American Journal of
Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Research Article

Comparative Effects of Metformin, Glibenclamide and their Combination on Some Biochemical Profiles in Type-2 Diabetes Patients Attending Abia State University Teaching Hospital (ABSUTH), Aba

Christian O Onyemereze[1]*, Prince U Unekwe[1], Emmanuel O Ogbuagu[1], Glory Onyemereze[2] and Augustine I Airaodion[3]

[1]*Department of Pharmacology and Therapeutics, Abia State University, Uturu, Nigeria*

[2]*School of Public Health, University of Port Harcourt, Rivers State, Nigeria*

[3]*Department of Biochemistry, Lead City University, Ibadan, Oyo State, Nigeria*

***Corresponding author:** Christian O Onyemereze, Department of Pharmacology and Therapeutics, Abia State University, Uturu, Nigeria.

To Cite This article: *Christian O Onyemereze*, Prince U Unekwe, Emmanuel O Ogbuagu, Glory Onyemereze and Augustine I Airaodion , Comparative Effects of Metformin, Glibenclamide and their Combination on Some Biochemical Profiles in Type-2 Diabetes Patients Attending Abia State University Teaching Hospital (ABSUTH), Aba. Am J Biomed Sci & Res. 2026 29(6) AJBSR.MS.ID.003859,*

DOI: 10.34297/AJBSR.2026.29.003859

Received: January 15, 2026; **Published:** January 28, 2026

Abstract

Background: Type 2 diabetes mellitus remains a major public health challenge in Nigeria, with increasing morbidity linked not only to poor glycaemic control but also to associated dyslipidaemia and metabolic derangements. Metformin and glibenclamide are widely prescribed oral antidiabetic agents, either alone or in combination, yet comparative local data on their broader biochemical effects remain limited. This study evaluated and compared the effects of metformin, glibenclamide, and their combined therapy on selected biochemical profiles in patients with type 2 diabetes attending Abia State University Teaching Hospital, Aba.

Methods: A prospective, cross-sectional, comparative study was conducted among adults aged 35 to 65 years with recently diagnosed type 2 diabetes mellitus. Thirty-three participants who completed the study were evenly assigned into three groups: metformin monotherapy (1000 mg daily), glibenclamide monotherapy (10 mg daily), and a combination of both drugs at the same doses. Fasting blood glucose, lipid profile, serum electrolytes, urea, and creatinine were measured at baseline and after six weeks of treatment. Data were analyzed using SPSS, with paired t-tests and one-way ANOVA applied as appropriate. Statistical significance was set at $p < 0.05$.

Results: Metformin monotherapy produced modest improvements in lipid parameters, with significant increases in HDL cholesterol and reductions in triglycerides, but no significant change in fasting blood glucose. Glibenclamide monotherapy resulted in significant reductions in total cholesterol, LDL cholesterol, triglycerides, and improvements in HDL cholesterol, with a non-significant reduction in fasting blood glucose. In contrast, the combination therapy demonstrated the most pronounced effects, showing significant reductions in fasting blood glucose, total cholesterol, LDL cholesterol, triglycerides, urea, and creatinine levels, alongside significant increases in HDL cholesterol. Notable but clinically tolerable changes in serum electrolytes were observed in the combination group. No serious adverse drug reactions were reported.

Conclusion: Combined metformin and glibenclamide therapy was more effective than either agent alone in improving glycaemic control, lipid profile, and renal biochemical indices in patients with type 2 diabetes. These findings support the clinical benefit of combination therapy for improved metabolic control in this population, with careful monitoring of electrolyte balance.

Keywords: Type 2 diabetes mellitus, Metformin, Glibenclamide, Combination therapy, Lipid profile

Introduction

Type-2 Diabetes Mellitus (T2DM) is a chronic metabolic condition characterized by persistent hyperglycemia resulting from impaired insulin secretion, reduced insulin sensitivity, or a combination of both. The global prevalence of T2DM has risen sharply over the past decades as a consequence of ageing populations, lifestyle changes, urbanization, and increasing rates of obesity [1,2]. It poses a significant burden on healthcare systems worldwide because of its microvascular and macrovascular complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy. Effective pharmacologic management

aims not only to achieve optimal glycemic control but also to favourably influence associated biochemical profiles, notably lipid metabolism and oxidative stress markers, which are implicated in the pathogenesis of T2DM-related complications [3,4].

Metformin, a biguanide antihyperglycemic agent, is the recommended first-line pharmacotherapy for T2DM due to its well-documented efficacy, safety profile, and additional metabolic benefits [5]. It primarily reduces hepatic glucose production by inhibiting gluconeogenesis and glycogenolysis, enhances insulin sensitivity in peripheral tissues, and modestly decreases intestinal glucose absorption. Unlike many other antidiabetic drugs, metformin does not stimulate pancreatic insulin release and thus carries a low risk of hypoglycemia. It is also associated with modest reductions in body weight and favourable effects on certain components of the lipid profile, such as lowering low-density lipoprotein cholesterol (LDL-C) and triglycerides, which may confer cardiovascular benefits beyond glucose lowering [6].

Glibenclamide (glyburide), in contrast, belongs to the sulfonylurea class of antidiabetic agents. Its principal action is to stimulate insulin secretion from pancreatic beta cells by inhibiting ATP-sensitive potassium channels in the cell membrane, resulting in membrane depolarization and increased insulin exocytosis. While generally effective in lowering fasting and postprandial plasma glucose, glibenclamide is more strongly associated with hypoglycemia and weight gain compared to metformin. Its effects on lipid profiles and oxidative stress markers are variable, with some data showing lesser improvements or even potential adverse shifts in lipid parameters when compared with metformin monotherapy [7].

In clinical practice, monotherapy with a single agent may be insufficient for many patients to achieve and maintain target glycemic levels over time, especially as beta-cell function declines progressively in T2DM. As a result, combination therapy using metformin with a sulfonylurea like glibenclamide is often employed. The rationale for combination therapy lies in the complementary mechanisms of action of the two drugs: metformin addresses peripheral insulin sensitivity and hepatic glucose output, while glibenclamide directly increases insulin secretion. Early randomized clinical trials and comparative studies have shown that combined metformin–glibenclamide therapy enhances glycemic control more effectively than either drug alone, facilitating greater reductions in fasting plasma glucose and glycated haemoglobin (HbA1c), and in some cases allowing for reduced doses of each component [8].

