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CORRELATION BETWEEN OVARIAN ARTERY DOPPLER INDICES AND ULTRASOUND FINDINGS IN PCOS PATIENTS

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Abstract

This study, conducted at the University of Lahore Teaching Hospital from July 15, 2024, to February 21, 2025, assessed the prevalence of abnormal ovarian artery Doppler indices in 210 women aged 20–45 years with polycystic ovarian syndrome (PCOS). Using ultrasound, Pulsatility Index (PI) and Resistive Index (RI) values were measured, with abnormal ranges defined as PI <2.01 or >4.30 and RI <0.80 or >0.95. Abnormal Doppler indices were observed in 73.81% of participants. A significant association was found between BMI and abnormal Doppler findings ($p = 0.022$), with a higher prevalence in those with BMI <30 kg/m². No significant difference was noted by residence (urban vs. rural; $p = 0.30$). The findings suggest a high prevalence of disordered ovarian artery Doppler indices in women with PCOS, supporting their potential role in early diagnosis and intervention to reduce long-term complications.

INTRODUCTION

Polycystic ovary syndrome affects around one in fifteen women globally. In addition to increased androgen secretion or activity, which is the main endocrine disturbance, many women also have aberrant insulin activity(Adali et al., 2009). Polycystic ovarian syndrome affects several bodily systems, leading to problems with menstruation, infertility, hirsutism, acne, obesity, and metabolic syndrome, among other health issues. This illness has been linked to an increased risk of type 2 diabetes in women, and its association with an increased risk of cardiovascular disease is still up for dispute. On ultrasound scans, 20 to 30 percent of women in their reproductive age group exhibit radiological signs related to polycystic ovaries(Azziz et al., 2016). The primary cause of ovarian dysfunction, which is linked to a higher incidence of infertility is PCOS. Hormonal testing is the primary method used to identify polycystic ovaries. Measurements of thyroid-stimulating hormone (TSH), prolactin (PL) blood serum levels, and gonadal hormones such as FSH and LH (follicle stimulating hormone and luteinizing hormone) are among the primary screening procedures. When assessing patients with PCOS, the FSH to LH ratio is most useful(*Baruah et al., 2009*)

According to the 2003 Rotterdam criteria, the diagnosis is advised and supported by two of the three criteria: polycystic ovarian morphology, hyperandrogenism, and irregular cycles. Because of its low specificity, ovarian morphology is excluded from the criteria for hyperandrogenism and irregular cycles in teenagers(*Battaglia et al., 2000*).

Clinical characteristics are varied, with symptoms usually beginning in infancy and then changing throughout adolescence and adulthood. The diagnostic criteria provide four phenotypes. Medical management and lifestyle changes are part of the treatment. In order to avoid gaining too much weight, lifestyle optimization involves eating a well-

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balanced diet and exercising often(Bostanci et al., 2013). Medical care options include the use of metformin to enhance metabolic characteristics and insulin resistance, the combination oral contraceptive pill to regulate the menstrual cycle and hyperandrogenism, and anti-androgens if necessary for refractory hyperandrogenism. The primary goal of this study was to assess Doppler ultrasonography as a non-invasive, accessible, affordable, and time-efficient modality and its critical role in diagnosing polycystic ovaries. I wanted to employ ultrasound Doppler of ovarian artery PI and RI to identify PCOS cases that were correctly identified so that, if approved, this may be used on a regular basis in our clinic[8].

Material & Method

After receiving clearance from the institutional ethical review committee, the study was carried out at the University of Lahore Teaching Hospital, Lahore, Pakistan between July 15, 2024, and February 21, 2025. A 95% confidence level, a 6% margin of error, and an incidence rate of disordered ovarian artery Doppler indices in women with polycystic ovarian syndrome of 85.4% were used to calculate the sample size. Using non-probability sequential sampling, 210 patients who met the inclusion criteria with a mean age of 32.00 ± 5.00 years (range from 20 to 45 years) were added to the research. All women with polycystic ovarian syndrome, as defined by operative definition, who are between the ages of 18 and 40 and who are married or single, must meet the inclusion criteria. Written permission was acquired prior to their inclusion, and all participants were briefed about the study's specifics and methodology. Following written informed permission, 210 patients Mean-SD=27.33-4.91kh/m^2 who satisfied the inclusion criteria were recruited. The ovarian arteries were identified by ultrasound in the vicinity of the ovarian hilum, and an average of three waveforms was recorded using Pulsed Doppler. Pulsatility index (PI) and resistive index (RI), two Doppler indices of the ovarian arteries, were examined; results that deviated from the typical ranges (PI: 2.01–4.30, RI: 0.80–0.95) were deemed abnormal. Age, BMI, location of residence (rural vs. urban), PCOS duration, and Doppler indices were among the data gathered and recorded in a standardized proforma. Statistical analysis was conducted using SPSS version 25.0, which computed the mean and standard deviation for continuous variables and displayed frequencies and percentages for categorical variables such as marital status and anomalies in the Doppler index. A chi square test was used to examine the impact of effect modifiers on disordered ovarian artery Doppler indices after stratification was used to adjust for factors such age, body mass index, marital status (married or unmarried), length of PCOS, and location of residence (rural versus urban). A P-value of 0.05 was regarded as significant.

