ASSOCIATION BETWEEN DIETARY PROTEIN-TO-CARBOHYDRATE RATIO AND SYMPTOMS PROFILE OF POLYCYSTIC OVARY SYNDROME IN OBESE FEMALES AGED 15–30 YEARS: A CROSS-SECTIONAL STUDY

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KEYWORDS

Polycystic Ovarian Syndrome, High protein, Low carbohydrate diet, Women with PCOS symptoms, Obesity, Anthropometry.

ABSTRACT

Background: Polycystic Ovarian Syndrome (PCOS) is a prevalent endocrine disorder among women of reproductive age, often associated with obesity and metabolic disturbances. Dietary modifications, particularly altering macronutrient composition, have been suggested as a potential intervention to alleviate PCOS symptoms.
Objective: This study aimed to evaluate the association between dietary protein-to-carbohydrate (P:C) ratio and PCOS symptoms in females aged 15–30 years.
Methods: A cross-sectional study was conducted among 50 obese women presenting with PCOS symptoms as per the Rotterdam diagnostic cri. Anthropometric measurements, including height, weight, waist circumference, and hip circumference, were recorded to calculate body mass index (BMI) and waist-to-hip ratio (WHR). Dietary intake data were collected through structured interviews and validated dietary recall questionnaires to determine the daily P:C ratio. The association between dietary P:C ratio and PCOS symptoms, including acne, hirsutism, and menstrual irregularities, was analysed using statistical methods.
Results: Women exhibiting PCOS symptoms had a significantly lower dietary P:C ratio compared to those without symptoms ($p < 0.05$). A lower P:C ratio (≤0.32) was significantly associated with acne ($p = 0.031$), irregular menses ($p = 0.028$), and hirsutism ($p = 0.046$).
Conclusion: Findings suggest that an increased dietary protein-to-carbohydrate ratio may have a beneficial effect on PCOS symptoms. Dietary interventions focusing on protein intake modulation could be considered as a non-pharmacological approach to managing PCOS. Further longitudinal studies with larger sample sizes are required to confirm these associations.

Introduction

One of the most common endocrine disorders affecting women of reproductive age is Polycystic Ovarian Syndrome (PCOS). This syndrome is manifested by anovulation characterised by menstrual irregularities, hirsutism and obesity associated with enlarged polycystic ovaries. The global prevalence of PCOS is estimated to range between 5% and 15% among women of reproductive age, with Indian prevalence studies reporting rates as high as 20%–25% in urban populations due to lifestyle changes and genetic predisposition. High-fat, sugar, and salt (HFSS) foods contribute to obesity by increasing insulin resistance, which exacerbates PCOS symptoms through hyperinsulinemia-driven androgen excess. A study found that dietary habits rich in refined carbohydrates and trans fats significantly correlated with higher PCOS prevalence (Moran et al., 2013). The annual healthcare cost of diagnosing and treating PCOS is around $4 billion, excluding expenses from related comorbidities. PCOS is linked to various health conditions like infertility, metabolic syndrome, obesity, type 2 diabetes, cardiovascular risk, depression, OSA, endometrial cancer, and NAFLD/NASH. Risk factors include

family history, prepubertal obesity, congenital virilising disorders, abnormal birth weight, premature adrenarche, and valproic acid use (Rasquin LI et.al, 2025). Diagnosing PCOS in adolescents is challenging due to overlapping symptoms with normal puberty, such as acne, menstrual irregularities, and hyperinsulinemia. Anovulatory cycles are common in the first 2–3 years post-menarche due to an immature hypothalamic-pituitary-ovarian axis. Persistent oligomenorrhea beyond this period suggests ongoing reproductive dysfunction. Ultrasound is less useful, as adolescents often have naturally large, multicystic ovaries (Rasquin LI et.al, 2025).

Elevated androgen levels in individuals with PCOS often lead to physical manifestations such as excessive hair growth on the face, chest, and back in a male-pattern distribution, scalp hair thinning, acne, and an increased likelihood of abdominal weight gain. Studies indicate that between 50% and 80% of women with PCOS are classified as overweight or obese.

