DOI: 10.7860/NJLM/2026/89392.3001

Original Article

Obstetrics and Gynaecology Section

Clinical and Biochemical Profile of Women with Polycystic Ovary Syndrome: A Cross-sectional Study

PRASANNAJEET HARIBHAU KOKATE[1], HARSHALI WALMIK SHIRSATH[2], MANOJ NAPHADE[3], KIRAN PATOLE[4]

(cc) BY-NC-ND

ABSTRACT

Introduction: Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder associated with metabolic and hormonal abnormalities that predispose women to long-term health complications. Alterations in serum magnesium levels, lipid profile, thyroid function, and glycaemic status may contribute to increased risks of diabetes mellitus and cardiovascular disease. Evaluating these parameters in women with PCOS can facilitate early identification of metabolic disturbances and support timely interventions to improve health outcomes.

Aim: To assess the demographic profile and biochemical parameters in women with PCOS.

Materials and Methods: A cross-sectional descriptive study was conducted in the Departments of Obstetrics and Gynaecology and Biochemistry at a tertiary care hospital in Nashik, Maharashtra, India. A total of 100 women aged 18-40 years diagnosed with PCOS as per the Rotterdam criteria were included over a period of six months from July 2025 to January 2026. Key variables included magnesium levels, lipid fractions, Thyroid Stimulating Hormone (TSH), Free Tetraiodothyronine (T4), and Glycated haemoglobin (HbA1c), while potential confounders such as Body Mass Index (BMI), diet, lifestyle, and medication use were documented.

Results: Most of the patients were aged 21-30 years (53%), with a mean age of 28.41±6.20 years. Mean serum magnesium was 1.60±0.25 mg/dL. Dyslipidaemia was observed with elevated total cholesterol (211.23±29.13 mg/dL) and Low Density Lipoprotein (LDL) (123.44±31.28 mg/dL), while the mean HbA1c was 6.16±0.85%, suggesting an increased risk of diabetes.

Conclusion: The findings emphasise the need for routine metabolic and endocrine evaluation in women with PCOS to facilitate early identification of associated abnormalities and guide timely clinical management.

Keywords: Biochemical profile, Dyslipidaemia, Rotterdam criteria, Serum magnesium

INTRODUCTION

PCOS was first described by Stein and Leventhal in 1935 [1]. PCOS is a complex endocrine disorder characterised by amenorrhoea, hirsutism, obesity, and polycystic ovaries. It is a multifactorial condition involving genetic, hormonal, and environmental influences, typically beginning at puberty and affecting women of reproductive age [2,3]. The global prevalence ranges from 6-13% [4], while in India it varies widely from 3.7-22.5% [5], depending on diagnostic criteria and population studied. PCOS is a growing public health concern due to its significant reproductive and metabolic complications, with insulin resistance and hyperinsulinaemia playing a central role in manifestations such as anovulation, acne, hirsutism, and infertility. Furthermore, it is associated with an increased risk of long-term complications including Type 2 Diabetes Mellitus, dyslipidaemia, metabolic syndrome, and cardiovascular disease [6-8].

Magnesium plays a crucial role in glucose metabolism and insulin signalling, and its deficiency may be associated with impaired glucose tolerance in PCOS [9]. Additionally, dyslipidaemia and thyroid dysfunction, particularly subclinical hypothyroidism, further worsen metabolic and reproductive outcomes [10,11]. HbA1c serves as an important marker of long-term glycaemic control and helps identify increased diabetes risk in these patients. Although several studies have evaluated individual metabolic abnormalities in PCOS [12,13], comprehensive assessment of multiple biochemical parameters remains limited, highlighting the need for the present study to assess these parameters in women with PCOS attending a tertiary care hospital.

MATERIALS AND METHODS

A cross-sectional descriptive study was conducted in the Departments of Obstetrics and Gynaecology and Biochemistry at MPGIMER, MUHS, Nashik, Maharashtra, India from July 2025 to January 2026 after obtaining ethical clearance and informed consent (MPGI/IEC/Outward number/114/2025). During the study period, a total of 100 women aged 18-40 years, diagnosed with PCOS according to the Rotterdam criteria were included [14].

