ORIGINAL RESEARCH ARTICLE

Hormonal Whirlwinds to Emotional Echoes: The Deep-Rooted Impact of Polycystic Ovary Syndrome on Psyche and Well-Being

Neeti Patel[1*], Ivvala Anand Shaker[2], Kandarp Patel[3], Nidhi Yogeshkumar Mangrola[4]

[1]Department of Biochemistry,Parul Institute of Medical Sciences and Research, Parul University, Vadodara, India
[2]Department of Biochemistry, Swaminarayan Institute of Medical Sciences and Research, Kalol, India
[3]Department of Pharmacology, Kiran Medical College, Surat, India
[4]Department of Community Medicine, Kiran Medical College, Surat, India

DOI: 10.55489/njcm.160520255258

ABSTRACT

Background: Polycystic Ovarian Syndrome (PCOS) can be presented with physical and emotional consequences. Despite large research on the effects of hormonal imbalances on physical manifestations, psychological domains are still under a grey area. This study integrates clinical and psychosocial aspects of PCOS, leading to the development of comprehensive care approaches.

Methods: 364 women aged between 18 and 35 were involved in a cross-sectional study at a tertiary care hospital. Participants were divided into four PCOS phenotype groups, diagnosed based on Rotterdam criteria, and a control group (n=240). Psychosocial domains were analysed using the HRQL-Health-Related Quality of Life questionnaire, biochemical and hormonal parameters were assessed. Correlation was found between hormones and various domains.

Results: PCOS subjects exhibited high psychosocial stress across various domains, including emotional and fertility-related concerns. Hormonal imbalances were found to be differently associated with increased psychosocial distress, body image dissatisfaction, and menstruation-related challenges in various phenotypes ($p<0.05$). Moreover, financial burden and fear of developing malignancies were also linked to hormonal disturbances.

Conclusion: Hormonal whirlwinds strongly affect the psychosocial aspects of PCOS subjects. Elucidating this link will pave a path for creating personalized treatment plans that can lead to physical and psychological well-being. By involving mental health support in the regular line of treatment, healthcare providers can create a better world for women suffering from PCOS.

Keywords: PCOS, Psychological Distress, Hormonal Imbalance, Self-Body Image, Fertility Concerns

ARTICLE INFO

Financial Support: None declared
Conflict of Interest: The authors have declared that no conflict of interests exists.
Received: 22-02-2025, **Accepted**: 02-04-2025, **Published**: 01-05-2025
***Correspondence:** Neeti Patel (Email: neetipatel44@gmail.com)

How to cite this article: Patel N, Shaker IA, Patel K, Mangrola NY. Hormonal Whirlwinds to Emotional Echoes: The Deep-Rooted Impact of Polycystic Ovary Syndrome on Psyche and Well-Being. Natl J Community Med 2025;16(5):456-465. DOI: 10.55489/njcm.160520255258

www.njcmindia.com | pISSN: 0976-3325 | eISSN: 2229-6816 | Published by Medsci Publications

Introduction

Polycystic Ovarian Syndrome (PCOS) is the most common hormonal disorder affecting women of reproductive age, with a worldwide prevalence of around 8% to 13%.[1] While most research done on PCOS has focused on clinical symptoms such as irregular menstrual cycles, hyperandrogenism, infertility, and metabolic disturbances, the emotional and psychological consequences of this condition remain unexplored.[2] There is a complex interplay between the hormonal imbalances and emotional challenges, which affects various domains of the mental health of PCOS patients.[3] This study tried to explore how PCOS not only affects the physical health but also psychosocial well-being based on their phenotypes.

A characteristic feature of PCOS is known to be hormonal disturbances, like elevated androgen levels, chronic inflammation, and insulin resistance, which can be followed by various psychological consequences.[4] PCOS subjects suffering from weight gain, acne, and hirsutism are at higher risk of developing mental health disorders like body image dissatisfaction, diminished self-esteem, depression, anxiety, social isolation, and eating disorders.[5] These emotional echoes lead to societal pressure regarding fertility and physical appearance, creating a vicious cycle that aggravates physical and psychological symptoms of PCOS.[6]

This study aims to shed light on developing a newer approach towards integrating hormonal and psychosocial aspects for better prognosis and resilience of PCOS subjects by exploring how hormonal imbalances contribute to psychosocial distress by examining the broader sociocultural factors that affect mental health. It is expected that this will inspire more comprehensive care strategies for women with PCOS based on their hormonal whirlwinds to mental empowerment and significant emotional resilience to face challenges.

Methodology

This cross-sectional study was conducted on 364 adult women aged between 18 and 35 years between March 2023 to December 2024, to find out the effects of hormonal disturbances on psychological manifestations in different PCOS phenotypes at the tertiary care hospital of the South Gujarat district. A convenience sampling technique was used for the selection of cases based on existing hospital records from previous years. All the patients with PCOS meeting the inclusion criteria were selected as cases, and 240 age-matched healthy individuals without any known metabolic disorders were included in the control group. Cases were categorized into four groups: four PCOS phenotypes (A, B, C, and D) based on the Rotterdam criteria,7 having 58, 16, 21, and 29 subjects, respectively.

Subjects with previous or current use of medication like OC pills, ovulation induction agents, estrogenic or anti-androgenic drugs, antidiabetic drugs (Metformin), glucocorticoids, anti-obesity drugs, history of hormone therapy, insulin sensitizers, Vitamin D or calcium supplements in the last 6 months, diagnosed cases of any chronic illness like cardiovascular disease, hyperprolactinemia, diabetes mellitus, thyroid disorders, psychiatric disorders, and recent history of pregnancy/lactation (6 months) were excluded from the study.

