Original Article
DOI: https://doi.org/10.70749/ijbr.v2i7.2018

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

The Impact of Clomiphene Citrate-Metformin Combination Versus Clomiphene Citrate Monotherapy on Ovulation in Infertile Patients with Average BMI

Sara Ahmad[1], Khair Un Nisa[1], Irum Mushtaq[1]

[1]Department of Obstetrics and Gynaecology, POF Hospital, Wah Cantt, Pakistan

ARTICLE INFO

Keywords: Clomiphene citrate, Metformin, Ovulation induction, Infertility, Insulin-sensitizing agents, BMI

Correspondence to: Sara Ahmad, Department of Obstetrics and Gynaecology, POF Hospital, Wah Cantt, Pakistan.
Email: drsarahmad1996@gmail.com

Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 03-06-2025 Revised: 27-06-2025
Accepted: 09-07-2025 Published: 15-07-2025

ABSTRACT

Background: Ovulation induction represents one of the most important treatments for infertility and most commonly utilizes clomiphene citrate. Nevertheless, evidence from recent studies indicates that the addition of metformin may enhance treatment success in women of normal BMI. **Objective:** To compare the efficacy of clomiphene citrate-metformin combination and clomiphene citrate monotherapy for ovulation induction in infertile patients with normal BMI. **Study Design:** Randomized controlled trial. **Duration and Place of Study:** The study was conducted from December 2024 to May 2025 at the Department of Obstetrics and Gynaecology, POF Hospital Wah Cantt. **Methodology:** A total of 100 infertile women aged 25-35 years with a normal BMI (20–25 kg/m^2) were enrolled using non-probability consecutive sampling. Patients were randomized into two groups: Group A (clomiphene citrate 50 mg combined with metformin 1500 mg daily) and Group B (clomiphene citrate 50 mg daily). The primary endpoint was ovulation, assessed by progesterone levels on the 21st day of the menstrual cycle. **Results:** The combination therapy group (Group A) demonstrated a significantly higher ovulation rate (74%) compared to the monotherapy group (Group B), which showed a 30% success rate ($p<0.01$). Stratified analysis revealed superior outcomes in younger patients (≤30 years), those with a BMI ≤23 kg/m^2, and those with a shorter duration of infertility (≤5 years). **Conclusion:** Clomiphene citrate-metformin combination therapy is significantly more effective than clomiphene citrate monotherapy for ovulation induction in infertile women, particularly in younger women and those with a normal BMI.

INTRODUCTION

Infertility is a common problem for most couples around the world, with about 10-15% of couples having trouble conceiving.[1] The condition is usually linked with several causes, ranging from hormonal imbalances, polycystic ovary syndrome (PCOS), and other disorders of the reproductive system.[2] Anovulation, one of the most widespread causes of infertility in women, is caused by the failure of ovaries to regularly release eggs, resulting in conception difficulties.[3] Ovulatory failure, especially in the case of PCOS, is one of the major causes of infertility, and thus effective treatment management is needed for enhancing the ability of such women or men to conceive.[4]
Treatment of infertility encompasses both medical intervention and changes in one's way of living with the objective of improving fertility.[5] Ovulation induction treatments are among the most frequently used treatments, stimulating the ovaries into producing eggs.[6] Such treatments involve medications such as clomiphene citrate, metformin, and gonadotropins, which are usually prescribed depending on the cause of infertility.[7] The success of these treatments is assisted with lifestyle adjustments such as body weight control, exercise, and diet modification.[8] Optimal ovulation, however, is still a challenge for the majority of the patients, therefore, they turn their attention towards combined treatments that could provide more effective results.[9] The first-line oral drug used commonly for triggering ovulation in women suffering from failure of ovulation is clomiphene citrate (CC). CC induces ovulation through blocking of hypothalamic estrogen receptors, leading to the release of gonadotropins and subsequent promotion of follicular maturation and ovulation.[10] Most notable is clomiphene citrate's efficacy for women with anovulatory infertility, including those with PCOS.[11] Notwithstanding its efficacy, certain side effects, such as ovarian cysts, multiple gestations, and hot flashes, occur in some women.[12] In addition, some of the patients do not respond to treatment with clomiphene, and other or adjunct treatments need to be used in order to maximize ovulatory results.
Metformin, which is a drug that has been used for years to treat type 2 diabetes, has drawn interest for its

