

Prevalence of metabolic syndrome in relation to body mass index and polycystic ovarian syndrome in Indian women

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ABSTRACT

OBJECTIVE: To study the prevalence of metabolic syndrome (MBS) in Indian women and to see how does it correlate to body mass index (BMI) and polycystic ovarian syndrome (PCOS) in this population. **STUDY DESIGN:** Prospective cross-sectional observational study. **SETTING:** Infertility clinic of a tertiary center. **MATERIALS AND METHODS:** Two hundred women, 120 with PCOs and 80 age-matched controls were enrolled. The prevalence of MBS was studied in the women with and without and was co related to BMI by further subgrouping as team (BMI <23 kg/m³) and obese (BMI >23 kg/m²). The sample size was: team controls-40, obese controls-40, team PCOS-80. Each subject underwent a physical examination and laboratory evaluation for the diagnosis of MBS, which was defined according to the guidelines of National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) 2005. **INTERVENTION:** None. **MAIN OUTCOME MEASURES:** Main Outcome Measures: Subjects with and without PCOs were compared with each other for the prevalence of MBS, and similarly team subjects were compared with obese subjects. Receiver operator characteristic (ROC) curves were obtained for both the PCOS and non PCOS population separately, co-relating the prevalence of MBS with BMI. These ROC curves were used to establish the cut off values of BMI, which could best predict the risk of MBS. **RESULTS:** The prevalence of MBS was significantly higher in the women with PCOS, as compared to age-matched controls. Similarly, when BMI was considered, MBS was more prevalent in overweight subjects than in lean subjects with or without PCOS. In subgroup analysis, the presence of PCOS had a lesser impact on the prevalence of MBS as compared to non-PCOS controls with higher BMI. The relative risk of MBS increased as follows: lean controls-1, lean PCOS-2.66, obese controls-5.33, and obese PCOS-6.5. The most appropriate cut-off level of BMI for predicting the risk of MBS in Indian women without PCOS seems to be 23 kg/m², whereas, with PCOS, it was 22.5 kg/m². **CONCLUSION:** MBS is more prevalent in women with PCOS. However, obesity is an independent and stronger risk factor for developing MBS. To reduce the risk of MBS and its related long-term health consequences, lifestyle modification is advisable above BMI of 23 kg/m² in the normal population and 22.5 kg/m² in women with PCOS.

KEY WORDS: Body mass index, metabolic syndrome, obesity, polycystic ovarian syndrome

INTRODUCTION

Polycystic ovarian syndrome (PCOS) is common disorder, affecting approximately 5–10% of the women in reproductive age group.^[1,2] It is characterized by chronic anovulation, hyperandrogenism, and polycystic ovaries. The other metabolic abnormalities associated with PCOS are obesity, dyslipidemia, insulin resistance, glucose intolerance, and hypertension, which

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confer an increased risk of long-term health consequences such as type II diabetes mellitus and cardiovascular risk.^[3] Most of these metabolic features are also shared by the syndrome X or metabolic syndrome (MBS), which is associated with atherosclerosis, hypertension, dyslipidemia, coronary artery disease, and diabetes. Some of the factors affecting the prevalence of MBS are age,^[4,5] obesity,^[4] insulin resistance,^[6] and underlying PCOS.^[7]

Till date, there are few studies, mainly from the American population^[8-10] and still fewer from the European continent,^[11,12] which have addressed the prevalence of MBS in women with PCOS. There is a scarcity of data from Asian population.^[13,14] Moreover, in most of these studies, the women with PCOS were found to have a higher body mass index (BMI) and waist circumference, as compared to the controls, which could have confounded in the higher prevalence of MBS.

This study was undertaken with an aim of comparing the prevalence and different characteristics of MBS in Indian women with PCOS and age-matched controls. To negate the confounding effect of the high BMI associated with PCOS, subgroups of lean and obese women were studied separately for the prevalence of MBS.

