Chapter

Polycystic Ovary Syndrome and Its Influence on Maternal Health

Gayathree Mohan, Rajasekar Dhanasekar and Vikraman Rakshagan

Abstract

Polycystic ovary syndrome (PCOS) is a condition that primarily affects women during their reproductive years, which is caused by hormonal imbalance and metabolic issues. It significantly increases the risk of complications, such as gestational diabetes, preeclampsia, high blood pressure, miscarriage, preterm delivery, and the need for cesarean delivery. Even if women with PCOS choose to use assisted reproductive technology (ART), there is a notably elevated risk of experiencing pregnancy complications and unfavorable neonatal outcomes. Conducting epidemiological studies to diagnose PCOS vulnerability early in large populations can greatly improve maternal health and help reduce the global maternal mortality ratio (MMR). Epidemiological studies on PCOS often focus on either endocrine or psychological aspects, rarely integrating both. Diagnosing PCOS as per the Rotterdam criteria typically requires ultrasound examinations, which can complicate large-scale studies involving more than 400 participants. This study included women aged between 16 and 54 years in Chennai educational institutes in July 2024, and the study was completed with 402 participants aged 18–45 years. Participants completed questionnaires during break times. Initially, we categorized the population based on endocrine symptoms alone, dividing them into complete health (CH), low vulnerability (LV), and high-vulnerability (HV) groups. However, when we recategorized the population based on psychological symptoms as well, we discovered a direct relationship between increased psychological symptoms and heightened vulnerability to PCOS. Interestingly, women in rural areas, those from upper-middle-class backgrounds, and girls under 18 exhibited a lower burden of PCOS. This dual stratification method allows us to identify treatment options for large populations without relying solely on ultrasound examinations.

Keywords: polycystic ovary syndrome (PCOS), stratification method, psychopathological model, non-clinical intervention, endocrine vulnerability, total vulnerability

1. Introduction

Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder that affects more than 10% of women of reproductive age globally [1, 2]. It is characterized by various symptoms, including abnormal weight gain, irregular menstrual periods, infertility, excessive growth of coarse facial and body hair, and cystic acne [3].

PCOS arises from an imbalance in female sex hormones, which leads to the development of cysts in the ovarian antral follicles. These cysts hinder ovulation by containing the eggs that should have been released for possible fertilization. As a result, blocked ovulation causes an irregular menstrual cycle and may lead to "amenorrhea." Although unchecked PCOS does not directly progress into cancers like ovarian cancer, women with PCOS may have a slightly heightened risk of certain cancers compared to those without PCOS [4]. Research indicates a potential correlation between PCOS and endometrial cancer, attributed to hormonal imbalances and irregular menstrual cycles [5, 6]. Women diagnosed with PCOS are at an increased risk of developing type 2 diabetes due to insulin resistance [7]. Additionally, PCOS can lead to abnormal cholesterol levels, specifically elevated levels of low-density lipoprotein (LDL) or "bad" cholesterol and reduced levels of high-density lipoprotein (HDL) or "good" cholesterol [8]. Therefore, it is crucial for women with PCOS to effectively manage their condition through lifestyle modifications and, if necessary, medication, to mitigate associated health risks. Regular medical checkups and screenings are recommended to proactively monitor and address any potential health concerns. Prompt attention is also needed for preventive treatment measures for PCOS, as it negatively impacts female fertility. However, there is a dearth of global and large-scale epidemiological studies on PCOS, particularly in terms of its incidence and disability-adjusted life years (DALYs). This lack of research results in an unclear understanding of the burden of PCOS. An additional challenge in diagnosing and managing endocrine disorders like PCOS is the lack of a dedicated psychopathological model specific to the condition [9]. It is widely recognized that psychiatric symptoms, including depression, anxiety, and cognitive impairment, often occur alongside endocrine dysfunctions. Developing effective treatment strategies for PCOS requires a comprehensive understanding of how endocrine and psychiatric conditions interact [10]. This study seeks to address this gap by conducting an extensive epidemiological investigation into PCOS, particularly focusing on its prevalence among women of reproductive age (18–54 years). Additionally, the study aims to develop two separate stratification models: one focusing exclusively on endocrine factors and the other incorporating both endocrine and psychiatric factors. These models will be instrumental in developing tailored treatment strategies for the various manifestations of PCOS.

