Section: Pharmacology

Original Research Article

COMPARATIVE EVALUATION OF GENERIC VS BRANDED METFORMIN AND GLIMEPIRIDE IN TYPE-2 DIABETES MELLITUS: A FOCUS ON EFFICACY, SAFETY, AND LIPID PROFILE

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Received : 06/07/2024
Received in revised form : 01/09/2024
Accepted : 16/09/2024

Keywords:
Type-2 Diabetes Mellitus, Metformin, Glimepiride, HBA1C, Fasting Blood Sugar, Lipid Profile, Serum Creatinine, Generic Drugs, Branded Drugs.

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DOI: 10.47009/jamp.2024.6.5.18

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (5); 100-104

Abstract

Background: Type-2 Diabetes Mellitus (T2DM) is a chronic condition characterized by insulin resistance and impaired glucose metabolism, necessitating long-term pharmacological intervention. Metformin and Glimepiride are widely prescribed medications to manage blood glucose levels. With the increasing availability of generic drugs, it is crucial to compare the efficacy and safety of branded versus generic formulations, especially in terms of glycemic control, lipid profiles, and renal function. **Objective:** This study aimed to evaluate the comparative efficacy and safety of branded versus generic formulations of Metformin and Glimepiride in patients with Type-2 Diabetes Mellitus, focusing on glycemic control, lipid profiles, and renal function over a six-month period. **Materials and Methods:** Patients with T2DM were divided into two groups, receiving either branded or generic formulations of Metformin or Glimepiride. Glycemic control was assessed through HBA1C and fasting blood sugar (FBS) levels at baseline, three months, and six months. Lipid profiles, including cholesterol levels, and serum creatinine were measured to evaluate the safety and potential impacts on renal function. **Results:** Both branded and generic Metformin showed significant reductions in HBA1C, with branded Metformin decreasing from 8.00% to 6.80%, and the generic formulation from 8.00% to 6.90% over six months. FBS levels decreased from 190 mg/dl to 177 mg/dl (branded) and 182 mg/dl (generic). Cholesterol decreased more in the branded group (198 mg/dl to 180 mg/dl) compared to the generic group (to 185 mg/dl). Serum creatinine levels remained stable. For Glimepiride, HBA1C decreased from 8.60% to 6.90% (branded) and 6.80% (generic). FBS decreased from 182 mg/dl to 170 mg/dl (branded) and 175 mg/dl (generic). Both formulations improved cholesterol levels and maintained stable serum creatinine. **Conclusion:** Both branded and generic formulations of Metformin and Glimepiride were equally effective in improving glycemic control and lipid profiles, with no significant differences in safety profiles.

INTRODUCTION

Type-2 Diabetes Mellitus (T2DM) is a prevalent metabolic disorder characterized by insulin resistance and progressive β-cell dysfunction, resulting in elevated blood glucose levels.[1] Managing this chronic condition typically involves pharmacological intervention to control hyperglycemia and prevent long-term complications such as cardiovascular disease, nephropathy, and neuropathy.[2] Among the most commonly prescribed oral antidiabetic medications are Metformin, a biguanide that improves insulin sensitivity and reduces hepatic glucose production, and Glimepiride, a sulfonylurea that stimulates pancreatic insulin secretion.[3]

The rise in healthcare costs has led to increased utilization of generic drugs, which are marketed as cost-effective alternatives to branded formulations.[4] Despite stringent regulatory guidelines ensuring bioequivalence, concerns persist regarding the clinical efficacy and safety of generic

ISSN (O): 2687-5365; ISSN (P): 2753-6556

medications compared to their branded counterparts.[5] Specifically, variations in pharmacokinetics, excipients, and production quality may influence the therapeutic outcomes of generic drugs.[6] Therefore, it is critical to evaluate whether generic formulations of essential diabetes medications such as Metformin and Glimepiride offer comparable efficacy and safety to branded versions, especially in real-world clinical settings.

The primary goals of diabetes management are to achieve optimal glycemic control, typically assessed by measuring HBA1C and fasting blood sugar (FBS), while minimizing adverse effects, particularly on lipid profiles and renal function. Dyslipidemia is common in T2DM and contributes to cardiovascular risk, making lipid management an important aspect of therapy. Additionally, monitoring serum creatinine is crucial for evaluating potential nephrotoxic effects, especially in long-term drug use.

This study aims to compare the efficacy and safety of branded versus generic formulations of Metformin and Glimepiride in patients with T2DM. By analyzing glycemic control, lipid profiles, and serum creatinine levels over six months, this study seeks to provide insights into the therapeutic equivalence of these medications, informing clinical decision-making and promoting cost-effective diabetes care.