Beyond glycemic measures, both monotherapy and combination regimens may differentially influence other biochemical profiles that are clinically relevant in T2DM. These include lipid parameters (total cholesterol, LDL-C, high-density lipoprotein cholesterol, triglycerides), markers of oxidative stress and antioxidant status (such as malondialdehyde and catalase), and inflammatory mediators. Studies comparing metformin versus glibenclamide have shown that metformin tends to exert more favourable effects on oxidative stress biomarkers and antioxidant capacity, which may translate into reduced oxidative damage among T2DM patients. Additionally, combination therapy has sometimes demonstrated superior reductions in dyslipidemia and enhanced improvements in biochemical indices compared to monotherapy, although findings are not uniform across all populations and study designs [9].

Despite these insights, existing data on the comparative biochemical effects of metformin, glibenclamide, and their combination among patients in sub-Saharan African clinical settings remains limited. Regional differences in genetics, diet, environmental exposures, and health system factors may influence treatment responses and biochemical outcomes. Moreover, most studies to date have focused primarily on glycemic endpoints rather than a broader panel of biochemical profiles relevant to cardiovascular and metabolic risk. A comprehensive assessment of how these common oral hypoglycemic regimens impact selected biochemical parameters among T2DM patients attending Abia State University Teaching Hospital (ABSUTH), Aba, can provide locally validated evidence to guide therapeutic decisions, optimize treatment protocols, and ultimately improve patient outcomes in the Nigerian context.

Materials and Methods

Study Design

This study employed a prospective, cross-sectional, comparative design involving adult patients with type 2 diabetes mellitus attending the Diabetic Clinic of Abia State University Teaching Hospital (ABSUTH), Aba. The study evaluated and compared the effects of metformin, glibenclamide, and their combined therapy on selected biochemical parameters. A total of 42 patients were initially recruited; however, only 33 participants completed the study and were included in the final analysis. Fasting blood glucose, fasting lipid profile, and serum electrolyte, urea, and creatinine levels were assessed at baseline prior to drug administration and reassessed at the end of the six-week intervention period.

Participants were allocated into three treatment groups. Group A received metformin monotherapy at a total daily dose of 1000 mg, administered as 500 mg twice daily. Group B received glibenclamide monotherapy at a total daily dose of 10 mg, administered as 5 mg twice daily. Group C received a combination of metformin 1000 mg daily and glibenclamide 10 mg daily, both administered in divided doses twice daily. Although forty-two patients were initially enrolled, eight participants did not complete the study due to travel outside the state, pregnancy, or withdrawal without stated reasons. To maintain equal group sizes, one additional participant was excluded by random selection, resulting in eleven participants per group who completed the study. No serious adverse drug reactions were reported during the study period.

Study Area and Population

The study was conducted at Abia State University Teaching Hospital, Aba, located in Abia State in the southeastern region of Nigeria. Abia State shares boundaries with Imo, Anambra, Enugu, Ebonyi, Cross River, and Akwa Ibom States and occupies a land area

of approximately 27,627.20 square kilometres [10]. ABSUTH is the only state-owned teaching hospital in Abia State and serves as a major referral center, with an estimated 80 to 90 newly diagnosed diabetic patients enrolled in its diabetic clinic annually. Aba is a rapidly expanding commercial and industrial city with an estimated population of over one million residents drawn from diverse ethnic backgrounds across Nigeria [11].

Study Duration

Drug administration and follow-up lasted for six weeks. At the end of this period, all biochemical parameters were reassessed and compared with baseline values.

Selection of Subjects

a) Inclusion Criteria: Participants included adults aged 35 to 65 years with a confirmed diagnosis of type 2 diabetes mellitus who attended the diabetic clinic at ABSUTH. Only patients diagnosed within one year prior to the study and who provided informed consent were enrolled.

b) Exclusion Criteria: Patients with known renal or hepatic disease, pregnant women, individuals younger than 35 years or older than 65 years, and severely ill patients were excluded from the study.

Main Intervention

The primary intervention involved the oral administration of metformin and or glibenclamide. Metformin was administered at a total daily dose of 1000mg, while glibenclamide was administered at a total daily dose of 10 mg. All medications were sourced from a reputable pharmaceutical company in Nigeria.

Sample Size Determination

The sample size was determined using Cochran's formula for estimating population proportions, as outlined by *Ezebuiro, et al.* [12]:

$$n=\frac{\mathbf{Z^2\left(Pq\right)}}{\mathbf{e^2}}$$

The formula components are defined as follows:

- n represents the minimum required sample size.
- Z is set at 1.96, corresponding to a 95% confidence level.
- P denotes the Prevalence of Diabetes Mellitus in Nigeria, 2%.
- e signifies the allowable margin of error, fixed at 5% (0.05).

q = 1 - p

P = 2% = 0.02

q = 1 – 0.02

= 0.98

$$n=\frac{\left(\mathbf{1.96}\right)^2\left(\mathbf{0.02\times0.98}\right)}{\left(\mathbf{0.05}\right)^2}$$

$$n=\frac{3.8416\times\left(\mathbf{0.0196}\right)}{0.0025}$$

$$n=\frac{\mathbf{0.0753}}{\mathbf{0.0025}}=30.12$$

The minimum sample size was 30, but it was adjusted to 33 to account for a 10% non-response rate.

Drug Sources and Administration

All study medications were purchased directly from a standard pharmaceutical company. Group A received metformin 1000 mg daily, Group B received glibenclamide 10 mg daily, and Group C received a fixed dose combination of metformin 1000 mg and glibenclamide 10 mg daily. All drugs were administered orally for six weeks.

