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Original Research Article

A prospective study of association of inflammatory markers with BMI in women with polycystic ovarian syndrome

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ABSTRACT

Background: Many studies have demonstrated the association between polycystic ovary syndrome (PCOS) and chronic low-grade inflammation to be of unknown mechanism or an unclear cause; which could either be due to the underlying obesity, insulin resistance, or the polycystic ovary syndrome itself. The aim of our study was to find if there was any correlation between the inflammatory markers and body mass index (BMI) in women with PCOS.
Methods: Our study included 100 women aged between 18-45 years with PCOS and were recruited for the study in the obstetrics and gynecology department, Pacific Medical College and Hospital, Rajasthan from October 2020 to April 2022. The enrolled patients then underwent a series of clinical, ultrasonographic and biochemical investigations.
Results: WBC was positively correlated with BMI ($r=0.453$, $p<0.000$) Along with that, we were also able to establish a moderate degree positive correlation between BMI and serum CRP levels ($r=0.396$, $p<0.000$). A high degree significant positive correlation was found between ESR count and BMI ($r=0.537$, $p<0.000$) and platelet count and BMI ($r=0.386$, $p<0.000$).
Conclusions: We discovered that higher WBC concentration, ESR count, platelet count, and serum CRP levels are linked to PCOS. Increase in serum inflammatory cardiovascular risk markers are brought on by PCOS and obesity. In order to determine the relative contributions of various factors, such as insulin resistance, androgen status, and BMI, further studies need to be carried out with a larger sample size as the mechanism for the chronic low-grade inflammation still remains unclear.

Keywords: BMI, Corelation, Inflammation, Inflammatory markers, PCOS

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder manifesting as biochemical hyperandrogenemia, polycystic ovaries, and continuous anovulation.[1]

PCOS women have a cluster of symptoms related to menstrual dysfunction as well as androgen excess and may be more prone to type II diabetes, cardiac disease, metabolic syndrome, insulin resistance, cancer, infertility, and mental disorders.[2] PCOS leads to adipocyte hypertrophy as well as hyperandrogenism and elevated levels of serum luteinizing hormone. CRP and IL-6 are being identified as independent factors leading to diabetes mellitus. Levels of CRP in PCOS patients have been noted to be elevated, proving the concept of increased risk due to PCOS for diabetes thereby stimulating inflammatory process.[3,4] Obesity and insulin resistance in patients with PCOS, are linked to circulating CRP as well as IL-6 levels, and the expression of IL-6 in adipocyte is linked to obesity. C-174G genetic variation inside the promoter region of IL-6 gene, which has been found to reconfigure promoter function in vitro, has been linked to elevated IL-6 levels as well as hyperandrogenism in a limited sample of thin

females. As a result, IL-6 could be a connection between metabolic and anthropometric changes, as well as hyperandrogenism in PCOS.[5] The current research was carried out to find the correlation between inflammatory markers with body mass index (BMI) in women with PCOS.

METHODS

This prospective study was done among 100 women in reproductive age group (18-45 years) presenting in gynecology OPD during a period of 18 months from November 2022 to July. Every patient's detailed menstrual history was collected. General and systemic examination was done. BMI and Inflammatory markers (CBC, ESR, CRP) of each patient were measured.

Inclusion criteria were female patients in reproductive age group (18-45 years) and all diagnosed cases of PCOS by Rotterdam's criteria.

Exclusion criteria includes pregnant women and patients having other causes of amenorrhea, diagnosed cases of PCOS who were on hormonal treatment in the last 6 months and patients with other known or incidentally detected health problems like Cushing syndrome, hypothyroidism, congenital adrenal hyperplasia, hyperprolactinemia and diabetes mellitus.

The data were recorded in an Excel sheet and descriptive analysis was performed, of which data are presented in tables. To know the association between dependent and independent variables chi-square was applied accordingly. P value less than 0.05 was considered as statistically significant.

RESULTS

In total, 1500 patients were screened for PCOS, out of which 109 patients were probable cases of PCOS. 9 patients were lost to follow-up and the overall prevalence of study was 7.27%.

Table 1: Distribution of patients according to age.

Age (years)	No. of patients	Percentage	Mean±SD
18-23	30	30	
24-29	38	38	26.77±5.45
30-35	26	26	
36-41	04	04	**Range**
42-45	02	02	18-45
Total	100	100	

It is observed in above table, that the mean age was 26.77±5.45 years. The age distribution of the study subject where majority i.e., 38 (38%) were from 24-29 years of age, 30 (30%) were in 18 to 23 years of age, 26 (26%) were 30 to 35 years of age and few 04 (04%) and 02 (02%) were in the 36 to 41 and 42 to 45 years of age.

Table 2: Distribution of patients according to age at menarche.

