



ABCD model–based assessment (Anthropometric, Biochemical, Clinical, and Dietary) of PCOS among adolescents in the Mahishadal Area of Purba Medinipur

Chumki Das¹, Anirban Pattanayak², Dipanwita Pal³, Nabanita Ghosh⁴, Shilpa Saha^{5*}

¹ Nutritionist, CINI Training Unit, West Bengal, India

² State Aided College Teacher, Department of Physiology, Mahishadal Raj College, West Bengal, India

³ SACT, Department of Nutrition, Mahishadal Raj College, West Bengal, India

⁴ Assistant Professor, Department of Clinical and Dietetics, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India

⁵ Consultant Dietitian and Nutritionist, Suraksha diagnostics Pvt. Ltd, West Bengal, India

Abstract

Polycystic Ovary Syndrome (PCOS) is a common endocrine and metabolic disorder affecting adolescent girls worldwide. The condition is characterized by menstrual irregularities, hyperandrogenism, and polycystic ovarian morphology. Early identification of PCOS is crucial because it is associated with obesity, insulin resistance, infertility, and increased risk of metabolic disorders. The ABCD model of nutritional assessment (Anthropometric, Biochemical, Clinical, and Dietary) provides a comprehensive framework for evaluating health status and identifying risk factors related to PCOS. This research paper focuses on assessing PCOS among adolescents in the Mahishadal area of Purba Medinipur using the ABCD model. Anthropometric measurements such as BMI and waist circumference, biochemical parameters including hormonal and metabolic markers, clinical symptoms like menstrual irregularities and hirsutism, and dietary patterns were evaluated to understand the multifactorial nature of PCOS. The findings highlight the importance of early screening, lifestyle modification, and nutritional intervention to reduce the prevalence and complications of PCOS among adolescents.

Keywords: PCOS, Adolescents, ABCD assessment, anthropometric indicators, biochemical markers, dietary habits, Purba Medinipur

Introduction

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age and often begins during adolescence (Mandal *et al.*, 2021) [13]. It is characterized by hormonal imbalance, irregular menstrual cycles, hyperandrogenism, and polycystic ovarian morphology (Patel *et al.*, 2022) [17]. The prevalence of PCOS among adolescents varies widely depending on diagnostic criteria and population characteristics (Peña *et al.*, 2020) [18]. Studies have reported that the prevalence ranges from 5–15% among adolescents, with some Indian studies reporting rates around 9–18% (Malhotra, S., & Patra, 2014) [12].

In India, the prevalence of PCOS among women has been estimated at approximately 10% based on Rotterdam criteria, highlighting its growing public health significance. PCOS is also associated with obesity, insulin resistance, dyslipidemia, and increased risk of cardiovascular disease (Tripathy *et al.*, 2018) [22].

Adolescence represents a critical stage for reproductive and metabolic health (Reinehr, 2016) [19]. However, the diagnosis of PCOS during adolescence can be challenging because some features such as acne, irregular menstruation, and hormonal fluctuations are common during puberty. Therefore, comprehensive evaluation methods are required for accurate identification (Tehrani and Amiri, 2019) [21].

The ABCD model (Anthropometric, Biochemical, Clinical, and Dietary assessment) is widely used in nutritional and epidemiological research to evaluate health and nutritional status. This model provides a holistic approach to assessing metabolic disorders and identifying lifestyle-related risk factors (Locks *et al.*, 2025) [11].

The present research paper aims to apply the ABCD model to assess PCOS among adolescents in the Mahishadal area of Purba Medinipur, West Bengal.

Objectives of the Study

1. To evaluate anthropometric parameters associated with PCOS among adolescents.
2. To assess biochemical markers related to metabolic and hormonal imbalance.
3. To identify clinical symptoms of PCOS among adolescents.
4. To analyze dietary patterns and nutritional habits associated with PCOS risk.
5. To examine the relationship between lifestyle factors and PCOS prevalence.

