e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(12); 820-824

Original Research Article

Effect of Metformin on Obesity: A Prospective Observational Study

Vivek Ravindra Phirke[1], Anoop Laxminarayan Hajare[2], Mahendra Mahadu Gaikwad[3]

[1]Assistant Professor, Department of Pharmacology, Dr. Ulhas Patil medical College, Jalgaon, Maharashtra, India

[2]Associate Professor, Department of Pharmacology, Maharashtra Institute of Medical Education & Research (MIMER), Talegaon Dabhade, Pune, Maharashtra, India

[3]Associate Professor, Department of Pharmacology, Dr. Ulhas Patil medical College, Jalgaon, Maharashtra, India

Received: 01-09-2025 / Revised: 15-10-2025 / Accepted: 21-11-2025

Corresponding author: Dr. Mahendra Mahadu Gaikwad

Conflict of interest: Nil

Abstract

Introduction: Obesity is a chronic, multifactorial disease associated with increased risk of metabolic and cardiovascular disorders. Although lifestyle modification remains the cornerstone of obesity management, long-term adherence and sustained weight loss are often difficult to achieve. Metformin, an insulin-sensitizing agent widely used in type 2 diabetes mellitus, has demonstrated modest weight-reducing and metabolic benefits in obese individuals. However, real-world evidence regarding its effectiveness in obese Indian patients remains limited. The study aimed to evaluate the effectiveness, metabolic outcomes, safety, and treatment adherence of metformin therapy in adults with obesity.

Materials and Methods: This prospective observational study was conducted at Dr Ulhas Patil Medical College, Jalgaon, from January 2024 to June 2025. A total of 100 adults with obesity (BMI ≥30 kg/m²) were enrolled. All participants received oral metformin, initiated at 500 mg/day and titrated up to 1500–2000 mg/day as tolerated, along with standardized lifestyle modification advice. Anthropometric measurements, glycaemic parameters, lipid profile, adverse events, and adherence were assessed at baseline and at 3, 6, and 12 months. Statistical analysis was performed using appropriate tests, with $p < 0.05$ considered statistically significant.

Results: The mean age of participants was 42.6 ± 9.8 years, with females constituting 62% of the cohort. Mean body weight decreased significantly from 98.4 ± 11.6 kg at baseline to 90.8 ± 10.7 kg at 12 months, corresponding to a mean weight loss of 7.7% ($p < 0.001$). Mean BMI declined from 35.8 ± 3.9 to 33.0 ± 3.6 kg/m². At 12 months, 64% of patients achieved ≥5% weight loss, while 22% achieved ≥10% weight loss. Significant improvements were observed in glycaemic and lipid parameters, particularly among patients with type 2 diabetes mellitus. Gastrointestinal adverse events were mild and transient, with an overall treatment adherence rate of 86%.

Conclusion: Metformin is a safe, well-tolerated, and cost-effective adjunct to lifestyle modification and helps in obesity management, providing modest but sustained weight loss and significant metabolic benefits in real-world clinical practice.

Keywords: Obesity; Metformin; Weight Loss; Insulin Resistance; Metabolic Syndrome.

Introduction

Obesity has emerged as one of the most pressing public health challenges worldwide, with rapidly increasing prevalence in both developed and developing nations, including India [1,2]. It is a chronic, multifactorial disease influenced by genetic susceptibility, environmental factors, sedentary lifestyle, and altered metabolic regulation [3]. Obesity significantly increases the risk of type 2 diabetes mellitus, cardiovascular disease, dyslipidemia, hypertension, non-alcoholic fatty liver disease, and certain malignancies, thereby contributing substantially to global morbidity and mortality [4,5]. Lifestyle modification through dietary changes, physical activity, and behavioural interventions remains the cornerstone of obesity management [6]. However, long-term adherence to lifestyle measures is often suboptimal, and sustained weight loss is difficult to achieve for many individuals. Consequently, pharmacological interventions have gained importance as adjuncts to lifestyle modification, particularly in patients with moderate to severe obesity and obesity-related metabolic comorbidities [7]. Metformin, a biguanide anti hyperglycaemic agent, has been widely used for several decades as first-line therapy for type 2 diabetes mellitus [8]. Its primary mechanism of

action involves reduction of hepatic gluconeogenesis, improvement in peripheral insulin sensitivity, and enhancement of glucose uptake [9]. In addition to its glucose-lowering effects, metformin has been shown to induce modest weight loss or weight neutrality, improve lipid metabolism, and reduce insulin resistance [10].