Blood Sample Collection and Processing

Following an overnight fast, ten millilitres of venous blood were collected from each participant by aseptic venipuncture of the antecubital vein. Two millilitres were collected into EDTA bottles for fasting blood glucose estimation, while eight millilitres were collected into plain bottles for lipid profile and serum electrolyte, urea, and creatinine analyses. All laboratory analyses were carried out at the Chemical Pathology Laboratory of Abia State University Teaching Hospital.

Biochemical Analyses

Fasting plasma glucose was determined using the glucose oxidase peroxidase (GOD PAP) method according to standard Randox protocols [13]. Lipid profile was determined according to the methods of *Owoade, et al.* [14]. Serum electrolyte, urea, and creatinine estimation were determined by the methods outlined by *Abali et al.* [15]

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS). Continuous variables were expressed as mean plus or minus standard deviation. Paired t-tests were used to assess within-group differences before and after treatment, while one-way analysis of variance was applied to compare differences among the three treatment groups. Post hoc analyses were conducted where appropriate, and statistical significance was set at a p-value of less than 0.05.

Ethical Considerations

Ethical approval for the study was obtained from the Ethics Committee of Abia State University Teaching Hospital prior to commencement. Written informed consent was obtained from all participants before enrolment.

Results

Fasting blood sugar levels for participants in Group A, who received metformin monotherapy, showed individual variations between baseline and post study measurements, with mean values of 102.02 ± 10.54 g/dL at baseline and 105.13 ± 10.45 g/dL after the study period (Table 1). In Group B, treated with glibenclamide

alone, the mean fasting blood sugar decreased from 114.70 ± 12.59 g/dL at baseline to 108.09 ± 9.38 g/dL post study (Table 2). Group C participants, who received a combination of metformin and glibenclamide, recorded a marked reduction in fasting blood sugar, with mean values changing from 120.50 ± 9.46 g/dL at baseline to 94.84 ± 4.31 g/dL post study (Table 3).

Table 1: Baseline and Post-Study Fasting Blood Sugar (FBS) of Group A Participants.

S/N	Baseline FBS (g/dL)	Post-Study FBS (g/dL)
1	108.2	96.6
2	96.4	102.2
3	93.8	109.2
4	121.6	98.3
5	95.8	94.6
6	94	102.4
7	102.6	100.5
8	114.2	128.8
9	86.4	98.2
10	111	119.2
11	98.2	106.4
Mean± Standard Deviation	**102.02 ± 10.54**	**105.13 ± 10.45**

***Note:** Group A participants received metformin monotherapy at a total daily dose of 1000 mg, administered as 500 mg twice daily.

Table 2: Baseline and Post-Study Fasting Blood Sugar (FBS) of Group B Participants.

S/N	Baseline FBS (g/dL)	Post-Study FBS (g/dL)
1	102.2	98.2
2	128.4	119
3	106.7	118.8
4	104.8	111
5	118.4	94.6
6	110.6	108
7	132.4	106
8	124	120.4
9	106.8	100.2
10	130.8	114.6
11	96.6	98.2
Mean± Standard Deviation	**114.70 ± 12.59**	**108.09 ± 9.38**

***Note:** Group B participants received glibenclamide monotherapy at a total daily dose of 10 mg, administered as 5 mg twice daily.

Table 3: Baseline and Post-Study Fasting Blood Sugar (FBS) of Group C Participants.

S/N	Baseline FBS (g/dL)	Post-Study FBS (g/dL)
1	134	94.2
2	117	88
3	123.8	90
4	112.4	98
5	120.2	100
6	116.6	94
7	100.2	96
8	128.8	100
9	130.5	92
10	124.7	91
11	117.3	100
Mean± Standard Deviation	**120.50 ± 9.46**	**94.84 ± 4.31**

***Note:** Group C participants received a combination of metformin 1000 mg daily and glibenclamide 10 mg daily, both administered in divided doses twice daily.

Table 4: Baseline and Post-Study Plasma Lipid Profile for Group A Participants.

S/N	Baseline (mg/dL)				Post study (mg/dL)			
	TC	LD L-C	HDL-C	TG	TC	LDL-C	HDL-C	TG
1	220	184.4	40.6	150.4	217.4	180.3	56.8	144.8
2	212.2	200.5	38.4	152.8	198.2	186.4	49.2	150.6
3	224.1	178.6	35.6	148.6	218.4	140.8	48.4	136.2
4	208.6	148.8	42.3	160.2	200.6	132.7	60.2	148.7
5	196.1	190.7	44.6	170.4	198.2	188.2	52.7	155.7
6	214.6	156.2	34.8	156.2	203.8	131.6	47.8	150.1
7	206.5	164.6	50.4	140.8	200.4	160.2	52.6	135.2
8	184.8	176.1	48.3	146.2	192.4	172	59.2	140.1
9	190.3	182.9	47.2	138.8	194.1	170.1	59.3	131.3
10	212.6	150.3	45.7	158.2	208.2	128.4	58.2	146.8
11	232	130.8	55.5	162.4	200.8	102.6	63.5	156.7
Mean± Standard Deviation	**209.25 ± 14.28**	**169.45 ± 21.06**	**43.95 ± 6.37**	**153.18 ± 9.50**	**202.95 ± 8.53**	**153.94 ± 28.21**	**55.26 ± 5.37**	**145.11 ± 8.43**

***Note:** Group A participants received metformin monotherapy at a total daily dose of 1000 mg, administered as 500 mg twice daily

Baseline and post study plasma lipid profiles showed changes across all treatment groups. In Group A, mean total cholesterol decreased from 209.25 ± 14.28 mg/dL to 202.95 ± 8.53 mg/dL, while LDL cholesterol reduced from 169.45 ± 21.06 mg/dL to 153.94 ± 28.21 mg/dL. Mean HDL cholesterol increased from 43.95 ± 6.37 mg/dL to 55.26 ± 5.37 mg/dL, and triglyceride levels declined from 153.18 ± 9.50 mg/dL to 145.11 ± 8.43 mg/dL (Table 4). For Group B, total cholesterol reduced from 203.04 ± 15.26 mg/dL at baseline to 174.52 ± 11.09 mg/dL post study, LDL cholesterol decreased from 181.80 ± 12.86 mg/dL to 150.65 ± 10.92 mg/dL, HDL cholesterol increased from 48.30 ± 4.64 mg/dL to 56.96 ± 5.43 mg/dL, and triglycerides declined from 159.68 ± 6.32 mg/dL to 139.31 ± 6.70 mg/dL (Table 5). In Group C, mean total cholesterol reduced from 201.86 ± 14.82 mg/dL to 172.10 ± 10.64 mg/dL, LDL cholesterol decreased from 181.12 ± 15.31 mg/dL to 147.38 ± 5.90 mg/dL, HDL cholesterol increased from 47.85 ± 4.80 mg/dL to 57.27 ± 5.36 mg/dL, and triglycerides reduced from 159.42 ± 5.92 mg/dL to 141.18 ± 6.53 mg/dL (Table 6).

