









Research Article

The Effect of Insulin Glargine in Control of Diabetes Among Sudanese Patients in 2024: A Cross-Sectional Study

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Abstract

Introduction: Diabetes mellitus is a chronic metabolic disorder marked by elevated blood sugar levels due to impaired insulin production, action, or both. Insulin glargine, a long-acting insulin analog, is widely used for patients who do not achieve adequate glycemic control with oral medications. In Sudan, where diabetes is increasingly prevalent, assessing the effectiveness of insulin glargine is essential to address local healthcare challenges and population-specific needs. This study explored the role of insulin glargine in managing diabetes among Sudanese patients, focusing on its impact on glycemic control, reduction in hypoglycemia, and patient satisfaction. **Methods:** A cross-sectional study was conducted between September 2023 and March 2024, involving 52 adult diabetic patients using insulin glargine. Data was collected using pre coded and pretested structured online questionnaire and analyzed using SPSS version 27. All data were summarized in frequency tables. **Results:** All participants achieved glycemic control after initiating insulin glargine. The frequency of hypoglycemic episodes decreased from 86.5% to 53.8% after insulin glargine use. While 98.1% of participants were satisfied with the treatment, a significant number (76.9%) found the cost prohibitive. Side effects of insulin glargine include hunger (19.2%), sweating (9.6%) and sweating (9.6%), although 38.5% of participants experienced none. Some patients continued to experience diabetes-related complications, including visual and neurological issues. **Conclusion:** Insulin glargine was effective in improving glycemic control and reducing hypoglycemia, with high patient satisfaction rates. Addressing cost-related barriers and incorporating this treatment into health insurance schemes could enhance diabetes care in Sudan.

Keywords

Insulin, Glargine, Diabetes, Patients, Glycemic Control, Managements, Cost, Health Insurance, Sudan

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1. Introduction

Diabetes mellitus (DM) is a heterogeneous metabolic disorder characterized by the presence of hyperglycemia due to impairment of insulin secretion, defective insulin action, or both [1]. DM is classified into two categories: juvenile-onset diabetes mellitus, now known as type 1 diabetes mellitus, and adult-onset diabetes mellitus, now known as type 2 diabetes mellitus [2]. Type 1 diabetes is caused by autoimmune damage to the insulin-producing β -cells found in the pancreatic islet cells, leading to severe insulin deficiency [3]. Type 2 diabetes (T2D) constitutes a major health problem worldwide; this metabolic disease is caused by high blood glucose levels due to insufficient insulin production by the pancreas [4]. The prevalence of type 2 diabetes mellitus is estimated to be more than 90% of patients with diabetes. It accounts for severe microvascular and macrovascular complications that cause profound physical and psychological distress to both patients and carers and put a huge burden on healthcare systems [5]. While it may be harder to prevent T1DM, T2DM is preventable by lifestyle modifications, namely by diet and exercise in conjunction with maintaining a healthy weight [6].

Many drugs have shown to be effective in treating diabetes mellitus, including biguanides (namely metformin), sulfonylureas, thiazolidinediones (TZDs), dipeptidyl peptidase-4 (DPP4) inhibitors, glucagon-like peptide 1 (GLP-1) analogues, sodium-glucose co-transporter-2 (SGLT2) inhibitors, and insulin [7-13]. Insulin glargine is a long-acting analogue of human insulin that provides a consistent level of plasma insulin over a long period, thereby resulting in a lower rate of weight gain and incidence of hypoglycemia. It is now preferable in patients with poor glycemic control despite the use of oral antidiabetic drugs [14]. Evidence demonstrates the benefits of using insulin glargine over neutral protamine Hagedorn (NPH) insulin in terms of glycemic control, nocturnal hypoglycemia variability, and a lower rate of severe hypoglycemia [15, 16].

Diabetes mellitus has emerged as a significant public health challenge in Sudan, with increasing prevalence rates attributed to lifestyle changes, urbanization, and genetic factors. Insulin therapy remains a cornerstone of diabetes management, yet many patients experience suboptimal glycemic control [17-19]. Insulin glargine, a long-acting insulin analog, has been shown to improve blood glucose levels and reduce the risk of hypoglycemia compared to other insulin types. However, its specific efficacy and safety in the Sudanese population remain under-researched.

Many studies have been conducted in Sudan to assess doctors' adherence to treatment guidelines. Factors such as the cost of drugs, health insurance coverage, and patient-related factors are significant barriers that impede doctors' implementation of these guidelines [20-23]. Such challenges could influence the management of diabetes and the use of insulin therapies, including insulin glargine, among Sudanese pa-

tients.

