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Metabolic Syndrome in Women Who Have Polycystic Ovary Syndrome Related Infertility

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Objective: The aim of the present study was to determine the prevalence of metabolic syndrome (MS) in infertile Mongolian women with polycystic ovary syndrome (PCOS) using the International Diabetes Federation (IDF) criteria. **Methods:** We used the case control retrospective study designs. Total 1340 infertile women enrolled in this study. Among the women, 114 were found with PCOS by Rotterdam's criteria at the Infertility and reproductive department, National Center for Maternal and Child Health, between December 2018 and 2019. The IDF diagnostic criteria for metabolic syndrome (MS) was used. The PCOS patients were divided into the following groups: (1) cases (with MS, n = 42) and (2) controls (without MS, n = 72). **Results:** The average age, body mass index (BMI), and duration of infertility were 28.7 ± 4.1 years, 27.3 ± 5.2 kg/m^2 and 4.4 ± 3.1y, respectively. Among the patients 57.9% of them had oligomenorrhea, 22.8% had amenorrhea, 57.0% had primary infertility, 51.9% had hirsutism and 50.8% had acne. As a result of hormone assays, LH was 9.3±3.5mIU/ml, LH/FSH ratio was 1.6 ± 0.83 [0.1-3.6], and AMH was 6.1ng/ml ± 3.6 [2.9 - 21.0]. The prevalence of MS was 36.8%. The variables which include age (30.9 ± 4.9), body mass (75.9 ± 11.6kg), and also some metabolic parameters such as hypertension (133.6/88.4 ± 13.6 mm Hg), WC (94.1 ± 8.6 cm) and high triglyceride (1.8 ± 1.0 mmol/l) were observed in the MS group and compared to the without MS group. **Conclusions:** We found out that the prevalence of metabolic syndrome was 36.8% among infertile women with PCOS. Age, BMI, WC, amenorrhea, acne, and acanthosis nigricans were highly related to metabolic syndrome.

Keywords: Polycystic Ovary, Metabolic Syndromes, Female Infertility

Introduction

Infertility is of increasing significance affecting almost 48.5 million couples around the world. Anovulation is a major cause of infertility in women with polycystic ovary syndrome (PCOS) accounting for about 80% of women with anovulatory infertility [1].

PCOS is one of the most common reproductive endocrinological disorders in women, affecting about 8-15% of women in the general population according to Rotterdam

criteria [2]. Therefore, androgen excess, clinically indicated by hirsutism and established by the finding of increased blood testosterone level, is usually considered as the main criterion for the definition of PCOS by endocrinologists. In contrast, menses abnormalities and chronic anovulation together with polycystic ovarian morphology on ultrasound are the criteria favored by gynecologists, whose primary interest is usually focused on ovarian dysfunction [3].

Rotterdam's criteria defines polycystic ovary as an ovary with at least 12 or more follicles measuring 2-9 mm each in diameter in a single plain or an increased ovarian volume of more than 10 cm^3 using transvaginal ultrasound scan [3]. The cysts in polycystic ovaries refer to antral follicles with arrested development. PCOS has been estimated to cause up to 75% of anovulatory infertility in some group of women [4]. Evidence has shown that insulin resistance (IR) and compensatory hyperinsulinemia also play central roles in the evolution of metabolic syndrome (MS). MS is a group of risk factors that identify individuals at increased risk for type 2 diabetes mellitus and atherosclerosis [5]. These risk factors include central obesity, hypertriglyceridemia, low levels of high-density lipoprotein (HDL) cholesterol, elevated blood pressure and fasting plasma glucose levels [6]. Many of the metabolic abnormalities of PCOS patients overlap with components of MS.