Table 5: Baseline and Post-Study Plasma Lipid Profile for Group A Participants.

S/N	Baseline (mg/dL)				Post study (mg/dL)			
	TC	LD L-C	HDL-C	TG	TC	LDL-C	HDL-C	TG
1	218.2	200.4	46.4	160.8	182	160.2	58.6	138.8
2	192.8	176.8	48.2	154.6	170.4	144.4	62.4	141.2
3	186.6	184.6	45.2	149.2	152.8	152.6	53.8	136.3
4	184.3	166.4	56.1	156.5	162.4	138.5	58.8	138.2
5	200.8	182.3	51.6	164.1	178.5	149.2	61.8	131.1
6	198.6	178.6	44.6	151.2	174.4	146.8	56.6	133.4
7	196.8	204.2	50.8	165.8	182.6	176.8	52.4	148.6
8	212.3	164.3	38.8	168.2	171.2	138.2	46.8	150.1
9	190.8	173.2	48.2	160.6	168.2	150.4	54.2	147.3
10	228.2	176.4	52.8	158.8	186.4	144.8	66.4	132.6
11	224	192.6	48.6	166.7	190.8	155.2	54.8	134.8
Mean± Standard Deviation	**203.04 ± 15.26**	**181.80 ± 12.86**	**48.30 ± 4.64**	**159.68 ± 6.32**	**174.52 ± 11.09**	**150.65 ± 10.92**	**56.96 ± 5.43**	**139.31 ± 6.70**

***Note:** Group B participants received glibenclamide monotherapy at a total daily dose of 10 mg, administered as 5 mg twice daily.

Table 6: Baseline and Post-Study Plasma Lipid Profile for Group C Participants.

S/N	Baseline (mg/dL)				Post-Study (mg/dL)			
	TC	LD L-C	HDL-C	TG	TC	LDL-C	HDL-C	TG
1	194	175.2	47.5	156.4	172	146.1	60.2	140.8
2	223	188.8	46.8	164.7	188.6	152.3	52.4	136.6
3	226.3	174.8	50.6	156.5	184	142.8	64.1	130.4
4	188.1	170.6	46.1	158.3	166.3	148.6	56.6	145.2
5	210.1	162.4	38.4	166.4	168.1	138.6	48.8	152.4
6	194.6	200.1	50.6	168.9	172	140.7	62.4	142.4
7	196.4	178.6	45.4	154.2	176	144.3	58.6	138.8
8	216.4	214.4	48.7	160.6	180.4	158.8	56.8	140.4
9	186.6	182.4	43.5	148.6	150.8	152.7	50.6	134.1
10	184.4	164.6	56.7	156.4	160.8	146.1	54.7	141.3
11	200.6	180.4	52.1	162.6	174.1	150.2	64.8	150.6
Mean± Standard Deviation	**201.86 ± 14.82**	**181.12 ± 15.31**	**47.85 ± 4.80**	**159.42 ± 5.92**	**172.10 ± 10.64**	**147.38 ± 5.90**	**57.27 ± 5.36**	**141.18 ± 6.53**

***Note:** Group C participants received a combination of metformin 1000 mg daily and glibenclamide 10 mg daily, both administered in divided doses twice daily.

Serum electrolyte measurements also showed variations between baseline and post study values. In Group A, mean sodium levels increased from 131.18 ± 7.68 mmol/L to 135.27 ± 3.10 mmol/L, potassium levels slightly decreased from 3.98 ± 0.60 mmol/L to 3.73 ± 0.34 mmol/L, chloride values remained relatively stable, and bicarbonate levels increased marginally from 28.18 ± 3.31 mmol/L to 28.82 ± 2.14 mmol/L (Table 7). Group B participants had baseline sodium levels of 140.09 ± 8.59 mmol/L, which changed to 137.55 ± 7.83 mmol/L post study, while potassium, chloride, and bicarbonate values showed minor shifts over the study period

(Table 8). In Group C, mean sodium decreased from 141.91 ± 8.11 mmol/L at baseline to 126.73 ± 5.53 mmol/L post study, potassium reduced from 4.66 ± 0.65 mmol/L to 3.83 ± 0.56 mmol/L, chloride decreased from 105.27 ± 5.82 mmol/L to 102.00 ± 4.98 mmol/L, and bicarbonate levels showed minimal change (Table 9).

Table 7: Baseline and Post-Study Serum Electrolytes for Group A Participants.

S/N	Baseline (mmol/L)				Post Study (mmol/L)			
	Na+	K+	Cl-	HCO3-	Na+	K+	Cl-	HCO3-
1	128	3.1	104	26	130	3.4	100	28
2	134	3.8	110	26	135	3.7	104	29
3	130	3.5	106	24	136	3.6	108	26
4	140	4.6	98	32	138	3.8	102	30
5	122	3.7	96	30	134	3.6	98	28
6	136	4.4	104	28	138	4.2	101	32
7	137	4.2	102	26	135	3.8	112	28
8	144	3.4	94	32	140	3.6	106	26
9	120	3.8	100	34	132	3.2	104	28
10	124	4.1	98	25	138	3.8	94	30
11	128	5.2	114	27	132	4.3	98	32
Mean± Standard Deviation	**131.18 ± 7.68**	**3.98 ± 0.60**	**102.36 ± 6.05**	**28.18 ± 3.31**	**135.27 ± 3.10**	**3.73 ± 0.34**	**102.45 ± 5.36**	**28.82 ± 2.14**

***Note:** Group A participants received metformin monotherapy at a total daily dose of 1000 mg, administered as 500 mg twice daily.

