



Evaluation of Some Hematological and Biochemical Parameters for Women with polycystic Ovary Syndrome in Wasit Governorate

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ABSTRACT:

The aim of the study; the Study of physiological causes and risk factors of ovarian cysts in women and Analyzing the results statistically to determine the extent of the relationship between the physiological and biochemical causes of the occurrence of polycystic ovaries.

Polycystic ovary syndrome (PCOS) is one of the commonest endocrine disorders affecting many females in reproductive period which start from menarche till the menopause and commonly caused infertility around the world, and is characterized by irregular menstrual cycle, Hyperandrogensim and polycystic ovary; it can be considered a conditions involving reproductive, metabolic and cardiovascular components leading to lifelong health implication. Its prevalence among infertile women is between (15% to 20%). There is evidence that PCOS is a pro inflammatory disorder, characterized by the presence of low-grade chronic inflammation that correlated with obesity or insulin resistance (IR). The purpose of this study is to investigate

the role of study included 100 females diagnosed with PCOS, there were recruited from Al-kut hospital in Wasit during November 2022 until January 2023, the diagnosis of polycystic ovary syndrome was based on the Rotterdam 2003 criteria. The control group consists of 50 fertile women who have regular menstrual cycle with no sign of hyperandrogenism and subjected to ultrasound

examination and have normal hormonal levels. The age was identical in both groups and it was between (20-40) years. . Body mass index (BMI) for both patients and control group were calculated. The questionnaire form has been filled for each patient and control. Hormones levels luteinizing hormone (LH), follicle stimulating hormone (FSH), and thyroid stimulating hormone (TSH) were estimated. The present study was carried out in two parts: immunological and physiological study. ELISA technique has been used to determine the serum level of High –sensitivity C-reactive protein(Hscrp) .

The results of Hscrp serum level were significantly increased ($p < 0.005$) in pcos patient (17.38 ± 1.36)

The results for physiological study demonstrated that insulin serum level recorded a highly significant difference ($p < 0.05$) in PCOS patients compared to control group, the mean level of this hormone for PCOS patients and control were (17.18 ± 2.84) $\mu\text{IU/mL}$, (8.68 ± 1.97) $\mu\text{IU/mL}$ respective.

While this study showed there were no significant differences in serum levels of T.protein, and TSH between PCOS patients (8.08 ± 1.28). ng/mL , (0.79 ± 0.17) $\mu\text{g/dL}$, and control group (7.09 ± 0.51) ng/mL , (1.20 ± 0.09) $\mu\text{g/dL}$.

This study illustrate that the serum levels of Hscrp and insulin were elevated in PCOS comparing to healthy women and this high levels related to PCOS independent on the presence of obesity or IR., and there was a positive correlation between the insulin hormone with the parameters Hscrp and this may be due to the background of PCOS which considered as inflammatory disease The reslts showed that ,Creatin ,cholesterol,GPT, and LDL ,Lympho ,TG were significantly increased in pcos patients than control group .

Conclusions: In patients with pcos, The plasma level of hscrp,lympho,GPT,LDL,cholesterol,LH,T.Protein and Ceratine is a major independent inflammatory predictor. Also, a ncrease in this hormone levels is an important indicator in predicting polycystic ovary syndrome.

Key Words: polycystic ovary syndrome, hematological, biochemical parameters.



1. INTRODUCTION

Polycystic ovarian syndrome (PCOS) is one of the most common endocrinopathies diseases that affect early reproductive age in females, the first description of PCOS in 1935 by Stein and Leventhal. The diagnose is achieved by three different criteria that were used in this field and was developed by the National Institutes of Health (NIH) in 1990, Rotterdam Criteria (ROT) in 2003, Androgen Excess and PCOS Association (AE-PCOS) criteria in 2006 (1)

The prevalence of PCOS is depended on the method of diagnosis, World Health Organizations (WHO) estimate the prevalence of PCOS worldwide is 2% to 26% (1, 2), with a high prevalence in obese patients at approximate 73%, the type of 8labdominal wall (3)

The main pathophysiological characteristic of PCOS is androgen excess with a prevalence of 60–80% (4), the biochemical hyperandrogenism includes an increase in total testosterone, free testosterone, dehydroepiandrosterone (DHEA), the dehydroepiandrosterone sulfate (DHEA-S) and androstenedione (4).

