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Relationship between Obesity and Infertility among Women with Polycystic Ovarian Syndrome Treated at the National Population and Family Development Board (NPFDB) Malaysia

(Hubungan antara Keobesitian dan Ketidaksuburan dalam Kalangan Wanita dengan Sindrom Ovari Polisistik Dirawat di Lembaga Penduduk dan Pembangunan Keluarga Negara (LPPKKN) Malaysia)

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ABSTRACT

Polycystic ovarian syndrome (PCOS) is a metabolic dysfunction and is closely related to infertility in women. Obesity has an impact on the clinical manifestations of PCOS. This study was designed to determine the relationship between obesity and infertility among women with PCOS treated at the National Population and Family Development Board (NPFDB) Malaysia. This is a cross-sectional study with a simple random sampling technique involving infertile women attending NPFDB Subfertility Clinic, Kuala Lumpur, Malaysia, from January 2018 to December 2019. Clinical and menstrual history were recorded, and subjects underwent physical examination by a medical doctor. Subjects were diagnosed with PCOS based on Rotterdam criteria, and blood was taken for reproductive hormone, blood glucose, cholesterol, and triglyceride determination. A total of 179 infertile women completed the study, and 84 (47%) were diagnosed with PCOS. Results showed a significant increase in follicle-stimulating hormone (FSH) levels along with a significant reduction in progesterone level (p<0.05) in PCOS women compared to non-PCOS women. A total of 44% of PCOS women were found to be obese, and they exhibited significantly higher blood pressure and triglyceride level but lower high-density lipoprotein (HDL) level (p<0.05). Chi-square ($\chi 2$) showed PCOS women who are obese are more likely to experience ovulatory dysfunction, as evidenced by oligo- and amenorrhea, compared to non-obese women with PCOS. In addition, they were also presented with significantly higher testosterone levels (p<0.05) and reduced progesterone levels compared to non-obese PCOS women. This study showed that PCOS women with obesity had more prominent ovulatory dysfunction and reproductive hormonal imbalance than non-obese PCOS women. These findings suggest that PCOS women with obesity are more prone to develop infertility.

Keywords: Infertility; obesity; polycystic ovarian syndrome

ABSTRAK

Sindrom ovari polisistik (PCOS) adalah disfungsi metabolik dan berkait rapat dengan ketidaksuburan pada wanita. Keobesitian pula mempunyai kesan ke atas manifestasi klinikal PCOS. Kajian ini direka untuk menentukan hubungan antara keobesitian dan ketidaksuburan dalam kalangan wanita dengan PCOS yang dirawat di Lembaga Penduduk dan Pembangunan Keluarga Negara (LPPKN) di Malaysia. Kajian ini merupakan kajian keratan rentas dengan teknik persampelan rawak mudah melibatkan wanita tidak subur yang menghadiri Klinik Subfertiliti di LPPKN, Kuala Lumpur, Malaysia dari Januari 2018 hingga Disember 2019. Sejarah klinikal dan haid direkodkan dan subjek menjalani

pemeriksaan fizikal oleh doktor perubatan. Subjek didiagnosi menghidap PCOS berdasarkan kriteria Rotterdam dan darah diambil untuk penentuan aras hormon reproduktif, glukosa, trigliserida dan kolesterol. Seramai 179 orang wanita tidak subur menyelesaikan kajian ini dan 84 (47%) daripadanya telah didiagnosis mengalami PCOS. Hasil kajian mendapati hormon perangsang folikel (FSH) adalah lebih tinggi dan progesteron adalah lebih rendah dengan ketara ($p<0.05$) pada wanita PCOS berbanding wanita tanpa PCOS. Seramai 44% wanita PCOS didapati obes dan mempunyai tekanan darah dan trigliserida yang lebih tinggi serta aras lipoprotein berketumpatan tinggi (HDL) lebih rendah dengan ketara ($p<0.05$). Khi kuasa dua ($\chi 2$) menunjukkan wanita PCOS yang mengalami obesiti mengalami disfungsi ovulasi yang ketara yang ditunjukkan oleh oligo dan amenorea berbanding wanita PCOS bukan obes. Tambahan pula, tahap testosteron adalah lebih tinggi secara signifikan ($p<0.05$) dan progesteron lebih rendah pada wanita PCOS yang obes. Sebagai kesimpulan kajian ini mendedahkan bahawa wanita PCOS dengan obesiti mempunyai disfungsi ovulasi dan ketidakseimbangan hormon reproduktif yang lebih ketara berbanding wanita PCOS bukan obes. Penemuan ini menunjukkan bahawa wanita PCOS dengan obesiti lebih cenderung untuk mengalami ketidaksuburan.