Copyright © 2025. IJBR Published by Indus Publishers
This work is licensed under a Creative Commons Attribution 4.0 International License.

effectiveness in enhancing the body's responsiveness to insulin and leveling out hormonal imbalance in women with PCOS.[13] In PCOS women, resistance to insulin frequently causes levels of androgens to be too high, which disrupts proper ovulation.[14] By enhancing the body's responsiveness to insulin, metformin restores proper hormonal levels and makes overlying more likely.[15] Research has demonstrated that the association of clomiphene citrate with metformin is more effective for stimulating ovulation in PCOS women than clomiphene citrate used individually.[16] The synergy between these medications simultaneously combines treatment of both the hormonal and metabolic causes of anovulation, providing a new direction for improving fertility treatment.[16]

A study conducted by Gul HM et al. demonstrated that the combination of clomiphene citrate and metformin achieved an ovulation induction success rate of 63.16%, compared to a 35.09% success rate with clomiphene citrate monotherapy in infertile patients.[17]

There is increasing necessity for research into the effect of the clomiphene citrate-metformin combination over clomiphene citrate single treatment on ovulation of infertile women with the average BMI. Whereas the efficacy of these treatments has been proven in those with disorders such as PCOS, few studies have investigated their effect in women with the average BMI. The latter group might be affected differently with treatment, and knowledge of the particular outcomes in this group of women could assist with more effective, personalized treatment strategies for infertility. Through research into this area, treatment protocols could be improved and ovulation induction treatments be optimized for more patients, providing improved fertility rates.

METHODOLOGY

This randomized controlled trial was conducted from December 2024 to May 2025 at the Department of Obstetrics and Gynaecology, POF Hospital Wah Cantt. The sample size was calculated using WHO sample size software with an alpha level of 5% (two-sided) and a power of 80%. The anticipated efficacy of clomiphene citrate and metformin combination was 63.16%, compared to 35.09% for clomiphene citrate monotherapy.[17] Based on these values, the required sample size was 100 patients, with 50 patients in each group.

Patients were selected using non-probability consecutive sampling. Inclusion criteria required women aged 25 to 35 years with infertility, which was defined as the inability to conceive after 12 months of regular, unprotected intercourse. All participants had a male partner with a sperm concentration of at least 14 million sperm per milliliter, as confirmed by laboratory testing. Patients also had to have a normal BMI, defined as a BMI ranging from 20 to 25 kg/m^2. Exclusion criteria included women with hyperprolactinemia (serum prolactin >40 ng/dL), a history of a bicornuate uterus, chronic liver disease, or renal impairment.

After receiving approval from the ethical committee, informed consent was obtained from all participants. Basic demographic data, such as age, BMI, residential status, educational level, and duration of infertility, were collected. Randomization was carried out using a lottery method, with 50 patients assigned to the clomiphene citrate and metformin combination group (Group A) and 50 patients assigned to the clomiphene citrate monotherapy group (Group B). Group A received a daily dose of 1500 mg of metformin in combination with 50 mg of clomiphene citrate for three months, while Group B received only 50 mg of clomiphene citrate daily for the same duration.

After three months, all patients were sent to the hospital's laboratory for progesterone level testing on the 21st day of their menstrual cycle. Ovulation was considered to have occurred if progesterone levels were 10 ng/mL or higher. The efficacy of the treatments was documented.

