CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.3813047

Available online at: http://www.iajps.com *Research Article*

EVALUATION OF FSH, LH AND MDA IN POLYCYSTIC OVARIAN SYNDROME PATIENTS FROM LAHORE PAKISTAN

Hina Mumtaz[1], Hafiz Muhammad Arsalan[2], Zeemal Seemab Amin[1], Munib Ashfaq[1], Iqra Maqsood[1]

[1] School of Biochemistry, Minhaj University Lahore-Pakistan
[2] Faculty of Life Sciences, University of Central Punjab, Lahore-Pakistan

Article Received: March 2020 **Accepted:** April 2020 **Published:** May 2020

Abstract

Background: *Polycystic ovary syndrome (PCOS) is an endocrine disorder in reproductive age of women categorized by hyper-androgenism, chronic ovulation and menstrual disturbance. Obesity, infertility, and insulin resistance are the major sign and symptoms of all these three indications. PCOS can be diagnosed by occurrence of 12 or more follicles which diameter is about 2 to 9 mm and or on transvaginal ultrasound study raised volume is about >10cm3. About 6-8% population of women disturb by PCOS.* ***Objectives:*** *To evaluate the level of different hormones FSH, LH and Malondialdehyde status in polycystic ovary syndrome patients.* ***Methodology:*** *Venous blood (5.0 ml) samples of 50 polycystic ovary syndrome patients and 50 blood samples (5.0 ml) of control individuals were taken in clotted gel vials. Blood serum was further processed for the estimation of Follicle stimulating hormone (FSH), Luteinizing hormone (LH), Malondialdehyde (MDA), Advanced Glycation End products (AGE's) , Nitric oxide (NO), serum liver function tests (LFT's), Lipid Profile, and Renal Profile by using spectrophotometer.* ***Results:*** *Level of AGE's in control (1.05) and in diseased patients (1.38), level of MDA in control (3.15) and in diseased patients is (0.88) and level of LH significantly increase in patients (10.81) as compare to healthy individuals (8.45) also level of FSH is decrease in patients (14.65) as compare to control individuals (19.34). Serum hepatic profile status reveals that level of value of bilirubin elevate in diseased patients (0.58) as compare to healthy persons(0.42) while SGOT level in diseased individuals raise (47.62) as compare with healthy persons (40.12) and level of SGPT also elevate in diseased persons (52.97) as compare with control persons (43.12). All parameters showed statistically significant (P=0.00 <0.05).* ***Conclusion:*** *PCOS is an endocrine disorder at reproductive age of women. It is the major cause of infertility which also correlate with other metabolic disorders. PCOS mainly recognized by hyperandrogenism, irregular periods and presences of cysts.*

Key Words: PCOS, FSH, LH, MDA, SGOT, Bilirubin and SGPT

Corresponding author:
Dr. Hafiz Muhammad Arsalan,
Department of Biochemistry, Faculty of Life Sciences,
University of Central Punjab Lahore-Pakistan
E-Mail Address: dr.arsalan19@gmail.com

QR code

Please cite this article in press Hafiz Muhammad Arsalan et al, ***Evaluation Of FSH, LH And MDA In Polycystic Ovarian Syndrome Patients From Lahore Pakistan.,*** *Indo Am. J. P. Sci, 2020; 07(05).*

INTRODUCTION:

At Reproductive age of women, about 6-8% population disturbed by Polycystic ovary syndrome (PCOS) which is the most influential endocrine disorder (1) . Hyper-androgenism which cause excessive hair growth, menstrual disturbances, and especially polycystic ovaries are the major clinical signs. Obesity, infertility and insulin resistance are the major sign and symptoms of all these three indications. Diabetes mellitus, endometrial carcinoma are also correlate with PCOS women (2, 3) . Hirsutism, male pattern alopecia, and acne are the sign and symptoms of Hyperandrogenism. An uncontrolled growth of hairs like a male pattern in women (on back, abdomen, chest, chin, upper lip) are the identification of Hirsutism (4) . About 30 to 40% PCOS women have weakened glucose tolerance, and about Diabetes type 2 affecting about 10% (5, 6) .