Table 8: Baseline and Post-Study Serum Electrolytes for Group B Participants.

S/N	Baseline (mmol/L)				Post Study (mmol/L)			
	Na+	K+	Cl-	HCO3-	Na+	K+	Cl-	HCO3-
1	130	3.5	102	28	148	3.8	98	30
2	128	3.8	100	36	140	3.6	96	34
3	136	3.6	104	32	129	4.2	100	36
4	150	3.1	96	38	142	3.8	98	34
5	130	3.4	104	34	146	4.4	102	30
6	141	4.1	98	26	140	3.4	96	28
7	134	4.6	112	30	126	4.2	108	32
8	140	3.8	100	26	136	3.8	104	30
9	142	3.6	102	28	138	3.4	98	32
10	148	4.8	111	35	128	4.2	106	37
11	152	4.2	96	31	140	4.6	102	34
Mean± Standard Deviation	**140.09 ± 8.59**	**3.86 ± 0.52**	**102.27 ± 5.77**	**31.27 ± 4.20**	**137.55 ± 7.83**	**3.95 ± 0.43**	**100.73 ± 4.32**	**32.45 ± 3.36**

***Note:** Group B participants received glibenclamide monotherapy at a total daily dose of 10 mg, administered as 5 mg twice daily.

Table 9: Baseline and Post-Study Serum Electrolytes for Group C Participants.

S/N	Baseline (mmol/L)				Post-Study (mmol/L)			
	Na+	K+	Cl-	HCO3-	Na+	K+	Cl-	HCO3-
1	138	5.1	108	32	126	4.2	100	28
2	144	3.6	110	30	122	3.2	108	30
3	135	4.2	104	35	126	3.1	102	32
4	138	3.8	98	34	132	3.2	96	34
5	142	5	106	28	128	4.2	104	30
6	152	4.6	112	30	134	3.8	110	32
7	148	5.4	102	32	130	4.4	96	30

8	128	4.8	96	26	116	4.2	98	28
9	136	4.2	100	24	120	4	98	25
10	146	4.4	108	32	132	3.2	102	34
11	154	5.2	114	28	128	4.6	108	26
Mean± Standard Deviation	**141.91 ± 8.11**	**4.66 ± 0.65**	**105.27 ± 5.82**	**30.09 ± 3.36**	**126.73 ± 5.53**	**3.83 ± 0.56**	**102.00 ± 4.98**	**29.91 ± 2.98**

***Note:** Group C participants received a combination of metformin 1000 mg daily and glibenclamide 10 mg daily, both administered in divided doses twice daily.

Baseline and post study serum urea and creatinine levels are presented in Tables 10 to 12. In Group A, mean urea decreased from 5.15 ± 1.69 mmol/L to 4.71 ± 1.03 mmol/L, while mean creatinine increased slightly from 89.00 ± 9.26 µmol/L to 91.64 ± 5.59 µmol/L (Table 10). Group B showed mean urea values of 7.00 ± 0.92 mmol/L at baseline and 7.14 ± 0.76 mmol/L post study, with creatinine changing from 95.55 ± 5.28 µmol/L to 93.55 ± 6.25 µmol/L (Table 11). In Group C, mean urea decreased from 7.12 ± 0.77 mmol/L at baseline to 3.66 ± 0.44 mmol/L post study, while creatinine reduced from 94.09 ± 9.53 µmol/L to 73.27 ± 10.67 µmol/L (Table 12).

Table 10: Baseline and Post-Study Serum Urea and Creatinine for Group A Participants.

S/N	Baseline		Post-Study	
	Urea (mmol/L)	Creatinine (µmol/L)	Urea (mmol/L)	Creatinine (µmol/L)
1	3.4	80	4.2	85
2	2.8	88	3.6	94
3	3.2	86	4.6	83
4	5.2	77	4.2	86
5	4.8	92	3.6	94
6	6.2	98	5.8	100
7	7.6	102	6.2	94
8	6.8	100	5.4	96
9	3.8	84	3.2	88
10	5.6	76	5.2	90
11	7.2	96	5.8	98
Mean± Standard Deviation	**5.15 ± 1.69**	**89.00 ± 9.26**	**4.71 ± 1.03**	**91.64 ± 5.59**

***Note:** Group A participants received metformin monotherapy at a total daily dose of 1000 mg, administered as 500 mg twice daily.

Table 11: Baseline and Post-Study Serum Urea and Creatinine for Group B Participants.

S/N	Baseline		Post Study	
	Urea (mmol/L)	Creatinine (µmol/L)	Urea (mmol/L)	Creatinine (µmol/L)
1	5.8	100	6.2	96
2	6.2	102	7.3	98
3	5.4	96	6	94
4	7.2	98	6.8	88
5	8.2	98	7.4	100
6	7.8	92	8.2	94
7	7.6	102	7.2	104
8	6.8	88	7.4	96
9	8	94	7.6	84
10	7.4	86	8.2	85
11	6.6	95	6.2	90
Mean± Standard Deviation	**7.00 ± 0.92**	**95.55 ± 5.28**	**7.14 ± 0.76**	**93.55 ± 6.25**

***Note:** Group B participants received glibenclamide monotherapy at a total daily dose of 10 mg, administered as 5 mg twice daily.

Table 12: Baseline and Post-Study Serum Urea and Creatinine for Group C Participants.

S/N	Baseline		Post-Study	
	Urea (mmol/L)	Creatinine (µmol/L)	Urea (mmol/L)	Creatinine (µmol/L)
1	8.1	100	3.8	84
2	8.4	104	4.2	86
3	6.8	98	3.4	62
4	7.4	102	2.8	78
5	6.6	96	3.6	82
6	7.2	85	3.2	72
7	7.8	88	3.6	64
8	6.4	96	4.2	84
9	6.8	106	3.5	76
10	7	76	3.8	62
11	5.8	84	4.2	56
Mean± Standard Deviation	**7.12 ± 0.77**	**94.09 ± 9.53**	**3.66 ± 0.44**	**73.27 ± 10.67**

***Note:** Group C participants received a combination of metformin 1000 mg daily and glibenclamide 10 mg daily, both administered in divided doses twice daily.

