RESEARCH ARTICLE

Impact of Body Mass Index on the Prevalence of Metabolic Syndrome among Infertile South Indian Women

Radha Vembu[1], Mathivanan Nandini Devi[2], Sanjeeva R Nellepalli[3], Monna Pandurangi[4], Siddhartha Nagireddy[5]

Abstract

Aim and objective : To study the prevalence of metabolic syndrome (MBS) in different body mass index (BMI) group infertile women in both polycystic ovarian syndrome (PCOS) and non-PCOS subgroups.

Materials and methods: A prospective cross-sectional study of all infertile women attending the outpatient in the department of reproductive medicine and surgery in a tertiary care center catering patients from South India was conducted. These women were categorized based on BMI into groups as ≤23 kg/m^2, 23.1–25 kg/m^2, 25.1–27 kg/m^2, 27.1–30 kg/m^2, and >30 kg/m^2. They were further subdivided as PCOS and non-PCOS based on Rotterdam criteria (2003). These women underwent screening for MBS according to the modified American Heart Association/National Heart Lung Blood Institute AHA/NHLBI (ATP III 2005) definition. The results were analyzed for significance by the unpaired *t* test and the Chi-square test.

Results: A total of 1,030 infertile women were analyzed. The mean age was 28.8 ± 4.5 years; mean BMI was 26.9 ± 3.7 kg/m^2. More than 90% of women had waist circumference >80 cm. The prevalence of MBS among the infertile women was 35.3% and among PCOS and non-PCOS women was 44.7 and 28.9%, respectively. Even though there was statistically no significant difference in the metabolic parameters among PCOS and non-PCOS subgroups in different BMI cutoff levels, there was an increase in abnormal metabolic parameters with increase in BMI. The prevalence of MBS in the BMI groups among PCOS women was 11.1, 28.1, 29.7, 51.8, and 73.6%, respectively ($p = 0.0005$) and among non-PCOS women was 4.9, 20.4, 24.6, 41.6, and 66.7%, respectively ($p = 0.0005$).

Conclusion: The BMI is an independent risk factor for MBS in both PCOS and non-PCOS infertile women.

Clinical significance: Screening for MBS in infertile women helps in early identification and primary prevention by lifestyle modification helps in delaying long-term consequences of type 2 diabetes mellitus and cardiovascular diseases.

Keywords: Body mass index, Metabolic syndrome, PCOS, Prospective cross-sectional study.

International Journal of Infertility and Fetal Medicine (2019): 10.5005/jp-journals-10016-1188

Introduction

The metabolic syndrome (MBS) is becoming a global health issue among the younger age group. These individuals are at twofold risk of cardiovascular diseases and fivefold risk of type 2 diabetes mellitus (DM).[1] The prevalence of MBS varies among different countries and ethnicities. It is reported as 43% in the United States[2], 28.4% in Brazil,[3] 24.9% in Hong Kong,[4] 1.6% in Czech women,[5] and 37.9% in India.[6] There are many factors involved in the causation of MBS, which cannot be changed but many can be curtailed and amenable for correction.

There are very few studies comparing the prevalence of MBS based on body mass index (BMI) among the Asian population, more so among the polycystic ovarian syndrome (PCOS) women. Many studies have shown that prevalence of MBS is high among the PCOS women. Among the various risk factors for MBS like age, BMI, PCOS, and hyperinsulinemia, only BMI is a modifiable risk factor. Among the infertile population, even non-PCOS women have a high BMI. So, this study was conducted involving both PCOS and non-PCOS women, to study the impact of BMI on the prevalence of MBS among both the groups. Probably this is one of the few studies of its kind, to study the prevalence of MBS in different BMI group women in both PCOS and non-PCOS infertile women.

Materials and Methods

It is a prospective cross-sectional study conducted in the department of reproductive medicine and surgery of a tertiary care center catering to the South Indian population. A total of 1,030 infertile women in the age group of 18–40 years were enrolled over a period of 6 months. Institutional Ethical committee approval was obtained (CSP-MED/17/AUG/37/85). A written consent was taken from all the participants.

