OPEN ACCESS

Saudi Journal of Medicine
Abbreviated Key Title: Saudi J Med
ISSN 2518-3389 (Print) |ISSN 2518-3397 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Review Article

The Chances of Infertility in a Patient Presenting with PCOS in Childbearing Age

Junaid Yousaf[1*], Syeda Khadija[2], Nosheen Arshad[3], Muhammad Rohail Amjad[4], Javeria Gulzar[4], Asad Ullah[4]

[1]University Institute of Radiological Sciences and Medical Imaging Technology, The University of Lahore, Lahore, Pakistan
[2]Assistant Professor Department of Allied Health Sciences, The University of Lahore, Pakistan
[3]Lecturer Department of Radiological Sciences and Medical Imaging technology, The University of Lahore, Gujrat, Pakistan
[4]Medical Imaging Doctor Department of Radiological Sciences and Medical Imaging Technology, The University of Lahore, Lahore Pakistan

DOI: 10.36348/sjm.2022.v07i01.003 | **Received:** 15.12.2021 | **Accepted:** 11.01.2022 | **Published:** 17.01.2022

***Corresponding Author:** Junaid Yousaf
University Institute of Radiological Sciences and Medical Imaging Technology, The University of Lahore, Lahore, Pakistan

Abstract

Background: PCOS is a leading cause of infertility globally. Polycystic ovarian syndrome (PCOS) is a complicated disease pigeon-holed by high testosterone levels, irregular menstruation, and/or tiny cysts on one or both ovaries. The disease can be anatomical (polycystic ovaries) or biochemical (hyperandrogenemia). Follicular developmental inhibition, ovarian microcysts, anovulation, and menstrual irregularities are all symptoms of hyperandrogenism, a clinical characteristic of PCOS. ***Objective:*** The objective is to determine the chances of infertility in a patient presenting with PCOS in childbearing age. ***Methodology:*** Data was collected from Medline, PubMed, ScienceDirect, and the Obsgyne online library for papers published between 2005 and 2021 using specified MeSH keywords in this systematic review. We examined 10 cross-sectional type analytical studies for data collecting in this systematic work. ***Results*:** 10 studies conducted between the years 2005 to 2021 were included in this systematic review. There were 3900 women in the study, ranging in age from 10 to 40. The 2nd most prevalent etiology of feminine factor-related infertility was determined to be PCOS in this investigation. In 70% of cases of anovulatory infertility, PCOS is the reason. As a result, it's critical to screen for and treat it in primary care settings. Ultrasound is the best modality for the detection of PCOS. PCOS has been identified using ultrasonography methods in several investigations. The basal follicle counts by TVS might be included among sonographic findings in the diagnosis of PCOS, with basal follicle counts of more than 10 is a PCOS criterion. Slightly swollen stroma, hypertrophy, enhanced ovarian mass and thickness, and the percentage of ovarian stroma to total ovary area are among the other characteristics. ***Conclusion:*** From this systematic review we concluded that infertility is most commonly caused by PCOS. In 70% of cases of anovulatory infertility, PCOS is the reason. Despite the fact that TVS is the gold standard for detecting ovarian abnormalities in young girls we examine trans-abdominally by using a high-frequency probe. Ultrasonography results for PCOS of the periphery cyst patterns include a considerable variety of small subcapsular follicles (10 follicles with a maximal diameter of 8 millimeter), enhanced ovarian volume (12.3 millimeter), and increased echo density of the ovarian stroma.

Keywords: Anovulatory infertility, Polycystic Ovarian Syndrome, Hyperandrogenaemia, Hirsutism, Oligomenorrhea, Ultrasound.

