International Journal of Environment, Agriculture and Biotechnology
Vol-9, Issue-4; Jul-Aug, 2024
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Polycystic Ovary Syndrome (PCOS): From Diagnosis to Treatment

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Received: 01 May 2024; Received in revised form: 12 Jun 2024; Accepted: 28 Jun 2024; Available online: 08 Jul 2024

Abstract**—** *Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting women of reproductive age. It is characterized by the presence of multiple cysts on the ovaries, menstrual irregularities, and hormonal imbalances. PCOS is a complex condition with a wide range of symptoms and varying degrees of severity. PCOS not only affects women of childbearing age but also adolescent girls and post- menopausal women. Most of the women affected by PCOS belong to the age group of 18-44 year. This condition affects about 5-10 percent of women of reproductive age and it is the most common endocrine disorder in women. Some of the most common symptoms include irregular periods, excessive hair growth, acne, and weight gain. PCOS is also associated with an increased risk of infertility, diabetes, and cardiovascular disease. The exact cause of PCOS is not fully understood, but it is believed to be a combination of genetic, hormonal, and lifestyle factors. Treatment for PCOS is focused on managing symptoms and reducing the risk of complications. Lifestyle changes, such as exercise and a healthy diet, are often recommended as the first line of treatment. Medications may also be prescribed to regulate menstrual cycles, reduce androgen levels, and improve insulin sensitivity. PCOS can be a challenging condition to manage, but with proper diagnosis and treatment, most women with PCOS can lead healthy and fulfilling lives. Regular medical check-ups, healthy lifestyle choices, and ongoing support from healthcare providers can help women with PCOS to manage their symptoms and reduce their risk of complications.*

Keywords**— Polycystic ovary syndrome (PCOS), young women, health, lifestyle, healthy diet**

Polycystic ovarian syndrome (PCOS): Polycystic ovarian syndrome is a disorder suspected in patients with irregular menses and clinical signs of hyperandrogenism (Aswini and Jayapalan 2017, Lilhare and Pawar 2014). PCOS is a complex endocrine condition that affects the ovaries. It's linked to long-term metabolic problems like insulin resistance (IR), dyslipidemia and other disorders that predispose to cardiovascular risk, systemic inflammation and endothelial dysfunction. Elevated serum levels are another symptom of PCOS (Iervolino *et al.* 2021).

Polycystic Ovarian Syndrome (PCOS) is a prevalent endocrine disorder affecting up to 10% of women of reproductive age worldwide (Teede et al. 2018). It is characterized by a constellation of symptoms including hyperandrogenism, menstrual irregularities, and polycystic ovaries on ultrasound examination (American College of Obstetricians and Gynecologists [ACOG], 2018). PCOS is a complex condition with multifactorial etiology, involving genetic, environmental, and lifestyle factors (Teede et al. 2018). Diagnosis of PCOS typically follows the Rotterdam criteria, requiring the presence of at least two of the following: oligo- or anovulation, clinical or biochemical signs of hyperandrogenism, and polycystic ovaries on ultrasound. These criteria aim to capture the heterogeneous nature of the syndrome, which can manifest differently in affected individuals (ACOG, 2018).

Clinical manifestations of PCOS extend beyond reproductive health, encompassing metabolic disturbances such as insulin resistance, dyslipidemia, and obesity (Teede et al. 2018). These metabolic features contribute to an increased risk of developing type 2 diabetes mellitus and cardiovascular disease among women with PCOS (ACOG,

2018). Management strategies for PCOS focus on alleviating symptoms and reducing long-term health risks. Lifestyle modifications, including diet and exercise interventions, are recommended as first-line treatments to improve insulin sensitivity and regulate menstrual cycles (Teede et al. 2018). Pharmacological therapies, such as oral contraceptives and anti-androgen medications, may also be prescribed to manage symptoms like hirsutism and irregular bleeding (ACOG, 2018).

Recently, PCOS has been related to metabolic syndromes and patients may develop obesity, insulin resistance, keratoosis nigricans (acanthosis nigricans), Type 2 diabetes, dyslipidemias, hypertension, non-alcoholic liver disease and obstruction sleep apnea (Madnani *et al.* 2013). PCOS is a common endocrine disorder affecting women of reproductive age. PCOS is a diverse illness in which the ovary produces too many eggs. Mostly androgens derived primarily from the ovaries (Alshdaifat *et al.* 2021). This condition's complexity isn't due to its name; it's due to the fact that it's linked to a slew of other issues. In the sac of their ovary, PCOS patients develop many cysts measuring 8 mm in diameter. In the ovary, there are more than 12 cysts and because of this disease, around 70 percent of females are sterile (Ajmal *et al*. 2019).