Ultrasound scanning of polycystic ovaries have no clinical effects but polycystic ovarian syndrome is mainly recognized by the presence of irregular periods, prolonged periods, heavy or oligo menorrhea having irregular secretion of gonadotropin in PCOS women than those women who have normal menstrual cycles (7) . Level of two hormones like luteinizing hormone (LH) and follicle stimulating hormones (FSH) helps in the evaluation of disease severity. Thus, in regular medical checkup irregular level of Gonadotropins (like high level of luteinizing hormone or an abnormal proportion of luteinizing hormone to follicle stimulating hormone) needs to be noted for the diagnoses of PCOS (8) .

Some evidences suggested that vitamin D deficiency leads to the development of insulin resistance and metabolic syndromes (9, 10) . Genetic and cellular pathways moderate the effects of vitamin D. The process of Gene transcription controlled by vitamin D through nuclear vitamin D receptors (VDR). These receptors are scattered across different tissues, including skeleton, ovaries and parathyroid glands (11) . Deficiency of vitamin D increases the production of parathyroid hormone (PTH) which is maintained by level of serum calcium and vitamin D, and increased PTH is individually correlates with an ovulatory, infertility, PCOS and also increased level of testosterone (12) . Cardiovascular diseases, autoimmune and infectious diseases, cancer and psychological disorders included depression also increases the risk of chronic pain due to the deficiency of vitamin D (13) .

In PCOS women, hyper androgenism caused by obesity which is more common. About 35% PCOS women are obese. (14) . Oxidant level will also elevate by central obesity (15) . As obesity plays a vital role in increasing the oxidative stress.

This is responsible for insulin resistance status (16) . Insulin resistance Factors and androgen level both have consequently effects on upper body adipose scattering. On other side the elevated body mass index (BMI) >25 considered as the most important cause in endocrinology and metabolic disturbances in PCOS women (17) . Oxidative stress cause by the elevation of reactive oxygen species (ROS) and/or reactive nitrogen species (RNS) or a reduction in antioxidant of defense mechanism which can change this ratio (18, 19) . Body's natural antioxidant defense mechanism can be affected by the elevation of ROS production which creates unfavorable conditions for females which perform normal biological functions and reaction (20) .

Clomiphene citrate (CC) is one of the best medical treatment which is reasonable, easy to use, but it has some antagonistic effects which is required to be check and controlled time by time (21) . CC interrupts with the estrogen-signaling pathway of negative feedback because of its adverse nature towards receptors of estrogen which results in high accessibility of Follicle stimulating hormone (FSH). Because the high amount of FSH manage follicular growth, which is monitored by ovulation and overflow of LH. CC works well in PCOS patients and an ovulation with standard level of FSH, but it has some types of restrictions with patients BMI <30 and with debility and weakness of body.

OBJECTIVES

The objective of present study was to evaluate the level of different hormones FSH, LH and Malondialdehyde (MDA) status in polycystic ovary syndrome patients (PCOS).

METHODOLOGY:

Place of Work

The whole experimental work was done in the Biochemistry Lab, School of Biochemistry and Medical Lab Technology, Faculty of Allied Health Sciences, after the approval of Ethical and Research Committee, Minhaj University Lahore.

Study Design

Whole study was divided into two groups i.e. 1st group A consist of Diseased Persons and 2nd group B Consist of Healthy individuals.

Sr. No	Group	Sample Size (n)
A	Diseased Persons (PCOS)	50

B	Control / Healthy	50

Blood/Data Collection

Venous blood samples (5.0 ml) of 50 diagnosed PCOS patients and 50 blood samples (5.0 ml) of Healthy individuals were taken in clotted gel vial from gynecology department, Jinnah hospital Lahore. Blood serum was further processed for the estimation of Malondialdehyde (MDA), advanced oxidation protein products (AOPPs), AGEs, Serum FSH, LH, Liver Functions tests (LFTs), Lipid Profile, urea and creatinine by spectrophotometric method.

Blood/Sample Analysis

Blood was centrifuged at 4000 rpm for 10 minutes and serum was separated. Blood sample was collected into EDTA tubes or gel clotted vials.

RESULTS:

TABLE 1: Comparison of Anti-Oxidant Parameters between Control and Poly Cystic Ovary Syndrome Patients.

