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Research Article

Prescription of dipeptidyl peptidase-4 inhibitor–containing regimens and their effectiveness in blood glucose control among Vietnamese outpatients with type 2 diabetes mellitus

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder that is increasing in prevalence and is a leading cause of death due to cardiovascular, renal, and neurological complications. Dipeptidyl peptidase-4 inhibitors (DPP-4i) have been increasingly used due to their ability to provide stable glycemic control and their suitability for elderly patients. The aim of this study was to investigate the effectiveness of treatment regimens containing DPP-4 inhibitor in outpatients with T2DM. A retrospective descriptive study conducted over 6 months, compared pre- and post-treatment outcomes on 308 T2DM outpatients who were prescribed DPP-4 inhibitors at Dong Nai General Hospital from January 2024 to May 2025. Results showed that the median age of patients was 67 years, with a higher proportion of females than males (60.4%). Most patients had comorbidities such as lipid disorder (93.2%) and hypertension (73.4%). The DPP-4 inhibitors prescribed were primarily sitagliptin and vildagliptin, administered at doses appropriate to renal function. Metformin, insulin, and sulfonylureas were the most commonly co-administered drugs with DPP-4 inhibitors. Following the DPP-4 inhibitor–based regimen, mean HbA1c decreased by 0.7%, FBG decreased by 0.94 mmol/L, and the proportion of patients achieving HbA1c < 7% increased to 28.2%, which was statistically significant ($p < 0.05$). In conclusion, DPP-4 inhibitors demonstrated a moderate glucose-lowering effect, making them suitable for elderly T2DM patients with comorbidities or a high risk of hypoglycemia. Drug use adhered to clinical guidelines and was appropriate in most cases.

Keywords:
Type 2 diabetes mellitus; Dipeptidyl peptidase-4 inhibitors; HbA1c; Fasting blood glucose; Outpatients.

1. INTRODUCTION

Currently, there are nearly 7 million Vietnamese people with diabetes, of whom 55% have type 2 diabetes–related complications [1]. Diabetes causes many serious complications and is a leading cause of cardiovascular disease, blindness, kidney failure, and limb amputation, thereby placing a substantial burden on the health system and significantly affecting patients' quality of life [2]. According to the American Diabetes Association (ADA) 2025 guidelines, the treatment of type 2 diabetes should be patient-centered, not only focusing on effective glycemic control but also considering the prevention and management of disease-related complications, including cardiovascular disease, kidney disease, hypoglycemia risk, body weight management and other complications [3]. Dipeptidyl peptidase-4 (DPP-4) inhibitors are a group of oral antidiabetic agents widely used in the treatment of type 2 diabetes due to their mechanism of action, which involves

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inhibition of the DPP-4 enzyme. This inhibition increases the concentration of active glucagon-like peptide-1, thereby enhancing glucose-dependent insulin secretion and reducing glucagon secretion [4]. DPP-4 inhibitors offer several advantages, including stable glycemic control, a low risk of hypoglycemia, minimal effects on body weight, and good tolerability [5]. Common DPP-4 inhibitors currently used in Vietnam include sitagliptin, vildagliptin, saxagliptin, and linagliptin. In clinical practice, DPP-4 inhibitors are often used as monotherapy or in combination with other antidiabetic agents such as metformin, sulfonylureas, or insulin to optimize treatment effectiveness [6]. However, data evaluating the effectiveness of this drug class in Vietnam are limited. Therefore, this study aims to evaluate the prescription of dipeptidyl peptidase-4 inhibitor–containing regimens and their effectiveness in blood glucose control among Vietnamese outpatients with type 2 diabetes mellitus, thereby contributing to the optimization of treatment strategies for outpatients with type 2 diabetes.