There are different diagnostic criteria with ethnic and gender-specific cut-off values for metabolic syndrome recommended by the International Diabetic Federation (IDF), National Cholesterol Education Program Adult Treatment panel III (NCEP-ATP III) and the World Health Organization (WHO). By IDF criterion, the prerequisite for MS must be central obesity and waist circumference (WC) is used as a measure for adiposity. On the other hand, NCEP-ATP III criterion eliminates central obesity as a prerequisite and the diagnosis of MS is simply based on the level of WC, TG, HDL-C, BP, and fasting blood glucose (FBG) [7]. One thing that needs to mention here is that the ethnicity difference is a remarkably important factor even between Asian populations especially when using different approaches to the MS definition with either IDF or ATP-III criteria. Ko et al. noted that there is a major ethnic difference in terms of adiposity and its distribution with Asians developing these risk factors and MS at a lower degrees of adiposity. The crude prevalence of MS defined by the IDF criterion was 7.4% (compared to other criteria: NCEP, 9.6%; WHO, 13.4% and EGIR, 8.9%). Subjects with MS defined by IDF criterion had higher body mass index and waist compared to those with MS defined by NCEP or WHO criteria, and lower triglyceride compared to those with MS defined by NCEP criterion after adjustment for age, gender and smoking. The authors concluded that the IDF criterion for MS is easy to implement in clinical practice [7].

On the other hand, the prevalence rates of MS in PCOS women vary among different countries and ethnicities [7, 8]. For example, it has been demonstrated that the prevalence of MS as defined by the NCEP-ATP III definition was 37.5% in the Indian population with 5.8 % of the population having diabetes mellitus, 8.3% having impaired fasting glucose, and dyslipidemia was present in 93.3% of the cases of PCOS [9]. Another study of Ni et al. showed significantly lower prevalence of MS (16.8%) but higher occurrence of various metabolic disorders in Chinese population with PCOS by the IDF definition. BMI and age were the most contributing factors for MS rather than free testosterone, free androgen index, fasting insulin, or sex hormone-binding globulin [10]. A cross-sectional study of Korean women with PCOS demonstrated that the prevalence of MS in women was 14.5% according to the modified NCEP-ATP III criteria. PCOS women with MS had higher post-glucose load insulin levels which indicates a higher degree of insulin resistance compared to those without MS [3]. The prevalence in the Thailand population with PCOS was 35.3% using IDF criteria with significantly higher parameters with age and increased BMI as well as insulin resistance [10]. On the other hand, there are still a few studies that have attempted to investigate how MS may affect infertility of women with PCOS [9]. A cross-sectional study of infertile Iranian women with PCOS using the ATP-III criteria showed a 19.7% MS prevalence. The most prevalent metabolic parameter was HDL-C and the least prevalent metabolic parameter was hypertension [11].

There are also several studies that have investigated the comparison of the three criterions of MS on PCOS women. In the study of cardiometabolic risk in PCOS of Australian women conducted by Cussons et al. the prevalence of the MS in PCOS subjects was 33% by WHO, 37% by NCEP-ATP-III and 40% by IDF criteria, compared with 10% by NCEP-ATP-III and 13% by IDF in controls ($p < 0.001$). The authors also showed that the prevalence of MS was significantly higher among obese women (BMI > 30 kg/m2), and higher but not significantly so in overweight women (BMI 25-30 kg/m^2) who had PCOS [12].

Moreover, Caliskan et al. revealed that Rotterdam, IDF and WHO criteria showed significantly higher MS prevalence in patients with PCOS as compared to the control group in Turkish women. The highest frequency of MS (26%) was observed according to the IDF definition due to its lower cutoff values of waist circumference and fasting glucose level. The authors include that IDF is a more discriminative approach for treatment and management of MS against future cardiovascular events as a preventive strategy [13]. In the cross-sectional study conducted by Indhavivadhana et al. the prevalence of MS in Thai women who had PCOS was 18.0% by the NCEP ATP III definition, and 21.2% by the IDF definition. Moreover, among the non-MS women with PCOS, more that 40% had one to two criteria by IDF definition, while a MS group had 100% central obesity, 50.9% high blood pressure, 28.3% impaired fasting blood glucose, 62.3% hypertriglyceridemia, and 92.5% elevated high-density lipoprotein cholesterol < 50 mg/dL [14].

As seen in the above-mentioned studies, the prevalence and risk factors of MS in Asian women with PCOS significantly vary across the regions and countries due to the different demographic, socioeconomic as well as phycological factors. Also, most studies have been conducted on how metabolic syndrome affects PCOS, however there have been only a few reports that concluded hyperandrogenistic parameters in PCOS. In a study done on Indian women with PCOS, 28.8% of the participants had hirsutism and 9.2% had acne. However, there was not significant difference in acne between PCOS patients with or without metabolic syndrome [15]. We have aimed, therefore, in the present study, to determine the prevalence of MS in infertile Mongolian women with PCOS using the IDF criteria and evaluate important risk factors for MS prevalence. We have included metabolic as well as hyperandrogenic parameters in order to determine the effect of PCOS. Our study is the first demonstration, to our knowledge, of the prevalence of MS in infertile Mongolian women with PCOS.