In-depth Interview: After being informed about the purpose and procedure of the study, voluntary written informed consent was taken. Interviews were conducted in-depth with each individual, using a Health-Related Quality of Life (HRQL) questionnaire with 23 questions, which was specifically designed for PCOS women[8], adapted and validated by a few studies conducted in Indian PCOS women[9,10]. HRQL was classified under five major domains: Psychosocial and Emotional Domain, Self-Body Image Domain, Fertility Domain, Menstrual Disorder Domain, and Miscellaneous Domain, containing four possible answers: "never, sometimes, most of the times, and all the times", followed by giving scores as 0, 1, 2, and 3, respectively.

Clinical Assessments: A detailed medical history along with anthropometric data, including age, weight, height, waist, and hip circumference, was recorded. Fasting blood samples were collected in the morning after an overnight fast of 10-12 hours for biochemical analyses on the next day after menstruation ends (follicular phase of the menstrual cycle). Blood samples were processed to obtain serum for the quantification of serum Testosterone, serum Luteinizing Hormone (LH), serum Follicle-Stimulating Hormone (FSH), serum Anti-Mullerian Hormone (AMH), serum fasting Insulin, and serum Prolactin levels using enzyme-linked immunosorbent assay (ELISA) kits.

Statistical Analysis:

Body Mass Index (BMI), Waist-to-hip Ratio (WHR), LH:FSH Ratio, and Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) were calculated. Continuous variables were denoted as mean with standard deviation (mean $\pm$ SD). Differences between study groups were assessed using one-way ANOVA, with a p-value of < 0.05 deemed statistically significant. Correlations between parameters were evaluated using Pearson's correlation coefficient as the R-value. Interpretation was done according to r-values as 0.00-0.19 (very weak correlation), 0.20-0.39 (weak correlation), 0.40-0.59 (moderate correlation), 0.60-0.79 (strong correlation), and 0.80-1.00 (very strong correlation). Data were analyzed using SPSS 24.0 software.

Approval of Institutional Ethical Board: Kiran Hospital Ethics Committee Biomedical & Health Research, EC No: EC/NEW/INST/2021/2173; dated: 04.03.2023.

RESULTS

PCOS subjects are classified into 4 Phenotypes. Phenotype A (full-blown syndrome: HA+OD+PO) includes hyperandrogenism (HA) (clinical or biochemical), ovulatory dysfunction (OD), and polycystic ovaries (PO), Phenotype B (non-PO PCOS: HA+OD) includes HA and OD, Phenotype C (ovulatory PCOS: HA+PO) includes HA and PO and Phenotype D (non-hyperandrogenic PCOS: OD+PO) includes OD and PO; having a prevalence of 46.77% (58 patients), 12.90% (16 patients), 16.94% (21 patients) and 23.39% (29 patients) respectively.

Table 1: Age and anthropometric measures of the participants

	Control (n=240)	PCOS Phenotype A (n=58)	PCOS Phenotype B (n=16)	PCOS Phenotype C (n=21)	PCOS Phenotype D (n=29)	η^2	P-value*
Age (years)	27.10 ± 5.03	27.34 ± 4.03	28.06 ± 3.02	27.90 ± 4.25	27.93 ± 3.68	0.004	0.832
Height (cm)	1.62 ± 0.03	1.61 ± 0.04	1.61 ± 0.07	1.62 ± 0.05	1.62 ± 0.04	0.019	0.134
Weight (kgs)	63.26 ± 4.44	71.47 ± 5.37	68.56 ± 3.89	67.34 ± 5.59	69.1 ± 4.4	0.334	<0.001
BMI (kg/m^2)	23.93 ± 0.87	27.41 ± 0.77	26.59 ± 0.97	25.62 ± 0.80	26.2 ± 0.7	0.730	<0.001
Waist Circumference (cm)	69.96 ± 2.95	92.55 ± 5.31	85.81 ± 5.27	87.10 ± 5.89	86.0 ± 5.7	0.847	<0.001
Hip Circumference (cm)	91.83 ± 3.72	98.00 ± 4.71	101.50 ± 4.49	100.48 ± 5.18	99.7 ± 5.1	0.436	< 0.001
Waist-Hip Ratio (WHR)	0.76 ± 0.02	0.95 ± 0.05	0.85 ± 0.04	0.87 ± 0.05	0.9 ± 0.0	0.836	<0.001

Values are presented as mean ± SD with confidence intervals (CI) of 95%. *P value <0.05 indicate statistical significance, η^2= eta-squared (effect size of ANNOVA).

Table 2: Comparison of Laboratory Parameters among various phenotypes of PCOS and control group

	Control (n=240)	PCOS Phenotype A (n=58)	PCOS Phenotype B (n=16)	PCOS Phenotype C (n=21)	PCOS Phenotype D (n=29)	η^2	P-value*
FSH	5.87± 1.63	2.07 ±1.09	3.80 ±1.59	4.29± 1.74	3.70 ±1.50	0.469	<0.001
LH	8.63 ±2.79	19.79± 3.29	17.09± 2.60	11.19 ±2.72	9.80± 2.80	0.686	<0.001
LH: FSH Ratio	1.14 ± 0.35	11.54±4.84	5.36±2.55	3.14±1.63	3.03± 1.45	0.752	<0.001
Testosterone	17.53±4.64	85.43 ±6.54	86.11± 6.76	82.66 ±4.83	27.93± 2.86	0.972	<0.001
AMH	1.92± 0.28	8.21 ±0.62	3.86± 0.66	5.27± 0.71	7.37± 0.92	0.967	<0.001
Prolactin	15.38± 7.64	107.35 ±9.20	39.40± 8.76	79.18± 8.94	47.67 ±8.54	0.949	<0.001
HOMA IR	1.56 ±0.37	12.83± 3.00	8.60± 2.56	6.29± 2.59	7.35± 2.53	0.874	<0.001

Values are presented as mean ± SD with confidence intervals (CI) of 95%. *P value <0.05 indicate statistical significance, η^2= eta-squared (effect size of ANNOVA)

Table 1 shows that different phenotypes of PCOS have significant differences in weight, BMI, waist and hip circumference, and WHR, when compared to healthy controls. Age and height were not statistically significant between groups, which was fulfilling the inclusion criterion.