2. MATERIALS AND METHODS

2.1. Study settings

This retrospective descriptive study collected data from the medical records of outpatients aged 18 years and older who were diagnosed with T2DM and treated with DPP-4 inhibitor–containing regimens at the Department of Endocrinology, Dong Nai General Hospital, from January 2024 to May 2025. Patients were diagnosed with T2DM if fasting blood glucose (FBG) concentrations were ≥ 126 mg/dL (7.0 mmol/L) or glycosylated hemoglobin (HbA1c) values were ≥ 6.5% (48 mmol/mol) [6]. Inclusion criteria were patients with complete biochemical testing (FBG and HbA1c) at the initiation of DPP-4 inhibitor treatment (T0) and at the 6-month follow-up visit (T6m); no changes to the treatment regimen during the 6-month follow-up period. Exclusion criteria included patients with type 1 diabetes, gestational diabetes, or other forms of diabetes apart from T2DM; patients aged < 18 years; those who were pregnant or breastfeeding; patients with hematopoietic disorders affecting HbA1c results; and patients with a T2DM treatment duration of less than 6 months.

2.2. Study size

The sample size of the study is calculated based on the formula:

$$N=\frac{Z^2_{1-\alpha/2}(1-p)p}{d^2}$$

Where N is the minimum sample size of the study; Z is the confidence coefficient (1.96 with type I error (α) = 0.05); Previous studies show percentages of diabetes patients achieving maximum improvement (optimal HbA1c) from 22% to over 40% goals [7], so this study chose p-value of 0.277; d is the absolute error (d = 0.05). Thus, the minimum sample size of the study was calculated as 308 patients.

2.3. Study design

Medical records of outpatients aged 18 years and older who were diagnosed with T2DM and treated with DPP-4 inhibitor–containing regimens at the Department of Endocrinology, Dong Nai General Hospital, from January 2024 to May 2025 were collected in this study.

2.3.1. Evaluation of study population characteristics

Variables describing study population characteristics included age (divided into two groups: ≤ 65 years and > 65 years [6]), sex (male/female), body mass index (BMI), smoking, number of drugs in the prescription, number and classification of comorbidities. BMI (kg/m²) was calculated by dividing body weight by the square of height, as recorded in the patients' medical records. BMI was classified according to World Health Organization (WHO) criteria for Asian populations as underweight (<18.5 kg/m²), normal weight (18.5–22.9 kg/m²), overweight (23.0–24.9 kg/m²), and obese (≥25.0 kg/m²) [8].

2.3.2. Evaluation of the prescription of antidiabetic agents in outpatients with T2DM

The antidiabetic drugs prescribed for patients with T2DM in this study were evaluated in terms of the number of drugs per prescription, the dosage, and the composition of combination regimens containing DPP-4 inhibitors. Moreover, the prescription of DPP-4 inhibitors was evaluated according to the baseline HbA1c and eGFR levels.

2.3.3. Evaluation of the effectiveness of DPP-4 inhibitor-containing regimens

The effectiveness of DPP-4 inhibitor-containing regimens on FBG and HbA1c control in outpatients with T2DM was evaluated after 6 months of treatment, compared to the baseline time. FBG and HbA1c levels were collected at baseline (T0), before initiation of DPP-4 inhibitor therapy, and at 6 months after treatment initiation (T6m). Changes in FBG and HbA1c concentrations after 6 months of treatment (T6m), compared with baseline (T0), were evaluated based on glycemic targets recommended by the Vietnam Ministry of Health (2020) [6] and the American Diabetes Association (ADA) 2025 guidelines [9]. The proportion of patients achieving target glycemic control

was determined. Patients with T2DM were considered to have achieved glycemic targets if the HbA1c value was < 7.0% (53 mmol/mol) or the FBG level was between 80 and 130 mg/dL (4.4–7.2 mmol/L) at the end of the treatment period [6,9].

