Revealing Polycystic Ovarian Syndrome (PCOS): A Thorough Survey Employing Rotterdam Criteria and Modified Ferriman-Gallwey Scoring for Hirsutism Detection in Indian Women

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ABSTRACT:

Polycystic ovarian syndrome (PCOS), an endocrinopathological condition characterized by three main factors that include hirsutism, irregular menstrual cycle and Polycystic Ovaries. The main objective of our article is quantifying the PCOS prevalence and educate females that hirsutism too unfeigned to be assumed as a taboo. The survey is designed in accordance with Rotterdam Criteria broadly, and FG (i.e., Ferriman Gallwey) scoring for hirsutism specifically. Through our survey, we observed the undiagnosed PCOS cases and the none- PCOS cases with different severity of hirsutism.

Introduction

Polycystic Ovarian Syndrome (PCOS) is a prevalent endocrinopathy affecting reproductive-aged women, linked to evolving lifestyles. *Teede et al.,2018.* It's characterized by heterogeneity and diverse symptoms. Menstrual irregularities, including heavy bleeding (BLM ≥ 80 mL, termed Large Periods of Bleeding - LPB), *Habibi et al.,2015* significantly impact physical, emotional, and social well-being. Research indicates a correlation between PCOS and menstrual disorders, such as oligomenorrhoea, secondary amenorrhoea, polymenorrhea, hypermenorrhea, and dysmenorrhoea. *Zafar et al.,2018.* These conditions are often attributed to the inadequate development of the hypothalamic-pituitary-ovarian (HPO) axis. *Dambhare et al.,2012.* Recognizing and treating PCOS and related menstrual disorders is crucial for preventing long-term implications on adults' quality of life. Early detection is vital, as menstrual issues may signal underlying serious conditions like endometriosis. *Michelle et al., 2006.*

Polycystic Ovarian Syndrome (PCOS) presents distressing symptoms such as hirsutism, acne, irregular menstrual cycles, and infertility *Prathap et al.,2018.* Weight gain, particularly in adolescents and young women, is a significant concern. The syndrome is characterized by persistent anovulation and hyperandrogenism, affecting 5-7% of reproductively mature women. *Yildiz et al., 2010- Rosenfield et al., 1979.* Anovulation is the primary cause of infertility in PCOS patients, impacting the effectiveness of Clomiphene Citrate (CC) treatment. *Imani et al.,2002.* Hirsutism, a common symptom, is linked to excessive androgen levels, affecting various body regions. Elevated testosterone levels during adolescence lead to the transformation of vellus hair into conspicuous terminal hair, driven by androgens. *Yildiz et al., 2010* PCOS is associated with adverse pregnancy outcomes, including preterm births and higher rates of ADHD and autism in offspring *Ding et al.,2014.* A self-examined questionnaire could aid in the timely diagnosis of PCOS, reducing underdiagnosis. PCOS poses risks during pregnancy, increasing the likelihood of complications

like gestational diabetes and preeclampsia. *Azziz et al., 2016.* Ovarian drilling is a key method to enhance pregnancy rates in PCOS patients. Psychological challenges, including reactive depression and elevated stress responses, impact the quality of life in PCOS patients. *Debras, et al., 2019* The 2003 Rotterdam diagnostic criteria require satisfaction of at least two out of three conditions for PCOS diagnosis: oligo- or amenorrhea, hirsutism, and polycystic ovaries. *Group et al.,2004- Spritzer, et al.,2014.*

Fig.1: Normal Ovary and Polycystic Ovary
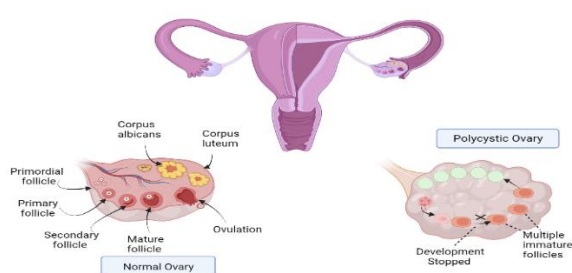
Understanding the Modified Ferriman-Gallwey Scale and Its Evolution

The modified Ferriman-Gallwey (FG) Scale assesses unwanted hair growth in 9 regions: upper lips, chin, upper and lower back, abdominal area, upper arms, and thighs, scored from 0 to 4. The updated scale ranges from 0 to 36, summing scores from all regions. In 2001, an additional 10 regions, such as sideburns and pubic area, were added with unique definitions for each on the four-point scale. The diagram illustrates these regions. *Goodman et al., 2001.*

