

A retrospective cohort study to assess the correlation of weight loss and GLP-1 analogs in patients with type 2 diabetes

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ABSTRACT

Background: Obesity, defined as a BMI of 30 kg/m² or above, has become a key driver of type 2 diabetes mellitus (T2DM), a condition linked to considerable morbidity, mortality, and healthcare resource utilization. While pharmacological management of T2DM continues to evolve, glucagon-like peptide-1 (GLP-1) analogs have gained attention for their dual metabolic benefit of glycaemic control and weight reduction. This study examined the extent to which GLP-1 analog therapy influences weight outcomes among adults with T2DM.

Methods: A retrospective cohort design was used to evaluate obese adults with T2DM treated at Max Super Specialty Hospital, Saket, New Delhi, between July 2017 and February 2018. Patients were stratified into GLP-1 analog cohort and non-GLP-1 cohort, and changes in weight and HbA1c from baseline to 6 months were analyzed using paired t-tests within groups and independent samples t-tests between groups.

Results: Diagnostic and treatment records were available for 376 patients, evenly split into a GLP-1 analog cohort (n=188) and a comparator cohort (n=188), with a mean participant age of 58.4 years. Across the entire study population, HbA1c declined modestly by approximately 0.3 percentage points (7.9 ± 0.8% to 7.6 ± 0.7%). In the GLP-1 analog cohort, HbA1c reduction was substantially greater, averaging about 1.3 percentage points, indicating a stronger glycemic response among exposed patients.

Conclusion: The magnitude of metabolic improvement with GLP-1 analog therapy appeared proportional to baseline disease severity, with patients presenting higher initial BMI, glucose, and HbA1c values showing the greatest gains. As HDL and LDL changes were not statistically significant, this conclusion should be limited to glycaemic profile (HbA1c) and BMI as predictors.

INTRODUCTION

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A body mass index (BMI) of more than 25 kg/m² is considered overweight, and a BMI above 30 kg/m² is classified as obesity [1]. The increasing prevalence of obesity has become a major public health concern because it contributes substantially to chronic noncommunicable diseases, including type 2 diabetes mellitus (T2DM). Obesity prevalence among children and adolescents aged 5–19 years increased more than fourfold between 1990 and 2022, while prevalence among adults aged 18 years and older doubled over the same period [1].

According to the International Diabetes Federation, the global burden of diabetes continues to rise, and the number of people living with diabetes is projected to increase further by 2045 [2]. Most people with diabetes have T2DM, and the growth in its prevalence is driven by urbanization, aging populations, reduced physical activity, obesity, and overweight status. T2DM remains an important health challenge because it is associated with substantial morbidity, mortality, and healthcare expenditure [1–3].

Several pharmacological options and treatment guidelines are available for the management of T2DM. When choosing therapy, the clinician must balance glycemic control, weight management, and the risk of hypoglycemia [4]. Age, lifestyle, and environmental factors also influence glycemic control [4]. In addition, treatment selection should account for the possibility of weight gain with some agents, while others may support weight reduction. Sulfonylureas, thiazolidinediones, and insulin are more commonly associated with weight gain, whereas other glucose-lowering agents may have weight-neutral or weight-reducing effects [5].

Glucagon-like peptide-1 (GLP-1) analogs have emerged as an effective option because they provide the dual benefit of improving glycemic control and supporting weight loss [6–10]. Randomized trials and systematic reviews have shown that GLP-1 receptor agonists can produce clinically meaningful reductions in HbA1c and body weight in adults with T2DM [6–10]. Against this background, the present retrospective cohort study was undertaken to assess the association between GLP-1 analog use and changes in weight, BMI, and HbA1c in patients with T2DM.

METHODS

Design and participants

This was a retrospective cohort study evaluating the effect of GLP-1 analogs on weight and glycemic control in obese patients with type 2 diabetes. A retrospective cohort study on obese patients with T2DM was conducted from July 2017 to February 2018 at Max Super Specialty Hospital, Saket, New Delhi, India.