Data analysis was performed using IBM SPSS version 26. Frequencies and percentages were used to summarize categorical variables. Quantitative variables were presented as mean ± standard deviation or median (interquartile range) for non-normally distributed data. The normality of the data was assessed using the Shapiro-Wilk test. Efficacy between the two groups was compared using the chi-square test, with a significance level set at $p \leq 0.05$. Additionally, stratified analysis based on age, BMI, residential status, educational level, and duration of infertility was conducted, and post-stratification analysis was performed using either the chi-square or Fisher's exact test. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Both groups demonstrated similar baseline characteristics with identical mean ages of 29.62±3.08 years and comparable BMI values of 23.04±1.01 kg/m^2 and 23.04±0.98 kg/m^2 respectively. The duration of infertility was also similar between groups at 4.34±1.78 years for combination therapy and 4.31±1.78 years for monotherapy. Regarding residential distribution, the combination group had 23 (46.0%) rural and 27 (54.0%) urban patients, while the monotherapy group comprised 30 (60.0%) rural and 20 (40.0%) urban patients. Educational levels varied with uneducated patients representing 9 (18.0%) in combination therapy versus 10 (20.0%) in monotherapy, primary education 19 (38.0%) versus 15 (30.0%), secondary education 16 (32.0%) versus 14 (28.0%), and higher education 6 (12.0%) versus 11 (22.0%) respectively (as shown in Table 1).

Table 1

Demographics of the Patients (n=100)

Demographics		Group A (n=50)	Group B (n=50)
		Mean±SD	Mean±SD
Age (years)		29.62±3.08	29.62±3.08
BMI (kg/m^2)		23.04±1.01	23.04±0.98
Duration of infertility (years)		4.34±1.78	4.31±1.78
Residential Status	Rural n(%)	23 (46.0%)	30 (60.0%)
	Urban n(%)	27 (54.0%)	20 (40.0%)
Educational Level	Uneducated n(%)	9 (18.0%)	10 (20.0%)
	Primary n(%)	19 (38.0%)	15 (30.0%)
	Secondary n(%)	16 (32.0%)	14 (28.0%)
	Higher n(%)	6 (12.0%)	11 (22.0%)

The primary efficacy analysis revealed significantly superior ovulation induction with clomiphene citrate-

Copyright © 2025. IJBR Published by Indus Publishers
This work is licensed under a Creative Commons Attribution 4.0 International License.

metformin combination therapy achieving success in 37 (74.0%) patients compared to 15 (30.0%) patients with clomiphene citrate monotherapy (p<0.01). Treatment failure occurred in 13 (26.0%) patients receiving combination therapy versus 35 (70.0%) patients receiving monotherapy (as shown in Table 2).

Table 2

Comparison of Efficacy between the Two Groups

Efficacy	Group A (n=50)	Group B (n=50)	P value
	n (%)	n (%)	
Yes	37 (74.0%)	15 (30.0%)	<0.01
No	13 (26.0%)	35 (70.0%)	
Total	50 (100%)	50 (100%)	

Stratified analysis by demographic variables demonstrated that age significantly influenced treatment outcomes, with patients ≤30 years showing higher efficacy rates in combination therapy (26 patients, 86.7%) compared to monotherapy (12 patients, 40.0%) with p<0.01. Similarly, patients >30 years had better outcomes with combination therapy (11 patients, 55.0%) versus monotherapy (3 patients, 15.0%) with p<0.01. BMI stratification revealed that patients with BMI ≤23 kg/m^2 responded better to combination therapy (22 patients, 88.0%) than monotherapy (13 patients, 52.0%) with p<0.01, while those with BMI >23 kg/m^2 also favored combination therapy (15 patients, 60.0%) over monotherapy (2 patients, 8.0%) with p<0.01. Residential status showed no significant difference in rural areas (p=0.981) but urban patients demonstrated superior response to combination therapy (20 patients, 74.1%) compared to monotherapy (7 patients, 35.0%) with p<0.01. Educational level analysis indicated that patients with primary education had significantly better outcomes with combination therapy (15 patients, 78.9%) versus monotherapy (2 patients, 13.3%) with p<0.01, and those with higher education also favored combination therapy (5 patients, 83.3%) over monotherapy (2 patients, 18.2%) with p=0.025, while uneducated and secondary education groups showed no significant differences. Duration of infertility significantly impacted treatment success, with patients having ≤5 years of infertility showing superior response to combination therapy (30 patients, 85.7%) compared to monotherapy (15 patients, 42.9%) with p<0.01, and those with >5 years of infertility also benefited more from combination therapy (7 patients, 46.7%) than monotherapy (0 patients, 0.0%) with p<0.01 (as shown in Table 3).