Inclusion criteria:

- Women aged 18-40 years;
- Diagnosed with PCOS based on the Rotterdam criteria (presence of at least two of the following: oligo/anovulation, clinical and/or biochemical signs of hyperandrogenism, and polycystic ovaries on ultrasound);
- Willing to provide informed consent to participate in the study.

Exclusion criteria:

1. Women with untreated or uncontrolled endocrine disorders known to affect ovulation, menstrual function, or androgen metabolism, including untreated hypothyroidism or hyperthyroidism requiring immediate medical management, hyperprolactinaemia, Cushing syndrome, congenital adrenal hyperplasia, acromegaly, adrenal disorders, androgen-secreting ovarian tumours;
2. Pregnant or lactating women;
3. Women on medications known to affect serum magnesium levels, lipid profile, thyroid function, or HbA1c (e.g., magnesium supplements, statins, thyroid medications, or anti-diabetic drugs) within the last three months;
4. Women with chronic illnesses such as renal failure, liver disease, or cardiovascular disease;
5. Women with a history of recent surgery or acute illness in the past three months.

Sample size: A retrospective sample size calculation was performed using the reported prevalence of subclinical hypothyroidism in women with PCOS (22.5%) from a comparable Indian tertiary-care study (Sinha U et al.,) [11]. Using the formula $n=Z^2pq/d^2$ (Z=1.96 for 95% confidence, p=0.225, q=0.775, absolute precision d=10%), the minimum required sample size was 67. A total of 100 women with PCOS were enrolled, exceeding this requirement and providing an adequate margin for missing data and improved precision for the additional biochemical parameters assessed.

Study Procedure

The demographic profile of patients, and lifestyle characteristics of patients were recorded. The study evaluated serum magnesium, lipid profile (total cholesterol, triglycerides, High Density Lipoprotein (HDL), LDL, Very Low Density Lipoprotein (VLDL), TC/HDL ratio, LDL/HDL ratio), thyroid function tests (TSH, Free T4, T3, T4), and glycaemic parameters (HbA1c and fasting blood glucose). Fasting venous blood samples were analysed using standard laboratory methods: serum magnesium by colorimetric assay, lipid profile by enzymatic methods, thyroid function tests by chemiluminescent immunoassay, and HbA1c by HPLC technique [15].

Biochemical parameters were classified as normal or abnormal using established clinical guideline recommendations and the reference intervals adopted by the hospital laboratory. Serum magnesium was considered normal at 1.7-2.2 mg/dL [15]. Total cholesterol was classified as normal when <200 mg/dL, triglycerides <150 mg/dL, HDL cholesterol ≥50 mg/dL (women), and LDL cholesterol <100 mg/dL, according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) recommendations [16]. VLDL was considered normal within the laboratory reference range of 5-30 mg/dL. The TC/HDL ratio and LDL/HDL ratio were considered elevated when >4.5 and >3.5, respectively. Thyroid function tests were interpreted according to the hospital laboratory reference ranges (TSH 0.4-4.5 mIU/L, Free T4 0.8-1.8 ng/dL, T3 0.8-2.0 ng/mL, and T4 5.0-12.0 µg/dL) [15]. Glycaemic status was classified according to the American Diabetes Association (ADA) criteria, with HbA1c <5.7% and fasting plasma glucose <100 mg/dL considered normal [17].

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, SD, frequency, percentages) were calculated. Continuous variables were expressed as mean±SD and categorical variables were summarised as frequencies and percentages.

RESULTS

[Table/Fig-1] shows that most of the patients were aged 21-30 years (53%), with a mean age of 28.41±6.20 years.

Phenotype A predominated in the study population (76%), accounting for more than three-fourths of all PCOS cases [Table/Fig-2]. In women with PCOS, most participants fulfilled the Rotterdam criteria, with high proportions showing polycystic ovaries on ultrasound (94%) [Table/Fig-3].

