 Waist hip ratio was significantly high among post-menopausal women with metabolic syndrome. [9] Similarly KB Mishra et al 2006 observed significantly higher Waist/ hip ratio (WHR) (0.87 ± 0.07 , $p<0.05$) for women with metabolic syndrome as compared to those without metabolic syndrome. [10] N Chhabra et al 2013 observed that post-menopausal women had significantly higher mean WHR, than their pre-menopausal counterparts.[11]

In present study TG cholesterol levels were higher in post- menopausal study group as compared to pre-menopausal women whereas lower HDL cholesterol levels were observed in both the study groups. In a study by Kanvar et al 2014 there was no significant difference in the total cholesterol and the triglyceride levels between pre- menopausal and post-menopausal groups ($p>0.005$). However there was significant reduction in HDL and VLDL-C fraction in the post-menopausal group and a significant increase in the value of LDL-C ($p<0.005$). [12] In another study by S Jesmin et al 2013 significant high TG levels were observed in post-menopausal women than pre-menopausal women ($p<0.05$). However, prevalence of low HDL cholesterol levels were significantly lower in post-menopausal women than pre-menopausal women ($p<0.001$). [13] R Dosi et al 2014 revealed that post-menopausal women had significantly higher prevalence of abnormal lipid profiles (total cholesterol, LDL-C and HDL-C) as compared to their pre-menopausal counterparts. [14] In the study by F K Nanse Arthur et al 2013, there is increase in serum triglyceride levels in post- menopausal women but mean levels of HDL-cholesterol were similar between pre-menopausal and post- menopausal women. [15]

In our study FBS levels were found to be higher in post- menopausal subjects compared to pre-menopausal subjects with mean of 73.01 ± 21.16 and 77.41 ± 24.17 mg/dl respectively which was not statistically significant. ($p=0.18$) Significant association was detected between FBS and menopause ($p<0.0001$) indicating raised FBS levels in post-menopausal subjects. According to a study by Walton et al 1993 a significant difference of impaired fasting glucose was found among post-menopausal women with and without metabolic syndrome. Walton and colleagues also report an increase in FBS among post-menopausal women with metabolic syndrome. [16] In another study S Jesmin et al 2013 found prevalence of elevated fasting blood glucose, was significantly higher in post- menopausal women than pre-menopausal women ($p<0.05$). [13] M Shalini et al 2013 found in their study that fasting blood glucose levels, were significantly higher among women with metabolic syndrome ($p=0.009351$). [17]

The concept of Metabolic Syndrome and its grave consequences has emerged for several decades, but only after the standardization of diagnostic criteria, it was possible to evaluate the prevalence of Metabolic Syndrome in different regions. The prevalence of Metabolic Syndrome varies a lot owing to differences in genetic profile, eating habits, levels of physical activity, age, gender, lifestyle etc.

The overall prevalence of Metabolic Syndrome as per NCEP ATP III and IDF criteria was 38% and 50.7%. respectively in our study. The prevalence of Metabolic Syndrome in post-menopausal women as per NCEP ATP III and IDF criteria was 48.6% and 56.8% respectively. Prevalence of Metabolic Syndrome in pre-menopausal women as per NCEP ATP III criteria is 27.4%. and 44.6% respectively as per IDF criteria. In a study by Jesmin et al 2013 the overall prevalence of Metabolic Syndrome was 25.6% where 39.3% of post-menopausal women and 16.8% of pre-menopausal women had Metabolic Syndrome which is statistically significant ($p<0.001$). [13] According to study by FK Nanse Arthur et al 2013 the percentage prevalence of Metabolic Syndrome was 14.4%, 25.6%, 29.2% and 30.4% using WHO, NCEP ATP III, IDF and H_{MS} criteria respectively for the total population. The prevalence was higher among the post- menopausal group (i.e. 25.2%, 41.1%, 43.0% and 43.9% for WHO, NCEP ATP III, IDF and H_{MS} respectively) compared to the pre-menopausal population (i.e. 6.3%, 14.7%, 18.9% and 23.1% respectively for WHO, NCEP ATP III, IDF and H_{MS} criteria respectively) The prevalence of metabolic syndrome was significantly higher among post-menopausal women ($p<0.05$ by all criteria) compared to their pre-menopausal cohort, but with marked inter-criteria variations in his study. [15] In A study by Zahra Jouyandeh et al 2013 overall prevalence of metabolic syndrome among study subjects was 30.1% by NCEP ATP III criteria. Waist circumference, HDL cholesterol, fasting blood glucose, diastolic blood pressure, Systolic blood pressure, and triglyceride were significantly higher among women with metabolic syndrome ($p<0.05$). There is high prevalence of abdominal obesity and

