

COMPARISON OF GLYCEMIC CONTROL USING COMBINATION OF EMPAGLIFLOZIN WITH METFORMIN VERSUS SITAGLIPTIN WITH METFORMIN

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) has been a major health issue in Pakistan which needs combination therapy as metformin monotherapy fails. The purpose of the study was to compare the glycemic efficacy of the Empagliflozin and Sitagliptin as an add-on to Metformin in a local clinical context.

Methods: The randomized controlled trial conducted in the Medicine Department of the Combined Military Hospital (CMH) in Abbottabad from 3rd December 2025 to 3rd April 2026.

Using non-probability consecutive sampling technique, 60 patients who had poorly controlled T2DM and were on metformin baseline therapy were randomly assigned in two groups (n=30, each). Group A was treated with Sitagliptin (50 mg twice a day) and Group B had Empagliflozin (10 mg once a day) along with Metformin (1,000mg/day). The main outcome was change in HbA1C at 12 weeks from the baseline values. The SPSS version 25.0 was used to analyze the data.

Results: The mean age of participants was 41.73±13.38 years. After 12 weeks, the mean reduction in HbA1C was significantly greater in the Empagliflozin group (-1.18±0.25) compared to the Sitagliptin group (-0.86±0.17), with a statistically highly significant difference ($p < 0.001$). Stratification analysis confirmed the superior efficacy of Empagliflozin was consistent across age, gender, BMI, and duration of diabetes. Both treatments were well-tolerated with no major adverse events.

Conclusion: The use of Empagliflozin and Metformin as a combination has better glycemic control than the use of Sitagliptin and Metformin in patients with poorly controlled T2DM. These results indicate that Empagliflozin could be a better second-line intervention in the Pakistani diabetic population.

KEYWORDS: Glycemic control, metformin, type II diabetes mellitus, HbA1C, Empagliflozin, Sitagliptin.

INTRODUCTION

Type II diabetes mellitus (T2DM) is a chronic disorder characterized by insulin resistance and elevated blood glucose levels, representing an increasing risk for health around the globe, particularly in Pakistan, where more than 17% of individuals are impacted [1]. Urbanization, genetic predispositions, sedentary behaviours, and inadequate dietary practices contribute to its prevalence, with prevalent risk factors including obesity, familial history, and hypertension [2]. T2DM can result in significant consequences such as cardiovascular disease, renal impairment, and neuropathy if not well treated [3]. Effective treatment encompasses lifestyle modifications, glucose-lowering pharmacotherapy, and occasionally insulin administration [4].

Glycaemic control is essential in diabetes therapy, as hyperglycaemia is a major risk factor for disease progression and vascular complications [5]. Monotherapy with metformin at the time of T2DM diagnosis mitigates concerns regarding hypoglycaemia and potential side effects compared to early combination therapy; however, it is extremely unlikely to consistently achieve HbA1c targets due to the intricate pathophysiology of T2DM [6].

Sodium-glucose cotransporter-2 (SGLT2) inhibitors, including Empagliflozin, are a novel category of antidiabetic agents that diminish renal tubular glucose reabsorption, hence lowering blood glucose levels without inducing insulin secretion. This leads to a reduction in postprandial and fasting glucose levels. Empagliflozin has demonstrated efficacy both as a monotherapy and in combination with other oral antidiabetic agents in many randomized controlled trials [7,8]. Dipeptidyl peptidase 4 (DPP-4), like sitagliptin, degrades the gastrointestinal hormones gastric inhibitory polypeptide (GIP) and glucagon-like peptide 1 (GLP-1), which are released postprandially, thereby promoting insulin secretion and inhibiting glucagon release from pancreatic alpha cells by preventing the degradation of GIP and GLP-

1. While the beneficial glycaemic properties of sitagliptin have been established, its effects on glycaemic and non-glycaemic factors remain contentious, in contrast to empagliflozin [9,10,11].