2.3.4. Evaluation of the safety of DPP-4 inhibitor-containing regimens

The effectiveness of DPP-4 inhibitor-containing regimens on eGFR and body weight control in outpatients with T2DM was evaluated. The estimated glomerular filtration rate (eGFR) and body weight (kilograms) were collected at T0 when patients were not prescribed DPP-4 inhibitor and at 6 months after patients were prescribed DPP-4 inhibitor (T6m). The changes in body weight and eGFR at 6 months after treatment were compared to baseline.

2.4. Sampling

Medical information of T2DM patients was collected through eHOSPITAL software and handwritten medical records including age, sex, body weight, height, laboratory parameters, and clinical status.

2.5. Statistical method

Collected data was entered into Excel 2021 software and statistically processed using SPSS 26 software, using appropriate statistical methods. Continuous variables, if normally distributed, are presented as mean ± standard deviation (± SD); if not normally distributed, they are presented as median (interquartile range – IQR). McNemar's test is used to compare the difference in proportion between two nominal variables. The Wilcoxon test (if non-normal distribution) and a paired sample T-test (if normally distributed) were used to compare means between two dependent groups. Differences were considered statistically significant when $p < 0.05$ [10].

2.6. Ethical considerations

All procedures in this study were approved by the Ethics Committee of Dong Nai General Hospital, Vietnam (10/CN-HDĐĐ April 02, 2025).

3. RESULTS

3.1. Demographic characteristics of outpatients with T2DM

During the period from January 2024 to May 2025, 308 medical records of T2DM patients treated as outpatients at the Endocrinology Clinics of Dong Nai General Hospital using DPP-4 inhibitor drugs met the inclusion criteria and were collected in this study. They had a median age of 67 (61 - 72), the lowest was 31 years old and the highest was 95 years old. In this study, two-thirds of outpatients with type 2 diabetes were female (61.0%). The median BMI of outpatients with type 2 diabetes was 23.9 kg/m^2. The total proportion of overweight and obese patients was 60%. Most patients were non-smokers (98.1%). The median number of drugs per patient's prescription was 6 (4 – 7). There were 303 T2DM outpatients with comorbidities, of which the proportion of patients with 3–4 comorbidities was the highest (42.9%). Lipid disorder (91.2%) was the comorbidity with the highest proportion in the study sample, followed by hypertension (76.9%) and atherosclerosis (49.4%) (see table 1).

3.2. Evaluation of the prescription of antidiabetic agents in outpatients with T2DM

3.2.1. Prescription of hypoglycemic medications for treatment of outpatients with T2DM

Most T2DM outpatients were prescribed DPP-4 inhibitors in combination with other hypoglycemic agents, most commonly metformin (82.1%) and insulin (59.7%). The most commonly prescribed DPP-4 inhibitors for outpatients with type 2 diabetes mellitus were sitagliptin (66.2%) and the least commonly prescribed was linagliptin (8.5%) (see Table 2).

3.2.2. Prescription of DPP-4 inhibitors based on baseline HbA1c and eGFR levels

In this study, the most commonly prescribed DPP-4 inhibitors for outpatients with T2DM were sitagliptin at a dose of 100 mg/day and vildagliptin at a dose of 50 mg twice daily. Sitagliptin and linagliptin were not prescribed for patients with eGFR < 30 ml/min/1.73 m^2, while vildagliptin 50 mg once daily is used. Sitagliptin 25 mg was primarily prescribed to patients with HbA1c < 7% (44.4%). Sitagliptin 100 mg was commonly prescribed for patients with HbA1c ≥ 9% or eGFR ≥ 60. Sitagliptin 50 mg/day is commonly used for the eGFR 30–60 groups. The fixed-dose combination tablet of sitagliptin + metformin was primarily indicated for patients with high HbA1c levels and eGFR ≥ 60. Vildagliptin was also frequently used for patients with HbA1c ≥ 9%. Linagliptin 5 mg was prescribed equally across different baseline HbA1c levels (see table 3).