A dysfunctional interaction of behavioral, environmental, and genetic factors causes PCOS. Enlargement of ovaries, as well as secreting higher levels of androgens than normal theca cells are the most common clinical presentations of PCOS. Increased androgenic secretion results from increased enzyme activity in the steroid production pathway (5).

Many PCOS women have abdominal obesity which it lead to adipose tissue dysfunction, characterized by hypertrophic adipocytes, lipolysis impairments and insulin action. The secretion and expression of adipokines involved in insulin resistance such as adiponectin hormone and dysfunction in the adipose tissue that plays a key role in the metabolic abnormalities of PCOS patients(6) Many PCOS women showed an increased risk for nonalcoholic fatty liver disease (NAFLD) which is one of the most serious hepatic multiplication of metabolic abnormalities with a wide spectrum ranged from hepatic steatosis, inflammation, fibrosis to hepatocellular carcinoma. (7,8) Obesity, androgen excess, dyslipidemia and insulin resistance are the prime factors related to NAFLD in PCOS patents. (9) The immune ascendancy cytokines in follicular fluid lymphocytes may be the immunological feature of PCOS ovary, Many evidence shows that immune dysregulation and chronic inflammation may be involved in the etiology of PCOS but the underlying mechanisms still an unclear. (10) The decreasing of dendritic cells percentage and cytokines in follicular fluid of PCOS women indicate a confusion in the immunological microenvironment of the follicles in the ovary, that may be involved in the folliculogenesis dysfunction. (11) Due to the great number of women infected by PCOS in Iraq ,the current study has been designed to highlight some of the causes of PCOS via measure the biochemical, and immunological parameters.

2. PATIENT AND METHODS

2.1 Study design

The study included 100 females diagnosed with PCOS, there were recruited from Al-kut hospital in Wasit during November 2022 until January 2023 , the diagnosis of polycystic ovary syndrome was based on the Rotterdam 2003 criteria. The control group consists of 50 fertile women who have regular menstrual cycle with no sign of hyperandrogenism and subjected to ultrasound examination and have normal hormonal levels. The age was identical in both groups and it was between (20-40) years. . Body mass index (BMI) for both patients and control group was calculated. The questionnaire form has been filled for each patient and control. Hormones levels luteinizing hormone (LH), follicle stimulating hormone (FSH), and thyroid stimulating hormone (TSH) were estimated. The present study was carried out in two parts: immunological and physiological study. ELISA technique has been used to determine the serum level of High –sensitivity C-reactive protein(HsCrp).

first group consisted of 100 diagnosed women with PCOS the patient's group who were diagnosed by consultant gynecologist based on Rotterdam criteria (Rotterdam, 2004), and second group consisted of 50 healthy women (as controls).

(Triglycerides,cholestriol,urea,ceritinin)the method of work 1ml from R1,R2 and in three tubes and put 10 micron from dstile water in blank also,10micron from stander sleution to tube STD and 10micron from sample to tubeTest in spectropotoe meter and test.

2.2 Sampling (Blood samples)

Fasting venous blood samples were collected from each case during 2nd – 5th day of the menstrual cycle (early follicular phase) for those of normal cycle. about 5 ml of blood samples were obtained from veins of patients having polycystic ovarian syndrome and healthy control subjects.

about 3 ml of blood sample was placed into a gel tube and kept at room temperature for 15 minutes, following coagulation, the serum was separated by a centrifuge 4000 R per M for 10 min used to test.

Statistical Analysis

The data were analyzed statistically using SPSS vet.25, and the averages were compared using Chi-square under a probability level of 0.05.

3. RESULTS AND DISCUSSION

Table (1): the basic characteristics of PCOS patients and controls

Samples	Age (year)	Weight (kg)	Length (cm)	BMI
Patients	27.45 ± 5.79 a	28.89 ± 3.27 a	6.20 ± 158.29 b	52.18 ± 2.62 a
Control	27.40 ± 6.36 a	27.08 ± 2.70 a	5.94 ± 160.69 a	48.81 ± 6.81 a
Sig	0.96	0.08	0.02	0.08

Table (1) illustrates the basic characteristics of PCOS patients and controls groups. There were no statistically significant differences found in the mean age between patients (27.45 ± 5.79 a) and controls (27.40 ± 6.36 a), and there was a significant difference in the mean of BMI between patients (52.18 ± 2.62 a) and controls (48.81 ± 6.81 a).