Methodology

Study Design

The present study was conducted using a cross-sectional community-based research design to assess the prevalence and associated risk factors of Polycystic Ovary Syndrome (PCOS) among adolescent girls in the Mahishadal area of Purba Medinipur, West Bengal (Yasmin *et al.*, 2025) [24]. A cross-sectional design was selected because it allows the simultaneous assessment of multiple health indicators and risk factors at a single point in time (Fortin *et al.*, 2014) [8]. This design is widely used in epidemiological and nutritional research to evaluate health conditions and their associations with lifestyle, dietary, and metabolic factors within a defined population (Boeing, 2013) [7].

Study Population

The study population consisted of adolescent girls aged between 13 and 19 years residing in the Mahishadal area of Purba Medinipur district. Adolescence is considered a critical stage for reproductive and metabolic development, and hormonal changes during this period may influence the onset of conditions such as PCOS. Participants were selected from schools and local communities within the study area to ensure representation of adolescents from different socioeconomic and educational backgrounds (Biswas *et al.*, 2016) ^[6].

Sample Size

A total of 120 adolescent girls were included in the study. The sample size was determined based on the feasibility of data collection and the need to obtain representative information regarding PCOS risk factors among adolescents in the selected region. Participants were selected using a simple random sampling technique, which ensured that each eligible adolescent had an equal probability of being included in the study. This sampling method helped minimize selection bias and improved the reliability of the collected data.

Data Collection

Data were collected using structured questionnaires and clinical assessment forms developed according to the ABCD model of nutritional assessment. The questionnaire included sections on demographic information, menstrual history, lifestyle habits, dietary intake, and family medical history. Anthropometric measurements and clinical observations were recorded using standardized procedures, while biochemical parameters were obtained through laboratory analysis of blood samples. The ABCD model provided a comprehensive framework for assessing the nutritional and health status of the participants.

Components of ABCD Assessment

The assessment of PCOS risk among adolescents was conducted using the ABCD model of nutritional assessment, which includes anthropometric, biochemical, clinical, and dietary evaluation (Abdolahian *et al.*, 2020) ^[1]. This multidimensional approach allows researchers to identify various health indicators related to nutritional status, metabolic function, and lifestyle behaviors. Anthropometric assessment measures body composition and obesity indicators, biochemical assessment evaluates hormonal and metabolic markers, clinical assessment identifies physical symptoms and medical conditions, and dietary assessment analyzes food intake patterns and nutritional habits. Together, these components provide a comprehensive understanding of the factors contributing to PCOS among adolescents (Franks, 2008) ^[9].

Anthropometric Assessment

Anthropometric assessment was conducted to evaluate body composition and identify obesity-related risk factors associated with PCOS among the participants (Parua *et al.*, 2025) ^[15]. Standardized procedures were used to measure body weight, height, body mass index (BMI), waist circumference, and waist-to-hip ratio. These measurements provide valuable information about overall body fat distribution and central adiposity, which are strongly linked with insulin resistance and hormonal imbalance (Patel and

Abate, 2013) ^[16]. Previous studies have reported that overweight and obesity significantly increase the risk of PCOS and related metabolic complications (Anagnostis *et al.*, 2018) ^[3]. Therefore, anthropometric indicators serve as important tools for identifying adolescents who may be at higher risk of developing PCOS and related metabolic disorders.

Biochemical Assessment

Biochemical assessment was performed to evaluate hormonal and metabolic abnormalities associated with PCOS among the participants (Shah *et al.*, 2017) ^[20]. Blood samples were collected and analyzed in a laboratory to measure several important biochemical parameters including fasting blood glucose, serum insulin levels, lipid profile (total cholesterol, triglycerides, HDL, LDL), luteinizing hormone (LH), follicle-stimulating hormone (FSH), serum testosterone, and anti-Müllerian hormone (AMH) (Biadgo *et al.*, 2016) ^[5]. These biomarkers are essential for identifying metabolic dysfunction, insulin resistance, and hyperandrogenism, which are key features of PCOS. Elevated insulin levels and abnormal lipid profiles are commonly observed in adolescents with PCOS and may increase the risk of metabolic syndrome and cardiovascular disease later in life.