In order to reduce the serious long-term consequences related to MBS, we have attempted to find out the predictors of MBS, and the action points, at which screening for MBS and lifestyle modification would be beneficial, in respect to preventing, or modifying long-term morbidity.

MATERIALS AND METHODS

We performed a prospective cross-sectional observational study of Indian women with normal (BMI 19-23) and higher BMI (BMI >23 kg/m²). A total of 200 subjects were enrolled over a period of 18 months, 120 with a diagnosis of PCOS, and 80 age-matched controls. Proper approval was taken from the institutional review board regarding the materials and methods of the study.

All these women were taken from a tertiary care infertility center and presented with oligoovulatory or anovulatory cycles. PCOS was defined by the 2003 Rotterdam's criteria. Women with menstrual irregularity (fewer than eight cycles per year) and polycystic appearance of ovaries on ultrasound were both taken as inclusion criteria with or without clinical evidence of hyperandrogenism. Biochemical evidence was looked for only in cases, where it was required for the establishment of the diagnosis. Subjects were recruited from the infertility clinic of a tertiary care center. Controls were the women with normal and higher BMI, who had regular menstrual cycles, no evidence of

polycystic ovaries on ultrasound, and no clinical evidence of hyperandrogenism.

Hypothyroidism and hyperprolactinemia were ruled out as a cause of menstrual irregularity.

Each subject underwent a physical examination and laboratory evaluation for the diagnosis of MBS. Serum triglyceride and high-density lipoprotein-cholesterol (HDL-C) levels were measured in fasting state. An oral glucose tolerance test (OGTT) along with measurement of serum insulin was done in all the patients with 75 g of glucose. All subjects who were enrolled in the study were enquired about past medical history, family history of diabetes mellitus and/or hypertension, and underwent a physical examination, including determination of clinical features of hyperandrogenism. Weight was measured in kilograms, and height was measured in centimeters to the nearest 0.5 cm. BMI was calculated. Blood pressure (BP) was measured in sitting position in left arm, and an average of two measurements was taken into consideration. Waist circumference was measured in the standing position, halfway between the lower ribs and the crest of the pelvis. Hip circumference was measured at the widest part of the hips. Waist to hip ratio was also calculated.

Results were analyzed in three steps, keeping the objectives of the study in mind.

In the first step of the analysis, the prevalence of MBS was calculated separately in women with and without PCOS and the results was compared by applying the Chi-square test. A two-tailed $P < 0.05$ was considered statistically significant.

MBS was defined as having three or more of the following abnormalities:^[15]

- Waist circumference in females >88 cm
- Fasting serum glucose ≥ 100 mg/dl
- Fasting serum triglycerides ≥ 150 mg/dl
- Serum HDL-C <50 mg/dl
- BP $\geq 130/85$ mmHg.

The anthropometric and biochemical parameters in the women with and without PCOS were evaluated and expressed as a mean \pm standard deviation, and comparison was done by applying the student's *t*-test.

The second step of analysis, to eliminate high BMI as a confounding factor in the prevalence of MBS, the women with and without PCOS were further studied in subgroups groups based on BMI as follows:

- Non-PCOS: Lean controls ($n = 40$) and obese controls ($n = 40$)
- PCOS: Lean PCOS ($n = 40$) and obese PCOS ($n = 80$).

BMI of 23 kg/m² was taken on the basis of the WHO expert consultation on BMI in the Asian population.^[16]

Prevalence and characteristics of MBS were studied in each of the above-mentioned group. The prevalence of MBS in different groups was compared by using the Chi-square test ($P < 0.05$ as statistically significant). The student's *t*-test was used to compare the continuous variables between different groups.

The relative risk of MBS was calculated for each group, depicting its correlation with BMI and underlying PCOS.

The third step of analysis, to establish the cutoff level of BMI, above which lifestyle modification would be advisable. Receiver operator characteristics (ROC) curves were obtained for both the PCOS and non-PCOS population separately, co-relating the prevalence of MBS with BMI. Data analysis was done with statistical package for social sciences software (SPSS) version 17.0 (Chicago).