Participants: The study included a sample of 402 females aged 18–54 years who were in their reproductive age range. These participants were recruited from various educational institutions in Chennai. The assessment was conducted during designated break times, and participants provided verbal consent. Moreover, participants were assured of confidentiality, and the study obtained approval on July 1, 2024 with a reference number of SRB/SDC/FACULTY/24/PROSTHO/413 from the Scientific Review Board and email permissions were obtained on condition of anonymity with the participating educational institutions.

Instruments: To evaluate the various symptoms associated with PCOS, we employed Cronin's questionnaire, which consisted of 26 questions [11]. These questions encompassed different facets, such as emotions, menstrual patterns, body hair growth, weight fluctuations, fertility concerns, and physical symptoms. We also integrated non-clinical interventions about physical exercise, as well as inquiries about comorbid factors like diabetes and cholesterol [12]. Furthermore, we included a small number of questions concerning sexual health. In general, the questionnaire was meticulously crafted, comprising 30 questions about PCOS, in addition to a few demographic details. Although Cronin's questionnaire utilized a 7-point Likert scale for assessment, we simplified the responses to a simple yes, no, or unsure for most

questions to facilitate the development of a stratification model and the implementation of the questionnaire for PCOS awareness. However, three questions employed a 5-point Likert scale for evaluation. The questionnaire's validity and reliability were assessed through a pilot study, expert reviews, and test-retest analysis.

Procedure: Two stratification models, one based only on endocrine conditions and another including psychiatric conditions, have been developed to categorize the population into three distinct groups: high vulnerability, low vulnerability, and complete health (with zero vulnerability). To assign individuals to these groups, the endocrine model considered only five different domains: body hair, weight, menstrual problems, physical symptoms, and infertility. Each domain has three levels: low, medium, and high, each with its unique scoring patterns within our population as shown in **Table 1**. Here with the same questionnaires and population, the endocrine conditions are treated as symptoms in the psychopathological model, and the remaining four domains of emotion, physical health, sexual health, and physical exercise are considered as non-clinical interventions that can be managed to drastically reduce the incidence of PCOS as shown in **Figure 1**. In the second method using the same questionnaires and population, all the nine domains are considered as the symptoms in the psychopathological model as shown in **Figure 2**. Using all nine domains, the entire population is stratified into high vulnerability, low vulnerability, and complete

SNo	Endocrine Domain (Symptoms)	Number of Questions	MIN	MAX	CH	LV	HV
SYM1	Body Hair	1	1	3	1	2	3
SYM2	Weight Management	2	2	6	2	3	4–6
SYM3	Infertility	1	1	3	1	2	3
SYM4	Menstrual Symptoms	5	5	15	5–8	9–10	11–15
SYM5	Physical Symptoms	6	6	18	6–8	9–10	11–18
	Total	15	15	45	15–20	21–27	28–45

Table 1.
The five endocrine domains or symptoms of PCOS and their criteria for stratification.

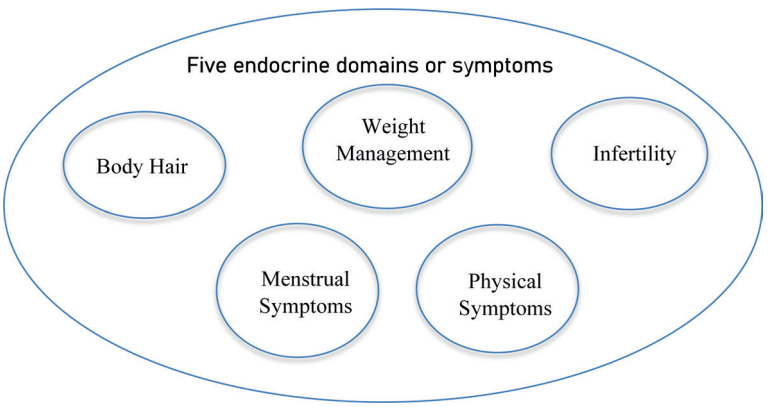

Figure 1.
A novel network psychopathological model of five symptoms (endocrine domains) of PCOS along with four non-clinical interventions.