## PCOS Unveiled: Navigating the Multifaceted Landscape of an Endocrinopathy

PCOS is an endocrinopathy with multifactorial causes. Etiological factors include insulin resistance, *Clemmons et al.,2004.* hormonal imbalance, genetic influences, psychological disorders, ovarian follicular defects, and miscellaneous factors. Insulin resistance, a key contributor, leads to increased insulin levels, triggering androgen production and disrupting hormonal balance. Hormonal imbalance, linked to insulin resistance, results in elevated androgen levels causing symptoms like irregular menstrual cycles and excess hair growth. *Gurevich. et al.,2022.* Genetic factors, involving genes

like CYP11A1, CYP17, and androgen receptor, contribute to PCOS susceptibility. Psychological disorders, including stress and depression, may exacerbate PCOS symptoms. Environmental factors like BPA exposure are also implicated. *Azziz et al.,1998* Ovarian follicular defects lead to improper maturity, causing infertility. *Olga et al.,2017, Talpade et al.,2018* Miscellaneous factors, such as eating disorders and obesity, indirectly affect hormonal balance and contribute to PCOS development. PCOS is a complex condition with interconnected factors influencing its manifestation. *Krug et al., 2019*

Unravelling the Intricate Pathophysiology of Hormonal Imbalance, Metabolic Dysfunction, and Ovarian Disruption

PCOS pathophysiology begins with hormonal imbalance and metabolic dysfunction, disrupting the hypothalamus-pituitary-ovarian axis. Abnormal gonadotropin release causes ovarian dysfunction, leading to menstrual irregularities and infertility. The liver contributes to hirsutism by increasing free androgens, while the pancreas, influenced by increased IGF-1, disrupts insulin secretion, causing glucose intolerance. *Jeshica et al., 2021* Specific culprits aggravate endocrinopathy in PCOS, like progesterone resistance in endometriosis, impacting the normal menstrual cycle and fertility. Progesterone resistance results from altered progesterone receptor expressions, *Marwa et al.,2012.* genetic variations, inflammatory responses, and immune dysregulation. Insulin resistance, neuroendocrine defects, and dysregulated HPA and HPG axes further contribute to PCOS manifestations, *Steegers et al.,2020.* including hyperandrogenism. The interconnected mechanisms underscore the complexity of PCOS pathogenesis. *Amy et al.,2019.*

Fig.2: Pathophysiology of Hormonal Imbalance
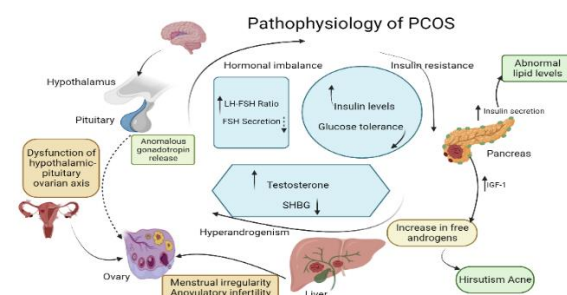
PCOS symptoms manifest through various physical signs:

I. Acne: Androgens stimulate sebaceous glands, causing acne on the face, neck, chest, and upper back.

II. Acanthosis nigricans: Indicates hyperinsulinemia and aids in identifying Type 2 diabetes in PCOS patients. *Lee et al.,2007.*

III. Dark skin patches: Common in body folds, like the neck and armpits, signaling insulin resistance.

IV. Hirsutism: Abnormal hair growth in male-pattern areas, such as the face, chest, and thighs. *Rittmaster et al.,1997.*

V. Obesity: Unusual weight gain attributed to hormonal imbalance and psychological factors.

VI. BMI increase, insomnia, excessive sweating, heat intolerance, fatigue, depression, and dyspnoea are common in PCOS. *Barber et al.,2006.*

VII. Androgenic alopecia: Scalp hair loss and baldness due to elevated androgen levels.

VIII. Menstrual irregularities: Emotional changes, bloating, abnormal bleeding, and severe cramps characterize disrupted menstrual cycles in PCOS. *Nida et al.,2019.*

Methodology

The Polycystic Ovarian Syndrome is a ubiquitous endocrinal disorder, one should not be ashamed of but, a biological bias to be rectified. Our main concern to run this survey is to erase the hesitation of self-doubts in fertile females and get knowledge about the factors that are responsible for diagnosing PCOS. We used The Rotterdam criteria for evaluating undiagnosed PCOS cases. The Rotterdam criteria was recommended by the endocrine society to diagnose PCOS in 2003. [which says "if at least two of the three features are present. i.e., oligomenorrhea, hyperandrogenism and polycystic ovaries at ultrasound scan"] In this survey, we used FG scoring for hirsutism which is caused due to hyperandrogenism. Feriman gallway scoring is based on 0-4 scoring for unwanted abnormal hair growth at 9 different body regions.