Table 3

Association of Efficacy with Demographic Variables

Demographic Variables		Groups	Efficacy		P value
			Yes (n, %)	No (n, %)	
Age (years)	≤30	A	26 (86.7%)	4 (13.3%)	<0.01*
		B	12 (40.0%)	18 (60.0%)	
	>30	A	11 (55.0%)	9 (45.0%)	<0.01
		B	3 (15.0%)	17 (85.0%)	
BMI (kg/m^2)	≤23	A	22 (88.0%)	3 (12.0%)	<0.01*
		B	13 (52.0%)	12 (48.0%)	
	>23	A	15 (60.0%)	10 (40.0%)	<0.01
		B	2 (8.0%)	23 (92.0%)	
Residential Status	Rural	A	17 (73.9%)	6 (26.1%)	0.981
		B	8 (26.7%)	22 (73.3%)	
	Urban	A	20 (74.1%)	7 (25.9%)	<0.01
		B	7 (35.0%)	13 (65.0%)	
Educational Level	Uneducated	A	5 (55.6%)	4 (44.4%)	0.439*
		B	4 (40.0%)	6 (60.0%)	
	Primary	A	15 (78.9%)	4 (21.1%)	<0.01*
		B	2 (13.3%)	13 (86.7%)	
	Secondary	A	12 (75.0%)	4 (25.0%)	0.273*
		B	7 (50.0%)	7 (50.0%)	
	Higher	A	5 (83.3%)	1 (16.7%)	0.025*
		B	2 (18.2%)	9 (81.8%)	
Duration of infertility (years)	≤5	A	30 (85.7%)	5 (14.3%)	<0.01*
		B	15 (42.9%)	20 (57.1%)	
	>5	A	7 (46.7%)	8 (53.3%)	<0.01*
		B	0 (0.0%)	15 (100.0%)	

*Fisher Exact Test

DISCUSSION

The present study demonstrates that clomiphene citrate-metformin combination therapy is significantly more effective than clomiphene citrate monotherapy for ovulation induction in infertile patients, with success rates of 74.0% versus 30.0% respectively (p<0.01). This superior efficacy can be attributed to the synergistic mechanisms of action, where clomiphene citrate acts as a selective estrogen receptor modulator to stimulate gonadotropin release and follicular development, while metformin enhances insulin sensitivity and reduces hyperinsulinemia, thereby improving ovarian function and reducing androgen levels that may interfere with normal ovulation.

The age-stratified analysis revealing better outcomes in younger patients (≤30 years) with combination therapy (86.7% vs 40.0%) reflects the natural decline in ovarian reserve and oocyte quality with advancing age, making younger patients more responsive to ovulation induction agents. The significant improvement observed in patients with BMI ≤23 kg/m^2 receiving combination therapy (88.0% vs 52.0%) is explained by metformin's insulin-sensitizing properties, which are particularly beneficial in patients with normal BMI who may have underlying insulin resistance without overt metabolic dysfunction. The enhanced efficacy in patients with shorter duration of infertility (≤5 years: 85.7% vs 42.9%) suggests that prolonged anovulation may lead to progressive ovarian dysfunction and reduced responsiveness to ovulation induction, emphasizing the importance of early intervention.

