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EVALUATION OF PCOS IN OBESE AND NON-OBESE INDIVIDUALS THROUGH ULTRASOUND

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Abstract:

Introduction: Polycystic ovary syndrome (PCOS) is a common hormonal disorder affecting women of reproductive age. It is characterized by irregular periods, excess androgen levels, and polycystic ovaries, often leading to fertility issues and metabolic complications

Aim of Study: To compare the ultrasound features of polycystic ovaries between obese and non-obese patients.

Methodology: A prospective observational design was conducted at Gilani Ultrasound Center in Lahore. A total of 100 participants were included using a non-probability purposive sampling technique. Data collection spanned a period of 9 months. The study included females of all ages, categorized into four groups: obese with PCOS, obese without PCOS, non-obese with PCOS, and non-obese without PCOS. Exclusion criteria encompassed females with treated PCOS, those undergoing infertility treatment, individuals with congenital anomalies, and those with ovarian abnormalities other than

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PCOS.

Results: This study on polycystic ovary syndrome (PCOS) included 126 participants with a mean age of 28.7 ± 4.6 years, of whom 66.7% were diagnosed with polycystic ovaries. The mean body mass index (BMI) was 27.6 ± 5.1, with a significant association found between PCOS and obesity ($p = 0.01$). Mean ovarian volumes were similar for both ovaries (left: 16.452 ± 8.2930 cm^3; right: 16.573 ± 8.2358 cm^3), which are higher than previously reported values. Clinically, PCOS was significantly associated with a string-like appearance of the ovaries ($p < 0.001$), diabetes ($p = 0.040$), hypertension ($p = 0.040$), amenorrhea ($p < 0.001$), and infertility ($p = 0.02$). Hormonal analyses showed significant links with thyroid dysfunction, progesterone, luteinizing hormone (LH), testosterone, and follicle-stimulating hormone (FSH).

Conclusion: These findings underscore the complex nature of PCOS and its associations with metabolic and hormonal disturbances, highlighting the need for a comprehensive approach to diagnosis and management

Keywords: Body Mass Index (BMI), Polycystic ovarian syndrome (PCOS), Metabolic Syndrome (METs), Infertility, Primary infertility.

Introduction:

PCOS is a prevalent disease that affects 4%-8% of females of childbearing age according to estimated prevalence data from the National Institute of health [1-5]. Several studies have discovered that the incidence of PCOS varies depending on the diagnostic criteria utilized. Based on studies, the prevalence assessed using the Rotterdam criteria is two to three times higher than the prevalence assessed using the NIH/NICHD criteria. [6-9].

However, the basic etiology of the polycystic ovarian syndrome is uncertain; important symptoms include insulin resistance, aberrant gonadotropin dynamics, and androgen excess. In comparison to insulin resistance, obesity affects roughly 65 to 70% of women with polycystic ovarian syndrome, and obesity is linked to insulin resistance. Insulin resistance is greater in women with polycystic ovary syndrome than in other women in the general population [10]. A past history of PCOS is another risk factor for the condition.

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PCOS is thought to be a heritable illness based on many instances in families [11, 12]. The significant frequency of polycystic ovary syndrome among first-degree relatives suggests that genetic factors are involved [13, 14]. Polycystic ovaries syndrome affects 85% of women who report with signs of androgen excess [15]. Hirsutism is the most prevalent clinical manifestation of hyperandrogenism, affecting more than 70% of women with PCOS [16]. Acne is less prevalent in PCOS and not as frequent, as hirsutism but it can also be a marker of hyperandrogenism around 15%–30% of adult women with PCOS have clinical presentation of acne [17]. More than 40% of women presented with acne were diagnosed with PCOS [18].

This study aimed to determine the relationship between specific ultrasound features and the severity of PCOS in obese and non obese patients, investigate the association between ultrasound characteristics and how PCOS effect both obese and non obese, assess the potential of using ultrasound features. By addressing these gaps, the research aimed to contribute to better understanding of PCOS.

Aim:

To compare the ultrasound features of polycystic ovaries between obese and non-obese patients.

Methodology:

A prospective observational design was conducted at Gilani Ultrasound Center in Lahore. A total of 100 participants were included using a non-probability purposive sampling technique. Data collection spanned a period of 9 months. The study included females of all ages, categorized into four groups: obese with PCOS, obese without PCOS, non-obese with PCOS, and non-obese without PCOS. Exclusion criteria involved females with treated PCOS, those undergoing infertility treatment, individuals with congenital anomalies, and those with ovarian abnormalities other than PCOS.