Overweight and obesity rank as the fifth highest risk factor for deaths worldwide. Since 1980, obesity rates have more than doubled across the globe. By 2008, over 1.4 billion adults aged 20 and older were classified as overweight, including more than 200 million men and nearly 300 million women who were considered obese. The dietary and lifestyle adjustments beneficial for managing PCOS are not drastic measures. In fact, if these habits were widely adopted, there could be a significant reduction in various chronic health conditions, including heart disease, diabetes, obesity, high blood pressure, cancer, and cognitive decline. Maintaining a nutritious diet and staying physically active contribute to overall well-being by boosting energy levels, enhancing mood, promoting better sleep, improving self-perception and body image, and reducing stress.

Compared to subcutaneous fat, intra-abdominal adipose tissue has a higher cell density per unit mass, greater blood flow, an increased number of glucocorticoid (cortisol) and androgen (testosterone) receptors, and heightened catecholamine-induced lipolysis. These characteristics make intra-abdominal fat more responsive to both normal stimuli and changes in lipid metabolism and storage. There is substantial evidence indicating that abdominal obesity significantly contributes to the onset of insulin resistance and metabolic syndrome. This condition is marked by elevated insulin levels, abnormal lipid profiles, impaired glucose regulation, and high blood pressure, establishing a connection between obesity and cardiovascular disease.

Although body weight alone is not a precise measure of excess adiposity, it remains a widely utilised index for evaluating obesity. Conventionally, obesity is defined as body weight exceeding +2 standard deviations (SD) from the median weight-for-height reference value. Body weight assessment is commonly performed using both BMI and Broca's Index are widely used internationally as reference standards for assessing obesity prevalence in populations.

Pathophysiological Mechanisms Linking Obesity to Polycystic Ovary Syndrome (PCOS)

An abnormal hypothalamic-pituitary-ovarian (PHO) axis leading to the development of PCOS could be triggered by obesity among other causes. Android obesity, characterised by excess abdominal fat deposition, is linked to a higher risk of insulin resistance, metabolic syndrome, and androgen excess, which are key factors in PCOS pathology. Studies indicate that visceral fat has greater metabolic activity, contributing to increased insulin resistance, chronic low-grade inflammation, and dysregulated steroidogenesis, thereby worsening PCOS symptoms (Rudnicka et al.,2021).

The ideal macronutrient distribution for managing PCOS remains debated, but research suggests a protein-to-carbohydrate ratio of at least 0.4 may help reduce insulin resistance and hyperandrogenism (Moran et al., 2013)

Effect on Ovary :

Obesity is linked to insulin resistance and compensatory hyperinsulinemia. In cultured cells, insulin acts as a co-gonadotropin, stimulating ovarian androgen production. The use of anti-diabetic medications that reduce insulin levels or enhance insulin sensitivity has been associated with lower circulating androgen levels and improved ovulation rates. Additionally, obesity leads to an increase in various growth and inflammatory factors, which may further contribute to excessive ovarian androgen production or hinder the conversion of androgens to estrogen.(Diamanti-Kandarakis & Dunaif, 2012).

A high-fat, high-sugar, and high-salt diet, combined with a sedentary lifestyle, can greatly increase the risk of developing and worsening Polycystic Ovary Syndrome (PCOS) by promoting insulin resistance, weight gain, and hormonal imbalances. Studies have shown that adolescent girls with PCOS in Iran tend to consume high amounts of fatty and salty foods, sugar-rich items, and unhealthy snacks, while their intake of fiber, dairy products, fish, seafood, and legumes remains low. (Hajivandi et al. 2020).

Obesity is a significant factor in PCOS, contributing to insulin resistance and hyperinsulinemia, which in turn stimulate gonadal androgen production, leading to hirsutism and menstrual irregularities. Individuals with obesity not only vary in the amount of excess fat they store but also in how it is distributed throughout the body. Fat distribution influenced by weight gain impacts both the health risks associated with obesity and the specific diseases that may develop. It is important to differentiate between individuals with "abdominal fat distribution" or "android obesity," which carries a higher risk, and those with "gynoid fat distribution," where fat is more evenly and peripherally distributed.

Diet has an important role in obesity management[1]. Excess carbohydrates in the Indian diet are a major contributory factor in obesity as more calories are ingested than expended. Excessive carbohydrates are converted into fat for the purpose of storage. Proteins in the diet are required for highly specialised functions in our body in the form of immune proteins, hormones, enzymes, blood proteins and nucleoproteins. Increased percentage of proteins in the diet may have a beneficial role in reducing weight in obese patients and thus it may have a definitive role in reducing the severity of symptoms of PCOS like hirsutism and menstrual irregularities.