These findings are consistent with several previous studies that have demonstrated the superiority of combination therapy. Vaidya et al. [18] reported similar results with combination therapy achieving a higher ovulation rate (66.74%) compared to clomiphene alone (57.12%), while Uzma et al. [19] found significantly higher ovulation rates in the combination group (39.2%) versus clomiphene-only group (21.6%) with p=0.02. Similarly, Sadiq et al. [20] demonstrated superior efficacy with metformin plus clomiphene (23.2%) compared to clomiphene alone (17.9%) with statistical significance (p=0.044). These consistent findings across multiple studies strengthen the evidence for combination therapy's superior efficacy in ovulation induction.

However, some studies have reported contrasting results. Abuelghar et al. [21] found no significant differences in biochemical pregnancy rates between clomiphene citrate alone, clomiphene with metformin, and clomiphene with pioglitazone groups in overweight and obese women with

Copyright © 2025. IJBR Published by Indus Publishers
This work is licensed under a Creative Commons Attribution 4.0 International License.

PCOS. Similarly, Abd El-Al et al. [22] reported no statistically significant difference in ovulation rates between combination therapy and clomiphene alone. These discrepancies may be attributed to differences in patient populations, with Abuelghar's study specifically focusing on overweight and obese patients, while our study included patients with normal BMI, suggesting that metformin's insulin-sensitizing benefits may be more pronounced in patients without overt obesity-related insulin resistance.

The age-stratified analysis in our study revealing better outcomes in younger patients (≤30 years) with combination therapy (86.7% vs 40.0%) reflects the natural decline in ovarian reserve and oocyte quality with advancing age, making younger patients more responsive to ovulation induction agents. This finding aligns with the general principle discussed by Palomba et al. [23], who emphasized that younger women with PCOS typically respond better to ovulation induction therapies due to preserved ovarian function.

Our study's significant improvement observed in patients with BMI ≤23 kg/m^2 receiving combination therapy (88.0% vs 52.0%) is particularly noteworthy as it extends the benefits of metformin beyond obese populations. While Basirat et al. [24] found that adding metformin significantly increased follicular development (68% vs 54.5%) but did not enhance pregnancy rates, our study demonstrates both improved ovulation induction and clinical efficacy in normal BMI patients. This suggests that metformin's insulin-sensitizing properties are beneficial even in patients with normal BMI who may have underlying insulin resistance without overt metabolic dysfunction.

The enhanced efficacy in patients with shorter duration of infertility (≤5 years: 85.7% vs 42.9%) observed in our study suggests that prolonged anovulation may lead to progressive ovarian dysfunction and reduced responsiveness to ovulation induction, emphasizing the importance of early intervention. This concept is supported by Kamenov et al. [25], who demonstrated that early intervention with insulin-sensitizing agents like myo-inositol improved ovarian activity in PCOS patients with insulin resistance.

Interestingly, our study found educational level differences, particularly in primary and higher education groups favoring combination therapy, which may reflect better treatment compliance and lifestyle modifications that complement the pharmacological intervention. This finding supports the conclusions of Arvindar et al. [26], who emphasized that lifestyle modification is key for successful treatment outcomes in PCOS and metabolic disorders. The urban population's superior response to combination therapy in our study could be attributed to better access to healthcare monitoring and adherence to treatment protocols, factors that may enhance the effectiveness of combination therapy.

This study has some limitations that must be acknowledged. It was conducted at a single center, which may limit the generalizability of the findings to other populations or settings. Additionally, the sample size was relatively small, and larger multicenter studies are needed to validate the results. The study also did not assess the long-term effects of combination therapy, which warrants further investigation. Furthermore, the absence of detailed genetic or metabolic profiling of the participants means that individual variability in treatment response could not be fully explored.

CONCLUSION

We have determined in our study that combination treatment with metformin and clomiphene citrate provides enhanced efficacy in ovulation induction in infertile women, in younger women and in women with normal BMI. Our findings align with increasing evidence that the addition of insulin-sensitizing drugs to ovulation induction treatments can be beneficial. The implication supports the value of individualized treatment modalities and underlines the potential value of metformin in enhancing ovulation rate even in groups of women who have not been linked with resistance to insulin.

