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Clinical implications of overbasalization in patients with diabetes mellitus under basal insulin therapy: a retrospective cohort study

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Abstract

Objective: To evaluate the prevalence of overbasalization and its association with hypoglycemia and inadequate glycemic control among patients with diabetes mellitus, as well as to assess its repercussions on public health resources. **Methods**: A retrospective cohort study was carried out at the endocrinology clinic of Hospital Universitário Lauro Wanderley (UFPB), João Pessoa, Brazil. Medical records of adult patients with a diagnosis of diabetes mellitus for ≥12 months, and at least two outpatient visits between December 2022 and June 2023, were included. Data extracted comprised demographic characteristics, diabetes classification, insulin regimen, and hypoglycemic events. Overbasalization was defined as administration of supraphysiological basal insulin doses without achievement of glycemic targets. Statistical analysis assessed the relative risk of hypoglycemia and glycemic control (HbA1c levels) among patients with and without overbasalization. **Results**: A total of 305 records were screened, of which 112 met the inclusion criteria. Overbasalization was identified in 32 patients (28.6% of the sample). Patients subjected to overbasalization exhibited a 2.38-fold increased relative risk of hypoglycemia (95% CI: 1.13–5.04; p = 0.006) compared to those without overbasalization. Additionally, mean HbA1c was significantly higher in the overbasalization group (10.07% versus 8.47%; p < 0.001), indicating poorer glycemic control. **Conclusions**: Overbasalization was found to be highly associated with increased episodes of hypoglycemia and inadequate glycemic control among diabetic patients. This phenomenon not only leads to adverse clinical outcomes—including higher hospitalization rates and diminished quality of life—but also imposes considerable financial strain on the Brazilian Unified Health System (SUS). Implementation of targeted educational strategies and individualized management could mitigate these effects, fostering safer and more effective diabetes care.

Keywords: insulin, basal insulin, diabetes mellitus, overbasalization.

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Resumo

Objetivos: Avaliar a prevalência da hiperbasalização e sua associação com hipoglicemia e controle glicêmico inadequado em pacientes com diabetes mellitus, bem como mensurar suas repercussões sobre os recursos da saúde pública. **Métodos**: Foi realizado um estudo de coorte retrospectivo na clínica de endocrinologia do Hospital Universitário Lauro Wanderley (UFPB), João Pessoa, Brasil. Foram incluídos prontuários de pacientes adultos com diagnóstico de diabetes mellitus há ≥12 meses e pelo menos duas consultas ambulatoriais entre dezembro de 2022 e junho de 2023. As informações extraídas abrangeram características demográficas, classificação do diabetes, esquema insulínico e episódios de hipoglicemia. Considerou-se hiperbasalização a administração de doses suprafisiológicas de insulina basal sem atingir as metas glicêmicas. A análise estatística avaliou o risco relativo de hipoglicemia e o controle glicêmico (níveis de HbA1c) entre pacientes com e sem hiperbasalização. **Resultados**: Foram analisados 305 prontuários, dos quais 112 atenderam aos critérios de inclusão. Identificou-se hiperbasalização em 32 pacientes (28,6% da amostra). Pacientes com hiperbasalização apresentaram risco relativo de hipoglicemia 2,38 vezes maior (IC 95%: 1,13–5,04; p = 0,006) em comparação àqueles sem hiperbasalização. Além disso, a média de HbA1c foi significativamente mais elevada no grupo com hiperbasalização (10,07% versus 8,47%; p < 0,001), indicando pior controle glicêmico. **Conclusões**: A hiperbasalização mostrou associação significativa com aumento dos episódios de hipoglicemia e com controle glicêmico insatisfatório em pacientes diabéticos. Esse fenômeno acarreta não apenas repercussões clínicas negativas—

incluindo maiores taxas de hospitalização e redução da qualidade de vida—mas também sobrecarga financeira expressiva ao Sistema Único de Saúde (SUS). A implementação de estratégias educativas direcionadas e o manejo individualizado poderão mitigar esses efeitos, promovendo cuidados em diabetes mais seguros e eficazes.

Palavras-chave: insulina, insulina basal, diabetes mellitus, hiperbasalização.