Materials and Methods

Study design and sampling

We used the case-control retrospective study design and the study was conducted at the Infertility and Reproductive Department of the National Center for Maternal and Child Health between December 2018 and December 2019. In total, 1334 infertile women were observed and we followed 114 of them who were diagnosed as PCOS according to Rotterdam's criteria. According to the Rotterdam criteria, a clinical diagnosis of PCOS requires that a patient present with two of the following symptoms: oligo-ovulation or anovulation; hyperandrogenism, clinical hypotestosteronemia including signs (such as hirsutism) or biological tests (including a raised free androgen index or free testosterone); or polycystic ovaries visible on ultrasound.

Metabolic syndrome (MS) was diagnosed according to the International Diabetes Federation's (IDF) criteria. According to the new IDF definition, for a person to be defined as having metabolic syndrome they must have central obesity (waist circumstance > 80 cm) plus any two of the following four factors: 1) triglyceride ≥ 150 mg/dL, 2) HDL cholesterol < 50 mg/dL, 3) raised blood pressure – a systolic BP ≥ 130 or diastolic BP ≥ 85 mm/Hg, 4) Fasting plasma glucose ≥ 100 mg/dL. If three or more of these symptoms are present, it is considered metabolic syndrome. A standardized investigation for infertile couples which was released from WHO consisting of a self-assessment for PCOS and a 3 parts 41 question survey were used in this study.

Inclusion criteria

According to the Rotterdam's criteria definition, the diagnosis of PCOS/D is justified when at least two of the stated three inclusion parameters are fulfilled.

Infertility is defined as trying to get pregnant (with frequent intercourse) for at least a year with no success.

Exclusion criteria

Women age over 45 years, and incomplete infertility diagnosis and treatment information.

Laboratory test

Blood tests for checking hormone levels and fat metabolism were taken using a Roche Diagnostic GmbH which was made in Germany and agents from D-68298 Mannheim were used. A fully automated analyzer, Roche- Hitachi cobas e-411, was used for evaluating LH, FSH, E2, AMH, TSH, PRL, P4, total testosterone level, HDL, LDL, cholesterol, fasting glucose, and triglyceride level.

Statistical analysis

We carried out chi-square tests for comparing categorical variables. For comparing mean of the two groups the unpaired t-tests were used. The differences were considered statistically significant when $p < 0.05$. Further, for categorical variables, if the frequency in a cell was less than 5, the Fishers exact test was used instead of the chi-square test. Statistical analysis was done using SPSS 23.0.

Ethical statement

The study was approved by the Research Ethics Committee of Mongolian National University of Medical Sciences (No.2019/03-01).

Results

Totally, 114 (8.5%) women were diagnosed with PCOS among 1334 infertile women. 17.5% of the participants were aged between 20-24, the majority of them were aged between 25-29, 30.7% of the participants were aged between 30-34 and 7.9% of them were aged 35-39 years old. The mean age of the participants 28.7 ± 4.1. Additionally, 34.2% of the participants were overweight and 29.8% of them were obese. As to demographic data, 80.9% of the participants were from Ulaanbaatar and 19.1% were from the countryside. The majority of participants were employed (78.8%), 14.9% of them were unemployed, 4.4% were students and 1.8% were herdsmen. 91.2% of the participants' working conditions were normal and 8.8% of them were working in toxic conditions.

Mean first menstruation age was 14.1 ± 1.69 and mean infertility years was 4.39 ± 3.11. 19.3% of the women had regular menstrual cycles, 57.9% of them had oligomenorrhea and 22.8% of them had amenorrhea. 57% of the participants had primary infertility, 10.5% of the women had experienced early miscarriage, 10.5% of them had experienced abortion, 9.6% of them had experienced intrauterine growth restriction, and 84.2% of the couples had no child.