A structured exercise regimen, including 150 minutes of moderate-intensity aerobic exercise per week, has been associated with improved insulin sensitivity and menstrual cycle regulation in PCOS patients (Harrison et al ,2011).

The "80/20 rule" for diet and exercise suggests that 80% of metabolic improvements stem from dietary choices, while 20% result from physical activity. However, clinical studies emphasise that a combined approach yields the best results (Patikorn et al ,2021)

High-Fat Nutritional Protocols for Polycystic Ovary Syndrome (PCOS)

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder affecting women of reproductive age, often associated with metabolic disturbances such as insulin resistance, obesity, and hormonal imbalances. Various dietary interventions, particularly high-fat nutritional protocols, have been investigated for their potential benefits in managing PCOS symptoms. This essay summarises relevant studies examining the effects of different dietary approaches, including ketogenic and low-carbohydrate diets, on PCOS outcomes.

Dietary Interventions and Their Impact on PCOS

Several studies have explored the effects of high-fat diets on PCOS patients, with mixed results based on different dietary models and population samples.

Dietary Patterns and Macronutrient Intake

A case-control study by Altieri et al. (2013) analysed dietary intake among 100 women with PCOS and obesity or overweight. The study found a high intake of high glycemic index sweets, saturated fat, and cheese in PCOS patients. However, the assessment of advanced glycosylated end product (AGE) content in food was limited, and the inclusion of overweight individuals may have influenced the findings.

Mediterranean and Low-Carbohydrate Diet (MED/LC Diet)

Mei et al. (2022) conducted a 12-week randomised controlled clinical trial on 72 overweight PCOS patients. Their findings showed that the MED/LC diet effectively restored menstrual cycles, improved anthropometric parameters, and reduced insulin resistance. However, patient adherence to the diet was challenging, and the study was limited to a single center with only Chinese participants.

Ketogenic Diet and Metabolic Improvements

A series of controlled clinical trials assessed the impact of ketogenic diets (KD) on PCOS.

- **Paoli et al. (2020)** examined 14 overweight women with PCOS following the KEMEPHY diet for 12 weeks. The study found reductions in body weight, BMI, visceral adipose tissue, glucose, insulin, triglycerides, LDL cholesterol, and androgen levels, while increasing estradiol, progesterone, and SHBG levels. However, the small sample size and lack of an oral glucose tolerance test were limitations.
- **Cincione et al. (2021)** studied 17 women with PCOS and obesity over 45 days, revealing improvements in LH, FSH, SHBG, insulin sensitivity, and the HOMA index while reducing androgen levels. However, the small sample size and concerns about long-term adherence were noted.

• **Mavropoulos et al. (2005)** investigated 11 women with a BMI over 27 kg/m² following a low-carbohydrate ketogenic diet (LCKD) for six months. The results demonstrated significant improvements in weight, free testosterone levels, LH/FSH ratio, and fasting insulin. However, weight loss was a potential confounding factor, and hormonal measurements were not taken at specific menstrual cycle phases.

Weight Loss and Hormonal Modulation

Magagnini et al. (2022) conducted a 12-week controlled clinical trial on 25 obese women with PCOS. The study observed reductions in BMI, waist circumference, and HOMA index, along with increased progesterone and SHBG levels. However, the absence of a control group made it difficult to determine whether the benefits were due to the ketogenic diet alone or weight loss.

Review Findings on Short-Term Ketogenic Diets

Khalid et al. (2023) reviewed multiple studies investigating the effects of short-term ketogenic diets on PCOS. The findings suggested that KD may improve hormonal imbalances, but the review format limited clinical conclusions.

High-fat nutritional protocols, particularly ketogenic and low-carbohydrate diets, have shown promise in improving metabolic and hormonal parameters in women with PCOS. While studies suggest benefits such as improved insulin sensitivity, weight reduction, and hormonal balance, limitations such as small sample sizes, short intervention periods, and adherence challenges highlight the need for further research. Long-term studies are essential to establish the sustainability and broader applicability of these dietary interventions in managing PCOS effectively.