Assessment of hirsutism using the Ferriman-Gallwey scoring system [18] showed that the majority of participants had moderate hirsutism (51%), followed by mild (25%) and severe (24%) forms. The mFG score was assessed in all 100 participants; hence, [Table/Fig-4] reflects the mFG severity distribution across the entire cohort and is not restricted to the subset with clinically documented hirsutism (76%) in [Table/Fig-3], as structured scoring can identify mFG-positive women (score ≥8) who were not documented as having hirsutism as a presenting clinical symptom. The mean Ferriman-Gallwey score was 20.2±6.66 [Table/Fig-4].

The mean systolic blood pressure was 124.52±9.74 mmHg, and the mean diastolic blood pressure was 80.79±6.56 mmHg.

Demographic data of patients		n (%)
Age group (years)	18-20	10 (10.0)
	21-30	53 (53.0)
	31-40	37 (37.0)
Height (cm)	<150	19 (19.0)
	150-159	46 (46.0)
	160-169	19 (19.0)
	≥170	16 (16.0)
Weight (kg)	<50	09 (09.0)
	50-69	48 (48.0)
	70-89	39 (39.0)
	≥90	04 (4.0)
BMI (kg/m²)	Normal weight (<25 kg/m²)	27 (27.0)
	Overweight (25-29.9 kg/m²)	56 (56.0)
	Obese (≥30 kg/m²)	17 (17.0)
Education level	Nil	03 (3.0)
	Up to 10th Standard	26 (26.0)
	>10th Standard	71 (71.0)

[Table/Fig-1]: Demographic profile of patients.

Rotterdam phenotype	Diagnostic components	n (%)
Phenotype A	O + H + P	76 (76.0)
Phenotype B	O + H	06 (6.0)
Phenotype C	H + P	09 (9.0)
Phenotype D	O + P	09 (9.0)

[Table/Fig-2]: Distribution of Rotterdam PCOS phenotypes.

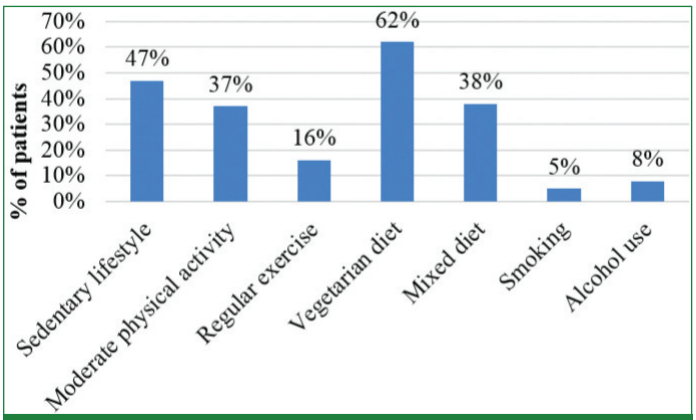
Parameters		n (%)
Clinical manifestations	Oligoanovulation	89 (89.0)
	Clinical hyperandrogenism	76 (76.0)
	Biochemical hyperandrogenism	82 (82.0)
	Polycystic ovaries on ultrasound	94 (94.0)
Symptoms of hyperandrogenism	Hirsutism	76 (76.0)
	Acne	58 (58.0)
	Alopecia	34 (34.0)
	Weight gain	55 (55.0)
Menstrual history	Oligomenorrhoea	65 (65.0)
	Amenorrhoea	19 (19.0)
	Irregular cycles	84 (84.0)
	Regular cycles	16 (16.0)
Medical conditions	Family history of diabetes	36 (36.0)
	Family history of PCOS	42 (42.0)
	Known thyroid disorder	22 (22.0)
	Hyperprolactinoemia	15 (15.0)
Medication* history	No medication	74 (74.0)
	Oral contraceptive pills (past)	12 (12.0)
	Metformin (past)	09 (9.0)
	Thyroid medication (past)	06 (6.0)

[Table/Fig-3]: Clinical characteristics, menstrual history, medical history and medication history of women with PCOS.
*- medication use occurred >3 months before enrolment

Hirsutism severity	Modified ferriman-gallwey score	n (%)
Mild	8-16	25 (25.0)
Moderate	17-24	51 (51.0)
Severe	≥25	24 (24.0)
Mean mFG score	20.2±6.66	

[Table/Fig-4]: Distribution of hirsutism severity based on modified Ferriman-Gallwey (mFG) score.