RESULTS

The anthropometric and metabolic parameters of Indian women with PCOS and the controls are compared in Table 1.

Women with PCOS had a significantly higher BMI, higher mean of systolic BP, diastolic BP, fasting insulin, and 2 h insulin levels (2 h after 75 g of glucose). The mean of HDL-C was significantly lower in women with PCOS. There was no statistical difference in the means of fasting blood sugar, 2 h OGTT values, and serum triglyceride levels.

The prevalence of MBS was significantly higher in women with PCOS [Table 1].

The prevalence of various components of MBS in women with and without PCOS are given in Table 2.

On comparing the prevalence of the components of MBS in women with PCOS to the controls, irrespective of their BMI, a significant difference was present in the prevalence of high BP ($P = 0.0001$) and low HDL-C ($P = 0.0006$), thus increasing cardiovascular risk in the women with PCOS.

For the second step of the analysis, women with and without PCOS were further divided into sub-groups based on BMI (lower or higher than 23 kg/m²) [Table 3].

It is evident from Table 3 that most of the factors which favor the development of MBS were significantly higher in the obese subgroups, in both the PCOS and control groups.

The prevalence of MBS was also significantly higher in the obese subgroups as compared to their lean counterparts [Table 3].

Obesity had a strong impact on the prevalence of MBS in both PCOS and control groups. Further, to eliminate the effect of high BMI as a confounding factor in the prevalence of MBS, lean PCOS were compared with lean controls and obese PCOS were compared to obese controls [Table 4].

Within the lean population, the presence of PCOS had an impact only on diastolic BP and HDL as compared to the controls. All the other parameters were not significantly different in the PCOS and controls in the lean population. For the obese population (BMI >23 kg/m²), when the obese PCOS were compared with the obese controls, no statistically significant difference was found in the prevalence of any of the studied parameters.

The family history of type II diabetes mellitus was significantly higher in the women with PCOS in both lean and obese populations ($P = 0.033$ and 0.036 , respectively).

It is evident that the women with PCOS had a higher prevalence of MBS, as compared to the controls both in lean and obese populations, although it failed to achieve statistical significance, probably due to a small sample size [Table 4].

Table 1: Anthropometric and metabolic parameters in women with and without PCOS, along with the prevalence of MBS

	PCOS (n=120)	Controls (n=80)	P
Age	29.80 (4.20)	30.612 (4.01)	0.17
BMI	27.38 (5.90)	24.62 (5.06)	0.0007
Weight	66.913 (14.576)	61.48 (10.925)	0.0049
WC	88.78 (10.75)	85.86 (10.53)	0.06
W/H ratio	0.86 (0.057)	0.86 (0.051)	0.943
SBP	123.42 (12.83)	118.25 (12.05)	0.0047
DBP	82.86 (12.09)	77.78 (9.46)	0.0018
FBS	89.06 (11.95)	89.72 (11.6)	0.702
TG	132.20 (49.80)	121.78 (36.9)	0.1
HDL	41.65 (7.56)	44.78 (9.02)	0.0087
Fasting insulin	12.65 (4.67)	8.81 (2.10)	<0.001
PP insulin	99.90 (77)	38.03 (27.94)	<0.001
2 h OGTT	111.22 (34.84)	108.82 (27)	0.603
Prevalence of MBS	39.16% (47/120)	23.75% (19/80)	0.034

PCOS= Polycystic ovarian syndrome, BMI=Body mass index, WC=Waist circumference, W/H= Waist/hip, SBP= Systolic blood pressure, DBP= Diastolic blood pressure, FBS= Fasting blood sugar, TG= Triglycerides, HDL= High density lipoproteins, OGTT= Oral glucose tolerance test, MBS= Metabolic syndrome, PP= Postprandial