Prevalence: According to the World Health Organisation (WHO), PCOS is affecting 116 million women worldwide in 2012, which is approximately 3.4 percent of world population (Bharathi *et al.* 2017). PCOS not only affects women of childbearing age but also adolescent girls and post- menopausal women. Most of the women affected by PCOS belong to the age group of 18-44 year (Ganie *et al.* 2019). This condition affects about 5-10 percent of women of reproductive age and it is the most common endocrine disorder in women. Obesity, hirsutism and infertility are all reported to have a significant impact on one's psychosocial well-being. Women with PCOS are more likely to have fertility issues (menstrual irregularities etc.), metabolic issues (insulin resistance, late menopause, endometrial cancer and infertility), failure to ovulate, late menopause, endometrial cancer and infertility resistance, type 2 diabetes, dyslipidemia, hypertension and cardiovascular illnesses (Thara and Divakar 2017).

PCOS) is one of the most common endocrine disorders among women of reproductive age, with prevalence estimates ranging from 6% to 12% globally depending on the diagnostic criteria used (March et al. 2010). In the United States, it is estimated that about 5 million women are affected by PCOS, which translates to a prevalence of approximately 6% to 10% among women of reproductive age (Centers for Disease Control and Prevention [CDC], 2023). Studies conducted in Europe and Australia have reported similar prevalence rates, generally between 8% and 13% (March et al. 2010). In some populations, particularly in South Asian countries, the prevalence of PCOS is even higher, with estimates ranging from 9% to 18% (Tehrani et al. 2011). The variability in prevalence rates is partly due to differences in the diagnostic criteria used, as well as genetic, environmental, and lifestyle factors that can influence the occurrence of PCOS (Azziz et al. 2016).

Symptoms: Polycystic Ovarian Syndrome (PCOS) is characterized by a range of symptoms that can vary in severity among affected individuals. One of the primary symptoms is irregular menstrual cycles, which may manifest as fewer than eight menstrual periods per year or prolonged intervals between periods (American College of Obstetricians and Gynecologists. This irregularity is often due to the lack of ovulation, a common feature of PCOS (ACOG, 2015). Hyperandrogenism is another key symptom observed in PCOS. This condition presents with clinical signs such as hirsutism (excessive hair growth on the face, chest, or back), acne, and male-pattern baldness. Biochemical signs of hyperandrogenism can include elevated levels of serum testosterone, free testosterone, or dehydroepiandrosterone sulfate (DHEAS) (ACOG, 2015; Escobar-Morreale, 2018).

Oligomenorrhea, hirsutism, severe acne and hair loss are some of the symptoms of PCOS. It produces major psychological disorders in adolescence, such as anxiety and depression. PCOS is the most common cause of infertility. Female infertility is a condition in which a woman is unable to conceive. Impaired glucose tolerance and type 2 diabetes are among the metabolic effects. Diabetes, obesity and a higher risk of cardiovascular disease are all linked to an increased risk of cardiovascular disease. Complications of metabolism and when compared to other PCOS types, the classic PCOS was found to have a higher rate of cardiovascular morbidity. PCOS is a condition that affects both obese and non-obese women. Obese women, on the other hand, have a higher prevalence of IR (Insulin resistance) indicators (Ganie *et al.* 2019).

PCOS promotes hirsutism and acne due to an increase in male hormones, specifically androgen. Insulin resistance is a condition that leads to obesity and type 2 Diabetes. This issue causes irregularities in the menstrual cycle, which leads to infertility. Sleep apnea affects 20 percent of females on a regular basis. Anxiety and depression are very frequent. The normal concentration of hormones in the body has a big impact on how healthy ovarian function and as a result, menstrual cycle regulation that sustains fertility (Ajmal *et al.* 2019).

In PCOS patients, Acanthosis Nigricans is a sign for hyperinsulinemia and insulin resistance darkening and thickening of the upper layer of skin in body folds and wrinkles characterize Acanthosis Nigricans, giving it a velvety look. Acanthosis Nigricans primarily affects the armpits, groin and neck (Shivaprakash *et al.* 2013). PCOS management is as difficult as the disorder itself. A nutritious diet, frequent physical activity and drugs that address the related symptoms and co-morbidities are all part of PCOS management and treatment. The four basic components of PCOS, including regular menstrual cycles, control of hyperandrogenism (acne and hirsutism), treatment of infertility and insulin resistance, as well as its related risk factors (T2DM, hyperlipidaemia and obesity) are the focus of PCOS management techniques (Ganie *et al.* 2019).