Kata kunci: Keobesitian; ketidaksuburan; sindrom ovari polisistik

Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disorder (Hart & Doherty 2015), affecting 4-8% of women of reproductive age (Sirmans & Pate 2014). PCOS is associated with menstrual irregularities, anovulation, hyperandrogenism and infertility (Hart & Doherty 2015). PCOS is a condition involving reproductive, metabolic, and hormonal disturbances (Teede et al. 2018). Based on Rotterdam's criteria, PCOS is characterised by two of three diagnostic criteria: oligo ovulation or anovulation, clinical and/or biochemical hyperandrogenism, and the presence of polycystic ovaries (Rotterdam 2004). Importantly, PCOS is the most common cause of menstrual irregularities leading to infertility; hence, it is often referred to as the most common cause of anovulatory infertility in women (Barthelmess & Naz 2015). On top of that, the fertility rate of Malaysian women saw a significant decline from 4.9 in 1970 to 1.7 in 2021 (Jabatan Statistik Malaysia 2023). A study done in Malaysia found that the prevalence rate of PCOS was quite significantly high at 12.6% (Sareh et al. 2018). Having PCOS exposes them to an increased risk of cardiovascular disease, type 2 diabetes, dyslipidemia, atherosclerosis, and endometrial cancer (Osibogun, Ogunmoroti & Michos 2020).

The prevalence of obesity has increased significantly worldwide over the past 40 years (Jaacks et al. 2019; Poh et al. 2019). Malaysia is no exception and is experiencing an increase in obesity rates, with approximately one in two adult Malaysians suffering from weight gain or obesity (Chong et al. 2023). According to the Institute of Public Health (2020), Malaysia has the highest number of overweight and obese people in Southeast Asia. Obesity is one of the critical features of PCOS patients and the prevalence of obese women with PCOS ranges from 61% to 76% (Randeva et al. 2012). In the United States, nearly 80% of women with PCOS are obese, and 50% have metabolic syndrome (Diamanti et al. 2008). Studies have shown that obesity is one of the risk factors that synergistically affect the manifestations of PCOS, influencing insulin sensitivity, diabetes, and cardiovascular disorders (Randeva et al. 2012).

Obesity in women of reproductive age may increase the risk of developing PCOS and implicate the reproductive system, hence increasing the risk of infertility and complications in pregnancy (Bruyneel et al. 2014). Obesity induces insulin resistance, whereby hyperinsulinemia interacts synergistically with luteinising hormone to induce polycystic ovaries (Lungu et al. 2012). Hence, by managing the influence of excessive obesity on ovarian and metabolic function, the treatment of PCOS will become more fundamental (Best, Avenell & Bhattacharya 2017; Dunaif 2012). On the other hand, weight reduction is associated with significant improvement in menstrual regularity, hyperandrogenic characteristics, and fertility (Best, Avenell & Bhattacharya 2017; Diamanti & Dunaif 2012). Therefore, the management of body weight of women with PCOS may play an important role in preventing reproductive complications and preserving fertility.

To the best of our knowledge, no studies have been conducted in Malaysia to investigate the relationship

between obesity and infertility among PCOS women. Since Malaysia has one of the highest rates of obesity among its population as well as a high prevalence of PCOS women, this study aimed to determine the relationship between obesity and infertility among infertile PCOS women treated at the National Population and Family Development Board (NPFDB), Malaysia.

Methods

Study design and research procedures

This cross-sectional study was performed using a simple random sampling technique. It was conducted at the Subfertility Clinic of NPFDB, Malaysia, from January 2018 to December 2019. This study was approved by the National Population and Family Development Board (NPFDB) Ethics Committee (Ref. Bil (8) dlm. SPK 10/2/3 Jld. 4), and written informed consent was obtained from all participating women. The women who participated in this study came for infertility treatment and fulfilled the inclusion criteria as follows: aged under 40 years old, Malaysian, diagnosed with PCOS according to the Rotterdam criteria (Rotterdam 2004). The Rotterdam criteria referred to the presence of two out of three parameters: i) oligo or anovulation state detected by the presence of progesterone in the luteal phase, ii) clinical hyperandrogenism defined by the presence of hirsutism and biochemical hyperandrogenism defined by serum total testosterone, iii) polycystic ovarian morphology on ultrasound examination. Subjects were excluded from this study if they had the following criteria: thyroid, renal, and liver diseases, endocrine disorders such as hyperprolactinemia, and taking medications or hormones within the past year.

