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Current Treatment Regimens Used by Diabetologists to Manage Postprandial Hyperglycemia in Type 2 Diabetes (T2D) Patients

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Abstract: ***Background**: Postprandial hyperglycemia (PPHG) plays a key role in the progression of type 2 diabetes (T2D), it increases glycemic burden and cardiovascular risk. While HbA1c and fasting plasma glucose are standard markers, growing evidence indicates how critical is postprandial glucose (PPG) control. **Objective**: To assess real-world treatment patterns, diabetologists preferences and clinical rationale for PPHG management among diabetologists in India, emphasizing Voglibose and combination therapies. **Methods**: A cross-sectional electronic survey was conducted among 327 diabetologists in India. The structured questionnaire captured data on commonly used drug classes, combinations, decision-making factors, comorbidities, adherence strategies and Voglibose usage. Responses were analyzed to identify clinical trends as well as variability. **Results**: Postprandial hyperglycemia (PPHG) in T2D is commonly managed by prioritizing efficacy (35.5%) and minimizing hypoglycemia risk (31.8%). Voglibose (44.9%) is the most preferred agent. Combination therapy is considered because of inadequate monotherapy response (35.5%). Voglibose is valued for its intestinal action (51.7%) and low hypoglycemia risk (34.3%), with occasional GI side effects reported by 46.2% of diabetologists. Many diabetologists also accounted for endothelial dysfunction and atherosclerosis for their treatment approach. Patient education, simplified dosing and addressing side effects were key to improving adherence. **Conclusion**: This study finds critical gaps in the uniformity of PPHG management among diabetologists across India. While alpha-glucosidase inhibitors like Voglibose are commonly used and favored for their efficacy and safety, the findings highlights that there is need for more consistent, evidence-based and patient-tailored strategies in clinical practice.*

Keywords: Postprandial Hyperglycemia (PPHG), Type 2 Diabetes (T2D), Voglibose, Diabetologists

1. Introduction

Postprandial hyperglycemia (PPHG) is defined as an abnormal rise in blood glucose levels following meals, typically exceeding 140 mg/dL one to two hours after food intake.[1] It plays an important role in the progression of type 2 diabetes mellitus (T2D) but is still underrecognized and significantly increases glycemic burden.[2,3] PPHG results from complex dysfunctions, including delayed insulin secretion, reduced peripheral glucose uptake, accelerated gastric emptying, impaired incretin response and increased hepatic glucose output (Fig. 1).[2] These glucose spikes promote oxidative stress, endothelial dysfunction and chronic inflammation, accelerating both microvascular and macrovascular diabetic complications.[4] Importantly, PPHG is linked to increased all-cause mortality in T2D, with a 2-hour blood glucose threshold of 13.8 mmol/L (250 mg/dL) indicating elevated mortality risk.[5]

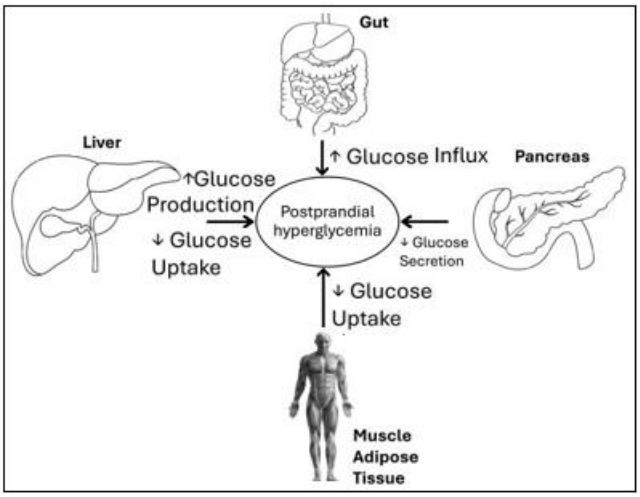

Figure 1: Pathophysiology of PPHG

Globally, over 537 million adults are living with T2D.[6] Epidemiological factors such as obesity, central adiposity, high glycemic diets, sedentary lifestyle and circadian rhythm disruption worsen PPHG control, particularly in urban Indian populations.[7] In Western T2D patients, fasting plasma glucose (FPG) contributes more as HbA1c rises; in contrast, in Asian T2D patients, postprandial blood glucose (PPBG) is the dominant contributor, especially when HbA1c is below 7.5%.[8]

PPG control is important in diabetes management when PPG is on target, 94% of patients achieve HbA1c goals, but when not, only 30% do.[9] This highlights important role of PPG

control in achieving overall glycemic targets, especially in carbohydrate-sensitive Indian populations.

