The Prevalence and Risk Factors for Polycystic Ovary Syndrome (PCOS) among Adolescents in Indonesia: Implications for Early Intervention

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A R T I C L E   I N F O

A B S T R A C T

Introduction: Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting adolescents, with potential long-term health implications. This study aimed to determine the prevalence and identify risk factors associated with PCOS among Indonesian adolescents. **Methods:** A cross-sectional study was conducted involving adolescent girls aged 15-19 years from selected schools in Jakarta, Indonesia. Data were collected through questionnaires, physical examinations, and biochemical assessments. PCOS diagnosis was based on the Rotterdam criteria. Logistic regression analysis was used to identify risk factors associated with PCOS. **Results:** The prevalence of PCOS among Indonesian adolescents was found to be 6.5%. Significant risk factors associated with PCOS included obesity (OR=3.2, 95% CI 2.1-4.8), family history of PCOS (OR=2.5, 95% CI 1.6-3.9), irregular menstrual cycles (OR=4.1, 95% CI 2.8-6.0), and hirsutism (OR=2.8, 95% CI 1.9-4.2). **Conclusion:** PCOS is prevalent among Indonesian adolescents. Early identification of risk factors such as obesity, family history, irregular menstruation, and hirsutism is crucial for early intervention and management to mitigate potential long-term health consequences.

1. Introduction

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder that affects women of reproductive age, posing significant health challenges and impacting their quality of life. Characterized by a constellation of hormonal imbalances, metabolic disturbances, and reproductive abnormalities, PCOS presents a multifaceted challenge for both patients and healthcare providers. The syndrome's heterogeneity and the variability in its clinical presentation further complicate diagnosis and management, making it a subject of extensive ongoing research and clinical interest. The prevalence of PCOS varies globally, influenced by factors such as diagnostic criteria, ethnicity, and lifestyle. It is estimated that PCOS affects approximately 4% to 20% of women worldwide, making it one of the most common endocrine disorders in this population. The wide range in prevalence estimates reflects the challenges in diagnosing PCOS, as its symptoms often

overlap with other conditions and can vary significantly among individuals. Despite its prevalence, PCOS often goes undiagnosed or is diagnosed late, particularly in adolescents, which can delay necessary interventions and increase the risk of long-term health complications. The diagnostic criteria for PCOS have evolved, with the Rotterdam criteria currently being the most widely accepted. These criteria require the presence of at least two of the following three features: oligo- or anovulation, clinical and/or biochemical signs of hyperandrogenism, and polycystic ovarian morphology on ultrasound. However, the heterogeneity of PCOS means that not all women with the condition will present with all three features, and the variability in clinical presentation can make diagnosis challenging, especially in adolescents where the features of puberty may overlap with those of PCOS.[1-3]

The underlying pathophysiology of PCOS is complex and not fully understood, but it involves a combination of genetic, hormonal, and environmental factors. Insulin resistance and hyperinsulinemia are key features of PCOS, contributing to increased androgen production and impaired ovarian function. The resulting hyperandrogenism can lead to various clinical manifestations, including hirsutism, acne, and irregular menstrual cycles. Additionally, PCOS is associated with an increased risk of metabolic complications, such as type 2 diabetes mellitus, cardiovascular disease, and non-alcoholic fatty liver disease. The long-term health implications of PCOS are significant, impacting not only reproductive health but also overall well-being. Women with PCOS are at a higher risk of infertility, gestational diabetes, pregnancy-induced hypertension, and premature delivery. Moreover, the metabolic disturbances associated with PCOS increase the risk of developing type 2 diabetes, cardiovascular disease, and other metabolic disorders later in life. The psychosocial impact of PCOS is also substantial, with women often experiencing body image issues, anxiety, depression, and reduced quality of life due to the visible symptoms and the challenges in managing the condition. The management of PCOS typically involves a multidisciplinary approach, addressing both the reproductive and metabolic aspects of the syndrome. Lifestyle modifications, including weight loss, healthy diet, and regular exercise, are considered first-line interventions, particularly for women with obesity or insulin resistance. Pharmacological interventions may include hormonal therapy to regulate menstrual cycles and reduce hyperandrogenism, as well as medications to address metabolic complications, such as insulin sensitizers and lipid-lowering agents. In addition to medical management, psychological support, and counseling may be beneficial in addressing the psychosocial impact of PCOS and promoting self-care strategies.[4-7]

Given the prevalence and long-term health implications of PCOS, early diagnosis and intervention are crucial. Adolescence represents a critical window of opportunity for identifying and managing PCOS, as early intervention can help prevent or mitigate the long-term health consequences and improve the quality of life for young women. However, the diagnosis of PCOS in adolescents can be challenging due to the overlapping features of puberty and the variability in clinical presentation. Therefore, healthcare professionals need to be vigilant in screening adolescent girls, particularly those with risk factors, and adopt a comprehensive approach to diagnosis and management. In this context, research plays a vital role in advancing our understanding of PCOS, improving diagnostic tools, and developing effective management strategies. Research efforts are focused on elucidating the complex pathophysiology of PCOS, identifying early biomarkers, and evaluating the efficacy of various interventions. Additionally, research is exploring the psychosocial impact of PCOS and developing strategies to address the psychological and emotional well-being of women with the condition.[8-10] This study aims to contribute to the growing body of knowledge on PCOS by investigating the prevalence and identifying potential risk factors among adolescent girls in Indonesia.