Both empagliflozin and sitagliptin have their own pros and cons in combination with metformin. With diabetes prevalence high and treatment options limited, effective as well as accessible therapies are essential for better management in a resource constraint country like Pakistan. This research is to evaluate the effectiveness of the empagliflozin and metformin combination vs sitagliptin and metformin in the management of T2DM among our local diabetic population. Both combinations of anti-diabetic medications aim to regulate glucose levels via distinct processes; nonetheless, there is a paucity of local and worldwide studies directly comparing their effectiveness. This study may uncover a more effective combination, so guiding appropriate treatment techniques to mitigate diabetes-related problems and assist healthcare practitioners in resource-constrained environments.

MATERIAL AND METHODS

The study was carried out as a randomized controlled trial at the Medicine Department of Combined Military Hospital (CMH), Abbottabad, between December 03, 2025 and April 03, 2026 after the research synopsis was ethically approved. The study utilized a non-probability consecutive sampling technique to recruit participants. Based on the findings of Salankar H [11], taking test value population mean as 0.65, anticipated population mean as 1.34 and standard deviation as 0.12, the sample size of 60 patients (30 patients in each group) was calculated based on the WHO sample size calculator with a level of significance of 5 percent, and statistical power of 95 percent. 30 participants will be used in each study group.

Inclusion criteria included male and female diabetic patients aged between 18 and 65 years and had at least three months of monotherapy with metformin, and had a baseline HbA1c of 7.5%. Patients who already use other anti-diabetic drugs, those having chronic liver or renal failure and pregnant or lactating females were excluded. In addition, the study excluded patients that were lost to follow-up in the course of the trial. Participants who took part were fully informed and signed an informed consent in either Urdu or English, having been extensively explained on the aims of the study. The detailed clinical history was taken and a comprehensive physical examination and initial laboratory investigations were performed for all the subjects.

Blocked randomization was then used to assign the participants into either Group A or Group B. All subjects were given 1,000 mg of Metformin daily in a standardized dose. Group A received Sitagliptin (50 mg twice a day), whereas Group B received Empagliflozin (10 mg a day). Both groups were treated for a period of 12 weeks and monitored fortnightly. The main outcome measure was the mean difference in the level of HbA1c, which was calculated as the difference between the post-treatment values at 12 weeks and the baseline values. All clinical and biochemical information was noted on a specially designed data collection questionnaire. The SPSS software version 25.0 was used to conduct the statistical analysis. Shapiro-Wilk test was used to determine the normality of values of continuous variables, including age, BMI, baseline HbA1c, duration of diabetes and 12-week post-treatment HbA1c. These variables were outlined as mean standard deviation (SD) or median with interquartile range (IQR). Categorical variables, such as the gender, residential status, marital status and financial status were expressed in terms of frequencies and percentages. The mean change in HbA1c between the two groups was compared using student t-test or the Mann-Whitney U test, based on the data distribution. In order to control possible confounding variables like age, BMI and the duration of disease, stratification analysis was performed. The *t*-test or Mann-Whitney U test were applied to post-stratify the analysis and a *p*-value less than 0.05 was regarded as statistically significant.

RESULTS

Analysis of the gathered data reflected the mean age of the participants as 41.73±13.38 years, baseline mean HbA1c for the Sitagliptin group as 8.97±0.81 and 8.78±0.86 for Empagliflozin group. Table 1 showing the detailed statistical analysis of all the baseline numeric variables among both groups of this study.

Table 1: Mean and standard deviation analysis for various quantitative variables of study

Variable	Sitagliptin (n=30)	Empagliflozin (n=30)	Total (N=60)
Age (Years)	42.47±13.14	41.00±13.81	41.73±13.38
BMI (kg/m ²)	27.08±3.84	28.30±3.74	27.69±3.80
Duration of DM (Months)	70.00±35.88	55.30±33.62	62.65±35.26
Baseline HbA1c (%)	8.97±0.81	8.78±0.86	8.87±0.83

The study population was male dominant as it consisted of 35 (58.3%) males and 25 (41.7%) females, most of the patients belonged to urban areas (51.7%) and having age >40 years (58.3%). Patients were also categorized in different subgroups on the basis of age, BMI and duration diabetes. Detailed frequency distribution of categorical variables in both groups is provided in figure 1, figure 2 and table 2.