Table (2): Hormones levels (LH, FSH and TSH) in patients and controls.

Samples	LH	FSH	TSH
Patients	11.54 ± 2.78 a	6.85 ± 2.75 a	0.79 ± 0.17 a
Control	4.80 ± 1.48 b	6.03 ± 1.63 b	1.20 ± 0.09 a
Sig	0.01	0.02	0.51

Serum levels of hormones (LH , FSH and TSH) in patients and controls.

Table (2) revealed the serum levels of LH , FSH and TSH in PCOS patients and controls. The result for the three parameters for PCOS patients were (11.54 ± 2.78 µIU/mL , 11.54 ± 2.78 µIU/mL and 0.79 ± 0.17 µIU/mL) respectively, while the result in the controls group for LH , FSH and TSH were (4.80 ± 1.48 µIU/mL ; 6.03 ± 1.63 µIU/mL ; and 1.20 ± 0.09 µIU/mL) respectively, there was a significant difference (P<0.001) in LH PCOS patients compared to controls group, and (P<0.02) for FSH while there was no significant difference in TSH levels between the two group.

by ovarian estrogen is blamed to play role in this discriminated increase in LH release, and there is no cyclic production of progesterone by a corpus luteum in PCOS, in addition the pituitary and hypothalamus are less sensitive to the inhibitory effect of exogenous progesterone on LH secretion in PCOS (12).

Altered sex steroid production, metabolic dysfunction, and obesity may all contribute to the changes in LH secretion pattern (13), Insulin resistance/hyperinsulinemia may directly or indirectly contribute to the abnormal gonadotropin secretion (14). It was found that PCOS women had infertility rate 66% in the study (15) and 68% in(16).

High percentage of hirsutism in PCOS women which was recorded in this study. This result is in agreement with (17) who explained that all patients with PCOS have an increased sensitivity to androgens, up to 70% have elevated levels, and the other30% are in the normal range. Main sources of excessive amount of androgen in PCOS are the ovaries, mainly theca cells and the zona reticularis of the adrenal cortex (18), In the ovarian theca cells, androgen biosynthesis are mediated by cytochrome P-450c17 enzymes to form androstenedione which converted to testosterone by17b-hydroxysteroid enzyme or aromatized to form estrone (19) .

showed that PCOS ovaries have an increased cytochrome P-450c17 enzymatic activity, leading to enhanced the synthesis of androgenic precursors and thereby testosterone. Many researchers found an association between elevated testosterone,

blood pressure, abnormal lipids metabolism with cardiovascular diseases in PCOS, suggesting that hyperandrogenism increases the cardiovascular risk in PCOS (20). However, the association between hyperandrogenism and cardiovascular risk is not universally accepted(21). Therefore many studies may be useful to find out the interaction between immune signals and androgens that may provide biomarkers for a pre-disease existence in women with PCOS at risk to develop cardiovascular diseases.

Menstrual irregularity that present in our study might be considered as a marker for IR in PCOS. Irregular menstrual cycle(Oligomenorrhea and amenorrhea) has been associated with hyperinsulinemia and with increased prevalence and future risk of type 2 diabetes mellitus (22). The irregularity of the menstrual cycle in PCOS subject is due to anovulatory cycle. The state of anovulation will cause no formation of corpus luteum, consequently no progesterone will be secreted so the endometrium continues its. Table(2) shows that the levels of LH concentration in the blood level observed a statistically significant increase in the proportion of the polycystic ovary syndrome women compared to the control women , this is in line with the findings of Nada, and Al-Wazzan, who found an LH production rises levels in PCOS women (23). The speed and intensity of the LH spike are growing in women having PCOS, leading to higher 24-h

production the frequency of the hypothalamus gonadotropin-releasing hormone (GnRH) pulse is assumed to be the reason for this elevation in LH production (24) ; as a result, a high quantity of LH can result in irregular menstrual cycles and infertility, leading to PCOS.