On applying *Bonferroni correction in post hoc analysis*, age and height did not significantly differ between the phenotypes and control. In weight, association was observed only between Phenotype A and C and between controls and other phenotypes (*p<0.05*), rest all the groups showed no significant difference (*p>0.05*). BMI levels, waist circumference and WHR differ in between all the phenotypes and controls except between Phenotype D and Phenotype B or C. Chest circumference showed significant difference between Phenotype A and Phenotype B and between controls and all other phenotypes (*p<0.05*), rest all the other groups showed no significant differences (*p>0.05*).

Table 2 depicts that, women with PCOS, irrespective of the specific phenotype, have significant hormonal differences in comparison to healthy controls. Differences in levels of FSH and LH, an elevated LH:FSH ratio, increased testosterone (though varying across phenotypes), elevated AMH, higher prolactin, and increased insulin resistance with p-value <0.001 indicating statistically significant difference among the four phenotypes and controls.

Post hoc analysis with *Bonferroni correction* showed no statistically significant differences in LH levels between Phenotype D vs Phenotype C and Controls, rest all the groups showed statistically significant difference (*p<0.05*). Similarly, FSH levels did not significantly differ between Phenotype B, C and D (*p>0.05*). In LH:FSH ratio, Phenotype C showed no association with Phenotype D, while Testosterone levels showed no difference between Phenotype A vs B or C and between Phenotype B vs C or A, all other groups showed significant differences (*p<0.05*). HOMA IR did not differ between Phenotype D and B or C (*p>0.05*). AMH and Prolactin showed significant difference between all four phenotypes and controls (*p<0.05*).

Table 3 shows a strong correlation between PCOS and negative psychosocial, emotional, body image, fertility, and other concerns. Majority, the percentages in the PCOS groups were above 80% and often above 90%, while in the control group below 50%. The consistently higher percentages in all PCOS phenotypes, indicate the repercussions of the disease on women's well-being other than clinical symptoms.

Table 3: HRQL Domain Classification and Their Effects on Participants in Percentage

Domain		Control (n=240)	PCOS Phenotype A (n=58)	PCOS Phenotype B (n=16)	PCOS Phenotype C (n=21)	PCOS Phenotype D (n=29)
Psychosocial and Emotional Domain	Depressed	37.92	91.38	93.75	85.71	93.10
	Worried	41.67	86.21	93.75	95.24	100
	Tensed	50.42	91.38	87.5	100	89.66
	Angry	45	93.10	100	90.48	96.55
	Anxious	40	86.21	93.75	71.43	51.74
	Tearful	24.58	81.03	68.75	85.71	65.52
	Irritability	22.50	94.83	87.5	100	93.10
	Insomnia	31.25	82.76	81.25	80.95	51.74
	Tired	36.25	84.48	75	71.43	68.97
	Mood Swings	44.17	94.83	93.75	90.48	96.55
	Low self esteem	50.83	87.93	87.5	95.24	100
	Being self-conscious	39.17	94.83	81.25	90.48	89.66
	Get upset easily	46.67	91.38	93.75	71.43	65.52
	Feel lack of control over the situation	42.50	98.28	100	95.24	100
Self-body image Domain	Frustration of not losing weight	45	91.38	81.25	100	96.55
	Embarrassed due to excessive hair growth	42.50	94.83	87.5	85.71	34.48
Fertility Domain	Feel worried of infertility	52.08	98.28	93.75	95.24	96.55
	Fear of not having children	33.33	91.38	87.5	100	93.10
	Fear of divorce or separation	26.67	87.93	56.25	52.38	34.48
	Feel worried about long term effects of Medications	51.25	93.10	93.75	90.48	100
Menstrual Disorder Domain	Concerned about menstruation at long interval	12.50	96.55	100	95.24	96.55
Miscellaneous Domain	Fear of getting cancer	22.92	81.03	56.25	28.57	37.93
	Financial issues for diagnosis/treatment	66.67	89.66	81.25	80.95	68.97

Figures in parenthesis are percentages

Table 4: Comparison of Corelation of BMI and WHR with HRQL scale in different phenotypes of PCOS and Control group

Domains		BMI					WHR				
		Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)	Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)
Psychosocial & Emotional Domain	R*	-0.040	-0.029	-0.079	-0.144	-0.076	-0.026	0.127	0.057	-0.3108	-0.128
	P†	0.534	0.826	0.770	0.533	0.694	0.694	0.342	0.833	**0.049‡**	0.507
Self-body image Domain	R	-0.028	-0.020	-0.032	-0.306	0.382	-0.129	0.055	0.014	-0.042	-0.039
	P	0.663	0.882	0.905	**0.027‡**	**0.041‡**	**0.046‡**	0.682	0.960	0.858	0.840
Fertility Domain	R	-0.066	0.012	-0.650	-0.040	-0.067	-0.005	-0.041	0.653	-0.435	-0.134
	P	0.305	0.927	**0.006‡**	0.863	0.728	0.937	0.758	**0.006‡**	**0.049‡**	0.489
Menstrual Disorder Domain	R	0.054	0.125	-0.303	-0.098	-0.162	-0.075	-0.265	0.295	-0.345	-0.189
	P	0.402	0.350	0.255	0.673	0.402	0.249	**0.044‡**	0.267	0.126	0.325
Miscellaneous Domain	R	-0.024	0.051	-0.055	0.187	-0.049	-0.046	0.117	0.054	0.116	-0.026
	P	0.709	0.704	0.839	0.416	0.803	0.475	0.383	0.844	0.615	0.893

*R-values represent correlation coefficients, R > 0 indicates a positive correlation and R < 0 indicates a negative correlation; †P value <0.05 indicate statistical significance; ‡indicates statistically significant result

Table 5: Comparison of Corelation of LH: FSH and Testosterone with HRQL scale in different phenotypes of PCOS and Control group