The overall distribution of baseline and post study biochemical parameters for each treatment group is summarized in Tables 13, 14, and 15. These tables present the mean and standard deviation values for fasting blood sugar, lipid parameters, serum electrolytes, urea, and creatinine in Groups A, B, and C respectively, alongside their corresponding p values, providing a consolidated overview of the measured biochemical changes across the study period.

Table 13: Baseline and Post-Study Mean ± Standard Deviation Distribution of All Biochemical Parameters of Group A (Metformin alone).

Parameter	Baseline	Post-Study	p-value
Fasting Blood Sugar (g/dl)	102.02± 10.54	105.1 ± 10.5	0.695(0.495)
Total Cholesterol, TC (mg/dl)	209.3 ± 14.3	203.0 ± 8.5	1.256(0.224)
LDL – Cholesterol (mg/dl)	169.4 ± 21.1	153.9 ± 28.2	1.461(0.160)
HDL – Cholesterol (mg/dl)	44.0 ± 6.4	55.3 ± 5.3	4.505(<0.001)*
Triglycerides, TG (mg/dl)	153.2 ± 9.5	145.1 ± 8.4	2.108(0.048)*
Sodium, Na+ (mmol/I)	131.2 ± 7.7	135.3 3.1	1.638(0.117)
Potassium, K+ (mmol/I)	4.0 ± 0.6	3.7 ± 0.3	1.245(0.228)
Chloride, CL – (mmol/I)	102.4 ± 6.1	102.5 5.1	0.038(0.970)
Bicarbonate, HCO3(mmol/I)	28.2 ± 3.3	28.8 ± 2.0	0.543(0.593)
Urea (mmol/I)	5.2 ± 1.7	4.7 ± 1.0	0.731(0.473)
Creatinine (mmol/I)	89.0 ± 9.3	91.6 ± 5.6	0.808(0.428)

Table 14: Baseline and Post-Study Mean ± Standard Deviation Distribution of All Biochemical Parameters of Group A (Metformin alone).

Parameter	Baseline	Post- Study	p-value
Fasting Blood Sugar (g/dl)	114.7 ± 12.6	108.1 ± 9.4	1.396(0.178)
Total Cholesterol, TC (mg/dl)	203.0 ± 15.3	174.5 ± 11.1	5.015(<0.001)*
LDL – Cholesterol (mg/dl)	181.8 ± 12.9	150.6 ± 10.9	6.124(<0.001)*
HDL – Cholesterol (mg/dl)	48.3 ± 4.6	57.0 ± 5.4	4.023(0.001)*
Triglycerides, TG (mg/dl)	159.7 ± 6.3	139.3 ± 6.7	7.338(<0.001)*
Sodium, Na+ (mmol/l)	139.2 ± 8.4	137.6 ± 7.2	0.491(0.629)
Potassium, K+ (mmol/l)	3.9 ± 0.5	3.9 ± 0.4	0.415(0.682)
Chloride, CL – (mmol/l)	102.3 ± 5.3	100.7 ± 4.0	0.767(0.452)
Bicarbonate, HCO3 (mmol/l)	31.3 ± 4.1	32.5 ± 2.8	0.789(0.439)
Urea (mmol/l)	7.0 ± 0.9	7.1 ± 0.8	0.378(0.709)
Creatinine (mmol/l)	95.6 ± 5.3	93. 6 ± 6.3	0.811(0.427)

Table 15: Baseline and Post Study Mean ± Standard Deviation Distribution of All Biochemical Parameters of Group C (Both Metformin and Glibenclamide).

Parameter	Baseline	Post-Study	p-value
Fasting Blood Sugar (mg/dl)	120.5 ± 9.5	94.8 ± 4.3	8.188(<0.001)*
Total Cholesterol, TC (mg/dl)	201.9 ± 14.8	172.1 ± 10.6	5.410(<0.001)*
LDL–Cholesterol (mg/dl)	181.1 ± 15.3	147.4 ± 5.9	6.819(<0.001)*
HDL–Cholesterol (mg/dl)	47.9 ± 4.8	57.3 ± 5.4	4.340((<0.001)*
Triglycerides, TG (mg/dl)	159.4 ± 5.9	141.2 ± 6.5	6.865(<0.001)*
Sodium, Na+ (mmol/l)	141.9 ± 7.8	126.7 ± 5.5	5.252(<0.001)*
Potassium, K+ (mmol/l)	4.6 ± 0.6	3.8 ± 0.6	3.062(<0.001)*
Chloride, CL – (mmol/l)	105.3 ± 5.8	102.0 ± 5.0	1.418(<0.001)*
Bicarbonate, HCO3(mmol/l)	30.1 ± 3.4	29.9 ±3.0	0.134(<0.001)*
Urea (mmol/l)	7.1 ± 0.8	3.7 ± 0.4	12.922(<0.001)*
Creatinine (mmol/l)	94.1 ± 9.5	73.3 ± 10.7	4.826(<0.001)*

Discussion

Type 2 diabetes mellitus is a growing public health challenge in Nigeria, often accompanied by dyslipidaemia and alterations in renal and electrolyte balance [16]. Metformin and glibenclamide are commonly prescribed oral hypoglycaemic agents, either alone or in combination, yet their comparative biochemical effects in routine clinical settings remain underreported in southeastern Nigeria. This study compared the effects of metformin, glibenclamide, and their combined therapy on fasting blood glucose, lipid profile, serum electrolytes, urea, and creatinine levels in patients with type 2 diabetes attending Abia State University Teaching Hospital, Aba. Our findings show distinct patterns in how metformin, glibenclamide and their combination influence glycemic control, lipid metabolism, kidney function and electrolyte balance in adults with type-2 diabetes mellitus. Understanding these patterns helps position our results within the broader landscape of diabetes therapy.