Parameters	Control(n=50) Mean±S.D	Diseased(n=50) Mean±S.D	P-Value (P ≤ 0.05)
AGE'S	1.05± 0.67	1.38 ± 0.33	0.000
AOPP	6.05 ± 2.04	1.97 ± 0.41	0.000
MDA (nmol/ml)	3.15 ± 0.82	0.88 ± 0.89	0.000

Data in Table 1 presents the clear picture of different Bio-markers of anti-oxidants in PCOS patients. Data shows that the serum AGE'S level in diseased persons is **1.38 ± 0.33** and in control persons is **1.05 ± 0.67** which explains that serum level in diseased persons increased serum AOPP level in diseased patients is **1.97 ± 0.41** and in control Patients is **6.05 ± 2.04** which reveals that serum AOPP level in diseased patients is highly decreased. Serum MDA level in diseased patients is **0.88 ± 0.89** and in control patients is **3.15 ± 0.82** which shows that serum MDA level in diseased patients is decreased.

TABLE 2: Comparison of Hormones between Control and Poly Cystic Ovary Syndrome Patients

Parameters	Control(n=50) Mean±S.D	Diseased(n=50) Mean±S.D	P-Value (P ≤ 0.05)
FSH (IU/L)	19.34 ± 22.40	14.65 ± 32.60	0.007
LH (IU/L)	8.45 ±7.45	10.81 ± 18.48	0.001
Normal Ranges: FSH= 4.7-21.5IIU/L, LH= 8.7- 76.3IU/L.			

Values in Table 2 shows clear picture of different hormones in PCOS patients. Results show that the level of FSH in diseased patients is **14.65 ± 32.60** and in control patients the value of FSH is **19.34 ± 22.40** which explains that the level of FSH in diseased patients is decreased. Level of LH in diseased patients is **10.81 ± 18.48** and in control patients is **8.45 ± 7.45** which shows that the level of LH in diseased patients is increased.

TABLE 3: Comparison of LFT's Parameters between Control and Poly Cystic Ovary Syndrome Patients

Parameters	Control(n=50) Mean±S.D	Diseased(n=50) Mean±S.D	P-Value (P ≤ 0.05)
Bilirubin (ml/dL)	0.42 ± 0.37	0.58 ± 0.11	0.000
SGPT (U/L)	43.12 ± 9.32	52.97 ± 9.47	0.000
SGOT (U/L)	40.12 ± 16.25	47.62 ± 7.83	0.000
Normal Ranges: bilirubin= 0.2- 0.8ml/dL, SGPT: 7-55U/L, SGOT= 8-48U/L.			

Results in Table 3 presents the clear picture of different Parameters of LFT's in PCOS patients. Data shows that Bilirubin level in diseased patients is **0.58 ± 0.11** and in control patients is **0.42 ± 0.37** which explains that level of Bilirubin in diseased patients is increased. Level of SGPT in diseased patients is **52.97 ± 9.47** and in control patient is **43.12 ± 9.32** which reveals that the level of SGPT in diseased patients is increased. Level of SGOT in diseased patients is **47.62 ± 7.83** and in control patients is **40.12 ± 16.25** which shows that the level of SGOT in diseased patients is increased.

TABLE 4: Comparison of Lipid Profile between Control and Poly Cystic Ovary Syndrome Patients

Parameters	Control (n=50) Mean±S.D	Diseased (n=50) Mean±S.D	P-Value (P ≤ 0.05)
Triglycerides (mg/dl)	192.10 ± 16.34	175.72 ± 21.25	0.000
Cholesterol (mg/dl)	187.45 ± 23.34	192.10 ± 16.34	0.000
Normal Ranges: Tg=<150mg/dl, Cholesterol= <200mg/dl.			

Data in Table 4 presents the visible values of different Bio-markers of Lipid profile in patients of PCOS. Result shows that Triglycerides level in diseased patients is **175.72 ± 21.25** and in control patients the value is **192.10 ± 16.34** which shows that Triglycerides level in diseased patients is decreased . Cholesterol level in diseased patients is **192.10 ± 16.34** and in control patients is 1**87.45 ± 23.34** these results shows that cholesterol level in diseased patients is increased.