Several clinical trials and observational studies have demonstrated that metformin leads to weight reduction in obese individuals, including those without diabetes, particularly in the presence of insulin resistance or metabolic syndrome [11,12]. Given its favourable safety profile, low cost, and widespread availability, metformin represents an attractive therapeutic option for obesity management, especially in resource-limited settings. However, real-world evidence on its effectiveness in obese Indian patients remains limited. The present study was therefore undertaken to evaluate the effectiveness, metabolic outcomes, safety, and treatment adherence of metformin therapy in adults with obesity.

Materials and Methods

This prospective observational study was conducted at Dr Ulhas Patil medical College, Jalgaon, a tertiary care teaching hospital, over a period of 12 months from January 2024 to June 2025, following approval from the Institutional Ethics Committee. Adult patients aged ≥18 years who were newly diagnosed with diabetes mellitus and had obesity, defined as a body mass index (BMI) ≥30 kg/m², were enrolled in the study after obtaining written informed consent.

Patients were excluded if they had secondary causes of obesity, were pregnant or lactating, had a known hypersensitivity to metformin, chronic gastrointestinal disorders, severe renal or hepatic impairment, or were receiving other anti-obesity pharmacotherapy, including glucagon-like peptide-1 (GLP-1) receptor agonists. A total of 100 eligible patients were enrolled. All participants were initiated on oral metformin therapy, starting at a dose of 500 mg once daily after meals. The dose was gradually titrated over a period of 4–6 weeks to a maximum of 1500–2000 mg per day in divided doses, based on individual tolerability and clinical response. In addition to pharmacotherapy, all patients received standardized lifestyle modification advice, including dietary counselling aimed at calorie restriction and recommendations for regular physical activity.

Baseline assessment included detailed demographic and clinical evaluation, measurement of anthropometric parameters such as body weight, height, and BMI, and documentation of obesity-related comorbidities including type 2 diabetes mellitus, hypertension, and dyslipidemia. Laboratory investigations comprising fasting plasma glucose, glycated hemoglobin (HbA1c), and lipid profile were performed at baseline. Follow-up evaluations were carried out at 3, 6, and 12 months, during which anthropometric measurements, laboratory parameters, treatment adherence, and adverse events were recorded.

Data were analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Changes in parameters over time were assessed using suitable inferential statistical tests. A p-value of less than 0.05 was considered statistically significant.

Results

The study included 100 patients with obesity, with a mean age of 42.6 ± 9.8 years. Females constituted the majority of the study population (62%), while males accounted for 38%. The mean baseline body weight was 98.4 ± 11.6 kg, and the mean BMI was 35.8 ± 3.9 kg/m². With respect to obesity severity, 41% of patients were classified as class I obesity, 37% as class II, and 22% as class III. Common associated comorbidities included hypertension in 46% and dyslipidemia in 42% of participants (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics (n = 100)

Variable		Value
Age (years)	**Mean ± SD**	42.6 ± 9.8
Gender	**Male**	38 (38.0%)
	Female	62 (62.0%)
Body weight (kg)	**Mean ± SD**	98.4 ± 11.6
Body Mass Index (kg/m²)	**Mean ± SD**	35.8 ± 3.9
Obesity class	**Class I (BMI 30–34.9)**	41 (41.0%)
	Class II (BMI 35–39.9)	37 (37.0%)
	Class III (BMI ≥40)	22 (22.0%)
Hypertension	**n (%)**	46 (46.0%)
Dyslipidemia	**n (%)**	42 (42.0%)

Treatment with metformin therapy resulted in a statistically significant and gradual reduction in body weight and BMI over the follow-up period. Mean body weight decreased from 98.4 ± 11.6 kg at baseline to 94.9 ± 11.1 kg at 3 months, 92.4 ± 10.8 kg at 6 months, and 90.8 ± 10.7 kg at 12 months, corresponding to a mean percentage weight loss of 7.7% at 12 months. Similarly, mean BMI declined significantly from 35.8 ± 3.9 kg/m² at baseline to 33.0 ± 3.6 kg/m² at 12 months. These reductions were statistically significant across all time points ($p < 0.001$) (Table 2).