INTRODUCTION

Infertility is a global issue with significant social and emotional consequences for those affected. According to a 2004 WHO-DHS Comparative Report, over Primary or secondary infertility affected 186 million ever-married women in developing nations (except China). Even though Pakistan is one of the world's most populous countries, with a population growth rate at about 2 percent, Pakistan also has a higher incidence of infertility (21.9 percent); the incidence of infertility in Pakistan is 21.9 percent, with 3.5 percent primary and 18.4 percent secondary [1]. Infertility in females can be caused by a variety of factors. Polycystic ovarian syndrome, which is frequent in young females and causes ovulatory infertility in 70 percent of cases, caused by a variety of factors, the most frequent of which is treatable. The World Health

Organization categorization system provides a helpful framework for diagnosing and treating diseases. The utmost frequent cause of oligo ovulation and anovulation is a polycystic ovarian syndrome [2].

PCOS is most common hormonal disorder among females of childbearing age, which is also anovulation is the major risk factor for infertility. According to several research, PCOS affects 5-10 percent of women. And Ashtyn and Leventhal characterized the typical type of PCOS for the first time in 1935 [3]. Several variables appear to have had a role in its evolution. Perhaps the condition is a hereditary tendency in the individual, and with environmental and lifestyle factors exacerbating the symptoms [4]. PCOS symptoms include amenorrhoea or oligo amenorrhoea, acne, reproductive problems, obesity, hirsutism, and androgenic alopecia, which affect both the endocrine and gynecologic systems [5]. PCOS is not only a condition that affects fertility and adolescence; it may have a wide range of consequences on a person's life. Amenorrhea, oligomenorrhea, hirsutism, obesity, and acne are the most common consequences of the illness in adolescence. Infertility and irregular ovulation are the most common complaints among patients in their reproductive years. The difficulties of adolescence are still there throughout this time. Before the age of 40, PCOS affects 30–40percent of females who have diabetes or have reduced glucose tolerance. PCOS is a complex condition characterized by elevated ovarian androgens, as well as possible adrenal and metabolic problems [3]. Most PCOS individuals only have a couple of clinical signs. The most commonly diagnosed findings are month-to-month problems, which generally begins at or shortly after menarche and can manifest as oligomenorrhea, amenorrhea, or poly menorrhea, as well as a regular menstrual cycle [6, 7]. Hair growth, pimple, and androgenic alopecia are all signs of clinical hyperandrogenism, as well as the occurrence of masculine features, which affects 66 percent of teenagers with PCOS [8].

PCOS is generally linked with hormonal irregularities due to alterations in luteinizing hormone, prolactin, oestrogen, and serum androgens concentrations. There are no single diagnostic criteria for this condition. Rather, it is identified using a mix of clinical, laboratory, and ultrasound ovarian morphology, although three criteria are frequently employed for its diagnosis [9]. According to 1st definition which was recommended by the NIH in 1990, said it included clinical and biochemical signs of hyperandrogenism or hyperandrogenemia, as well as clinical symptoms of ovulation disorder such as amenorrhea, oligomenorrhea, or infertility in the absence of non-classical adrenal hyperplasia [8, 10]. The Fertility and Embryology Association of Europe and the American Fertility Society presented the second definition (Rotterdam) at the Rotterdam conference in 2003, It acknowledged two of the three criteria listed below as diagnostic criteria for PCOS [11]. Oligo-ovulation is defined by monthly cycles of more than forty days or anovulation of less than 9 times annually. Clinical hyperandrogenism and biochemical hyperandrogenism are two different types of hyperandrogenism.

When ovarian volume greater than 10 millimeter and more than 12 follicles ranging in size from 2 to 9 millimeter are shown on pelvic ultrasonography, polycystic ovaries are present [12].

The Androgen Excess Society (AES) published the third and latest definition in 2006, which included hyperandrogenism, anovulation, and oligoovulation, and a rise in androgen levels or associated diseases in the diagnosis of PCOS.

PCOS has been identified only using ultrasound techniques in certain investigations. The basal follicle counts by TVS might be included among sonographic findings in the diagnosis of PCOS, with basal follicle counts of more than 10 is a PCOS criterion. Slightly swollen stroma, hypertrophy, enhanced ovarian mass and thickness, and the percentage of ovarian stroma to total ovary area are among the other characteristics [9].