A detailed history and clinical examination were performed on all the participants. Blood pressure was recorded in the sitting position in the left arm, height and weight were recorded, and BMI was calculated. Waist circumference (WC) was measured halfway between the lower ribs and the crest of pelvis. The laboratory evidence for MBS was assessed by measuring HDL–C and serum triglycerides and 2-hour oral glucose tolerance test (OGTT) with 75 g of glucose.

[1,3–5]Department of Reproductive Medicine and Surgery, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India

[2]Department of Infertility, Indira IVF Centre, Chennai, Tamil Nadu, India

Corresponding Author: Radha Vembu, Department of Reproductive Medicine and Surgery, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India, Phone: +91 9841141310, e-mail: ganesh_radha@yahoo.in

How to cite this article: Vembu R, Nandini Devi M, Nellepalli SR, *et al.* Impact of Body Mass Index on the Prevalence of Metabolic Syndrome among Infertile South Indian Women. Int J Infertil Fetal Med 2019;10(3):42–45.

Source of support: Nil

Conflict of interest: None

The MBS was defined according to the modified American Heart Association/National Heart Lung Blood Institute AHA/NHLBI (ATP III 2005) definition. It was diagnosed if at least three out of five criteria were present: (i) waist circumference of ≥80 cm, (ii) blood pressure of ≥130/85 mm Hg, (iii) fasting blood sugar of ≥100 mg/dL, (iv) triglycerides of ≥150 mg/dL, and (v) HDL-C of ≤50 mg/dL.[1]

Based on BMI, the study population was divided into groups, namely ≤23, 23.1–25, 25.1–27, 27.1–30, and >30 kg/m^2. Each group was further subdivided into PCOS and non-PCOS groups based on Rotterdam's criteria (2003). Then each BMI groups and subgroups were compared for the baseline parameters and the components of MBS. The prevalence of MBS is evaluated among the PCOS and non-PCOS women in each BMI groups.

The collected data were analyzed with the IBM SPSS statistics software 23.0 version. To describe about the descriptive data, frequency analysis was used, percentage analysis was used for categorical variables, and for continuous variables the mean and SD were used. To find the significant difference between the bivariate samples in independent groups, the unpaired sample *t* test was used. To find the significance of association in categorical data, the chi-square test was used. The means were compared by ANOVA. The probability value of 0.05 was considered as statistically significant.

Results

All 1,030 women were analyzed. The age of these women ranged from 19 to 40 years; the mean age was 28.8 ± 4.5 years. The mean duration of infertility was 5.6 ± 3.5 years, 73.4% had primary infertility, and mean BMI was 26.9 ± 3.7 kg/m^2. The mean systolic and diastolic blood pressure were 124.8 ± 11.3 mm Hg and 82.7 ± 9.7 mm Hg, respectively. The mean FBS was 94.4 ± 13.9 mg/dL, triglycerides 124.7 ± 39.3 mg/dL, LDL 102.3 ± 21.9 mg/dL, and HDL-C 40.4 ± 7.2 mg/dL. The prevalence of MBS among the infertile women was 35.3%. The baseline and demographic characteristics of PCOS and non-PCOS infertile women were compared at various cutoff levels of BMI (Table 1).

The prevalence of MBS at various cutoff values of BMI was compared among the PCOS and non-PCOS groups separately (Table 2).

Discussion

In the present study, the prevalence of MBS was 35.3% among the infertile women and among PCOS and non-PCOS women was 44.7 and 28.9%, respectively. This is slightly higher than the western population, which might me due to high-carbohydrate diet pattern of South Indian women that leads to high BMI and obesity and a predisposing factor for early-onset type 2 DM. A similar study conducted among the Indian population in 2011 among the PCOS women showed the prevalence to be 37.5%[6] and in 2015 was 37.16% among the PCOS and 23.75% among non-PCOS women.[7] This raising trend might be due to the epidemic of obesity and change in lifestyle.

In the present study, 40.8% were PCOS, majority of them were in late twenties and early thirties and were overweight. So, it was decided that this would be the suitable population to be screened for MBS as early detection of the risk factors can help in prevention of long-term sequela.

The consensus definition of IDF criteria and AHA/NHLB (2004)[8] has included elevated WC with a cutoff of ≥80 cm for Asian women. In the present study, more than 80% of women had WC >80 cm. This is one of the simplest anthropometric measurements, which can be recorded in outpatient as one of the screening tools.