Cohort Selection / Study groups

- GLP-1 cohort (exposed): Obese adults with type 2 diabetes who were prescribed GLP-1 analog therapy during the study period.
- Non GLP-1 cohort (control): Obese adults with type 2 diabetes managed without GLP-1 analog therapy during the same period.

Patients in both cohorts were followed retrospectively for 6 months, and outcomes including weight change (kg) and HbA1c reduction (%) were recorded.

Participants were included if they met the following criteria:

- Adults diagnosed with type 2 diabetes mellitus (T2DM)
- Obesity defined as BMI $\geq$ 30 kg/m²

Exclusion criteria include patients with the following conditions:

- Type 1 diabetes
- Pregnancy or lactation
- Concomitant use of SGLT-2 inhibitors

Outcomes

The primary outcome was the change in body weight from baseline to 6 months. The secondary outcomes were changes in BMI, HbA1c, and lipid profile parameters, including total cholesterol, HDL, and LDL, over the same follow-up period.

In total, 376 participants had complete diagnostic records. One hundred eighty-eight participants were grouped under the control group, and 188 participants were in the case group. The average age of the patients was 58.4 years. The average duration of T2DM was ten years.

Patient selection procedure

Patients fulfilling the inclusion criteria for either the GLP-1 exposure cohort or the control cohort were identified from existing electronic medical records. Previous data already present in electronic form were screened, and patients who fulfilled our study inclusion criteria were selected. Data from those patients were collected for all visits. Demographic and clinical data were recorded, along with side-effects reported by the patients (if any). Some patients were contacted for additional health-related information.

Data collection method

The data were collected from authenticated sources such as the Hospital Information System (HIS), official patient medical records, and laboratory reports maintained and regularly updated by healthcare professionals. A structured data collection sheet was used to ensure consistency in recording relevant variables such as medical history, body weight, and GLP-1 intake. Two independent researchers performed the data extraction to minimize errors and discrepancies. Any inconsistencies were resolved through discussion or consultation with the senior clinical pharmacist. Cases with incomplete or unclear data were excluded or clarified by referring to additional medical records when available. Weight changes over multiple time points (baseline and six months) assessed to detect any anomalies or inconsistencies that could indicate data entry errors.

Sample size estimation

The sample size was estimated using effect sizes derived from comparable real-world observational studies of GLP-1 receptor agonist use in patients with type 2 diabetes, which showed clinically meaningful reductions in body weight and HbA1c under routine care. Based on the anticipated between-group difference in weight change, with 80% power and a two-sided alpha of 0.05, the required sample size was 188 participants per group [11, 12]. The following formula was used for the calculation:

$$(\sigma_1^2 + \sigma_2^2)(Z_{(\alpha/2)} + Z_{\beta})^2 / \delta^2$$

Where,

$$\sigma_1 = 7.3$$

$$\sigma_2 = 6.5$$

$$Z_{\alpha/2} = 1.96 \text{ Corresponding to 5\% confidence level.}$$

$$Z_{\beta} = 0.84 \text{ Corresponding to 80\% power}$$

δ = Difference to be detected

Statistical analysis

Continuous variables were summarized as mean $\pm$ standard deviation or median (interquartile range), as appropriate. Within-group changes from baseline to 6 months were analyzed using the paired t-test for normally distributed continuous variables. Between-group comparisons of continuous outcomes were analyzed using the independent samples t-test. Normality was assessed using standard shapiro– wilk test, and non- parametric methods were applied if assumptions were not met. A two-sided p-value <0.05 was considered statistically significant.

Ethical consideration

All patient records were anonymized before data extraction, with personal identifiers such as names, hospital IDs, and contact details removed. Data access was limited to authorized researchers involved in the study, following institutional data security protocols. The collected data was stored on password-protected systems, ensuring compliance with institutional and ethical guidelines. The study adhered to the principles of the Declaration of Helsinki and institutional regulations on patient confidentiality. The study was further bolstered by the approval of the Institutional Ethics Committee of Max Healthcare, New Delhi, ensuring its ethical compliance.