3.2.3. Combination of hypoglycemic drugs with DPP-4 inhibitor for outpatients with T2DM

The number of medications used to treat type 2 diabetes in patients prescribed DPP-4 inhibitor ranged from 1 to 5. The 3-drug combination was the most common,

Table 1. Demographic characteristics of outpatients with T2DM.

Characteristics (N = 308)		Number	Percentage (%)
Age (years)	67 (61-72)		
	≤ 65	135	43.8
	> 65	173	56.2
Sex	Male	120	39.0
	Female	188	61.0
BMI (kg/m^2)	23.5 (21.8 - 25.2)		
	< 18.5	9	2.9
	18.5 - 22.9	114	37.0
	23 - 24.9	91	29.5
	≥ 25	94	30.5
Smoking	Yes	6	1.9
	No	302	98.1
Number of drugs in the prescription	**6 (4 – 7)**		
	< 5	104	33.8
	≥ 5	204	66.2
Number of comorbidities	0	5	1.6
	1-2	81	26.3
	3-4	132	42.9
	≥ 5	90	29.2
Comorbitities	Lipid disorder	281	91.2
	Hypertension	237	76.9
	Atherosclerosis	152	49.4
	Varicose veins	67	21.8
	Chronic kidney disease (CKD)	58	18.8
	Neurological disease	29	9.4
	Osteoporosis	15	4.9
	Other diseases	129	41.9

accounting for 49.7%. This was followed by 2-drug regimens at 29.2%, 4-drug combination regimens at 17.9%, and 5-drug regimens at 0.6%. Eight cases were prescribed DPP-4 inhibitor monotherapy, one case used vildagliptin, two cases used linagliptin, and five cases used sitagliptin (see figure 1).

The antidiabetic agents prescribed for outpatients with T2DM were DPP-4 inhibitor, metformin, insulin, sulfonylureas (SU), sodium-glucose cotransporter-2 inhibitors (SGLT-2i), and acarbose, used in monotherapy or combination regimens containing DPP-4 inhibitor. The most commonly combined drugs with

Table 2. Prescription of hypoglycemic drugs for treatment of outpatients with T2DM.

Prescription (N = 308)	Number (n)	Percentage (%)
Antidiabetic drugs combined with DPP-4i		
Metformin	253	82.1
Insulin	184	59.7
SU	88	28.6
SGLT-2i	28	9.1
Glinid	13	4.2
Acarbose	5	1.6
DPP-4i		
Sitagliptin	204	66.2
Vildagliptin	78	25.3
Linagliptin	26	8.5

SGLT-2i: Sodium-glucose-agonist-2 inhibitor; DPP-4i: dipeptidyl peptidase-4 inhibitor; SU: sulfonylurea.

Table 3. Prescription of DPP-4 inhibitors based on baseline HbA1c and eGFR.

Dosage of DPP-4i/day	Prescription of DPP-4i based on baseline HbA1c (n,%)				Prescription of DPP-4i based on baseline eGFR (n,%)		
	< 7%	7-8%	8-9%	≥ 9%	< 30 ml/min/1.73 m^2	30 – 60 ml/min/1.73 m^2	≥ 60 ml/min/1.73 m^2
Sitagliptin (n= 165)							
25 mg (n= 18)	8	5	1	4	0	9	9
50 mg (n= 50)	10	17	7	16	0	20	30
100 mg (n= 97)	11	19	26	41	0	9	88
[a]Fixed-dose combination tablet (n= 39)							
½ tablet (n= 1)	0	0	1	0	0	0	1
1 tablet (n= 10)	1	3	3	3	0	3	7
1 tablet x 2 (n= 28)	3	5	8	12	0	1	27
Vildagliptin (n= 78)							
50 mg (n= 34)	7	6	7	14	1	17	17
50 mg x 2 (n= 44)	2	14	9	19	0	7	36
Linagliptin (n= 26)							
5 mg (n= 26)	5	7	5	9	0	11	15

[a] 50mg Sitagliptin + 1000 mg Metformin ; DPP-4i: dipeptidyl peptidase-4 inhibitor.