Lifestyle Interventions for the Management of Polycystic Ovary Syndrome (PCOS)

Obesity is linked to insulin resistance and compensatory hyperinsulinemia. In cultured cells, insulin acts as a co-gonadotropin, stimulating ovarian androgen production. The use of anti-diabetic medications that reduce insulin levels or enhance insulin sensitivity has been associated with lower circulating androgen levels and improved ovulation rates. Additionally, obesity leads to an increase in various growth and inflammatory factors, which may further contribute to excessive ovarian androgen production or hinder the conversion of androgens to estrogen.

Healthy eating means going out of your way to eat good, nourishing food- not hyper focusing on all the “bad food” you need to avoid. There’s an 80/20 rule[3]. Its 80% of what you eat and 20% represents how much physically active you are (exercise).

The impact of macronutrient composition and ratios in PCOS management has become crucial especially with respect to the protein intake. Higher protein intakes, with a protein-to-carbohydrate ratio of at least 0.4, has been associated with improved insulin sensitivity, reduced hyperandrogenism, and better weight management in women with PCOS. Adequate protein intake supports satiety, lean muscle mass, and metabolic regulation, which are critical in mitigating PCOS symptoms (Moran et al., 2013).

AIMS & OBJECTIVES

To assess the incidence of Polycystic Ovary Syndrome (PCOS) among the study participants and investigate the association between the dietary protein-to-carbohydrate ratio with respect to PCOS symptoms.

OBJECTIVES: -

To determine the prevalence of Polycystic Ovary Syndrome (PCOS) among the study participants using standardized Rotterdam diagnostic criteria.

To evaluate the dietary patterns of the participants, with a specific focus on the protein-to-carbohydrate ratio in their daily intake.

To analyse the association between the dietary protein-to-carbohydrate ratio and the presence or severity of PCOS symptoms, such as menstrual irregularities, hyperandrogenism, and metabolic disturbances.

MATERIALS AND METHODS

Study Design and Participants

A cross-sectional study was conducted from October 2023 to March 2024 at a corporate hospital in Pune, India, to investigate the association between obesity and Polycystic Ovary Syndrome (PCOS) symptoms. Out of 100 women initially screened, 50 obese women aged 15–30 years presenting with PCOS symptoms were enrolled based on predefined inclusion and exclusion criteria. The inclusion criteria comprised women aged 15–30 years exhibiting clinical manifestations of PCOS, such as acne, hirsutism, and menstrual irregularities, with obesity defined as a body mass index (BMI) ≥ 25 kg/m² or a waist-to-hip ratio (WHR) > 0.85. Exclusion criteria included married women with children and lean women (BMI < 25 kg/m²) presenting with PCOS symptoms. This study aimed to explore the relationship between obesity and PCOS symptomatology in the selected cohort. The approvals for the study were conducted by IEC committee at the Asha Kiran JHC hospital, Pune.

Anthropometric Assessment

A wall-mounted stadiometer was used for measuring height to the nearest 0.5 cm while the weight was recorded using a calibrated electronic weighing scale. Waist circumference was measured using the standard protocols at the midpoint between the lower rib cage and iliac crest, while hip circumference was measured at the widest part of the buttocks. BMI was calculated as weight (kg) divided by height squared (m²), and WHR was determined as waist circumference divided by hip circumference.

Dietary Assessment

Dietary intake was assessed using a pre-tested structured interview and validated dietary recall questionnaire. Participants provided details of their daily dietary consumption, which was analysed to estimate protein and carbohydrate intake. The P:C ratio was calculated as:

P:C ratio = Daily Protein Intake (g)

Daily Carbohydrate intake (g)

A threshold of ≤0.32 was defined as a low P:C ratio based on existing literature.

Assessment of PCOS Symptoms

PCOS symptoms were documented based on participant-reported history and clinical examination conducted at the hospital. The severity of acne was graded as mild, moderate, severe, or cystic. Menstrual irregularities were classified into irregular and very irregular cycles. Hirsutism was categorised into facial, navel, or areolar distribution.

Statistical Analysis

Data were analysed using SPSS version 25. Descriptive statistics were used to summarise demographic and clinical characteristics. The association between dietary P:C ratio and PCOS symptoms was evaluated using chi-square tests, and a p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and Anthropometric Characteristics

The study included 50 women aged 15–30 years, with the 26 of them (52%) belonging to the 21–25 age group. A significant portion (46%) had higher education, while 20% belonged to the lower socioeconomic class. Most participants (84%) were unmarried. Regarding lifestyle factors, 56% of participants had a sedentary lifestyle, while only 14% engaged in active physical activity. The dietary assessment revealed that 56% of the participants followed a non-vegetarian diet, while 44% were vegetarians (table 1).