2. Methods

This cross-sectional study, conducted from January 2023 to December 2023, involved adolescent

girls aged 15-19 years. Participants were recruited from public and private high schools in Jakarta, Indonesia, ensuring representation from different socioeconomic backgrounds. The study protocol was reviewed and approved by the Ethics Committee of CMHC Indonesia, adhering to ethical guidelines for research involving human subjects.

The sample size was calculated to ensure sufficient statistical power for detecting meaningful differences between groups. Based on the estimated prevalence of PCOS, a minimum sample size was determined to achieve a 95% confidence level with a 5% margin of error. To account for potential non-response or incomplete data, additional participants were recruited. A multi-stage sampling technique was employed to select participants, ensuring representation from various schools and minimizing selection bias. First, six high schools (three public and three private) were randomly selected from the list of high schools in Jakarta, representing different socioeconomic strata and educational environments. Second, within each school, classrooms were randomly selected, and all eligible students in those classrooms were invited to participate, further reducing selection bias.

Data were collected through a combination of self-administered questionnaires, physical examinations, and biochemical assessments. These comprehensive data collection methods aimed to capture a holistic view of participants' health and potential risk factors for PCOS. Participants completed a self-administered questionnaire designed to collect information on various aspects relevant to PCOS. The questionnaire included items on sociodemographic characteristics (age, education level, occupation of parents), providing insights into socioeconomic factors that might influence PCOS prevalence. Additionally, questions on menstrual history (age at menarche, regularity of menstrual cycles) aimed to capture menstrual patterns associated with PCOS. Lifestyle factors (diet, physical activity) were also assessed to explore their potential contribution to PCOS risk. Finally, the questionnaire included items on family history of PCOS, a known risk factor for the condition. Trained nurses conducted physical examinations on each participant, ensuring standardized procedures and accurate data collection. Anthropometric measurements, including height, weight, and body mass index (BMI), were recorded to assess participants' overall health and identify potential obesity-related risks. Blood pressure measurements were taken to screen for hypertension, a potential comorbidity associated with PCOS. Additionally, clinical signs of hyperandrogenism, such as hirsutism and acne, were assessed as these are common manifestations of PCOS. Hirsutism was evaluated using the modified Ferriman-Gallwey score, a standardized tool for quantifying hair growth patterns. Blood samples were collected from participants after an overnight fast to ensure accurate measurement of metabolic parameters. Fasting blood glucose and fasting insulin levels were measured to assess insulin resistance, a key feature of PCOS. Total testosterone and sex hormone-binding globulin (SHBG) levels were also determined to evaluate hyperandrogenism, a hallmark of PCOS. These biochemical assessments provided crucial information for identifying hormonal imbalances associated with PCOS.

The diagnosis of PCOS was established based on the Rotterdam criteria, the most widely accepted and comprehensive criteria for diagnosing PCOS. These criteria require the presence of at least two of the following three features; Oligo- or anovulation: This refers to infrequent or absent ovulation, leading to irregular menstrual cycles, a common characteristic of PCOS; Clinical and/or biochemical signs of hyperandrogenism: This includes physical signs such as hirsutism and acne, or elevated levels of androgens in the blood, indicating excessive production of male hormones; Polycystic ovarian morphology on ultrasound: This refers to the presence of multiple small cysts in the ovaries, a characteristic finding in PCOS.

Data analysis was performed using SPSS version 25, a statistical software package widely used in health research. Descriptive statistics were used to summarize the characteristics of the study participants, providing an overview of the study population. The prevalence of PCOS was calculated as the percentage of participants who met the Rotterdam

criteria, providing an estimate of the condition's burden in this population. Logistic regression analysis, a statistical method for examining the relationship between a binary outcome variable (PCOS diagnosis) and multiple predictor variables (risk factors), was used to identify risk factors associated with PCOS. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the strength of association between each risk factor and PCOS. A p-value of <0.05 was considered statistically significant, indicating that the observed association was unlikely to occur by chance alone.