Results:

The study included 126 participants with a mean age of 28.7 ± 4.6 years, ranging from 20

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to 36 years. Of these, 84 (66.7%) had polycystic ovaries, while 42 (33.3%) were healthy controls. The participants were almost evenly split between married (46.8%) and single (53.2%). The mean BMI was 27.6 ± 5.1, with participants equally distributed among normal, overweight, and obese categories (33.3% each). Other notable characteristics included hirsutism (38.9%), acne (28.6%), diabetes (50.8%), hypertension (19.8%), amenorrhea (50%), and infertility (41.3%).

Within-group analysis showed that in the PCOS group, there was a significant association between PCOS and obesity ($p = 0.01$), while no significant association was found in the non-obese group ($p = 0.98$). The mean BMI for the normal weight group was 22.4 ± 0.01, for the overweight group 28.10 ± 1.3, and for the obese group 33.26 ± 2.25. The mean ovarian volumes were similar for both left (16.452 ± 8.2930 cm^3) and right (16.573 ± 8.2358 cm^3) ovaries.

Between-group analysis revealed several significant associations with PCOS. There was a strong link between PCOS and string-like appearance of ovaries ($p < 0.001$), diabetes ($p = 0.040$), hypertension ($p = 0.040$), amenorrhea ($p < 0.001$), and infertility ($p = 0.02$). Hormonal analyses showed significant associations between PCOS and thyroid dysfunction ($p < 0.001$), progesterone levels ($p < 0.001$), LH levels ($p = 0.030$), testosterone levels ($p = 0.001$), and FSH levels ($p = 0.022$). However, no significant associations were found between PCOS and marital status, estrogen levels, or prolactin levels.

Table 1: Group Statistics BMI

	Normal BMI group	**Overweight group**	**Obese group**
Mean BMI	22.4± 0.01	28.10± 1.3	33.26± 2.25

The mean + SD BMI of normal group was 22.4± 0.01, mean + SD BMI of Overweight

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group was 28.10± 1.3 and mean + SD BMI of obese group was 33.26± 2.25 (Table 1).

Table 2: Statistics of Left ovarian volume and Right ovarian volume

	Left Ovary Volume	Right ovary volume
Mean	16.452	16.573
Std. Error of Mean	.7388	.7337
Std. Deviation	8.2930	8.2358
Variance	68.773	67.829
Minimum	5.1	4.7
Maximum	32.1	30.5

The mean $\pm$ SD ovarian volume on left side was 16.45 $\pm$ 8.2 and on right side 16.5 $\pm$ 8.2 (Table 2).

Discussion:

Polycystic ovary syndrome (PCOS) is the most common endocrine and metabolic disorder in women with a prevalence of up to 17.8%, and is characterized by hyperandrogenism, irregular cycles and polycystic ovaries. Obesity and an aberrant metabolic profile are common in women with PCOS, and 50- 70% of them are insulin resistant. Most women with PCOS are able to compensate for their insulin resistance (IR), but a large proportion of them have altered beta-cell function causing glucose intolerance, which increases the risk of developing type 2 diabetes (T2D), independently of body mass index (BMI) and age. Further, women with PCOS have an increased risk of developing dyslipidemia and hypertension with an increased prevalence of metabolic syndrome. The etiology of PCOS is unclear, but it is thought to be multifactorial. There is a strong

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association between hyperinsulinemia and hyperandrogenism (HA) in PCOS, but the mechanisms behind their relationship with PCOS are not fully understood [19].

Sipahi et al. (2019) investigated ultrasound findings that could predict MetS in PCOS patients. They found that 15.6% of PCOS patients had MetS, with a higher mean ovarian volume (OV) in MetS patients (11.7 mL) compared to non-MetS patients (9.6 mL). The study determined an optimal OV cut-off of 9.2 mL for predicting MetS, with 80% sensitivity and 50.6% specificity. This suggests that PCOS patients with higher OV values may have an increased risk of developing MetS [20].

Memon et al. (2020) conducted a cross-sectional study on females aged 16-40 years, finding a PCOS prevalence of 48.5% using Rotterdam criteria. PCOS patients showed higher BMI, waist circumference, and systolic blood pressure compared to non-PCOS participants. The study highlighted that PCOS patients exhibit hormonal and metabolic abnormalities, as well as menstrual irregularities, regardless of their weight [21].

Odera O (2015) studied the prevalence of PCOS among women with amenorrhea and oligomenorrhea at Kenyatta National Hospital. Using Rotterdam criteria, 37.4% of participants were diagnosed with PCOS. The mean age of PCOS patients was 25.9 years, with a mean BMI of 25.9. This study emphasized that PCOS should be a primary consideration when evaluating women with oligomenorrhea or amenorrhea [22].