While pharmacologic options like Voglibose, DPP-4 inhibitors and fixed-dose combinations exist, their optimal use is hindered by clinical inertia, side-effect profiles and no standardized guidelines for PPG management[10]. This survey was conducted to capture real-world insights into how diabetologists in India manage PPHG, with an emphasis on treatment rationale, diabetologists preferences as well as therapeutic approach. The objective is to identify current practices gaps in treatment as well as opportunities for refining patient-centric strategies to improve postprandial glucose control and overall diabetes outcomes.

2. Methods

This was a cross-sectional, structured electronic survey conducted in May 2025 to evaluate real-world clinical practices of Diabetologists in India in managing PPHG in patients with type 2 diabetes (T2D). A total of 327 practicing diabetologists from different clinical settings across India participated, selected based on relevant specialization and clinical experience.

This study involved a voluntary, anonymous survey among registered medical professionals without collection of patient-level or personally identifiable data. As per the Indian Council of Medical Research (ICMR) National Ethical Guidelines (2017), research involving anonymous or non-identified data is considered 'less than minimal risk' and is eligible for exemption from ethical review by an Institutional Ethics Committee. All institutional ethical standards were followed.[11]

A validated questionnaire was developed with help of expert guidance and literature review. The questions focused on prescribing patterns, use of combination therapy, various comorbidity considerations, Voglibose use and different strategies in order to increase patient adherence.

The survey was distributed using an online platform which is secure and responses were collected anonymously to make sure reporting was unbiased.

Data were compiled and analyzed using Microsoft Excel 2019 (Version 2306, Build 16.0.16529.20168). Descriptive statistical methods were applied and results were expressed in terms of frequencies and percentages to identify current practice patterns and therapeutic trends. This analytical approach enabled a comprehensive understanding of real-world diabetologists preferences and treatment approaches in clinical practice. All relevant data generated or analyzed during this study are included in the manuscript and its supplementary files.

3. Results

PPHG in T2D is managed through multifaceted strategies that integrate pharmacologic therapy, lifestyle interventions and patient monitoring. When asked about the most important factor in selecting medication for PPHG, the majority of diabetologists identified efficacy in lowering postprandial glucose (35.5%) as the top priority (Fig. 2).

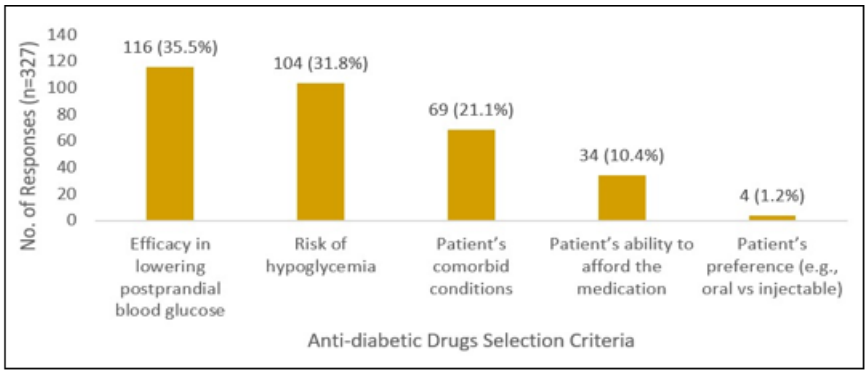

Figure 2: Key Factors in Selecting Medications for PPHG

This response highlights the clinical urgency to address glucose spikes after meals, which contributes to vascular damage, oxidative stress and long-term complications in T2D. Prioritizing efficacy highlights a disease-modifying approach, where rapid postprandial control plays important role in glycemic management.[12]

Regarding drug class preferences, alpha-glucosidase inhibitors (AGIs) emerged as the most frequently used agents (44.9%) (Fig. 3).