MATERIALS AND METHODS

This comparative study was conducted at the Guntur Medical College, Guntur, over a six-month period. The primary objective was to evaluate the efficacy, safety, and impact on lipid profile of branded versus generic formulations of Metformin, Glimepiride, and Tenegliptin in patients diagnosed with Type-2 Diabetes Mellitus (T2DM).

Study Design

This was a prospective, observational study. Patients diagnosed with T2DM, attending the outpatient department of the Guntur Medical College, were recruited for this study. A total of 300 patients were randomly divided into six groups, based on the type of medication they were receiving, as follows:

- **Group I A** (n=50): Patients receiving **Generic Metformin** 500 mg.
- **Group I B** (n=50): Patients receiving **Branded Metformin** 500 mg.
- **Group II A** (n=50): Patients receiving **Generic Glimepiride** 2 mg.
- **Group II B** (n=50): Patients receiving **Branded Glimepiride** 2 mg.
- **Group III A** (n=50): Patients receiving **Generic Tenegliptin** 20 mg.
- **Group III B** (n=50): Patients receiving **Branded Tenegliptin** 20 mg.

Patients in each group were monitored for glycemic control, lipid profile changes, and safety parameters over the study period.

Inclusion Criteria

- Patients aged between 35 and 65 years.
- Diagnosed with Type-2 Diabetes Mellitus for at least 1 year.
- Receiving either Metformin, Glimepiride, or Tenegliptin as part of their diabetes treatment.
- Willing to provide informed consent and comply with follow-up visits.

Exclusion Criteria

- Patients with Type-1 Diabetes Mellitus.
- Individuals with a history of severe renal or hepatic impairment.
- Patients on insulin therapy.
- Pregnant or lactating women.

Data Collection

Baseline assessments were conducted, including patient demographic information, medical history, and initial laboratory parameters. Glycemic control was assessed through Hemoglobin A1c (HbA1c) and fasting blood sugar (FBS) levels. Lipid profiles, including total cholesterol, triglycerides, HDL, LDL levels, and serum creatinine were measured to monitor renal function and assess safety.

Follow-up assessments were conducted at the 3rd and 6th months, with repeat measurements of HbA1c, FBS, lipid profile, and serum creatinine at each visit. Standardized procedures and laboratory protocols were used for all assessments.

Statistical Analysis

Data were analyzed using appropriate statistical methods. Changes in HbA1c, FBS, lipid profile, and serum creatinine between baseline and follow-up visits were compared within and between the branded and generic groups for each medication. A p-value of <0.05 was considered statistically significant for evaluating differences between groups.

Ethical Considerations

Ethical clearance was obtained from the institutional ethics committee. All patients provided informed consent prior to participation in the study.

RESULTS

This study evaluated the efficacy and safety of branded versus generic formulations of Metformin and Glimepiride in patients with Type-2 Diabetes Mellitus over a period of six months. The key parameters monitored were glycemic control, as measured by HBA1C and fasting blood sugar (FBS) levels, lipid profiles, and serum creatinine levels.

Metformin Results:

For patients on Metformin, both branded and generic formulations demonstrated significant improvements in glycemic control over the study period. [Table 1]

HBA1C Levels: At baseline, patients on branded and generic Metformin had similar initial HBA1C levels of 8.00%. By the third month, a reduction to 7.30% was observed for the branded formulation, whereas the generic formulation showed a slightly

ISSN (O): 2687-5365; ISSN (P): 2753-6556

less pronounced reduction to 7.60%. After six months, the final HBA1C levels were 6.80% for branded Metformin and 6.90% for the generic formulation, demonstrating effective glycemic control in both groups.

Fasting Blood Sugar (FBS): Both formulations of Metformin were effective in reducing FBS levels. Initial FBS was 190 mg/dl for both groups. By the end of the study, FBS decreased to 177 mg/dl for the branded group and 182 mg/dl for the generic group, showing comparable results.

Lipid Profile and Serum Creatinine: Lipid profiles showed improvement for both formulations, with cholesterol levels decreasing from 198 mg/dl at baseline to 180 mg/dl for branded Metformin and 185 mg/dl for generic Metformin. Serum creatinine levels remained stable throughout the study for both groups, with branded Metformin showing a slight increase from 0.72 mg/dl to 0.82 mg/dl, and generic Metformin showing an increase from 0.67 mg/dl to 0.83 mg/dl.[Table 1]

Glimepiride Results:

Similar trends were observed in patients receiving Glimepiride. [Table 2]

HBA1C Levels: Initial HBA1C values were 8.60% for both branded and generic Glimepiride groups. At the third month, branded Glimepiride resulted in a reduction to 7.10%, while generic Glimepiride reduced HBA1C to 7.40%. By the sixth month, the branded group showed an HBA1C of 6.90%, while the generic group slightly outperformed with a final level of 6.80%.