In our study, metformin alone did not produce a significant reduction in mean Fasting Blood Sugar (FBS) from baseline to post-study, while glibenclamide monotherapy also showed modest, non-significant changes. In contrast, the combination of metformin and glibenclamide produced a significant decrease in FBS (from 120.5 to 94.8 g/dL; p<0.001). This suggests that the dual therapy provided superior glycemic control compared with either agent alone.

These findings are supported by prior clinical trials showing that combination therapy often yields greater improvements in fasting plasma glucose and HbA1c than monotherapy. A well-conducted randomized, double-blind comparative study reported that combination treatment with metformin and a sulfonylurea like glibenclamide was more effective in achieving glycemic targets than either drug alone, enabling a higher proportion of patients to reach HbA1c goals (for example, ≤6%) compared with monotherapy regimens [17]. The synergistic effect is explained by the complementary mechanisms of action: metformin primarily reduces hepatic gluconeogenesis and improves peripheral insulin sensitivity, while glibenclamide stimulates pancreatic insulin secretion dependent on residual beta-cell function [18].

Our results show that metformin alone did not significantly alter total cholesterol (TC) or LDL-cholesterol (LDL-C), though there were favourable increases in HDL-cholesterol and a significant reduction in triglycerides. Glibenclamide monotherapy produced highly significant improvements in all major lipid markers (TC, LDL-C, HDL-C, TG). Most notably, the combination therapy led to marked and statistically significant improvements in lipid profiles as well. What we observed echoes findings from earlier clinical work demonstrating that combined therapy generally results in more favourable changes in total and LDL-cholesterol levels compared with monotherapy. In a trial comparing metformin, glibenclamide and their combination over six months, patients on the combination experienced greater decreases in total and LDL-cholesterol than either treatment alone [19].

Improvements in HDL-cholesterol in response to combination therapy also align with broader evidence that metformin frequently augments HDL levels. Elevated HDL is clinically important since it is inversely associated with cardiovascular risks, a common and dangerous complication of type-2 diabetes [20].

The serum electrolyte results showed no statistically significant changes for metformin or glibenclamide monotherapy in sodium (Na+), potassium (K+), chloride (Cl–), or bicarbonate (HCO3–). However, in the combination therapy group, we observed significant reductions in sodium and potassium levels. Although still within clinically acceptable ranges, these shifts highlight the importance of monitoring electrolytes in patients on multiple antidiabetic medications.

Sodium and potassium changes in combination therapy may reflect improved glucose utilization and insulin-mediated intracellular shifts of potassium. Insulin facilitates cellular uptake of potassium; with enhanced glycemic control via combination therapy, we might expect enhanced insulin effect and altered potassium distribution. Electrolyte changes were not a major focus in most human clinical trials of antidiabetic therapy, but they are noted in experimental animal models that examine how combined agents affect renal and cellular handling of electrolytes [21].

Markers of kidney function differed most strikingly across our groups. Both monotherapy regimens had minimal impact on serum urea and creatinine, with no statistically significant changes. In contrast, the combination therapy produced significant reductions in serum urea and creatinine. Our results suggest that dual therapy may confer benefits for renal biochemical profiles. Clinical trials that focus on glucose-lowering medications and kidney outcomes (such as the large GRADE trial) often show that adding certain agents to metformin does not create significant differences in long-term kidney outcomes when compared across classes of medications. However, short-term improvements in urea and creatinine as seen in our study are clinically meaningful as early indicators of improved metabolic and perhaps renal physiology [22].

These early short-term changes align with smaller clinical observations where improved glycemic control correlates with reduced microalbuminuria and better renal handling of nitrogenous waste products in type-2 diabetes. Metformin, in particular, has been associated with reductions in microalbuminuria, improved blood pressure, and favourable lipid profile changes that could indirectly support better kidney outcomes [23].

Across the published literature, there is consistent evidence supporting our central observation: combination therapy with metformin and glibenclamide tends to provide superior metabolic control compared to either agent alone. In multiple trials, dual therapy achieves greater reductions in fasting glucose and HbA1c, often with better improvements in lipid profiles, although the magnitude of effect can vary with dose and patient characteristics [17,24].

Monotherapy with metformin remains a backbone for early management of type-2 diabetes due to its favourable effects on insulin resistance and cardiovascular risk parameters, but it may be insufficient alone for many patients. Sulfonylurea monotherapy, like glibenclamide, can yield moderate improvements in glycemia and lipid metabolism, but when combined with metformin, the clinical benefits on both glucose and lipid markers appear additive.

The renal benefits we observed with combination therapy are intriguing and merit further exploration in larger, longer-term studies. While broad randomized trials have not shown dramatic differences in kidney outcomes across glucose-lowering strategies in the long term, early biochemical improvements may presage later clinical benefits if maintained.

Conclusion

Our study reinforces the concept that combination therapy with metformin and glibenclamide produces better glycemic control and more comprehensive improvements in lipid profiles and kidney function markers compared with either monotherapy. These findings are consistent with other rigorous clinical evidence showing enhanced efficacy of combined oral agents in type-2 diabetes management. Regular monitoring of electrolytes and kidney function remains essential, especially when multiple pharmacological agents are used concurrently.

Availability of Data and Material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

Competing Interests

The authors declare that they have no competing interests.

Funding

This research did not receive any grant from funding sources in the public, commercial, or not-for-profit sources. It was personally funded by the authors.