TABLE 5: Comparison of RFT's between Control and Poly Cystic Ovarian Syndrome Patients

Parameters	Control (n=50) Mean±S.D	Diseased (n=50) Mean±S.D	P-Value (P ≤ 0.05)
Urea (mg/dL)	43.12 ± 2.12	187.45 ± 23.34	0.000
Creatinine (mg/dL)	1.13 ± 0.12	0.68 ± 0.93	0.000
Normal Ranges: : Urea = 7-20mg/dL ,Creatinine = 0.6-1.2 mg/dL.			

Values exist in Table 5 shows the level of bio-markers of RFT's checked in PCOS patients. Data shows that Urea level in diseased persons is **187.45 ± 23.34** while in control persons the value is **43.12 ± 2.12** which reveals that Urea value in diseased persons is highly increased. Level of Creatinine in diseased patients is **0.68 ± 0.93** and in control patients is **1.13 ± 0.12** which reveals that the value of Creatinine in diseased patients is decreased.

DISCUSSIONS:

PCOS is heterogeneous in nature and endocrine and metabolic disorder associated with hyper-insulinemia, hyper-lipidemia obesity and hyperglycemia these are observed as basic origin of Met's. By notice our inhabitants, IR the occurrence of Met's is high as compare to non-IR patients. This observation occurs from previous work which express that largely present in about one-third of PCOS patients especially in those having high BMI's and level of insulin (22). ROS shows an important role in hyperglycemia-mediated in difficulties of micro vascular (23, 24). Oxidative stress and cardiovascular disorders highly caused by PCOS. PCOS is related with high assembly of ROS and it has also been confirmed that Production of ROS associate with IR, it all done by these findings. In our work we study different anti-oxidant parameters between control and polycystic ovarian syndrome patients (25) .

Depression existence as compare with the results given by USA reveals that during 40 to 59 years in female nearly about 12.3% depression occurs (26). Unusually, In PCOS patient's depression occurs in between 31 to 46 years. The recent study shows that the association of depression and anxiety in PCOS patients is high than without symptoms of PCOS (27). Oxidative stress introduced by homocysteine which enhance the production of ROS by decreasing thioredoxin or by increasing NADPH (28).

In PCOS patients, it was observed that level of FSH and LH is mainly high about more than 2-4.5% in polycystic ovary patients. Furthermore, they observe that PCOS patients mainly associated with obesity, hyperinsulinemia. While a large subdivision suffer from elevated level of LH and hyperandrogenism which comes from high androgenic movement (29) . On the other hand ratio of FSH/LH in PCOS patients has minimum role because of investigating of PCOS and also in control cases (30) . The conservative assurance is that obesity shows vital role in pathophysiology of PCOS. but if revise the work of Stein Leventhal in fact confusing section is that all PCOS women are not obese and not all have abnormal ratio of FSH and LH and also no have everyone abnormal hormonal changes during this disease (31) .

By analysis, we observe different parameters in 50 control and 50 diseased persons such as value of AGE's in control **(1.05 ± 0.67)** and in diseased **(1.38 ± 0.33)** which shows that value of AGE's increased in PCOS patients, while measuring parameter Advance oxidation protein product (AGE'S) in control is **(6.05 ± 2.04)** and in diseased patients is **(1.97 ± 0.41)** these our results shows that AOPP parameters has been decreased in infected patients with PCOS. Another parameter is MDA which plays important role in oxidative stress and its observed value which reveals that level of MDA in diseased person decreased.

In our whole work we analyze different Gonadotropin releasing hormones such as FSH and LH factors which highly discuss in Polycystic ovarian syndrome and play important in PCOS , we evaluate different parameters in 50 control and 60 diseased persons .by complete analysis we observe that the level of FSH in control patients is **19.34 ± 22.40** and in diseased persons is **14.65 ± 32.60** these values shows that level of FSH is decreased .In PCOS low level of FSH contributes to poor egg development and an ability to ovulate. And we also check the level of LH in PCOS that is in control persons is **8.45 ± 7.45** and in diseased persons the value is **10.81 ± 18.48** which clearly reveals that the level of LH increased in PCOS patients contributes to the high level of androgens (male hormone such as testosterone) by theca cells within the ovary . Because high level of LH in women's blood can be a sign of primary ovarian failure which leads women's to polycystic ovarian syndrome (PCOS).