Aalei B and Naderi T (2014) investigated PCOS characteristics and their interrelationships in Kerman. They found oligomenorrhea and hirsutism to be the most frequent complaints among PCOS patients. The study revealed significant relationships between various hormonal levels and clinical features, such as LH/FSH > 2 and hirsutism, and hyperprolactinemia and galactorrhea. However, no significant relationships were found between hormonal status and ultrasound or clinical features [23].

Chen et al. (2008) investigated OV as a diagnostic criterion for Chinese adolescents with PCOS. They found that mean and maximum OV were significantly larger in PCOS patients compared to controls. The study determined optimal thresholds for mean OV (6.74 cm^3) and maximum OV (7.82 cm^3) for diagnosing PCOS in Chinese adolescents,

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which were lower than the 10 cm³ threshold proposed by the Rotterdam consensus [24].

Chun et al. (2019) examined differences in ovarian size between the right and left ovaries in Korean women with PCOS. They found that the right ovary had significantly higher antral follicle count (26.75 vs 23.98) and larger volume (11.06 cm³ vs 9.12 cm³) compared to the left ovary [25].

Lee NS et al. (2021) explored the relationship between OV, anthropometry, and hormonal levels in PCOS patients. They found that mean OV was significantly larger in the PCOS group (7.65 cm³) compared to the non-PCOS group (6.08 cm³). OV positively correlated with serum anti-Müllerian hormone (AMH) and luteinizing hormone (LH) levels [26].

Han et al. (2017) studied OV and follicle number (FN) in Korean women with PCOS. They reported mean OVs of 7.9 cm³ (right) and 6.7 cm³ (left), which were smaller than those observed in other ethnic groups. Serum AMH and testosterone levels were found to be good markers for PCOS diagnosis in Korean women [27].

Yang et al. (2015) investigated the relationship between iron status, obesity, and ovarian reserve in women with PCOS. They found that obese women with PCOS had higher ferritin levels but lower AMH levels compared to non-obese women with PCOS. Elevated ferritin levels and obesity were negatively associated with ovarian volume and AMH levels, respectively [28].

The results from this study are largely in concordance with the findings from the previously mentioned studies, particularly in several key areas. The mean ovarian volumes reported (16.452 ± 8.2930 cm³ for left and 16.573 ± 8.2358 cm³ for right ovaries) are significantly higher than the thresholds proposed in earlier studies. Chen et al [24]. (2008) suggested a threshold of 7.82 cm³ for maximum ovarian volume, while Lee NS et al [26]. (2021) reported a mean ovarian volume of 7.65 cm³ in PCOS patients. This aligns with the consistent finding that PCOS patients tend to have larger ovarian volumes compared to healthy controls.

The significant association between PCOS and obesity ($p = 0.01$) in this study corroborates findings from Yang et al [28]. (2015), who reported that obese women with

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PCOS had different hormonal profiles compared to non-obese women with PCOS5. This reinforces the importance of considering BMI in PCOS diagnosis and management. The significant associations found between PCOS and various hormonal levels (LH, FSH, testosterone, progesterone) align with the hormonal abnormalities typically observed in PCOS patients, as mentioned in several of the cited studies.

The high prevalence of hirsutism (38.9%), acne (28.6%), amenorrhea (50%), and infertility (41.3%) in the PCOS group is consistent with the common symptoms of PCOS described in the NHS and WHO fact sheets. The strong associations between PCOS and diabetes ($p = 0.040$) and hypertension ($p = 0.040$) support the findings from previous studies that PCOS patients are at higher risk for metabolic syndrome and cardiovascular complications. The significant association between PCOS and the string-like appearance of ovaries ($p < 0.001$) aligns with the ultrasound criteria for polycystic ovaries mentioned in several studies.

Conclusion:

In conclusion, polycystic ovary syndrome (PCOS) is a complex endocrine disorder characterized by a diverse array of hormonal imbalances, metabolic disturbances, and distinctive ovarian morphology. The syndrome's heterogeneity, manifesting in various phenotypes and associated health risks, underscores the need for a comprehensive approach to diagnosis and management

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CASE 1:

Ultrasound images of 25 year-old obese unmarried females with polycystic ovaries.