METHOD

Search Strategy

Data was collected from Medline, PubMed, ScienceDirect, and the Obsgyne online library for papers published between 2005 and 2021 using specified MeSH keywords in this systematic review.

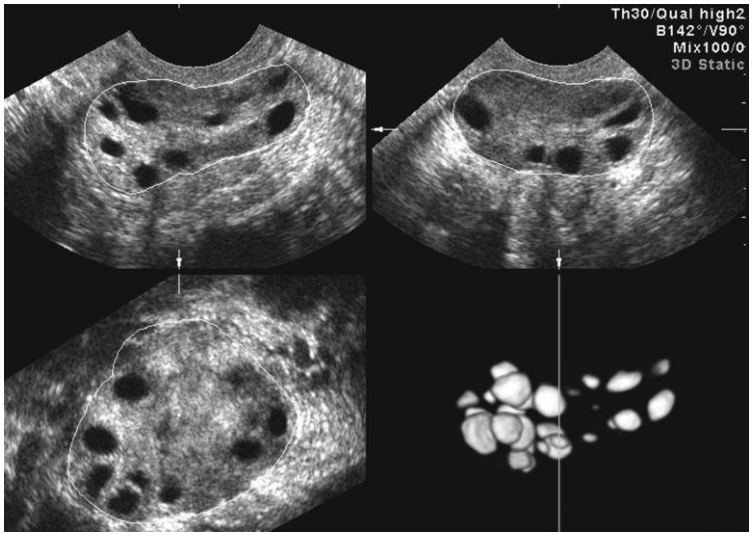
Study Selection

We extract data from 10 original articles. In this systematic article we reviewed 10 cross-sectional style analytical studies for the collection of data.

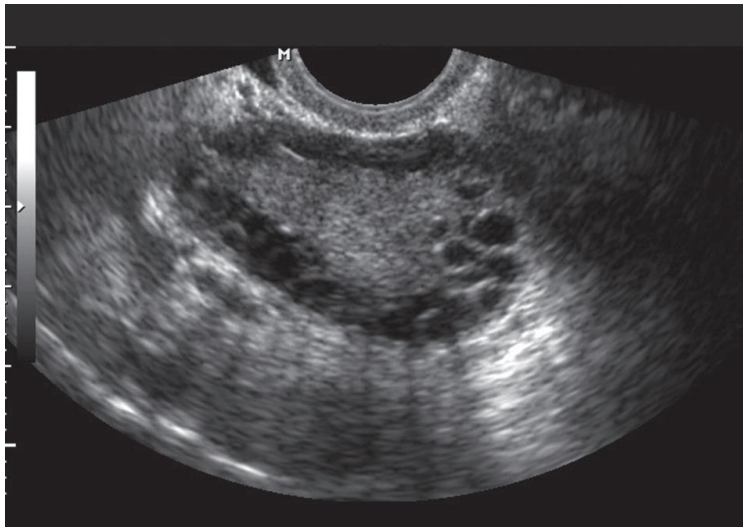
RESULT

10 studies conducted between the years 2005 to 2021 were included in this systematic review. There were 3900 women in the study, ranging in age from 10 to 40. The 2nd most prevalent etiology of feminine factor-related infertility was determined to be PCOS in this investigation. In 70% of cases of anovulatory infertility, PCOS is the reason. As a result, it's critical to screen for and treat it in primary care settings. Ultrasound is the best modality for the detection of PCOS. PCOS has been identified using ultrasonography methods in several investigations. The basal follicle counts by TVS might be included among sonographic findings in the diagnosis of PCOS, with basal follicle counts of more than 10 is a PCOS criterion. Slightly swollen stroma, hypertrophy, enhanced ovarian mass and thickness, and the percentage of ovarian stroma to total ovary area are among the other characteristics.

