ISSN 2664-4169 (Print) & ISSN 2664-7923 (Online)
South Asian Research Journal of Biology and Applied Biosciences
Abbreviated Key Title: South Asian Res J Bio Appl Biosci

| Volume-8 | Issue-3 | May-Jun -2026 | **DOI: https://doi.org/10.36346/sarjbab.2026.v08i03.018**

Original Research Article

Assessment of Antioxidant and Oxidative Stress Biomarkers in Women with Polycystic Ovary Syndrome

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Article History
Received: 01.05.2026
Accepted: 16.06.2026
Published: 26.06.2026

Abstract: Polycystic ovarian syndrome (PCOS), a prevalent endocrine and metabolic condition, is frequently considered a principal cause of anovulatory infertility in women. The pathophysiology of PCOS is intricate and affected by various factors. Recent research indicates that disruption in energy metabolism and oxidative stress are critical factors in abnormal follicular growth and reduced fertility in people with PCOS. The present study aimed to evaluated level of glutathione, catalase, malondialdehyde (MDA), 8-hydroxy-2-deoxyguanosine (8- OHdG) in PCOS women. The study had a total of 90 samples, with 60 of them being diagnosed with PCOS and the remaining 30 serving as controls. The age range of the participants was between 20 and 45 years. The patients were admitted to both Tikrit Teaching Hospital and a private hospital in Tikrit. The present study demonstrated decrease level of glutathione and catalase in PCOS as compared with control at p-value < 0.05. While increase level of MDA and 8-OHdG in PCOs as compared with control, at p-value < 0.05. ***Conclusion***: The current investigation has shown that serum glutathione and catalase levels were reduced in women with PCOS. Patients with polycystic ovary syndrome exhibit elevated oxidative stress.

Keywords: Polycystic ovary syndrome, Glutathione (GSH), Catalase, Malondialdehyde (MDA), 8-Hydroxy-2-Deoxyguanosine.

INTRODUCTION

The polycystic ovarian syndrome, also known as PCOS, is a gynaecological endocrine condition that affects anywhere from five percent to twenty percent of women of reproductive age all over the world (Joham *et al*., 2022; Lin-Lin Chen & Zheng, 2021; Stener-Victorin *et al*., 2024). The inability to conceive and irregular menstruation are not the only problems that people face; they also face financial restrictions and protracted health concerns (Berni *et al*., 2025; Forslund *et al*., 2026). Hyperandrogenism, hyperinsulinemia, insulin resistance (IR), obesity, cystic ovarian follicles, elevated luteinizing hormone (LH), cystic ovarian anovulation, oligoamenorrhea, and diabetes are the main symptoms of this syndrome (Amini *et al*., 2015; Kim, 2024; Zhao *et al*., 2022). One of the most important aspects of the pathophysiology of PCOS is IR, which also plays a role in the promotion of oxidative stress (OS), which is caused by an imbalance between antioxidants and pro-oxidants and (Panti *et al*., 2018). An increase in reactive nitrogen species (RNS) and/or reactive oxygen species (ROS), or a decrease in antioxidant defence systems, might affect this ratio. It is the mitochondria that are primarily responsible for the generation of ROS, which must be continuously neutralised in order to refrain from an excessive buildup and, as a result, maintain normal cellular activity. Due to the fact that they contain the highest concentration of mitochondria in the body, the ovaries, testes, and uterus are the organs that are most susceptible to the effects of ROS. This is because these organs have the highest energy requirements for the synthesis of ATP (Panti *et al*., 2018). Glutathione, composed of cysteine, glutamic acid, and glycine, is essential for regulating cellular oxidation(Oluboyo *et al*., 2022). The female reproductive system serves multiple functions. In addition to its antioxidant properties, it regulates other cellular functions, including DNA synthesis, immunological response, and detoxification(Dutta *et al*., 2024). In the

ovaries, it is essential for protecting the developing oocyte from oxidative damage. The glutathione content in an egg can indicate its quality, with reduced levels signifying inferior quality. Furthermore, glutathione is crucial for the union of sperm and egg, facilitating successful fertilisation(Dutta *et al*., 2024; Sari & Audreylia, 2025).

MATERIALS AND METHODS

The study had a total of 90 samples, with 60 of them being diagnosed with PCOS and the remaining 30 serving as controls. The age range of the participants was between 20 and 45 years. The patients were admitted to both Tikrit Teaching Hospital and a private hospital in Tikrit.

Exclusion Criteria

Individuals without PCOS, females over 45 years old, and those afflicted by these conditions: Type II diabetes, hyperlipidemia, and obesity.

Measurement of Inflammatory Cytokines in Serum

The samples were centrifuged for five minutes at a speed of 3000 revolutions per minute. The liquid component of the combination was then separated and stored at -20ºC until further analysis. The manufacturer's instructions were followed for measuring the serum levels of inflammatory cytokines, which include glutathione, catalase, MDA, and 8-OHdG.

The Sandwich-ELISA method is used with this ELISA kit (SunLong-China). Antibodies specific to glutathione, catalase, MDA, and 8-OHdG have been pre-coated on the Microelisa strip plate that comes with this kit. Spectrophotometry is used to measure the optical density (OD) at a particular wavelength of 450 nm.