47% of participants had a sedentary lifestyle, while 37% reported moderate activity and 16% regular exercise. Most followed a vegetarian diet (62%) [Table/Fig-5].



[Table/Fig-5]: Lifestyle characteristics.

Among women with PCOS, a high proportion showed abnormal serum magnesium levels (65%) [Table/Fig-6].

Parameter	Normal range/Cut-off	Normal n (%)	Abnormal n (%)
Magnesium	1.7-2.2 mg/dL	35 (35)	65 (65)
Total cholesterol	<200 mg/dL	38 (38)	62 (62)
Triglycerides	<150 mg/dL	52 (52)	48 (48)
HDL	≥50 mg/dL	60 (60)	40 (40)
LDL	<100 mg/dL	58 (58)	42 (42)
VLDL	5-30 mg/dL	55 (55)	45 (45)
TC/HDL ratio	≤4.5	30 (30)	70 (70)
LDL/HDL ratio	≤3.5	33 (33)	67 (67)
TSH	0.4-4.5 mIU/L	41 (41)	59 (59)
Free T4	0.8-1.8 ng/dL	88 (88)	12 (12)
T3	0.8-2.0 ng/mL	92 (92)	8 (8)
T4	5.0-12.0 µg/dL	90 (90)	10 (10)
HbA1c	<5.7%	36 (36)	64 (64)
Fasting glucose	<100 mg/dL	36 (36)	64 (64)

[Table/Fig-6]: Distribution of normal and abnormal biochemical parameters (n=100).

In women with PCOS, the biochemical profile indicated relatively low mean serum magnesium levels (1.60±0.25 mg/dL [Table/Fig-7].

Biochemical profile		Mean±SD
Magnesium (mg/dL)		1.60±0.25
Lipid profile	Total cholesterol (mg/dL)	211.23±29.13
	Triglycerides (mg/dL)	149.14±44.21
	HDL (mg/dL)	44.32±8.35
	LDL (mg/dL)	123.44±31.28
	VLDL (mg/dL)	29.3±9.18
	TC/HDL ratio	5.26±0.89
	LDL/HDL ratio	3.51±0.72
Thyroid function profile	TSH (mIU/L)	5.29±2.64
	Free T4 (ng/dL)	1.19±0.34
	T3 (ng/mL)	1.37±0.32
	T4 (µg/dL)	8.41±1.91
Glycaemic and insulin resistance parameters	HbA1c levels	6.16±0.85
	Fasting glucose (mg/dL)	108.4±20.29

[Table/Fig-7]: Biochemical profile of PCOS patients.

DISCUSSION

In the present study, the highest prevalence of PCOS was observed in the 21-30 years age group (53%), with a mean age of 28.41±6.20 years, comparable to findings by Rajbanshi I et al., where they reported the mean age of the participants was 27.0±4 years, with the most common age group being 25-30 years (56%) [8]. A majority of participants (56%) were pre-obese in the study by Dhakal S et al., [19]. Most participants fulfilled the Rotterdam criteria, with high prevalence of polycystic ovaries, oligoanovulation, and hyperandrogenism. Dhakal S et al., in their study showed that patients presented with clinical symptoms like inability to conceive (36%), followed by irregular cycle (33%), and abnormal bleeding (31%) [19].