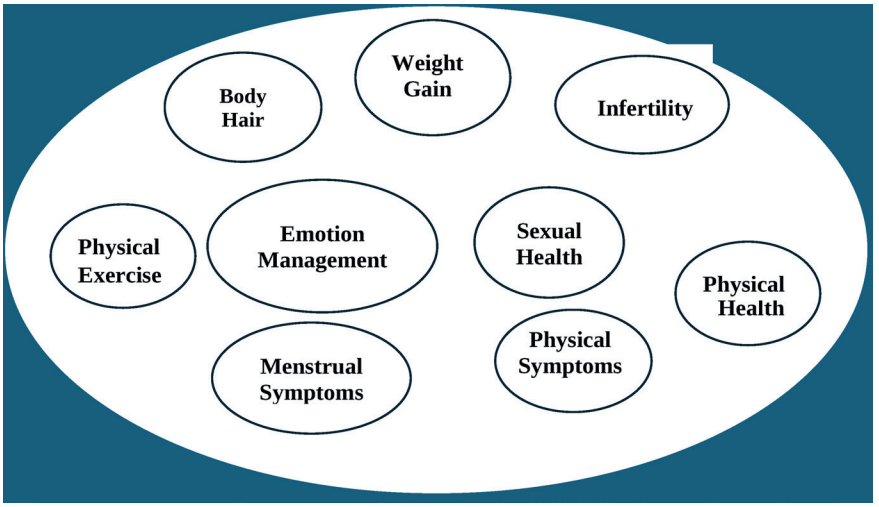

Figure 2.
A novel network psychopathological model of nine symptoms (five endocrine domains + four psychiatric and physical domains) of PCOS.

health (with zero vulnerability). **Table 2** shows the nine domains consisting of five endocrine symptoms and four non-clinical interventions, the number of questions under each symptom or non-clinical intervention, minimum and maximum scores, and their scoring criteria to be in the three stratified groups of complete health (CH), low vulnerability (LV), and high vulnerability (HV).

Interpretation: The same questionnaires and population were utilized; however, the interpretation varied between the two stratification methods. As outlined in Borsboom's psychopathological model [13], several diseases linked to psychiatric conditions identify the five endocrine domains as symptomatic manifestations. The remaining four domains—stress, physical exercise, physical health, and sexual

SNo	Domains in Questionnaire	Number of Questions	MIN	MAX	CH	LV	HV
SYM1	Body Hair	1	1	3	1	2	3
SYM2	Weight Management	2	2	6	2	3	4–6
SYM3	Infertility	1	1	3	1	2	3
SYM4	Menstrual Symptoms	5	5	15	5–8	9–10	11–15
SYM5	Physical Symptoms	6	6	18	6–8	9–10	11–18
NC1	Emotion Management	10	10	34	10–15	16–20	21–34
NC2	Physical Health Management	2	2	6	2	3	4–6
NC3	Sexual Health	2	2	6	2	3	4–6
NC4	Physical Exercise	1	1	5	1	2	3–5
	Total	30	30	96	30–40	41–55	56–96

Table 2.
The 5 + 4 endocrine and non-clinical intervention domains of PCOS and their criteria for stratification.

health—are considered non-clinical strategies that, when effectively managed, can play a pivotal role in reducing PCOS prevalence. In the second framework, all nine domains are treated as symptomatic contributors to PCOS, aligning with Borsboom's model. These two perspectives enable the differentiation of endocrine vulnerability, with the second model incorporating all nine domains to determine total vulnerability. Distinguishing endocrine vulnerability from psychological vulnerability proves invaluable for tailoring treatment strategies to address specific symptoms and achieve personalized health objectives.

Treatment options for PCOS: Some common treatment approaches for women with PCOS [14].

a. Lifestyle changes: Weight management is crucial, as even a small reduction in weight can help regulate menstrual cycles. A healthy diet low in carbohydrates and high in fiber can assist in managing insulin levels.

b. Medications: Estrogen and progestin medications can help regulate menstrual cycles, reduce androgen levels, and manage acne and excess body hair.

c. Other treatments: Hair removal methods, such as electrolysis and laser hair removal, can address excess hair growth. Acne treatments or oral medications may also be used to manage acne.

d. Monitoring and support: Regular monitoring of physical health parameters, such as blood pressure, glucose tolerance, and cholesterol levels, is important to manage potential complications. Additionally, mental health screenings for depression and anxiety, along with seeking support when needed, can be beneficial.