Clinical manifestations result showed 81 of the women with PCOS suffered pain, 75 of them had premenstrual symptoms, 75 of them had symptom of hair loss, 73 of those women felt stress, 71 of them had hirsutism, 69 of them were easily depressed, 68 of them had painful periods and 58 of the participants had acne.

Genetic risk of hypertension, obesity, diabetes mellitus 2 and PCOS was 40, 39, 15 and 15. Furthermore, 36 women had sleeping problem, 34 women had eating disorder and 11 women had hyperprolactinemia (Figure 1).

According to the Ferriman Gallwey scale, 51.8% of the participants had mild hirsutism, 8.8% of them had moderate hirsutism and 0.9% of them had severe hirsutism. In addition, 50.8% of the women had mild acne. According to the Rotterdam

Table 1. Demographics and Gestational histories of the PCOS patients.

Characteristics	No. of patients/means
	Mean ± SD
Age, years	28.7 ± 4.13
Menarche, years	14.15 ± 1.69
During of infertility, years	4.39 ± 3.11
Age group	**N (%)**
20-24	20 (17.5)
25-29	50 (43.9)
30-34	35 (30.7)
35-39	9 (7.9)
BMI	
25-29.9	39 (53.4)
≥30	34 (46.6)
Marital status	
Married	70 (61.4)
Unmarried	44 (38.6)
Menstrual cycle	
Regular	22 (19.3)
Oligomenorrhea	66 (57.9)
Amenorrhea	26 (22.8)
Gestations	
No	65 (57.0)
One and two	45 (39.5)
Three	4 (3.5)
Miscarriages	
No	102 (89.5)
Yes	12 (10.5)
Abortions	
No	102 (89.5)
Yes	12 (10.5)
Missed abortion	
No	103 (90.4)
Yes	11 (9.6)
Child history	
Having children	18 (15.8)
Not having children	96 (84.2)

Table 2. Clinical features of PCOS patients with and without metabolic syndrome.

Characteristics	Metabolic Syndrome			p-value
	Case (n = 42)	Control (n = 72)	Total (n = 114)	
	Mean ± SD	Mean ± SD	Mean ± SD	
Mean age (years)	29.60 ± 4.45	28.25 ± 3.95	28.92 ± 4.20	0.097
BMI (kg/m2)	30.92 ± 4.72	24.99 ± 4.20	27.96 ± 4.46	0.000
Waist circumference (cm)	95.60 ± 11.22	81.62 ± 11.97	88.61 ± 11.59	0.000
Systolic blood pressure (mmHg)	133.90 ± 20.28	108.11 ± 16.36	121.01 ± 18.32	0.000
Diastolic blood pressure (mmHg)	88.22 ± 14.60	71.79 ± 11.66	80.01 ± 13.13	0.000
Hormones				
Serum basal FSH (miu/L)	5.94 ± 1.98	6.13 ± 1.65	6.04 ± 1.82	0.578
Serum basal LH (miu/L)	9.19 ± 5.74	9.10 ± 4.58	9.14 ± 5.16	0.930
LH/FSH ratio	1.62 ± 0.90	1.56 ± 0.91	1.59 ± 0.91	0.705
Serum basal E2 (pg/ml)	42.37 ± 25.29	43.46 ± 36.71	42.92 ± 31.01	0.457
Serum AMH (ng/ml)	6.32 ± 3.36	6.12 ± 3.77	6.22 ± 3.57	0.806
Serum TSH (miu/l)	2.11 ± 1.14	2.34 ± 1.38	2.26 ± 1.26	0.318
Serum Total testosterone (ng/ml)	0.36 ± 0.28	0.31 ± 0.29	0.34 ± 0.57	0.450
Lipids				
Fasting plasm glucose (mmol/l)	5.43 ± 1.34	5.05 ± 0.40	5.24 ± 0.87	0.135
LDL (mmol/l)	3.32 ± 1.04	2.84 ± 0.67	3.08 ± 0.86	0.059
HDL(mmol/l)	1.30 ± 0.32	1.40 ± 0.25	1.35 ± 0.29	0.209
Triglyceride (mmol/l)	1.88 ± 1.00	1.00 ± 0.64	1.44 ± 0.82	0.000
Cholesterol (mmol/l)	5.48 ± 1.48	4.76 ± 0.75	5.12 ± 2.23	0.027
Ultrasound				
RO volume (cm^3)	18.4 ± 2.91	7.98 ± 3.44	13.19 ± 3.16	0.010
RO-AFC	15.65 ± 3.51	15.10 ± 4.19	15.36 ± 3.85	0.475
LO-AFC	14.35 ± 4.03	13.72 ± 4.05	14.04 ± 4.04	0.429
LO volume (cm^3)	16.0 ± 3.69	7.18 ± 3.06	11.59 ± 3.30	0.068
Volume of uterus (ml)	46.26 ± 26.71	41.38 ± 14.64	43.31 ± 20.67	0.217