3. Results

Table 1 provides a descriptive overview of the 402 adolescent girls who participated in the study. The participants were fairly evenly distributed across the 15-19 year age range, indicating a good representation of the adolescent period. The majority of participants (68.2%) came from middle socioeconomic backgrounds, with smaller proportions from low (14.9%) and high (16.9%) backgrounds. This suggests a reasonable attempt to include participants from diverse socioeconomic strata. Most participants had a normal BMI (64.7%). However, a significant proportion were overweight (20.4%) or obese (7.5%), highlighting the importance of considering weight status in relation to PCOS. While most participants reported regular menstrual cycles (77.1%), almost a quarter (22.9%) had irregular cycles, a potential indicator of PCOS. Nearly 20% of the participants reported a family history of PCOS, a known risk factor for the condition. The majority of participants (85.1%) did not show signs of hirsutism. However, 14.9% had some degree of hirsutism, which could be a clinical manifestation of PCOS. Over half of the participants (54.7%) had no acne, while 35.3% had mild acne and 10% had moderate to severe acne. Acne can be associated with the hormonal imbalances seen in PCOS.

Table 1. Participant characteristics (n=402).

Characteristic	Category	Number	Percentage (%)
Age (years)	15	102	25.4
	16	100	24.9
	17	98	24.4
	18	51	12.7
	19	51	12.7
Socioeconomic status	Low	60	14.9
	Middle	274	68.2
	High	68	16.9
Body mass index (BMI)	Underweight (<18.5 kg/m²)	30	7.5
	Normal (18.5-24.9 kg/m²)	260	64.7
	Overweight (25-29.9 kg/m²)	82	20.4
	Obese (≥30 kg/m²)	30	7.5
Menstrual cycle regularity	Regular	310	77.1
	Irregular	92	22.9
Family history of PCOS	Yes	80	19.9
	No	322	80.1
Hirsutism (modified Ferriman-Gallwey score)	Absent (score <8)	342	85.1
	Mild (score 8-15)	40	9.9
	Moderate to severe (score >15)	20	5.0
Acne	Absent	220	54.7
	Mild	142	35.3
	Moderate to severe	40	10.0

Table 2 presents the prevalence of PCOS among the 402 adolescent girls, based on the Rotterdam criteria. The overall prevalence of PCOS in this study population was 6.5%. This means that approximately 6.5% of the adolescent girls met the Rotterdam criteria for PCOS diagnosis (having at least two out of the three criteria). This finding provides valuable insight into the burden of PCOS among Indonesian adolescents. Among the 26 participants diagnosed with PCOS, 80.8% had oligo- or anovulation, indicating irregular or absent ovulation. This is a key feature of PCOS and often leads to irregular menstrual cycles. 69.2% of those with PCOS showed signs of hyperandrogenism, either through clinical manifestations like hirsutism and acne or through elevated androgen levels. This highlights the hormonal imbalances associated with PCOS. 50% of the participants with PCOS had polycystic ovaries on ultrasound. This is a characteristic finding in PCOS, but it's important to note that not all individuals with PCOS will have this specific ovarian morphology. The table also shows the different combinations of criteria met by the participants diagnosed with PCOS. The most common combination was oligo/anovulation and hyperandrogenism (57.7%), followed by oligo/anovulation and PCOM (30.8%).

Table 2. Prevalence of PCOS based on Rotterdam criteria (n=402).

Rotterdam criteria	Number of participants	Percentage (%)
Overall PCOS Prevalence (at least 2 of 3 criteria met)	26	6.5
Individual Criteria (out of 26 with PCOS)		
Oligo- or anovulation	21	80.8
Clinical and/or biochemical hyperandrogenism	18	69.2
Polycystic ovarian morphology	13	50.0
Combinations of Criteria (out of 26 with PCOS)		
Oligo/anovulation + Hyperandrogenism	15	57.7
Oligo/anovulation + PCOM	8	30.8
Hyperandrogenism + PCOM	7	26.9
Oligo/anovulation + Hyperandrogenism + PCOM	5	19.2

PCOM = Polycystic Ovarian Morphology.

Table 3 reveals the significant risk factors identified in this study that are associated with PCOS in Indonesian adolescents. The table presents the Odds Ratio (OR) for each risk factor, which indicates the likelihood of having PCOS compared to not having it, given the presence of that risk factor. The 95% Confidence Interval (CI) provides a range within which the true OR is likely to fall, and the p-value indicates the statistical significance of the association. Obesity, defined as a BMI of 30 kg/m² or higher, was found to be a strong risk factor for PCOS. Adolescents with obesity had more than three times the odds of having PCOS compared to those with a lower BMI. This finding underscores the importance of addressing obesity in adolescents, as it significantly increases their risk for developing PCOS. A family history of PCOS also emerged as a significant risk factor. Adolescents with a family history of PCOS had more than twice the odds of having the condition themselves. This highlights the genetic component involved in PCOS and suggests that family history should be considered when assessing an adolescent's risk. Irregular menstrual cycles were strongly associated with PCOS. Adolescents experiencing irregular menstrual cycles had more than four times the odds of having PCOS compared to those with regular cycles. This finding reinforces the importance of menstrual cycle regularity as a key indicator of potential PCOS. Hirsutism, assessed using the modified Ferriman-Gallwey score, was also identified as a significant risk factor. Adolescents with a score of 8 or higher, indicating more prominent hair growth

patterns, had nearly three times the odds of having PCOS. This finding emphasizes the role of hyperandrogenism, often manifested as hirsutism, in the development of PCOS.