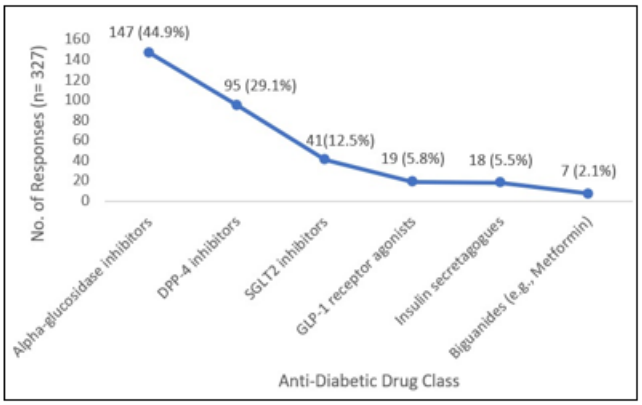

Figure 3: Medications for PPHG in T2D

This choice highlights their localized action in the gastrointestinal tract, ability to blunt postprandial spikes and compatibility with high-carbohydrate Indian diets. AGIs, particularly Voglibose, are well-suited for populations with early insulin resistance and delayed insulin response, offering a practical, safe and also effective treatment choice. Their minimal systemic absorption and low hypoglycemia risk make them ideal for early-stage intervention and long-term disease modulation.[12]

In terms of therapy intensification, inadequate control with monotherapy was the most common reason for adopting combination treatment strategies (35.5%) (Fig. 4).

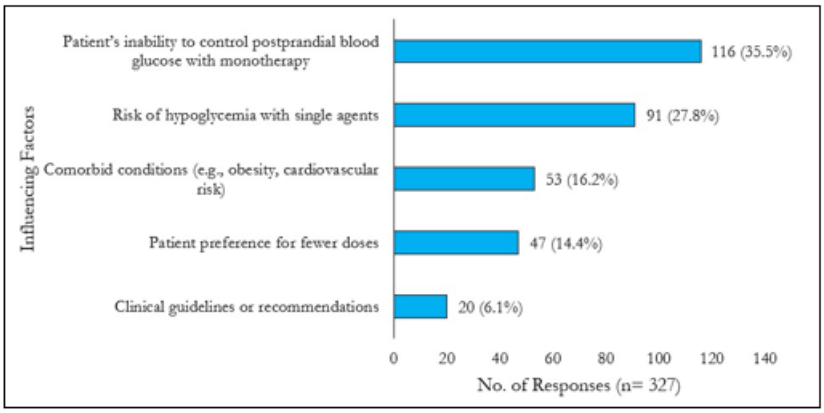

Figure 4: Key Factors for Using Combination Therapy in PPHG

This response indicates the need for therapeutic escalation in many patients with suboptimal responses to single agents. The reason lies in combining agents with complementary mechanisms, enabling improved glucose coverage and minimal side effects. It also shows the critical role of proactive treatment intensification to avoid therapeutic inertia and long-term complications.[13]

Among various drug combinations for managing PPHG, the most preferred was Voglibose with Metformin (42.5%) (Fig. 5).