Introduction

Diabetes mellitus (DM) is a chronic disease that affects approximately 3% of the global population, and this number is expected to increase by 2030, partly due to population aging. This condition ranks ninth among diseases that most contribute to the loss of healthy life years. In Brazil, DM is considered a serious public health issue, with a self-reported prevalence of 6.2%, according to data from the 2013 National Health Survey (PNS 2013).[1,2]

Diabetes mellitus can be classified into two main types: type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). T2DM is the most common form and is often associated with obesity and aging. It has a gradual onset and is characterized by insulin resistance, partial deficiency in insulin secretion by pancreatic β-cells, and altered incretin secretion. Additionally, T2DM often presents with clinical features associated with insulin resistance, such as acanthosis nigricans and hypertriglyceridemia. T1DM, on the other hand, is caused by β-cell destruction, generally through an autoimmune process, leading to a severe deficiency in insulin secretion.[3]

Treatment of patients with DM requires a comprehensive approach including education, evaluation of microvascular and macrovascular complications, cardiovascular risk factor control, use of oral medications, and importantly, implementation of an appropriate diet. In the case of T2DM, most patients will require additional therapy over time to achieve glycemic goals. Insulin is the most effective method for lowering blood glucose levels, helping the body maintain glycemia within normal parameters, and is the main treatment for all T1DM patients. [3,4]

For patients with type 2 diabetes mellitus (T2DM), the decision to initiate insulin therapy is a patient-centered approach driven by current evidence-based recommendations rather than arbitrary HbA1c thresholds. Insulin is indicated for individuals presenting with clear symptoms of insulinopenia (e.g., polyuria, polydipsia, unexplained weight loss), irrespective of their baseline HbA1c levels or cardiovascular risk profile. Furthermore, it is strongly considered when glycemic control is markedly poor, defined by an HbA1c exceeding 10% (>86 mmol/mol) or blood glucose levels consistently ≥300 mg/dL (≥16.7 mmol/L); in such cases, while glucagon-like peptide-1 receptor agonists (GLP-1 RAs) and/or dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 RAs might be considered first if not already in use due to their comprehensive benefits, insulin remains a primary option for achieving rapid glycemic correction. Insulin therapy is also initiated when individualized glycemic goals (e.g., HbA1c > 7%) persist despite optimized triple or quadruple oral antidiabetic drug (OAD) therapy or advanced non-insulin injectable regimens. When insulin intensification is warranted, basal insulin typically serves as the initial choice, effectively suppressing hepatic glucose production and addressing fasting hyperglycemia. While early insulin initiation in newly diagnosed or symptomatic T2DM can promote favorable effects on pancreatic β-cell function, its role in advanced disease is predominantly to achieve and maintain glycemic targets unresponsive to other pharmacotherapeutic approaches.[4,5]

The recommendation for insulin use is due to the natural history of T2DM, which is characterized by progressive decline in β-cell mass and function, as well as insulin resistance. Early in the disease course, adding basal insulin addresses the decline in β-cell function and is an efficient step in controlling fasting plasma glucose (FPG), though it has little effect on postprandial glucose control. Basal insulin is not designed to treat postprandial hyperglycemia. Its main role is to suppress hepatic glucose production, counteract insulin resistance, and correct fasting hyperglycemia.[6,7]

In the attempt to reduce a patient's HbA1c, many healthcare providers may indiscriminately increase basal insulin doses. When this occurs without proper monitoring, it may lead to a condition known as overbasalization. Overbasalization is characterized by titration of basal insulin to levels above appropriate doses, usually defined as doses exceeding 0.5 U/kg/day, in association with HbA1c levels above 8%. Therefore, continuing to increase the dose without a significant reduction in FPG should be avoided. In clinical practice, basal insulin is often suboptimally titrated, as current guidelines suggest intensification to address postprandial hyperglycemia when HbA1c targets are not met with basal insulin doses above 0.5 U/kg/day.[6] However, the strength of this recommendation is not based on high-level evidence, as few studies have investigated the maximum effective basal insulin dose at which treatment intensification is indicated. Most studies have focused on glucose reduction, with limited data on the impact of multiple insulin regimens on microvascular or macrovascular complications or on mortality.[7] In a study conducted in Florida with 655 patients, the prevalence of overbasalization was 38.1%, 42.7%, and 42.0% for those with A1c >8, ≥9, and ≥10%, respectively.[6]

This study aims to determine the prevalence of overbasalization in patients with diabetes and to identify its potential adverse health impacts.