According to the standard definitions, the upper limit of the cutoff value of BMI for normal weight is taken as 25 kg/m^2. But for the Asian population, the WHO expert consultation[9] for BMI has suggested it as 23 kg/m^2. In the present study, 86.4% of women had BMI more than this cutoff value. This is alarming as these young infertile women are vulnerable to these noncommunicable disease in future. Many studies on BMI have included only PCOS women. But the increase in overweight and obese women even among non-PCOS needs to be addressed. So, in the present study based on BMI they were subgrouped as PCOS and non-PCOS and the demographic and metabolic parameters were analyzed. Comparatively, all PCOS women were younger in all BMI groups. This might be due to seeking early intervention as their cycles are irregular. Even though there was statistically no significant difference in the metabolic parameters, we observed a steady increase in the values as BMI increased in both PCOS and non-PCOS women. So, the subgroup analysis showed that BMI is an independent correctable risk factor for MBS and adequate counseling about lifestyle modification plays an important role. This is supported by Monterio et al. study, where they suggested regular physical activity can reduce the risk of MBS through reduction in WC and BMI.[10]

In the present study, only limited number of women suffered from type 2 DM and hypertension. Probably this might be due to younger age of these infertile women. Insulin resistance was measured by 2-hour OGTT, which showed increase in prevalence of insulin resistance as BMI increased. In women with BMI >27 kg/m^2, there was almost twofold increase in 2-hour GTT among PCOS women when compared to non-PCOS women. So, obesity is one of the contributory factors for glucose intolerance. Similarly HDL-C was <50 mg/dL in more than 80% of the women and increased further as the BMI increased. This suggests that lifestyle modification should be stressed much earlier.

The main advantage of this study is large sample size, prospective study design, involving the vulnerable South Indian population, stratify the study population based on BMI, and analyzing the subgroups of PCOS and non-PCOS women. This gives a complete analysis of the infertile women for MBS. However, the only limitation being the study was conducted in a single tertiary care center. This leads to further scope of a multicentric study analyzing the long-term consequences in these infertile women.

Conclusion

The prevalence of MBS is increasing among infertile women of both PCOS and non-PCOS subgroups with BMI being an independent risk factor. In view of raising prevalence, the clinicians should emphasize the importance of screening for MBS and counsel about the lifestyle modification as these women will be more receptive at this stage when they are seeking help for conceiving.

Acknowledgments

We thank all the postgraduates, staff, and the patients for cooperating during the study. We thank the management for encouraging us to conduct this study.

Table 1: Comparison of parameters based on BMI between PCOS and non-PCOS infertile women

Parameters	*BMI*														
	≤23 (N-140)			*23.1–25 (N-214)*			*25.1–27 (N-196)*			*27.1–30 (N-321)*			*>30 (N-159)*		
	A (18)	*B (122)*	*p value*	*A (57)*	*B (157)*	*p value*	*A (74)*	*B (122)*	*p value*	*A (112)*	*B (209)*	*p value*	*A (72)(87)*	*B*	*p value*
Age (years)	24.7 (3.2)	26.7 (3.8)	0.03[a]	26.1 (3.3)	27.4 (3.7)	0.01[a]	26.9 (2.9)	29.2 (4.2)	0.0005[a]	27.8 (4.2)	31.7 (4.7)	0.0005[a]	30.3 (3.6)	31.3 (3.7)	0.08
Irregular cycles (%)	66.7	10.7	0.0005[a]	75.4	9.6	0.0005[a]	91.9	18.9	0.0005[a]	80.4	19.6	0.0005[a]	83.3	21.8	0.0005[a]
BP (>135/85 mm Hg) (%)	0.3	0	1.0	0.7	0.3	1.0	0.9	1.6	0.8	2.8	1.3	0.8	13.9	16.1	0.08
WC (>80 cm) (%)	55.6	32.8	0.06	91.2	96.8	0.08	100	100	0.5	100	99.5	1.0	100	98.9	1.000
FBS (>100 mg/dL) (%)	16.7	9.0	0.4	17.5	11.5	0.2	19.9	13.1	0.7	30.6	19.2	0.05	54.2	32.2	0.0005[a]
2-hour GTT 75 g glucose (>140 mg/dL) (%)	17.0	10.6	0.8	18.9	12.6	0.5	21.0	14.8	0.6	31.6	18.7	0.04	56.2	35.7	0.0005[a]
TGL (0.150 mg/dL) (%)	11.1	12.3	1.0	28.1	19.7	0.2	18.9	21.3	0.7	35.7	29.2	0.2	62.0	33.3	0.0005[a]
HDL (<50 mg/dL) (%)	88.9	81.1	0.3	93	74.5	0.0002[a]	94.6	89.3	0.3	93.8	97.1	0.1	97.2	96.6	1.000
MBS (%)	2 (11.1)	6 (4.9)	0.27	16 (28.1)	32 (20.4)	0.23	22 (29.7)	30 (24.6)	0.42	58 (51.8)	82 (47.6)	0.08	53 (73.6)	58 (66.7)	0.34

