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Psychological Status During Menopausal Transition in Women With Polycystic Ovarian Syndrome Living in a Frontline City: A Cross-Sectional Study in Kharkiv, Ukraine

Igor Lakhno

Department of Obstetrics and Gynecology, Kharkiv National Medical University, Kharkiv, Ukraine

Correspondence: Igor Lakhno (igorlakhno71@gmail.com; iv.lakhno@knmu.edu.ua)

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ABSTRACT

Background: Polycystic ovarian syndrome (PCOS) is an evolutionary disease that negatively affects reproductive, dermatological, cardiovascular and psychological aspects of health. The study was focused on the investigation of the relationship between PCOS and clinical, biochemical and psychological features in perimenopausal women in the frontline city of Kharkiv.

Material and Methods: A descriptive cross-sectional study was conducted in 68 perimenopausal women who were enroled in the study. The 38 women without prior PCOS were included in Group I. The 30 women with a history of PCOS were enroled in Group II. The variables of body mass index (BMI), heart rate (HR) and blood pressure (BP) were measured at inclusion. The menopausal Cooperman's score and psychological tests were assessed. The latter were Spielberger's scale (personal and reactive anxiety), Taylor's anxiety measurement and the Perceived Stress Scale (PSS). The acceleration capacity (AC) and deceleration capacity (DC) via electrocardiography were detected. The atherogenic index (AI), which reflects the ratio of atherogenic and antiatherogenic fractions of cholesterol, was calculated. Homeostatic Model Assessment (HOMA) index was detected. C-reactive protein (C-RP) as a marker of chronic inflammation was investigated.

Results: The variables of BMI, HR, systolic BP, diastolic BP, Cooperman's score, HOMA index, AI, C-RP and AC/DC did not differ significantly between the study groups. However, the level of anxiety and stress variables was significantly higher in women with prior PCOS in Group II. The variable of BMI demonstrated moderate correlation with HOMA index ($r = 0.33$, $p = 0.006$) and C-RP ($r = 0.43$, $p < 0.001$). The systolic BP had a strong or moderate correlation with diastolic BP ($r = 0.74$, $p < 0.001$), HR ($r = 0.53$, $p < 0.001$) and Cooperman's score ($r = 0.45$, $p < 0.001$). Similar trends were found in diastolic BP: diastolic BP versus systolic BP ($r = 0.74$, $p < 0.001$), diastolic BP versus HR ($r = 0.52$, $p < 0.001$) and Cooperman's score ($r = 0.54$, $p < 0.001$). HR correlated with Taylor's anxiety measurement ($r = 0.27$, $p = 0.028$). Cooperman's score demonstrated a relationship with systolic BP ($r = 0.45$, $p < 0.001$), diastolic BP ($r = 0.54$, $p < 0.001$), AC ($r = -0.28$, $p = 0.021$) and DC ($r = -0.27$, $p = 0.027$). Moderate correlation was found in the pairs HOMA index versus BMI ($r = 0.33$, $p = 0.006$), HOMA index versus C-RP ($r = 0.45$, $p < 0.001$) and HOMA index versus PSS ($r = -0.35$, $p = 0.040$). The relationship between AI and Taylor's anxiety measurement ($r = -0.3$, $p = 0.014$) was detected. The multivariate logistic regression detected the link between Spielberger's scale score and prior PCOS. The found coupling between Spielberger's scale score and PSS demonstrated a mutual nature of these scales' parameters.

Conclusion: PCOS was a reason for psychological disorders in perimenopausal women residents of a frontline city of Kharkiv. While metabolic profiles between women with and without a history of PCOS could equalize with age, PCOS served as a primary trigger for significantly higher psychological distress under wartime conditions. Therefore, healthcare programmes for

this demographic must integrate psychological support and potentially pharmacological interventions (sedatives, anxiolytics or HRT).

1 | Introduction

Polycystic ovarian syndrome (PCOS) is an evolutionary disease that negatively affects reproductive, dermatological, cardiovascular and psychological aspects of health. The origin of PCOS remains unclear [1]. The main pathogenic scenario harmful for women's health is cardiometabolic. The effect is associated with androgenicity, which triggers resistance to insulin, dyslipidemia, obesity, chronic inflammation and endothelial dysfunction [2, 3]. However, mental disorders related to eating or sleep disturbances, anxiety, depression, negative attitude to body composition or skin acne, and sexual dysfunction are features of the population with PCOS [4, 5]. Menopause is associated with a physiological decline in androgens and thus related sexual dysfunction [6]. Although the use of androgens is controversial, the issues of quality of life in a transition period stimulate the search in the field [7].