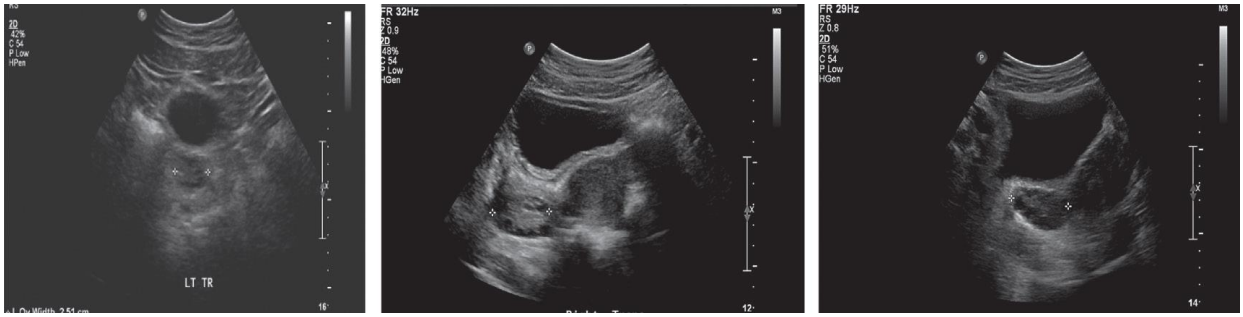
Images



The rendered inversion mode accentuates hypoechoic features such as follicles in this multiplanar depiction of a polycystic ovary [23]



An ultrasound picture of a polycystic ovary in a person. Ovarian cysts appear as black rings in the ovary's perimeter [24]



Transabdominal transverse ultrasound images (A) normal ovary. (B) Right ovary in a non-obese adolescent with PCOS (ovarian volume 13 mL). Several small follicles are peripherally located, without evidence of a dominant follicle. (C) Right ovary in an obese PCOS adolescent (ovarian volume 17 mL). Several small follicles are also peripherally located. Body habitus limits the quality of the image [25]

DISCUSSION

Fauzia Haq *et al.,* (2018) conducted a study on "Infertile women with polycystic ovarian syndrome; clinical, biochemical, and ultrasonographic characteristics". The clinical characteristics of patients attending infertility clinics at Karachi's Concept Fertility Centre and Aga Khan University Hospital were investigated. Measurements of serum prolactin, fasting

serum insulin, LH, serum testosterone, and FSH were obtained on day 2 to give a comprehensive biochemical evaluation. On the data collection form, these findings were noted. The morphological appearance of the ovaries was checked with ultrasonography using transvaginal ultrasound. PCOS-related epidemiological parameters were examined in a total of 508 individuals. In the infertility clinic, 17.6% of patients had PCOS, with a high prevalence of obesity (68.5%) and hyperinsulinemia (59 percent). Above a BMI of 30, the highest prevalence of aberrant clinical and biochemical characteristics was seen [13].

K. F. Michelmore *et al*., (2003) conducted a study on "Young women with polycystic ovaries and accompanying clinical and biochemical aspects". In the 224 women who had an ultrasound scan, polycystic ovarian morphology was found in 74 (33 percent, 95 percent CI = 27–39 percent). Women with polycystic ovaries had 20 percent more irregular menstruation than women with normal ovaries among nonusers of hormonal contraception (P = 0.07). Polycystic ovaries vs. normal ovaries in women, there were no significant changes in acne, hirsutism, BMI, or body fat %. Women with polycystic ovaries exhibited greater total serum testosterone concentrations (P = 0.03), according to biochemical analysis. Depending on whatever criteria were used to identify PCOS, the incidence of the syndrome in this age range might be as low as 8 percent or as high as 26 percent. Subgroup studies of women based on ovarian morphology and PCOS features indicated a higher mean BMI in women with PCOS, In comparison to women with normal ovaries, polycystic ovary and PCOS patients had lower fasting insulin values and improved insulin sensitivity. In this age group, polycystic ovaries are common. Although they aren't always linked to other symptoms. Depending on the criteria used, the prevalence of polycystic ovarian syndrome varies greatly. A subgroup study of females with PCO based on the presence or absence of polycystic ovarian syndrome characteristics reveals no evidence of an increasing trend in the development of the endocrine abnormalities often associated with polycystic ovary syndrome [14].