RESULTS

The mean BMI and body weight reduction were compared in the case and control groups under the Dulaglutide (Trulicity) and Liraglutide (Victoza) medications. Therefore, the results obtained in these groups were summarized.

Changes in BMI after 6 months for case and control groups:

The mean baseline weight for 188 patients was 101 ± 18.1 kg, and the mean BMI at baseline was 39.5 ± 3.5 kg/m² (case group). Changes in weight or average weight loss after six months were significant, from 101 ± 18.1 kg to 85 ± 17.9 kg. An essential change in BMI was observed from 39.5 ± 5.5 to 36.1 ± 3.7 kg/m² with a P-value of ≈ 0.0001 . For the control group, the mean baseline weight for 188 patients was 100.7 ± 17.9 kg, and the mean BMI at baseline was 38.6 ± 6.3 kg/m². After six months, a small but statistically significant reduction in weight was observed (from 100.7 ± 17.9 kg to 98.8 ± 18.0 kg; $p = 0.0153$), which was clinically modest compared with the GLP-1 cohort. In contrast, the change in BMI (from 38.6 ± 6.3 to 37.8 ± 6.7 kg/m²; $p = 0.796$) remained non-significant. Details are available in Table-1 and 2.

Change in Body Weight

For the case group, the mean weight reduction was approximately 16%, which was greater than that of the control group (1.9%). Although the 1.9% weight loss in controls was statistically significant ($p = 0.0153$), it was clinically negligible compared with the GLP-1 cohort. Overall, the difference in mean weight loss between case and control groups remained highly significant (Table 3).

What has changed after treatment with a GLP-1?

Tables 4 and 5 show the clinical characteristics at baseline and after 6 months of treatment with a GLP-1. By the end of the therapy period (24 weeks), BMI fell by 11.31% ($P < 0.001$) among patients taking Trulicity and 12.55% ($P < 0.001$) among patients taking Victoza. Also, an improvement in body loss was noted: patients taking Trulicity experienced approximately 12.42% weight loss, whereas patients taking Victoza experienced approximately 12.93% weight loss. Further, among the GLP-1 treatment subgroups, patients taking Trulicity and Victoza showed mean HbA1c reductions of 1.31 % and 1.25 %, respectively, consistent with the overall cohort trend (0.3 % reduction when including controls).

A compelling body weight loss was observed in 56.9% of the participants (case group), and

target HbA1c reduction was observed in 53% of the patients (case group). Good treatment response as BMI reduction did not always coincide with target HbA1c reduction: among patients with effective BMI loss, HbA1c decline of <1% was observed in the case group.

Due to GLP-1 analogues, weight, BMI, and HbA1c levels were significantly reduced. However, Differences in average weight loss, average BMI reduction, and average HbA1C reduction between Trulicity and Victoza were small and non-significant.

Biochemical characteristics at baseline and changes after 6 months:

Some important changes in clinical characteristics were also recorded during the study via retrospective data. Across all study participants, HbA1c decreased from 7.9 (7.2–8.9) % to 7.6 (6.9– 8.3) % after 6 months (≈ 0.3 % absolute reduction). Among patients receiving GLP-1 analogs, the mean Hba1c reduction was approximately 1.3% (trulicity 1.31%, victoza 1.25%), clearly indicating a greater glycemic response in the exposed cohort than in the overall population. A significant reduction in total cholesterol level was also observed, from 72 (64.8-82.8) mg/dl at baseline to 68.4(61.2-82.8) mg/dl after six months. Changes in average HDL and LDL were small and non-significant. Details are available in Table 6.

Tables

Groups	No. of Patients	Baseline, mean bodyweight (kg)	Weight after 6 months (kg)	p-value
Case (GLP-1 group)	188	101±18.1	85±17.9	<0.0001
Control (non-GLP-1 group)	188	100.7±18	98.8±18	0.0153

Table 1: Mean body weight changes for case and control group. Values are means (± standard deviation) or numbers (percentages).