Table 2: Prevalence of the components of MBS in PCOS and Controls

Components of MBS	PCOS (n=120) (%)	Controls (n=80) (%)	P
WC >88 cm	55 (45.8)	28 (35)	0.16
BP ≥130/85 mmHg	53 (44.1)	13 (16.2)	0.0001
TG ≥150 mg/dl	18 (15)	13 (16.2)	0.96
HDL <50 mg/dl	105 (87.5)	53 (66.2)	0.0006
FBS ≥100 mg/dl	21 (17.5)	14 (17.5)	0.84

MBS= Metabolic syndrome, PCOS=Polycystic ovarian syndrome, WC= Waist circumference, BP= Blood pressure, TG= Triglycerides, HDL= High density lipoproteins, FBS= Fasting blood sugar

Table 3: Anthropometric and biochemical parameters, and prevalence of MBS in women with and without PCOS in relation to BMI

	Controls (n=80)		P	PCOS (n=120)		P
	Lean controls (n=40)	Obese controls (n=40)		Lean PCOS (n=40)	Obese PCOS (n=80)	
Age	29.72±4.01	31.5±3.86	0.04	28.52±3.75	29.42±4.12	0.24
WC	79.64±7.11	92.08±9.73	0.00	80.38±6.61	92.99±9.94	0.00
W/H ratio	0.853±0.05	0.87±0.049	0.13	0.85±0.059	0.87±0.056	0.207
FBS	87.75±10.12	91.67±12.76	0.132	84.47±11.67	91.36±11.48	0.0026
SBP	114.9±7.67	121.6±14.57	0.012	117.37±11.3	126.45±12.54	0.0002
DBP	73.85±7.62	81.72±9.56	0.0001	79.72±10.85	84.43±12.42	0.043
TG	107.95±26.6	135.62±40.73	0.0006	116.15±22.77	140.23±57.3	0.011
HDL	47.25±9.32	42.32±8.09	0.013	42.65±6.25	41.16±8.13	0.31
2 h OGTT	106.97±28.8	110.67±25.28	0.543	105.02±28.90	114.32±37.25	0.169
FH DM	13	20	0.173	24	57	0.30
Number of women with MBS (%)	3 (7.5)	16 (40)	0.0016	8 (20)	39 (48.75)	0.0045

PCOS= Polycystic ovarian syndrome, WC= Waist circumference, W/H= Waist/hip, FBS= Fasting blood sugar, SBP= Systolic blood pressure, DBP= Diastolic blood pressure, TG=Triglycerides, HDL= High density lipoproteins, OGTT= Oral glucose tolerance test, FH DM= Family history of type II diabetes mellitus, MBS= Metabolic syndrome

Table 4: Anthropometric and biochemical parameters, and prevalence of MBS in women with normal and high BMI in relation to PCOS

	Lean population		P	Obese population		P
	Lean controls (n=40)	Lean PCOS (n=40)		Obese controls (n=40)	Obese PCOS (n=80)	
	Age	29.72±4.01		28.52±3.75	0.17	
WC	79.64±7.11	80.38±6.61	0.63	92.08±9.73	92.99±9.94	0.63
W/H ratio	0.853±0.05	0.85±0.059	0.629	0.87±0.049	0.87±0.056	0.77
FBS	87.75±10.12	84.47±11.67	0.183	91.67±12.76	91.36±11.48	0.89
SBP	114.9±7.67	117.37±11.3	0.25	121.6±14.57	126.45±12.54	0.06
DBP	73.85±7.62	79.72±10.85	0.0064	81.72±9.56	84.43±12.42	0.22
TG	107.95±26.6	116.15±22.77	0.142	135.62±40.73	140.23±57.3	0.65
HDL	47.25±9.32	42.65±6.25	0.011	42.32±8.09	41.16±8.13	0.46
2 h OGTT	106.97±28.8	105.02±28.90	0.763	110.67±25.28	114.32±37.25	0.577
FH DM	13	24	0.033	20	57	0.036
Number of women with MBS (%)	3 (7.5)	8 (20)	0.19	16 (40)	39 (48.75)	0.47