Parameter	Kokate PH et al.,	Babar B et al., [20]	Swetha N et al., [21]
Magnesium (mg/dL)	1.60±0.25	Not reported	2.01±0.30
Fasting glucose (mg/dL)	108.4±20.29	98.5±12.3	98.3±9.02
HbA1c (%)	6.16±0.85	Not reported	Not reported
Total cholesterol (mg/dL)	211.23±29.13	Not reported	182.23±9.26
Triglycerides (mg/dL)	149.14±44.21	145.8±34.7	116.76±12.90
HDL (mg/dL)	44.32±8.35	42.1±8.5	40.33±3.90
LDL (mg/dL)	123.44±31.28	126.3±30.2	118.54±9.07
TSH (mIU/L)	5.29±2.64	Not reported	Not reported

[Table/Fig-8]: Comparative table present study vs previous studies [20,21].

When compared with previous studies, similar metabolic disturbances were observed. Babar B et al., reported elevated fasting glucose (98.5±12.3 mg/dL), increased LDL (126.3±30.2 mg/dL), elevated triglycerides (145.8±34.7 mg/dL), and reduced HDL (42.1±8.5 mg/dL), supporting the atherogenic pattern seen in the present study [20]. Swetha N et al., reported biochemical parameters in PCOS patients and observed that the mean serum magnesium level was 2.01±0.30 mg/dL [Table/Fig-8] [20,21]. These NCEP ATP III cut-offs remain the standard categorical reference ranges used for descriptive classification of dyslipidaemia in current PCOS literature [20]. The subsequent 2018 AHA/ACC/multi-society cholesterol guideline retained the same numerical LDL-C and total cholesterol thresholds but reoriented its recommendations toward individualised, risk-based statin-eligibility decisions rather than providing revised categorical cut-offs for descriptive classification; as the present study is descriptive rather than a treatment/risk-stratification study, the ATP III criteria were therefore retained [22].

Limitation(s)

The present study was limited by its single-centre, hospital-based design and small sample size, which may restrict the generalisability of findings in women with PCOS. Self-reported lifestyle and dietary data may have introduced bias, and the study population may not fully represent the general community. Therefore, large-scale longitudinal studies are recommended to better understand the long-term outcomes of PCOS.

CONCLUSION(S)

The present study demonstrated that women with PCOS exhibited biochemical abnormalities, including low serum magnesium levels, dyslipidaemia, abnormal thyroid function test parameters, and impaired glycaemic control. These findings highlight the importance of comprehensive metabolic and endocrine evaluation in women with PCOS for the early identification and appropriate management of metabolic abnormalities.

REFERENCES

[1] Stein IF, Leventhal ML. Amenorrhea associated with bilateral polycystic ovaries. Am J Obstet Gynecol. 1935;29(2):181-91.
[2] Azziz R. Polycystic ovary syndrome. Obstet Gynecol. 2018;132(2):321-36. Doi: 10.1097/AOG.0000000000002698. PMID: 29995717.
[3] Escobar-Morreale HF. Polycystic ovary syndrome: Definition, aetiology, diagnosis and treatment. Nat Rev Endocrinol. 2018;14(5):270-84.
[4] World Health Organization. Sexual and reproductive health: Polycystic ovary syndrome. Geneva: WHO Press; 2023.
[5] Joshi B, Mukherjee S, Patil A, Purandare A, Chauhan S, Vaidya R. A cross-sectional study of polycystic ovarian syndrome among adolescent and young girls in Mumbai, India. Indian J Endocrinol Metab. 2014;18(3):317-24.