Groups	No. of Patients	Initial BMI (kg/m²) (mean)	BMI after 6 months (kg/m²) (mean)	p-value
Case (GLP-1 group)	188	39.5±3.5	36.1±3.7	<0.0001
Control (non-GLP-1 group)	188	38.6±6.3	37.8±6.7	0.7965

Table 2: Mean BMI changes after 6 months for case and control group.

Groups	No. of Patients	Baseline, mean bodyweight (kg)	Weight after 6 months (kg)	Change in body weight (kg)	Percentage change (%)
Case (GLP-1 group)	188	101±18.1	85±17.9	16	15.84
Control (non-GLP-1 group)	188	100.7±18	98.8±18	1.9	1.88

Table 3: Mean body weight changes in percentage for case and control group.

GLP-1 analogous	No. of Patients	Initial BMI (kg/m²) (mean)	BMI after 6 months (kg/m²) (mean)	Change in BMI (kg/m²)	Percentage change (%)	p-value
Trulicity	107	38.17(3.69)	33.85(3.34)	4.32	11.31	<0.0001
Victoza	67	38.54(4.26)	33.70(4.05)	4.84	12.55	<0.0001

Table 4: Body mass index at baseline and changes after 6 months due to different GLP-1 analogues.

GLP-1 analogous	No. of Patients	Initial HbA1C (%)	HbA1C level after 6 months (%)	Change in HbA1C level (%)	p-value
Trulicity	107	8.63(0.70)	7.32(0.43)	1.31	<0.0001
Victoza	67	8.57(0.75)	7.32(0.32)	1.25	<0.0001

Table 5: HbA1C at baseline and changes after 6 months for different GLP-1 analogues.

Characteristics	At baseline	After 6 months	p-value
HbA1C (%)	7.9 (7.2-8.9)	7.6 (6.9-8.3)	<0.0001
Total cholesterol (mg/dl)	72 (64.8-82.8)	68.4 (61.2-82.8)	0.011
HDL (mg/dl)	19.8 (16.2-23.4)	19.8 (16.2-23.4)	0.834
LDL (mg/dl)	37.8 (28.8-45)	37.8 (28.8-45)	0.601

Table 6: Clinical characteristics at baseline and changes after 6 months.

DISCUSSION

Previous studies have consistently examined the role of GLP-1 receptor agonists in improving weight outcomes and glycemic control in patients with T2DM. In this retrospective cohort study, we observed that treatment with GLP-1 analogs were associated with meaningful reductions in body weight, BMI and HbA1c among obese patients with long-standing type 2 diabetes. Across the overall cohort (GLP-1 and control groups combined), HbA1c declined modestly by approximately 0.3 percentage points (from 7.9% to 7.6%) over 6 months, reflecting the average change in routine care. However, among patients receiving GLP-1 analogs, the mean HbA1c reduction was substantially greater, around 1.3 percentage points (trulicity 1.31%, victoza 1.25%), indicating a more pronounced glycemic response in the exposed cohort than in the overall population. This pattern is consistent with randomised trials and observational studies demonstrating that GLP-1 receptor agonists produce clinically relevant reductions in HbA1c and body weight in adults with T2DM [13].

With respect to body weight, the GLP-1 cohort experienced a mean weight reduction of approximately 16%, whereas the control cohort showed a much smaller loss of about 1.9%. The reduction in the control group, although statistically significant (p = 0.0153), was clinically modest compared with the GLP-1 cohort and did not translate into substantial BMI change. By contrast, GLP-1–treated patients exhibited marked decreases in both absolute weight and BMI, in line with previous evidence that GLP-1 therapy contributes to weight management and improved metabolic control [14].

A retrospective cohort analysis of GLP-1 receptor agonist use between 2014 and 2022 also showed that trulicity and victoza were the only agents with more than 5,000 annual users, reflecting the growing uptake of these medications in routine practice, including for weight management [15].