Other manifestations of PCOS include skin changes such as skin tags and darkened patches of skin, especially in body creases like the neck, groin, and underneath breasts. Psychological symptoms such as depression, anxiety, and mood swings are also commonly reported, impacting the overall quality of life for individuals with PCOS (ACOG, 2015).

Causes: Although the cause of PCOS is unknown, some genetic variables are thought to contribute to its pathophysiology, making those who have a genetic predisposition more likely to exhibit PCOS symptoms when exposed to particular environmental conditions (Alshdaifat *et al.* 2021). Several epidemiological studies have discovered a correlation between PCOS and lifestyle choices, as well as a link between food and the risk of polycystic ovarian syndrome (Eslamian and Hekmatdoost 2019).

The exact causes of Polycystic Ovarian Syndrome (PCOS) are not completely understood, but it is believed to result from a combination of genetic and environmental factors (Escobar-Morreale, 2018).

Genetic predisposition plays a significant role, as PCOS tends to run in families, suggesting a hereditary component (Goodarzi, Dumesic, Chazenbalk & Azziz, 2011). Studies have identified several genes that may be involved in the development of PCOS, highlighting the complex genetic basis of the disorder (Goodarzi et al. 2011).

Insulin resistance, where the body's cells do not respond normally to insulin, is a common feature of PCOS and can contribute to elevated androgen levels, leading to symptoms of PCOS (Dunaif, 1997). This insulin resistance is often accompanied by compensatory hyperinsulinemia, which exacerbates hyperandrogenism by stimulating ovarian androgen production and reducing sex hormone-binding globulin (SHBG) levels (Dunaif, 1997).

Elevated levels of androgens, or male hormones, are another critical factor in the development of PCOS, and these hormonal imbalances can disrupt the normal function of the ovaries (Azziz, Carmina, Dewailly, Diamanti-Kandarakis, Escobar-Morreale, Futterweit, Janssen, Legro, Norman, Taylor & Witchel, 2006). Hyperandrogenism, which manifests as hirsutism, acne, and alopecia, is a hallmark of PCOS and is linked to both ovarian and adrenal sources (Azziz et al. 2006).

Lifestyle factors, including diet and physical activity, can also influence the onset and severity of PCOS, particularly through their impact on insulin resistance and weight (Gambineri, Pelusi, Vicennati, Pagotto & Pasquali, 2002). Obesity, in particular, is closely associated with PCOS and can exacerbate symptoms and metabolic complications (Gambineri et al. 2002).

Chronic low-grade inflammation has also been linked to PCOS, as women with the condition often exhibit elevated levels of inflammatory markers (González, Sia, Shepard & Rote, 1999). This inflammation may contribute to insulin resistance and other metabolic disturbances associated with PCOS (González et al. 1999).

Diagnose: Diagnosing Polycystic Ovarian Syndrome (PCOS) involves a comprehensive evaluation of symptoms, physical examination, and laboratory tests. According to the American College of Obstetricians and Gynecologists (ACOG, 2015), diagnostic criteria include the presence of two out of three of the following features: irregular menstrual cycles, clinical or biochemical signs of hyperandrogenism, and polycystic ovaries on ultrasound.

Irregular menstrual cycles are often the first indicator, with women experiencing fewer than eight menstrual cycles per year or cycles that are prolonged (ACOG, 2015).

Hyperandrogenism can be assessed through clinical signs such as hirsutism, acne, and male-pattern baldness, or through elevated levels of androgens in blood tests, such as testosterone and dehydroepiandrosterone sulfate (DHEAS) (ACOG, 2015; Escobar-Morreale, 2018).

Polycystic ovaries are visualized via ultrasound, which reveals enlarged ovaries containing multiple small follicles arranged peripherally around a central stroma, giving them a "string of pearls" appearance (ACOG, 2015; Escobar-Morreale, 2018).

Laboratory tests may also include measuring fasting glucose and insulin levels to assess for insulin resistance, which is common in PCOS (Escobar-Morreale, 2018). Lipid profiles and thyroid function tests may be conducted to evaluate metabolic and hormonal status (Escobar-Morreale, 2018).

It's important to rule out other conditions that may present similarly to PCOS, such as congenital adrenal hyperplasia and androgen-secreting tumors, through additional hormonal testing and imaging studies if indicated (Escobar-Morreale, 2018).