hypertension which were the most prevalent components of metabolic syndrome.[18] In a study by S Pandey et al 2010 prevalence of metabolic syndrome amongst post-menopausal women was significantly higher ($p < 0.001$) than that in pre-menopausal women by both, IDF (pre-menopausal 45% and post- menopausal 55%) and H_MS criteria (pre-menopausal 44% and post- menopausal 56%). However, this significance disappeared when data was adjusted for the confounding variable of age. [19]A S Sapkota et al 2015 in their study observed that the prevalence of Metabolic Syndrome was found to be 57.8% in postmenopausal and 20% in premenopausal women using the IDF criteria. Metabolic Syndrome was highly prevalent in postmenopausal women than in premenopausal women.[20] Eshtiaghi et al 2010, showed a prevalence of 53.5% Metabolic Syndrome in post-menopausal Iranian women, on the other hand it was only 18% in pre-menopausal women.[21] The overall prevalence of Metabolic Syndrome in a study by Samir Ben Ali et al 2014 was 35.9%. They found that the prevalence of Metabolic Syndrome was significantly higher among postmenopausal women (45.7%) than among premenopausal women (25.6%).[22]

The mechanisms underlying the association between menopausal transition and Metabolic Syndrome have not fully been elucidated. The decline in ovarian function is considered the main cause of this phenomenon.[23] In premenopausal and postmenopausal women, the prevalence of metabolic syndrome were 8.69% and 21.85%, respectively in a study done by Jong Kil Joo et al 2012.[24] Neto et al 2010 estimated prevalence of the syndrome among Brazilian pre-and postmenopausal women to be 24.0% and 44.4% according to NCEP ATP III criterion.[25] Similarly, the prevalence of the syndrome was 13.8% and 54.6% among Korean pre-and postmenopausal women respectively in a study by Kim H et al 2007.[26]Our findings were consistent with many of previous studies where post-menopausal women have been found to be at higher risk of Metabolic Syndrome than pre-menopausal women. These differences in prevalence of metabolic syndrome in different studies can be due to different investigation methods of the syndrome . Asian Indians have different anthropometric characteristics in comparison with white Caucasians and blacks. Metabolic abnormalities contributing to CV risk factors are detectable at a lower WC in Asians. Hence, using NCEP ATP III, IDF, WHO, EGIR and AACE criteria might underestimate the prevalence of Metabolic Syndrome in Asians. In our study deranged lipid profiles i.e. high Triglyceride levels with low HDL levels were most predominantly observed followed by increased Waist Circumference. So Dyslipidemia and abdominal obesity were the most prevalent components of Metabolic Syndrome among these women although Hypertension and Impaired Fasting blood sugar levels were also the risk factors observed in our study. The results of our study suggest that the prevalence of Metabolic Syndrome in post-menopausal women was significantly higher than premenopausal women.

V. Conclusion

In our study there was high prevalence of Metabolic Syndrome (48.6%) among post-menopausal women than pre-menopausal women (27.4%) The incidence of Metabolic Syndrome increases with age, peak is seen in fourth to sixth decade. Dyslipidemia and abdominal obesity were the most prevalent components of Metabolic Syndrome among these women. Although Indians have lower average WC by virtue of their smaller body size, they carry excess morbidity risks even at lower BMI. It should be made a point to incorporate measurements of Height, Weight, Waist Hip Ratio, Blood Pressure and blood investigations as FBS and lipid profile estimation in routine by all Physicians. Many patients were ignorant about the Metabolic Syndrome and its complications so women who are showing derangements but not meeting the criteria of Metabolic Syndrome should be taught about lifestyle changes so as to check the disease at its infancy and reduce the hidden burden of future cardiovascular complications and morbidity. Prevention through changes in lifestyle, or early detection and treatment of elevated fasting blood glucose, hypertension, and hyperlipidemia are necessary for prevention of many chronic diseases in women reaching after menopausal status. Health professionals should consider the post-menopausal women as a major target group for prevention of Metabolic Syndrome, which is an underlying condition of many non -communicable diseases.

Acknowledgement

The authors would like to thank staff of Department of Medicine, Pt. J.N.M.Medical College, Raipur and also to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

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