Women who agreed to participate were required to attend four appointments according to their menstrual cycle. During the first appointment, age, ethnicity, menstrual and infertility history, body mass index (BMI) and blood pressure were recorded. Menstrual history was categorised as regular menstrual cycles, oligomenorrhea and amenorrhea. Meanwhile, the presence of hirsutism was confirmed by a medical doctor. Blood was drawn for the determination of follicle-stimulating hormone (FSH) and luteinising hormone (LH) levels during the follicular phase of the menstrual cycle. According to the standard procedure of the Subfertility Clinic NPFDB, this procedure was carried out between the second and fifth days of the subject's menstrual cycle, and aimed to observe the development of the follicles.

On the second appointment, at the luteal phase of the menstrual cycle, blood was drawn for progesterone level determination, aimed to determine the ovulation status. Testosterone levels were also determined during this period. On the third appointment, a transvaginal ultrasound was performed by a trained doctor to determine the number of follicles and the volume of the ovaries during clinical examination. The diagnosis of polycystic ovary was based on the observation of 12 or more follicles with a diameter of 2-9 mm in each ovary and/or an increase in the volume of each ovary by at least 10 mL (Rotterdam 2004). Confirmation of PCOS made according to the Rotterdam criteria. During the fourth scheduled appointment, the subjects were requested to observe an overnight fast, following which a lipid profile test and oral glucose tolerance test (OGTT) were conducted.

Hormonal and biochemical assay

After overnight fasting, blood was obtained from each woman for lipid profile and OGTT. Glucose, total cholesterol, triglycerides (TG), low-density lipoproteins (LDL), and high-density lipoproteins (HDL) levels were measured with a fully automated photometric chemistry analyser (Cobas 311, Roche Diagnostics). Reproductive hormones (progesterone, testosterone, FSH, LH) levels were performed using Cobas e411 analyser, Roche Diagnostic.

Statistical analysis

Statistical analysis was performed using SPSS version 23 (IBM, Illinois, USA). The results of descriptive analysis for all clinical, biochemical, and hormonal parameters were expressed as mean ± standard deviation (SD). Differences between groups were assessed using an independent t-test for continuous variables and a chi-square ($\chi 2$) test for categorical variables, where $p < 0.05$ was considered statistically significant.

Results and Discussion

A total of 179 women participated in this study, and 84 (46.9%) of them were diagnosed with PCOS. Of these PCOS women, 91.7% were Malays, 6.0% were Chinese, 1.2% were Indians, and 1.2% were indigenous to Sabah/Sarawak. As the majority of patients visiting the NPFDB Subfertility Clinic are Malay women, this explains

the dominance of Malay ethnicity in the current study population. It is worth noting that the predominant ethnic group in the Malaysian Peninsular is Malay followed by Chinese and Indian, hence the study population reflects the ethnic distribution of Malaysia (MyGoverment Demography of Population 2016).

The characteristics of the subjects participating in this study are shown in Table 1. The mean age of women with PCOS was 33.08 ± 2.99 years and the median was 33 years. This shows the majority of patients who come for fertility treatment are still in middle reproductive age. Fertility level changes with age and a woman in her early to mid-20s has a 25-30% chance of conceiving every month. The age range that represents the highest fertility rate in women is typically observed in their twenties. However, as women advance into their thirties, and particularly after crossing the threshold of 35 years of age, the level of fertility and the quality of the female ovum tend to experience a decline. Hence, it is recommended to have family planning started earliest possible as a woman's fertility will decline by almost 60% by the age of 35. At 40 years of age, the chance of getting pregnant in any monthly menstrual cycle is around 5% (Deatsman et al. 2016).

The menstrual cycle provides information on whether a woman is fertile or not. About 30% of the infertility problem is due to ovulation problems associated with abnormal menstrual cycles (oligomenorrhea) or absence of menstruation (amenorrhea) (Lyngs et al. 2014). The findings showed that women with PCOS experience oligomenorrhea and amenorrhea at a higher rate of 30%, compared to women without PCOS (Table 1). In addition, in women primary infertility (never conceived) is more common than secondary infertility (incapability to conceive with at least one successful conception in the past) (Benksim et al. 2018). The study found that women with PCOS had a higher incidence of primary infertility compared to those without PCOS. This finding is supported by Deshpande and Gupta (2019), who found that primary infertility is more common than secondary infertility.