Baqai *et al*., (2010) conducted a study on "Prevalence of PCOS In Infertile Patients". The 1210 participants in the research were women who visited the BIRDS OPD with concerns about their fertility. In all of the women who were chosen, a detailed history, examination, transvaginal ultrasound, and hormonal profile were done. Women with additional endocrinological diseases, such as hyperthyroidism and hypothyroidism, hyperprolactinemia, Cushing's syndrome, and androgenic tumors, were excluded from the research. PCOS was found in 496 (40.9%) of the 1210 women who attended the BIRDS OPD last year. The average age of the participants was 278 years old. 282 (31.5%) of the 1210 women in the study had a normal menstrual cycle and no signs of hyperandrogenism, such as hirsutism or acne (GROUP N). GROUP 1: 430 of 1210 women (35.5%) experienced menstrual symptoms such oligomenorrhoea or amenorrhea but no hirsutism or acne. With a normal menstrual cycle, 90 of 1210 women (7.4%) had androgenic signs (GROUP 2). Group 3 included 308 of 1210 women (25.45%) who had moderate to severe hirsutism and menstrual symptoms. The Rotterdam Criteria were met by 125 women in group 1, 63 women in group 2, and 308 women in group 3. PCO was discovered to be present in 40.9 percent of infertile women, which is a very high rate. For the diagnosis of the polycystic ovarian syndrome, the Rotterdam criteria were shown to be effective [15].

The study "Causes and Prevalence of Factors Causing Infertility in a Public Health Facility" was done by Priyanka Sanjay *et al*., (2019). A total of 120 couples participated in the research, who were evaluated and treated for infertility. The couple's infertility was diagnosed based on their medical history and physical findings. Each cause's prevalence was assessed. Primary infertility was more common (57.5%) than secondary infertility (42.5 percent). Polycystic ovarian syndrome (PCOS) was the most common etiology, accounting for 46.6 percent of the cases (46 percent). Infertility was observed in both lean and obese PCOS patients. Tubal factor infertility was strongly linked with Infectious reasons such as PID and TB (P = 0.001) were found to be the most common (P = 0.001). The causes of infertility changed as people became older. PCOS was the most common explanation among couples who had been married for less than 5 years, followed by male factor and unexplained infertility. Tobacco and alcohol usage were shown to be substantially connected to abnormal sperm reports (P = 0.001), while malefactors were found to be accountable for 20percent of infertility cases. The causes of infertility vary based on the age of the spouse and the age of the marriage. Infections are the most common cause of tubal factor infertility, and cigarettes and alcohol make it worse. Unsolved cases account for one-third of all cases [16].

Urooj Zafar *et al*., (2019) published a paper titled "Prevalence of PCOS with Associated Symptoms and Complications in a Tertiary Care Hospital in Karachi". During four months, 335 premenopausal females presented to clinic with various pregnancy problems, with 305 agreeing to participate. The Rotterdam criteria 2003 were used to diagnose PCOS. Menstrual abnormalities were evaluated based on the patient's medical history. The Acne Global Grading System and the revised Ferriman–Gallwey scale have been used to evaluate clinical hyperandrogenism. BMI was used to determine obesity. Hamilton scale was applied to assess the mental abnormalities that were present. In premenopausal, PCOS was the most frequent gynaecological condition (55.41 percent). Infertility was the most common presenting complaint

overall, although there were differences in symptoms with age, with young adolescence and adulthood having extra menstrual abnormalities and late adolescence having infertility as the main complaint. Furthermore, 32% of these individuals were overweight, and 46.2 percent were obese. Anxiety and migraine headaches were shown to be more common. In our area, PCOS is the frequent gynecology issue. These women frequently come with changed complaints that have an influence on their physical and mental well-being, lowering their quality of life [17].