Table 2: Frequency and percentages of patients in different categorical variables

Variable	Category	Sitagliptin (n,%)	Empagliflozin (n,%)	Total (n,%)
Gender	Male	17 (56.7%)	18 (60.0%)	35 (58.3%)
	Female	13 (43.3%)	12 (40.0%)	25 (41.7%)
Living Status	Rural	13 (43.3%)	16 (53.3%)	29 (48.3%)
	Urban	17 (56.7%)	14 (46.7%)	31 (51.7%)
Age Subgroups	≤ 40 Years	11 (36.7%)	14 (46.7%)	25 (41.7%)
	> 40 Years	19 (63.3%)	16 (53.3%)	35 (58.3%)
Financial Status	Poor (<100k)	5 (16.7%)	10 (33.3%)	15 (25.0%)
	Middle (100-300k)	12 (40.0%)	6 (20.0%)	18 (30.0%)
	Upper (>300k)	13 (43.3%)	14 (46.7%)	27 (45.0%)
Duration of Diabetes Subgroups	< 24 Months	5 (16.7%)	7 (23.3%)	12 (20.0%)
	24-60 Months	5 (16.7%)	11 (36.7%)	16 (26.7%)
	> 60 Months	20 (66.7%)	12 (40.0%)	32 (53.3%)

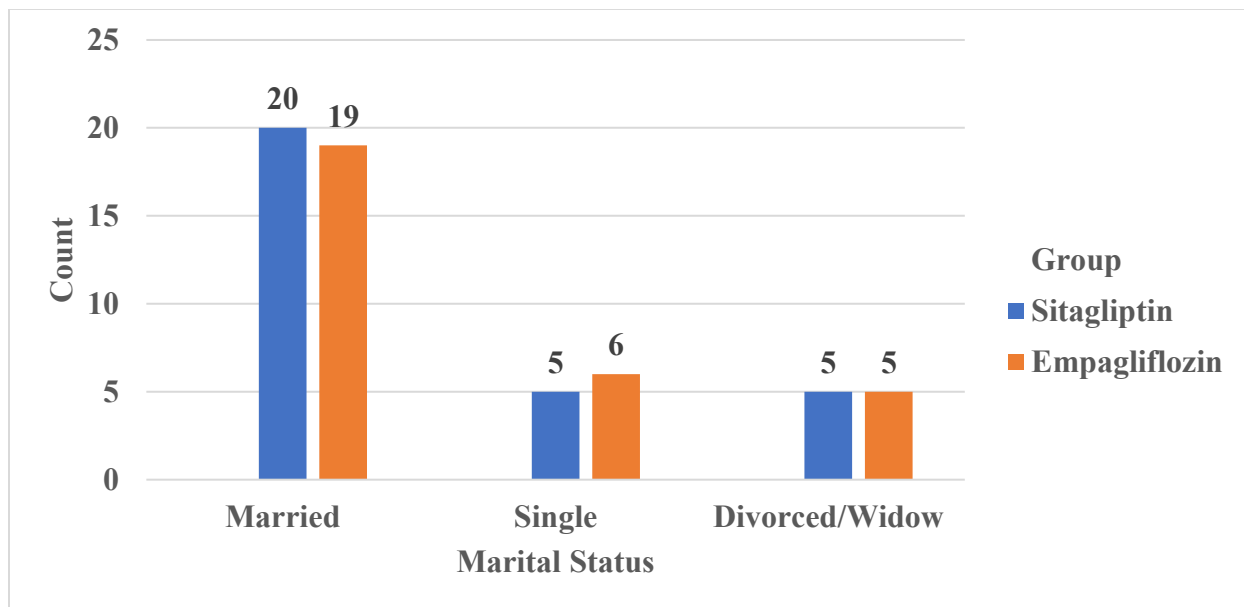


Figure 1: Distribution of patients in different groups on the basis of marital status