RO-right ovary, LO-left ovary, AFC-Antral follicle count

criteria, 51 (44.7%) of the 114 participants were diagnosed as Type A category of PCOS with the presence of hyperandrogenism, chronic anovulation and polycystic ovaries while 4 (3.5%) women were diagnosed as Type B category with hyperandrogenism and chronic anovulation. Moreover, 14 (12.3%) of the participants were diagnosed as Type C category of PCOS with the presence of hyperandrogenism and polycystic ovaries and rest of the 45 (39.5%) participants were diagnosed as Type D category of PCOS with presence of chronic anovulation and polycystic ovaries.

There was no statistically significant correlation observed between hormone lab test and symptoms of Rotterdam criteria. However, elevation of LH and AMH were statistically correlated ($r = 0.261$, $p = 0.015$).

Furthermore, there were significant differences between AMH (8.1ng/ml ± 4.7) and LH (8.9 miu/ml ± 3.5) level of infertile women with PCOS and AMH (2.1ng/ml ± 1.0) and LH (5.3 miu/ml ± 1.3) of infertile women without PCOS ($p = 0.004$, $p = 0.001$).

According to the IDF's evaluation, 36,8% of the total women with PCOS had metabolic syndrome and they had a higher risk for genetic factors than the control group. For instance, of the total participants 7.9% ($p = 0.047$) had a family history of DM and 21.1% ($p = 0.000$) had a family history of hypertension.

Additionally, women with metabolic syndrome had a higher incidence of amenorrhea (13,2%, $p = 0.016$) and pigmentation (15,3%, $p = 0.015$) than the control group (Table 4).

Table 3. Clinical features of PCOS patients with and without metabolic syndrome.

Characteristics	Metabolic Syndrome			p-value
	Case (n = 42)	Control (n = 72)	Total (n = 114)	
	N (%)	N (%)	N (%)	
Gainful weight				
Yes	37 (88.1)	44 (61.1)	81 (71.1)	0.000
No	5 (11.9)	28 (38.9)	33 (28.9)	
Angry and stressful				
Yes	31 (73.8)	42 (58.3)	73 (64.0)	0.097
No	11 (26.2)	30 (41.7)	41 (36.0)	
Depression				
Yes	28 (66.7)	41 (56.9)	69 (60.5)	0.307
No	16 (33.3)	31 (42.1)	47 (39.5)	
Genetic risks of DMT-2				
Yes	9 (21.4)	6 (8.3)	15 (12.2)	0.000
No	33 (78.6)	66 (91.7)	99 (86.8)	
Menstrual cycle				
Regular	5 (11.9)	18 (25.0)	23 (20.2)	0.016
Oligomenorrhea	22 (52.4)	43 (59.7)	65 (57.0)	
Amenorrhea	15 (35.7)	11 (15.3)	26 (22.8)	
Acne				
Yes	22 (52.4)	37 (51.4)	59 (51.8)	0.421
No	20 (47.6)	35 (48.6)	55 (48.2)	
Acanthosis nigricans				
Yes	17 (40.5)	14 (19.4)	31 (27.2)	0.015
No	25 (59.5)	58 (80.6)	83 (72.8)	
Hair loss				
Yes	37 (88.1)	38 (52.8)	75 (65.8)	0.000
No	5 (11.9)	34 (47.2)	39 (34.2)	
Male pattern balding				
Yes	20 (47.6)	23 (31.9)	43 (37.7)	0.107
No	22 (52.4)	49 (68.1)	71 (62.3)	
Hirsutism				
Yes	28 (66.7)	42 (58.3)	70 (61.4)	0.209
No	14 (33.3)	30 (41.7)	44 (38.6)	
Miscarriages				
Yes	1 (2.4)	11 (15.3)	12 (10.5)	0.030*
No	41 (97.6)	61 (84.7)	102 (89.5)	
Missed abortion				
Yes	4 (9.5)	7 (9.7)	11 (9.6)	0.972*
No	38 (90.5)	65 (90.3)	103 (90.4)	