Meanwhile, the lipid profile and blood glucose from OGTT are depicted in Table 2. Lipid profile analysis demonstrated that PCOS women have significantly higher triglyceride levels ($p<0.05$) than non-PCOS women. This finding is in line with Panidis et al (2013), who reported that women suffering from PCOS and metabolic syndrome have notably higher BMI, blood pressure, fasting glucose, and triglyceride levels.

Disturbances in fertility status statusare significantly associated with PCOS. Ovulation problems occur when the hypothalamus fails to secrete gonadotropin-releasing hormone (GnRH), leading to a deficiency of FSH hormone (Allahbadia & Merchant 2011). Most women with PCOS have elevated LH and androgen levels, low FSH levels, and increased insulin levels (Haqq et al. 2014). However, as shown in Table 3, the FSH, LH, progesterone and testosterone levels in all women participating in this study were found to be within the normal range. In addition, women with PCOS were shown to have significantly low progesterone levels as compared with non-PCOS women. Progesterone deficiency could contribute to a high risk of infertility (Mirza, Patki & Pexman-Fieth 2016). On top of that, FSH levels were also found to be significantly lower in PCOS women compared to women without PCOS, further indicating the presence of ovulation problems as reflected by the reproductive hormone imbalance.

Determination of progesterone levels among PCOS women with oligomenorrhea and amenorrhea should be done in the middle of the luteal phase of the menstrual cycle (usually at day 21). During this phase, the secretion of progesterone and estradiol leads to the thickening of the uterine wall. When progesterone level exceeds 30 nmol/l during the luteal phase, it stimulates the endometrium to facilitate the successful implantation of an embryo within the uterus. At this point, progesterone will also respond to the pituitary gland and reduce FSH secretion. However, low progesterone secretion in PCOS women during the luteal phase causes ovulation failure (Sidika 2017). Our findings indicate that progesterone can be a reliable indicator for diagnosing ovulation problems in women with PCOS.

Hyperandrogenism can be determined clinically by the presence of hirsutism or biochemically with the evidence of increased serum testosterone. It is important to consider both clinical and biochemical evidence for accurate diagnosis. Nevertheless, in clinical practice, not all PCOS women have hirsutism (Aswini & Sabeena Jayapalan 2017). Table 4 shows clinical manifestation, hormonal, and biochemical parameters in PCOS women with and without obesity. In this study, only 30% of PCOS women were presented with hirsutism and interestingly there is 10% of non-PCOS women also presented with hirsutism. However, the presence of hirsutism is not significant among obese PCOS women compared to non-obese PCOS women. Hyperandrogenism is biochemically measured via testosterone levels and our study showed

that obese PCOS women have significantly higher levels of total testosterone compared to non-obese PCOS women. A previous study has also shown that women with PCOS who are obese tend to have elevated levels of testosterone hormone, including free testosterone, which may be associated with metabolic problems (Borruel et al. 2013).

Obesity contributes significantly to higher risk of cardiovascular diseases either directly or due to metabolic syndrome-related problems, which would indirectly promote the development of cardiovascular complications. According to the Women's Health U.S. Department of Health and Human Services (2015), women with PCOS have about four to seven times higher risk of heart attack than women without PCOS of the same age. Women with PCOS are also at a higher risk of getting high blood pressure and cardiovascular problems (Daniilidis & Dinas 2009). PCOS women are almost twice as likely to have coronary heart disease compared to women without PCOS with matching age and BMI (Randeva et al. 2012). Interestingly, this study also showed that systolic and diastolic blood pressure were significantly increased in obese PCOS women compared to non-obese PCOS women, indicating a risk of hypertension. Hypertension among women diagnosed with PCOS can potentially result in severe cardiovascular outcomes, namely atherosclerosis and myocardial infarction, thereby accentuating morbidity and mortality rates among these patients (Sangaraju et al. 2022).