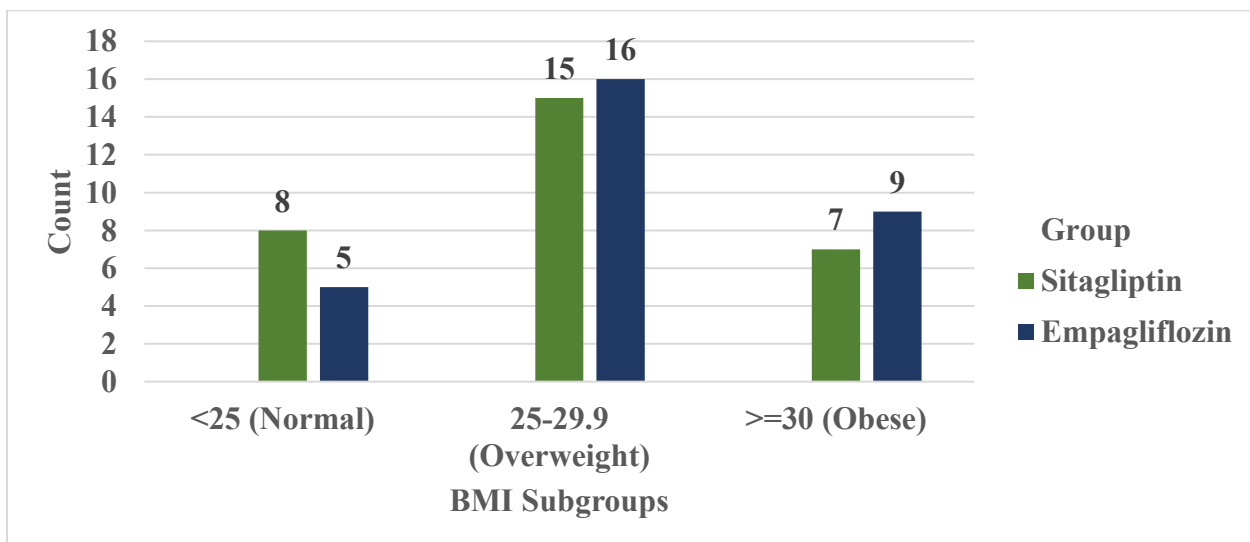


Figure 2: Distribution of patients in different BMI Categories

The mean post-treatment HbA1C in the Sitagliptin group was 8.12 ± 0.79 , whereas the Empagliflozin group achieved a significantly lower mean of 7.59 ± 0.91 . The primary outcome of the study, the Mean Change in HbA1C, was -0.86 ± 0.17 for the Sitagliptin + Metformin group and -1.18 ± 0.25 for the Empagliflozin + Metformin group. An independent samples *t*-test revealed a statistically highly significant ($p < 0.001$), with a 95%CI.

Table 3: Comparison of Glycemic Control between Study Groups (N=60)

Variable	Sitagliptin (n=30)	Empagliflozin (n=30)	Mean Difference	t-value	p-value
HbA1C at 12 Weeks (%)	8.12 ± 0.79	7.59 ± 0.91	0.523	2.384	0.020
Mean Change in HbA1C (%)	-0.86 ± 0.17	-1.18 ± 0.25	0.329	6.025	<0.001

The results consistently favored the Empagliflozin + Metformin combination. Notably, in patients aged upto 40 years, the mean reduction in HbA1c was significantly higher in the Empagliflozin group (-1.26 ± 0.27) compared to Sitagliptin (-0.79 ± 0.16 , $p < 0.001$). Similarly, among patients with long-term diabetes (>60 months), Empagliflozin demonstrated a markedly higher reduction (-1.17 ± 0.17) than Sitagliptin (-0.84 ± 0.17 , $p < 0.001$). The only subgroups where the difference did not reach statistical significance were patients with a BMI ≥ 30 kg/m² ($p = 0.072$), those with a duration of diabetes < 24 months ($p = 0.117$), and the divorced/widow subgroup ($p = 0.487$). In all other categories, the *p*-values remained significantly below 0.05, confirming that the efficacy of Empagliflozin is independent of these demographic and clinical variables.