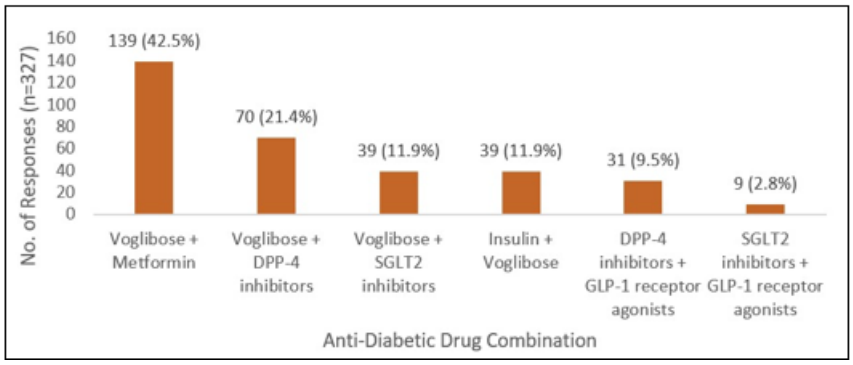

Figure 5: Combinations Prefer for Managing PPHG in T2D

This combination is logical as Metformin targets hepatic glucose production and improves insulin sensitivity, while Voglibose delays carbohydrate absorption, thereby effectively covering both fasting and postprandial components of glycemia. Such combinations reflect a pathophysiology-based approach that helps to target both disease mechanisms and patient tolerability in making personalized regimens.[14]

Comorbid conditions play an important role in order to guide therapeutic decisions. Cardiovascular disease was the leading factor influencing therapy choice (38.5%), indicating that diabetologists prioritize agents with proven cardiovascular benefits such as GLP-1 receptor agonists and SGLT2 inhibitors (Fig. 6).[14]

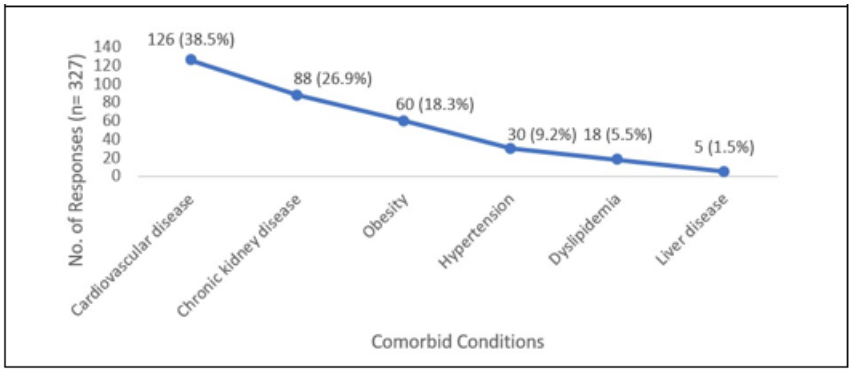

Figure 6: Comorbid Conditions Influencing Therapy for PPHG in T2D

This insight indicates the growing as well as evolving standard of care that consider not only glycemic control but also include macrovascular protection, especially considering the high cardiovascular burden in T2D patients.[15]

Endothelial dysfunction and atherosclerosis were explicitly considered by more than half of the diabetologists during therapy selection (51.4%). This supports the growing recognition of postprandial glucose spikes as independent predictors of endothelial damage and cardiovascular events. The result shows importance of early vascular risk identification.[16]

Weight management was rated as extremely important in managing PPHG in obese patients by the largest proportion of diabetologists (53.8%) (Fig. 7).

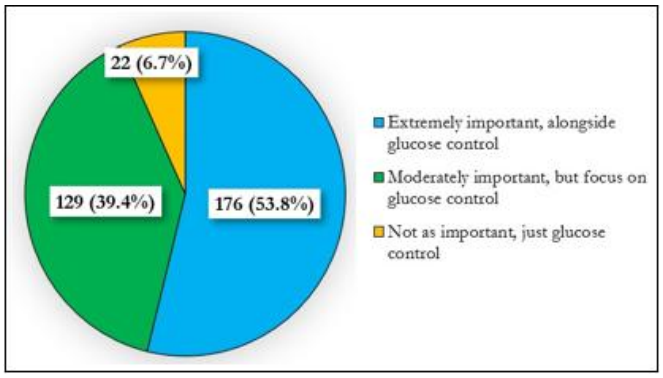

Figure 7: Role of Weight Reduction in Managing PPHG with Obesity

In individuals with type 2 diabetes and obesity, achieving and sustaining ≥5–10% weight loss helps in improving glycaemic control and also reduces cardiometabolic risk factors as weight loss results in improved insulin sensitivity and hepatic glucose production is also reduced. This result reaffirms the importance of integrating weight loss strategies into diabetes care plans, especially in Indian populations with high rates of abdominal obesity and insulin resistance.[17]
Voglibose reduces PPHG by reversibly inhibiting intestinal α-glucosidase enzymes that delays the digestion as well as absorption of carbohydrates in the small intestine. In the survey, 51.7% of diabetologists identified this as the main mechanism (51.7%) (Fig. 8).