Clinical Assessment

Clinical assessment involved a detailed physical examination and evaluation of symptoms commonly associated with PCOS. Participants were assessed for irregular menstrual cycles, oligomenorrhea or amenorrhea, hirsutism, acne, hair thinning or alopecia, and acanthosis nigricans, which are typical clinical manifestations of hormonal imbalance and insulin resistance (Al Wattar *et al.*, 2021) ^[2]. In addition, information regarding family history of metabolic disorders, blood pressure, and reproductive health status was collected (Hunt *et al.*, 2020) ^[10]. Previous research has shown that symptoms such as acne, hirsutism, and menstrual irregularities are among the most frequently observed indicators of PCOS in adolescents. Clinical assessment therefore plays an important role in identifying suspected PCOS cases and evaluating overall reproductive and metabolic health.

Dietary Assessment

Dietary assessment was conducted to evaluate the nutritional habits and dietary patterns of the participants, as diet plays a significant role in the development and management of PCOS (Barrea *et al.*, 2019) ^[4]. Information on food intake was collected using 24-hour dietary recall, food frequency questionnaire, and diet history method. These tools helped assess the consumption of major food groups, macronutrients, and processed foods. Dietary patterns associated with PCOS commonly include high intake of refined carbohydrates, excessive consumption of processed and fast foods, low intake of fruits and vegetables, and high consumption of saturated fats (Xenou and Gourounti, 2021) ^[23]. Studies have demonstrated that unhealthy dietary patterns combined with low physical activity can negatively influence metabolic markers and inflammatory responses in adolescents with PCOS (Mizgier *et al.*, 2021) ^[14]. Therefore, promoting balanced nutrition and healthy eating habits is essential for managing PCOS symptoms and improving metabolic health.

Results and Discussion

Table 1: Socio-Demographic Characteristics of Participants (N = 120)

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	13–15	32	26.7
	16–17	46	38.3
	18–19	42	35.0
Educational status	School student	68	56.7
	College student	52	43.3
Family income	Low	36	30.0
	Middle	62	51.7
	High	22	18.3

Table 1 presents the socio-demographic characteristics of the study participants (N = 120). The age distribution shows that the majority of adolescents belonged to the 16–17 years age group (38.3%), followed by 18–19 years (35.0%), while 26.7% were in the 13–15 years age group. This indicates that most of the participants were in mid to late adolescence, a critical developmental stage during which hormonal fluctuations and menstrual irregularities are common. Previous studies have reported that symptoms of polycystic ovary syndrome (PCOS) often begin to appear during late adolescence due to hormonal changes associated with puberty. Therefore, the higher proportion of participants in this age range may increase the likelihood of identifying PCOS-related symptoms and metabolic risk factors.

In terms of educational status, 56.7% of participants were school students, while 43.3% were college students. This distribution reflects the educational profile of adolescents within the study area and suggests that the majority of participants were still in secondary education. Educational level plays an important role in shaping awareness regarding reproductive health, dietary habits, and lifestyle practices. Studies have shown that adolescents with higher educational exposure may have better awareness of health issues and preventive practices related to PCOS and metabolic disorders.

The data on family income indicate that 51.7% of participants belonged to middle-income households, followed by 30% from low-income families and 18.3% from high-income groups. Socioeconomic status can significantly influence dietary habits, access to healthcare services, and lifestyle patterns, which in turn affect the risk of developing PCOS. Adolescents from middle-income families may have increased exposure to processed foods and sedentary lifestyles, whereas those from lower-income backgrounds may face nutritional deficiencies and limited access to healthcare facilities. Similar socio-demographic patterns have been reported in previous community-based studies examining PCOS among adolescents, where socioeconomic and educational factors were found to influence both lifestyle behaviors and health outcomes.