Domains		LH: FSH					Testosterone				
		Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)	Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)
Psychosocial & Emotional Domain	R*	-0.033	0.460	0.011	0.122	0.188	0.048	0.010	0.860	-0.107	0.022
	P†	0.613	**0.037‡**	0.967	0.597	0.329	0.458	0.940	**0.047‡**	0.644	0.911
Self-body image Domain	R	0.091	-0.164	-0.297	-0.140	-0.260	0.102	-0.051	-0.274	-0.144	0.445
	P	0.158	0.217	0.264	0.544	**0.033‡**	0.115	0.704	0.305	0.534	**0.015‡**
Fertility Domain	R	-0.072	-0.059	0.578	-0.002	-0.383	0.087	-0.048	0.648	-0.224	-0.307
	P	0.264	0.661	**0.019‡**	0.993	**0.040‡**	0.177	0.720	**0.007‡**	0.330	**0.015‡**
Menstrual Disorder Domain	R	0.052	-0.203	0.516	0.007	-0.266	0.007	-0.251	0.179	-0.132	0.026
	P	0.424	0.126	**0.041‡**	0.974	0.163	0.915	0.057	0.508	0.568	0.893
Miscellaneous Domain	R	0.062	-0.030	0.100	-0.228	-0.117	-0.005	-0.072	0.029	-0.158	0.296
	P	0.339	0.821	0.713	0.319	0.544	0.934	0.592	0.914	0.494	**0.018‡**

*R-values represent correlation coefficients, where R > 0 indicates a positive correlation and R < 0 indicates a negative correlation; †P value <0.05 indicate statistical significance; ‡indicates statistically significant result

Table 6: Comparison of Corelation of AMH and HOMA-IR with HRQL scale in different phenotypes of PCOS and Control group

Domains		AMH					HOMA IR				
		Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)	Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)
Psychosocial & Emotional Domain	R*	0.050	0.010	0.255	0.016	0.071	-0.073	0.003	0.630	0.099	-0.026
	P†	0.438	0.940	0.341	0.944	0.713	0.261	0.982	**0.045‡**	0.671	0.893
Self-body image Domain	R	0.180	-0.051	-0.072	-0.349	-0.316	-0.032	-0.041	0.025	-0.478	-0.328
	P	**0.005‡**	0.704	0.791	**0.021‡**	**0.048‡**	0.617	0.762	0.926	**0.028‡**	**0.043‡**
Fertility Domain	R	-0.025	-0.048	0.504	-0.025	-0.360	-0.010	-0.021	0.558	-0.225	-0.226
	P	0.699	0.720	**0.046‡**	0.915	**0.045‡**	0.883	0.873	**0.025‡**	0.327	0.238
Menstrual Disorder Domain	R	0.091	-0.251	0.397	0.056	-0.255	-0.001	-0.168	-0.088	-0.312	-0.111
	P	0.160	**0.017‡**	**0.028‡**	0.811	0.182	0.986	0.207	0.745	0.169	0.566
Miscellaneous Domain	R	0.054	-0.072	-0.095	-0.218	0.130	-0.022	-0.061	-0.125	-0.152	0.082
	P	0.406	0.592	0.727	0.343	0.501	0.730	0.648	0.646	0.510	0.674

*R-values represent correlation coefficients, where R > 0 indicates a positive correlation and R < 0 indicates a negative correlation; †P value <0.05 indicate statistical significance; ‡indicates statistically significant result

Table 7: Comparison of Corelation of Prolactin with HRQL scale in different phenotypes of PCOS and Control group

Domains		Prolactin				
		Control (n=240)	Phenotype A (n=58)	Phenotype B (n=16)	Phenotype C (n=21)	Phenotype D (n=29)
Psychosocial & Emotional Domain	R*	0.114	0.026	0.660	0.126	-0.029
	P†	0.079	0.849	**0.037‡**	0.586	0.883
Self-body image Domain	R	0.070	0.011	-0.176	-0.284	-0.158
	P	0.278	0.933	0.515	0.212	0.414
Fertility Domain	R	-0.007	0.014	0.466	-0.033	-0.339
	P	0.916	0.920	**0.049‡**	0.887	**0.042‡**
Menstrual Disorder Domain	R	0.067	-0.230	0.060	-0.104	-0.260
	P	0.298	0.082	0.825	0.655	**0.043‡**
Miscellaneous Domain	R	-0.022	-0.044	-0.169	-0.313	-0.056
	P	0.731	0.743	0.532	0.167	0.774

*R-values represent correlation coefficients, where R > 0 indicates a positive correlation and R < 0 indicates a negative correlation; †P value <0.05 indicate statistical significance; ‡indicates statistically significant result

Table 4 illustrates that BMI and self-body image had inverse relationships in Phenotypes C and D. WHR showed unique association in Phenotype C and involvement in psychological disorders related to menstruation were seen in Phenotype A.

Table 5 shows significant hormonal correlations in Phenotypes B and D linked to fertility and psychological concerns. Phenotype B shows association with menstrual disorders and Phenotype D shows the impact of on testosterone on psychological domain. Also, both Phenotypes highlight the role of the LH:FSH ratio in these associations.

Table 6 shows that HOMA-IR was positively associated with psychosocial distress in Phenotype B but negatively linked to self-body image in Phenotypes C and D. AMH showed negative correlations with self-body image in Phenotypes C and D and with the menstrual disorder domain in Phenotype A, while it was positively associated with the fertility and menstrual disorder domains in Phenotype B but negatively in Phenotype D.

A statistically significant positive correlation is seen between prolactin and the psychosocial domain (R = 0.660, p = 0.037) and the Fertility Domain (R = 0.466, p = 0.049) in Phenotype B. Phenotype D showed a statistically significant negative correlation is seen between prolactin and the Fertility Domain (R = -0.339, p = 0.042) along with Menstrual Disorder Domain (R = -0.260, p = 0.043).