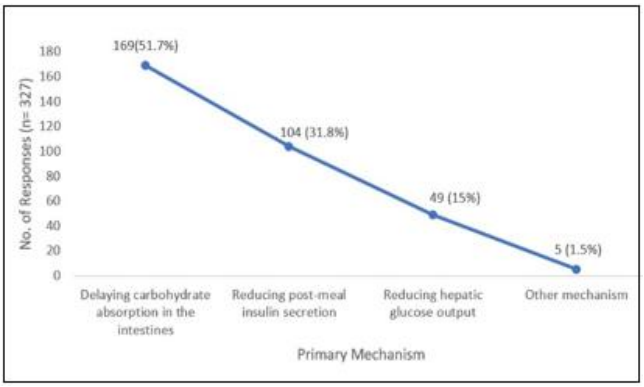

Figure 8: Primary Mechanism of Voglibose in PPHG Control

This indicates a strong understanding of the drug's localized, reversible mechanism, which limits absorption of glucose and helps in reducing post-meal glycemic excursions. The pharmacodynamic profile of Voglibose makes it suitable for early-stage diabetes and management of prediabetes, mostly when the primary concern is postprandial dysregulation.[18,19]

According to diabetologists most significant advantage of Voglibose, was its efficacy in controlling post-meal glucose (47.4%). This preference highlights its importance in managing a critical and often undertreated component of dysglycemia. The benefit of reducing glycemic variability extends to vascular protection and beta-cell preservation, making Voglibose a frontline agent for PPHG-targeted interventions.[18–20]

In terms of combination strategies, Voglibose with SGLT2 inhibitors was the most frequently used (46.2%) (Fig. 9).

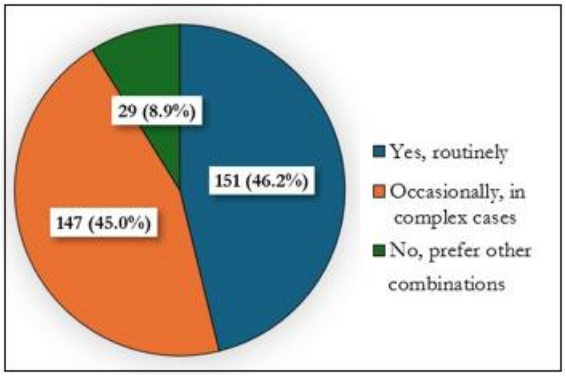

Figure 9: Combining Voglibose with SGLT2 Inhibitors for PPHG

This combination has dual action in delaying carbohydrate absorption and enhanced urinary glucose excretion providing robust postprandial control without increasing hypoglycemia risk. It reflects an approach having forward-thinking in which multiple mechanisms are used in order to achieve tighter and safer glucose regulation.[21]

Gastrointestinal side effects, a known concern with AGIs, were reported to occur occasionally by the majority of diabetologists (46.2%) (Fig. 10).