Dyslipidemia is a significant prognostic risk factor for cardiovascular disease. Dyslipidemia is characterized by hypertriglyceridemia, low HDL levels and increased LDL levels (Dixon, Riche & Kelly 2021) and is frequently found in women with PCOS (Robert 2012). Our findings showed that serum triglyceride levels were significantly higher whereas HDL levels were significantly lower in obese women with PCOS compared to non-obese PCOS women (Table 4). Therefore, early screening for cardiovascular risk factors is essential to prevent the development and progression of cardiovascular diseases in obese women with PCOS. Women with high BMI are most likely to seek medical assistance for infertility treatment (Vahratian & Smith 2009), On the other hand, almost 90% to 95% of anovulatory women only discover they have PCOS after seeking infertility treatment (Teede, Deeks & Moran 2010). Our study agrees with the finding that BMI plays a critical role in the infertility of women with PCOS and maintaining BMI <30 kg/m^2 may increase the chance of conceiving.

Most studies reported a positive correlation between insulin resistance and BMI (Reyes et al. 2016). A study found that 30% of PCOS women have glucose intolerance while 4.5% to 10% were diagnosed with type 2 diabetes (Reyes et al. 2016). A previous study discovered that conversion rates from normal glucose tolerance to impaired glucose tolerance or type 2 diabetes mellitus were accelerated in women with PCOS compared with healthy women. Therefore, women with PCOS should be tested regularly for early detection of abnormal glucose tolerance (Celik et al. 2014). However, our study found no correlation between obesity and diabetes in PCOS women as shown in Table 4. Despite the risk of diabetes being greater in anovulatory women with PCOS and obese, taking reasonable precautions such as maintaining a healthy lifestyle and diet (Bee Koon Poh et al. 2013) and regular medical check-ups may help women with PCOS to prevent type 2 diabetes in the long term (Teede, Deeks & Moran 2010).

According to the Institute of Public Health (2020), the prevalence of obesity among adults in Malaysia stood at 30.4% in the year 2019, with a consistent increase in the rate observed every year. Obesity is commonly associated with ovulatory dysfunction, and our study showed that obesity in PCOS women was significantly associated with oligomenorrhea and amenorrhea. Broughton and Moley (2017) concluded that obese women experienced oligo-anovulation and had poor fertility outcomes. Table 5 shows that 44.1% of PCOS women were obese and this is likely to be a factor contributing to the problem of infertility among women with PCOS. Therefore, establishing significant indicators for infertility in PCOS women may assist in predicting their response to infertility treatment. In addition, women with high BMI were found to have a lower success rate in assisted reproductive treatment procedures and require extended ovarian stimulation (Pandey, Maheshwari & Bhattacharya 2010). On top of that, weight reduction and lifestyle modification may improve ovulation rate and fertility and decrease testosterone levels (Glintborg & Andersen 2010). Therefore, lifestyle modification and weight management seems to be more cost-effective in treating infertility among PCOS women (Palomba et al. 2018). In addition, 'fertility research among women' should focus on the better characterisation of obesity, including body fat distribution especially among PCOS women.

TABLE 1. Characteristic among PCOS and Non-PCOS subjects

	PCOS (n=84)	Non-PCOS (n=95)
Age (years)	33.08 ± 2.99	34.98± 3.03
Period cycle		
Normal	55 (70%)	86 (90%)
Oligo and amenorrhea	29 (30%)	9 (10%)
Infertility status		
Primary	72 (90%)	75 (80%)
Secondary	12 (10%)	20 (20%)
BMI (kg/m^2)	28.53 ± 5.58	25.51±5.63
Systolic blood pressure (mmHg)	124.75 ± 11.65	119.78±11.34
Diastolic blood pressure (mmHg)	79.96 ± 9.94	75.74±11.47
Non-hirsutism	62 (70%)	88 (90%)
Hirsutism	22 (30%)	7 (10%)

Data were presented as mean ± standard deviation (SD) / frequency (%)

TABLE 2. Lipid profile and glucose levels among PCOS and Non-PCOS subjects

	PCOS (n=84)	Non-PCOS (n=84)	*p*-value
Total cholesterol (mmol/L)	5.13 ± 1.02	5.07± 1.01	0.69
Triglyceride (mmol/L)	1.27 ± 0.93	0.98± 0.77	0.02*
HDL (mmol/L)	1.17 ± 0.34	1.55± 2.00	0.08
LDL (mmol/L)	3.29 ± 0.88	3.19± 0.92	0.44
Oral glucose tolerance test (OGTT)			
Fasting blood sugar (mmol/L)	5.11 ± 1.74	5.04± 1.94	0.79
2 h postprandial (mmol/L)	6.55 ± 2.93	5.73± 3.34	0.08