The study "Prevalence of Infertility and Use of Fertility Treatment in Female with PCOS" was done by Anju E *et al*., (2015). In this research, PCOS prevalence was self-reported to be 5.8 percent (95 percent confidence interval [CI]: 5.3 percent–6.4 percent). 72 percent of 309 females with PCOS reported infertility, compared to 16 percent of 4547 females without PCOS (p0.001). Infertility was 15 times higher in females with PCOS regardless of BMI. Those with PCOS were more likely to take fertility hormone therapy (62 percent, n=116 vs. 33 percent, n=162, p0.001) than females without PCOS. Infertility and the usage of fertility hormone therapy were shown to be substantially greater in females with PCOS in this study [18].

Farzana Arain *et al*., (2015) conducted a research on "Infertility caused by polycystic ovaries: frequency and treatment outcomes". From 2005 to 2008, this was done at Muhammad Medical College for 3 year. This research comprised a total of 1289 infertile couples. PCOs were found in 38.5 percent of female infertility cases. Female infertility was also caused by 44 percent pelvic inflammatory illness, 1.35 percent have hypothyroidism, 2.9 percent have hyperprolactinemia, and 12.3 percent of women have endometriosis, according to the study. Patients with PCOS were treated in a variety of ways. Ovulation induction with clomiphene citrate was administered to 150 individuals with PCO, and 109 (72 percent) of them conceived. Clomiphene citrate and Metformin were administered to 63 women as a combination. 50 (79%) of them became pregnant. Five patients were administered gonadotrophins, and two of them (40%) became pregnant. Three (60 percent) of the five patients who had laparoscopic drilling conceived. Contrary to the findings of the literature analysis, Polycystic Ovarian Syndrome is the 2nd most prevalent reason of infertility. However, it had a very positive outcome following medicinal and/or surgical treatment [19].

"PCOS and its complications in Iranian women," was published by Jalilian A *et al*., (2015). Between 2006 and 2011, 30 studies were done. A total of 19, 226 women aged 10 to 45 years old were included in the study. According to the National Institute of Child Health and Human Disease in the US, the prevalence of PCOS was 6.8% (95 percent confidence interval: 4.11–8.5), 19.5 percent (95 percent confidence interval: 2.24–8.14), and 4.41 percent based on ultrasonography (95 percent). In addition, It was estimated that hirsutism would affect 13% of women, acne to be 26%, androgenic alopecia to be 9%, menstruation problems to be 28%, overweight to be 21%, obesity to be 19%, and infertility to be 8%. Iran does not have a significant frequency of PCOS. However, PCOS prevention is important for a variety of reasons, including heart disease, cardiovascular disease, and infertility; we propose that health officials submit community-wide initiatives in this respect [20].

"Infertility and polycystic ovarian syndrome: an investigation on the relationship between BMI and intrafamily marriages," by Fauzia Haq and colleagues, was published in 2008. Patients at the Aga Khan University Hospital's infertility clinic in Karachi were assessed for clinical characteristics from January 2005 to December 2006. During this time, 203 individuals were assessed for PCOS-related demographic and biochemical characteristics. According to the HOMA index technique, Obesity was prevalent at 70percent, with hyperinsulinemia affecting 59.3percent of women and insulin resistance affecting 52.3 percent of patients. With intrafamily marriage and BMI as dependent factors, the researchers observed a link between oligomenorrhea, diabetes in the family, insulin resistance, high fasting serum insulin levels, tonic LH, and an abnormal glucose tolerance test. In this society, first-degree intrafamily marriages accounted for 48 percent of all marriages, implying that, in addition to ethnic predisposition, there may be a significant genetic propensity for aberrant metabolic characteristics. Insulin resistance, oligomenorrhea, and poor glycemic control have all been linked to a linear association between high BMI and family marriages. Our community is genetically vulnerable to metabolic problems due to high incidence of intrafamily marriages and the percentage of obese women [21].