A multivariate regression analysis indicated that BMI significantly predicted fertility domain scores (p<0.05). Weight and height also showed similar trend as BMI. Testosterone levels were significantly associated to poor body image perception (p = 0.010, Partial Eta Squared = 0.013). Group differences were significant across all the domains (p < 0.001), with PCOS phenotypes showing higher levels of distress and reproductive issues compared to controls. The strongest effects were seen in menstrual disorder (η^2 = 0.232) and fertility concerns (η^2 = 0.151). Age, WHR, LH, FSH, LH/FSH ratio, HOMA-IR, AMH, Prolactin did not significantly influence any of the domains (p > 0.05) despite their biological importance in PCOS. The overall model explained 75.9% of the variance in fertility outcomes and 63.5% of the variance in self-body image scores.

All these results suggest that better understanding of the psychosocial health of women with PCOS is dependent on hormonal imbalances, which leads to the need for personalized management strategies for the betterment of patients.

Discussion

PCOS is a multifaceted endocrine disorder that extends its influence far beyond the physical manifestations of irregular menstrual cycles, hirsutism, and metabolic disturbances.[3] We tried to find the association of hormonal dysregulations on the psychosocial health of PCOS subjects, by correlating hormonal fluctuations and different domains of emotions. We found a complex and interconnected area of challenges faced by PCOS women, indicating the need for a more personalized treatment approach.

Phenotypes A, B, C, and D recorded prevalence of 46.77%, 12.90%, 16.94%, and 23.39%, respectively. Regardless of the phenotype, women with PCOS, exhibit significant differences in height, weight, BMI, altered levels of FSH, LH, an elevated LH:FSH ratio, increased testosterone, elevated AMH, higher prolactin, and increased insulin resistance compared to women without PCOS (P<0.001). Similar results were illustrated in the study conducted by Sachdeva et al[11] and Gluszak *et al*[12]

Psychosocial Burden and Variability Among Phenotypes: The findings of this study emphasize the profound impact of hormonal imbalances associated with PCOS on various psychological, emotional, and metabolic parameters. Increased rates of depression, mood swings, anxiety, and self-body image concerns among different phenotypes of PCOS indicate the higher psychosocial distress in subjects, which was similar to previous research done on mental stress and psychological burden of disease.[13,14] PCOS sub-

jects on comparison with healthy controls showed higher levels of anxiety and depression.[15] PCOS, being a long-term disorder, develops various psychological symptoms like frustration, helplessness, loss of control over situation leading to mood-related disorders, and diminished mental health of subjects.[16]

The self-esteem domain was observed to be the most affected area in our study. Clinical manifestations of PCOS, like weight gain, acne, hirsutism, etc., affect self-body concern to a large extent.[17] These physical changes, being the opposite of the societal beauty standard, lead to lower self-esteem in subjects by developing shame, a devasted sense of femininity, embarrassment regarding looks, and social isolation.[6]

BMI and WHR showed a correlation with the self-body image domain in specific phenotypes, elucidating the requirement of the body image concern-focused treatment approach to restore self-esteem in PCOS women. Many of the symptoms of the disorder are chronic and difficult to control, so that creates a negative feedback loop and can worsen the mental stress, so it becomes necessary to address them for the betterment of subjects.

The influence of PCOS on fertility has become a significant cause of anxiety, distress, grief, depression, and disappointment in many women.[18] A significant emotional weight is added by long-term reproductive complications, fertility treatments, and pregnancy-related anxieties, leading to negative effects on relationships and overall well-being. The increased concerns about fertility in Phenotype B~~,~~ highlight the need for focused fertility counselling and therapies that address both medical and psychological aspects of reproductive health. Characteristic features of PCOS, unpredictability of cycles, prolonged bleeding, associated pain and discomfort can cause anxiety, frustration, and increased concerns about fertility.[19,20] Societal norms of considering menstruation as a sign of femininity~~,~~ can increase anxiety in PCOS patients.[21] An open education regarding menstrual health can empower women to cope ~~up~~ with these challenges.

The financial impact of PCOS is an important yet frequently overlooked domain. PCOS management often comes with significant costs of medical consultation, medicines, and fertility treatments for a lifetime. The financial burden, along with lost productivity from emotional distress or severe symptoms, heightens psychological stress for women with PCOS, creating a cycle of physical and financial hardship, further worsening anxiety and mental health.[22]

The relationship between PCOS and mental health is now the subject of various theories. According to some, PCOS patients' hyperactive hypothalamic-pituitary-ovarian and hypothalamic-pituitary-adrenal axes may change their hormonal profile and play a part in the development of mental illnesses.[23]

Impact of Hormonal Alterations on Psychological Well-being: Our study identified a strong association between elevated levels of FH: LSH, testosterone, insulin resistance, and prolactin with psychological distress in PCOS subjects. Similar findings were observed in a cross-sectional study conducted in the gynaecology department at a tertiary medical centre, where blood LH levels, LH:FSH ratios, and total testosterone levels were higher in PCOS-diagnosed women with high anxiety scores.[24] A study conducted by Karjula et al in 2017 have also shown a relationship between high testosterone levels and anxiety.[25] In a recent meta-analysis, moderate to severe depression and anxiety symptoms were weakly associated with age, BMI, elevated testosterone, hirsutism, and IR.[26]

Women with PCOS frequently report feeling frustrated with weight gain, excessive hair growth (hirsutism), acne, and other dermatological manifestations, which negatively affect their self-esteem and mental well-being. Body image dissatisfaction is a crucial component of psychological distress in PCOS patients, especially in Phenotype C and D as observed in our study, and it is often exacerbated by hormonal imbalances such as the LH:FSH ratio, elevated testosterone, and AMH levels. Obese PCOS women with high WHR suffer more negative emotions due to physical changes, leading to social withdrawals.[27] Elevated testosterone levels cause increased facial and body hair~~s~~, acne, and scalp hair-thinning, aggravating body image concerns.[13] Higher levels of AMH correlated with self-body image perceptions, due to physical symptoms caused by AMH disturbances.[28]