Perimenopausal age is the time for the manifestation of cardiovascular disease [8, 9]. Psychological disorders capture the postponed effects from the reproductive period to early ageing. PCOS is known to affect the age of menopause. Menopause itself changes the psychological portrait of a woman [10]. Wartime stress is a significant issue for all age groups. Nowadays, the war in Ukraine emphasizes the residents of frontline cities as a target population for cardiovascular and psychological disorders [11].

The therapeutic interventions could not restore the ovarian steroid metabolism in PCOS. The modifications of a lifestyle and the use of combined oral pills are effective interventions in the prevention of long-term consequences of PCOS [12–14]. The lack of evidence in the field of menopausal disorders in prior PCOS is known. The search for novel approaches to women's health in armed conflict is a challenge for the healthcare system.

The study *was focused* on the investigation of the relationship between PCOS and clinical, biochemical and psychological features in perimenopausal women in the frontline city of Kharkiv.

2 | Material and Methods

Among women who visited the outpatient department of Kharkiv Municipal Perinatal Center for a preventive checkup between 1 September 2024 and 31 August 2025. The data was obtained from the hospital automation system. Ethics approval was received from the Research Council and Ethical Committee of Kharkiv National Medical University. Informed consent was obtained from all the patients. The eligible participants were informed about the study's methodology, aims, objectives, indications and eventual complications before enrolment. Patients were selected randomly. Inclusion criteria: perimenopausal age. Exclusion criteria: severe medical disorders like diabetes mellitus, metabolic syndrome, cardiac diseases, renal disease, thyrotoxicosis and malignancies. The exclusions of diabetes mellitus and metabolic syndrome were made to focus on the psychological status independent of the distress caused by managing severe physical illness. All patients included in the study did not have any indication for operative interventions related to gynaecological disease. In total, 68 perimenopausal women were enroled in the study. The 38 women without prior PCOS were included in Group I. The 30 women with a history of PCOS were enroled in Group II.

The variables of body mass index (BMI), heart rate (HR) and blood pressure (BP) were measured at inclusion. The menopausal Cooperman's score and psychological tests were assessed. Anxiety and stress levels in the study groups were measured using psychological diagnostic methods to assess the women's psychological and emotional state [15]. The psychological assessments were conducted during in-person outpatient visits, and the scores were subsequently recorded and retrieved from the digital medical system. The study used the following methods:

- Spielberger's scale of personal and reactive anxiety, where an indicator of up to 30 points corresponds to a low, from 31 to 44 points to a moderate, and over 45 points to a high level of anxiety.
- Taylor's anxiety measurement, where a total score of 40–50 points is considered an indicator of a very high level of anxiety; 25–40 points indicates a high level of anxiety; 15–25 points indicates an average (with a tendency to high) level; 5–15 points indicates an average (with a tendency to low) level; 0–5 points indicates a low level of anxiety.
- Perceived stress scale (PSS), where a score of more than 32 points corresponds to a high level of stress.

Biochemical studies were performed on a Cobas 6000 analyzer (Roche Diagnostics, Switzerland). The study population was tested for serum triglycerides (TG), total cholesterol (CHC), high-density lipoprotein cholesterol (HDL cholesterol), low-density lipoprotein cholesterol (LDL cholesterol) and very-low-density lipoprotein cholesterol (VLDL cholesterol). The concentrations of TG and CHC were studied by the colorimetric enzymatic method, and HDL cholesterol was investigated by the colorimetric enzymatic method with pre-precipitation of LDL cholesterol and chylomicrons. The atherogenic index (AI), which reflects the ratio of atherogenic (CHD and LDL cholesterol) and antiatherogenic (HDL cholesterol) fractions of cholesterol, was also calculated. Glycemia and insulin levels on an empty stomach were measured, and the Homeostatic Model Assessment (HOMA) index was subsequently calculated. C-reactive protein (C-RP) as a marker of chronic inflammation was investigated.