The study "PCOS Prevalence among Infertile Women Attending a Fertility Clinic at a Nigerian University Teaching Hospital "was done by Vaduneme Kingsley Oriji *et al*., (2019). Between January and June 2016, 174 women visited the reproductive clinic of the University of Port Harcourt Teaching Hospital. To compare the means and proportions of traits of infertile women with PCOS to those of infertile women without PCOS, the chi-square test and the student t-test were utilized. At a 95 percent confidence interval, the statistical significance threshold was chosen at 0.05. The polycystic ovarian syndrome was found in 16.7% (29) of infertile individuals using Rotterdam criteria. Hirsutism was seen in 55.2 percent (16) of PCOS-positive infertile women, but only 12.6 percent (16) of infertile women with normal ovaries (P0.001). Oligomenorrhoea was reported by 27.5 percent (8) of PCOS infertile women and 2.4 percent (3) of infertile women with normal ovaries (P=0.01). Infertile women with PCOS exhibited significantly greater mean mid-

luteal progesterone (7.546.3ng/ml) than those with normal ovaries (17.8910.8 ng/ml) P=0.015, and higher mean testosterone level (0.94 0.08IU/L) than those with normal ovaries (0.470.31IU/L) P 0.001.PCOS was shown to be present in 16.7% of infertile women. Compared to infertile women with normal ovaries, PCOS patients exhibited a significantly greater rate of anovulatory cycles with oligomenorrhea, hirsutism, and serum testosterone levels [22].

CONCLUSION

From this systematic review we concluded that infertility is most commonly caused by PCOS. In 70% of cases of anovulatory infertility, PCOS is the reason. Despite the fact that TVS is the gold standard for detecting ovarian abnormalities in young girls we examine trans-abdominally by using a high-frequency probe. Ultrasonography results for PCOS of the periphery cyst patterns include a considerable variety of small subcapsular follicles (10 follicles with a maximal diameter of 8 millimeter), enhanced ovarian volume (12.3 millimeter), and increased echo density of the ovarian stroma.