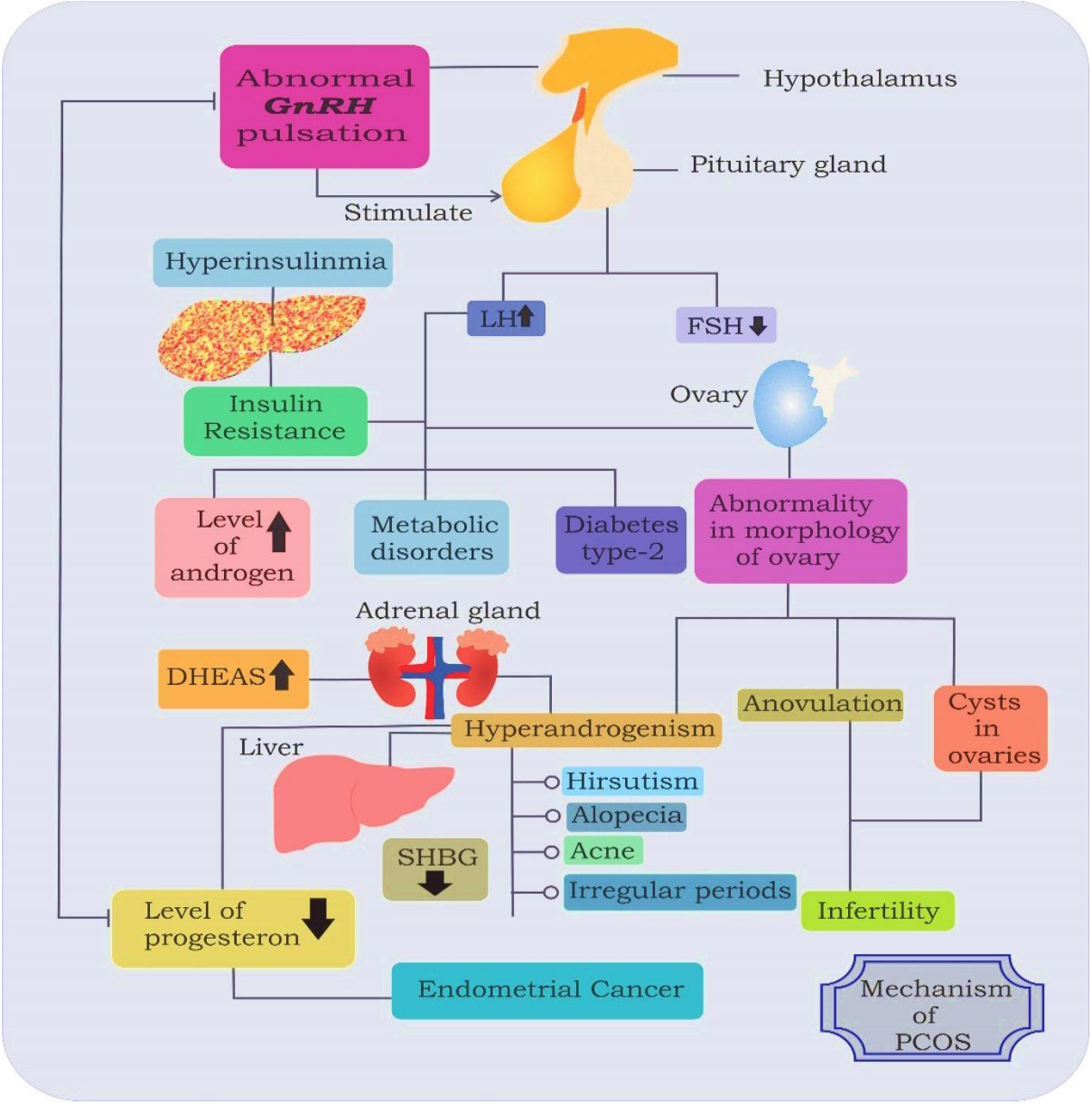

Figure: Mechanism of Polycystic Ovarian Syndrome (PCOS)

CONCLUSION:

Polycystic ovary syndrome (PCOS) is an endocrine disorder present in reproductive age of women. PCOS women have infrequent or prolong menstrual period, excessive level of androgen and polycystic ovaries. Infertility, obesity, cardiovascular disorders, diabetes mellitus and also endometrial carcinoma also correlate with PCOS. The present study concludes that there is deep association between oxidative stress, FSH, LH, lipid profile, LFT's parameters in PCOS. There is a positive association between SGOT and SGPT in PCOS patients that is significant statistically. Level of MDA and AGE's is decrease in PCOS. Level of FSH is decrease in PCOS patients and LH level is elevate in PCOS patients that is statistically proved and it is significant.