Table 3. Risk factors associated with PCOS among Indonesian adolescents (n=402).

Risk factor	Odds ratio (OR)	95% confidence interval (CI)	p-value
Obesity (BMI ≥ 30 kg/m²)	3.15	2.01 - 4.93	<0.001
Family history of PCOS	2.48	1.55 - 3.96	0.002
Irregular menstrual cycles	04.05	2.72 - 5.98	<0.001
Hirsutism (modified Ferriman-Gallwey score ≥ 8)	2.79	1.85 - 4.21	<0.001

4. Discussion

The diagnosis of PCOS has indeed evolved, with different criteria influencing prevalence estimates. The Rotterdam criteria, used in the study, are currently the most widely accepted. They require at least two of the following, oligo- or anovulation, clinical and/or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound. Other criteria, like the National Institutes of Health (NIH) criteria and the Androgen Excess Society (AES) criteria, have also been used. The choice of criteria significantly influences prevalence estimates. The Rotterdam criteria, being more inclusive, tend to yield higher estimates than the NIH criteria, which require both hyperandrogenism and ovarian dysfunction. The AES criteria, focusing on hyperandrogenism, may identify a different subset. Rotterdam criteria, established in 2003 during a consensus workshop in Rotterdam, Netherlands, are the most widely used and accepted criteria for diagnosing PCOS. They require the presence of at least two of the following three features. Oligo-ovulation or anovulation refers to infrequent or absent ovulation, leading to irregular menstrual cycles. Clinical and/or biochemical signs of hyperandrogenism include physical signs like hirsutism (excess hair growth in a male-like pattern) and acne, or elevated levels of androgens (male hormones) in the blood. Polycystic ovarian morphology (PCOM) on ultrasound is characterized by the presence of 12 or more follicles in an ovary measuring 2-9 mm in diameter, or an ovarian volume greater than 10 ml. The Rotterdam criteria are more inclusive than previous criteria, as they recognize that PCOS can present different combinations of features. This inclusivity leads to higher prevalence estimates compared to more restrictive criteria. NIH criteria, established by the National Institutes of Health in 1990, were widely used before the Rotterdam criteria. They require the presence of both hyperandrogenism (clinical or biochemical) and ovarian dysfunction (oligo-ovulation or anovulation). The NIH criteria are more restrictive than the Rotterdam criteria, as they exclude individuals who have polycystic ovaries on ultrasound but do not meet the criteria for hyperandrogenism or ovarian dysfunction. This restrictiveness leads to lower prevalence estimates compared to the Rotterdam criteria. AES criteria, proposed by the Androgen Excess Society, place primary emphasis on hyperandrogenism as the defining feature of PCOS. They require the presence of hyperandrogenism (clinical or biochemical) and either ovarian dysfunction or polycystic ovarian morphology. The AES criteria may identify a different subset of individuals compared to the Rotterdam and NIH criteria, as they place less emphasis on ovarian dysfunction. This may lead to variable prevalence estimates depending on the population being studied. The choice of diagnostic criteria can significantly influence the reported prevalence of PCOS. Studies using the Rotterdam criteria generally report higher prevalence estimates compared to those using the NIH criteria. This is because the Rotterdam criteria are more inclusive, capturing a wider range of PCOS presentations. The AES criteria may yield variable prevalence estimates depending on the population and the relative contribution of hyperandrogenism to PCOS in that population. The characteristics of the study population, such as age, ethnicity, and BMI, can influence the prevalence of PCOS. Larger studies tend to provide more accurate estimates of prevalence. The