Hormonal disturbances in LH and FSH among PCOS subjects are the main reasons for anovulation and menstrual irregularities. Phenotype B and D showed significant correlation with concern for menstrual irregularities and fertility in our study, similar to the study done by Sachdeva et al.[11] in 2019, indicating that hyperandrogenism is the main cause of mood changes and fertility concerns. Gunkaya et al.[24], also concluded that hirsutism and menstrual irregularities were related to anxiety, stress, and depression-like symptoms. Higher LH levels have been associated with persistent anovulation and prolonged menstrual intervals, leading to oligomenorrhea or amenorrhea in PCOS.[29]

Phenotype B and D showed increased AMH levels, which correlated with fertility-related distress in our study. This supports the hypothesis that hormonal imbalance and increased ovarian follicular activity play a pivotal role in reproductive concerns and psychological stress.[30] Prolactin levels also showed a significant association with fertility-related depression, particularly in phenotype B and D.[31]

Financial stress could impact the hypothalamic-pituitary-ovarian axis, leading to LH/FSH imbalance, irregular menstrual cycles, weight gain, acne, and hirsutism. These physical changes prompt women to

seek medications and cosmetic treatments, which can be a monetary burden.[22,32] A common cause of infertility is PCOS, which leads to a cause of financial burden due to fertility treatments like IUI and IVF. Chronic health issues will lead to increased levels of depression, frustration, and feelings of helplessness about the situation due to an inability to afford basic treatments.[22]

Another critical concern for women with PCOS is the possibility of getting cancer, especially endometrial cancer, as a result of unopposed estrogen exposure and prolonged anovulation.[33] Our study found that this fear was significantly correlated with hormonal disturbances, particularly with elevated testosterone levels in Phenotypes D. This aligns with previous research indicating that chronic anovulation raises the risk of endometrial hyperplasia, a precursor to malignancy. Additionally, insulin resistance and obesity, which are more prevalent in PCOS phenotypes with metabolic dysfunction, are known risk factors for endometrial cancer, further contributing to anxiety and health-related stress in affected women.[34]

Correlations Between Metabolic Parameters and Psychological Domains: In a study of women diagnosed with PCOS, anxiety was found to be associated with an increased incidence of IR.[35] The insulin-related metabolic and reproductive characteristics of PCOS are exacerbated by central obesity based on BMI and IR and may have a direct or indirect detrimental impact on AMH. A strong relation between AMH and central adiposity was found in PCOS subjects.[36] HOMA-IR, a measure of insulin resistance, is related to menstrual disturbances by disrupted ovarian function and hyperandrogenism and showed a significant correlation with fertility and self-body image concerns in PCOS.[17] Our study found a significant association between HOMA-IR values and menstrual irregularities, supporting the hypothesis that insulin resistance contributes to reproductive dysfunction in PCOS women, as seen in Robinson et al.[37] IR was more significantly associated with atypical menstrual cycles in PCOS patients under 25 years of age, without parity or gestations, with a raised AFC, and with higher levels of prolactin, testosterone, INHB, and AMH.[38]

Moreover, insulin resistance contributes to central adiposity and weight gain, which are associated with body dissatisfaction in PCOS subjects.[39] Metabolic dysfunctions are also linked to higher psychological distress in PCOS women.[40] The relation between WHR and menstrual disorder concerns in PCOS women proves that central obesity contributes to menstrual cycle disturbances along with psychological stress.[41]

Limitations and Future aspects

Even though this research found strong results regarding the relationship of hormonal imbalances on the psychological health of women with PCOS, it still has some limitations. The cross-sectional design of the study could not conclude about the causality, and the limited sample size may not depict the variations. Future studies can be beneficial if they adapt longitudinal design and will give a deeper understanding of the dynamics of hormonal imbalances and mental health. More personalized and detailed understanding of women's emotional experiences can be assessed by different qualitative approaches. The contribution of diet, lifestyle modification, weight management, and emotional support should also be evaluated for their role in mental health in PCOS.

Conclusion

The hormonal disturbances are strongly intertwined with the mental health of women with PCOS. By acknowledging this correlation healthcare providers can generate comprehensive treatment approaches that cover both the physiological and psychological aspects for different PCOS phenotype subjects based on their hormonal imbalances and, leading to the overall betterment of PCOS subjects in terms of physical and emotional well-being.

Author Contribution: NP: Conceptualized the study, developed the research design and drafted the manuscript **IS:** Reviewed and edited the manuscript and provided critical revisions **KP:** Data collection and laboratory sample testing **NM:** Analysis and interpretation of data.

Use of generative AI tools: The generative AI tool was only used for correction of grammatical errors. All findings, analysis, data generation, interpretations and content creations are based solely on the authors' independent work and expertise.

References

1. Yasmin A, Roychoudhury S, Paul Choudhury A, et al. Polycystic Ovary Syndrome: An Updated Overview Foregrounding Impacts of Ethnicities and Geographic Variations. Life (Basel). 2022 Nov 25;12(12):1974. DOI: https://doi.org/10.3390/life12121974 PMid:36556340 PMCid:PMC9785838

2. Simon, V.; Peigné, M.; Dewailly, D. The Psychosocial Impact of Polycystic Ovary Syndrome. Reprod. Med. 2023; 4(1): 57-64. DOI: https://doi.org/10.3390/reprodmed4010007

3. Almhmoud H, Alatassi L, Baddoura M,et al. Polycystic ovary syndrome and its multidimensional impacts on women's mental health: A narrative review. Medicine (Baltimore). 2024 Jun 21;103(25): e38647. DOI: https://doi.org/10.1097/MD.0000000000038647 PMid:38905372 PMCid:PMC11191963