Age at menarche	No. of patients	Percentage	Mean±SD
09	02	02	
10	08	08	12.07±1.027
11	09	09	
12	47	47	**Range**
13	30	30	
14	04	04	09-14
Total	100	100	

The mean age at menarche was 12.07±1.027 years. The majority of the patients, 47 (47%) had an average age at menarche of 12 years, whereas just 02 (2%), had an average age at menarche of 9 years. 2% were in 09 years of age at menarche.

Table 3: Distribution of patients according to BMI.

BMI (Kg/m^2)	No. of patients	Percentage	Mean±SD
Underweight (<18.5)	01	01	
Healthy weight (18.5-24.9)	47	47	25.4±2.68
Overweight (25.0-29.9)	50	50	
Obesity (≥30.0)	02	02	**Range**
Total	100	100	18.42-31.14

The distribution of study participants by BMI is shown in the above table. Of the total participants, 50 (or 50%) were overweight, followed by 47 (or 47%), and just two (2%) were obese.

Table 4: Distribution of patients according to ESR count.

ESR count (mm/hour)	No. of patients	Percentage	Mean±SD
15.0-24.99	24	24	
25.0-34.99	24	24	35.50±11.49
35.0-44.99	30	30	
45.0-54.99	19	19	**Range**
55.0-64.99	03	03	
Total	100	100	15.17-64.25

Table 4 depicts the distribution of the patients according to ESR count; the majority, or 30 (30%) were in the 35-44.99 age range, followed by 24 (24%) in the both groups i.e., 15.0-24.99 mm/hour and 25.0-34.99 mm/hour, 19 (19%) in the 45.0-54.99 mm/hour range, and just 03 (03%) in the 55.0-64.99 mm/hour range.

Table 5: Distribution of patients according to CRP levels.

CRP levels (mg/dl)	No. of patients	Percentage	Mean±SD
<2.0	83	83	1.40±1.75
2.0-4.9	13	13	
5.0-7.9	02	02	
8.0-10.9	02	02	**Range**
Total	100	100	0.012-10.56

Above table represents that in group majority 83 (83%) of patients had their CRP levels in the range of below 2.0 mg/dl, followed by 13 (13%) and few i.e., 02 (02%) of patients were in both levels, i.e., 5.0 to 7.9 mg/dl and 8.0 to 10.9 mg/dl respectively. The average CRP level was 1.40±1.75 mg/dl.

Table 6: Correlations of inflammation markers and BMI.

Correlations between	Correlation coefficient (r)	P value
BMI and WBC	0.453	0.000 p<0.05 sig.
BMI and Hb	0.015	0.881 p>0.05 not sig.
BMI and RDW	-0.101	0.317 p>0.05 not sig.
BMI and Platelet count	0.386	0.000 p<0.05 sig.
BMI and MPV	-0.118	0.244 p>0.05 not sig.
BMI and neutrophil count	0.467	0.000 p<0.05 sig.
BMI and lymphocyte count	0.167	0.096 p>0.05 not sig.
BMI and NLR	0.160	0.111 p>0.05 not sig.
BMI and ESR	0.537	0.000 p<0.05 sig.
BMI and CRP	0.396	0.000 p<0.05 sig.

DISCUSSION

Polycystic ovary syndrome is one of the most frequent endocrine disorders in women affecting 4-20% of women of reproductive age worldwide.[6] Our study was intended to find a correlation between inflammatory markers and BMI in PCOS women. The findings of our study suggested that chronic low-grade inflammation especially seen as the elevated levels of WBC, platelet count, neutrophil count, ESR and CRP levels which commonly occurs in PCOS when compared to their normal ovulating, non-hyperandrogenic, BMI and age matched counterparts. In our study, we found statistically significant levels of WBC in 37% of the patients, which is also a marker of chronic inflammation, and these were similar to the results interpreted by Orio et al, Herlihy et al and Papalou et al.[4,7,8] High serum CRP levels were noted in a study by Kelly et al. Additionally, they observed that whereas serum CRP concentrations in PCOS and controls did not correlate with total testosterone levels, they did positively correlate with the degree of obesity and negatively with insulin sensitivity.[3] Elevated levels were also seen in studies conducted by Tola et al and Orio et al.[4,9] Contrarily, independent of PCOS, the CRP levels in obese women were higher (>3.0 mg/dl) than those in normal-weight women (3.0 mg/l). As a result, obesity masks PCOS-related CRP rises, which are below the threshold for predicting metabolic or cardiovascular risk.[10] Several writers point to BMI and insulin resistance as the most significant causes of PCOS women's chronic low-grade inflammatory condition, which leads to the onset and advancement of atherosclerosis.[4]