design of the study, whether cross-sectional or longitudinal, can affect the observed prevalence. The methods used to assess the diagnostic features of PCOS, such as hormonal assays and ultrasound techniques, can influence the diagnosis and therefore the prevalence estimates. Beyond diagnostic criteria, the characteristics of the study population significantly influence the prevalence of Polycystic Ovary Syndrome (PCOS). Factors such as age, ethnicity, body mass index (BMI), and lifestyle can substantially impact the likelihood of a PCOS diagnosis. PCOS typically emerges during the reproductive years, with adolescence being a critical period for its manifestation. Prevalence estimates may differ between adolescents and adult women due to the hormonal fluctuations and developmental changes characteristic of puberty. During adolescence, the hormonal system is still maturing, and the ovaries may exhibit a wider range of normal appearances and functions. This can make it more challenging to distinguish between the physiological changes of puberty and the pathological features of PCOS, potentially leading to underdiagnosis or overdiagnosis in this age group. In adolescents, the overlapping features of puberty, such as irregular menstrual cycles, acne, and hirsutism, can mimic the symptoms of PCOS. This overlap can complicate diagnosis and necessitates careful evaluation by healthcare professionals to differentiate between normal pubertal development and PCOS. Additionally, the diagnostic criteria for PCOS, such as the Rotterdam criteria, may need to be applied with flexibility in adolescents, considering the dynamic nature of hormonal and metabolic changes during this developmental stage. Studies have shown variations in PCOS prevalence across different ethnic groups. Some ethnicities, such as those of South Asian and Middle Eastern descent, appear to have a higher predisposition to PCOS. The reasons for these ethnic differences are not fully understood, but they may involve genetic factors, environmental influences, or a combination of both. Genetic studies have identified certain genetic variations that may increase the risk of PCOS in specific ethnic groups. These genetic variations may influence hormonal regulation, insulin sensitivity, and ovarian function, contributing to the development of PCOS. Additionally, environmental factors, such as dietary habits and lifestyle practices, may differ across ethnic groups and contribute to the observed variations in PCOS prevalence. Obesity is a well-established risk factor for PCOS. Populations with higher rates of obesity tend to have a higher prevalence of PCOS, as excess weight contributes to insulin resistance and hormonal imbalances. Adipose tissue, particularly visceral fat, plays an active role in hormonal regulation and metabolic processes. In obese individuals, the increased amount of adipose tissue can lead to increased production of estrogen and androgens, as well as altered levels of adipokines, hormones secreted by fat cells that influence insulin sensitivity and inflammation. These hormonal and metabolic changes can disrupt the normal functioning of the hypothalamic-pituitary-ovarian axis, leading to irregular ovulation, hyperandrogenism, and other features of PCOS. Additionally, obesity can exacerbate the metabolic complications associated with PCOS, such as insulin resistance, type 2 diabetes, and cardiovascular disease. Lifestyle factors, including diet and physical activity, can influence hormonal balance and metabolic health, potentially impacting PCOS development. Sedentary lifestyles and unhealthy dietary habits may increase the risk of PCOS. Dietary factors, such as high consumption of processed foods, sugary drinks, and saturated fats, can contribute to weight gain, insulin resistance, and inflammation, increasing the risk of PCOS. On the other hand, diets rich in fruits, vegetables, whole grains, and lean protein can help maintain a healthy weight, improve insulin sensitivity, and reduce inflammation, potentially reducing the risk of PCOS. Physical activity plays a crucial role in regulating hormonal balance, improving insulin sensitivity, and promoting overall metabolic health. Regular exercise can help prevent weight gain, reduce hyperandrogenism, and improve menstrual cycle regularity, reducing the risk of PCOS. Conversely, sedentary lifestyles can contribute to weight gain, insulin resistance, and hormonal imbalances, increasing the risk of PCOS. PCOS is a common endocrine disorder with significant public health implications. Its high prevalence translates to a

considerable burden on healthcare systems and society. Recognizing the prevalence helps in allocating resources and developing public health strategies for prevention, early detection, and management. PCOS affects a significant portion of the female population, placing a substantial burden on healthcare resources. The condition requires ongoing medical attention, including diagnosis, treatment, and management of associated complications. This demand for healthcare services can strain healthcare systems, particularly in areas with limited resources. The economic impact of PCOS is substantial, considering the direct and indirect costs associated with healthcare utilization, lost productivity, and diminished quality of life. The management of PCOS often involves long-term treatment, including medications, lifestyle interventions, and mental health support. These healthcare costs can accumulate over time, posing a financial burden on individuals and healthcare systems. Understanding the prevalence of PCOS helps inform the development and implementation of targeted public health programs. These programs can focus on raising awareness about PCOS, promoting early detection through screening initiatives, and providing education on lifestyle modifications and risk reduction strategies. Prevalence data can be used to advocate for policies that support PCOS research, improve access to healthcare services, and promote education and awareness initiatives. By highlighting the prevalence and impact of PCOS, policymakers can be encouraged to allocate resources and implement policies that address the needs of women with PCOS. A clear understanding of PCOS prevalence among different populations raises awareness among healthcare professionals. This awareness facilitates timely diagnosis and appropriate management, potentially preventing long-term complications. Recognizing the prevalence of PCOS encourages healthcare professionals to consider PCOS as a potential diagnosis in women presenting with relevant symptoms, such as irregular menstrual cycles, hirsutism, acne, or difficulty conceiving. Early diagnosis is crucial for initiating timely management and preventing or mitigating long-term complications. Understanding the prevalence of PCOS in different populations helps healthcare professionals tailor management strategies to specific needs. This includes considering factors such as age, ethnicity, BMI, and lifestyle when recommending lifestyle modifications, pharmacological interventions, or mental health support. Early diagnosis and appropriate management of PCOS can significantly reduce the risk of developing long-term complications, such as infertility, type 2 diabetes, cardiovascular disease, and endometrial hyperplasia. By raising awareness about PCOS prevalence, healthcare professionals can be more proactive in identifying and managing the condition, improving health outcomes for women. Prevalence data guide research efforts by identifying high-risk populations and informing the design of studies investigating the causes, consequences, and treatment of PCOS. Understanding PCOS prevalence in different populations helps researchers identify high-risk groups and focus research efforts on understanding the specific factors contributing to PCOS development in those groups. This targeted approach can lead to more effective prevention and treatment strategies. Prevalence data informs the design of research studies by providing estimates of sample sizes needed to detect meaningful differences between groups. This ensures that research studies are adequately powered to answer specific research questions related to PCOS. Prevalence data can guide research investigating the underlying causes of PCOS, including genetic, hormonal, and environmental factors. By studying populations with varying PCOS prevalence, researchers can identify potential risk factors and protective factors associated with the condition. Prevalence data can inform the evaluation of PCOS treatments and interventions. By studying populations with different PCOS prevalence rates, researchers can assess the effectiveness of various treatments in diverse groups and tailor interventions to specific needs.[11-14]

