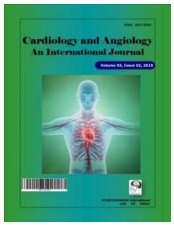

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Prevalence of Risk Factors for the Metabolic Syndrome in a Global Perspective: A Brief Review

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Authors' contributions

This work was carried out in collaboration between all authors. All authors contributed to the literature search. Author PC wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Metabolic syndrome refers to the clustering of a number of risk factors which have the potential to develop cardiovascular disease and type 2 diabetes mellitus and thus causing an increase in mortality rate. The prediction is that by 2020, there will be an increase by almost 75% in global cardiovascular disease prevalence and almost all of this increase will occur in developing countries. The prevalence of type 2 diabetes mellitus is also rapidly increasing all over the world at an alarming rate. In this paper, we have made an attempt to briefly review and compare the prevalence of metabolic syndrome risk factors in India as well as other regions of the world. We have also compared the metabolic syndrome risk factors for premenopausal and postmenopausal women for sample populations in India, Iran and Korea.

Keywords: Metabolic syndrome; cardiovascular disease; risk factors; global prevalence; ethnic predisposition.

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1. INTRODUCTION

Metabolic syndrome (MetS) refers to the clustering of a number of physiological, biochemical, clinical and metabolic factors, which increases the risk of developing cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM) and hence increasing mortality rate. Apart from these, insulin resistance, atherogenic dyslipidemia, obesity, genetic heritance, elevated blood pressure all contribute to the syndrome. MetS results in a 5-fold increase in T2DM, a 2-fold increase in CVD which causes myocardial infarction and stroke compared to those who have shown almost no MetS. It is the most prominent syndrome and could act as biomarker for atherothrombotic complications. As a consequence, it is an indirect measure for determining long term risk factor [1-6].

The prevalence of MetS is increasing globally with a range from less than 10% to as high as 84% depending on the region, urban or rural, age, sex, race and ethnicity [1,7,8]. About one-quarter of world's adult population has been reported to have MetS. It has been reported that in 1990, there were 5.2 million deaths from CVD in economically developed countries and 9.1 million deaths from the same cause in developing countries. The prediction is that by 2020, there will be an increase by almost 75% in global CVD prevalence and almost all of this increase will occur in developing countries [9-12]. The prevalence of diabetes is rapidly increasing all over the world at an alarming rate. The major driver of the epidemic is the more common form of diabetes, namely T2DM, which accounts for more than 90 per cent of all diabetes cases. India is the worst hit country with an estimated 32 million people had diabetes in the year 2000. This number is steadily increasing and set to reach about 70 million by the year 2025. The worldwide prevalence of diabetes for all age-groups was estimated to be 2.8% in 2000 which will reach 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million by the year 2030 [13-24].

The other factors that may cause high prevalence of MetS include high socio-economic status, sedentary lifestyle, smoking, alcohol consumption, low physical activity, diet and nutrition along with genetic predisposition causing overweight, obesity, high body-mass index (BMI), hypertension, dyslipidemia and hyperglycemia. It has been observed that there is a direct relationship between development of MetS with age and weight. Fig. 1 illustrates risk factors for CVD and possible causation pathway [25,26]. It has also been observed that women are more likely to develop MetS than men and also postmenopausal women are likely to be at higher risk of developing MetS than their premenopausal counterpart [1,10,27,28].

In this paper, we have made an attempt to briefly review and compare the prevalence of MetS in India as well as other regions of the world. Also we have compared the MetS risk factors for premenopausal and postmenopausal women in India and Iran.