According to the Rotterdam criteria, PCOS can be diagnosed if at least two of the following three criteria are present: oligoovulation or anovulation, clinical and/or biochemical signs of hyperandrogenism, and polycystic ovaries visualized on ultrasound (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004).

Oligoovulation or anovulation is typically confirmed through a history of irregular menstrual cycles, characterized by intervals longer than 35 days or fewer than eight menstrual cycles per year. This criterion is essential, as it reflects the hormonal dysregulation that is central to the syndrome (Azziz et al. 2006).

Clinical signs of hyperandrogenism include hirsutism, defined as excessive hair growth in a male-pattern distribution, acne, and androgenic alopecia. Biochemical evidence of hyperandrogenism can be established through elevated levels of serum testosterone, free testosterone, or dehydroepiandrosterone sulfate (DHEAS) (Azziz et al. 2006).

Polycystic ovaries are visualized on ultrasound as ovaries with 12 or more follicles measuring 2-9 mm in diameter and/or increased ovarian volume (>10 cm^3). The presence of polycystic ovaries is a supportive criterion but not necessary for diagnosis if the other criteria are met (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004).

Laboratory tests are crucial in diagnosing PCOS and may include measuring fasting glucose and insulin levels to assess for insulin resistance, which is common in PCOS. Lipid profiles and thyroid function tests are also recommended to evaluate metabolic and hormonal status (Azziz et al. 2006).

Diagnostic evaluation should also aim to exclude other conditions that may mimic PCOS, such as congenital adrenal hyperplasia, androgen-secreting tumors, Cushing's syndrome, and thyroid disorders. This may involve additional hormonal testing (Azziz et al. 2006).

Risk Factors: Polycystic Ovarian Syndrome (PCOS) is influenced by several risk factors that contribute to its development and severity. These risk factors are crucial for understanding the pathogenesis of PCOS and for identifying individuals at higher risk for the condition.

1. Genetic Predisposition

Genetic factors significantly contribute to the risk of developing PCOS. Family history is a strong indicator, with first-degree relatives of women with PCOS having an increased likelihood of developing the condition themselves (Teede et al. 2018). Twin studies and familial clustering suggest a hereditary component, indicating that genetic predisposition plays a crucial role in the pathogenesis of PCOS (Dumesic et al. 2015).

2. Insulin Resistance

Insulin resistance is a common feature of PCOS and a significant risk factor for its development (Dunaif, 1997). Insulin resistance leads to hyperinsulinemia, which exacerbates hyperandrogenism by increasing ovarian androgen production and reducing sex hormone-binding globulin levels (Dunaif, 1997). This hormonal imbalance disrupts normal follicular development, contributing to the anovulation characteristic of PCOS (Teede et al. 2018).

3. Obesity

Obesity is both a risk factor and a consequence of PCOS, creating a vicious cycle that exacerbates the condition (Teede et al. 2018). Excess adipose tissue increases insulin resistance and hyperinsulinemia, which in turn aggravates hyperandrogenism and menstrual irregularities (Franks, 2008). Women with PCOS are more likely to be overweight or obese compared to the general population, and weight gain further complicates the metabolic and reproductive aspects of the syndrome (Teede et al. 2018).

4. Hormonal Imbalances

Hormonal imbalances, particularly elevated levels of androgens and luteinizing hormone (LH), are central to the pathophysiology of PCOS (Goodarzi et al. 2011). Elevated LH levels relative to follicle-stimulating hormone (FSH) lead to ovarian dysfunction, anovulation, and the development of polycystic ovaries (Franks, 2008). These hormonal disturbances are both a feature and a risk factor for the perpetuation of PCOS symptoms (Teede et al. 2018).

5. Environmental and Lifestyle Factors

Environmental and lifestyle factors also play a significant role in the risk of developing PCOS. Exposure to endocrine-disrupting chemicals, such as bisphenol A (BPA), has been associated with hormonal imbalances that may contribute to PCOS (Diamanti-Kandarakis et al. 2009). Additionally, diet and physical activity levels influence the risk and severity of PCOS. Poor dietary habits and sedentary lifestyles increase the risk of obesity and insulin resistance, thereby exacerbating PCOS symptoms (Teede et al. 2018).

6. Prenatal Factors

Prenatal factors, including maternal obesity and androgen exposure, have been suggested as potential risk factors for

PCOS. Animal studies have shown that fetal exposure to elevated androgen levels can lead to the development of PCOS-like symptoms in offspring, suggesting that in utero environment may influence the risk of developing PCOS later in life (Abbott et al. 2005).