The assessment of the heart rate variability was performed. The study used the Cardiolab (KHAI-Medica Research Center,

Ukraine) for the detection of acceleration capacity (AC) and deceleration capacity (DC) variables via electrocardiography.

IBM Corp. Released 2022. IBM SPSS Statistics for Windows, Version 28. Armonk, NY: IBM Corp. was used for statistical analysis. Numeric variables were reported as means with standard deviations, while categorical data were summarized using frequencies and percentages. Normality of numeric variables was evaluated using skewness and histograms. Independent sample *t* tests were used to compare numeric variables that were normally distributed. Variables that were not normally distributed were analyzed using the Mann–Whitney *U* test. Chi-square (or Fisher's exact test) was used to compare categorical variables. Fisher's exact test (for 2×2 tables only) was used as a significance test for qualitative data. For multivariate analyses, logistic regression analysis with an input model was used. Sample size was determined at a 95% confidence level with a 5% margin of error. A sample size of 68 was statistically appropriate for these parameters, given the relatively small total population being studied. It likely reflected the specific number of eligible patients who visited the outpatient department of the Kharkiv Municipal Perinatal Center during the study period from 1 September 2024 to 31 August 2025. A p value below 0.05 indicated statistical significance.

3 | Results

The mean age was 49.4 ± 4.2 years in Group I and 50.1 ± 4.6 years in Group II ($p = 0.5152$). The main PCOS patients' phenotype in Group II was classical, completely associated with anovulation, polycystic ovarian morphology and hyperandrogenism—76.7%. Other representatives of the main group had an ovulatory type of PCOS—13.3% or PCOS without polycystic ovarian morphology—10%. The level of parity was almost similar in both groups. Women (92.1%) in Group I delivered one or more babies. Patients (90%) in Group II had at least one delivery. However, 33.3% of the Group II population conceived their children via artificial reproductive technologies. The variables of BMI, HR, systolic BP, diastolic BP, Cooperman's score, HOMA index, AI, C-RP and AC/DC did not differ significantly between the study groups (Table 1). However, the level of anxiety and stress variables was significantly higher in women with prior PCOS in Group II. Therefore, the women with prior PCOS demonstrated an increased level of mental stress due to the wartime environment during early ageing.

The study revealed the linear correlation between several observed parameters (Table 2). The variable of BMI demonstrated moderate correlation with HOMA index ($r = 0.33$, $p = 0.006$) and C-RP ($r = 0.43$, $p < 0.001$). The systolic BP had a strong or moderate correlation with diastolic BP ($r = 0.74$, $p < 0.001$), HR ($r = 0.53$, $p < 0.001$) and Cooperman's score ($r = 0.45$, $p < 0.001$). Similar trends were found in diastolic BP: diastolic BP versus systolic BP ($r = 0.74$, $p < 0.001$), diastolic BP versus HR ($r = 0.52$, $p < 0.001$) and Cooperman's score ($r = 0.54$, $p < 0.001$). HR correlated with Taylor's anxiety measurement ($r = 0.27$, $p = 0.028$). Cooperman's score demonstrated a relationship with systolic BP ($r = 0.45$, $p < 0.001$), diastolic BP ($r = 0.54$, $p < 0.001$), AC ($r = -0.28$, $p = 0.021$) and DC ($r = -0.27$, $p = 0.027$). Moderate correlation was found in the pairs HOMA index versus BMI ($r = 0.33$, $p = 0.006$), HOMA index versus C-RP ($r = 0.45$, $p < 0.001$) and HOMA index versus PSS ($r = -0.35$, $p = 0.040$). The relationship between AI and Taylor's anxiety measurement ($r = -0.3$, $p = 0.014$) was detected. The found relationship between anxiety and stress markers was evident.

The multivariate logistic regression detected the link between Spielberger's scale score and prior PCOS (Table 3). The model itself was meaningful. The found coupling between Spielberger's scale score and PSS demonstrated a mutual nature of these scales' parameters. The perimenopausal women with prior PCOS were featured by an increased level of anxiety.