Significant at $p < 0.05$. Data were presented as mean ± standard deviation (SD). Results were analysed using an independent t-test
Reference range (mmol/l): Total cholesterol: <5.2; Triglyceride: <1.7; HDL: >1.68; LDL: <2.6; OGTT: 7.8-11.0 (Komathy et al. 2021)

TABLE 3. Reproductive hormonal profile among PCOS and Non-PCOS subjects

	PCOS (n=84)	Non-PCOS (n=84)	*p*-value
FSH (mIU/mL)	8.35 ± 5.48	5.38± 2.35	0.00*
LH (mIU/mL)	6.49 ± 2.85	7.00± 1.64	0.14
Progesterone (nmol/L)	5.70 ± 9.96	30.45± 25.07	0.00*
Testosterone (nmol/L)	1.37 ± 0.71	1.02± 2.48	0.25

Significant at $p < 0.05$. Data were presented as mean ± standard deviation (SD). Results were analysed using an independent t-test
Reference range: FSH (follicular phase): 3.5-13. mIU/mL;LH (follicular phase): 2.4-12.6 mIU/mL; Progesterone (luteal phase): 5.3-86.0 nmol/L; Testosterone: 0.22-29.0 nmol/L (Komathy et al. 2021)

TABLE 4. Clinical, hormonal, and biochemical parameters in PCOS women with and without obesity

	Obese ≥30 kg/m^2 (n=37)	Non-Obese <30 kg/m^2 (n=47)	*p*-value
Age (years)[a]	32.46±2.38	33.57±3.35	0.042*
Oligo and amenorrhea	18(62.1%)	11(37.9%)	0.016*
Infertility status[b]			0.012*
Primary infertility	35(49.3%)	36(50.7%)	
Secondary infertility	1(9.1%)	10(90.9%)	
BMI (kg/m^2)[a]	33.67 ± 2.97	24.49 ± 3.38	0.000*
Systolic blood pressure (mmHg)[a]	128.84 ± 11.31	121.53 ± 11.00	0.004*
Diastolic blood pressure (mmHg)[a]	83.53 ± 9.85	77.16 ± 9.17	0.003*
Non-Hirsutism	29 (78.4%)	33 (70.2%)	0.398
Hirsutism	8 (36.4%)	14 (29.8%)	
Lipid profile			
Total cholesterol (mmol/L)[a]	5.02±0.91	5.22±1.10	0.392
Triglyceride (mmol/L)[a]	1.51±1.16	1.09±0.644	0.039*
HDL (mmol/L)[a]	1.01±0.26	1.29±0.35	0.000*
LDL (mmol/L)[a]	3.35±0.85	3.25±0.90	0.593
Oral glucose tolerance test (OGTT)			
Fasting blood sugar (mmol/L)[a]	5.31±2.15	4.97±1.35	0.379
2 hours postprandial (mmol/L)[a]	7.21±3.19	6.06±2.64	0.075
FSH (mIU/mL)[a]	7.76±3.93	8.82±6.44	0.382
LH (mIU/mL)[a]	6.00±2.01	6.88±3.34	0.166
Progesterone (nmol/L)[a]	4.50±9.15	6.64±10.56	0.330
Testosterone (mmol/L)[a]	1.52±0.83	1.21±0.56	0.044*

Significant at $p < 0.05$. Data were presented as mean ± standard deviation (SD) / frequency (%). [a]: Independent t-test; [b]: Chi-square ($\chi 2$)

TABLE 5. Relationship of obesity status and PCOS status of subjects

	PCOS (n=84)	Non-PCOS (n=95)	$\chi 2$ (p-value)
Non-obese (< 30 kg/m^2)	47 (55.9%)	75 (78.9%)	0.01*
Obese (≥ 30 kg/m^2)	37 (44.1%)	20 (21.1%)	

Significant at $p < 0.05$. Data were presented as frequency (%)

CONCLUSION

In summary, this study showed that women with PCOS who are obese tend to experience more severe ovulatory dysfunction, dyslipidemia and higher blood pressure compared to their non-obese counterparts. By understanding the link between obesity and infertility among PCOS women, this provide valuable insights that can help in identifying infertility risk factors and to prompt early diagnosis and treatment.

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