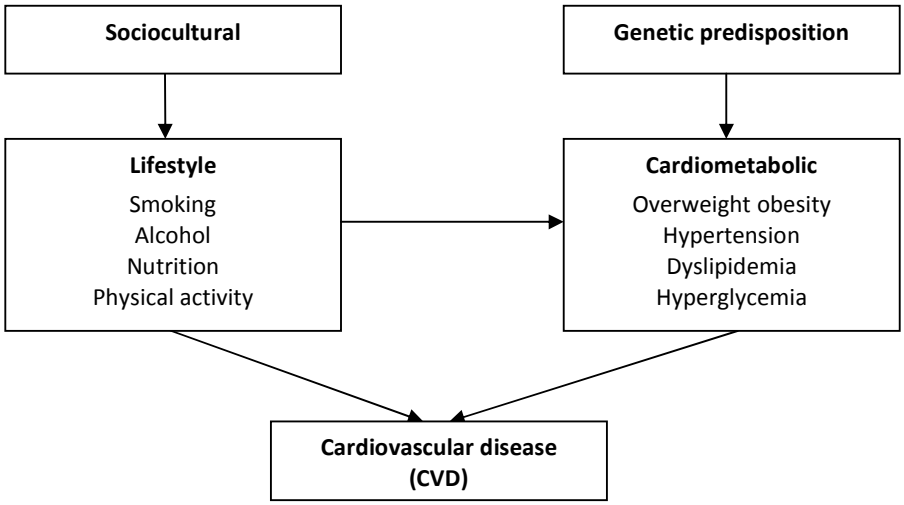

Fig. 1. Risk factors for CVD and causation pathway [25,26]

2. CRITERIA FOR CLINICAL DIAGNOSIS OF THE METS

Several organizations or groups have proposed criteria for the clinical diagnosis of the MetS, such as the World Health Organization (WHO), European Group for the study of Insulin Resistance (EGIR), the American Association of Clinical Endocrinologists (AACE), the National Cholesterol Education Program/Adult Treatment Panel (NCEP/ATP), and the International Diabetes Federation (IDF) [1,29-32]. Table 1 summarizes these clinical diagnostic criteria for MetS.

Alberti et al. [33] made an attempt for harmonizing the benchmark for MetS risk factors. The main difference with other benchmarks concerns the measure for central obesity. Alberti et al. [33] reported the findings of a meeting between several major organizations in an attempt to harmonize the criteria. It was agreed that although abdominal obesity would continue to be a useful preliminary screening tool, it should not be a prerequisite for diagnosis but it is one of the five criteria and that the presence of any three of five risk factors (elevated WC, elevated TG, reduced HDL, elevated BP, elevated FBG) would be used to diagnose a person for MetS. In the harmonized benchmark for MetS risk factors, a single set of cut points are used for all components except WC for which respective national or regional cut points for WC may be used.

Table 1. Criteria for clinical diagnosis of the MetS [1,29-32]

Clinical parameters	WHO[a]	EGIR[b]	AACE[c]	NCEP/ATP[d]	IDF[e]
Insulin resistance	IGT, IFG, T2DM or lowered insulin sensitivity	Plasma insulin > 75th percentile	IGT or IFG		
WC or BMI	Men: waist-to-hip ratio >0.90; women: waist-to-hip ratio >0.85 and/or BMI > 30 kg/m^2	Body weight WC ≥94 cm in men or ≥80 cm in women	BMI ≥ 25 kg/m^2	WC ≥102 cm in men or ≥88 cm in women	Increased WC (population specific)
TG, HDL	TG ≥150mg/dL and/or HDL <35 mg/dL in men or <39 mg/dL in women	TG ≥150 mg/dL and/or HDL <39 mg/dL in men or women	TG ≥150 mg/dL, HDL <40 mg/dL in men or <50 mg/dL in women	TG ≥150 mg/dL, HDL<40 mg/dL in men or <50 mg/dL in women	TG ≥150 mg/dL or on TG medication, HDL<40 mg/dL in men or <50 mg/dL in women or on HDL medication
BP	≥140/90 mmHg	≥140/90 mmHg or on hypertension medication	≥130/85 mmHg	≥130/85 mmHg	≥130mmHg systolic or ≥85 mmHg diastolic or on hypertension medication
FBG	IGT, IFG, or T2DM	IGT or IFG (but not diabetes)	IGT or IFG (but not diabetes)	>110 mg/dL (includes diabetes)	≥100 mg/dL (includes diabetes)
Other	Microalbuminuria: Urinary excretion rate of >20 mg/min or albumin: creatinine ratio of >30 mg/g		Other features of insulin resistance such as family history, polycystic ovary syndrome, sedentary lifestyle, advancing age, etc.		