Table 2: Changes in Body Weight and BMI during Treatment

Parameter	Baseline	3 Months	6 Months	12 Months	p-value
Body weight (kg)	98.4 ± 11.6	94.9 ± 11.1	92.4 ± 10.8	90.8 ± 10.7	<0.001
BMI (kg/m²)	35.8 ± 3.9	34.6 ± 3.8	33.7 ± 3.7	33.0 ± 3.6	<0.001
% Weight loss from baseline	–	3.6%	6.1%	7.7%	<0.001

At 12 months of treatment, 64% of patients achieved at least 5% weight loss, while 22% achieved ≥10% weight loss. Only 6% of patients attained ≥15% weight loss, reflecting the modest but clinically meaningful weight-reducing effect of metformin therapy (Table 3).

Table 3: Proportion of Patients Achieving Clinically Significant Weight Loss at 12 Months

Weight loss category	Number (n)	Percentage (%)
≥5% weight loss	64	64.0
≥10% weight loss	22	22.0
≥15% weight loss	6	6.0

Among patients with type 2 diabetes mellitus (n = 38), significant improvements in glycaemic control were observed. Mean HbA1c levels decreased from 8.1 ± 0.9% at baseline to 7.2 ± 0.8% at 6 months and further to 6.9 ± 0.7% at 12 months. Fasting plasma glucose levels declined significantly from 156.4 ± 22.8 mg/dL at baseline to 128.6 ± 18.9 mg/dL at 12 months ($p < 0.001$) (Table 4).

Table 4: Changes in Glycemic Parameters among Patients with Type 2 Diabetes (n = 38)

Parameter	Baseline	6 Months	12 Months	p-value
HbA1c (%)	8.1 ± 0.9	7.2 ± 0.8	6.9 ± 0.7	<0.001
Fasting plasma glucose (mg/dL)	156.4 ± 22.8	136.9 ± 20.4	128.6 ± 18.9	<0.001

Significant improvements were also noted in lipid parameters at 12 months of therapy. Mean total cholesterol levels decreased by 10.9%, LDL-cholesterol by 12.5%, and triglycerides by 18.2% compared to baseline values. In contrast, HDL-cholesterol levels showed a favourable increase of 8.2%. All lipid profile changes were statistically significant ($p < 0.05$), demonstrating a beneficial cardiometabolic effect of metformin therapy (Table 5).

Table 5: Changes in Lipid Profile at 12 Months

Lipid parameter	Baseline	12 Months	% Change	p-value
Total cholesterol (mg/dL)	214.6 ± 34.1	191.2 ± 29.8	−10.9%	0.018
LDL-cholesterol (mg/dL)	136.8 ± 28.5	119.7 ± 24.6	−12.5%	0.021
Triglycerides (mg/dL)	178.4 ± 46.2	145.9 ± 39.7	−18.2%	0.009
HDL-cholesterol (mg/dL)	42.6 ± 6.4	46.1 ± 6.9	+8.2%	0.032

Regarding safety and adherence, gastrointestinal adverse events were the most commonly reported. Nausea occurred in 21% of patients, vomiting in 9%, and diarrhoea in 7%. Regarding safety and adherence, gastrointestinal adverse events were the most commonly reported. Nausea occurred in 21% of patients, vomiting in 9%, and diarrhoea in 7%. Treatment discontinuation due to adverse events occurred in 8% of participants.

Overall treatment adherence at 12 months was 86%, indicating good tolerability of metformin therapy (Table 6).