Overall, the socio-demographic profile of the participants highlights a predominantly mid-adolescent population with diverse socioeconomic backgrounds. These characteristics are important for understanding the potential environmental, lifestyle, and educational factors that may contribute to the development and management of PCOS among adolescents in the Mahishadal area of Purba Medinipur.

Table 2: Anthropometric Characteristics of Adolescents

Parameter	Mean ± SD	Minimum	Maximum
Age (years)	16.8 ± 1.7	13	19
Height (cm)	156.4 ± 6.8	145	170
Weight (kg)	57.6 ± 9.5	40	78
BMI (kg/m ²)	23.5 ± 3.4	17.2	30.6
Waist circumference (cm)	76.8 ± 7.9	62	94

Table 2 presents the anthropometric characteristics of the adolescents included in the study. The mean age of the participants was 16.8 ± 1.7 years, ranging from 13 to 19 years, indicating that the study mainly involved mid to late adolescents, a critical period for hormonal and physical development. The mean height and weight of the participants were 156.4 ± 6.8 cm and 57.6 ± 9.5 kg, respectively, reflecting normal growth patterns for this age group. The mean Body Mass Index (BMI) was 23.5 ± 3.4 kg/m², which falls within the upper limit of the normal BMI range; however, the wide range (17.2–30.6 kg/m²) suggests the presence of both underweight and overweight individuals within the sample population. Additionally, the mean waist circumference was 76.8 ± 7.9 cm, indicating moderate central adiposity among some participants. Increased BMI and waist circumference are important indicators of obesity and abdominal fat accumulation, both of which are strongly associated with insulin resistance and hormonal imbalance in adolescents with PCOS. Previous studies have also reported that higher BMI and central obesity significantly increase the risk of metabolic disturbances and reproductive complications in adolescents with PCOS. Therefore, the anthropometric findings of the present study highlight the importance of monitoring body weight and fat distribution among adolescents to identify individuals who may be at higher risk of developing PCOS and related metabolic disorders.

Table 3: Prevalence of PCOS Symptoms among Adolescents

Clinical Parameter	Frequency (n)	Percentage (%)
Irregular menstruation	42	35.0
Acne	36	30.0
Hirsutism	24	20.0
Weight gain/obesity	28	23.3
Acanthosis nigricans	16	13.3

Table 3 presents the prevalence of common clinical symptoms associated with Polycystic Ovary Syndrome (PCOS) among the adolescents included in the study. The findings indicate that irregular menstruation was the most frequently reported symptom (35%), followed by acne (30%), weight gain or obesity (23.3%), hirsutism (20%), and acanthosis nigricans (13.3%). Irregular menstrual cycles are considered one of the earliest and most common indicators of hormonal imbalance in adolescents with PCOS, often resulting from disrupted ovulation and altered endocrine function. The presence of acne and hirsutism further suggests elevated androgen levels, which are characteristic features of PCOS. Additionally, the occurrence of weight gain and obesity among some participants highlights the role of metabolic factors such as insulin resistance in the development of the syndrome. Acanthosis nigricans, although observed in a smaller proportion of participants, is an important clinical marker of insulin resistance and metabolic dysfunction. Similar

findings have been reported in previous studies where menstrual irregularities, acne, and hirsutism were among the most prevalent symptoms observed in adolescents with suspected PCOS. Overall, the results emphasize the importance of early clinical screening and awareness programs among adolescents to identify PCOS symptoms at an early stage and prevent long-term metabolic and reproductive complications.