Treatment: Pharmacological therapy and a lifestyle modification program are used in the management of PCOS, with a focus on behavioral change, a balanced diet, and frequent exercise. Menstrual irregularities, the impact of hyperandrogenism (acne and hirsutism), infertility and insulin resistance, as well as related long-term metabolic problems (T2DM, hyperlipidaemia and obesity) are the key components of PCOS that are the focus of the therapeutic plan (Ganie *et al.* 2019).

Women with PCOS are more likely to have mood disorders and psychiatric issues than women without the condition. The distress related with the symptoms commonly found in PCOS (obesity, hirsutism etc.) causes mood disorders (Barry *et al.* 2011). When compared to the urban population, the prevalence in rural areas is lower. However, the rural population may have fewer PCOS cases due to a lack of understanding and/or little or no exposure to junk foods, pollution and other endocrine disruptors. Furthermore, girls in rural areas do not rely on labor-saving technology or automobiles for home duties, which help them, maintain a healthy BMI. As a result of the constant health demands of globalization and economic liberalization, middle-class urban women are more vulnerable than rural women who live a traditional lifestyle. The higher prevalence of PCOS among India's higher socio-economic urban population has been attributed to sedentary lifestyles, access to high-calorie foods and machineries for all housework. The strongest and most significant link between the illness and family history has been discovered. As a result, further genetic research is needed to understand the hereditary pathophysiology of this complex condition (Bharathi *et al.* 2017).

The treatment of Polycystic Ovarian Syndrome (PCOS) focuses on managing individual symptoms and addressing the underlying hormonal imbalances (Legro, Arslanian, Ehrmann, Hoeger, Murad, Pasquali & Welt, 2013). Lifestyle modifications, including diet and exercise, are often the first line of treatment and can significantly improve symptoms by promoting weight loss and improving insulin sensitivity (Moran, Hutchison, Norman & Teede, 2011). Weight loss of even a small percentage can restore menstrual regularity and improve fertility outcomes in overweight women with PCOS (Moran et al. 2011).

Pharmacological treatments are also commonly used to manage PCOS symptoms. Metformin, an insulin-sensitizing agent, is often prescribed to improve insulin resistance and lower insulin and androgen levels, which can help restore ovulatory cycles (Banaszewska, Pawelczyk, Spaczynski & Duleba, 2011). Oral contraceptives are another mainstay of treatment and are used to regulate menstrual cycles, reduce androgen levels, and manage symptoms such as hirsutism and acne (Brown, Imran & Abbas, 2022).

For women who wish to conceive, ovulation induction medications such as clomiphene citrate or letrozole are often prescribed to stimulate ovulation (Legro et al. 2014). Letrozole, an aromatase inhibitor, has been found to be more effective than clomiphene in inducing ovulation and achieving live birth rates in women with PCOS (Legro et al. 2014).

In cases where pharmacological treatments are not effective, other options such as laparoscopic ovarian drilling (LOD) may be considered. LOD is a surgical procedure that can reduce androgen production and induce ovulation by destroying a portion of the ovarian tissue (Amer, 2009).

Managing metabolic issues is also critical in the treatment of PCOS. Statins may be used to address dyslipidemia, and antihypertensive medications may be required for those with high blood pressure (Diamanti-Kandarakis, Papavassiliou, Kandarakis & Chrousos, 2007).

Overall, pharmaceutical therapy combined with a lifestyle modification program focusing on behavioral management, a healthy diet and frequent physical activity is used to treat PCOS (Deeks *et al.* 2011).

CONCLUSION

Polycystic Ovarian Syndrome (PCOS) is a complex endocrine disorder affecting women of reproductive age, characterized by hormonal imbalances, irregular menstrual cycles, and metabolic disturbances. It involves genetic predisposition, insulin resistance, and lifestyle factors such as diet and physical activity. Management includes lifestyle modifications, pharmacological interventions, and sometimes surgical options, tailored to alleviate symptoms and reduce long-term health risks. Multidisciplinary care is crucial for addressing both physical and emotional aspects of PCOS, aiming to improve quality of life and fertility outcomes through personalized treatment approaches.

It is evident from the range of studies that early diagnosis and treatment of PCOS is pivotal for normal health, well-being and improved nutritional status of young women suffering from PCOS. There is great scope for improvement in the health and nutritional status of young women if they are advised timely about their health issues and emphasis is given on making them understand the importance of taking

balanced diet, inclusion of protective foods in diet specially fruits and vegetable and role of physical activity in overall health. Nutrition awareness programmes aimed at women of reproductive age group are the need of the day for promoting utilization of available community and national level health and nutrition referral facilities.

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