PCOS (the most common endocrinopathy) is the most prevalent condition in now a day, basically PCOS is a hormonal imbalance that usually come about when the ovaries produce excessive hormones mainly androgens. For the assessment of the PCOS the main criteria are Rotterdam criteria involving the oligo anovulation, hyperandrogenism and polycystic ovaries. For the PCOS assessment 2 out of 3 criteria must satisfy.

Ferriman Gallwey scoring is done for the detection of hirsutism (abnormal hair growth) (Hyperandrogenism related factor). The scoring system generally involves the 9 body parts, with score marking from 0(no excessive hair terminal growth) to 4 (extensive hair terminal growth). For the final scoring each body part score is to be calculated accurately. Maximum score possible is 36 but the minimum score for the hirsutism to be present in women is >= 8. Severity of hirsutism can be found out from the Hirsutismal scoring i.e., no hirsutism (less than 8), mild hirsutism (8 – 16), moderate hirsutism (17 – 25), severe hirsutism (more than 25). This Ferriman Gallwey scoring is limited to some extent, limitations involved the removal of hair by cosmetic procedures and its subjective nature. A survey was conducted on 203 women for the assessment of pcos. Different questions were there in the survey ranging from age, weight, period irregularity, and ferryman Gallwey scoring system. All the data was studied precisely and put in the Rotterdam criteria for the assessment of PCOS.

Result

We conducted the survey on the three main criterias for diagnosing PCOS, with an outlook of self-exposing own symptoms and clear off the doubts and therefore, decrease underdiagnosed cases. As we studied PCOS, there were androgenic symptoms along with polycystic ovaries and comorbidities like hypothyroidism, diabetes mellitus and hypersensitivity reactions, we included almost every question that may arise as a doubt to be having PCOS. As the standard survey criterias, it includes basic questions like age, weight, acne longevity, acne type, acne severity, family PCOS history, menstrual bleeding frequency [whether regular or irregular], menstrual bleeding flow, conception related issues, skin related issues [like abnormally dark complexion at specific sites], hair growth changes, and Ferryman Gallwey standard questionnaire on hyperandrogenism symptoms [. i.e., abnormal hair growth called as hirsutism].

Our survey had on an average age group of 20-25 years Indian females. In our 203 responses, the average weight was 68kgs. There was a total of 70 undiagnosed PCOS cases which we concluded from our survey. We did

graphical evaluation for ferryman gallwey scoring and hirsutism severity and graphical representation of survey questions.

1. Firstly, the questions asked on period irregularities gave a graphical representation 1. Here, we plotted number of cases on y-axis and how often do you get your periods on x-axis.

Table.1: No. of Cases are Regular Periods and Irregular periods

Get your periods	No. of Cases
Regular Periods	133
Irregular periods	70

Fig.3: Frequently do you have your periods?

Out of 203 cases,133 reported regular periods and 70 reported irregular periods.

2. Secondly, the graphical representation 2 depicts the ferryman gallway standard questions to diagnose hirsutism. Here, we plotted a total of every score for 203 patients for each question which will give us the quantitative score between 0-4[according to latest ferryman gallway scoring] to calculate how many cases were Hirsutismal and how many cases were reported as normal hair growth. In this there were 8 questions.

On an average, every question has a majority of score 1, i.e., from 203 cases, an average of 122 cases reported score 1 in all questions. The minority goes to score 5, i.e., from 203 cases, an average of 6 cases reported score 5. All were Indian females, that may depict that brown females have a little normal hair growth that is at least score 1.

Table.2: Now, individually, every score's average for all questions, is as following: -

Score	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8
0	25	28	13	08	03	04	11	16
1	177	91	131	87	151	126	148	126
2	34	61	47	62	38	48	33	37
3	20	17	09	31	01	17	07	15
4	07	06	03	15	01	08	04	09

The following Questions are asked in the survey: -

1 Choose the no. which shows your chin hair growth?
2 Choose the no. which shows your forearm hair?
3 Choose the no. which shows your back hair?
4 Choose the no. which shows your hair around lower abdomen?

5 Do you see any hair growth on your chest?
6 Do you see any hair growth on your upper lips?
7 Do you see any hair growth on lower back?
8 Do you see any changes in hair growth on your thighs?