*Fisher's exact test

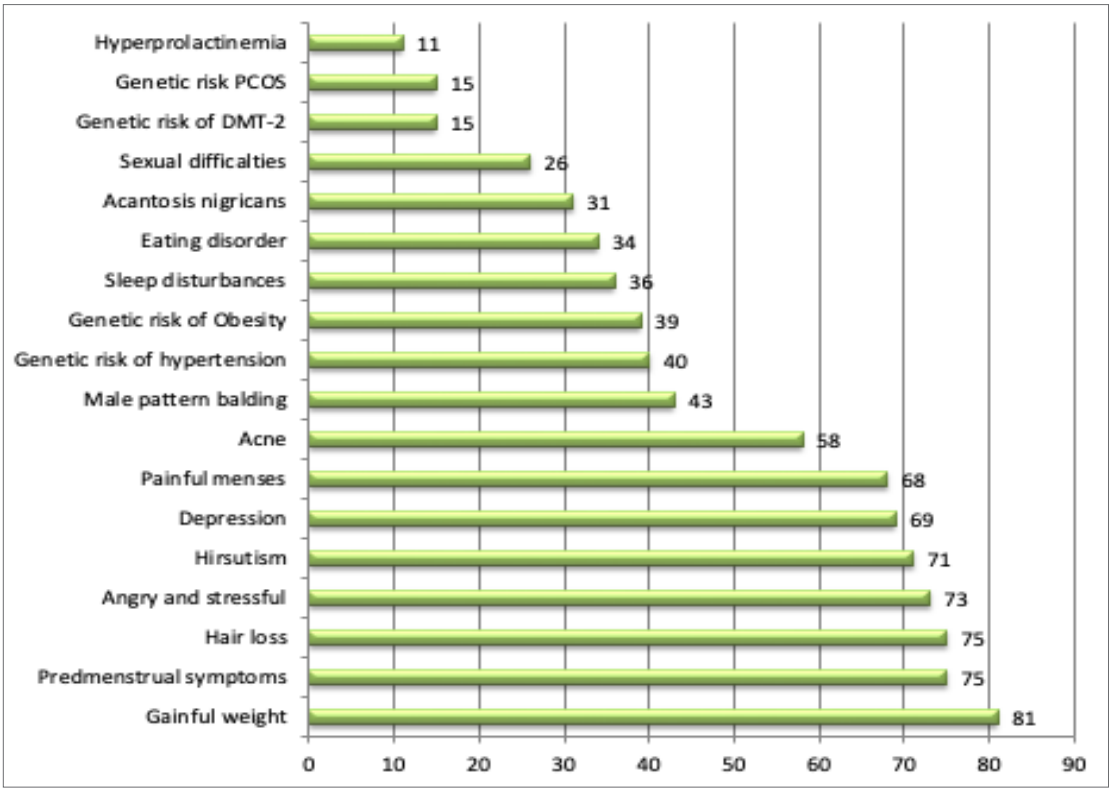

Figure 1. Clinical manifestations of PCOS patients.

Table 4. Rotterdam criteria and metabolic syndrome.

Classifications of Rotterdam criteria	Case With MS (n = 42)	Control Without MS (n = 66)
	N (%)	N (%)
A	27 (64.3)	22 (33.3)
B	1 (2.4)	1 (1.5)
C	3 (7.1)	10 (15.2)
D	11 (26.2)	33 (50.0)

Women with PCOS had higher body mass (77.0 kg ± 13.4, p = 0.0001), BMI (30.9 ± 4.7, p = 0.000), waist circumference (95.6 cm ± 11.2, p = 0.000) and blood pressure (133 ± 20.2/88 ± 14.2 mm.Hg, p = 0.000) than the control group. Moreover, women with metabolic syndrome had higher LDL (3.32 ± 1.0 mmol/l, p = 0.05), triglyceride (1.88 ± 1.0 mmol/l, p = 0.000) and total cholesterol (5.48 ± 1.48 mmol/l, p = 0.020).