4. Dong J, Rees DA. Polycystic ovary syndrome: pathophysiology and therapeutic opportunities. BMJ Med. 2023 Oct 12;2(1):e000548. DOI: https://doi.org/10.1136/bmjmed-2023-000548 PMid:37859784 PMCid:PMC10583117

5. Barbagallo F, Tiranini L, Placentino C, et al. Body Image and Other Mood Vulnerabilities in Adolescents with Polycystic Ovary Syn-drome and Metabolic Alterations. Children (Basel). 2024 Apr 26;11(5):521. DOI: https://doi.org/10.3390/ children11050521 PMid:38790516 PMCid:PMC11119722

6. Merino M, Tornero-Aguilera JF, Rubio-Zarapuz A, et al. Body Perceptions and Psychological Well-Being: A Review of the Impact of Social Media and Physical Measurements on Self-Esteem and Mental Health with a Focus on Body Image Satisfaction and Its Rela-tionship with Cultural and Gender Factors. Healthcare (Basel). 2024 Jul 12;12(14):1396. DOI: https://doi.org/10.3390/healthcare12141396 PMid:39057539 PMCid:PMC11276240

7. Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). Hum Reprod. 2004 Jan;19(1):41-7. DOI: https://doi.org/10.1093/humrep/deh098 PMid:14688154

8. Sachdeva G, Gainder S, Suri V, et al. Comparison of the Different PCOS Phenotypes Based on Clinical Metabolic, and Hormonal Profile, and their Response to Clomiphene. Indian J Endocrinol Metab. 2019 May-Jun;23(3):326-331. DOI: https://doi.org/10.4103/ijem.IJEM_30_19 PMid:31641635 PMCid:PMC6683693

9. Głuszak O, Stopińska-Głuszak U, Glinicki P, et al. Phenotype and metabolic disorders in polycystic ovary syndrome. ISRN Endo-crinol. 2012; 2012:569862. DOI: https://doi.org/10.5402/2012/569862 PMid:22462015 PMCid:PMC3302054

10. Alur-Gupta S, Chemerinski A, Liu C, et al. Body-image distress is increased in women with polycystic ovary syndrome and mediates depression and anxiety. Fertil Steril. 2019 Nov;112(5):930-938.e1. DOI: https://doi.org/10.1016/j.fertnstert.2019.06.018 PMid:31395311 PMCid:PMC6858949

11. Keeratibharat P, Sophonsritsuk A, Saipanish R, et al. Prevalence of depression and anxiety in women with polycystic ovary syn-drome (PCOS) and associated factors in a quaternary hospital in Thailand: a cross-sectional study. BMC Psychiatry. 2024 Nov 1;24(1):760. DOI: https://doi.org/10.1186/s12888-024-06154-8 PMid:39487412 PMCid:PMC11529037

12. Sulaiman MA, Al-Farsi YM, Al-Khaduri MM, et al. Psychological burden among women with polycystic ovarian syndrome in Oman: a case-control study. Int J Womens Health. 2017 Dec 12;9:897-904. DOI: https://doi.org/10.2147/IJWH.S145383 PMid:29276413 PMCid:PMC5731436

13. Azizi M, Elyasi F. Psychosomatic Aspects of Polycystic Ovarian Syndrome: A Review. Iran J Psychiatry Behav Sci. 2017;11(2): e6595. DOI: https://doi.org/10.5812/ijpbs.6595

14. Alkheyr Z, Murad M, Das P, et al. Self-esteem and body image satisfaction in women with PCOS in the Middle East: Cross-sectional social media study. PLoS One. 2024 Apr 25;19(4):e0301707. DOI: https://doi.org/10.1371/journal.pone.0301707 PMid:38662709 PMCid:PMC11045070

15. ALSumri H, Szatkowski L, Gibson J, Fiaschi L, Bains M. Psychosocial Impacts of Infertility among Omani Women with Polycystic Ovarian Syndrome: A Qualitative Study. Int J Fertil Steril. 2023 Feb 1;17(2):107-114. DOI: https://doi.org/10.22074/ijfs.2022.550111.1310. PMID: 36906827; PMCID: PMC10009516.

16. Sharma A, Shrivastava D. Psychological Problems Related to Infertility. Cureus. 2022 Oct 15;14(10):e30320. DOI: https://doi.org/10.7759/cureus.30320. PMID: 36407201; PMCID: PMC9661871

17. Attia GM, Alharbi OA, Aljohani RM. Impact of Irregular Menstruation on Health: A Review of the Literature. Cureus. 2023 Nov 20;15(11):e49146. DOI: https://doi.org/10.7759/cureus.49146. PMID: 38130524; PMCID: PMC10733621.

18. Nasiri Amiri F, Ramezani Tehrani F, Simbar M, et al. The experience of women affected by polycystic ovary syndrome: a qualitative study from iran. Int J Endocrinol Metab. 2014 Apr 1;12(2):e13612. DOI: https://doi.org/10.5812/ijem.13612 PMid:24829583 PMCid:PMC4013493

19. Xing L, Xu J, Wei Y, et al. Depression in polycystic ovary syndrome: Focusing on pathogenesis and treatment. Front Psychiatry. 2022 Aug 31;13:1001484. DOI: https://doi.org/10.3389/fpsyt.2022.1001484 PMid:36117653 PMCid:PMC9470949

20. Sarkisian KI, Ho L, Yang J, et al. Neuroendocrine, neurotransmitter, and gut microbiota imbalance contributing to potential psychi-atric disorder prevalence in polycystic ovarian syndrome. F S Rep. 2023 Sep 9;4(4):337-342. DOI: https://doi.org/10.1016/j.xfre.2023.08.009 PMid:38204948 PMCid:PMC10774902

21. Gunkaya OS, Tekin AB, Bestel A, Arslan O, Şahin F, Taymur BD, Tuğ N. Is polycystic ovary syndrome a risk factor for depression and anxiety?: a cross-sectional study. Rev Assoc Med Bras (1992). 2024 Apr 22;70(3):e20230918. PMID: 38655994; PMCID: PMC11042827.