DPP-4 inhibitor are metformin, insulin, and SU. In the 2-drug regimens, the combination of DPP-4 inhibitor + metformin was the most prescribed combination with a rate of 16.2%. In the 3-drug regimens, the combination of DPP-4 inhibitor + insulin + metformin accounted for the highest rate of 29.5%. The combination of DPP-4i + insulin + metformin + SU accounted for the highest proportion of the 4-drug combinations (8.1%). The acarbose group only appeared in the 4-drug combination form, while the glinide group was only used for 1 patient in the 2-drug combination (see table 4).

3.3. Evaluation of the effectiveness of DPP-4 inhibitor containing regimens

After 6 months of treatment for T2DM using DPP-4 inhibitor-containing regimens, the median HbA1c and FBG levels of 308 outpatients in this study decreased significantly ($p < 0.01$) compared to baseline,

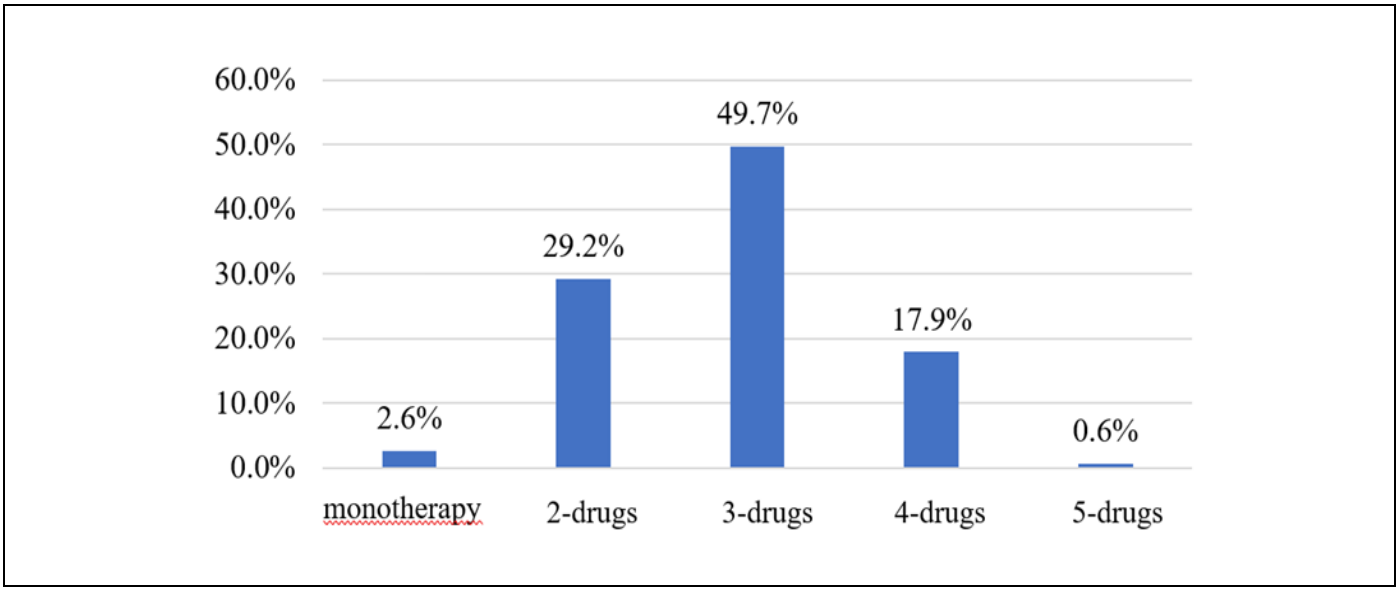

Figure 1. Proportion of combination therapy regimens for T2DM containing DPP-4 inhibitor.

Table 4. Combination of hypoglycemic drugs indicated for outpatients with T2DM.