Table 4: Biochemical Characteristics of Participants

Parameter	Mean ± SD	Normal Range
Fasting blood glucose (mg/dl)	94.6 ± 12.3	70–100
Serum insulin (µIU/ml)	16.4 ± 4.2	5–15
Total cholesterol (mg/dl)	182.3 ± 28.4	<200
Triglycerides (mg/dl)	138.5 ± 26.7	<150
LH/FSH ratio	2.3 ± 0.8	<2

Table 4 presents the biochemical characteristics of the study participants, which provide insight into the metabolic and hormonal status associated with PCOS risk among adolescents. The mean fasting blood glucose level was 94.6 ± 12.3 mg/dl, which falls within the normal reference range (70–100 mg/dl), indicating that most participants maintained

normal glucose levels; however, values toward the upper limit may suggest a tendency toward impaired glucose regulation in some individuals. The mean serum insulin level was 16.4 ± 4.2 µIU/ml, slightly higher than the normal range (5–15 µIU/ml), which may indicate the presence of insulin resistance among certain participants, a common metabolic feature of PCOS. The mean total cholesterol level (182.3 ± 28.4 mg/dl) and triglyceride level (138.5 ± 26.7 mg/dl) were within acceptable limits but relatively close to the upper normal range, suggesting a possible risk of lipid metabolism disturbances. Additionally, the mean LH/FSH ratio was 2.3 ± 0.8, which exceeds the normal ratio (<2) and is often considered an important hormonal indicator of PCOS due to increased luteinizing hormone secretion relative to follicle-stimulating hormone. Similar biochemical alterations have been reported in previous studies where adolescents with PCOS frequently exhibited elevated insulin levels, abnormal lipid profiles, and altered LH/FSH ratios. These findings highlight the importance of biochemical screening in identifying early metabolic and endocrine abnormalities associated with PCOS and emphasize the need for early intervention through lifestyle and dietary modifications.

Table 5: Dietary Habits of Adolescents

Dietary Variable	Category	Frequency (n)	Percentage (%)
Meal frequency	<3 meals/day	34	28.3
	3 meals/day	56	46.7
	>3 meals/day	30	25.0
Fruit & vegetable intake	Low	48	40.0
	Moderate	50	41.7
	High	22	18.3
Fast food consumption	Weekly	52	43.3
	Occasionally	40	33.3
	Rarely	28	23.3

Table 5 presents the dietary habits of the adolescent participants, highlighting meal patterns, fruit and vegetable intake, and fast-food consumption. The findings indicate that 46.7% of adolescents consumed three meals per day, while 28.3% consumed fewer than three meals, suggesting that a considerable proportion of participants may have irregular eating patterns or skip meals. Irregular meal frequency can affect metabolic balance and may contribute to hormonal disturbances associated with PCOS. Regarding fruit and vegetable intake, 41.7% of participants reported moderate consumption, while 40% had low intake and only 18.3% reported high consumption. This indicates that a large proportion of adolescents may not be consuming adequate amounts of fruits and vegetables, which are essential sources of dietary fiber, vitamins, and antioxidants that help regulate metabolism and hormonal balance. The results also show that 43.3% of participants consumed fast food on a weekly basis, while 33.3% consumed it occasionally and 23.3% rarely consumed fast food. Frequent consumption of fast food is associated with high intake of saturated fats, refined carbohydrates, and excess calories, which may increase the risk of obesity, insulin resistance, and metabolic disorders related to PCOS. Similar findings have been reported in previous studies where unhealthy dietary patterns, including low consumption of fruits and vegetables and high intake of processed foods, were linked with increased risk of metabolic disturbances among adolescents. Overall, these results highlight the importance

of promoting healthy dietary habits and balanced nutrition to reduce the risk of PCOS and improve metabolic health among adolescents.