PCOS= Polycystic ovarian syndrome, WC= Waist circumference, W/H= Waist/hip, FBS= Fasting blood sugar, SBP= Systolic blood pressure, DBP= Diastolic blood pressure, TG=Triglycerides, HDL= High density lipoproteins, OGTT= Oral glucose tolerance test, FH DM= Family history of type II diabetes mellitus, MBS= Metabolic syndrome

Table 5 shows the relative risk of MBS in correlation with BMI and underlying PCOS. In the third step of the analysis, we intended to find out a cutoff level of BMI at which counseling should be done for lifestyle modification to reduce the risk of MBS. ROC curves were obtained for the prevalence of MBS in relation to BMI, for the women with and without PCOS separately [Figures 1 and 2].

In both, women with and without PCOS, BMI could independently predict the risk of MBS (area under the curve [AUC] being 0.766 and 0.811). However, the prediction was stronger in the control group, as we can see that AUC 0.811 (for ROC of women without PCOS) is more than AUC 0.766 (for ROC of women with PCOS). More the AUC, higher the prediction and association. This is probably because PCOS itself is a risk factor for the development of MBS and independently influences its prevalence.

The analysis of the coordinates of the ROC curves for women with and without PCOS is given in Figures 3 and 4.

To avoid missing out on women with actual risk of MBS, the cut-off level of BMI should have high sensitivity with a balanced (or lower) specificity. On analyzing the coordinates of the ROC curves, the most appropriate cut-off level of BMI for predicting MBS in women without PCOS seems to be 23 kg/m², with a sensitivity of about 90% and a specificity of about 60% [Figure 4]. In order to achieve the same sensitivity for the risk of MBS, the cut-off levels of BMI in women with PCOS had to be brought down to 22.5 kg/m² [Figure 3]. This clearly indicates that the women with PCOS have a risk of developing MBS at a lower level of BMI as compared to the controls and should be advised lifestyle modification at a lower BMI in order to minimize the risk.

DISCUSSION

In this study, the prevalence of MBS was significantly higher in the women with PCOS as compared to the controls, which is favorably comparable to the studies from the USA^[8,9] and Indian population [Table 6].^[14]

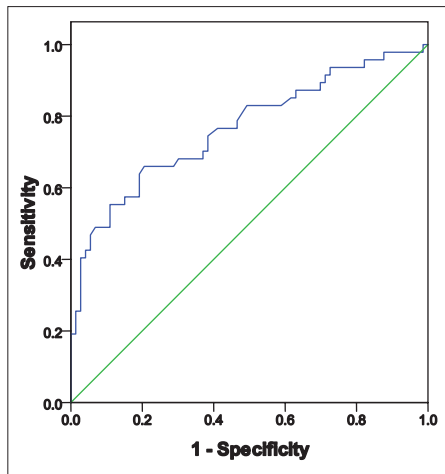


Figure 1: Women with polycystic ovarian syndrome: Receiver operator characteristics curve to predict metabolic syndrome in relation to body mass index area under the curve - 0.766 Sig - 0.000 95% confidence interval (0.675–0.875)

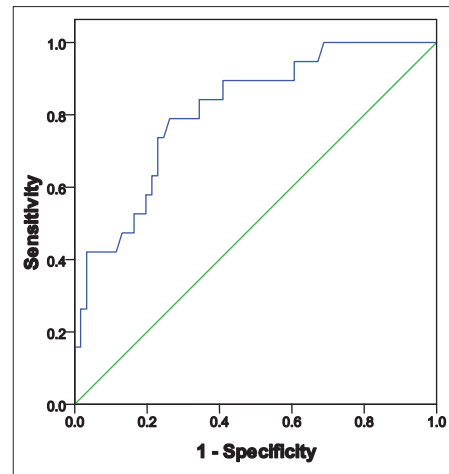


Figure 2: Controls (women without polycystic ovarian syndrome): Receiver operator characteristics curve to predict metabolic syndrome in relation to body mass index area under the curve-0.811 Sig- 0.000 95% confidence interval (0.706–0.917)