[a,b] Insulin resistance plus any two from the rest; [c] Insulin resistance plus any of the following; [d] Any three of the five features (two are listed under Lipids); [e] Increased WC plus any two from the rest; BMI: Body Mass Index; BP: Blood Pressure; FBG: Fasting Blood Glucose; HDL: High Density Lipoprotein; IFG: Impaired Fasting Glucose; IGT: Impaired Glucose Tolerance; T2DM: Type 2 Diabetes Mellitus; TG: Triglycerides; WC: Waist Circumference

3. PREVALENCE OF METS RISK FACTORS IN DIFFERENT REGIONS OF THE WORLD

3.1 India

In both developed and developing countries the major causative agent of death is the CVD, which is steadily increasing in developing counties compared to developed counties. CVD is higher in population from subcontinent descent compared to population elsewhere, and hence these people have a high triglycerides (TG) concentration, total cholesterol (TC) concentration, low high density lipoprotein (HDL): low density lipoprotein (LDL) ratio, T2DM and obesity [9].

Cardiovascular risk usually increases with age, smoking, hypertension, blood lipids and is a male dominated disease. Hormones such as estrogen protects females against CVD and so does not develop disease pre-menopausal (at a younger age) and when such hormone level drops then disease has an equivalent prevalence in women compared to men. Age is an important factor in CVD. With age, high BP, obesity, BMI along with TC, TG, lower HDL: LDL ratio become prevalent causing an upsurge in CVD in older people.

Even though there existed differences between BMI, minimum waist circumference (MWC) and waist:hip ratio (WHR), but overall there exists similarity in percent body fat among Asian population. Asian Indians tend to have a high prevalence rate of central obesity due to overall high MWC and WHR even though BMI suggests low obesity. They also have a high rate of insulin resistance due to high abdominal and visceral fat as suggested by BMI. Blood Pressure is one of the biomarker for CVD. As we age our BP changes for worse and there exists significant differences in both systolic blood pressure (SBP) and diastolic blood pressure (DBP). Again, another notable observation is that the Asian Indians have high TC, LDL, VLDL, and TG levels and all of these generally increase with age [9].

It is evident that as age increases so thus the risk factors for CVD such as high BMI, high TC, high TG and high BP which is evident in this survey. Dyslipidemia increase the risk of developing CVD. This is a vicious cycle as dyslipidemia cause CVD and high risk factors for CVD causes dyslipidemia. It should be noted that CVD in Asian Indians occurs at an early age compared to sample populations in America and Europe [9]. CVD is rising at an alarming speed, threatening to adversely affect India's growth and productivity as its youth is also most vulnerable to due to lifestyle and dietary changes for worse in the coming years causing a substantial loss of potentially productive years of life due to early onset of CVD. Many advances have taken place for preventing CVDs. Goenka et al. [34] have reviewed prevalence of CVD risk factors in India with an emphasis on relevant policy issues to arrest the increasing trend of CVD and thus reducing the burden of CVD in India.

A coronary heart disease (CHD) prevalence survey was carried out in a north Indian town including a clinical and electrocardiographic examination of 2,030 persons, above 30 years of age, living in the area. CHD diagnosis was determined by taking history of myocardial infarction or angina pectoris and electrocardiographic abnormalities [35].

CHD generally depends on factors such as age, socio-economic status, sedentary nature of occupation and hypertensions. The risk of CHD increases as these factors increases. People who are obese generally develop CHD and also there is a positive relation between sub-scapular thickness in men and CHD. Approximately 63% of men and 88% of women has clinically silent CHD [35].

In urban middle class there is an increased population of low-middle income group i.e., (Rs. 401-1200 per capita per year). CHD increased proportionately from low-income to high- income group. This difference is particularly higher in men compared to women, who have no statistical differences between the groups, in terms of CHD cases. One of the common risk factor for development of CHD is hypertension. It has been found that hypertensive men develops CHD more readily than men who are normal and this can be seen with age differences as well. Women, on the contrary, have no significant differences between age groups.

People with sedentary lifestyles are more prone to develop CHD. Both men and women significantly differed in sedentary lifestyles with those doing light manual work more prone to develop CHD compared with those who did high manual work. This shows that physical activity is inversely proportional to development of CHD [35].

Joshi et al. [36] have studied on the prevalence and risk factors for acute myocardial infarction (AMI) in native South Indians, especially at younger ages, compared with individuals from other countries. In this study, it is observed that South Asians had a lower age at presentation of first AMI. The mean age of first AMI was found to be 53.0 years than in participants from other countries (58.8 years). The relative younger age of first AMI among the South Asian cases appeared to be due to the higher prevalence of risk factors in native South Indians.