Table 4: Stratification analysis of Glycemic Control Between Study Groups (N=60)

Confounding Variable		Sitagliptin Mean Δ HbA1c	Empagliflozin Mean Δ HbA1c	p-value
Age	≤ 40 Years	-0.79 ± 0.16	-1.26 ± 0.27	<0.001
	> 40 Years	-0.89 ± 0.17	-1.11 ± 0.19	0.001
Gender	Male	-0.85 ± 0.16	-1.17 ± 0.23	<0.001
	Female	-0.86 ± 0.19	-1.19 ± 0.26	0.001
BMI (kg/m ²)	< 25 (Normal)	-0.85 ± 0.14	-1.14 ± 0.12	0.004
	25-29.9 (Overweight)	-0.83 ± 0.17	-1.18 ± 0.18	<0.001
	≥ 30 (Obese)	-0.90 ± 0.19	-1.21 ± 0.37	0.072
Duration of DM	< 24 Months	-0.93 ± 0.18	-1.25 ± 0.38	0.117
	24-60 Months	-0.83 ± 0.14	-1.14 ± 0.21	0.013
	> 60 Months	-0.84 ± 0.17	-1.17 ± 0.17	<0.001
Living Status	Rural	-0.84 ± 0.13	-1.15 ± 0.28	0.001
	Urban	-0.86 ± 0.19	-1.21 ± 0.18	<0.001
Financial Status	Poor (<100k)	-0.77 ± 0.08	-1.12 ± 0.23	0.007
	Middle (100-300k)	-0.92 ± 0.18	-1.31 ± 0.31	0.004
	Upper (>300k)	-0.82 ± 0.16	-1.17 ± 0.21	<0.001
Marital Status	Married	-0.82 ± 0.15	-1.16 ± 0.22	<0.001
	Single	-0.87 ± 0.12	-1.32 ± 0.26	0.008
	Divorced/Widow	-0.97 ± 0.24	-1.09 ± 0.27	0.487

DISCUSSION

The major findings of this randomized controlled trial indicate that Empagliflozin + Metformin is very effective in glycemic control when compared to the Sitagliptin + Metformin combination in Pakistani patients with poorly controlled T2DM. The average change HbA1c decreased significantly in Empagliflozin (-1.18 ± 0.25) than Sitagliptin (-0.86 ± 0.17 , $p < 0.001$). This difference in efficacy lies in the different pharmacological mechanisms of the two agents. Whereas Sitagliptin, a DPP-4 inhibitor, is dependent on the glucose-dependent stimulation of insulin release through the incretin system, which might be impaired in patients with more advanced beta-cell exhaustion, Empagliflozin acts through an insulin-independent mechanism [12]. Empagliflozin inhibits SGLT2 in the proximal renal tubules to facilitate direct urinary glucose excretion (UGE), which, in effect, gets around the constraints of the compromised endocrine pancreas commonly observed in inadequately controlled diabetic groups [13]. These results are also