Table 6: Lifestyle Characteristics

Variable	Category	Frequency	Percentage (%)
Physical activity	Sedentary	46	38.3
	Moderate	52	43.3
	Active	22	18.3
Sleep duration	<6 hours	32	26.7
	6–8 hours	64	53.3
	>8 hours	24	20.0

Table 6 presents the lifestyle characteristics of the adolescent participants, focusing on physical activity levels and sleep duration. The results indicate that 43.3% of participants engaged in moderate physical activity, while 38.3% had a sedentary lifestyle and only 18.3% were classified as physically active. This distribution suggests that a considerable proportion of adolescents may not be engaging in sufficient physical activity, which is an important factor in maintaining metabolic health. Sedentary behavior has been widely associated with increased risk of obesity, insulin resistance, and hormonal imbalance, all of which contribute to the development of PCOS. Regarding sleep patterns, the majority of participants (53.3%) reported sleeping 6–8 hours per day, which is generally considered

the recommended duration for maintaining good health. However, 26.7% reported sleeping less than 6 hours, indicating that a significant portion of adolescents may experience insufficient sleep. Inadequate sleep has been linked with metabolic disturbances, increased stress hormones, and hormonal imbalance, which may exacerbate symptoms of PCOS. Similar findings have been reported in

previous studies where sedentary lifestyle and poor sleep patterns were identified as important lifestyle factors influencing metabolic and reproductive health among adolescents. Overall, these findings emphasize the importance of encouraging regular physical activity and adequate sleep to support hormonal balance and reduce the risk of PCOS and related metabolic complications.

Table 7: Association between BMI and PCOS Symptoms (Chi-Square Test)

BMI Category	PCOS Symptoms Present	PCOS Symptoms Absent	Total
Normal BMI	18	42	60
Overweight/Obese	30	30	60

Table 7 shows the association between Body Mass Index (BMI) and the presence of PCOS symptoms among the adolescents using the Chi-square test. The results indicate that among participants with normal BMI, only 18 individuals exhibited PCOS symptoms, while 42 participants did not show any symptoms. In contrast, among those categorized as overweight or obese, 30 adolescents presented with PCOS symptoms, which is noticeably higher compared to those without symptoms (30 individuals). This pattern suggests that adolescents with higher BMI are more likely to exhibit symptoms related to PCOS compared to

those with normal BMI. Excess body weight, particularly central obesity, is known to contribute to insulin resistance and hormonal imbalance, both of which play a crucial role in the development of PCOS. Previous studies have also reported a strong association between obesity and increased prevalence of PCOS symptoms among adolescent girls. Therefore, the findings highlight the importance of maintaining a healthy body weight through balanced nutrition and regular physical activity to reduce the risk of PCOS and its associated metabolic complications.

Table 8: Association between Dietary Pattern and PCOS Risk

Dietary Pattern	PCOS Cases	Non-PCOS	χ^2 value	p-value
High fast-food intake	26	30	5.34	0.021*
Low fruit & vegetable intake	24	24	4.16	0.041*
Balanced diet	12	48	—	—

Table 8 presents the association between dietary patterns and the risk of PCOS among adolescents using the Chi-square test. The results indicate that adolescents with high fast-food intake showed a higher number of PCOS cases (26) compared to non-PCOS participants (30), and this association was found to be statistically significant ($\chi^2 = 5.34$, $p = 0.021$). Fast foods are generally high in saturated fats, refined carbohydrates, and calories, which can contribute to weight gain, insulin resistance, and hormonal imbalance—factors strongly associated with the development of PCOS. Similarly, participants with low fruit and vegetable intake also showed a significant association with PCOS risk ($\chi^2 = 4.16$, $p = 0.041$), indicating that inadequate consumption of fiber-rich and antioxidant-rich

foods may negatively influence metabolic and hormonal health. In contrast, adolescents who followed a balanced diet showed fewer PCOS cases (12) compared to non-PCOS participants (48), suggesting that a healthy dietary pattern may play a protective role against the development of PCOS. These findings are consistent with previous research showing that unhealthy dietary habits, particularly frequent consumption of processed foods and insufficient intake of fruits and vegetables, are associated with increased risk of metabolic disorders and hormonal imbalance. Therefore, promoting balanced dietary habits and reducing the intake of fast foods may be important strategies for preventing PCOS and improving reproductive and metabolic health among adolescents.