[6] Teede HJ, Tay CT, Laven JJE, Dokras A, Moran LJ, Piltonen TT, et al. Recommendations from the 2023 International Evidence-based guideline for the assessment and management of polycystic ovary syndrome. J Clin Endocrinol Metab. 2023;108(10):2447-69. Doi: 10.1210/clinem/dgad463. PMID: 37580314; PMCID: PMC10505534.
[7] Diamanti-Kandarakis E, Dunaif A. Insulin resistance and the polycystic ovary syndrome revisited: An update on mechanisms and implications. Endocr Rev. 2012;33(6):981-1030.
[8] Rajbanshi I, Sharma VK, Tuladhar ET, Bhattarai A, Raut M, Dubey RK, et al. Metabolic and biochemical profile in women with polycystic ovarian syndrome attending tertiary care centre of central NEPAL. BMC Womens Health. 2023;23(1):208.
[9] Paolisso G, Scheen A, D´Onofrio F, Lefebvre P. Magnesium and glucose homeostasis. Diabetologia. 1990;33(9):511-14.
[10] Osibogun O, Ogunmoroti O, Michos ED. Polycystic ovary syndrome and cardiometabolic risk: opportunities for cardiovascular disease prevention. Trends Cardiovasc Med. 2020;30(7):399-404.
[11] Sinha U, Sinharay K, Saha S, Longkumer TA, Baul SN, Pal SK. Thyroid disorders in polycystic ovarian syndrome subjects: A tertiary hospital based cross-sectional study from Eastern India. Indian J Endocrinol Metab. 2013;17(2):304-09.
[12] Moran LJ, Misso ML, Wild RA, Norman RJ. Impaired glucose tolerance, type 2 diabetes and metabolic syndrome in polycystic ovary syndrome: A systematic review and meta-analysis. Hum Reprod Update. 2010;16(4):347-63.
[13] Wongwananuruk T, Prasongvej P, Chantrapanichkul P, Indhavivadhana S, Tanmahasamut P, Rattanachaiyanont M, et al. Measures of serum markers HbA1c, HOMA-IR, HOMA-β, QUICKI and G/I ratio as predictors of abnormal glucose tolerance among Thai women with polycystic ovary syndrome. J Clin Med. 2025;14(5):1452.
[14] Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). Hum Reprod. 2004;19(1):41-47.
[15] Rifai N, Horvath AR, Wittwer CT, editors. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 6th ed. St. Louis (MO): Elsevier; 2018.
[16] Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). JAMA. 2001;285(19):2486-97.
[17] American Diabetes Association Professional Practice Committee. Standards of Care in Diabetes-2024. Diabetes Care. 2024;47(Suppl 1):S1-S321.
[18] Lumezi BG, Berisha VL, Pupovci HL, Goçi A, Hajrushi AB. Grading of hirsutism based on the Ferriman-Gallwey scoring system in Kosovar women. Postepy Dermatol Alergol. 2018;35(6):631-35.
[19] Dhakal S, Yadav NK, Poudel S, Rana TK, Shah B. Clinical and biochemical profile of polycystic ovarian syndrome patients attending a tertiary care hospital. JGMC Nepal. 2024;17(2):140-43.
[20] Babar B, Farooq G, Manzoor M, Khan H. Clinical and biochemical profile in adolescent and adult polycystic ovary syndrome patients. Pak J Med Sci. 2025;41(9):2518-22.
[21] Swetha N, Vyshnavi R, Modagan P, Rajagopalan B. A correlative study of biochemical parameters in polycystic ovarian syndrome. Int J Biol Med Res. 2013;4(2):3148-54.
[22] Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA guideline on the management of blood cholesterol. A Report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. J Am Coll Cardiol. 2019;73(24):e285-e350. Doi: 10.1016/j.jacc.2018.11.003

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Obstetrics and Gynaecology, GMC and MPGIMER, MUHS, Nashik, Maharashtra, India.
2. Junior Resident, Department of Obstetrics and Gynaecology, GMC and MPGIMER, MUHS, Nashik, Maharashtra, India.
3. Associate Professor, Department of Biochemistry, GMC and MPGIMER, MUHS, Nashik, Maharashtra, India.
4. Dean, MPGIMER, MUHS, Nashik, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Harshali Walmik Shirsath,
Shree Swami Samarth Nagar, Satana Road, Pimpalner Taluka Sakri,
Dist Dhule-424306, Pimpalner, Maharashtra, India.
E-mail: harshushirsath13@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 13, 2026
- Manual Googling: Jul 22, 2026
- iThenticate Software: Jul 28, 2026 (9%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Apr 06, 2026**
Date of Peer Review: **Jun 09, 2026**
Date of Acceptance: **Jul 29, 2026**
Date of Publishing: **Oct 01, 2026**