Acknowledgments

We sincerely appreciate the unwavering commitment of the medical team within the department, whose diligence in maintaining precise records and methodical patient data management has been invaluable.

REFERENCES

1. Nik Hazlina NH, Norhayati MN, Shaiful Bahari I, Nik Muhammad Arif NA, Worldwide prevalence, risk factors and psychological impact of infertility among women: a systematic review and meta-analysis. BMJ Open. 2022;12(3):e057132. https://doi.org/10.1136/bmjopen-2021-057132.
2. Singh S, Pal N, Shubham S, Sarma DK, Verma V, Marotta F, et al. Polycystic ovary syndrome: etiology, current management, and future therapeutics. J Clin Med. 2023;12(4):1454. https://doi.org/10.3390/jcm12041454.
3. Carson SA, Kallen AN. Diagnosis and management of infertility: a review. JAMA. 2021;326(1):65-76. https://doi.org/10.1001/jama.2021.4788.
4. Zhuang S, Jing C, Yu L, Ji L, Liu W, Hu X. The relationship between polycystic ovary syndrome and infertility: a bibliometric analysis. Ann Transl Med. 2022;10(6):318. https://doi.org/10.21037/atm-22-714.
5. Öztürk R, Herbell K, Morton J, Bloom T. "The worst time of my life": treatment-related stress and unmet needs of women living with infertility. J Community Psychol. 2021;49(5):1121-1133. https://doi.org/10.1002/jcop.22527.
6. Ren M, Liu J, Zhang Y, Fan L. Effects of different ovulation induction regimens on sex hormone levels and serum CTRP3 and CTRP15 levels in patients with polycystic ovary syndrome (PCOS). Biomed Res Int. 2022;2022:6027878. https://doi.org/10.1155/2022/6027878.
7. Cunha A, Póvoa AM. Infertility management in women with polycystic ovary syndrome: a review. Porto Biomed J. 2021;6(1):e116. https://doi.org/10.1097/j.pbj.0000000000000116.
8. Emokpae MA, Brown SI. Effects of lifestyle factors on fertility: practical recommendations for modification. Reprod Fertil. 2021;2(1):R13-R26. https://doi.org/10.1530/RAF-20-0046.

Copyright © 2025. IJBR Published by Indus Publishers
This work is licensed under a Creative Commons Attribution 4.0 International License.