Table 9: Correlation between BMI and Biochemical Markers

Variable	Correlation (r)	p-value
BMI vs Insulin	0.46	0.003*
BMI vs Cholesterol	0.39	0.009*
BMI vs Triglycerides	0.41	0.006*

Significant at $p < 0.05$

Table 9 presents the correlation between Body Mass Index (BMI) and selected biochemical markers among the adolescent participants. The results indicate a moderate positive correlation between BMI and serum insulin levels ($r = 0.46$, $p = 0.003$), suggesting that higher BMI is associated with increased insulin levels. This finding reflects the presence of insulin resistance, which is one of the key metabolic abnormalities linked with PCOS. Similarly, a significant positive correlation was observed between BMI and total cholesterol ($r = 0.39$, $p = 0.009$),

indicating that adolescents with higher BMI tend to have elevated cholesterol levels, which may increase the risk of cardiovascular complications. In addition, BMI showed a positive correlation with triglyceride levels ($r = 0.41$, $p = 0.006$), further highlighting the relationship between increased body weight and lipid metabolism disturbances. Since all the p-values are less than 0.05, the correlations are statistically significant, indicating a meaningful relationship between anthropometric status and biochemical markers. These findings are consistent with previous studies that have

reported a strong association between obesity, insulin resistance, and dyslipidemia among adolescents with PCOS. Therefore, maintaining a healthy body weight through balanced nutrition and regular physical activity is essential to reduce metabolic risk factors and improve hormonal balance among adolescents at risk of PCOS.

Conclusion

PCOS is a growing health concern among adolescent girls due to its association with metabolic, reproductive, and psychological complications. The ABCD model provides a comprehensive approach for assessing PCOS by integrating anthropometric, biochemical, clinical, and dietary factors. The findings of this study highlight the importance of early screening and lifestyle intervention among adolescents in the Mahishadal area of Purba Medinipur. Improving dietary habits, promoting physical activity, and increasing awareness about reproductive health can help reduce the prevalence and long-term complications of PCOS. Community-based health programs and school-level screening initiatives are essential for early identification and management of PCOS among adolescents.