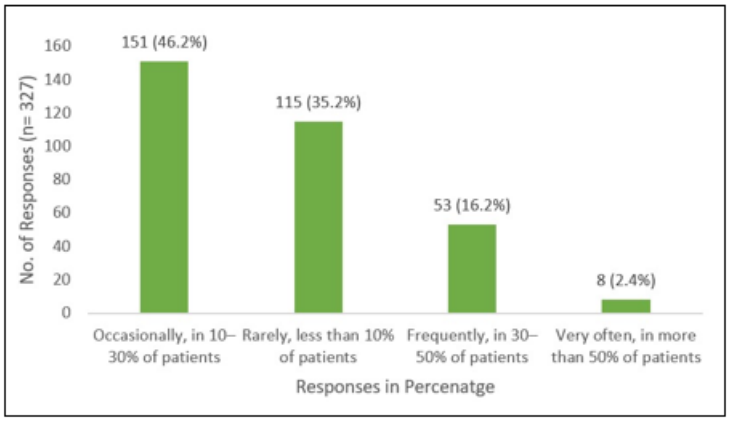

Figure 10: Gastrointestinal Side Effects using Voglibose for PPHG

This indicates that while tolerability issues exist, but generally they are manageable and do not overshadow the clinical benefits of the drug. Tolerability can be improved by patient education and minimizing side effects through dose titration.[19]

To improve adherence to Voglibose therapy, simplifying dosing schedules was found to be most favored strategy (42.8%) (Fig. 11).

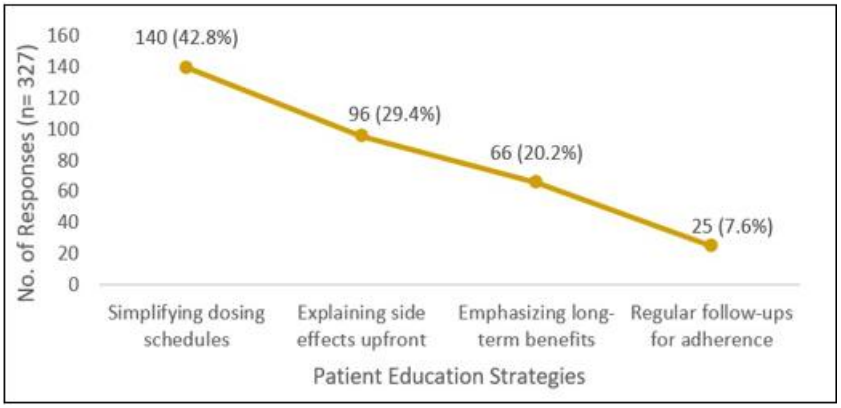

Figure 11: Patient Education Strategies to Improve Adherence to Voglibose Therapy

The complexity of regimen can be minimized by this practical treatment approach and improves patient compliance, which is essential for the long-term success of any therapeutic plan. Simplifying treatment helps with real-world challenges faced by patients and adds value to the doctor-patient communication in chronic disease management.[19]

4. Discussion

PPHG is an underrecognized but important factor of type 2 diabetes (T2D) management[1]. Although fasting plasma glucose and HbA1c remain standard metrics, but sometimes fail to capture glycemic variability and acute spikes after meals key drivers of oxidative stress, inflammation and vascular complications. In India, where carbohydrate-rich diets, late meals and sedentary lifestyles are prevalent, managing PPHG becomes especially important.[22] This nationwide survey among 327 diabetologists offers insight into real-world PPHG management practices and identifies critical gaps in treatment approaches and decision-making.

Efficacy in lowering post-meal glucose emerged as the foremost factor influencing medication selection, followed closely by considering safety like minimizing hypoglycemia. Alpha-glucosidase inhibitors (AGIs), particularly Voglibose, were most preferred for PPHG control, reflecting their suitability in Indian dietary contexts.[10,12] Diabetologists also indicated a preference for combination therapy when monotherapy fails, often opting for combinations such as Voglibose + Metformin or Voglibose + SGLT2 inhibitors due to their complementary mechanisms.[14,21]

Comorbid conditions especially cardiovascular disease plays a major role in order to guide treatment approaches, highlighting a shift toward risk-aligned prescribing.[15,20] Most diabetologists also consider endothelial dysfunction, atherosclerosis and obesity when tailoring interventions.[16] Importantly, adherence strategies like simplifying the dosing schedules as well as proactive patient education were emphasized, reinforcing the growing significance patient-centric care in chronic disease management.