One of the leading causes of death in India is caused by ischemic heart disease (IHD). About 25% of mortality in India is caused by CVD and it is expected that this figure would double for Indians between 1985 and 2015. There is a high prevalence of IHD among abroad Indians, which is about 40%, compared to Europeans [37].

The risk factor for high IHD in India is due to low intake of vitamin B-6, folate and high intakes of trans fat. The most commonly used oil for cooking in India is mustard oil. Mustard oil contains α-linolenic acid which reduces the risk for IHD development. α-Linolenic acid reduces the capacity of blood platelets to aggregate and hence, reduces the tendency for development of thrombosis and subsequent myocardial infarction. Folate which is present in green leafy vegetables provides protection from IHD. Increased plasma homocysteine levels and low folic acid intake lead to increased risk of development of IHD. Another risk factor for IHD is due to intake of trans fat which has a predominant effect on blood lipids. These trans fat raise LDL, triacylglycerols, lipoprotein; lower HDL cholesterol. All these interfere negatively in fatty acid metabolism. In conclusion, consumption of vegetables and mustard oil, due to protective effects, leads to lower risk of IHD among Indians [37].

3.2 Other Regions of the World

3.2.1 Caribbean, hispanic and latino regions

O'Brien Cherry et al. [38] studied the presence of MetS risk factors in a sample population in the middle income Caribbean nation of St. Lucia. As a result of economic and health transition, obesity is on the rise in the Caribbean countries. Obesity is a major risk factor of MetS. Due to lack of physical exercise and a sedentary lifestyle, the study population is found to be more prone to MetS. Smoking and alcohol consumption are risk factors for MetS and this is a result of lifestyle and behavioral changes which varied by gender in St. Lucia.

Women are more prone to development of MetS in the Caribbean than men because of high rates of sedentary lifestyle, lower HDL, high WC and BMI. All of these are risk factors for development of MetS. Psychosocial stress such as depression also considered a risk factor for development of MetS. Stress causes generally high intake of caloric food, such as fat and carbohydrate consumption and alcohol consumption, and this leads to obesity more in women than men. In St. Lucia, 56% of females and 18% of males had WC equal to or above the indicator for the MetS. Thirty-six percent of women and 22% of men reported a sedentary lifestyle and 43% of women and 65% of men reported to have regular alcohol consumption [38].

Daviglus et al. [39] has studied on the major cardiovascular risk factors and its resultant impact of CVDs among Hispanic/Latino individuals of diverse background in USA (Cuban, Dominican, Mexican, Puerto Rican, Central American and South American). This group is now the largest racial minority group in the USA. The major cause of death in this ethnical minority is from CVD which shows that the youth population has high risk factor for this disease. The study also involved socioeconomic status and the duration of stay in USA.

Those Hispanics/Latinos who were born in USA have multiple risk factors of CVD and hence, higher rates of CHD and stroke compared with those from indigenous population. The length of stay in USA is also a major factor as adopting a western lifestyle (rich in fat and carbohydrate diet), caused a high prevalence rate of CVD risk factors and death by CHD in these people. Again, according to non-white Hispanic population, Hispanics have a higher rate of developing CVD risk factors and hence, CHD diseases. This study also reveals that Puerto Ricans among Hispanic groups are more prone to develop CVD risk factors and hence, later develop CHD. Generally, Mexican people have prevalence rate of obesity and diabetes which seems in accordance with the study. Again, rates of hypertension and smoking differed accordingly to the place where Hispanics immigrated. This study is highly relevant to prevent the development of CVD risk factors and hence, CHD at younger age among Hispanics [39].

Sangaleti et al. [40] have studied the CVD risk factors with a selected group of population in

Brazil, who are prone to develop CVD and hence CHD. They used truck drivers as a sample population as they are more prone to develop CVD. This study can provide insights into the cause and probable treatment of CVD and its risk factors.