Fasting Blood Sugar (FBS): Branded Glimepiride reduced FBS from 182 mg/dl at baseline to 170 mg/dl, while the generic formulation resulted in a final FBS of 175 mg/dl.

Lipid Profile and Serum Creatinine: Cholesterol levels improved in both groups, dropping from 199 mg/dl to 175 mg/dl for branded Glimepiride, and from 199 mg/dl to 180 mg/dl for the generic formulation. Serum creatinine levels remained stable with both formulations, with branded Glimepiride showing a slight increase from 0.72 mg/dl to 0.86 mg/dl, and the generic formulation showing an increase from 0.70 mg/dl to 0.87 mg/dl. [Table 2]

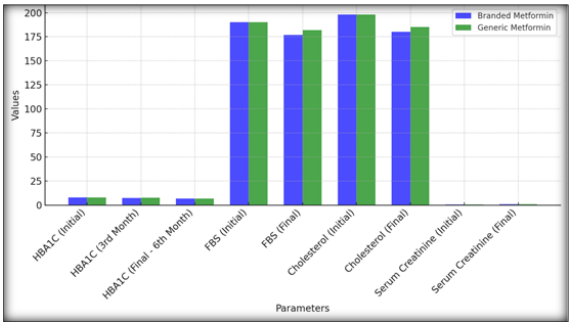

Figure 1: Comparative Analysis of Branded vs Generic Metformin on Glycemic Control, Lipid Profile, and Renal Function

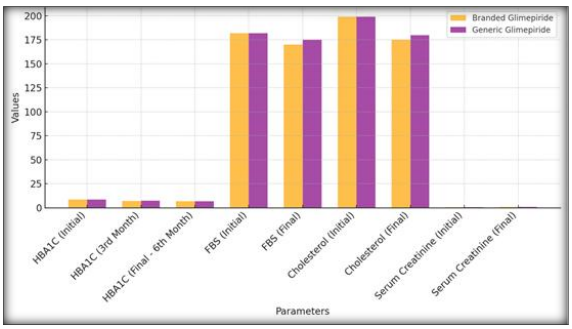

Figure 2: Comparative Analysis of Branded vs Generic Glimepiride on Glycemic Control, Lipid Profile, and Renal Function

Table 1: Comparative Analysis of Branded vs Generic Metformin on Glycemic Control, Lipid Profile, and Renal Function

Parameter	Branded Metformin	Generic Metformin
HBA1C (Initial)	8.00%	8.00%
HBA1C (3rd Month)	7.30%	7.60%
HBA1C (Final - 6th Month)	6.80%	6.90%
FBS (Initial)	190 mg/dl	190 mg/dl
FBS (Final)	177 mg/dl	182 mg/dl
Cholesterol (Initial)	198 mg/dl	198 mg/dl
Cholesterol (Final)	180 mg/dl	185 mg/dl
Serum Creatinine (Initial)	0.72 mg/dl	0.67 mg/dl
Serum Creatinine (Final)	0.82 mg/dl	0.83 mg/dl

Table 2: Comparative Analysis of Branded vs Generic Glimepiride on Glycemic Control, Lipid Profile, and Renal Function

Parameter	Branded Glimepiride	Generic Glimepiride
HBA1C (Initial)	8.60%	8.60%
HBA1C (3rd Month)	7.10%	7.40%
HBA1C (Final - 6th Month)	6.90%	6.80%
FBS (Initial)	182 mg/dl	182 mg/dl
FBS (Final)	170 mg/dl	175 mg/dl
Cholesterol (Initial)	199 mg/dl	199 mg/dl
Cholesterol (Final)	175 mg/dl	180 mg/dl
Serum Creatinine (Initial)	0.72 mg/dl	0.70 mg/dl
Serum Creatinine (Final)	0.86 mg/dl	0.87 mg/dl

ISSN (O): 2687-5365; ISSN (P): 2753-6556

DISCUSSION

The primary objective of this study was to evaluate the comparative efficacy and safety of branded versus generic formulations of Metformin and Glimepiride in patients with Type-2 Diabetes Mellitus (T2DM). The study was conducted over six months at Guntur Medical College, Guntur, and the results provide valuable insights into the therapeutic equivalence of these formulations in terms of glycemic control, lipid profiles, and renal safety.