9. Jurczewska J, Szostak-Węgierek D. The influence of diet on ovulation disorders in women-a narrative review. Nutrients. 2022;14(8):1556. https://doi.org/10.3390/nu14081556.
10. Teede HJ, Tay CT, Laven J, 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. Hum Reprod. 2023;38(9):1655-1679. https://doi.org/10.1093/humrep/dead156.
11. Wasim T, Nasrin T, Zunair J, Irshad S. Efficacy of letrozole vs clomiphene citrate for induction of ovulation in women with polycystic ovarian syndrome. Pak J Med Sci. 2024;40(1Part-I):78-83. https://doi.org/10.12669/pjms.40.1.7971.
12. Elkhalifa WS, Suliman HM, Abdoon IH, Mohamed W, Osman B. Letrozole vs clomiphene citrate in Sudanese patients with infertility secondary to polycystic ovary syndrome. Heliyon. 2023;9(7):e18107. https://doi.org/10.1016/j.heliyon.2023.e18107.
13. Saadati S, Mason T, Godini R, Vanky E, Teede H, Mousa A. Metformin use in women with polycystic ovary syndrome (PCOS): opportunities, benefits, and clinical challenges. Diabetes Obes Metab. 2025;27(Suppl 3):31-47. https://doi.org/10.1111/dom.16422.
14. Ding H, Zhang J, Zhang F, Zhang S, Chen X, Liang W, et al. Resistance to the insulin and elevated level of androgen: a major cause of polycystic ovary syndrome. Front Endocrinol (Lausanne). 2021;12:741764. https://doi.org/10.3389/fendo.2021.741764.
15. Herman R, Kravos NA, Jensterle M, Janež A, Dolžan V. Metformin and insulin resistance: a review of the underlying mechanisms behind changes in GLUT4-mediated glucose transport. Int J Mol Sci. 2022;23(3):1264. https://doi.org/10.3390/ijms23031264.
16. Peng G, Yan Z, Liu Y, Li J, Ma J, Tong N, et al. The effects of first-line pharmacological treatments for reproductive outcomes in infertile women with PCOS: a systematic review and network meta-analysis. Reprod Biol Endocrinol. 2023;21(1):24. https://doi.org/10.1186/s12958-023-01075-9.
17. Gul HM, Ather S, Ain QU. Comparison of efficacy of clomiphene citrate alone and with glucophage for treatment of infertility in polycystic ovarian syndrome. J Soc Obstet Gynaecol Pak. 2022;12(3):272-5.
18. Arvindar T. A comparative study of different treatment modalities of polycystic ovarian syndrome in women of reproductive age group at tertiary care centre. Int J Reprod Contracept Obstet Gynecol. 2023;12(9):2785-92. https://doi.org/10.18203/2320-1770.ijrcog20232739
19. Palomba S, Falbo A, La Sala GB. Ovulation induction in anovulatory patients with polycystic ovary syndrome. South Asian Fed Obstet and Gynecol. 2010;2(3):175-82. https://doi.org/10.5005/jp-journals-10006-1092
20. Kamenov Z, Kolarov G, Gateva A, Carlomagno G, Genazzani AD. Ovulation induction with myo-inositol alone and in combination with clomiphene citrate in polycystic ovarian syndrome patients with insulin resistance. Gynecol Endocrinol. 2015;31(2):131-5. https://doi.org/10.3109/09513590.2014.964640
21. Basirat Z, Adib Rad H, Esmailzadeh S, Jorsaraei SG, Hajian-Tilaki K, Pasha H, et al. Enhanced ovarian follicular development by metformin does not correlate with pregnancy rate: a randomized trial. Int J Fertil Steril. 2012;6(1):31-6. https://doi.org/10.29252/ijrm.14.1.39
22. El Gohary DS, Allam AA, Elsaid NY. Effect of empagliflozin metformin with clomiphene citrate versus metformin with clomiphene citrate on cases of polycystic ovary syndrome. J Med Sci Res. 2023;6(2):10-4. https://doi.org/10.59299/2537-0928.1025
23. Vaidya T, Mahajan N, Rathod K, Patel S. Comparison of clomiphene citrate versus clomiphene citrate and metformin combination in ovulation induction for subfertile women with polycystic ovarian syndrome. World J Pharm Res. 2018;7(3):858-71.
24. Abuelghar WM, Khairy MM, Elsayed HH, Abdelaziz A. Clomiphene citrate alone, in combination with metformin or in combination with pioglitazone as first line therapy in induction of ovulation in infertile women with polycystic ovary syndrome, a randomized controlled trial. Middle East Fertil Soc J. 2013;18(3):135-41. https://doi.org/10.1016/j.mefs.2013.05.002
25. Patel H, Rupareliya C, Thakur M, Shah JS. The efficacy and safety of clomiphene citrate and metformin on ovulation induction in patients suffering from anovulatory infertility. Int J Basic Clin Pharmacol. 2015;4(6):1241-6. https://doi.org/10.18203/2319-2003.ijbcp20151366
26. Sadiq F, Bhatti A, Zahra N, Khan A. Comparison between the efficacy of metformin plus clomiphene and clomiphene alone in the treatment of primary infertility due to polycystic ovarian syndrome in obese women. Prof Med J. 2022;29(8):1127-31. https://doi.org/10.53350/pjmhs22168427

Copyright © 2025. IJBR Published by Indus Publishers
This work is licensed under a Creative Commons Attribution 4.0 International License.