REFERENCES

1. Shaheen, R., Subhan, F., Sultan, S., Subhan, K., & Tahir, F. (2010). Prevalence of infertility in a cross section of Pakistani population. *Pakistan Journal of Zoology*, *42*(4), 389-393.
2. Haq, F., & Rizvi, J. (2008). Infertility and polycystic ovarian syndrome: a study of association between body mass index and intrafamily marriages. *Gynecologic and obstetric investigation*, *65*(4), 269-274.
3. Asgharnia, M., Mirblook, F., & Soltani, M. A. (2011). The prevalence of polycystic ovary syndrome (PCOS) in high school students in Rasht in 2009 according to NIH criteria. *International journal of fertility & sterility*, *4*(4), 156-159.
4. Lankarani, M., Valizadeh, N., Heshmat, R., Shafaee, A. R., Amini, M. R., Nouri, M., & Ale, Y. A. (2005). Evaluation of dyslipidemia in polycystic ovary syndrome. *J Diabetes Metab Disord*, 4, E11+E11i–E11x.
5. Arshad, M., Moradi, S., Ahmmadkhani, A. R., & Emami, Z. (2012). Increased prevalence of depression in women with polycystic ovary syndrome. *Iranian journal of Endocrinology and metabolism*, *13*(6), 582-586.
6. Arefi, S. (2000). PCO prevalence and association with menstrual irregularity in adolescence. *J Reprod Infertil*, *5*, 57-62.
7. Aali, B., & Naderi, T. (2004). Evaluation of clinical, ultrasound and laboratory features of PCOS in Kerman in 1381. *Iranian Journal of Endocrinology and Metabolism*, *6*, 153-161.
8. Naderi, T., Akbarzadeh, M., Dabagh, M. M. H., Tabatabaei, H., & Zareh, Z. (2011). Frequency of facial and body acne in 14-to 18-year-old female high school students and its relationship to polycystic ovary syndrome. *JDC*, 2, 124–131.
9. Haji Shafiha, M., Zabiri, T., & Salari Lak, S. H. (2007). Investigating validity criteria of vaginal ultrasound (ovarian volume, the ovarian stroma and the stromal surface of the ovary) in the diagnosis of polycystic ovary syndrome. *Urmia Medical Journal*, *3*, 538-543.
10. Mehrabian, F., Khani, B., Kelishadi, R., & Ghanbari, E. (2011). The prevalence of polycystic ovary syndrome in Iranian women based on different diagnostic criteria. *Endokrynologia Polska*, *62*(3), 238-242.
11. Rahmanpour, H., Heidari, R., & Fekri, S. (2009). The prevalence of polycystic ovarian syndrome in 14-18 year old girls of Zanjan High Schools, 2008. *J Adv Med Biomed Res*, *17*(67), 79-88.
12. Akbari, D., & Hossein, P. N. (2010). Causes of hirsutism in premenopausal women. JDC. 1, 119–124.
13. Haq, F., Aftab, O., & Rizvi, J. (2007). Clinical, biochemical and ultrasonographic features of infertile women with polycystic ovarian syndrome. *Journal of the College of Physicians and Surgeons Pakistan*, *17*(2), 76-80.
14. Michelmore, K. F., Balen, A. H., Dunger, D. B., & Vessey, M. P. (1999). Polycystic ovaries and associated clinical and biochemical features in young women. *Clinical endocrinology*, *51*(6), 779-786.
15. Baqai, Z., Khanam, M., & Parveen, S. (2010). Prevalence of PCOS in Infertile Patients. *Medical channel*, *16*(3), 437-440.
16. Deshpande, P. S., & Gupta, A. S. (2019). Causes and prevalence of factors causing infertility in a public health facility. *Journal of human reproductive sciences*, *12*(4), 287-293.
17. Zafar, U., Memon, Z., Moin, K., Agha, S., Hassan, J. A., & Zehra, D. (2019). Prevalence of PCOS with associated symptoms and complications at Tertiary Care Hospital of Karachi. *Journal of Advances in Medicine and Medical Research*, 30(4), 1-9.
18. Joham, A. E., Teede, H. J., Ranasinha, S., Zoungas, S., & Boyle, J. (2015). Prevalence of infertility and use of fertility treatment in women with polycystic ovary syndrome: data from a large community-based cohort study. *Journal of women's health*, *24*(4), 299-307.
19. Arain, F., Arif, N., & Halepota, H. (2015). Frequency and outcome of treatment in polycystic ovaries related infertility. *Pakistan journal of medical sciences*, *31*(3), 694-699.
20. Jalilian, A., Kiani, F., Sayehmiri, F., Sayehmiri, K., Khodaee, Z., & Akbari, M. (2015). Prevalence of polycystic ovary syndrome and its associated complications in Iranian women: A meta-analysis. *Iranian journal of reproductive medicine*, *13*(10), 591-604.

21. Haq, F., & Rizvi, J. (2008). Infertility and polycystic ovarian syndrome: a study of association between body mass index and intrafamily marriages. *Gynecologic and obstetric investigation*, *65*(4), 269-274.
22. Oriji, V. K., & Onwuegbulam, C. (2019). Prevalence of polycystic ovary syndrome (PCOS) among infertile women attending fertility clinic at a university teaching hospital in Nigeria. *J Gynecol Women Health*, *15*(5), 555922.
23. Lam, P. M., Johnson, I. R., & Raine-Fenning, N. J. (2007). Three-dimensional ultrasound features of the polycystic ovary and the effect of different phenotypic expressions on these parameters. *Human Reproduction*, *22*(12), 3116-3123.
24. Oakley, O., Lin, P. C., Bridges, P., & Ko, C. (2011). Animal models for the study of polycystic ovarian syndrome. *Endocrinology and Metabolism*, *26*(3), 193-202.
25. Senaldi, L., Gopi, R. P., Milla, S., & Shah, B. (2015). Is ultrasound useful in the diagnosis of adolescents with polycystic ovary syndrome?. *Journal of Pediatric Endocrinology and Metabolism*, *28*(5-6), 605-612.