4 | Discussion

The research revealed that cardiometabolic profiles in post-reproductive aged women with or without prior PCOS were similar. The metabolic variables (BMI, BP, HOMA, etc.) did not differ significantly between groups, but anxiety and stress were drastically higher in the PCOS group. Most of the previous studies supported the opinion that PCOS-related hyperandrogenism caused glucose intolerance, dyslipidemia and chronic inflammation [16–18]. One study showed that cardiometabolic phenotype in PCOS ameliorated with ageing [19]. Another research demonstrated the healing of phenotypic changes in the process of ageing and the absence of deterioration of cardiovascular health [20]. Probably, the small size of the study population and the limited insight into the postmenopausal years restricted our findings. The elevated anxiety and stress levels were detected in women with PCOS, although both groups of women were affected by wartime stress, living close to the frontline [21]. The wartime stress caused an early menopause in military veterans [22]. The increased use of sedatives was found in Israel in women settled near a conflict zone [23]. The disturbed mental health was detected in women from Woldia (Ethiopia) [24].

The data obtained from linear correlation showed a coupling between BP and Cooperman's score, HR and Taylor's anxiety measurement. Cooperman's score was also related to AC/DC. These results demonstrated the links between autonomic regulation, anxiety levels and hemodynamics during menopausal transition [21]. The weak linear correlation between AI and Taylor's anxiety measurement, as well as the moderate correlation between the HOMA index and PSS, indicated the involvement of mental regulatory processes in metabolic pathways. The observed relationships between HOMA index and BMI, and between HOMA index and C-RP, were not novel; however, they demonstrated the initial role of glucose intolerance in the negative effect on the cardiovascular system in PCOS [5, 20]. The logistic regression supported the opinion on the relationship of anxiety level and PCOS, thus demonstrating a prospect for psychological interventions [10, 18]. Therefore, PCOS was a primary trigger or vulnerability factor for psychological disorders in perimenopausal women that amplified the psychological impact of external stressors. A wartime environment was the constant external variable, while PCOS history was the internal variable that determined the intensity of the psychological response.

TABLE 1 | The variables of BMI, Cooperman's score, carbohydrate and lipid metabolism, C-RP, AC/DC and psychological tests in the study population.

Variable (units of measure)	Group	Frequency	Mean	Std. Deviation	Minimum	Maximum
BMI (kg/m^2)	I	38	30.08	4.58	25	46
	II	30	30.03	4.27	25	41
				$p = 0.9634$		
HR (beats/min)	I	38	78	10.04	50	100
	II	30	80.1	9.44	66	100
				$p = 0.3825$		
Systolic BP (mmHg)	I	38	128.16	13.48	90	150
	II	30	130.67	12.71	110	150
				$p = 0.4372$		
Diastolic BP (mmHg)	I	38	82.89	11.37	60	120
	II	30	84.5	11.84	60	130
				$p = 0.5711$		
Cooperman's score (points)	I	38	27.68	9.62	11	40
	II	30	30.03	6.18	19	40
				$p = 0.2497$		
HOMA index	I	38	2.84	1.39	1.15	6.2
	II	30	3.34	1.87	0.74	7.3
				$p = 0.2104$		
C-RP (mg/L)	I	38	3.1	4.3	0.3	18.5
	II	30	3.19	3.96	0.6	17.5
				$p = 0.9296$		
AI	I	38	2.47	0.83	0.86	4.77
	II	30	2.88	1.01	1.25	5.92
				$p = 0.0706$		
AC (ms)	I	38	8.41	2.42	4.25	14.44
	II	30	9.1	3.89	4.44	17.44
				$p = 0.3733$		
DC (ms)	I	38	8.63	2.4	5.11	13.58
	II	30	8.87	3.47	4.53	17.13
				$p = 0.7374$		
Spielberger's scale (points)	I	38	30.08	3.21	24	36
	II	30	42.43	3.24	38	47
				$p < 0.0001$		
Taylor's anxiety measurement (points)	I	38	24.32	4.72	15	38
	II	30	43.2	2.62	39	48
				$p < 0.0001$		
PSS (points)	I	38	20.42	6	14	37
	II	30	35	2.89	31	44
				$p < 0.0001$		

Abbreviations: AC, acceleration capacity; AI, atherogenic index; BMI, body mass index; BP, blood pressure; C-RP, C-reactive protein; DC, deceleration capacity; HOMA, Homeostatic Model Assessment; HR, heart rate; PSS, Perceived Stress Scale.