supported by our stratification analysis which demonstrates that Empagliflozin is more effective in all age groups and periods of diabetes and is a strong clinical tool when used in different patient groups [14]. These findings are consistent with and also far-reaching the results of various current international and regional studies. Most notably, Salankar H and colleagues, compared the efficacy of empagliflozin versus sitagliptin, as an add on therapy to metformin in T2DM patients and they found that the mean reduction in HbA1c from baseline in sitagliptin group was (-0.65 ± 0.11) and in empagliflozin was $(-1.34 \pm 0.13; p\text{-value} = 0.000)$, which strongly correlates with our observed trend of SGLT2 inhibitor superiority [11]. Also, a local study by Qamar et al. (2022) also found out that SGLT-2 inhibitors were better choice in reducing the HbA1c level compared to DPP-4 inhibitors as an add on therapy to Metformin since statistically significant difference in HbA1c levels after three months of therapy was found in both groups. [15]. Conversely, certain previous studies provided non-inferiority of the two classes although recent data has changed the paradigm to SGLT2 inhibitors because of their multifaceted metabolic advantages. They also indicate that the glucose-lowering efficacy of Empagliflozin is especially successful in South Asian phenotypes, where diabetes at a young age and visceral obesity are more widespread [6, 9, 10]. The similarity of our findings to the international data indicates that the physiological reaction to Empagliflozin can be considered strong despite ethnic and regional differences in the dietary habits [4, 8]. Recently, a study by Mubashir et al. (2022) in Islamabad shared almost the same results, where the reduction in HbA1c with Empagliflozin was -1.13 compared to -0.81 with Sitagliptin [16]. In the same manner, the mean change in HbA1c with Empagliflozin (-1.33) was significantly greater than with Sitagliptin $(-0.70; p < 0.001)$ according to local evidence at Kohat, which supports the geographical consistency of our findings in Pakistan [17]. In addition to glycemic indices, Babar et al. (2021) emphasized that the advantages of Empagliflozin in obese Pakistani patients are related not only to the substantial decrease in weight but also to the systolic decline in blood pressure, which is of paramount importance to our patient population [18]. Interestingly, although both drugs were found equally effective in reducing HbA1c in a smaller observational set of study by Khan et al. (2025), Empagliflozin was found to be more effective in improving renal safety markers, which is consistent with the overall cardioprotective profile of SGLT2 inhibitors observed in the 2025 trial by Mesri Alamdari et al. [19,20]. Egyptian evidence in 2023 of triple therapy regimens shows that the addition of Empagliflozin to an underlying Metformin/Sitagliptin base has a significant rescue effect on HbA1c that Sitagliptin cannot replicate [21].

The clinical implications of the current study are immense in the management of T2DM in resource-limited settings such as in Pakistan. Since obesity and hypertension are common among the local diabetics, the triple action of an agent that reduces glucose, weight and blood pressure provide a triple benefit which could reduce the cost of the diabetic complication in the long term [2]. Our findings favor the use of SGLT2 inhibitors over DPP-4 inhibitors as the second-line treatment of choice in cases of Metformin failure, particularly in patients with an initial HbA1c of over 7.5 percent. Also, the safety profile of recent studies in the country, including the 2025 report by Batool and Abdullah, suggests that even though increased urination is an undesirable effect, the overall tolerability and reduced likelihood of diarrhea and rash makes it a highly viable choice in long-term adherence [22].

Research directions in the future should aim at determining the long-term sustainability of such glycemic improvements beyond the 12 weeks. Although our study demonstrated short-term effectiveness, multi-center longitudinal trials are required to determine the effect of such combinations on hard clinical outcomes, including major adverse cardiovascular events (MACE) and renal progression of local Pakistani cohort. It would also be interesting to examine the long-term safety profile and the possibility of weight loss as a second effect in this group to get a more comprehensive picture of the effect of the drug. In addition, the comparative cost-benefit analysis of these combinations would be invaluable in the national health policy development.

The strengths of this study are that it is randomized controlled, and the stratification analysis is detailed with a large number of confounding variables controlled. Nevertheless, there are some restrictions that should be admitted. The research was carried out in one tertiary care unit (CMH Abbottabad), and this might not give a clear understanding of the results to be applied to the general population of the country. Moreover, the 12-week follow up (although standard in monitoring HbA1c changes) fails to indicate the long-term safety or possible medication non-adherence in a period of several years. Lastly, the sample size, although statistically appropriate to the main goal, might not be adequate to identify any uncommon side effects of either of the drug classes.