Truck drivers particularly because of their living and working conditions are more at risk of developing CVD. This can be seen from the evidence that among all the subjects, the prevalence of physical inactivity was 72.8%, hypertension was confirmed in 45.2%, and abnormal glucose levels were detected in 16.4%. Truck drivers in Brazil have multiple risk factors to develop CVD, along with drug resistance and unique features of the demanding work prevents traditional precautions from overcoming these factors. This has a negative consequence in economic terms to Brazil [40].

3.2.2 China

He et al. [41] have studied on risk factors of CVD, stroke and prevalence of CHD in China. Earlier, the death rates of Chinese population were mostly attributed to stroke but this incidence has changed over the last few decades. This study concluded that death rates from CHD have surpassed that of stroke in both rural and urban areas in China. This change is particularly due to China's economic growth, aging population, nutritional transition and urbanization especially in nearby cities of and within Beijing.

The other risk factors such as diabetes, hypertension and obesity were more prevalent in plains and non-hilly areas compared to those living in hilly areas. This shows that the occurrence of CHD and stroke varies from different demographic regions in China. Generally, the people living in hilly areas have low socio-economic status and cannot travel to cities either. The main cause is that healthy public is travelling to cities whereas the sick and poorer populations are staying behind. These people are less aware about CVD risk factors due to poor education and hence, the cities are going through CHD/stroke epidemic. Another cause of this epidemic is due to the aging population in China. These people mostly suffer from CVD risk factors and also have high mortality rates. As the trend towards aging population increases, the rates of both CVD and CHD also increase along with differences in genders as well. It has also been observed that people living in the rural areas which are in close proximity to cities have higher CVD risk factors [41].

Gu et al. [42] have studied on CVD risk factors and hence, CHD in China. CVD is generally low in developing countries, but on the other hand deaths from ischemic heart disease and stoke were prevalent in 1990's. On the contrary, deaths from CVD accounted for approximately 40% in China and this is projected to increase over the next two decades. Due to China's rapid changes in terms of demographic, social and economy, the toll on CVD increases. The main CVD risk factors that have been studied are: dyslipidemia, hypertension, diabetes, smoking and obesity. They have clustered the population of China into three groups, that is, those having 1 or more risk factors, 2 or more risk factors and finally 3 or more risk factors. These data were compared with the corresponding USA data. Approximately, 80.5% of Chinese aged between the age group 35 to 74 has one risk factor, whereas two or more and three or more risk factors were found in 45.9% and 17.2%, respectively.

3.2.3 Spain

Gabriel et al. [43] have studied on CVD risk factors in IHD as death rate from such a disease is highly prominent among Spanish population. The main CVD risk factors that were studied in Spain are as follows: BMI, BP, FBG, TC and HDL along with smoking and obesity in accordance with age-sex groups and geographic area.

In Spain, there is a north-south and west-east geographic gradient in terms of IHD with a prominent north-south distribution. On the contrary, south-east population is predominantly higher in smoking, high BP and obesity. In the Mediterranean area, T2DM and hypercholesterolemia is very prominent than other parts of Spain. The CVD risk factors such as obesity, hypertension, hypercholesterolemia and T2DM increase proportionately with age and more so in women than men. Smoking is observed to decrease with age. The geographic dividend provides a clue as to where IHD is more prominent [43].

Earlier studies have been conducted on a smaller population size among the Spanish working population in terms of CVD risk factors. Sanchez-Chaparro et al. [44] have studied CVD risk factors on a larger population size along with changes in prevalence of CVD risk factors in

terms of geographic and type of employment. Studies such as this can give an overall and more precise estimation on Spanish population, particularly for those who are suffering from CVD risk factors. This study covers as a whole the majority of working Spanish population with respect to employment types and different geographic areas they are living in. Young population is found to be the most affected group. Due to differences in age, sex, geographic area, risk threshold and professional activity, it is difficult to compare studies among working population. This study also concludes that prevalence of CVD risk factors varies according to the geographic regions and employment and thigh CVD risk factors are found in working population in Spain [44].

3.2.4 Sub-saharan African countries and their descent in Europe

BeLue et al. [45] have reviewed cardiovascular risk factor burden in sub-Saharan African countries. More specifically, they have explored the relation between socio-cultural factors and CVD risk. Life-style factors, diet, exercise and smoking are found to be the main contributors to the increasing rates of CVD in this region. Some life-style factors are found to be gender specific. For example, obesity is a predominant risk factor for women whereas smoking mostly remains as a risk factor for men.