We also assessed the response of individual metabolic parameters and found that treatment effects varied by outcome. For example, the small but statistically significant reduction in body weight seen in the control cohort did not result in a clinically important benefit, whereas the GLP-1–treated subgroup showed a larger HbA1c reduction of around 1.2 percentage points, compared with the ≈0.6 percentage point decline in the overall cohort [16]. In addition, nearly 40% of patients achieved a body weight reduction of at least 5%, a threshold commonly considered clinically meaningful in obesity and diabetes management [17].

Our findings suggest that GLP-1 therapy may be particularly effective in obese patients with poorer baseline glycemic control, a pattern supported by previous studies [18]. Greater weight loss and HbA1c reduction were observed in patients with higher initial body weight and longer duration of diabetes. Earlier research has likewise shown that GLP-1–based therapy is more effective in individuals with a higher baseline BMI, supporting the use of these agents in selected obese patients with T2DM who require both weight reduction and glycemic improvement [19].

Regarding lipid parameters, total cholesterol showed a modest reduction over 6 months, whereas changes in HDL and LDL were small and non-significant. Future studies with more detailed lipid profiling and longer follow up are needed to clarify the impact of GLP-1 therapy on broader cardiovascular risk markers.

Overall, this retrospective cohort analysis adds real world evidence to the growing literature on GLP-1 analogs in the management of obese patients with type 2 diabetes. While the retrospective design and single center setting pose inherent limitations, our results support the clinical utility of GLP-1 analogs in achieving meaningful weight loss and improved glycemic control, especially in patients with high baseline BMI and suboptimal metabolic status.

GLP-1 analog therapy was associated with meaningful improvements in weight, BMI, and glycemic control in this cohort of patients with type 2 diabetes. The magnitude of response was greatest in patients with higher baseline BMI, fasting glucose, and HbA1c, suggesting that treatment benefit may be more pronounced in those with poorer metabolic status at baseline. Although Trulicity and Victoza produced comparable reductions in weight and BMI, the difference between the two agents was not clinically significant. Nausea was the most frequently reported adverse effect, while a small proportion of patients experienced no side effects. Overall, GLP-1 analogs appear to be a valuable therapeutic option for obese patients with type 2 diabetes, but larger prospective studies are needed to confirm the durability of benefit, define patient subgroups most likely to respond, and better characterize tolerability, accessibility, and cost-effectiveness.

Limitations

As a retrospective cohort study, the analysis depends on preexisting medical records, which may vary in documentation quality and completeness. While we attempted to control for confounders, factors such as diet, physical activity, medication adherence, and concurrent treatments were not uniformly recorded and may have influenced weight changes. The study was conducted at a single center, which may limit the generalizability of our findings to broader populations with different demographics or healthcare settings.

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Declaration on the Use of Artificial Intelligence

Generative artificial intelligence tools were used solely for language editing and improvement of grammar, clarity, and readability during the preparation of this manuscript. Artificial intelligence was not used for data collection, data generation, statistical analysis, interpretation of results, or formulation of scientific conclusions. The authors critically reviewed and verified all AI-assisted modifications and took full responsibility for the accuracy, integrity, and content of the final manuscript.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

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Manuscript review and editing: Mohammed Aslam and M. Aamir Mirza.

All authors reviewed and approved the final version of the manuscript before submission to the journal.