Treatment regimens	Antidiabetic drugs	n (%)
Monotherapy (n = 8)	DPP-4i	8 (2.6%)
2-drug regimens (n = 89)	DPP-4i + metformin	50 (16.2%)
	DPP-4i + insulin	35 (11.4%)
	DPP-4i + SU	3 (1.0%)
	DPP-4i + glinides	1 (0.3%)
3-drug regimens (n = 153)	DPP-4i + insulin + metformin	91 (29.5%)
	DPP-4i + metformin + SU	48 (15.6%)
	DPP-4i + metformin + glinides	6 (1.9%)
	DPP-4i + insulin + SGLT-2i	6 (1.9%)
	DPP-4i + insulin + SU	2 (0.6%)
	DPP-4i + insulin + metformin + SU	25 (8.1%)
	DPP-4i + insulin + metformin + SGLT-2i	17 (5.5%)
	DPP-4i + insulin + metformin + glinides	6 (1.9%)
	DPP-4i + metformin + SU + acarbose	5 (1.6%)
4-drug regimens (n = 56)	DPP-4i + metformin + SU +SGLT-2i	3 (1.0%)
5-drug regimens (n = 2)	DPP-4i + insulin + metformin + SU + SGLT-2i	2 (0.6%)

DPP-4i: dipeptidyl peptidase-4 inhibitor; SGLT-2i: Sodium-glucose-agonist-2 inhibitor; SU: sulfonylurea.

by -0.66 [(-0.81) – (-2.45) % for HbA1c and -0.45 [(-0.17) – (-1.14)] mmol/L for FBG. The proportion of patients achieving HbA1c and FBG targets increased significantly compared to baseline, by +16.2% and +8.5%, respectively. However, the proportion of patients achieving the FBG target was higher than the proportion achieving the HbA1c target (see table 5).

3.4. Evaluation of safety of treatment regimens containing DPP-4 inhibitors

The median body weight at baseline and at the T6m follow-up visit was 60 kg. However, the estimated glomerular filtration rate (eGFR) decreased slightly after 6 months of treatment, which was statistically significant compared to baseline ($p < 0.05$). The majority of patients maintained stable renal function after 6 months, with more than 80% of patients in the eGFR ≥ 60 group at both time points (see table 6).

4. DISCUSSION

The incidence of T2DM in Southeast Asia was found highest in the 65–69 age group [11]. The T2DM outpatients treated at Dong Nai General Hospital had a mean age of 67 (61–72) and a median BMI of 23.5 (21.8 – 25.2) kg/m^2. According to the ADA recommendations, body weight control plays an important role in the prevention and treatment of type 2 diabetes. Moreover, hypertension and hyperlipidemia increase the risk of atherosclerotic cardiovascular disease and lead to increased mortality in type 2 diabetes patients [9]. In this study, the two most common comorbidities found were hypertension and lipid disorder, similar to the conclusions of previous studies but with different rates [12]. The reasons for the differences between the study results may be due to the duration of diabetes, age, gender, body mass index, etc. [13]. This study found that metformin was the most commonly combined drug with DPP-4 inhibitors. The previous study has demonstrated that early combination of vildagliptin with metformin will result in effective treatment [14]. Combining DPP-4 inhibitors with insulin showed benefits in tight glycemic control when HbA1c was higher, while limiting body weight gain [15]. HbA1c and FBG levels are two important indicators in diagnosing and monitoring the effectiveness of treatment for T2DM [16]. After 6 months of treatment with a regimen containing DPP-4 inhibitor drugs, the HbA1c and FBG levels of outpatients in this study both decreased significantly compared to baseline.