Agyemang et al. [46] have reviewed CVD and diabetes among populations of sub-Saharan African decent in Europe, mainly in the UK and Netherlands, and tried to establish possible risk factors. Three categories of populations of African descent in the UK and Netherlands, namely African Caribbeans, Sub-Saharan African and African Surinamise are considered in this study. Diabetes and hypertension are higher in populations of African descent in comparison to their European counterparts. These are the main factors for the rate of stroke among the population of African descent in Europe. However, they have a low rate of CVD cases which perhaps may be due to a more favourable lipid profile and the low prevalence of smoking.

3.2.5 Indigenous populations in Australia, New Zealand and USA

Lucero et al. [25] have studied in the CVD risk factors among indigenous populations from Australia, New Zealand and USA. All indigenous populations exhibit lower life expectancies and a higher rate of CVD than the corresponding non-indigenous populations. They all have higher rates of obesity and diabetes whereas for indigenous populations in Australia (Aboriginals) and New Zealand (Maori) there is a greater prevalence of hypertension, and for indigenous population of USA (American Indians/Alaska Natives) high cholesterol is the common risk factor [25]. Lucera et al. [25] have also compared the prevalence of selected MetS risk factors of indigenous populations of Australia, New Zealand and USA with their corresponding white counterparts.

Table 2. Prevalence of MetS risk factors in different regions of the world [9,25,38-40,43,47-51]

Country	Category	Obesity (%)	High BP (%)	High TC (%)	High TG (%)	High HDL (%)	High FBG (%)
India	Male	27.75	44	25.75	21.75	-	12.5
	Female	26.25	43	29.5	25.75	-	15.5
Caribbean	Male	27	-	-	-	21.7	9
(St. Lucia)	Female	55.7	-	-	-	36.7	25.6
Hispanic/Latino	Male	36.5	25.4	51.7	-		16.7
(Cuba, Dominica, Mexico, Puerto Rico, Central America, South America)	Female	42.6	23.5	36.9	-		17.2
China	Male	11.5	47.2	-	-	-	7.7
	Female	16.9	44.8	-	-	-	8.2
Spain	Male	21.9	48.5	49.2	-	-	8.9
	Female	30.1	51	48	-	-	8.7
Australia	White pop	22	10	7	-	-	4
	Indigenous pop	27	15	6	-	-	12
New Zealand	White pop	24	13	8	-	-	4
	Indigenous pop	42	17	9	-	-	8
USA	White pop	31	33	17	-	-	6
	Indigenous pop	42	30	31	-	-	15

Table 2 provides a comparison of the prevalence of MetS risk factors in different regions of the world [9,25,38-40,43,47-51].

4. METS RISK FACTORS IN PREMENOPAUSAL AND POST-MENOPAUSAL WOMEN

Even though men have a higher prevalence rate of developing CVD compared to women, this rate has significantly decreased during the past few decades. However, for women similar reductions have not happened. Men normally develop CVD faster and at an earlier age than women do. In the contrary, however, women develop CVD more rapidly after menopause. Estrogen hormone in women protects them from IHD and thromboembolism but as estrogen level declines after menopause so does their risk for developing CVD increase [10,52]. As a result postmenopausal women have a significant high rate of morbidity and mortality. Although it is important to intensely study the causes and hence to identify preventive measures to arrest the prevalence of metabolic diseases for elderly women across the world, only a few study reports on MetS risk factors specifically for the premenopausal and postmenopausal groups of women have been reported in the literature [10,27,28].

Menopause generally marks the end of reproductive phase in women. Because of this transitional change from premenopausal to postmenopausal state, there are certain metabolic changes which lead to CVD. In many cases, MetS occurs due to estrogen deficiency. Hormonal fluctuations in women lead to postmenopausal MetS. It is noteworthy that Asian Indian women are far worse than their corresponding male compatriots. After menopause ovaries are not only depleted of follicles but also stop estradiol synthesis and this is the major cause of development of CVD in women. Two major complications of MetS are (i) increased visceral fat and (ii) insulin resistance [10].