22. Karjula S, Morin-Papunen L, Auvinen J, et al. Psychological Distress Is More Prevalent in Fertile Age and Premenopausal Women with PCOS Symptoms: 15-Year Follow-Up. J Clin Endocrinol Metab. 2017 Jun 1;102(6):1861-1869. DOI: https://doi.org/10.1210/jc.2016-3863 PMid:28323926 PMCid:PMC5470769

23. Cooney LG, Lee I, Sammel MD, et al. High prevalence of moderate and severe depressive and anxiety symptoms in polycystic ovary syndrome: a systematic review and meta-analysis. Hum Reprod. 2017 May 1;32(5):1075-1091. DOI: https://doi.org/10.1093/humrep/dex044 PMid:28333286

24. Zachurzok A, Pasztak-Opilka A, Forys-Dworniczak E, et al. Are Psychosocial Consequences of Obesity and Hyperandrogenism Pre-sent in Adolescent Girls with Polycystic Ovary Syndrome? Int J Endocrinol. 2018 Jul 25; 2018:3269618. DOI: https://doi.org/10.1155/2018/3269618 PMid:30147723 PMCid:PMC6083491

25. Daescu AC, Dehelean L, Navolan DB, et al. Effects of Hormonal Profile, Weight, and Body Image on Sexual Function in Women with Polycystic Ovary Syndrome. Healthcare (Basel). 2023 May 19;11(10):1488. DOI: https://doi.org/10.3390/healthcare11101488 PMid:37239774 PMCid:PMC10218001

26. Fu W and Kuang Y. Role of luteinizing hormone elevation in outcomes of ovulation induction with letrozole for polycystic ovary syndrome. Front. Med. 2023; 10:1113840. DOI: https://doi.org/10.3389/fmed.2023.1113840 PMid:37144035 PMCid:PMC10151707

27. Tal R, Seifer DB, Khanimov M, et al. Characterization of women with elevated Anti-mullerian hormone levels (AMH): correlation of AMH with polycystic ovarian syndrome phenotypes and assisted reproductive technology outcomes. Am J Obstet Gynecol. 2014 Jul;211(1): 59.e1-8. DOI: https://doi.org/10.1016/j.ajog.2014.02.026 PMid:24593938

28. Iancu ME, Albu AI, Albu DN. Prolactin Relationship with Fertility and In Vitro Fertilization Outcomes-A Review of the Literature. Pharmaceuticals (Basel). 2023 Jan 13;16(1):122. DOI: https://doi.org/10.3390/ph16010122 PMid:36678618 PMCid:PMC9867499

29. Yadav S, Delau O, Bonner AJ, et al. Direct economic burden of mental health disorders associated with polycystic ovary syndrome: Systematic review and meta-analysis. Elife. 2023 Aug 3;12:e85338. DOI: https://doi.org/10.7554/eLife.85338 PMid:37534878 PMCid:PMC10471160

30. Khalenko VV, Guiglia RA, Alioto M. Are women with PCOS more at risk for endometrial cancer? What approach for such patients? Acta Biomed. 2023 Apr 24;94(2):e2023081. PMID: 37092622; PMCID: PMC10210553.

31. Yin W, Falconer H, Yin L, et al. Association Between Polycystic Ovary Syndrome and Cancer Risk. JAMA Oncol. 2019 Jan 1;5(1):106-107. DOI: https://doi.org/10.1001/jamaoncol.2018.5188 PMid:30489606 PMCid:PMC6439760

32. Livadas S, Chaskou S, Kandaraki AA, et al. Anxiety is associated with hormonal and metabolic profile in women with polycystic ovarian syndrome. Clin Endocrinol (Oxf). 2011 Nov;75(5):698-703. DOI: https://doi.org/10.1111/j.1365-2265.2011.04122.x PMid:21605157

33. Chen MJ, Yang WS, Chen CL, et al. The relationship between anti-Mullerian hormone, androgen and insulin resistance on the number of antral follicles in women with polycystic ovary syndrome. Hum Reprod. 2008 Apr;23(4):952-7. DOI: https://doi.org/10.1093/humrep/den015 PMid:18256110

34. Robinson S, Kiddy D, Gelding SV, et al. The relationship of insulin insensitivity to menstrual pattern in women with hyperandrogen-ism and polycystic ovaries. Clin Endocrinol (Oxf). 1993 Sep;39(3):351-5. DOI: https://doi.org/10.1111/j.1365-2265.1993.tb02376.x PMid:8222298

35. Niu, J., Lu, M. & Liu, B. Association between insulin resistance and abnormal menstrual cycle in Chinese patients with polycystic ovary syndrome. J Ovarian Res 2023:16:45. DOI: https://doi.org/10.1186/s13048-023-01122-4 PMid:36823522 PMCid:PMC9948335

36. Bhattacharya K, Sengupta P, Dutta S, et al. Waist-to-height ratio and BMI as predictive markers for insulin resistance in women with PCOS in Kolkata, India. Endocrine. 2021 Apr;72(1):86-95. DOI: https://doi.org/10.1007/s12020-020-02555-3 PMid:33400176

37. Zangeneh FZ, Jafarabadi M, Naghizadeh MM, et al. Psychological distress in women with polycystic ovary syndrome from imam Khomeini hospital, Tehran. J Reprod Infertil. 2012 Apr;13(2):111-5. PMID: 23926533; PMCID: PMC3719335.

38. Basu BR, Chowdhury O, Saha SK. Possible Link Between Stress-related Factors and Altered Body Composition in Women with Poly-cystic Ovarian Syndrome. J Hum Reprod Sci. 2018 Jan-Mar;11(1):10-18. DOI: https://doi.org/10.4103/jhrs.JHRS_78_17 PMid:29681710 PMCid:PMC5892097