Results:

With a mean age of 35.00 to 5.00 years, the age range in this research was 20 to 45 years. The majority of patients, 113 (53.81%), were in the 20–30 age range. PCOS was present for an average of 3.64 to 1.59 years. The mean BMI was between 27.33 and 4.91 kg/m2(Table 1). According to (Fig. 1), 43 (20.50%) were single and 167 (79.52%) were married. Patients were distributed by place of residence, with 126 patients (60.0%) residing in cities and 84 patients (40-.0%) in rural regions (Table 2).

Table 1: Frequency of Patents according to BMI(n=210)

BMI (kg/m^2)	No. of Patients	Percentage
<30	140	66.67%
>30	70	33.34%
Total	**210**	**100%**

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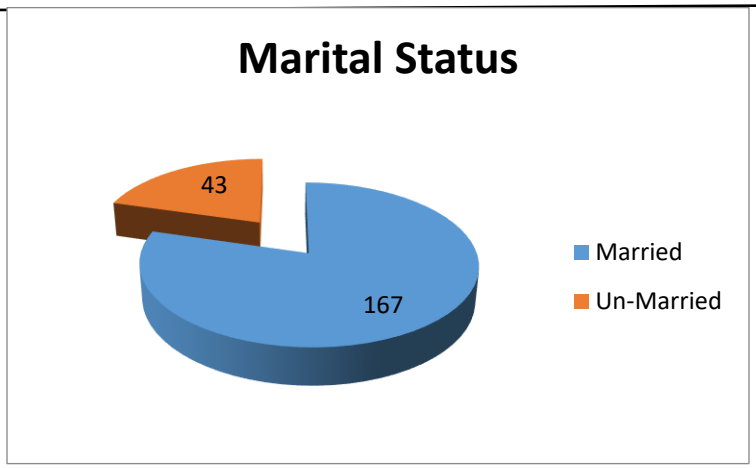

Fig 1: Frequency of patients according to Marital status (n=210)

Residence	No.of patients	Percentage
Urban	126	60.0%
Rural	84	40.0%
Total	**210**	**100%**

Table 2:
Frequency of Patients according to Residence

Abnormal ovarian artery Doppler values in patients with PCOS was found in 155(73.81%) as shows in figure 2.

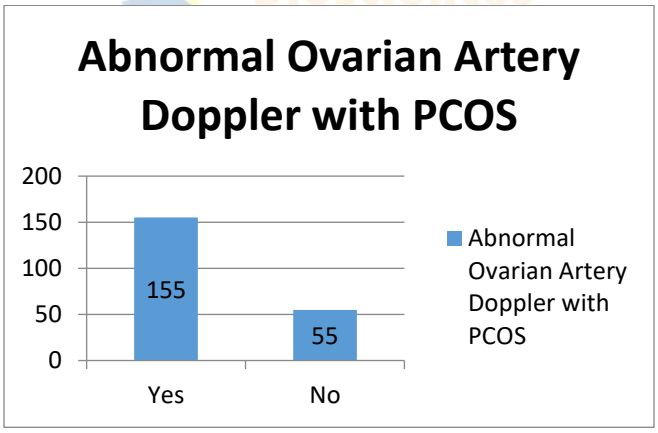

Fig 2: Frequency of Patients with PCOS

Doppler indices of disordered ovarian arteries were stratified according to BMI (P-value = 0.022) (Table 3), revealing that 107 patients with a BMI below 30 kg/m2 were deranged indices and 35 patients were normal Doppler artery indices. Of the patients with a BMI more than 30 kg/m2, 40 were disordered artery indices, whereas only 28 were normal Doppler artery indices.