Statistical Analysis

Mean ± SD is the way the data was reported after being processed with Statistical Package for the Social Sciences version 17. At $p < 0.05$, the disparity was deemed statistically significant.

RESULT

As shown in Table (1), the current investigation revealed statically ($p < 0.05$) reduced level of glutathione in PCOS compared to the Healthy women (0.9 ± 0.2 versus 1.5 ± 0.3).

Table 1: Level of Glutathione in the study groups

GSH nmol/ml	PCOS women	Healthy women	P-value
	0.9 ± 0.2	1.5± 0.3	0.02

As shown in Table (2), the current investigation revealed statically ($p < 0.05$) reduced level of Catalase in PCOS compared to the Healthy women (349.9 ± 23.8 vs. 537.5 ± 35.1).

Table 2: Level of Catalase in the study groups

Catalase pg/ml	PCOS women	Healthy women	P-value
	349.9 ± 23.8	537.5± 35.1	0.041

As shown in Table (3), the current investigation revealed statically ($p < 0.05$) increase level of MDA in PCOS compared to the Healthy women (5.7 ± 1.05 vs. 2.6 ± 0.9).

Table 3: Level of MDA in the study groups

MDA pg/ml	PCOS women	Healthy women	P-value
	5.7 ± 1.05	2.6± 0.9	0.025

As shown in Table (4), the current investigation revealed statically ($p < 0.05$) increase level of 8-OHdG in PCOS compared to the Healthy women (0.9 ± 0.19 vs. 0.4 ± 0.1).

Table 4: Level of 8-OHdG in the study groups

8-OHdG nmol/ml	PCOS women	Healthy women	P-value
	0.9 ± 0.19	0.4± 0.1	0.047

DISCUSSION

The body contains two types of antioxidant systems: enzymatic antioxidants, including catalase, and nonenzymatic antioxidants, such as glutathione. GSH, a tripeptide, serves as a vital antioxidant within living cells, acting as an intracellular radical scavenger. This study demonstrates that serum GSH levels in patients with PCOS are markedly

lower than those in the Healthy women. The results align with (Mohamed *et al*., 2020; Oyebanji & Asaolu, 2020),, which indicated a significant decrease in GSH levels in patients with PCOS relative to the Healthy women, implying that the reduced GSH levels may be indirectly linked to insulin resistance. Decreased GSH levels may result from increased glucose utilisation in hyperglycemic conditions through the polyol pathway, which necessitates nicotinamide adenine dinucleotide phosphate for GSH replenishment by the GSH-reductase enzyme. Thus, hyperglycemia associated with insulin resistance in PCOS patients may indirectly lead to GSH depletion, consequently increasing oxidative stress.

This study demonstrates a notable reduction in catalase activity in serum samples of PCOS patients relative to the Healthy women, a finding that aligns with the considerable drop in catalase activity described by (Kandasamy *et al*., 2010)in PCOS patients compared to controls. The reduction of catalase activity in PCOS relative to controls may result from elevated lipid peroxidation and MDA products, which could inactivate enzymes located in the plasma membrane. Conversely, it is also possible that increased lipid peroxidation arises from diminished catalase levels.

The elevated MDA levels observed in the current study among PCOS patients may be attributed to increased lipid peroxidation resulting from ROS generation in the ovaries.

MDA, the predominant metabolic end-product produced during lipid peroxidation, is crucial in oxidative stress. Although reactive oxygen species (ROS) are detrimental, they can occasionally have advantageous effects on physiological processes (Zuo *et al*., 2015). For example, oxidative stress induces the release of pro-inflammatory cytokines and causes cellular damage(Uddin *et al*., 2017). Moreover, an increase in MDA levels may induce phospholipase A2 and compromise cellular membrane integrity. Our investigation revealed that MDA levels were increased in patients with PCOS compared to controls. Comparable findings have been documented indicating that elevated MDA levels are correlated with hyperglycemia and insulin resistance (Kuşçu & Var, 2009). The study finding is in agreement with (Ergen *et al*., 2012; Mohamadin *et al*., 2010; Shirsath *et al*., 2015). While disagree with (Karadeniz *et al*., 2008) which indicated no variations in MDA levels between women with PCOS and healthy women.

One of the most common and accurate markers of oxidative DNA damage is 8-OHdG, a primary base change that occurs when the hydroxyl radical interacts with the C-8 site of guanine in DNA(Chen *et al*., 2007; Dincer *et al.*, 2007). 8-OHdG is considered the principal marker for oxidative damage to DNA nucleic acids(Sova *et al*., 2013). The present study agree with (Graille *et al.*, 2020; Sova *et al*., 2013) that showed increased levels of 8-OHdG in PCOS women (Graille *et al*., 2020; Sova *et al*., 2013). However, (Hamurcu *et al*., 2010)found no difference in the levels of 8-OHdG between healthy women and PCOS women.

CONCLUSION

The current investigation has shown that serum glutathione and catalase levels are reduced in women with PCOS. Patients with polycystic ovary syndrome exhibit elevated oxidative stress. These data suggest a compromised antioxidant defence mechanism and elevated oxidative stress in persons with PCOS. The disparity between oxidants and antioxidants may have a role in the pathogenesis of PCOS and its related metabolic and reproductive disorders. Consequently, oxidative stress seems to significantly influence the onset and advancement of PCOS and may serve as a viable target for therapeutic intervention.

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