Methods

Study Design and Population

This study was a retrospective cohort analysis incorporating both qualitative and quantitative data, designed to establish a clear temporal relationship between exposure (overbasalization) and outcome (hypoglycemia), thereby enabling appropriate causal inference. Medical records from the endocrinology outpatient clinic of Lauro Wanderley University Hospital (HULW), Federal University of Paraíba, located in João Pessoa, were reviewed for patients with multiple clinical visits between December 2022 and June 2023.

Inclusion criteria comprised: age between 18 and 80 years, a confirmed diagnosis of diabetes mellitus for at least 12 months prior to the study period, active basal insulin therapy at baseline, a minimum of two outpatient visits with documented clinical assessments, laboratory results, and insulin regimens, an initial visit occurring between December 2022 and February 2023, and a follow-up visit between February and June 2023, with a minimum interval of 16 weeks between visits. The follow-up duration varied from 16 weeks to 12 months, with a mean of 32 weeks (approximately 8 months), reflecting the natural variability in clinical scheduling. Pregnant women and individuals receiving injectable GLP-1 receptor agonists were excluded to minimize confounding factors affecting insulin requirements and hypoglycemia risk.

The study was approved by the HULW/UFPB Research Ethics Committee (CAAE: 59363222.5.0000.5183) under decision number 5,476,421, in compliance with Resolution 466/12 of the Brazilian National Health Council. No conflicts of interest were reported, and data were handled exclusively by the research team, ensuring patient confidentiality.

Exposure Definition and Assessment

The primary exposure was overbasalization at baseline, defined by two concurrent criteria: a basal insulin dose exceeding 0.5 IU/kg/day (supraphysiological dosing) and a glycated hemoglobin (HbA1c) level above 8% (indicating inadequate glycemic control despite high insulin doses.[7] This definition aligns with clinical observations of excessive insulin titration without achieving glycemic targets, as supported by existing literature. Patients were stratified into two groups: the exposed group (with overbasalization, n = 32) and the control group (without overbasalization, n = 80). Baseline characteristics were compared to assess potential confounding variables.

Outcome Definition and Assessment

The primary outcome was the occurrence of hypoglycemic episodes during follow-up, defined as either a documented capillary or plasma glucose level below 70 mg/dL or clinical symptoms consistent with hypoglycemia (e.g., tremors, sweating, palpitations, confusion, or behavioral changes)[3]. Hypoglycemia was evaluated at three time points: (1) baseline visit (documented episodes in the preceding 12 months), (2) follow-up visit (episodes during the follow-up period), and (3) incidence (new episodes between baseline and follow-up). The primary analysis compared hypoglycemia incidence between the exposed and control groups.

For the analysis of hypoglycemia, only patients with reliable and trustworthy data on hypoglycemic episodes were included. Of the 112 patients included in the study, 71 had sufficiently reliable data regarding hypoglycemic episodes and were included in the hypoglycemia analysis. Forty-one patients were excluded due to lack of reliable hypoglycemia data: 35 patients had no documented information regarding hypoglycemic episodes, and 6 patients had incomplete or ambiguous hypoglycemia data.

Follow-Up Period and Temporal Sequence

The follow-up period ranged from a minimum of 16 weeks to a maximum of 12 months, with a mean duration of 32 weeks. The temporal sequence ensured that exposure (assessed at baseline) preceded outcome assessment (during follow-up), reinforcing causal inference validity.

Data Collection and Variables

Standardized data were extracted from medical records, including: (1) demographic and clinical characteristics (age, sex, diabetes type and duration, comorbidities); (2) insulin regimen (type and dosage of basal/bolus insulin); (3) glycemic control (HbA1c, fasting glucose); (4) hypoglycemia assessment (documented episodes, symptoms, severity). Records with incomplete critical data were excluded after thorough review.

Statistical Analysis

Normality of continuous variables was assessed using the Shapiro-Wilk test. Continuous variables were compared between groups using independent samples t-tests (for normally distributed variables) or Mann-Whitney U tests (for non-normally distributed variables). Results are presented as mean ± standard deviation. Categorical variables were compared between groups using chi-square tests or Fisher's exact tests (when expected cell frequencies < 5). Results are presented as n (%), with percentages calculated within each group. Relative risk and 95% confidence intervals were calculated using standard epidemiological formulas. Confidence intervals (95%) were computed, and statistical significance was determined using the chi-square test ($p < 0.05$). Data were analyzed using Jamovi software (version 2.3.28).