CONCLUSION

Our study results conclude that Empagliflozin as an add-on therapy with Metformin is much more effective than Sitagliptin-Metformin combination in lowering the level of HbA1C in Pakistani individuals with poorly controlled Type 2 Diabetes Mellitus. The greater glycemic improvement with Empagliflozin was strong among all stratified subgroups that included differences in age, BMI, and disease time. Since SGLT2 inhibitors are insulin independent and have proven to be effective in this trial, Empagliflozin can be used as a first line agent of choice in order to achieve rapid and sustained glycemic control. These findings can be used to give evidence-based advice to local clinicians on how to best use treatment plans to minimize the burden of diabetic complications in a resource limited healthcare

setting. It is suggested that future long term research should be conducted on the sustainability of such effects and their effect on cardiovascular and renal outcomes in the local population.

REFERENCES

1. Azeem S, Khan U, Liaquat A. The increasing rate of diabetes in Pakistan: A silent killer. *Ann Med Surg (Lond)*. 2022 Jun 3;79:103901. doi: 10.1016/j.amsu.2022.103901.
2. Arshad MS, Alqahtani F, Rasool MF. The Economic Burden of Type 2 Diabetes Mellitus in Pakistan: A Cost of Illness Study. *Healthcare (Basel)*. 2024 Sep 12;12(18):1826. doi: 10.3390/healthcare12181826.
3. Antar SA, Ashour NA, Sharaky M, Khattab M, Ashour NA, Zaid RT, et al. Diabetes mellitus: Classification, mediators, and complications; A gate to identify potential targets for the development of new effective treatments. *Biomed Pharmacother*. 2023;168:115734-7. Available from: <https://doi.org/10.1016/j.biopha.2023.115734>
4. Padhi S, Nayak AK, Behera A. Type II diabetes mellitus: a review on recent drug based therapeutics. *Biomed Pharmacother*. 2020;131:110708-11. <https://doi.org/10.1016/j.biopha.2020.110708>
5. Singh AK, Singh R, Chakraborty PP. Diabetes Monotherapies versus Metformin-Based Combination Therapy for the Treatment of Type 2 Diabetes. *Int J Gen Med*. 2021 Jul 24;14:3833-3848. doi: 10.2147/IJGM.S295459.
6. Kim JY, Kim NH. Initial Combination Therapy in Type 2 Diabetes. *Endocrinol Metab (Seoul)*. 2024 Feb;39(1):23-32. doi: 10.3803/EnM.2023.1816.
7. Saisho Y. SGLT2 Inhibitors: the Star in the Treatment of Type 2 Diabetes? *Diseases*. 2020 May 11;8(2):14. doi: 10.3390/diseases8020014.
8. Fujiwara M, Shimizu M, Maejima Y, Shimomura K. Efficacy of SGLT2 inhibitors as additional treatment in Japanese type 2 diabetic patients: second or third choice? *BMC Res Notes*. 2022 Mar 29;15(1):120. doi: 10.1186/s13104-022-06010-6.
9. Talebi SS, Rezaie S, Hajmiri MS, Zamanirafe M, Ranjbar A, Moridi H, et al. Comparison of the effects of empagliflozin and sitagliptin, as add-on to metformin, on serum levels of asprosin and metabolic parameters in patients with type 2 diabetes mellitus. *Naunyn Schmiedebergs Arch Pharmacol*. 2024 Nov;397(11):9149-9165. doi: 10.1007/s00210-024-03219-z.
10. Suzuki Y, Kaneko H, Okada A, Ohno R, Yokota I, Fujii K, et al. Comparison of SGLT2 inhibitors vs. DPP4 inhibitors for patients with metabolic dysfunction associated fatty liver disease and diabetes mellitus. *J Endocrinol Invest*. 2024 May;47(5):1261-1270. doi: 10.1007/s40618-023-02246-6.