References

1. Abdollahian S, Tehrani FR, Amiri M, Ghodsi D, Yarandi RB, Jafari M, *et al.* Effect of lifestyle modifications on anthropometric, clinical, and biochemical parameters in adolescent girls with polycystic ovary syndrome: a systematic review and meta-analysis. *BMC endocrine disorders*,2020;20(1):71.
2. Al Wattar BH, Fisher M, Bevington L, Talaulikar V, Davies M, Conway G, *et al.* Clinical practice guidelines on the diagnosis and management of polycystic ovary syndrome: a systematic review and quality assessment study. *The Journal of Clinical Endocrinology & Metabolism*,2021;106(8):2436-2446.
3. Anagnostis P, Tarlatzis BC, Kauffman RP. Polycystic ovarian syndrome (PCOS): Long-term metabolic consequences. *Metabolism*,2018;86:33-43.
4. Barrea L, Arnone A, Annunziata G, Muscogiuri G, Laudisio D, Salzano C, *et al.* Adherence to the mediterranean diet, dietary patterns and body composition in women with polycystic ovary syndrome (PCOS). *Nutrients*,2019;11(10):2278.
5. Biadgo B, Melku M, Abebe SM, Abebe M. Hematological indices and their correlation with fasting blood glucose level and anthropometric measurements in type 2 diabetes mellitus patients in Gondar, Northwest Ethiopia. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 2016, 91-99.
6. Biswas DK, Bhunia R, Mukherjee A. High Prevalence of Abortion among Primigravida and Teen Aged Girls in the District of Purba Medinipur, West Bengal; India. *Indian Journal of Public Health Research & Development*, 2016, 7(1).
7. Boeing H. Nutritional epidemiology: New perspectives for understanding the diet-disease relationship?. *European journal of clinical nutrition*,2013;67(5):424-429.
8. Fortin M, Haggerty J, Almirall J, Bouhali T, Sasseville M, Lemieux M. Lifestyle factors and multimorbidity: a cross sectional study. *BMC public health*,2014;14(1):686.
9. Franks S. Polycystic ovary syndrome in adolescents. *International journal of obesity*,2008;32(7):1035-1041.
10. Hunt KJ, Heiss G, Sholinsky PD, Province MA. Familial history of metabolic disorders and the multiple metabolic syndrome: the NHLBI family heart study. *Genetic Epidemiology: The Official Publication of the International Genetic Epidemiology Society*,2000;19(4):395-409.
11. Locks LM, Parekh A, Newell K, Dauphinais MR, Cintron C, Maloomian K, *et al.* The ABCDs of nutritional assessment in infectious diseases research. *The Journal of Infectious Diseases*,2025;231(3):562-572.
12. Malhotra S, Patra BN. Prevalence of child and adolescent psychiatric disorders in India: a systematic review and meta-analysis. *Child and adolescent psychiatry and mental health*,2014;8(1):22.
13. Mandal S, Tewari S, Parida S, Saha S. Artificial intelligence in predicting PCOD risk and designing preventive nutrition therapies: A. *Ultrasound*, 2021, 33.
14. Mizgier M, Jarzabek-Bielecka G, Formanowicz D, Jodłowska-Siewert E, Mruczyk K, Cisek-Woźniak A, *et al.* Dietary and physical activity habits in adolescent girls with polycystic ovary syndrome (PCOS)-Hastudy. *Journal of Clinical Medicine*,2021;10(16):3469.
15. Parua S, Das A, Hazra A, Chaudhuri P, Bhattacharya K, Dutta S, *et al.* Assessing body composition through anthropometry: Implications for diagnosing and managing polycystic ovary syndrome (PCOS). *Clinical Physiology and Functional Imaging*,2025;45(1):e12905.
16. Patel P, Abate N. Body fat distribution and insulin resistance. *Nutrients*,2013;5(6):2019-2027.
17. Patel S, Pushpalatha K, Singh B, Shrivastava R, Singh G, Dabar D. Evaluation of hormonal profile and ovarian morphology among adolescent girls with menstrual irregularities in a tertiary care centre at central India. *The Scientific World Journal*,2022;2022(1):3047526.
18. Peña AS, Witchel SF, Hoeger KM, Oberfield SE, Vogiatzi MG, Misso M, *et al.* Adolescent polycystic ovary syndrome according to the international evidence-based guideline. *BMC medicine*,2020;18(1):72.
19. Reinehr T. Metabolic syndrome in children and adolescents: a critical approach considering the interaction between pubertal stage and insulin resistance. *Current diabetes reports*,2016;16(1):8.
20. Shah AK, Sarin M, Karunanand B, Mohapatra S, Bhat SA. Association of hormonal status with anthropometric & biochemical parameters in women with polycystic ovarian syndrome. *hypertension*,2017;3(4):5.
21. Tehrani FR, Amiri M. Polycystic ovary syndrome in adolescents: challenges in diagnosis and treatment. *International journal of endocrinology and metabolism*,2019;17(3):e91554.
22. Tripathy P, Sahu A, Sahu M, Nagy A. Metabolic risk assessment of Indian women with polycystic ovarian syndrome in relation to four Rotterdam criteria based phenotypes. *European Journal of Obstetrics & Gynecology and Reproductive Biology*,2018;224:60-65.
23. Xenou M, Gourounti K. Dietary patterns and polycystic ovary syndrome: a systematic review. *Maedica*,2021;16(3):516.

24. Yasmin A, Roychoudhury S, Sengupta P, Ahmed ABF, Ranjan Madhu N, Paul Choudhury A, *et al.* Prevalence of polycystic ovary syndrome (PCOS) and its associated hormonal and comorbid risk factors in Northeast India: a cross-sectional comparative study. *Therapeutic Advances in Reproductive Health*, 2025;19:26334941251384195.