One of the major causes for death in women is CVD and this disease is prevalent in women during post-menopause (PM) due to metabolic changes [27]. Most women suffer from CVD which undergoes a 4-fold increase in PM period along with aging. This high incidence of disease is found in women who have premature menopause along with women who have undergone surgeries which resulted in menopause. The symptoms of MetS which include: increased lipid accumulation in central parts of the body, insulin resistance, dyslipidemia, which includes elevated TG and LDL with reduced HDL, and hypertension which lead to CVD. Although the reason of MetS is not clearly understood, this syndrome is linked with visceral obesity [27]. Hormonal changes such as decrease in estrogen level which lead to MetS and increased abdominal obesity is a major cause for development of CVD in women.

Even after age adjustment, there is a significant increase of MetS in PM women and also there is a significant difference between menopause and pre-menopausal period. There is a significant increase of MetS risk factors in women with hyperglycerides and hypertension. There was no significant difference between menopausal transition when compared with MetS factors such as, FBG, HDL and abdominal obesity. Estrogen secretion causes fat to accumulate in lower extremities in pre-menopausal women. As there is a change in hormone secretion during menopause, fat is accumulated in abdomen causing central obesity. Many of such changes are caused by decrease in estrogen level which results in fat to be distributed in abdomen. Lifestyle modifications such as, controlling weight, lipid profile and blood glucose levels can reduce the incidence of MetS development and subsequent CVD in PM group of women. As a consequence of estrogen level decrease, lipid profile changes as well as insulin resistance increases. Again, increase in follicle stimulating hormone (FSH) and WC causes abdominal obesity. The MetS factors in PM changes significantly as testosterone hormone increases in PM. Women who are undergoing menopausal transition has experienced significant harmful change in inflammatory factors adipokines, lipoproteins with visceral obesity. Metabolic changes, lipid accumulation and changes in blood glucose levels are responsible for development of MetS in PM. It has been observed that for PM group of women MetS is independent of lifestyle and age [27].

Kim et al. [28] compared MetS risk factors in premenopausal and postmenopausal women in Korea. They have found a higher prevalence of MetS among women age > 50 years in Korea.

Table 3 provides a comparison of the MetS risk factors in the premenopausal and

Table 3. MetS risk factors in premenopausal and postmenopausal women in India and Iran [10,27,28]

Clinical parameters	Premenopausal women			Postmenopausal women		
	India (Mean ± SD)	Iran (Mean ± SD)	Korea (Mean ± SD)	India (Mean ± SD)	Iran (Mean ± SD)	Korea (Mean ± SD)
WC, cm	76.11±11.17	97.6 ±12.5	75.4 ±8.8	76.99±10.55	98.5±12.3	83.5 ±9.0
SBP, mmHg	112.75±17.24	120.2±20.2	112.0±13.2	124.56±21.74	132.4±22.1	131.2±21.4
DBP, mmHg	74.85±12.01	77.8±11.8	71.6±10.0	80.42±11. 36	82.5±11.8	79.0±11.4
TC, mg%	183.22±25.47	209.8±44.6	177.61±31.66	189.09±23.80	233.3±50.6	204.25±33.59
TG, mg%	136.00±31.47	176.1±98.9	108.85±64.6	141.56±34.01	207.8±104.9	150.4±74.34
HDL, mg%	47.43±5.88	48.3±10.1	49.42±10.42	48.65±7.16	49.5±10.8	45.56±9.65
LDL, mg%	108.27±21.65	127.2±38.2	106.56±27.03	110. 7±21.18	142.5±43.5	129.34±30.5
FBG, mg%	88.13±16.51	88.7±29.7	93.67±14.41	91.30±7. 45	95.1±38.2	99.1±18.02

postmenopausal groups of women for sample populations of India (Santiniketan), Iran (Isfahan) and Korea.

5. CONCLUSION

Our study on the prevalence of MetS risk factors in different regions of the world revealed that women have a higher prevalence of obesity and high FBG than their male counterparts. India, China and Spain are the countries having higher prevalence of high BP than other countries of the world. In Australia, New Zealand and USA, indigenous populations have higher prevalence of obesity, high TC, high FBG and with the exception of USA have higher prevalence of high BP. However, one limitation of our study is lack of availability of data regarding WC and inadequate data for TG and HDL among the study populations. Further, based on clinical parameters, it seems that Iranian women of are more prone to MetS risk factors than their Indian and Korean counterparts considering both premenopausal and postmenopausal groups of population.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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