Figure 3: Co-ordinates of the ROC curve (BMI vs MBS) in women with PCOS

Cut-off level of BMI (kg/m ²)	Sensitivity (%)	Specificity (%)
22.1	93.6	24.7
22.5	89.4	29
23.1	83	42.5
24.3	83	45.2
25.1	78.7	53.4

BMI= Body mass index, MBS= Metabolic syndrome, ROC= Receiver operator characteristics, PCOS= Polycystic ovarian syndrome

Figure 4: Co-ordinates of the ROC curve (BMI vs MBS) in women without PCOS (controls)

Cut-off level of BMI (kg/m ²)	Sensitivity (%)	Specificity (%)
22.0	94.7	36.1
23.0	89.5	59
24.09	84.2	62.3
25.1	78.9	72.1

BMI= Body mass index, MBS= Metabolic syndrome, ROC= Receiver operator characteristics, PCOS= Polycystic ovarian syndrome

Table 5: Relative risk of MBS in relation to PCOS and high BMI

	Lean controls	Lean PCOS	Obese controls	Obese PCOS
Prevalence of MBS	3/40	8/40	16/40	39/80
Percentage of MBS	7.5	20	40	48.75
Relative risk of MBS	1	2.66	5.33	6.5

MBS= Metabolic syndrome, BMI= Body mass index, PCOS= Polycystic ovarian syndrome

Table 6: Prevalence of MBS in different studies

	PCOS (n)	Controls (n)
Our study, India	39.16% (120)	23% (80)
Mandrelle <i>et al.</i> , India (2012)	37.5% (120)	
Ehrmann <i>et al.</i> , USA (2006)	33% (368)	
Dokras <i>et al.</i> , USA (2005)	47.3% (129)	4.3% (177)
NHANES III, USA		22.8% (1887)
Glueck <i>et al.</i> , USA (2002)	46.4% (138)	
Carmina <i>et al.</i> , Italy (2006)	8.2% (282)	2.4% (85)
Vrbikova <i>et al.</i> , Czechoslovakia (2001)	1.6% (69)	0% (73)
Zaman <i>et al.</i> , Bangladesh (2006)		<3%

MBS= Metabolic syndrome, NHANES= National Health and Nutrition Examination Survey, PCOS= Polycystic ovarian syndrome

In contradiction to the present study, the prevalence of MBS (in women with and without PCOS) is significantly lower in the studies from European population.^[11,12] Vrbikova reported the prevalence of MBS as 1.6% in women with

PCOS and 0% in controls from Czech population. A logical explanation to this difference could be a lower BMI (23 and 21.9 kg/m² for PCOS and controls) and waist circumference (74 and 68.2 cm in PCOS and controls) in the studied Czech population, as compared to our study population. Similarly, Zaman *et al.* observed that the prevalence of MBS in rural Bangladeshi population is <3%.^[13] This could be explained by the fact that their study group was primarily an agricultural population with high level of physical activity, as compared to the controls in our present study. This difference in the prevalence of MBS can further be explained by the high levels of triglycerides and fasting blood sugar, a lower concentration of HDL-C and higher prevalence of insulin resistance in the Bangladeshi immigrants to the UK, which could be attributed to increased stress, smoking, and physical inactivity.^[17] The prevalence of MBS in the Indian population, as reported by different authors varies between 30.9% and 41.1%.^[18,19] However, in both of these studies, neither the women with PCOS have been excluded from the studied population, nor has BMI has been addressed in relation to the prevalence of MBS. Thus, the prevalence of PCOS and high BMI could have confounded in the development of MBS, explaining the differently reported prevalence in different studies.