11. Salankar H, Rode S, Arjun C, Joseph R, Deshmane GB, Vijayan RP. Comparative Study on Efficacy of Empagliflozin Versus Sitagliptin, as an Add-on Therapy to Metformin in Type 2 Diabetic Patients. *J Pharm Bioallied Sci*. 2024 Feb;16(Suppl 1):S335-S338. doi: 10.4103/jpbs.jpbs_548_23.
12. Scheen AJ. SGLT2 Inhibitors as Add-On Therapy to Metformin for People with Type 2 Diabetes: A Review of Placebo-Controlled Trials in Asian versus Non-Asian Patients. *Diabetes Metab Syndr Obes*. 2020 Aug 5;13:2765-2779. doi: 10.2147/DMSO.S193528.
13. DeFronzo RA, Norton L, Abdul-Ghani M. Renal, metabolic and cardiovascular considerations of SGLT2 inhibition. *Nat Rev Nephrol*. 2017 Jan;13(1):11-26. doi: 10.1038/nrneph.2016.170.
14. Iqbal J, Hussain A, Aziz H, Hussain M. To compare the efficacy and safety profile of empagliflozin and sitagliptin as an add on therapy to metformin in T2DM patients. *Professional Med J*. 2025;32(08):940-948. Available from: <https://doi.org/10.29309/TPMJ/2025.32.08.8585>
15. Qamar MAMU, Sumreen T, Khan A, Butt KR, Ali E, Rehman A. Comparison of Effect of Sodium-Glucose Co-Transporter-2 (SGLT-2) Inhibitors with Dipeptidyl Peptidase-4 (DPP-4) Inhibitors on HbA1c Level in Type 2 Diabetes in Pakistani Population. *Pak Armed Forces Med J* 2022; 72(1): 25-28. Doi: <https://doi.org/10.51253/pafmj.v72i1.4278>
16. Mubashir M, Ahmed M, Atique H, Wassan A, Naqvi M, Ullah M. Randomized Clinical Trial on Efficacy of Empagliflozin Versus Sitagliptin, In Addition to Metformin in Type 2 Diabetic Patients. *Cureus*. 2022;14(11):e31699. doi: 10.7759/cureus.31699.
17. Din SU, Mumtaz A, Qasim M, Islam UU. Comparing Effect of Sitagliptin versus Empagliflozin as Add on Therapy to Metformin in Patients with Type 2 Diabetes Mellitus. *Ann Punjab Med Coll*. 2024;17(4):431-435. Available from: <https://doi.org/10.29054/apmc/2023.1233>
18. Babar M, Hussain M, Ahmad M, Akhtar L. Comparison of efficacy and safety profile of empagliflozin as a combination therapy in obese type 2 diabetic patients. *J Ayub Med Coll Abbottabad*. 2021;33(2):188-191. Available from: <https://jamc.ayubmed.edu.pk/index.php/jamc/article/view/8396>
19. Khan AU, Sharif MJH, Ashfaq M, Khan Q, Iqbal MM, Iqbal A, et al. Comparative assessment of treatment outcomes of empagliflozin add-on metformin and sitagliptin add-on metformin therapies in uncontrolled type 2 diabetes mellitus: findings from an observational study in Pakistan. *J Health Popul Nutr*. 2025 Aug 21;44(1):304. doi: 10.1186/s41043-025-01041-8.

20. Mesri Alamdari N, Barghaman M, Roshanravan N, Mobasseri M, Tutunchi H, Baharami A, et al. Comparison of the effects of empagliflozin and sitagliptin, as an add-on to metformin, on cardio-metabolic and glycemic parameters of patients with type 2 diabetes mellitus: a randomized, double-blind clinical trial. *BMC Res Notes*. 2025 Jul 31;18(1):339. doi: 10.1186/s13104-025-07214-2.
21. Zakaraia HG, Salem HF, Mostafa MAA, Ali AM, Rabea H. Adding empagliflozin to sitagliptin plus metformin vs. adding sitagliptin to empagliflozin plus metformin as triple therapy in Egyptian patients with type 2 diabetes: a 12-week open trial. *Eur Rev Med Pharmacol Sci*. 2023;27(15):7289-7298. doi: 10.26355/eurrev_202308_33300
22. Batool U, Abdullah. Comparative Study of Efficacy and Adverse Effects of Metformin Plus Empagliflozin Versus Metformin Plus Sitagliptin in Diabetes Mellitus Type II Patients. *Indus Journal of Bioscience Research*. 2025;3(7):195-199. Available from: <https://doi.org/10.70749/ijbr.v3i7.1254>