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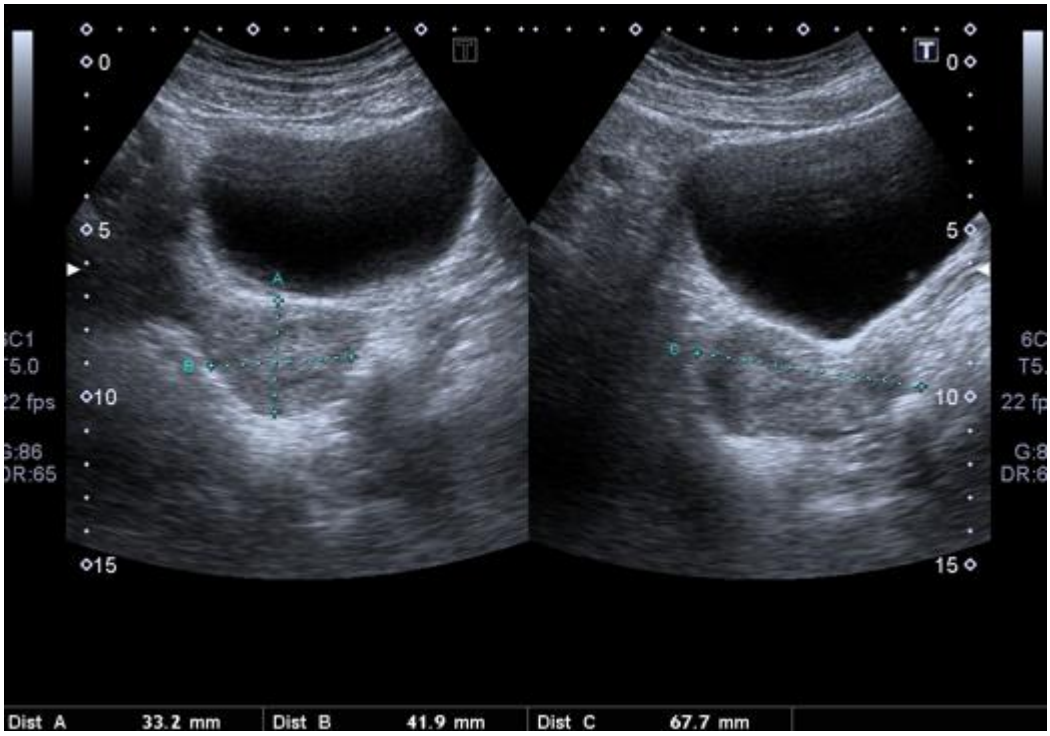

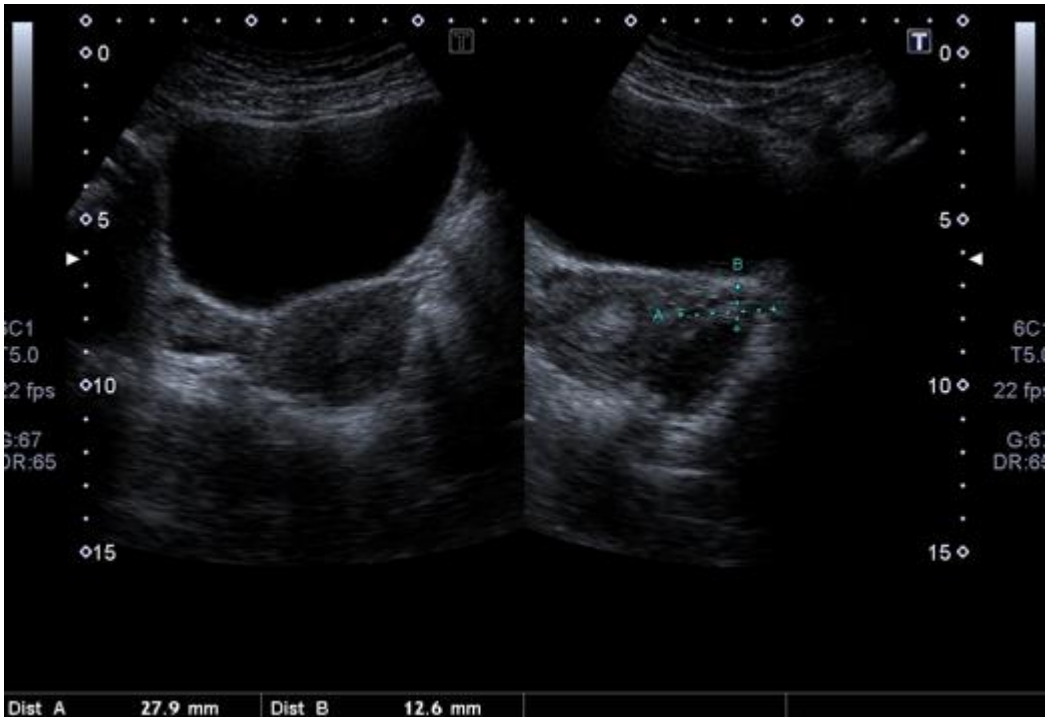

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CASE 2: Ultrasound images of 27-year-old unmarried females with polycystic ovaries.

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