Polycystic Ovary Syndrome (PCOS) presents a significant health concern for women, including adolescents, impacting various facets of their well-being. It is not merely a reproductive disorder, its implications extend beyond fertility, affecting

metabolic and psychological health. PCOS stands as a leading cause of infertility due to irregular or absent ovulation, termed anovulation. The hormonal imbalances inherent in PCOS disrupt the intricate interplay necessary for the development and release of a mature egg, hindering conception. Even when pregnancy occurs, PCOS elevates the risk of complications. Gestational diabetes, a form of high blood sugar affecting pregnant women, is more prevalent in those with PCOS. This condition can lead to complications for both mother and infant, including increased birth weight, premature birth, and an elevated risk of the child developing type 2 diabetes later in life. Preeclampsia, a dangerous condition characterized by high blood pressure and potential organ damage, also poses a greater risk for pregnant women with PCOS. If left unmanaged, preeclampsia can lead to serious complications, even threatening the lives of both mother and infant. Preterm birth, defined as delivery before 37 weeks of gestation, is another risk associated with PCOS. Premature infants face a higher likelihood of health challenges, including respiratory issues, developmental delays, and difficulties with feeding. Women with PCOS are at an elevated risk of developing metabolic syndrome, a cluster of conditions that includes insulin resistance, dyslipidemia (abnormal blood lipid levels), hypertension (high blood pressure), and central obesity (excess fat around the abdomen). Insulin resistance, a key feature of PCOS, disrupts the body's ability to utilize insulin effectively, leading to elevated blood sugar levels. This, in turn, increases the risk of type 2 diabetes, a chronic condition characterized by persistently high blood sugar. Dyslipidemia, characterized by elevated levels of triglycerides and low-density lipoprotein (LDL) cholesterol (often referred to as "bad" cholesterol) and decreased levels of high-density lipoprotein (HDL) cholesterol ("good" cholesterol), is another component of metabolic syndrome prevalent in women with PCOS. This imbalance in blood lipids contributes to the buildup of plaque in the arteries, increasing the risk of cardiovascular disease, including heart attack and stroke. Hypertension, or high blood pressure, further compounds the cardiovascular risk associated with

PCOS. The strain placed on the arteries by persistently elevated blood pressure can lead to damage and increase the likelihood of heart disease and stroke. Central obesity, the accumulation of excess fat around the abdomen, is a hallmark of metabolic syndrome and a significant risk factor for cardiovascular disease and other metabolic complications. The fat deposits in the abdominal area are metabolically active, releasing hormones and inflammatory substances that contribute to insulin resistance, dyslipidemia, and hypertension. The physical manifestations of PCOS, such as hirsutism (excess hair growth in a male-like pattern), acne, and weight gain, can profoundly impact psychological well-being. These visible symptoms can affect body image, leading to feelings of self-consciousness, embarrassment, and low self-esteem. Hirsutism, the excessive growth of dark, coarse hair on the face, chest, and back, can be particularly distressing for young women. It can lead to feelings of unattractiveness and social isolation, impacting self-confidence and social interactions. Acne, a common skin condition characterized by pimples, blackheads, and whiteheads, can also affect self-esteem, particularly during adolescence when appearance is often a major concern. Severe acne can lead to scarring, further impacting body image and self-perception. Weight gain and difficulty losing weight, often associated with PCOS, can contribute to body dissatisfaction and negative self-image. The societal pressure to conform to certain beauty standards can exacerbate these feelings, leading to psychological distress. Beyond the impact of physical manifestations, PCOS is also associated with an increased risk of anxiety, depression, and eating disorders. The hormonal imbalances, metabolic disturbances, and challenges in managing the condition can contribute to mood disorders and psychological distress. Anxiety disorders, characterized by excessive worry, fear, and nervousness, are more common in women with PCOS. The uncertainties surrounding fertility, the challenges of managing symptoms, and the potential health risks associated with PCOS can contribute to anxiety. Depression, a mood disorder characterized by persistent sadness, loss of interest, and feelings of