Table 3 shows that there are no combinations of CH and HV. This implies that when the yield difference exceeds one state—whether related to endocrine

SNo	Endocrine vulnerability	Endocrine + psychological vulnerability	Number of women	Treatment options
1	CH	CH	76	No treatment
2	CH	LV	100	Lifestyle changes
3	LV	CH	3	Other treatments to remove acne and excess hair
4	LV	LV	110	Mild medication with lifestyle changes
5	LV	HV	45	Mild medication with lifestyle changes and Monitoring and support
6	HV	LV	2	Severe medication and other treatments to reduce hair growth and acne with lifestyle changes.
7	HV	HV	66	Severe medication, other treatments to reduce hair growth and acne with lifestyle changes, and regular monitoring and support

Table 3.
Endocrine vulnerability and the total vulnerability including both endocrine and psychological vulnerability numbers and their treatment options.

vulnerability or total vulnerability—it cannot occur in practice, even if it is theoretically possible. The differences between the two vulnerabilities can only be one state apart, either above or below. A greater difference is not feasible; the only situation in which a difference exceeds one state would involve the presence of both CH and HV as values for either endocrine or total vulnerability, which has been demonstrated to be non-existent.

2. Results

The distribution of endocrine and total vulnerability, which combines endocrine and psychological factors, across the entire population of 402 women is depicted in **Figure 3**. To analyze the various determinants influencing vulnerability, **Figure 4** presents a graph correlating the type of residence—rural, suburban, and urban—with both endocrine and total vulnerability within the population. **Figure 5** illustrates a graph comparing the economic classes of women—lower middle class, upper middle class, and affluent—with respect to both endocrine and total vulnerability. Lastly, **Figure 6** provides a graphical representation of the different age groups of women—under 18, 18–24, 25–45, and 46–54 years—and their respective endocrine and total vulnerability.

3. Discussion

From **Figure 3**, we can see that for complete health or zero vulnerability, the endocrine domain value is more than double the total domain value, which indicates that when women are PCOS-free, their psychological well-being is better, and their depression and anxiety are manageable [15]. But for low vulnerability,

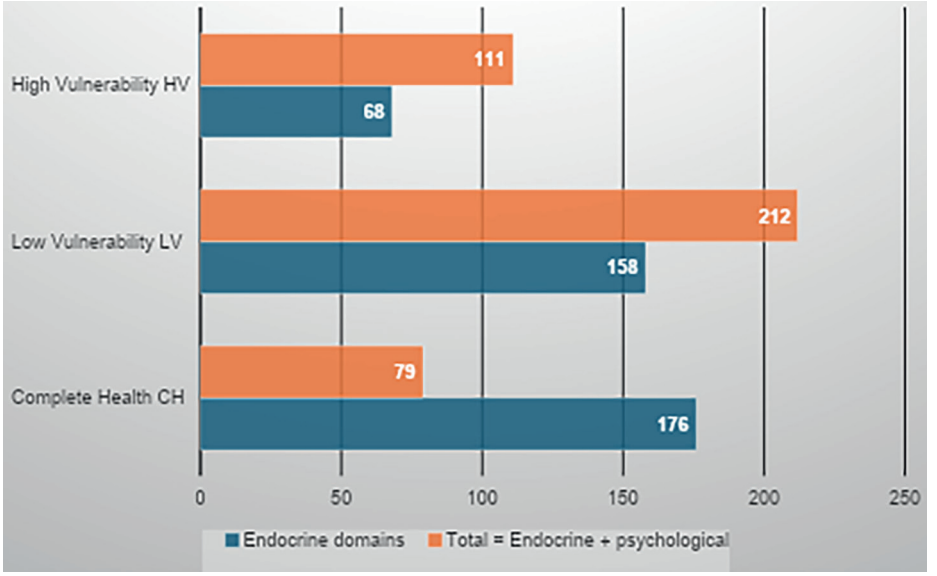

Figure 3.
Endocrine and total vulnerability of a population of 402 women in Chennai.