Table.3: Score's average for all questions

**Ferriman Gallway questions**
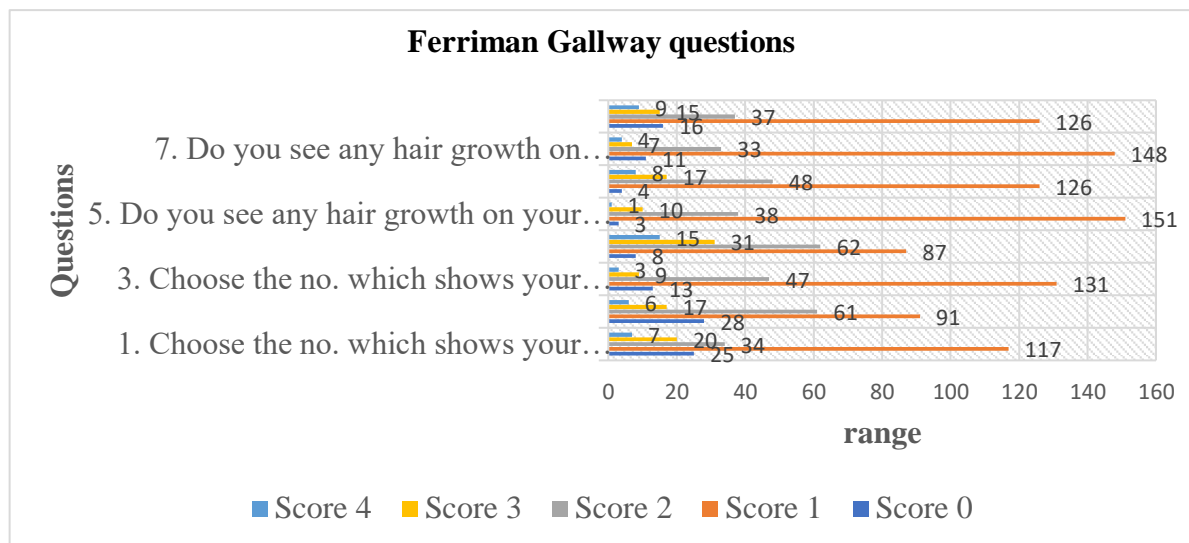
3. Now, hirsutism severity graphical representation 3 was plotted.

Here, no. of cases was plotted on y-axis and type of hirsutism on x-axis. There were 84 cases out of 203 with mild hirsutism according to FG scoring 48 cases with moderate hirsutism ,17 cases with severe hirsutism and 54 cases out of 203 were with no hirsutism.

Lastly, a pie chart is designed to represent hirsutism severity and number of cases falling in every category.

Table.4: Cases are according to Hirsutism

Types of Hirsutism	No of Cases
Mild	84
Moderate	48
Severe	17
No. Hirsutism	54

Fig.4: Cases are according to Hirsutism in Pie Chart.
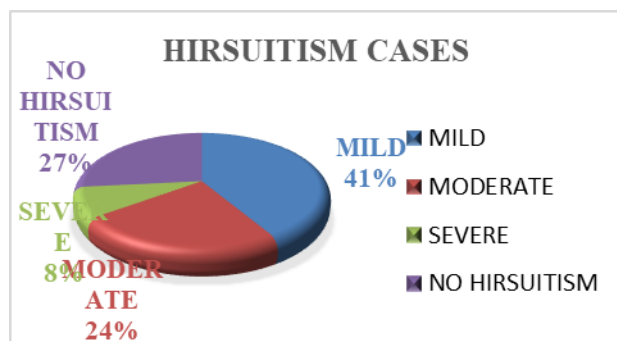
Conclusion

PCOS is a complex disorder characterized by the elevated androgen levels, menstrual irregularity and/or cyst on one or both ovary and associated comorbidities. For the evaluation of PCOS Rotterdam criteria is an efficient way which is used by us. Generally, there are symptomatic evidences for PR diagnosing PCOS. In this study, the spotlight was on hirsutism to satisfy our objective of the survey. The consequences of our self-designed survey using FG scoring showed undiagnosed PCOS cases and also, encouraged females to answer frankly without hesitation. Almost 34% of the studied Indian population is affected with pcos as per Rotterdam criteria (Hirsutism case + Period irregularity both present in particular women). Also, our survey showed different severity frequencies of hirsutism and menstrual cycle regularity. This not only diagnoses PCOS but also, non-PCOS hirsutism.

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