Table 7: Prevalence of individual components of MBS (expressed as percentage)

	Our study, India, (n=120)	Ehrmann <i>et al.</i> , 2006, USA ^[3] (n=368)	Apridonidze, 2005, USA ^[23] (n=106)	Vrbikova <i>et al.</i> , Czech ^[11] , 2001 (n=69)	Carmina <i>et al.</i> , 2006, Italy ^[10] (n=282)
WC >88 cm	45.83	80	67	11	39
BP ≥130/85 mmHg	44.16	21	45	13	21
TG ≥150 mg/dl	15	32	35	5.8	9.3
HDL <50 mg/dl	87.5	66	68	34.8	45
FBS ≥100 mg/dl	17.5	5 (FBS>110)	4	0	3.1
Prevalence of MBS	39.16	33		1.6	8.2

MBS= Metabolic syndrome, WC= Waist circumference, BP= Blood pressure, TG= Triglycerides, HDL= High density lipoproteins, FBS= Fasting blood sugar

The women with PCOS had a higher BMI, waist circumference, systolic and diastolic BPs, and lower HDL-C levels, as compared to the controls. These observations were in accordance with other studies.^[12,20-22]

From Table 7, it is clearly evident that the prevalence of MBS in a given population of PCOS is dependent on the anthropometric and biochemical parameters prevalent in that given population, and waist circumference is one of these important factors.

In this present study, we analyzed PCOS and high BMI separately as risk factors contributing to the development of MBS and found that both are independent risk factors, obesity being a stronger one. This is in accordance with the study of St-Onge *et al.*, where MBS in the general population increased in a graded fashion as the BMI increased slightly, even to the high normal range.^[24] Similarly Conway *et al.* also observed that hyperinsulinemia is more prevalent in women with PCOS, but the addition of obesity as a risk factor is associated with higher systolic BP, serum triglyceride, and plasma glucose concentration than lean women with PCOS and controls.^[20]

It is known that PCOS, age, BMI and associated hyperinsulinemia are the common risk factors for the development of MBS.^[4-7] Among these, BMI is the only risk factor which is modifiable, and its reduction may also partly correct the element of hyperinsulinemia. Thus, we attempted to find out a cut-off point of BMI, above which the risk of MBS increases and lifestyle modification becomes advisable. According to the 1993, WHO expert committee, a BMI of 25 kg/m² was selected as a cut-off between normal and overweight.^[25] However, there was an increasing evidence of high prevalence of type II diabetes mellitus and cardiovascular risk factors in parts of Asia where the average BMI is below the cut-off point of 25 kg/m². This led WHO to convene another expert consultation on BMI classifications, and a cut-off of 23 kg/m² was chosen as a public health action point.^[16] According to the present study, a BMI of 23 kg/m², when chosen as a cut-off point, had a sensitivity of approximately 90% in diagnosing the individuals at risk of MBS in

a normal population, whereas, to maintain the same sensitivity in the women with PCOS, the cut-off had to be brought down to 22.5 kg/m². This indicates the higher risk of developing MBS in women with PCOS at a lower BMI as compared to normal population and a need for lifestyle modification at a lower BMI, to reduce the long-term health consequences. However, larger multicentric studies with a bigger sample size are required for further supporting the findings of this study.

CONCLUSIONS

MBS is more prevalent in women with PCOS as compared to controls. Thus, PCOS is a risk factor for the development of MBS. However, obesity is an independent and stronger risk factor, as compared to PCOS. In order to reduce the risk of MBS and the long-term health consequences which may be related to it, lifestyle modification is advisable above a BMI of 23 kg/m² in the normal population and 22.5 kg/m² in women with PCOS.

Future prospects

Long-term prospective studies are required to see how this increased prevalence of MBS in PCOS and in slightly overweight individuals, translates to end-point cardiovascular events. The impact of weight loss and physical activity in this population group needs to be studied prospectively.

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Conflicts of interest

There are no conflicts of interest.

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