REFERENCES:

1. Azziz, R., Marin, C., Hoq, L., Badamgarav, E., & Song, P. (2005). Health care-related economic burden of the polycystic ovary syndrome during the reproductive life span. The Journal of Clinical Endocrinology & Metabolism, 90(8), 4650-4658.
2. Goodarzi, M. O., & Azziz, R. (2006). Diagnosis, epidemiology, and genetics of the polycystic ovary syndrome. Best practice & research Clinical endocrinology & metabolism, 20(2), 193-205.
3. Azziz, R., Carmina, E., Dewailly, D., Diamanti-Kandarakis, E., Escobar-Morreale, H. F., Futterweit, W., and Witchel, S. F. (2006). Criteria for defining polycystic ovary syndrome as a predominantly hyperandrogenic syndrome: an androgen excess society guideline. The Journal of Clinical Endocrinology & Metabolism, 91(11), 4237-4245.
4. Barth, J. H., Clark, S. (2003). Acne and hirsute in teenagers. Best Pract Res Clin Obstet Gynaecol, 17, 131-148.
5. Ehrmann, D. A., Barnes, R. B., Rosenfield, R. L., Cavaghan, M. K., & Imperial, J. (1999). Prevalence of impaired glucose tolerance and diabetes in women with polycystic ovary syndrome. Diabetes care, 22(1), 141-146.
6. Legro, R. S., Kunselman, A. R., Dodson, W. C., & Dunaif, A. (1999). Prevalence and predictors of risk for type 2 diabetes mellitus and impaired glucose tolerance in polycystic ovary syndrome: a prospective, controlled study in 254 affected women. The journal of clinical endocrinology & metabolism, 84(1), 165-169.
7. WALDSTREICHER, J., SANTORO, N. F., HALL, J. E., FILICORI, M., & CROWLEY JR, W. F. (1988). Hyperfunction of the hypothalamic-pituitary axis in women with polycystic ovarian disease: indirect evidence for partial gonadotroph desensitization. The Journal of Clinical Endocrinology & Metabolism, 66(1), 165-172.
8. Ehrmann, D. A., Barnes, R. B., Rosenfield, R. L., Cavaghan, M. K., & Imperial, J. (1999). Prevalence of impaired glucose tolerance and diabetes in women with polycystic ovary syndrome. Diabetes care, 22(1), 141-146.
9. Wehr, E., Pilz, S., Schweighofer, N., Giuliani, A., Kopera, D., Pieber, T. R., & Obermayer-Pietsch, B. (2009). Association of hypovitaminosis D with metabolic disturbances in polycystic ovary syndrome. European Journal of Endocrinology, 161(4), 575-582.
10. Ngo, D. T. M., Chan, W. P., Rajendran, S., Heresztyn, T., Amarasekera, A., Sverdlov, A. L., & Horowitz, J. D. (2011). Determinants of insulin responsiveness in young women: impact of polycystic ovarian syndrome, nitric oxide, and vitamin D. Nitric oxide, 25(3), 326-330.
11. Jones, G., Strugnell, S. A., &DeLUCA, H. F. (1998). Current understanding of the molecular actions of vitamin D. Physiological reviews, 78(4), 1193-1231.
12. Panidis, D., Balaris, C., Farmakiotis, D., Rousso, D., Kourtis, A., Balaris, V., ...& Diamanti-Kandarakis, E. (2005). Serum parathyroid hormone concentrations are increased in women with polycystic ovary syndrome. Clinical Chemistry, 51(9), 1691-1697.
13. Holick, M. F. (2007). Vitamin D deficiency. New England Journal of Medicine, 357(3), 266-281.
14. FRANKS, S. (1989). Polycystic ovary syndrome: a changing perspective. Clinical endocrinology, 31(1), 87-120.
15. Sabuncu, T., Vural, H., Harma, M., &Harma, M. (2001). Oxidative stress in polycystic ovary syndrome and its contribution to the risk of cardiovascular disease☆. Clinical biochemistry, 34(5), 407-413.
16. Urakawa, H., Katsuki, A., Sumida, Y., Gabazza, E. C., Murashima, S., Morioka, K., ...&Nakatani, K. (2003). Oxidative stress is associated with adiposity and insulin resistance in men. The Journal of Clinical Endocrinology & Metabolism, 88(10), 4673-4676.\
17. Cupisti, S., Kajaia, N., Dittrich, R., Duezenli, H., Beckmann, M. W., & Mueller, A. (2008). Body mass index and ovarian function are associated with endocrine and metabolic