[a]$p < 0.05$ is significant. A—PCOS, B—non-PCOS.

BP, Blood pressure; FBS, Fasting blood sugar; GTT, Glucose tolerance test; HDL, High density lipoproteins; MBS, Metabolic syndrome; TGL, triglycerides; WC, waist circumference

Table 2: Prevalence of MBS among PCOS and non-PCOS women based on BMI

BMI (kg/m^2)	*PCOS*	*p value*	*Non-PCOS*	*p value*
≤23	2/18 (11.1%)	0.0005[a]	6/122 (4.9%)	0.0005[a]
23.1–25	16/57 (28.1%)		32/157 (20.4%)	
25.1–27	22/74 (29.7%)		30/122 (24.6%)	
27.1–30	58/112 (51.8%)		87/209 (41.6%)	
>30	53/72 (73.6%)		58/87 (66.7%)	

[a]$p < 0.05$ is significant
MBS, Metabolic syndrome; PBMI, Body Mass Index; PCOS, Polycystic ovarian syndrome

References

1. Grundy SM, Cleeman JI, Daniels SR, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. Circulation 2005;112(17):2735–2752. DOI: 10.1161/CIRCULATIONAHA.105.169404.
2. Essah PA, Nestler JE. Metabolic syndrome in women with polycystic ovary syndrome. Fertil Steril 2006;86(Suppl 1):S18–S19. DOI: 10.1016/j.fertnstert.2006.04.013.
3. Soares EM, Azevedo GD, Gadelha RG, et al. Prevalence of the metabolic syndrome and its components in Brazilian women with polycystic ovary syndrome. Fertil Steril 2008;89(3):649–655. DOI: 10.1016/j.fertnstert.2007.03.081.
4. Cheung LP, Ma RC, Lam PM, et al. Cardiovascular risks and metabolic syndrome in Hong Kong chinese women with polycystic ovary syndrome. Hum Reprod 2008;23:1431–1438. DOI: 10.1093/humrep/den090.
5. Vrbikova J, Vondra K, Cibula D, et al. Metabolic syndrome in young Czech women with polycystic ovary syndrome. Hum Reprod 2005;20(12):3328–3332. DOI: 10.1093/humrep/dei221.
6. Mandrelle K, Kamath MS, Bondu DJ, et al. Prevalence of metabolic syndrome in women with polycystic ovary syndrome attending an infertility clinic in a tertiary care hospital in south India. Prevalence of metabolic syndrome in women with polycystic ovary syndrome attending an infertility clinic in a tertiary care hospital in south India. J Hum Reprod Sci 2012;5(1):26–31. DOI: 10.4103/0974-1208.97791.
7. Sharma S, Majumdar A. Prevalence of metabolic syndrome in relation to body mass index and polycystic ovarian syndrome in Indian women. J Hum Reprod Sci 2015;8(4):202–208. DOI: 10.4103/0974-1208.170394.
8. Alberti KG, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation 2009;120(16):1640–1645.
9. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363(9403):157–163. DOI: 10.1016/S0140-6736(03)15268-3.
10. Turi BC, Codogno JS, Fernandes RA, et al. Low levels of physical activity and metabolic syndrome: cross-sectional study in the Brazilian public health system. Cien Saude Colet 2016;21(4):1043–1050. DOI: 10.1590/1413-81232015214.23042015.