Moreover Both the thyroid and ovaries are part of the endocrine system and belong to a common hormonal axis consisting of hypothalamus–pituitary–thyroid–ovaries, and according to recent studies, many evidences showed that women who suffered from PCOS present in most cases, thyroid disorders which is often associated with hypothyroidism or at risk of future hypothyroidism (25). The hypothyroidism may lead to lower levels of sex hormone binding globulin (SHBG), which in turn leads to high concentrations of testosterone, one of the factors that contribute to the onset of some symptoms of PCOS such as infertility, polycystic ovaries, hirsutism and acne (26) . In the current study, no significant changes were found in the thyroid hormones among

PCOS patients which may link the PCOS with another factor such as obesity and IR.

Table (3) revealed the serum levels of T. Portion, H-CRP and insulin in PCOS patients and controls.

Samples	T. Portion	HsCRP	Insulin
Patients	8.08 ± 1.28 a	17.38 ± 1.36 a	17.18 ± 2.84 a
Control	7.09 ± 0.51 b	7.67 ± 1.55 b	8.86 ± 1.97 b
Sig	0.12	0.00	0.00

The result for the three parameters for PCOS patients were (8.08 ± 1.28 µIU/mL , 17.38 ± 1.36 µIU/mL and 17.18 ± 2.84 µIU/mL) respectively, while the result in the controls group were (7.09 ± 0.51 µIU/mL ; 7.67 ± 1.55 µIU/mL ;and 8.86 ± 1.97 µIU/mL) respectively, there was a significant difference (P<0.05) in CRPQ PCOS patients compared to controls group, and (P<0.00) for Insulin while there was no significant difference in T. Portion levels between the two group .

Serum levels of hormones (T. Portion , HsCRP and insulin) in patients and controls.

In the present study, it was found that the serum level of insulin to be significantly higher in PCOS females than in control group and this result is in agreement with almost studies that measure serum level of insulin in PCOS patient (27,28).

This study revealed that the serum level of insulin was increased significantly (P<0.05) in obese women with PCOS than lean women with PCOS (Table 3), this result agree with previous study performed by (29) and disagree with other study performed (30) who reported that the differences in levels of insulin between obese and lean women with PCOS is not significant, while (31) found higher insulin levels in lean women with PCOS as compared to normal women. The elevated level of insulin in PCOS patients may be related to ethnic background and different life styles (32) or may be due to the defect of post binding in insulin signaling, especially in the major insulin target tissues like adipocytes and skeletal muscles (33). Elevated fasting insulin level greatly than 20 µIU/mL may alone indicate of IR(34). However, in the past 20 years there has been growing evidence supporting that the defects in insulin actions or in the insulin signaling pathways are central in the pathogenesis of PCOS. In fact most of these females are metabolically IR, in part due to genetic

predisposition and in part secondary to obesity. But some women with typical PCOS do not display IR, which supports the hypothesis of a genetic predisposition specific to PCOS that would be revealed by the development of IR and compensatory hyperinsulinemia in most, but not all women with PCOS (35). However, these hypotheses are not yet appropriately confirmed, and more research is still needed to unravel the true pathogenesis underlying this syndrome.

Table (4) :serum levels (Cholesterol , T.G and LDL) in patients and controls.

Samples	Cholesterol	T.G	LDL
Patients	184.96 ± 9.37 a	104.62 ± 3.01 a	52.18 ± 2.52 a
Control	146.83 ± 8.10 b	90.48 ± 5.67 b	48.71 ± 6.81 b
Sig	0.01	0.03	0.04

In present study, it was found that serum level of insulin significantly increased ($P < 0.05$) in PCOS females with hyperandrogenism than in PCOS females without hyperandrogenism (Table 4). This result was in agreement with several studies that associate between insulin and hyperandrogenism in PCOS patients (30,8,32).

Serum levels of (Cholesterol, T.G and LDL) in patients and controls

The result for the three parameters for PCOS patients in table (4) were ($184.96 \pm 9.37 \mu\text{IU/mL}$, $104.62 \pm 3.01 \mu\text{IU/mL}$ and $52.18 \pm 2.52 \mu\text{IU/mL}$) respectively, while the result in the controls group were ($146.83 \pm 8.10 \mu\text{IU/mL}$; $90.48 \pm 5.67 \mu\text{IU/mL}$; and $48.71 \pm 6.81 \mu\text{IU/mL}$) respectively, there was a significant difference ($P < 0.01$) in Cholesterol PCOS patients compared to controls group, and ($P < 0.03$) for T.G and (0.04) for LDL between the two group.