Human Ethics and Consent to Participate declarations

This study was submitted to the HULW Research Ethics Committee (CAAE: 59363222.5.0000.5183) and was approved under opinion number: 5,476,421, in compliance with Resolution 466/12 of the National Health Council. There was no conflict of interest in carrying out the study.

Results

A total of 305 medical records were analyzed. Of these, 193 were excluded from the analysis due to specific criteria, including patients who were not diabetic or those who had diabetes but were not using insulin. In the end, 112 medical records were selected, divided into two main groups: 32 patients with overbasalization (basal insulin doses greater than 0.5 U/kg/day associated with HbA1c levels above 8%) and 80 patients without overbasalization, constituting the control group.

Table 1 shows some characteristics of the patients included in the study, distributed between the groups with and without overbasalization. The average age of patients with overbasalization was 48.2 years (SD = 18), while in the control group it was 47.2 years (SD = 16.3) ($p = 0.776$). Regarding sex, 53.12% of patients with overbasalization were female, compared to 61.25% in the control group ($p = 0.564$).

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Regarding the type of diabetes, there was a higher prevalence of type 2 diabetes in both groups, with 62.50% of patients in the overbasalization group and 57.50% in the control group (p = 0.785), suggesting that the variables age, sex, and diabetes type are comparable between the studied groups, allowing for an analysis focused on the impacts of overbasalization without interference from these factors.

Table 1. Characteristics of the patients included in the study

	Overbasalization		Control	
	n	%	n	%
Age (years)				
Mean	48.2	-	47.2	-
Median	45.2	-	49.0	-
Standart Deviation	18.0	-	16.3	-
Sex				
Female	17.0	53.12%	49.0	61.25%
Male	15.0	46.88%	31.0	38.75%
Types of diabetes				
Type 1	12.0	26.08%	34.0	73.91%
Type 2	20.0	30.30%	46.0	69.69%

Moreover, Table 2 presents the clinical data of the patients included in the study, comparing the groups with and without overbasalization. The average weight of patients with overbasalization was 67.6 kg, while in the control group it was 73 kg (p = 0.101). The average body mass index (BMI) was 26.7 kg/m² for the overbasalization group and 28.8 kg/m² for the control group (p = 0.109). The average HbA1c was 10.07% in the overbasalization group and 8.47% in the control group (p < 0.001). The average fasting capillary blood glucose was 211 mg/dL in the overbasalization group and 176 mg/dL in the control group (p = 0.192). The average total basal insulin dose was 45.3 units in the overbasalization group and 33 units in the control group (p < 0.001).

These data indicate that there were no statistically significant differences in weight, BMI, and fasting capillary blood glucose between the two groups. However, there was a significant difference in HbA1c levels and the total basal insulin dose, with the overbasalization group showing higher averages for both variables. This suggests that indefinitely increasing the basal insulin dose does not positively impact fasting blood glucose or HbA1c. These findings may suggest the ineffectiveness of excessive increases in basal insulin in improving glycemic control, highlighting the need for further research to confirm these observations and explore alternative strategies for glycemic management.

The relative risk calculated for the control group in managing HbA1c was 0.43 (95% CI: 0.24-0.78), indicating that the control group has a 56% reduction in the risk of having HbA1c levels out of target (p < 0.001).

Among patients with overbasalization, 65% had been diagnosed with diabetes for more than 10 years, compared to 53% in the control group (p = 0.452).

Additionally, 54.00% of patients with overbasalization had been using insulin for at least 5 years, while 37% of patients in the control group had been using insulin for more than 5 years (p = 0.260). These results suggest that in terms of the duration of diabetes diagnosis and insulin use, patients with and without overbasalization are comparable.

Table 2. Clinical data of the patients included in the study

	Overbasalization n (32)	Control N (80)	*P*
Weight (Kg)			
Mean	67.6	73.0	0.1
Standard Deviation	14.1	16.1	
BMI (Kg/m2)			
Mean	26.7	28.8	0.109
Standard Deviation	6.29	6.04	
HbA1c (%)			
Mean	10.07	8.47	<0.001
Standard Deviation	2.03	2.02	
Fasting capillary blood glucose (mg/dL)			
Mean	211	176	0.19
Standard Deviation	93.6	94.2	
Total basal insulin dose (unit/day)			
Mean	45.3	33.0	<0.001
Standard Deviation	13.8	16.2	

Table 3 presents the occurrence of hypoglycemia among the patients included in the study, comparing those with and without overbasalization. In the group without overbasalization, 16 patients (29.60%) experienced hypoglycemia. In the group with overbasalization, 12 patients (70.60%) experienced hypoglycemia (p = 0.006), indicating a statistically significant difference in the occurrence of hypoglycemia between the two groups, considering a significance level of 0.05. The relative risk of hypoglycemia for patients with overbasalization compared to those without overbasalization is 2.38 (95% CI: 1.13-5.04). However, it is important to note that 84.37% of patients in the overbasalization group were using bolus insulin concurrently (Table 4), which may represent a confounding factor in the association between overbasalization and hypoglycemia. This potential confounding is further explored in the Discussion and Limitations sections.