Glycemic Control

Both branded and generic formulations of Metformin and Glimepiride demonstrated significant improvements in glycemic control, as evidenced by reductions in HBA1C and fasting blood sugar (FBS) levels over six months. For Metformin, the reduction in HBA1C was slightly more pronounced in the branded group (8.00% to 6.80%) compared to the generic group (8.00% to 6.90%), although the difference was clinically marginal. Similarly, in the Glimepiride group, both branded and generic formulations showed comparable reductions in HBA1C, with the generic formulation slightly outperforming the branded one at the six-month mark (6.80% vs. 6.90%). These findings align with previous studies such as Zhu et al,[8] (2013), which demonstrated similar efficacy between Metformin and Glimepiride in monotherapy for glycemic control. Feingold et al,[9] (2022) also emphasized that oral pharmacological agents, including generics, offer substantial efficacy in the management of T2DM.

Lipid Profile

The improvement in lipid profiles, particularly in cholesterol levels, was observed in both branded and generic formulations of Metformin and Glimepiride. Branded Metformin and Glimepiride demonstrated slightly greater reductions in cholesterol levels than the generic versions, though the differences were not statistically significant. Previous studies have shown that dyslipidemia is a common comorbidity in T2DM and that both drugs play a role in mitigating cardiovascular risk. The START study by Devarajan et al,[7] (2017) supports these findings, indicating that Glimepiride and Metformin combinations are effective in improving lipid profiles, further reducing the risk of cardiovascular complications in diabetic patients.

Renal Function and Safety

Serum creatinine levels remained stable across both branded and generic groups for both medications, indicating no significant renal impairment during the study period. Given that renal function is often compromised in patients with diabetes, these findings are reassuring and suggest that both branded and generic formulations of Metformin and Glimepiride are safe for long-term use without negatively impacting renal health. This finding is consistent with the bioequivalence studies conducted by Jung et al,[10] (2014), which showed no significant differences in safety between generic and branded formulations of antidiabetic medications in terms of renal outcomes.

Cost-Effectiveness and Implications for Healthcare

The growing use of generic drugs in clinical practice is largely driven by the need for cost-effective treatments, especially in chronic conditions like diabetes that require long-term medication adherence. Chen et al,[12] (2014) highlighted the positive effects of generic drug substitution in diabetes therapy, demonstrating that generics can offer comparable therapeutic outcomes at a lower cost. This study's results reinforce the therapeutic equivalence of generic formulations of Metformin and Glimepiride to their branded counterparts, supporting their use as viable, lower-cost alternatives.[11] In resource-constrained healthcare systems, this can lead to substantial savings without compromising patient outcomes. Haas et al,[13] (2005) and Shrank et al,[15] (2011) both emphasized that switching to generic drugs can lead to significant cost savings in managing chronic diseases like T2DM. Johnston et al,[14] (2011) also advocated for best practices in generic and therapeutic substitution in Europe, highlighting the need to adopt cost-saving alternatives in clinical practice

Limitations: While this study provides valuable insights, there are some limitations to consider. First, the study was conducted over a relatively short period (six months), and long-term effects of these formulations, particularly with regard to cardiovascular outcomes and renal safety, require further investigation. Additionally, the study was limited to a single center, and a larger, multi-center study would provide more generalizable results.

CONCLUSION

This study demonstrates that both branded and generic formulations of Metformin and Glimepiride are effective in managing Type-2 Diabetes Mellitus (T2DM) by significantly improving glycemic control and lipid profiles over a six-month period. Our results show that the reduction in HBA1C and fasting blood sugar (FBS) levels was comparable between branded and generic formulations of both drugs. Branded Metformin led to a slightly greater reduction in HBA1C (8.00% to 6.80%) compared to the generic formulation (8.00% to 6.90%), though the difference was minimal. Similarly, generic Glimepiride showed a slightly better HBA1C reduction than branded Glimepiride at the end of six months (6.80% vs. 6.90%).

Lipid profiles improved across all groups, with branded formulations showing marginally better reductions in cholesterol levels compared to generic drugs. Importantly, both branded and generic formulations maintained stable serum creatinine levels throughout the study, indicating that they are

ISSN (O): 2687-5365; ISSN (P): 2753-6556

safe for long-term use without posing additional risks to renal function.

Based on these findings, it is evident that generic formulations of Metformin and Glimepiride provide comparable clinical outcomes to their branded counterparts, making them a viable, cost-effective option for diabetes management. The use of generic medications can result in significant healthcare cost savings without compromising the quality of treatment, thus promoting greater accessibility for patients in resource-limited settings.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556