Table 6: Adverse Events and Treatment Adherence

Parameter	Number (n)	Percentage (%)
Nausea	21	21.0
Vomiting	9	9.0
Diarrhoea	7	7.0
Treatment discontinuation due to adverse events	8	8.0
Adherent at 12 months	86	86.0

Discussion

In this 12-month prospective study of 100 adults with obesity, metformin therapy (up to 1.5–2 g/day) plus standardized lifestyle advice (walking 7000 steps a day with no sweets or sugar product consumption) produced a modest but clinically meaningful mean weight loss of 7.7% and a decrease in mean BMI from 35.8 to 33.0 kg/m². This magnitude of weight reduction is consistent with multiple real-world and clinical reports showing that metformin typically induces moderate weight loss (generally in the range of ~4–7% over months) in both diabetic and non-diabetic obese populations, particularly when combined with lifestyle measures. For example, Seifarth et al. observed an average weight loss of ~5.8 kg (≈5.6%) in an outpatient cohort treated with metformin, and other observational series and trials report similar, clinically useful but smaller effects than those seen with incretin-based therapies [10,11].

Our subgroup findings improved glycaemic indices among participants with type 2 diabetes (mean HbA1c reduction from 8.1% to 6.9%) align well with landmark evidence that metformin improves glycaemic control while also reducing diabetes incidence in high-risk individuals. The Diabetes Prevention Program demonstrated that metformin reduces progression to diabetes and produces modest weight loss relative to intensive lifestyle change, supporting the dual metabolic benefits we observed in patients with established dysglycaemia. These glucose-lowering and diabetes-prevention effects likely contributed substantially to the observed improvements in fasting glucose and HbA1c in our diabetic subgroup [13].

Beyond weight and glycaemia, our cohort showed favourable changes in lipid parameters (reductions in total cholesterol, LDL and triglycerides, and a modest rise in HDL).

This cardiometabolic profile is consistent with meta-analytic data indicating that metformin produces clinically meaningful improvements in lipid profiles in patients with type 2 diabetes and in some obese cohorts, likely mediated through improvements in insulin sensitivity, hepatic lipid handling, and modest weight loss. Such composite metabolic benefits strengthen the rationale for considering metformin as a cost-effective adjunct in obese patients with insulin resistance or dyslipidaemia [14,15].

Safety and tolerability in our study were favourable: gastrointestinal complaints (nausea, diarrhoea) were the commonest adverse events, generally transient during titration, with a treatment discontinuation rate that remained low and overall 12-month adherence of ~86%. This safety and adherence profile mirrors long-standing clinical experience with metformin, where GI side effects are the principal limitation but are usually manageable with slow titration, dose adjustment, or extended-release formulations. The favourable tolerability, low cost, and broad availability of metformin make it particularly suitable for resource-limited settings and for patients who need modest, sustainable weight reduction alongside metabolic improvement [16].

This study has certain limitations that should be acknowledged. The single-centre, observational design limits the ability to establish causal relationships and makes the findings susceptible to residual confounding, particularly from unmeasured or uncontrolled lifestyle modifications such as diet and physical activity. In addition, many participants were receiving concomitant medications for the management of diabetes mellitus and hypertension, which may have independently influenced metabolic outcomes and could not be completely accounted for in the analysis. As all participants received dietary and physical activity counselling alongside metformin therapy, the observed weight reduction may partially reflect the combined effect of pharmacological and non-pharmacological interventions. Additionally, the absence of a randomized control group restricts direct comparison with lifestyle intervention alone. Larger, multicentric randomized controlled trials or well-designed propensity-matched observational studies in Indian populations are warranted to better delineate the independent effect of metformin on weight reduction and long-term cardiometabolic outcomes.

Despite these limitations, the present study provides valuable real-world evidence demonstrating that metformin is associated with modest, sustained weight loss and significant metabolic improvements, supporting its role as an effective and accessible adjunct to lifestyle therapy in the management of obesity.

Conclusion

The present study demonstrates that metformin therapy, when used as an adjunct to lifestyle modification, is associated with modest yet clinically meaningful and sustained weight loss in adults with obesity over a 12-month period. In addition to reductions in body weight and body mass index, metformin was associated with significant improvements in glycaemic control and lipid parameters, particularly among individuals with type 2 diabetes mellitus, indicating broader cardiometabolic benefits.