abnormalities in women with hyperandrogenic syndrome. European journal of endocrinology, 158(5), 711-719.

18. Burton, G. J., &Jauniaux, E. (2011). Oxidative stress. Best practice & research Clinical obstetrics &gynaecology, 25(3), 287-299.

19. Cindrova-Davies, T., Yung, H. W., Johns, J., Spasic-Boskovic, O., Korolchuk, S., Jauniaux, E., ...& Charnock-Jones, D. S. (2007). Oxidative stress, gene expression, and protein changes induced in the human placenta during labor. The American journal of pathology, 171(4), 1168-1179.

20. Al-Gubory, K. H., Fowler, P. A., &Garrel, C. (2010). The roles of cellular reactive oxygen species, oxidative stress and antioxidants in pregnancy outcomes. The international journal of biochemistry & cell biology, 42(10), 1634-1650.

21. Homburg, R. (2005). Clomiphene citrate—end of an era? A mini-review. Human reproduction, 20(8), 2043-2051.

22. Ehrmann, D. A., Liljenquist, D. R., Kasza, K., Azziz, R., Legro, R. S., Ghazzi, M. N., & PCOS/Troglitazone Study Group. (2006). Prevalence and predictors of the metabolic syndrome in women with polycystic ovary syndrome. The Journal of Clinical Endocrinology & Metabolism, 91(1), 48-53.

23. Giacco, F., & Brownlee, M. (2010). Oxidative stress and diabetic complications. Circulation research, 107(9), 1058-1070.

24. Prieto, D., Contreras, C., & Sánchez, A. (2014). Endothelial dysfunction, obesity and insulin resistance. Current vascular pharmacology, 12(3), 412-426.

25. Jovanovic, V. P., Carmina, E., & Lobo, R. A. (2010). Not all women diagnosed with PCOS share the same cardiovascular risk profiles. Fertility and sterility, 94(3), 826-832.

26. Pratt, L. A., & Brody, D. J. (2014). Depression and obesity in the US adult household population, 2005-2010. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

27. Ekbäck, M. P., Lindberg, M., Benzein, E., & Årestedt, K. (2013). Health-related quality of life, depression and anxiety correlate with the degree of hirsutism. Dermatology, 227(3), 278-284.

28. Tyagi, N., Sedoris, K. C., Steed, M., Ovechkin, A. V., Moshal, K. S., & Tyagi, S. C. (2005). Mechanisms of homocysteine-induced oxidative stress. American Journal of Physiology-Heart and Circulatory Physiology, 289(6), H2649-H2656.

29. Banaszewska, B., Spaczynski, R. Z., Pelesz, M., &Pawelczyk, L. (2003). Incidence of elevated LH/FSH ratio in polycystic ovary syndrome women with normo-and hyperinsulinemia. Roczakad Med Bialymst, 48(1), 131-4.

30. Cho, L. W., Jayagopal, V., Kilpatrick, E. S., Holding, S., & Atkin, S. L. (2006). The LH/FSH ratio has little use in diagnosing polycystic ovarian syndrome. Annals of clinical biochemistry, 43(3), 217-219.

31. Insler, V., Shoham, Z., Barash, A., Koistinen, R., Seppäla, M., Hen, M., & Zadik, Z. (1993). Polycystic ovaries in non-obese and obese patients: possible pathophysiological mechanism based on new interpretation of facts and findings. Human Reproduction, 8(3), 379-384.