The issues of wartime stress in women with PCOS were already investigated in Syria. The necessity of physical activity and diet was shown then. The use of pharmacological interventions was confirmed by reducing the level of anxiety and stress in PCOS [25, 26]. Enhancing the quality of life was logical among the study participants in a frontline area. The lifestyle modification, psychological correction and medications for HRT, sedative and anxiolytic effects are the obvious interventions in middle-aged women around armed conflict [27]. The possible role of probiotics in improving mental health in PCOS has been reported [28]. It demonstrated the involvement of the "gut-brain axis" in the pathogenic scenario of psychological disorders in PCOS [29].

TABLE 2 | The linear correlation between BMI, Cooperman's score, carbohydrate and lipid metabolism, C-RP, AC/DC and psychological tests in the study population.

Variable	Correlation	BMI	Systolic BP	Diastolic BP	HR	Cooper-man's score	HOMA index	C-RP	AI	AC	DC	Spielberger's scale	Taylor's anxiety measurement	PSS
BMI	*r*	1	0.13	0.02	0.07	0.07	0.33	0.43	−0.16	0.17	0.21	0.08	0.07	0.06
	p		0.295	0.899	0.547	0.552	0.006	< 0.001	0.195	0.16	0.09	0.536	0.583	0.63
Systolic BP	*r*	0.13	1	0.74	0.53	0.45	−0.04	0.05	−0.05	0.02	0.03	0.13	0.13	0.14
	p	0.295		< 0.001	< 0.001	< 0.001	0.733	0.699	0.708	0.9	0.807	0.283	0.302	0.242
Diastolic BP	*r*	0.02	0.74	1	0.52	0.54	−0.01	0.04	−0.05	−0.01	−0.05	0.15	0.12	0.08
	p	0.899	< 0.001		< 0.001	< 0.001	0.909	0.736	0.704	0.926	0.671	0.235	0.317	0.492
HR	*r*	0.07	0.53	0.52	1	0.21	−0.08	0.14	−0.09	−0.02	−0.06	0.18	0.27	0.19
	p	0.547	< 0.001	< 0.001		0.083	0.531	0.265	0.448	0.903	0.616	0.137	0.028	0.121
Cooperman's score	*r*	0.07	0.45	0.54	0.21	1	−0.13	0.1	0.01	−0.28	−0.27	0.17	0.18	0.13
	p	0.552	< 0.001	< 0.001	0.083		0.277	0.415	0.915	0.021	0.027	0.177	0.15	0.282
HOMA index	*r*	0.33	−0.04	−0.01	−0.08	−0.13	1	0.45	0.1	−0.13	−0.08	−0.1	−0.19	−0.35
	p	0.006	0.733	0.909	0.531	0.277		< 0.001	0.416	0.288	0.493	0.398	0.111	0.004
C-RP	*r*	0.43	0.05	0.04	0.14	0.1	0.45	1	−0.2	−0.2	−0.16	0.09	0.07	−0.14
	p	< 0.001	0.699	0.736	0.265	0.415	< 0.001		0.103	0.096	0.197	0.474	0.574	0.266
AI	*r*	−0.16	−0.05	−0.05	−0.09	0.01	0.1	−0.2	1	0.06	0.01	−0.23	−0.3	−0.18
	p	0.195	0.708	0.704	0.448	0.915	0.416	0.103		0.622	0.936	0.057	0.014	0.131
AC	*r*	0.17	0.02	−0.01	−0.02	−0.28	−0.13	−0.2	0.06	1	0.96	−0.02	0.08	0.04
	p	0.16	0.9	0.926	0.903	0.021	0.288	0.096	0.622		< 0.001	0.877	0.491	0.747
DC	*r*	0.21	0.03	−0.05	−0.06	−0.27	−0.08	−0.16	0.01	0.96	1	−0.03	0.08	0.01
	p	0.09	0.807	0.671	0.616	0.027	0.493	0.197	0.936	< 0.001		0.821	0.5	0.932
Spielberger's scale	*r*	0.08	0.13	0.15	0.18	0.17	−0.1	0.09	−0.23	−0.02	−0.03	1	0.83	0.77
	p	0.536	0.283	0.235	0.137	0.177	0.398	0.474	0.057	0.877	0.821		< 0.001	< 0.001
Taylor's anxiety measurement	*r*	0.07	0.13	0.12	0.27	0.18	−0.19	0.07	−0.3	0.08	0.08	0.83	1	0.8
	p	0.583	0.302	0.317	0.028	0.15	0.111	0.574	0.014	0.491	0.5	< 0.001		< 0.001
PSS	*r*	0.06	0.14	0.08	0.19	0.13	−0.35	−0.14	−0.18	0.04	0.01	0.77	0.8	1
	p	0.63	0.242	0.492	0.121	0.282	0.004	0.266	0.131	0.747	0.932	< 0.001	< 0.001	