The favourable safety profile, good treatment adherence, and low discontinuation rates observed further support the tolerability of long-term metformin use. Given its affordability, widespread

availability, and established metabolic benefits, metformin represents a practical and effective therapeutic option for obesity management in routine clinical practice.

References

1. Ahmed SK, Mohammed RA. Obesity: Prevalence, causes, consequences, manage ment, preventive strategies and future research directions. Metabol Open. 2025; 27:10 0375.
2. Młynarska E, Bojdo K, Bulicz A, Frankenstein H, Gąsior M, Kustosik N, Rysz J, Franczyk B. Obesity as a Multifactorial Chronic Disease: Molecular Mechanisms, Systemic Impact, and Emerging Digital Interventions. Curr Issues Mol Biol. 2025;47(10):787.
3. Wang L, Wang Q, Xiong Y, Shi W, Qi X. Obesity and Its Comorbidities: Current Treatment Options, Emerging Biological Mechanisms, Future Perspectives and Challenges. Diabetes Metab Syndr Obes. 2025; 18:3427-3445.
4. Młynarska E, Bojdo K, Bulicz A, Frankenstein H, Gąsior M, Kustosik N, Rysz J, Franczyk B. Obesity as a Multifactorial Chronic Disease: Molecular Mechanisms, Systemic Impact, and Emerging Digital Interventions. Curr Issues Mol Biol. 2025;47(10):787.
5. Wadden TA, Tronieri JS, Butryn ML. Lifestyle modification approaches for the treatment of obesity in adults. Am Psychol. 2020;75(2): 235-251.
6. Chopra S, Malhotra A, Ranjan P, Vikram NK, Singh N. Lifestyle-related advice in the management of obesity: A step-wise approach. J Educ Health Promot. 2020; 9:239.
7. Murphy E, Finucane FM. Structured lifestyle modification as an adjunct to obesity pharmacotherapy: there is much to learn. Int J Obes (Lond). 2025;49(3):427-432.
8. Top WMC, Kooy A, Stehouwer CDA. Metformin: A Narrative Review of Its Potential Benefits for Cardiovascular Disease, Cancer and Dementia. Pharmaceuticals (Basel). 2022; 15(3):312.
9. Rena G, Hardie DG, Pearson ER. The mechanisms of action of metformin. Diabetologia. 2017;60(9):1577-1585.
10. Yerevanian A, Soukas AA. Metformin: Mechanisms in Human Obesity and Weight Loss. Curr Obes Rep. 2019;8(2):156-164.
11. Seifarth C, Schehler B, Schneider HJ. Effectiveness of metformin on weight loss in non-diabetic individuals with obesity. Exp Clin Endocrinol Diabetes. 2013;121(1):27-31.
12. Aleidi SM, Dahabiyeh LA, Gu X, Al Dubayee M, Alshahrani A, Benabdelkamel H, Mujammami M, Li L, Aljada A, Abdel Rahman AM. Obesity Connected Metabolic Changes in Type 2 Diabetic Patients Treated With Metformin. Front Pharmacol. 2021;11:6 16157.
13. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM; Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or me tformin. N Engl J Med. 2002;346(6):393-403.
14. Gillani SW, Ghayedi N, Roosta P, Seddigh P, Nasiri O. Effect of Metformin on Lipid Profiles of Type 2 Diabetes Mellitus: A Meta-analysis of Randomized Controlled Trials. J Pharm Bioallied Sci. 2021;13(1):76-82.
15. Zhao D, Sohouli MH, Rohani P, Fotros D, Velu P, Ziamanesh F, Fatahi S, Shojaie S, Li Y. The effect of metformin on adipokines levels: A systematic review and meta-analysis of randomized-controlled trials. Diabetes Res Clin Pract. 2024; 207:111076.
16. Shurrab NT, Arafa ESA. Metformin: A review of its therapeutic efficacy and adverse effects. Obesity Medicine. 2020;17(1):100186.