A major strength of this study lies in its nationwide scope and large sample size, which make the findings more applicable across a wide range of clinical settings in India. The structured questionnaire addressed key clinical dimensions of PPHG management, from pharmacological preferences to adherence strategies that offers a comprehensive overview. The data provide a snapshot of how real-world practices align or diverge from guidelines.

Several limitations of this study are that it is based on self-reported responses, which may be influenced by recall bias or social desirability bias. It does not include direct patient outcomes or chart audits to validate responses. Moreover, it lacks regional subgroup analysis or evaluation of institutional vs. private sector practices, which might affect prescribing trends. The cross-sectional design also limits causal interpretation.

In the context of existing evidence, this survey reinforces the pivotal role of individualized, pathophysiology-based therapy in PPHG control.[8] Prior studies have demonstrated that PPHG contributes significantly to total glycemic burden and vascular risk, particularly in early diabetes stages.[4,5] The survey results support this understanding and indicate that diabetologists in India increasingly favor early and rational use of AGIs and combination therapies. However, the different responses also reflect therapeutic inertia, lack of standardized PPHG guidelines and disparities in clinical education or access to newer drugs.

Notably, the findings align with recommendations from international consensus groups that endorse targeting PPHG in management of T2D, mostly when HbA1c targets are not met. The more focus on factors such as cardiovascular comorbidities and endothelial dysfunction also mirrors global shifts in diabetes care toward holistic, risk-reducing treatment approaches. Combination of Voglibose with SGLT2 inhibitors could help in improving the outcomes in clinical practice but more investigations are needed through real-world data studies or pragmatic clinical trials.[21]

One key controversy is the continued underutilization of new agents such as GLP-1 receptor agonists[23] and fixed-dose combinations that have both glycemic and weight benefits. It may suggest that decisions are being shaped more by cost concerns or limited awareness than by solid evidence. Another concern is the inconsistent application of structured education and CGM technology, which remain underutilized even with their proven utility that helps in monitoring and titrating therapy for PPHG. Early initiation and consistent access to CGM (Continuous Glucose Monitoring) and AID (Automated Insulin Delivery) systems in youth with type 1 diabetes improve A1c, enhance parental satisfaction, and support better outcomes, highlighting that proper training is needed and also uninterrupted device use.[24]

The survey also exposes a disconnect between clinical recognition of PPHG's importance and the lack of uniform protocols to assess and manage it. While many diabetologists understand the physiological rationale but lack of practical tools such as meal-time glucose tracking, CGM integration or risk scoring frameworks limits implementation.

The findings from this survey underscore the need for a multipronged strategy to improve PPHG management in India. First, clinical guidelines should formally incorporate PPHG targets alongside HbA1c, particularly for high-risk or early-stage patients. Second, national diabetes programs should promote physician training in using CGM and interpreting postprandial trends. Third, future research should assess real-world outcomes of commonly used combinations especially Voglibose + SGLT2 inhibitors for validation of efficacy and tolerability among the diverse populations.

Furthermore, large-scale longitudinal studies are needed to explore the long-term impact of PPHG control on cardiovascular events and microvascular outcomes. Interventional trials incorporating structured education, dietary counseling and digital adherence tools may help to provide insights for treatment approaches. This opens the door to explore circadian-based drug timing strategies and also emphasizes the role of gut microbiota modulation in improving PPHG control.

5. Conclusion

This study gives critical insights that how diabetologists in India approach the management of PPHG in type 2 diabetes. The findings highlight a strong preference for individualized, pathophysiology-driven therapy that balances glycemic control, safety and comorbidity management. While agents like Voglibose and combination regimens are widely used, but gaps are still remaining in areas like guideline adherence, patient-centered care and also proactive education. These results highlights that there is an urgent need for evidence-based, India-specific protocols that integrate pharmacological, dietary and behavioral strategies. By bridging the gaps in the evidence and practice through structured education, simplified regimens and integration of newer tools such as CGM could significantly enhance long-term metabolic results. Future research needs to focus on outcome-based validation of practices done currently and broader implementation of comprehensive, individualized PPHG management strategies.

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