Abbreviations: AC, acceleration capacity; AI, atherogenic index; BMI, body mass index; BP, blood pressure; C-RP, C-reactive protein; DC, deceleration capacity; HOMA, Homeostatic Model Assessment; HR, heart rate; PSS, Perceived Stress Scale.

TABLE 3 | Multivariate logistic regression model with Spielberger's scale score.

Variable	Unstandardized coefficients	Standardized coefficients				95% confidence interval for *B*	
Model	*B*	Beta	Standard error	*t*	*p*	Lower bound	Upper bound
(Constant)	26.42		6.86	3.85	< 0.001	12.67	40.18
BMI	−0.02	−0.01	0.11	−0.2	0.84	−0.25	0.2
Systolic BP	−0.02	−0.04	0.04	−0.49	0.624	−0.11	0.07
Diastolic BP	0.04	0.06	0.05	0.79	0.431	−0.05	0.13
HR	−0.01	−0.02	0.05	−0.29	0.772	−0.11	0.08
Cooperman's score	0.02	0.02	0.06	0.31	0.76	−0.1	0.14
HOMA index	0.4	0.1	0.31	1.3	0.2	−0.22	1.03
C-RP	−0.02	−0.01	0.11	−0.14	0.891	−0.24	0.21
AI	−0.3	−0.04	0.46	−0.65	0.518	−1.21	0.62
PCOS	−4.81	−0.35	2.11	−2.28	0.026	−9.04	−0.58
AC	0.19	0.09	0.44	0.44	0.662	−0.69	1.08
DC	−0.31	−0.13	0.47	−0.65	0.518	−1.25	0.64
Taylor's anxiety measurement	0.23	0.34	0.13	1.85	0.069	−0.02	0.49
PSS	0.21	0.27	0.1	2.08	0.042	0.01	0.42

Abbreviations: AC, acceleration capacity; AI, atherogenic index; BMI, body mass index; BP, blood pressure; C-RP, C-reactive protein; DC, deceleration capacity; HOMA, Homeostatic Model Assessment; HR, heart rate; PCOS, polycystic ovarian syndrome; PSS, Perceived Stress Scale.

Wartime stress was an additional issue to conventional metabolic and psychological problems in ageing women with PCOS [30].

5 | Strengths and Limitations

The study held in wartime Kharkiv was a unique context and an obvious strength. The small sample size and the cross-sectional nature of the study were the limitations.

6 | Conclusion

PCOS was a reason for psychological disorders in perimenopausal women residents of a frontline city of Kharkiv. These circumstances should be included in healthcare programmes for the management of middle-aged women. Clinicians should screen perimenopausal women with a history of PCOS for anxiety and stress, particularly in high-conflict areas and consider a multimodal approach including psychological correction and HRT. Healthcare programmes for middle-aged women in frontline areas should prioritize integrated psychological screening and pharmacological support for those with a history of PCOS to mitigate the combined effects of hormonal transition and chronic environmental stress.

Author Contributions

Igor Lakhno designed the research, compiled the materials, analyzed the data, and wrote and revised the manuscript.

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The author has nothing to report.

Ethics Statement

Ethics approval was received from the Research Council and Ethical Committee of Kharkiv National Medical University, No. 46.0624p. Informed consent was obtained from all the patients.

Consent

The author has given all rights for this manuscript to the publisher.

Conflicts of Interest

The author declares no conflicts of interest.

Data Availability Statement

The author has nothing to report.

Peer Review

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