Table 3. Hypoglycemia in patients included in the study

Overbasalization	Hypoglycemia n (%)	No Hypoglycemia n (%)	RR (95% CI)	p value
No (n=54)	16 (29.6)	38 (70.4)	2.38 (1.13–5.04)	0.006
Yes (n=17)	12 (70.6)	5 (29.4)		

Of the 112 patients included in the study, 71 had reliable data regarding hypoglycemic episodes and were included in the hypoglycemia analysis. Forty-one patients were excluded due to unreliable hypoglycemia data: 35 had no documented information regarding hypoglycemic episodes, and 6 had incomplete or ambiguous data. The final sample consisted of 17 patients with overbasalization and 54 without.

Ultimately, Table 4 presents the types of insulin used by patients with overbasalization included in the study. For basal insulin, 53.12% of patients used NPH, and 46.87% used Glargine, indicating an almost balanced distribution between the two types of basal insulin, with a slight predominance of NPH. For bolus insulin, Regular insulin was the most used, by 53.12% of patients, followed by Aspart insulin, used by 31.25%.

Table 4. Insulin used by patients with overbasalization

	n	%
Basal Insulin Used		
NPH	17	53.12%
Glargine	15	46.87%
Bolus Insulin Used		
Regular	17	53.12%
Aspart	10	31.25%
Do not use bolus insulin	5	15.62%

Discussion

The present study highlighted a significant prevalence of overbasalization among patients with diabetes mellitus, with approximately 29% of the sample receiving supraphysiological doses of basal insulin associated with inadequate glycemic control. Furthermore, patients experiencing overbasalization had a 2.38-fold increased risk of hypoglycemia, underscoring the clinical consequences of this practice. The findings also demonstrated significantly higher HbA1c levels in the overbasalization group, reinforcing the ineffectiveness of excessive basal insulin titration in achieving optimal glycemic control. Despite the clinical importance of these results, there is a notable scarcity of studies specifically addressing overbasalization in the scientific literature, emphasizing the urgent need for further research to deepen understanding of its impact, underlying mechanisms, and management strategies to prevent associated complications.

Challenge in Managing Diabetes Mellitus

The growing number of people diagnosed with diabetes mellitus represents a significant challenge in the long-term management of chronic diseases. The literature indicates that most patients do not achieve or maintain glycemic targets, exposing them to a wide range of diabetes-related complications. This therapeutic failure is attributed to clinical inertia and a lack of up-to-date knowledge among healthcare professionals, patients, and healthcare systems. As a result, approximately 30-50% of patients with type 2 diabetes (T2D) live with suboptimal glycemic control.[8] In this context, due to inadequate control in diabetes management, many healthcare professionals, in an attempt to reduce patients' HbA1c levels, indiscriminately increase basal insulin doses, raising the risk of overbasalization.

This pioneering study in Brazil investigated the efficacy of diabetes control and the risk of hypoglycemia in diabetic patients with overbasalization, showing that, in addition to having HbA1c levels above target, the relative risk of hypoglycemia in these patients was more than double compared to patients without this condition. This finding is supported by the existing literature, as demonstrated in the Cowart study.[9]

Impacts of Hypoglycemia

Hypoglycemia is a high-risk factor for several health problems, including physical and psychological morbidity. In this context, hypoglycemia can affect judgment, behavior, and performance in daily physical tasks. The physical morbidity associated with hypoglycemic episodes presents a range of symptoms, from vague discomfort to seizures and coma. While permanent neurological damage is rare, the psychological morbidity includes the fear of hypoglycemia, which can complicate glycemic control. The findings also suggest that the strategy of indiscriminately increasing the basal insulin dose to improve glycemic control may not be effective and may, in fact, increase the risk of hypoglycemia. This observation aligns with studies conducted in the United States, where patients with hypoglycemia during hospitalization had higher hospitalization costs and longer stays. Additionally, patients with type 2 diabetes who experienced hypoglycemia had significantly higher annual medical expenses, both for general causes and for complications directly related to diabetes.[10]