Table 1. Demographic Characteristics of Study Participants , n=50

Variable	Category	Frequency (n)	Percentage (%)
Age Group (Years)	15-20	11	22.0
	21–25	26	52.0
	26–30	12	24.0
	31–35	1	2.0
Education Level	No Formal Education	3	6.0
	Primary (Up to Grade 8)	6	12.0

	Secondary (Grade 9–12)	18	36.0
	Higher Education (College/University)	23	46.0
Marital Status	Unmarried	42	84.0
	Married	8	16.0
Socioeconomic Status	Lower	10	20.0
	Middle	30	60.0
	Upper	10	20.0
Physical Activity Level	Sedentary	28	56.0
	Moderate	15	30.0
	Active	7	14.0
Dietary Pattern	Vegetarian	22	44.0
	Non-Vegetarian	28	56.0

Obesity Classification Based on BMI and WHR

According to BMI classification, 68% of participants were categorised as pre-obese, followed by 18% in Obese Class 1, 8% in Obese Class 2, and 4% in the very severe obesity category (Table 2). The WHR assessment revealed that 60% of participants had high-risk obesity, while 18% had borderline obesity.

Table 2. Classification of Obesity Based on BMI

BMI Category	Frequency (n)	Percentage (%)
Normal (18.5–23.0)	5	10.0
Pre-Obese (23.0–29.9)	30	68.0
Obese Class 1 (30.0–34.9)	9	18.0
Obese Class 2 (35.0–39.9)	4	8.0
Very Severe Obesity (≥40)	2	4.0
Total	50	100.0

A significant proportion (60%) of participants had a high-risk WHR (>0.90), indicating central obesity. Since visceral fat is linked to insulin resistance, this supports the role of abdominal obesity in worsening PCOS symptoms (Table 3).

Table 3. Classification of Obesity Based on WHR

WHR Category	Frequency (n)	Percentage (%)
Normal (<0.85)	11	22.0
Borderline (0.85–0.90)	9	18.0
High Risk (>0.90)	30	60.0
Total	50	100.0

PCOS Symptoms profile Among Participants

Among sedentary participants, 65% had acne, 79% had irregular menses, and 50% had hirsutism, demonstrating an inverse correlation between physical activity levels and symptom severity. This suggests that metabolic and hormonal imbalances contribute to a broad spectrum of clinical manifestations in PCOS (Table 4). Physical activity was inversely correlated with PCOS symptoms—a higher proportion of women with a sedentary lifestyle reported acne, menstrual irregularities, and hirsutism. Non-vegetarians had a slightly lower Protein-to-Carbohydrate (P:C) ratio, which correlated with a higher prevalence of PCOS symptoms.

Table 4. Distribution of PCOS Symptoms Among Participants

Symptoms	Category	Frequency (n)	Percentage (%)
Acne (n=26)	Mild	18	36.0
	Moderate	3	6.0
	Severe	4	8.0
	Cystic	1	2.0
Menstrual Irregularities (n=32)	Irregular Menses	24	48.0

	Very Irregular Menses	8	16.0
Hirsutism (n=19)	Facial Hirsutism	17	28.0
	Navel Hirsutism	1	2.0
	Areolar Hirsutism	1	2.0

Association Between Dietary Protein-to-Carbohydrate Ratio and PCOS Symptoms

The study found a significant association between a lower protein-to-carbohydrate (P:C) ratio and the presence of PCOS symptoms (table 5). Women with acne, irregular menses, and hirsutism were more likely to have a P:C ratio ≤ 0.32 compared to those without these symptoms. The study found a significant association between a lower protein-to-carbohydrate (P:C) ratio and the presence of PCOS symptoms. Women with a sedentary lifestyle had a significantly lower mean P:C ratio (0.28 ± 0.04) compared to those with a moderate (0.34 ± 0.05) or active lifestyle (0.37 ± 0.06). Sedentary participants also reported a higher prevalence of acne (65%), irregular menses (79%), and hirsutism (50%). Non-vegetarians had a lower mean P:C ratio (0.29 ± 0.05) compared to vegetarians (0.33 ± 0.06). This was associated with a higher prevalence of acne (57% vs. 45%), irregular menses (70% vs. 55%), and hirsutism (42% vs. 32%). The P:C ratio was significantly lower in women with acne (0.27 ± 0.03), irregular menses (0.26 ± 0.04), and hirsutism (0.25 ± 0.04) compared to asymptomatic participants (0.35 ± 0.05) ($p < 0.05$).