Table (5) :serum levels (WBC, Lym. and Gran.) in patients and controls.

Samples	WBC	Lymphocyte	Granulocyte
Patients	9.60 ± 1.83	6.44 ± 1.29	7.14 ± 1.78
Control	9.32 ± 1.89	3.02 ± 0.90	6.74 ± 1.43
Sig	0.28	0.01	0.48

Table (5). illustrate Serum Lymph and Gran. Were significantly increased in PCOS patients compared with control group, while WBC levels are not significant between the two groups. Total WBC counts and lymphocyte counts were elevated in PCOS subjects (t -test $P < 0.05$). Higher lymphocyte counts which contributed to higher total WBC counts in PCOS women were compared to age-matched controls. When the data were adjusted by BMI, the difference of WBC counts and lymphocyte counts between patients and controls remained significant.

Serum levels of (WBC. , Lym. and Granulocyte.) in patients and controls

The result for this parameters for PCOS patients in table (5) for WBC. , Lym. and Gran were ($9.60 \pm 1.83 \mu\text{IU/mL}$, $6.44 \pm 1.29 \mu\text{IU/mL}$ and $7.14 \pm 1.78 \mu\text{IU/mL}$) respectively, while the result in the controls group were ($9.32 \pm 1.89 \mu\text{IU/mL}$, 3.02 ± 0.90 and $6.74 \pm 1.43 \mu\text{IU/mL}$) respectively, there was a significant difference ($P < 0.05$) in Lymphocyte PCOS patients compared to controls group.

In this study, the platelet count and lymphocyte count are remarkably higher in lean PCOS than healthy controls, supported by other researches (36) it may be expounded by the mechanism of chronic inflammation in PCOS (37) since the inflammatory state of PCOS may trigger an increased platelet count, but the higher platelet does not correlate with the inflammation markers (38) therefore, the preexisting procoagulant state in PCOS might be caused by platelet activation and endothelial dysfunction, (39) sedimentation rate. Of interest, when we divided the lean PCOS into three

subgroups and found that white blood cell count, lymphocyte count is positively associated with ALT levels in the lean PCOS(40).

Comparison of kidney profile between control group and PCOS patients.

Samples	Urea	Creatine
Patients	25.79 ± 4.70 a	1.83 ± 0.72 a
Control	24.73 ± 2.83 a	0.89 ± 0.63 b
Sig	0.07	0.04

Table (6) : (Urea and Creatine) in patients and controls

The table (6) showed that the level of serum urea is significantly increased in PCOS patients compared with control group also for creatinine level is significantly increased in PCOS patients compared with control.

REFERENCES

- [1] Chaudhary, N., Weissman, D., & Whitehead, K. A. (2021). mRNA vaccines for infectious diseases: principles, delivery and clinical translation. *Nature reviews Drug discovery*, 20(11), 817-838.
- [2] Deswal, R., Narwal, V., Dang, A., & Pundir, C. S. (2020). The prevalence of polycystic ovary syndrome: a brief systematic review. *Journal of human reproductive sciences*, 13(4), 261.
- [3] Ghatnatti, V., Patil, S., & Kour, H. (2022). Assessment of clinical, biochemical, and hormonal profile of lean versus overweight polycystic ovarian syndrome patients: a cross-sectional study. *APIK Journal of Internal Medicine*, 10(1), 13-16.
- [4] Chouhan, L., Ito, S., Thomas, E. M., Takano, Y., Ghimire, S., Miyasaka, H., & Biju, V. (2021). Real-time blinking suppression of perovskite quantum dots by halide vacancy filling. *ACS nano*, 15(2), 2831-2838. Qi, Y. X., Han, Y., & Jiang, Z. L. (2018).
- [5] Conway, G., Dewailly, D., Diamanti-Kandarakis, E., Escobar-Morreale, H. F., Franks, S., Gambineri, A., ... & Yildiz, B. O. (2014). The polycystic ovary syndrome: a position statement from the European Society of Endocrinology. *European journal of endocrinology*, 171(4), P1-P29
- [6] Villa, J., & Pratley, R. E. (2011). Adipose tissue dysfunction in polycystic ovary syndrome. *Current diabetes reports*, 11, 179-184.
- [7] Grapsa, D., Kairi-Vassilatou, E., Kleanthis, C., Dastamani, C., Fillipidou, A., & Kondi-Pafiti, A. (2011). Epithelial ovarian tumors in adolescents: a retrospective pathologic study and a critical review of the literature. *Journal of Pediatric and Adolescent Gynecology*, 24(6), 386-388.
- [8] Vernon, G., Baranova, A., & Younossi, Z. M. (2011). Systematic review: the epidemiology and natural history of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in adults. *Alimentary pharmacology & therapeutics*, 34(3), 274-285.