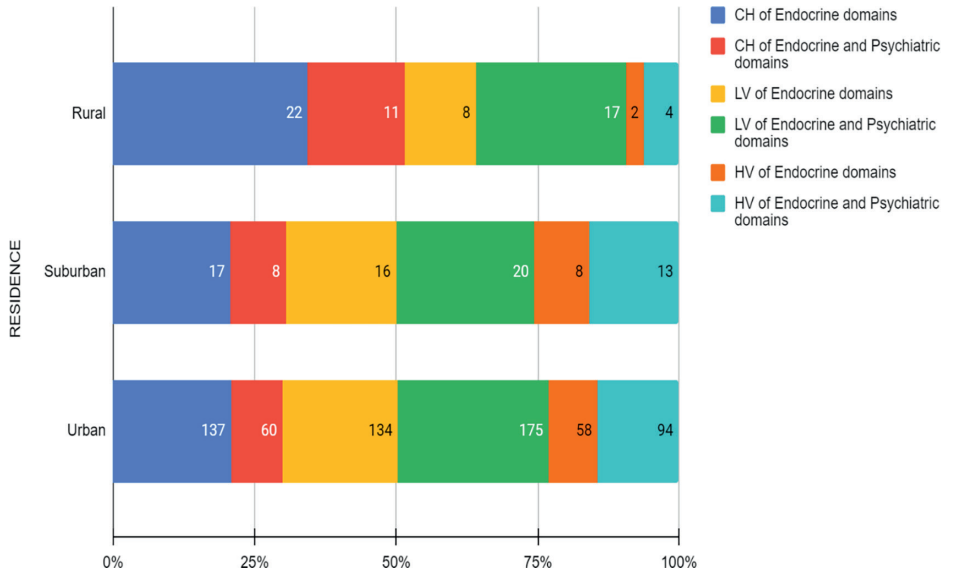

Figure 4.
Endocrine and total vulnerability of women in different types of residences.

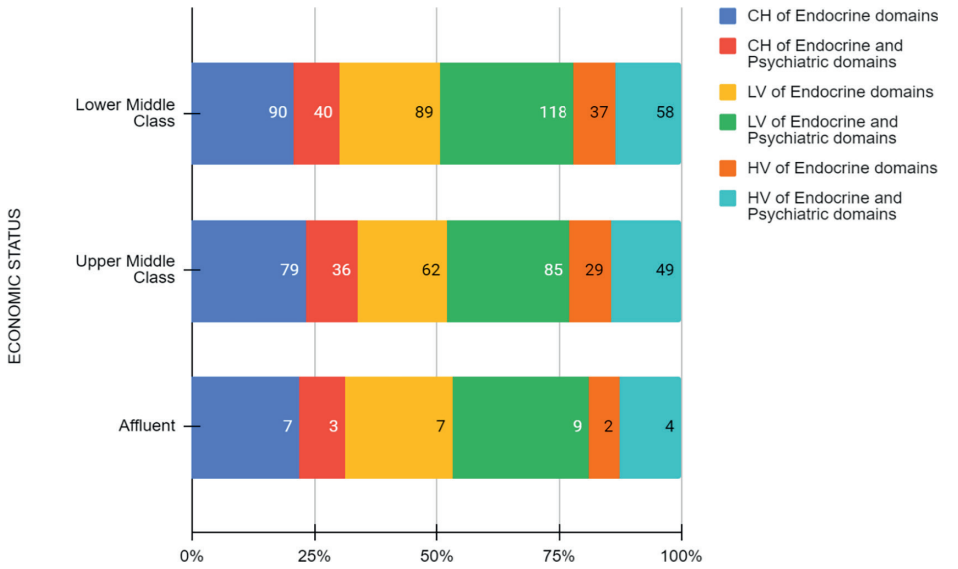

Figure 5.
Endocrine and total vulnerability of women in different economic statuses.

the total domain value is nearly one and a half times higher than the endocrine domain value. This shows that as the disease vulnerability increases, the comorbid factors of emotional well-being decrease causing disease-related anxiety and depression to increase [16]. This is also proved in the case of high vulnerability where the total domain value is nearly twice that of the endocrine domain value. This is also a cause-and-effect problem as the higher PCOS lead to higher anxiety and conversely higher depression and anxiety, leading once again to higher