References

1. Airaodion A, Ijioma C E, Ejikem P I, Abali I O, Aminu Ayinde O E, et al. (2023) Prevalence of erectile dysfunction in men with type 2 diabetes mellitus in Osun State, Nigeria. Direct Research Journal of Health and Pharmacology 9(6): 45-52.
2. Agu F U, Ijioma C E, Ogunnay F U, Amuta A C, Ogbonna U J, et al. (2023) Cutaneous manifestations of diabetes mellitus at tertiary health facilities in Nigeria. Asian Journal of Research in Dermatological Science 6(1): 129-144.
3. Okeji I E, Ijioma C E, Abali I O, Orji O J, Olusakin T C, et al. (2023) An examination of risk factors and quality of life of patients with diabetes mellitus foot syndrome. Asian Journal of Cardiology Research 6(1): 268-280.
4. Gieroba B, Kryska A, Sroka-Bartnicka A (2025) Type 2 diabetes mellitus: Conventional therapies and future perspectives in innovative treatment. Biochem Biophys Rep 42: 102037.
5. Akwuruoha E M,Airaodion A I (2025) Assessment of the efficacy of metformin in polycystic ovarian syndrome management in Nigeria and its associated risk factors. Journal of Obstetrics. Gynecology and Reproductive Sciences 9(8): 1-9.
6. Omole O R, Okeji I E, Odarah J E, Ogbonna U J, Areh J E, et al. (2024) Evaluation of dyslipidaemia and atherogenic index in patients with chronic kidney disease in a Nigerian tertiary health facility. International Journal of Advances in Nephrology Research 7(1): 26-33.
7. Airaodion A I, Ejikem PI, Otuka OAI, Ezirim EO, Abali IO, et al. (2022) Antidiabetic propensity of Tetracarpidium conophorum (African walnut) seed in alloxan-induced diabetic rats. Bionature 42(2): 56-75.
8. Marre M, Howlett H, Lehert P, Allavoine T (2002) Improved glycaemic control with metformin-glibenclamide combined tablet therapy (Glucovance) in Type 2 diabetic patients inadequately controlled on metformin. Diabet Med 19(8): 673-680.
9. Almulathanon AAY, Mohammad J A,Fathi FH (2021) Comparative effects of metformin and glibenclamide on the redox balance in type 2 diabetic patients. Pharmacia 68(2): 327-332.
10. Akwuruoha E M, Ezirim E O, Onyemereze C O, Abali I O,Airaodion A I (2025) Awareness and acceptance of hyoscine N-butylbromide in the management of labor among expectant mothers in Abia State University Teaching Hospital. International Journal of Studies in Midwifery and Women's Health 6(3): 1-9.
11. Akwuruoha E M, Ezirim E O, Amah C I, Onyemereze C O, Airaodion A I (2025). Prevalence and awareness of premature ovarian insufficiency among Nigerian women. Journal of Women Health Care and Gynecology 5(5): 1-8.
12. Ezebuiro E I, Adesina O, Alumona F C, Abali I O, Ezirim E O, et al. (2024) Awareness and acceptance of obstetric epidural analgesia among expectant mothers in Southeast Nigeria. International Journal of Reproductive Research 3(2).

13. Airaodion A I, Airaodion E O, Ogbuagu E O, Ogbuagu U, Osemwowa E U (2019) Effect of Oral Intake of African Locust Bean on Fasting Blood Sugar and Lipid Profile of Albino Rats. Asian Journal of Research in Biochemistry 4(4): 1-9.

14. Abali I O, Chika Igwenyi N M, Agu F U, Onyeaghala C A, Orji S F, et al. (2022) Nephroprotective efficacy of African locust bean seed against potassium bromate-induced renal damage. Asian Journal of Biochemistry, Genetics and Molecular Biology 12(3): 28-36.

15. Owoade A O, Airaodion A I, Adetutu A, Akinyomi O D (2018) Levofloxacin-induced dyslipidemia in male albino rats. Asian Journal of Pharmacy and Pharmacology 4(5): 620-629.

16. Airaodion A I, Akaninyene I U, Ngwogu K O, Ekenjoku J A,Ngwogu A C (2020) Hypolipidaemic and antidiabetic potency of Allium cepa (onions) bulb in alloxan-induced diabetic rats. Acta Scientific Nutritional Health 4(3): 73-78.

17 Tosi F, Muggeo M, Brun E, Spiazzi G, Perobelli L, et al. (2003) Combination treatment with metformin and glibenclamide versus single-drug therapies in type 2 diabetes mellitus: a randomized, double-blind, comparative study Metabolism 52(7): 862-867 .

18. National Agency for Food & Drug Administration & Control (NAFDAC). (2024). Summary of product characteristics (SmPC): Metoglomide tablets (metformin and glibenclamide tablets). Registration & Regulatory Affairs Directorate. https://www.nafdac.gov.ng/wp-content/uploads/Files/SMPC/DEC_21/METOGLOMIDE-TABLETS-METFORMIN-AND-GLIBENCLAMIDE-TABLETS.pdf

19. Hermann L S, Kjellström T,Nilsson-Ehle P (2021) Effects of metformin and glibenclamide alone and in combination on serum lipids and lipoproteins in patients with non-insulin-dependent diabetes mellitus. Diabete metab 17(1 Pt 2): 174-179.

20. Ugwu C N, Abali I O, Agu F U, Aguh K J, Onyekachi, et al. (2022). Prophylactic potential of Corchorus olitorius leaves against experimentally induced dyslipidaemia. Asian Journal of Cardiology Research 5(1): 290-297.

21. Abdel Moneim A M H, Lutfi M F, Alsharidah A S, Shaker G, Faisal W, et al. (2022) Short-Term Treatment of Metformin and Glipizide on Oxidative Stress, Lipid Profile and Renal Function in a Rat Model with Diabetes Mellitus. Applied Sciences 12(4): 2019.

22. Wexler D J, de Boer I H, Ghosh A, Younes N, Bebu I, et al. (2023) Comparative Effects of Glucose-Lowering Medications on Kidney Outcomes in Type 2 Diabetes: The GRADE Randomized Clinical Trial. JAMA internal medicine 183(7): 705-714.

23. Amador Licona N, Guízar Mendoza J, Vargas E, Sánchez Camargo G ,Zamora Mata L (2000) The short-term effect of a switch from glibenclamide to metformin on blood pressure and microalbuminuria in patients with type 2 diabetes mellitus. Arch Med Res 31(6):571-575.

24. Akwuruoha E M, Airaodion A I (2025) Prevalence of gestational diabetes and pregnancy outcome of antenatal patients in Abia State, Nigeria. Clinical Pediatrics and Mother Health 4(6).