Ultrasound investigation showed higher volume of the right ovary (18,4 ± 2.91 cm3) in women with metabolic syndrome than women without metabolic syndrome (p = 0.011). On the other hand, there was no statistically significant difference observed between level of reproductive hormones (Table 3).

In addition, we have compared women with and without metabolic syndrome according to the Rotterdam criteria. As a result of the study, 64,3% of the women with metabolic syndrome had 3 combinations of Rotterdam criteria while

50% of the women without metabolic syndrome had only 2 combinations: polycystic ovary and irregular period (Table 4).

Discussion

In this study, 116 (8.7%) of 1334 women were diagnosed with PCOS, which showed similar result with other studies in East Africa's Tanzania 10.3%, Iran 8% and North America 10.3%. In contrast, studies of Nigerian (27.6%) and Australian (11.9%) literature reported higher incidence than Japan, Korea and China (5.5-6.5%)[12]. These results indicate that prevalence of PCOS is related with lifestyle, culture, geographic location etc.

Generally, incidence of obesity, hirsutism, and irregular period of the reproductive age of women with PCOS were 40-60%, 60-90%, and 50-90% which showed similar results to our study [13]. Further, because of disturbances of thalamus and pituitary gland, LH/FSH hormone imbalance is induced in more than 60% of the women with PCOS [14]. Despite this, in our study, we have found LH/FSH hormone imbalance in 25.9% of the participants. This result indicates Mongolian women have less disturbance of thalamus and pituitary gland. However, further investigation is needed to prove this result.

According to the Rotterdam criteria, if the woman has the presence of 2 or 3 symptoms, she will be diagnosed as PCOS [15]. In our study, 44.7% of the participants were diagnosed with 3 symptoms combination and 39.5% of them were diagnosed with polycystic ovary and irregular period. This finding agrees with Korean and Chinese literature that reported 38%-36.5% [16, 17]. Further, our study shows that, among patients, 57.9% had oligomenorrhea, 22.8% had amenorrhea, 57.0% had primary infertility, 51.9% had hirsutism and 50.8% had acne. These presentations are significantly higher than Indian literature, where hirsutism was present in 28.3%, and acne in 9.2% [23-28].

Studies have reported 75% primary infertility and 25% secondary infertility among women with PCOS, which was similar to the result of our study that reported 57% primary infertility and 80% of the couples had no child. Furthermore, 36.8% of the participants had metabolic syndrome which coincides with result of Germany's literature (31%) and Indian literature (37.5%). In contrast, Korean (14.5%), Chinese (6.5%) and Hong Kong (24.9%) studies reported lower percentages of metabolic syndrome. However, USA's study showed higher result (46%) of metabolic syndrome [18-23].

Our study has some limitations. First, in the present study, MS diagnosis was made mainly with IDF criteria. IDF criterion mainly concerns abdominal adiposity increase, which in turn produces a greater difference of MS prevalence in different ethnic groups. Moreover, as we mentioned in the introduction, there are several studies which indicated that the MS prevalence is different for each international area. Some researchers demonstrated that the use of IDF criterion is less effective to predict MS effect on diabetes. Second, we have not included lifestyle factors such as smoking, alcohol consumption, diet, and exercise which are significantly important in PCOS women. Because of these reasons, future studies are needed to compare the NCEP ATP-III and IDF criteria on MS diagnosis of Mongolian women with PCOS, and reflect lifestyle factors in a future analysis.

Conclusions

In our study, 116 (8.7%) of 1334 women were diagnosed as PCOS, which coincides with other countries' study results. Moreover, most of those women were diagnosed with 3 symptoms. In this study, we used the IDF's criteria to diagnose metabolic syndrome in women who were diagnosed as PCOS, which showed similar results with other international studies. Besides, it indicates that we can use IDF criteria in clinical practice. Furthermore, every 1 of 3 women with PCOS were diagnosed with metabolic syndrome and it shows that early treatment is needed for those women before pregnancy.

Conflict of Interest

The authors declare that they have no conflict of interest concerning this study.

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