Inadequacy of Basal Insulin

A study conducted at Lapeyronie Hospital in France showed that, in patients with HbA1c below 7.3%, postprandial glucose contributed 70% to total hyperglycemia. However, as HbA1c increases, this relationship reverses, with postprandial glucose accounting for only 30% in patients with HbA1c above 10.2%. These findings indicate that, as glycemic control worsens, fasting glucose becomes the primary factor responsible for hyperglycemia. Thus, simply intensifying basal insulin in patients near the glycemic target may not be an effective strategy, as in this group, postprandial glucose has a greater impact, making the use of bolus insulin necessary.[11,12]

Weight and Overbasalization

Some studies show that patients treated with more than 0.5 units/kg/day of insulin experienced significantly greater weight gain. However, these same studies did not show statistical differences in weight between the groups with and without overbasalization, suggesting that these parameters are similar.[8,11]

Demographic Factors and Overbasalization

Parameters such as age and sex of patients in both groups did not show statistically significant differences. This suggests that overbasalization is not related to demographic factors. The prevalence of type 2 diabetes was similar in both groups, also indicating that overbasalization is not associated with a specific type of diabetes.

Strategies to Promote Safe Insulin Therapy

Safe insulin therapy should incorporate specific strategies to optimize titration and minimize risks such as hypoglycemia and overbasalization. Guided titration protocols, based on simple and iterative algorithms, enable patients to safely and effectively adjust their basal insulin doses with appropriate medical support.

These protocols reduce exclusive reliance on healthcare professionals, empowering patients to autonomously manage their treatment and preventing indiscriminate increases in insulin doses that may lead to serious adverse events. Additionally, continuous patient education is essential for early recognition of hypoglycemia signs, dose adjustments, and treatment adaptation to lifestyle changes.[13]

The use of advanced technologies, especially continuous glucose monitoring (CGM) and flash glucose monitoring systems, has proven to be valuable tools in ensuring safe insulin therapy. These devices provide real-time glucose data, allowing more precise and timely insulin adjustments, preventing hypoglycemia, and offering detailed assessments of glycemic fluctuations throughout the day. The integration of these technologies into clinical practice, combined with patient education and guided titration strategies, promotes a safer, more effective, and personalized management of diabetes, reducing adverse effects and optimizing glycemic control.[14-16]

Limitations

Some limitations of this study are associated with its retrospective nature, based on the analysis of medical records. Although gaps and inaccuracies were identified in the clinical records, measures were implemented to mitigate their impact, including careful review of available data, cross-validation with other information sources when accessible, and the application of statistical techniques to adjust for potential distortions. Furthermore, the lack of large-scale studies may have limited the depth of the discussion and comparison of results, as well as the understanding of the effects of overbasalization in diabetic.

An additional limitation of this study is the exclusion of 41 patients (36.6% of the total sample) from the hypoglycemia analysis due to unreliable hypoglycemia data. However, comparison of baseline characteristics (age, sex, diabetes type, BMI) between included and excluded patients revealed no significant differences, suggesting that missing data were likely missing at random (MAR) rather than missing not at random (MNAR).

Multivariable analysis was not conducted. Future prospective studies with larger sample sizes should conduct adjusted analyses to confirm whether the association between overbasalization and hypoglycemia remains significant after controlling for relevant covariates.

Conclusion

This study highlights the prevalence of overbasalization in patients with diabetes mellitus and its significant association with an increased risk of hypoglycemia. The practice of indiscriminately increasing basal insulin doses proved to be ineffective for glycemic control and potentially dangerous due to the high risk of hypoglycemia. Our findings reinforce the need for individualized strategies in managing basal insulin that balance effective glycemic control with minimizing complications. Future studies should focus on identifying interventions that improve outcomes for patients without increasing the risks of adverse events.

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Contributions

SDB and GHP wrote the main text of the manuscript. GRF and ALR served as the supervisors of the work. ARC, BMS, LOG, MCO, and DDM participated in the critical review of the manuscript. GRF was the final reviewer of the manuscript and was responsible for statistical analysis. All authors read and approved the final version of the article.

Conflicts of Interest:

The authors declare that there are no conflicts of interest.

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