These findings suggest that higher protein intake relative to carbohydrates may help reduce the severity of PCOS symptoms and that dietary and lifestyle modifications could play a crucial role in symptom management.

Table 5. Association Between Acne and Protein-to-Carbohydrate Ratio

Acne Status	P:C Ratio ≤ 0.32 (Low)	P:C Ratio ≥ 0.33 (High)	Total (n)	p-value
Present (n=26)	23 (88.5%)	3 (11.5%)	26	0.031
Absent (n=24)	15 (62.5%)	9 (37.5%)	24	
Total	38 (76.0%)	12 (24.0%)	50	

Among those with irregular menses, 87.5% had a low P:C ratio, compared to 55.6% in those without menstrual irregularities ($p = 0.028$). This highlights the potential role of dietary macronutrient composition in menstrual cycle regulation (Table 6).

Table 6. Association Between Irregular Menses and Protein-to-Carbohydrate Ratio

Irregular Menses Status	P:C Ratio ≤ 0.32 (Low)	P:C Ratio ≥ 0.33 (High)	Total (n)	p-value
Present (n=32)	28 (87.5%)	4 (12.5%)	32	0.028
Absent (n=18)	10 (55.6%)	8 (44.4%)	18	
Total	38 (76.0%)	12 (24.0%)	50	

A significant association was observed between a low P:C ratio and hirsutism ($p = 0.046$), with 93.8% of participants with hirsutism consuming a lower protein diet. This suggests that dietary interventions targeting protein intake may help mitigate excessive androgen-related symptoms in PCOS (Table 7).

Table 7. Association between Hirsutism and Protein-to-Carbohydrate Ratio

Hirsutism Status	P:C Ratio ≤ 0.32 (Low)	P:C Ratio ≥ 0.33 (High)	Total (n)	p-value
Present (n=16)	15 (93.8%)	1 (6.2%)	16	0.046
Absent (n=34)	23 (67.6%)	11 (32.4%)	34	
Total	38 (76.0%)	12 (24.0%)	50	

Discussion

The present study highlights a strong association between dietary macronutrient composition and PCOS symptom severity. The prevalence of menstrual irregularities (64%), acne (52%), and hirsutism (38%) among participants aligns with previous reports indicating that metabolic and hormonal imbalances play a crucial role in PCOS pathophysiology. These findings are consistent with global PCOS prevalence estimates, where 50–80% of affected women exhibit obesity or metabolic disturbances (Neubronner et al., 2021). The study further

reinforces that central obesity, observed in 60% of participants with high WHR (>0.90), is a critical factor exacerbating insulin resistance and hyperandrogenism in PCOS.

The study found that a lower dietary protein-to-carbohydrate (P:C) ratio (≤0.32) was significantly associated with increased PCOS symptom severity. Women with acne, menstrual irregularities, and hirsutism had an average P:C ratio of 0.27–0.29, compared to 0.35 in asymptomatic participants ($p < 0.05$). These findings align with Sorensen et al. (2012), who reported that an increased dietary protein intake (>30% of total energy) improved insulin sensitivity and reduced hyperandrogenic symptoms in women with PCOS. Similarly, Kasim-Karakas et al. (2007) demonstrated that excessive carbohydrate intake (>60% of total energy) exacerbates insulin resistance and androgen excess, contributing to PCOS pathogenesis. The present study supports the hypothesis that a higher protein intake relative to carbohydrates may serve as a dietary intervention to mitigate PCOS symptoms and improve metabolic outcomes.

A minority of them also showed signs of moderate to severe acne as well as cystic acne. The minority also presented a much severe irregularity in menses, areolar and naval hirsutism. A significant correlation was observed between those with acne, a history of irregular menses and hirsutism to a diet with low Protein-to-carbohydrate ratio. It was found that most of the participants who developed acne had a low protein-to-carbohydrate ratio in the diet compared to the participants who did not develop acne. Along with acne, a history of irregular menses and hirsutism was also correlated to the diet low in protein to Carbohydrate ratio. The study effectively demonstrated a link between cases with a history of irregular menses, hirsutism and low protein to carbohydrate ratio diet compared to the patients who did not have irregular menses history and/or hirsutism.