The serum TNF levels of 726 women with PCOS and 328 controls were similar while serum levels of the IL-6 were not significantly different according to meta analysis of nine research that was conducted recently. In our study, 83% patients had their CRP levels in the range below 2.0 mg/dl and the average CRP level was 1.40±1.75 mg/dl. Escobar-Morreale et al conducted a meta-analysis of 31 clinical trials and thereby came to the conclusion that the serum levels of CRP in women with PCOS on an average was 96% higher when compared to the control groups.[5] 48% patients had their lymphocyte count between 1.0-1.99 x 10^9/l and it has been shown that women with PCOS had increased blood levels of TNF and CRP, as well as circulating levels of monocytes and lymphocytes, alongside inflammatory infiltration in ovarian tissue.[11] We found statistically significant correlation between BMI and WBC (r=0.453), BMI and platelet count (r=0.386), BMI and ESR count (r=0.537), BMI and CRP levels (r=0.396) respectively. The favourable association between CRP, WBC, insulin resistance, and BMI has been demonstrated in numerous research.[4,7,12] However, it is still unclear whether the inflammation is brought on by PCOS alone or by insulin resistance with obesity.

There are few limitations of the studies. The tests involved in the study were not cost effective for patients. The sample size available for the study was not enough for extensive studies. However, it is still unclear whether the inflammation is brought on by PCOS alone or by insulin resistance with obesity.

CONCLUSION

We would like to conclude on the basis of our findings that PCOS is associated with increased WBC and CRP concentrations, which supports the evidence that PCOS is associated with low-grade inflammation. The main predicting factors of increased CRP are BMI and insulin resistance, but there is a relationship between WBC count in PCOS and androgen concentration itself so that inflammation may be mediated not only through adiposity but also through increased androgen concentration.

However, due to many factors that can affect WBC and CRP levels, further studies are needed to understand the precise mechanism of chronic low-grade inflammation in women with PCOS. Further prospective studies, however, are needed to prove this conclusion which has been based on risk markers that can only serve as surrogate parameters.

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REFERENCES

1. Azziz R. PCOS in 2015: new insights into the genetics of polycystic ovary syndrome. Nat Rev Endocrinol. 2016;12:74.
2. El Hayek S, Bitar L, Hamdar LH, Mirza FG, Daoud G. "Poly cystic ovarian syndrome: an updated overview." Front Physiol. 2016;7:124.
3. Kelly CC, Lyall H, Petrie JR, Gould GW, Connell JM, Sattar N. Low grade chronic inflammation in women with polycystic ovarian syndrome. J Clin Endocrinol Metab. 2001;86(6):2453-5.
4. Orio Jr F, Palomba S, Cascella T, Di Biase S, Manguso F, Tauchmanovà L, et al. The increase of leukocytes as a new putative marker of low-grade chronic inflammation and early cardiovascular risk in polycystic ovary syndrome. J Clin Endocrinol Metab. 2005;90(1):2-5.
5. Escobar-Morreale HF, Villuendas G, Botella-Carretero JI, Sancho J, San Millan JL. Obesity, and not insulin resistance, is the major determinant of serum inflammatory cardiovascular risk markers in pre-menopausal women. Diabetologia. 2003;46:625-33.
6. Deswal R. The prevalence of polycystic ovary syndrome: a brief systematic review. J Hum Reprod Sci. 2020;13(4): 261-71.
7. Papalou O, Livadas S, Karachalios A. White blood cells levels and PCOS: direct and indirect relationship with obesity and insulin resistance, but not with hyperandogenemia. Hormones. 2015;14(1):91-100, 2015.
8. Herlihy AC, Kelly RE, Hogan JL. Polycystic ovary syndrome and the peripheral blood white cell count. J Obstet Gynaecol. 2011;31(3):242-4.
9. Tola EN, Yalcin SE, Dugan N. The predictive effect of inflammatory markers and lipid accumulation product index on clinical symptoms associated with polycystic ovary syndrome in nonobese adolescents and younger aged women. Eur J Obstet Gynecol Reprod Biol. 2017;214:168-72.
10. Gonzalez F, Thusu K, Abdel-Rahman E, Dandona P. Elevated serum levels of tumor necrosis factor α in normal-weight women with polycystic ovary syndrome. Metabolism. 1999;48:437-41.
11. Xiong YL, Liang XY, Yang X, Li Y, Wei LN. Low-grade chronic inflammation in the peripheral blood and ovaries of women with polycystic ovarian syndrome. Eur J Obstet Gynecol Reprod Biol. 2011;159:148-50.
12. Tarkun I, Arslan BC, Cantürk Z. Endothelial dysfunction in young women with polycystic ovary syndrome: relationship with insulin resistance and low-grade chronic inflammation. J Clin Endocrinol Metab. 2004;89(11):5592-6.

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