Table 5. Effectiveness of DPP-4 inhibitor-containing regimens on blood glucose control

	T0	T6m	Difference (T6m-T0)	p
Concentrations	Median (IQR)	Median (IQR)	Median (IQR)	
HbA1c (%)	8.09 (6.72 – 9.90)	7.20 (6.13 – 8.82)	-0.66 [(-0.81) – (-2.45)	**0.007***
FBG (mmol/L)	8.40 (7.45 – 9.95)	7.58 (6.90 – 8.78)	-0.45 [(-0.17) – (-1.14)]	**< 0.001***
Patients (N = 308)	**Number (%)**	**Number (%)**		
HbA1c goals	91 (29.54%)	141 (45.77%)	+50 (16.23%)	**< 0.001****
FBG goals	176 (57.14%)	202 (65.58%)	+26 (8.44%)	**0.002****

p*: Wilcoxon test; p**: McNemar test.

Table 6. Safety of DPP-4 inhibitor-containing regimens on outpatients with T2DM

Factors	Baseline time (T0)	6 months after treatment (T6m)	P
Body weight (kg) Median (IQR)	60 (53 – 65)	60 (53 – 65)	0.472
eGFR (ml/min/1.73 m^2) (Mean ± SD)	76.75 ± 20.98	74.55 ± 19.59	**0.040*** **

p*: Wilcoxon test; p***: Paired sample T-test.

This reduction falls within the range observed in previous studies [17-19]. Higher baseline HbA1c levels made it more difficult to achieve the HbA1c treatment target [20]. Therefore, lowering HbA1c will reduce microvascular complications, myocardial infarction, and mortality rates associated with diabetes [21]. Other factors such as disease duration, education level, awareness level, treatment compliance, comorbidities, and the maintenance of non-pharmacological regimens such as physical exercise or healthy eating also greatly affected the glycemic control of patients [22,23]. The proportion of type 2 diabetes patients achieving HbA1c and fasting glucose targets improved significantly, but was lower than in other studies in Vietnam [20,24]. This reflects the need for a close combination of medication with dietary adjustments, lifestyle changes, and long-term exercise to achieve effective treatment. Many studies have concluded that DPP-4 inhibitors cause little change in body weight and renal function, such as linagliptin, which does not require dose adjustment in patients with renal impairment [25,26]. These study results showed that over 50% of patients with type 2 diabetes did not experience body weight change. Sitagliptin may result in mild weight loss when used alone or in combination with other drugs, while sulfonylureas cause weight gain when combined with sitagliptin [27]. Vildagliptin resulted in an average weight loss of 0.72 kg after 24 weeks of monotherapy [28]. Linagliptin generally did not cause significant weight changes [29]. Therefore, in patients with poorly controlled type 2 diabetes, combination therapy with DPP-4i drugs generally does not cause significant weight changes. Although the eGFR values of type 2 diabetes patients in this study decreased after 6 months of treatment with DPP-4 inhibitor regimens, there were no clinically significant changes in renal function.

This was the first study to evaluate the treatment of T2DM using DPP-4 inhibitor drugs in outpatients at Dong Nai General Hospital. Limitations of this study include small sample size and lack of adverse events on T2DM outpatients in medical records. Furthermore, the study did not compare the group of patients who did not and those who did use DPP-4 inhibitors to clarify the effectiveness of this drug group compared to other diabetes medications. Further clinical studies may be conducted with larger sample sizes and longer follow-up periods to evaluate adverse events of regimens containing DPP-4 inhibitor drugs and other factors that may influence the indication for DPP-4 inhibitor drugs such as health insurance and treatment costs.

5. CONCLUSIONS

DPP-4 inhibitors are new generation hypoglycemic drugs that are increasingly prescribed in hospitals in Vietnam due to their safety and protective effects on cardiorenal function in type 2 diabetes patients. The use of DPP-4 inhibitor-containing treatment regimens improved the proportion of outpatients achieving HbA1c and fasting glucose goals after 6 months of treatment.

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethics approval

All procedures in this study were approved by the Ethics Committee of Dong Nai General Hospital, Vietnam (10/CN-HDĐĐ April 02, 2025).

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