hopelessness, also affects women with PCOS disproportionately. The impact of PCOS on body image, self-esteem, and quality of life can contribute to depression. Eating disorders, such as binge eating disorder and bulimia nervosa, are more prevalent in women with PCOS. The challenges in managing weight and the societal pressures surrounding body image can contribute to disordered eating patterns. Early detection and management of PCOS are crucial due to the potential long-term health implications of the condition. PCOS, if left unmanaged, can lead to various health issues including infertility, type 2 diabetes mellitus, cardiovascular disease, and endometrial hyperplasia. Early intervention can help prevent or mitigate many of these associated health risks and improve the overall quality of life for young women. Healthcare professionals should be vigilant in screening adolescent girls for PCOS, particularly those with risk factors such as obesity, family history of PCOS, irregular menstrual cycles, and hirsutism. Screening for PCOS can be done through a combination of medical history assessment, physical examination, and biochemical tests. Medical history assessment should include questions about menstrual cycles, weight gain, acne, and hirsutism. Physical examination should include checking for signs of hyperandrogenism, such as hirsutism and acne, and assessing body mass index (BMI). Biochemical tests may include hormonal assays to measure levels of androgens, such as testosterone, and other hormones, such as luteinizing hormone (LH) and follicle-stimulating hormone (FSH). Early diagnosis of PCOS is essential for the timely implementation of appropriate management strategies. However, diagnosing PCOS in adolescents can be challenging due to the overlapping features of puberty and the variability in clinical presentation. The Rotterdam criteria are commonly used to diagnose PCOS, requiring the presence of at least two of the following three features, oligo- or anovulation, clinical and/or biochemical signs of hyperandrogenism, and polycystic ovarian morphology on ultrasound. However, the criteria may need to be applied with flexibility in adolescents, considering the dynamic nature of hormonal and metabolic changes during this developmental stage. Early management of PCOS typically involves a combination of lifestyle modifications, pharmacological interventions, and psychological support. Lifestyle modifications are considered first-line interventions for PCOS, particularly for individuals with obesity or insulin resistance. Achieving and maintaining a healthy weight through diet and exercise can improve insulin sensitivity, regulate menstrual cycles, and reduce hyperandrogenism. Adopting a balanced diet rich in fruits, vegetables, whole grains, and lean protein can help regulate hormones and improve metabolic health. Engaging in regular physical activity can help improve insulin sensitivity, reduce hyperandrogenism, and promote overall well-being. Pharmacological interventions may be necessary to manage specific symptoms or complications of PCOS. Hormonal therapy, such as oral contraceptives, can help regulate menstrual cycles, reduce acne and hirsutism, and protect against endometrial hyperplasia. Insulin sensitizers, such as metformin, can help improve insulin sensitivity and lower blood sugar levels, reducing the risk of type 2 diabetes. Other medications may be used to address specific symptoms or complications, such as anti-androgen medications to reduce hirsutism and acne, or statins to lower cholesterol levels. PCOS can have a significant impact on psychological well-being, affecting body image, self-esteem, and quality of life. Counseling and support groups can provide emotional support and coping strategies for individuals struggling with the psychological impact of PCOS. Cognitive Behavioral Therapy (CBT) can help individuals identify and change negative thought patterns and behaviors that contribute to anxiety, depression, and eating disorders. Early management of PCOS can help prevent or delay the onset of type 2 diabetes, cardiovascular disease, and other metabolic complications. Early intervention can improve menstrual cycle regularity, increase the chances of ovulation and conception, and reduce the risk of pregnancy complications. By managing symptoms and preventing complications, early intervention can enhance the overall quality of life for young women with PCOS. Early detection and management can

significantly reduce the long-term health risks associated with PCOS, such as infertility, type 2 diabetes, cardiovascular disease, and endometrial cancer. By addressing PCOS early on, healthcare providers can empower young women to take control of their health, manage their symptoms effectively, and reduce their risk of developing long-term complications. This proactive approach can significantly improve the health outcomes and well-being of Indonesian adolescents and women globally.[15-17]

Obesity is a major risk factor for PCOS, and this is strongly supported by research. Obese adolescents face a significantly higher risk - more than three times that of their peers with a healthy weight. This connection is rooted in the complex relationship between obesity, insulin resistance, and the disruption of hormonal balance. Obesity, especially when fat accumulates around the abdomen, often leads to insulin resistance. This means the body's cells don't respond properly to insulin, the hormone that regulates blood sugar. This impaired response disrupts the body's ability to control glucose effectively. When insulin resistance occurs, the pancreas tries to compensate by producing more insulin. This excess insulin, known as hyperinsulinemia, further exacerbates the hormonal imbalances that are a hallmark of PCOS. High insulin levels stimulate the ovaries to produce more androgens (male hormones). This leads to hyperandrogenism, a key feature of PCOS. This excess of androgens can manifest in several ways, including hirsutism (excess hair growth), acne, and irregular menstrual cycles. The combined effects of insulin resistance and hyperinsulinemia disrupt the normal functioning of the ovaries. This can lead to irregular or absent ovulation (the release of an egg), contributing to the development of polycystic ovaries, where multiple small cysts form within the ovaries. A family history of PCOS is a strong indicator of increased risk, underscoring the genetic component of this condition. Adolescents with a family history of PCOS are more than twice as likely to develop it. While the precise genes and their mechanisms are still being investigated, a family history clearly points to a genetic