Among participants, 64% were categorised as pre-obese (BMI 25.0–29.9), 24% as Obese Class 1 (BMI 30.0–34.9), and 12% as Obese Class 2 or higher (BMI ≥35). A significant proportion (60%) had a high-risk WHR (>0.90), reinforcing the role of central obesity in PCOS pathophysiology. The study also depicts a strong association between individuals with BMI 25-29 kg/m2 followed by obese grade I and grade II individuals. It can be concluded that as the BMI increases the risk for acquiring PCOS also increases. Amongst many other studies (Barthelmess EK et. al, 2014) (Willis D et. al, 1995), a study supports this conclusion by stating 1.85-fold higher mFG (modified Ferriman Gallwey) score of PCOS women due to higher BMI (Legro RS, 2012). A majority of overweight and obese female individuals develop PCOS. Excess nutrient intake often leads to hyperplasia and/or hypertrophy of adipocytes. The majority of the participants in this study showed a high Waist-to-hip ratio, thereby including WHR as another potential factor along with BMI. Many emerging studies support findings of reduced visceral fat and its correlation to improved menses regularity.

The present study supports findings by Moran et al., (2013), which reported that a diet low in protein and high in refined carbohydrates contributes to increased androgen levels and insulin resistance in women with PCOS. A meta-analysis by Lim et al., (2019) demonstrated that PCOS patients with a BMI ≥25 kg/m² had a 1.85-fold higher risk of developing hirsutism compared to those with a normal BMI. The observed high prevalence of acne (52%), menstrual irregularities (64%), and hirsutism (38%) in this study aligns with global reports, where hyperandrogenism-related symptoms remain a hallmark of PCOS. Visceral adiposity reduction has been linked to improved menstrual regularity and decreased androgen levels, reinforcing the need for targeted weight loss interventions in obese PCOS patients Azziz, R et. al (2016).

The most highlighted characteristic of PCOS is the excess production of ovarian and /or adrenal androgen secretion. There is an observed alteration in steroidogenesis and hyperinsulinemia which may be a few factors linked to excessive androgen production. Hyperandrogenism being a peculiar characteristic in PCOS females varies in its extent depending upon the circulating androgen levels, local androgen concentration, sensitivity of the pilosebaceous unit/hair follicle to androgens. Although it was also studied that the level of androgen concentration and severity of hirsutism cannot be associated. Through this study we could observe the severities of acne, irregularities in menses, and various forms of Hirsutism present in women with PCOS. Common symptoms observed in this study were mild acne, facial hirsutism, and irregular menses. One of the hallmark characteristics of PCOS is the excess production of ovarian and/or adrenal androgens. This study found that majority of the participants experienced symptoms of PCOS, indicating the role of hyperandrogenism in PCOS symptom development. The alteration in steroidogenesis and hyperinsulinemia are key contributors to excessive androgen production, which in turn affects the skin and hair follicles. However, previous studies suggest that while hyperandrogenism is a defining feature of PCOS, the severity of symptoms like hirsutism does not always directly correlate with circulating androgen levels Carmina et al., (2006).

In a study by Escobar-Morreale et al. (2018), acne was present in 50–70% of women with PCOS, while hirsutism was observed in 40–80%, depending on ethnicity and genetic predisposition. Similarly, a systematic review by Lim et al. (2012) found that 70–80% of women with PCOS experience menstrual irregularities due to disrupted folliculogenesis. The findings of our study align with these reports, reinforcing that multiple factors, including insulin resistance, androgen sensitivity, and lifestyle factors such as diet and obesity influence PCOS symptom severity.

Conclusion

This study highlights the significant association between a lower protein-to-carbohydrate ratio and increased severity of PCOS symptoms, particularly acne, hirsutism, and menstrual irregularities. A higher BMI and central obesity (WHR > 0.90) were strongly correlated with metabolic abnormalities in PCOS, emphasising the need for targeted lifestyle interventions. A diet with an increased protein-to-carbohydrate ratio, combined with structured physical activity, may serve as an effective non-pharmacological strategy for managing PCOS symptoms.

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