REFERENCES

1. WHO. Obesity and overweight. Geneva, <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>. Last accessed on 15 October 2025.
2. Magliano DJ, Boyko EJ; IDF Diabetes Atlas 10th edition scientific committee. IDF DIABETES ATLAS [Internet]. 10th edition. Brussels: International Diabetes Federation; 2021. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK581934/>. Last accessed on 10 October 2025.
3. Gassasse Z, Smith D, Finer S, Gallo V. Association between urbanisation and type 2 diabetes: an ecological study. *BMJ Global Health*, (2017); 2(4): e000473.
4. Hamdy O, Ashrafzadeh S, Mottalib A. Weight management in patients with type 2 diabetes: a multidisciplinary real-world approach. *Current Diabetes Reports*, (2018); 18(9): 66.
5. Apovian CM, Okemah J, O'Neil PM. Body weight considerations in the management of type 2 diabetes. *Advances in Therapy*, (2019); 36(1): 44-58.
6. Tella SH, Rendell MS. Glucagon-like polypeptide agonists in type 2 diabetes mellitus: efficacy and tolerability, a balance. *Therapeutic Advances in Endocrinology and Metabolism*, (2015); 6(3): 109-134.
7. Diamant M, Van Gaal L, Guerci B, Stranks S, Han J, Malloy J, et al. Exenatide once weekly versus insulin glargine for type 2 diabetes (DURATION-3): 3-year results of an open-label randomised trial. *Lancet Diabetes & Endocrinology*, (2014); 2(6): 464-473.
8. Wysham C, Grimm M, Chen S. Once weekly exenatide: efficacy, tolerability and place in therapy. *Diabetes, Obesity and Metabolism*, (2013); 15(10): 871-881.
9. Bergenstal RM, Wysham C, Macconell L, Malloy J, Walsh B, Yan P, et al. Efficacy and safety of exenatide once weekly versus sitagliptin or pioglitazone as an adjunct to metformin for treatment of type 2 diabetes (DURATION-2): a randomised trial. *Lancet*, (2010); 376(9739): 431-439.
10. Buse JB, Rosenstock J, Sesti G, Schmidt WE, Montanya E, Brett JH, et al. Liraglutide once a day versus exenatide twice a day for type 2 diabetes: a 26-week randomised, parallel-group, multinational, open-label trial (LEAD-6). *Lancet*, (2009); 374(9683): 39-47.
11. Hall GC, McMahon AD, Dain MP, Wang E, Home PD. Primary-care observational database study of the efficacy of GLP-1 receptor agonists and insulin in the UK. *Diabetic Medicine*, (2013); 30(6): 681-686.
12. Di Loreto C, Minarelli V, Nasini G, Norgiolini R, Del Sindaco P. Effectiveness in real world of once weekly semaglutide in people with type 2 diabetes: glucagon-like peptide receptor agonist naïve or switchers from other glucagon-like peptide receptor agonists: results from a retrospective observational study in Umbria. *Diabetes Therapy*, (2022); 13(3): 551-567.
13. Castellana M, Cignarelli A, Brescia F, Laviola L, Giorgino F. GLP-1 receptor agonist added to insulin versus basal-plus or basal-bolus insulin therapy in type 2 diabetes: a systematic review and meta-analysis. *Diabetes/Metabolism Research and Reviews*, (2019); 35(1): e3082.
14. Drab SR. Glucagon-like peptide-1 receptor agonists for type 2 diabetes: a clinical update of safety and efficacy. *Current Diabetes Reviews*, (2016); 12(4): 403-413.
15. Watanabe JH, Kwon J, Nan B, Reikes A. Trends in glucagon-like peptide 1 receptor agonist use, 2014 to 2022. *Journal of the American Pharmacists Association*, (2024); 64(1): 133-138.
16. Hansen KB, Svendstrup M, Lund A, Knop FK, Vilsbøll T, Vestergaard H. Once-weekly subcutaneous semaglutide treatment for persons with type 2 diabetes: real-world data from a diabetes out-patient clinic. *Diabetic Medicine*, (2021); 38(10): e14655.
17. Gulati K, Wijndaele K, Webb J, von Arx LB, Seif M, Jennison T, et al. Achievement of HbA1c and weight targets in adults with type 2 diabetes on once weekly injectable glucagon-like peptide-1 receptor agonist therapy in UK primary care: a retrospective, real-world study. *Diabetes Obesity and Metabolism*, (2025); 27(4): 2086-2095.
18. Williams DM, Ruslan AM, Khan R, Vijayasingam D, Iqbal F, Shaikh A, et al. Real-world clinical experience of semaglutide in secondary care diabetes: a retrospective observational study. *Diabetes Therapy*, (2021); 12(3): 801-811.
19. Nolen-Doerr E, Stockman MC, Rizo I. Mechanism of glucagon-like peptide 1 improvements in type 2 diabetes mellitus and obesity. *Current Obesity Reports*, (2019); 8(3): 284-291.



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