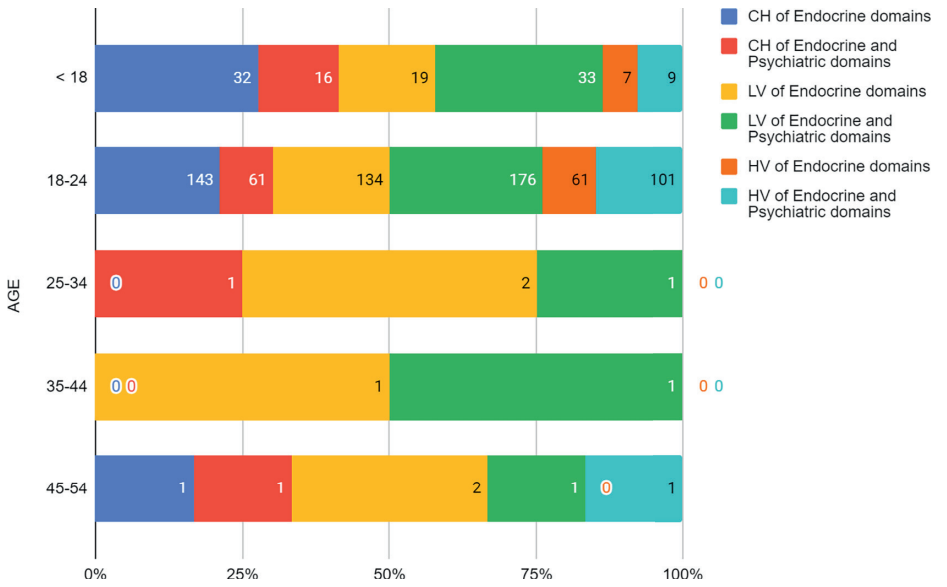

Figure 6.
Endocrine and total vulnerability of women in different ages.

PCOS levels [17]. From **Figure 4**, it is evident that the percentage of individuals with complete health or zero vulnerability is highest in rural areas, followed by suburban areas, and lowest in urban areas. Additionally, a consistent pattern is observed where the endocrine domain exhibits nearly double the percentage of complete health compared to the total domain, while for low and high vulnerability, the total domain is approximately twice that of the endocrine domain. Rural areas demonstrate minimal vulnerability due to a lifestyle that is relatively free from pollution and chemicals, whereas urban areas exhibit the highest vulnerability, attributed to factors like population congestion and environmental pollution [18]. Increased exposure to environmental chemicals, including pollutants and cosmetic products, has also been linked to the rising prevalence of PCOS among women [19, 20]. **Figure 5** shows that women from the upper middle class have a greater proportion of complete health or zero vulnerability compared to both lower-middle-class and affluent women, who display almost similar levels of complete health. Furthermore, the same trend is apparent where the endocrine domain reflects nearly double the proportion of complete health compared to the overall domain, while for low and high vulnerability, the overall domain is roughly twice that of the endocrine domain. This favorable outcome among upper-middle-class women may stem from their relatively balanced living conditions, as they are less impacted by financial challenges than lower-middle-class women and maintain higher levels of physical activity compared to affluent women, resulting in minimal vulnerability [21]. From **Figure 6**, it is observed that the percentage of women with complete health or zero vulnerability is highest in those under 18 years of age, with zero vulnerability declining as age increases. The majority of participants in the 18–24 age group were students, while only a few staff members were present in the older age range of 35–55 years. Consequently, the lack of substantial data for middle and higher age groups makes it challenging to ascertain definitive patterns of the disease.

3.1 Limitations

This epidemiological study, while not a substitute for a gynecological clinical evaluation, serves as an initial awareness initiative for women. The study was conducted in the absence of prior participant awareness regarding PCOS. As a subsequent phase, a comprehensive awareness workshop is planned within the educational institution, wherein a gynecologist will elucidate the pathophysiology, clinical manifestations, and therapeutic modalities of PCOS. Post-awareness, the same questionnaire will be readministered, allowing participants to self-assess symptoms using a scoring mechanism. This methodology aims to facilitate early symptom recognition, encourage timely medical consultation, and contribute to reducing disease burden, thereby enhancing overall quality of life.

4. Conclusion

The Rotterdam criteria established in 2003 used to diagnose PCOS necessitate an ultrasound examination of the ovaries, which can pose challenges in epidemiological studies involving a substantial population. To tackle this problem, the utilization of Cronin's questionnaire in the form of the total vulnerability including both endocrine and psychological vulnerability has been adapted and proven to be beneficial. Additionally, a newer perspective of looking at the endocrine domains separately paves the way for suggesting better treatment options for the diseased population. The motivation to take up the present pilot study was based on Niranjani et al. [22] who showed 21% of PCOS prevalence in Chennai with their study on 200 young girls between 13 and 21 years using the Rotterdam criteria. The same Chennai area according to a practicing gynecologist, who chose to be anonymous for the sake of privacy, safety, and backlash, had more prevalence than 21% and so the need to cover the entire reproductive 16–54 years was felt for a target population of at least 500 women. Future studies should target a combined cohort of 13–54 years with the newly designed questionnaire and extend it to 1000 participants. Also, an awareness cum screening campaign should be conducted with a team of gynecologists who could immediately stratify the entire 1000 high population, suggesting corrective measures to the high-vulnerability women. Furthermore, it is crucial to acknowledge that PCOS is an endocrine disorder frequently overlooked in women of reproductive age. Nevertheless, if early and easy volume diagnosis of very high populations is identified, it can efficiently manage the rapid risk to maternal health.

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