- [9] Habib, A., & Hasan, M. M. (2017). Social capital and corporate cash holdings. *International Review of Economics & Finance*, 52, 1-20.
- [10] Qin, J., Liu, Y., & Grosvenor, R. (2016). A categorical framework of manufacturing for industry 4.0 and beyond. *Procedia cirp*, 52, 173-178. *of Economics & Finance*, 52, 1-20.
- [11] Zhang, W., Gupta, S., Lian, X., & Liu, J. (2015). Staleness-aware async-sgd for distributed deep learning. *arXiv preprint arXiv:1511.05950*.
- [12] Ellis, S. B., Williams, M. E., Ways, N. R., Brenner, R., Sharp, A. H., Leung, A. T., ... & Harpold, M. M. (1988). Sequence and expression of mRNAs encoding the $\alpha 1$ and $\alpha 2$ subunits of a DHP-sensitive calcium channel. *Science*, 241(4873), 1661-1664.
- [13] Patel, S. R., Ayas, N. T., Malhotra, M. R., White, D. P., Schernhammer, E. S., Speizer, F. E., ... & Hu, F. B. (2004). A prospective study of sleep duration and mortality risk in women. *Sleep*, 27(3), 440-444
- [14] Allahbadia, G. N., & Merchant, R. (2011). Polycystic ovary syndrome and impact on health. *Middle East Fertility Society Journal*, 16(1), 19-37.
- [15] Joham, A. E., Teede, H. J., Ranasinha, S., Zoungas, S., & Boyle, J. (2015). Prevalence of infertility and use of fertility treatment in women with polycystic ovary syndrome: data from a large community-based cohort study. *Journal of women's health*, 24(4), 299-307.
- [16] Al-Musaway, S. H., Al-Saimary, I. E., & Flaifil, M. S. (2018). Levels of cytokines profile in polycystic ovary syndrome. *Medical Journal of Babylon*, 15(2), 124-128.
- [17] Barbieri, L., Battelli, M. G., & Stirpe, F. (1993). Ribosome-inactivating proteins from plants. *Biochimica et Biophysica Acta (BBA)-Reviews on Biomembranes*, 1154(3-4), 237-282.
- [18] Lizneva, D., Suturina, L., Walker, W., Brakta, S., Gavrilova-Jordan, L., & Azziz, R. (2016). Criteria, prevalence, and phenotypes of polycystic ovary syndrome. *Fertility and sterility*, 106(1), 6-15.
- [19] Tsilchorozidou, T., Overton, C., & Conway, G. S. (2004). The pathophysiology of polycystic ovary syndrome. *Clinical endocrinology*, 60(1), 1-17
- [20] Phillips, M. L., Young, A. W., Senior, C., Brammer, M., Andrew, C., Calder, A. J., ... & David, A. S. (1997). A specific neural substrate for perceiving facial expressions of disgust. *Nature*, 389(6650), 495-498.
- [21] Verthelyi, D., Ishii, K. J., Gursel, M., Takeshita, F., & Klinman, D. M. (2001). Human peripheral blood cells differentially recognize and respond to two distinct CPG motifs. *The Journal of Immunology*, 166(4), 2372-2377.
- [22] Dinnen, S. (2002). Winners and losers: Politics and disorder in the Solomon Islands 2000-2002. *Journal of Pacific History*, 37(3), 285-298.

[23] Nada, S. Z., & Al-Wazzan, H. A. J. (2021). The role of heat shock protein 70 and dysglycemia in Iraqi Women with Polycystic Ovarian Syndrome. *Al-Qadisiyah Medical Journal*, 17(2).