BMI	Abnormal Uterine artery Doppler Indices		p-value
	Yes	No	
<30	107	35	0.022
>30	40	28	

Frontiers in Biosciences
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Volume 2, Issue 2, 2025

Table 3: Abnormal Ovarian artery indices with BMI

Ovarian artery derangement stratification 46 patients were normal Doppler artery indices, but 80 patients who resided in rural areas were disordered indices according to Doppler indices by place of residence (P-value = 0.30). There were 60 patients with disordered artery indices and only 24 patients with normal Doppler artery indices among the urban patients (Tab.4).

Residence	Abnormal Uterine artery Doppler Indices		p-value
	Yes	No	
Rural	80	46	0.30
Urban	60	24	

Table 4: Abnormal Ovarian artery indices with Residence

Discussion

Ultrasound assessment of ovarian irregularities is recognized as the gold standard for defining polycystic ovary syndrome (PCO) and as being crucial in the diagnosis of PCOS patients. Women who have an aberrant FSH to LH ratio and the clinical symptoms of polycystic ovary syndrome have a structural ovarian phenotype known as polycystic ovary syndrome(Fauser et al., 2012). Nevertheless, not every woman with polycystic ovaries would exhibit every single clinical and biochemical characteristic that would classify them as a patient with polycystic ovarian syndrome. The use of transvaginal Doppler sonography, or TVS, for pelvic exams has greatly aided in accurate ultrasonography diagnosis(Ganesh et al., 2020).

Additionally, it has revealed a wealth of new information on the pathophysiology and anatomy of the female pelvic blood flow mechanism.[12].It has been shown that significant changes in ovarian vascularization occur at the level of the ovarian arteries within the area of the ovarian hilum in individuals who present with polycystic ovarian syndrome. Using color Doppler systems analysis, two or three-dimensional nultrasonography has validated these theories(Hamed et al., 2024).

In 155 individuals (73.81%) with polycystic ovarian syndrome, the incidence of aberrant ovarian artery Doppler indices was found. In 2019, Khan A conducted a research which revealed that 85.4% of women with PCOS had aberrant ovarian artery Doppler indices, including RI and PI(Hart et al., 2004).

In individuals with PCOS, evaluation using color Doppler angiography and three-dimensional ultrasonography assumes that uterine artery Doppler indices, comprising both the pulsatility index (PI) and resistive index (RI), are above the 95th *percentile* (Khan et al., 2019).

- According to a 2009 study by Mala YM on the link between insulin sensitivity, sex hormone levels, and ovarian stromal blood flows, women with PCOS were mean uterine artery PI and RI values below the 50th percentile(Mala et al., 2009).
- Women with PCOS exhibited a considerably reduced ovarian artery blood flow impedance, meaning that their ovarian RI was much lower (0.52–0.09 in cases vs 0.71–0.08 in controls) (McCartney & Marshall, 2016)

. According to earlier reports by Aleem and Predanic (1996), Bostanci et al. (2013)(ovarian RI 0.56–0.05), and Mohammed et al. (2003) (ovarian RI 0.55–0.16 in cases and 0.78–0.06 in controls).In one research, the ovarian stromal artery's PI was significantly reduced (1.15 to 0.45 in the case and 4.2 to 0.78 in the control) (Meier, 2018)

(Mohamed & Ebrahim, 2012).

According to Adali et al. (2009) (Ovarian PI, 1.40 – 0.63 in cases and 2.90 – 0.20 in controls) and Dhingra (0.96 + 0.19 in cases and 2.6 + 0.26 in

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controls), individuals with PCOS had higher blood flow in the ovarian stromal artery as compared to the control group. The PCOS group's uterine artery PI was higher than the 95th percentile, according to a comparison between the PCOS and PCO groups. As previously documented25, there are strong connections between elevated uterine artery PI and aberrant DHEAS and AS levels in the PCOS group*(Rojas et al., 2014)*.

Patients with PCOS are more likely to develop atherosclerosis, which thickens and stiffens the walls of vessels and raises systemic vascular resistance. The risk of myocardial infarction and coronary artery disease are important long-term risk factors to take into account in patients with PCOS.The use of Doppler ultrasonography parameters in women with PCO alone and PCOS is not well studied in the literature, despite the fact that this information is essential for understanding the primary mechanism of PCOS[22].

Conclusion

According to the study's findings, women with polycystic ovarian syndrome is a notably high prevalence of abnormal ovarian artery Doppler indices. Therefore, we advise using aberrant ovarian artery Doppler indices to diagnose polycystic ovarian syndrome early and promptly so that appropriate lifestyle modifications or medication may be taken to lower morbidity.

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