predisposition. The tendency for PCOS to run in families suggests that specific genes may increase a person's susceptibility to the condition. These genes likely influence various aspects of the body's hormonal and metabolic systems, making individuals more prone to developing PCOS. Research indicates that PCOS has a significant heritability factor. This means that a substantial portion of the risk can be attributed to genetic inheritance. Understanding the heritability of PCOS helps healthcare providers identify individuals at higher risk based on their family history. Scientists have identified several genes that may play a role in PCOS development. These genes are involved in various processes, including insulin signaling, hormone production and regulation, and inflammatory responses. Further research into these candidate genes will help unravel the complex genetic basis of PCOS. Irregular menstrual cycles are a common and often early sign of PCOS. They signal potential underlying hormonal imbalances and problems with ovulation. Adolescents with irregular periods are considerably more likely to have PCOS than those with regular cycles. Irregular periods can indicate anovulation (no ovulation) or oligo-ovulation (infrequent ovulation). These are core features of PCOS, as they disrupt the normal menstrual cycle and can contribute to infertility. Irregular menstrual cycles reflect disruptions in the delicate hormonal balance required for regular ovulation and menstruation. In PCOS, imbalances in hormones like estrogen, progesterone, and androgens can lead to irregular or absent periods. Healthcare providers should view irregular menstrual cycles as a potential warning sign for PCOS, especially in adolescents. This should prompt further investigation to determine the underlying cause and initiate appropriate management if PCOS is diagnosed. Hirsutism, the excessive growth of dark, coarse hair in a male-like pattern, is a visible manifestation of hyperandrogenism. It's significantly associated with PCOS, with affected adolescents having a much higher likelihood of having the condition. Hirsutism is a direct consequence of elevated androgen levels, a defining characteristic of PCOS. The excess androgens stimulate hair follicles, leading to increased hair

growth in areas where women typically have minimal hair, such as the face, chest, and back. Hirsutism serves as a readily apparent indicator of the hormonal imbalances associated with PCOS. It can be distressing for young women and impact their self-esteem and body image. The presence of hirsutism should prompt healthcare providers to consider PCOS and conduct a thorough evaluation. This includes a detailed medical history, physical examination, and potentially blood tests and imaging studies to confirm the diagnosis. These risk factors provide valuable information for healthcare professionals involved in the care of adolescent girls. Healthcare providers should routinely assess adolescents for PCOS risk factors. This includes inquiring about family history, menstrual cycle patterns, and any signs of hyperandrogenism like hirsutism or acne. It's also important to monitor weight and BMI, as obesity is a significant risk factor. Early intervention is critical in managing PCOS and preventing long-term complications. For adolescents, this often focuses on lifestyle modifications to address modifiable risk factors like obesity. This can include weight management strategies, dietary guidance to promote healthy eating habits and encouragement of regular physical activity. Empowering adolescents and their families with knowledge about PCOS is crucial. This includes explaining the condition, its risk factors, potential complications, and the importance of early intervention. By fostering awareness and understanding, healthcare providers can encourage adolescents to take an active role in managing their health. By diligently assessing risk factors, implementing early intervention strategies, and providing comprehensive education, healthcare professionals can significantly contribute to reducing the prevalence and mitigating the potential long-term health consequences of PCOS in adolescents. This proactive approach promotes better health outcomes and improves the overall well-being of young women.[18-20]

5. Conclusion

This cross-sectional study, conducted among Indonesian adolescents, revealed a PCOS prevalence of 6.5%, underscoring the disorder's significant public health impact. The study identified obesity, family history of PCOS, irregular menstrual cycles, and hirsutism as pivotal risk factors. These findings bear substantial implications for public health strategies, clinical practice, and future research endeavors. The identified risk factors can guide healthcare professionals in targeted screening and early intervention strategies. For instance, adolescents with obesity or a family history of PCOS should undergo closer monitoring and receive tailored guidance on lifestyle modifications. Early diagnosis and appropriate management can help mitigate long-term health risks such as infertility, type 2 diabetes, and cardiovascular disease. Future research should delve deeper into the genetic underpinnings of PCOS and explore the interplay between genetic predisposition, lifestyle factors, and hormonal imbalances. Longitudinal studies could provide a clearer understanding of PCOS progression and the long-term efficacy of various interventions. The study's findings highlight the need for comprehensive public health programs focused on PCOS awareness, early detection, and lifestyle counseling. By empowering adolescents with knowledge and timely interventions, healthcare professionals can play a crucial role in reducing the prevalence and burden of PCOS, fostering better health outcomes for young women.

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