[24] Koren, T., Amer, M., Krot, M., Boshnak, N., Ben-Shaanan, T. L., Azulay-Debby, H., ... & Rolls, A. (2021). Insular cortex neurons encode and retrieve specific immune responses. *Cell*, 184(24), 5902-5915.

[25] Allahbadia, G. N., & Merchant, R. (2011). Polycystic ovary syndrome and impact on health. *Middle East Fertility Society Journal*, 16(1), 19-37.

[26] Allahbadia, G. N., & Merchant, R. (2011). Polycystic ovary syndrome and impact on health. *Middle East Fertility Society Journal*, 16(1), 19-37.

[27] Dittrich, H., Stadler, A., Topa, D., Schimper, H. J., & Basch, A. (2009). Progress in sulfosalt research. *Physica status solidi (a)*, 206(5), 1034-1041.

[28] Lüthi, M. (2008). *Es war einmal: vom Wesen des Volksmärchens*. Vandenhoeck & Ruprecht.

Mehde, A. A. (2009). *Evaluation of Some Biochemical Markers in Patient's Sera of Polycystic Ovarian Syndrome* (Doctoral dissertation, University of Baghdad).

[29] Huang, Y., Huang, X., Yan, Y., Cai, J., Ouyang, Z., Cui, H., ... & Qin, Q. (2011). Transcriptome analysis of orange-spotted grouper (*Epinephelus coioides*) spleen in response to Singapore grouper iridovirus. *BMC genomics*, 12(1), 1-12.

[30] AL-Watify, D. G. O. (2014). Abnormalities of hormones and inflammatory cytokines in women affected with polycystic ovary syndrome. *Age (years)*, 27(6.31), 26-4.

[31] shiY, Y. (2013). Santoshm. *TectonicevolutionoftheQin□ lingorogenicbelt, centralchina: Newevidencefrom geo□ chemical, zirconUrPbgeochronologyandHfisotopes*, 231, 19r60

[32] Dale, L., Howes, G. B. M. J. P., Price, B. M. J., & Smith, J. C. (1992). Bone morphogenetic protein 4: a ventralizing factor in early *Xenopus* development. *Development*, 115(2), 573-585.

[33] Zhang, W., Gupta, S., Lian, X., & Liu, J. (2015). Staleness-aware async-sgd for distributed deep learning. *arXiv preprint arXiv:1511.05950*.

[34] Irvine, P. J., Park, S. S., & Yıldızhan, Ç. (2016). Customer-base concentration, profitability, and the relationship life cycle. *The Accounting Review*, 91(3), 883-906

[35] Wijeyaratne, C. N., Balen, A. H., Barth, J. H., & Belchetz, P. E. (2002). Clinical manifestations and insulin resistance (IR) in polycystic ovary syndrome (PCOS) among South Asians and Caucasians: is there a difference?. *Clinical endocrinology*, 57(3), 343-350.

- [36] Traub, W. A. (2011). Terrestrial, habitable-zone exoplanet frequency from Kepler. *The Astrophysical Journal*, 745(1), 20.
- [37] Corbould, A., Kim, Y. B., Youngren, J. F., Pender, C., Kahn, B. B., Lee, A., & Dunaif, A. (2005). Insulin resistance in the skeletal muscle of women with PCOS involves intrinsic and acquired defects in insulin signaling. *American Journal of Physiology-Endocrinology and Metabolism*, 288(5), E1047-E1054
- [38] Tagliabue, A., Bopp, L., Dutay, J. C., Bowie, A. R., Chever, F., Jean-Baptiste, P., ... & Jeandel, C. (2010). Hydrothermal contribution to the oceanic dissolved iron inventory. *Nature Geoscience*, 3(4), 252-256.
- [39] AL-Watify, D. G. O. (2014). Abnormalities of hormones and inflammatory cytokines in women affected with polycystic ovary syndrome. *Age (years)*, 27(6.31), 26-4.
- [40] shiY, YuJH. "Santoshm." *TectonicevolutionoftheQin□ lingorogenicbelt, centralchina: Newevidencefrom geo□ chemical, zirconUrPbgeochronologyandHfisotopes* 231 (2013): 19r60.
- [41] Selvi, J. Arockia, et al. "Corrosion inhibition by beet root extract." *Portugaliae Electrochimica Acta* 27.1 (2009): 1-11.