This study aimed to evaluate the effectiveness of insulin glargine in controlling diabetes in Sudanese patients in 2024. Understanding the effectiveness of insulin glargine in the Sudanese context is crucial for several reasons. First, with diabetes rates rising in Sudan, effective management strategies are essential to reduce complications associated with the disease, which can significantly impact quality of life and increase healthcare costs. Second, the unique cultural, dietary, and healthcare landscape in Sudan may influence how diabetes is managed, highlighting the need for tailored treatment protocols. By focusing on insulin glargine, this study could provide valuable insights into its role in diabetes management specific to Sudanese patients, potentially informing clinical guidelines and improving patient outcomes. Furthermore, the findings could pave the way for future research on insulin therapies in similar low-resource settings, contributing to global knowledge on diabetes management.

2. Materials and Methods

2.1. Study Design and Population

This is a descriptive, cross-sectional community-based study. The study population comprises Sudanese adult individuals aged 18 years or older with either type 1 or type 2 diabetes who are currently utilizing insulin glargine. The study was conducted using an online structural questionnaire created by researchers to fulfill the general and specific objectives of the study. Convenience sampling technique was utilized from September 2023 to March 2024, resulting in a participation of 52 patients.

2.2. Statistical Analysis

The data were entered into the Statistical Package for the Social Sciences (SPSS) version 27 for analysis. The mean, median and standard deviation were measured in frequency table. Chi-square (χ^2) test was used to determine the association between categorical variables. P value < 0.05 was considered statistically significant.

2.3. Ethical Approval and Consent to Participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was granted from Alzaeim Alazhari University Review Board (IRB) and the Sudan Ministry of Health (MOH). no personal identifiers were collected from the participants, guaranteeing 100% anonymity throughout the research pro-

cess. Informed consent was obtained from all parents after the study's objectives and procedures were explained. The participants were informed of their right to refuse participation or withdraw at any point without any consequences. This approach safeguarded participants' autonomy and upheld ethical research standards.

3. Results

The study included 52 diabetic patients using insulin glargine. More than half of the participants were females (27,

51.9%). The participants were divided into three groups according to their age, most of them were in the age group 41 – 60 years, amounting to (22, 42.3%). Investigation regarding residence of the participants during the period of the study revealed that, most of the participants (42, 80.8%) were living outside Sudan, while the rest of the (10, 19.2%) were living inside Sudan. Regarding marital status, most of the participants (39, 75.0%) were married. Regarding the education of the participants, most of them were educated till university (35, 67.3%), as displayed in [Table 1](#).

Table 1. Demographic characteristics of the participants, (n = 52).

Variables	Frequency	Percent (%)
Gender:		
Female	27	51.9
Male	25	48.1
Age groups:		
20 – 40 years	10	19.2
41 – 60 years	22	42.3
61 years or more	20	38.5
Residence:		
Inside Sudan	10	19.2
Outside Sudan	42	80.8
Marital status:		
Divorced	1	1.9
Married	39	75.0
Single	8	15.4
Widow	4	7.7
Educational level:		
Illiterate	1	1.9
Primary school level	2	3.8
Secondary school level	11	21.2
University level of education	35	67.3
Postgraduate level of education	3	5.8

Investigations regarding the original residence of the participants in Sudan revealed that, most of them from Khartoum state, Gezira state and River Nile state mounting to (11, 21.2%) for each of them, as displayed in [Figure 1](#).

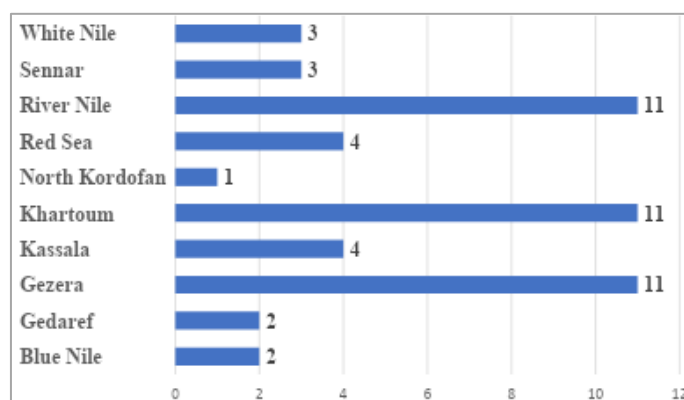


Figure 1. Distribution of the participants according to their residence in Sudan, (n = 52).

Regarding the duration of using insulin glargine, results of the study revealed that nearly half of the participants (25, 48.1%) are using the insulin glargine for less than one year. Only (8, 15.4%) reported using of the insulin glargine for more than five years, as displayed in Figure 2.

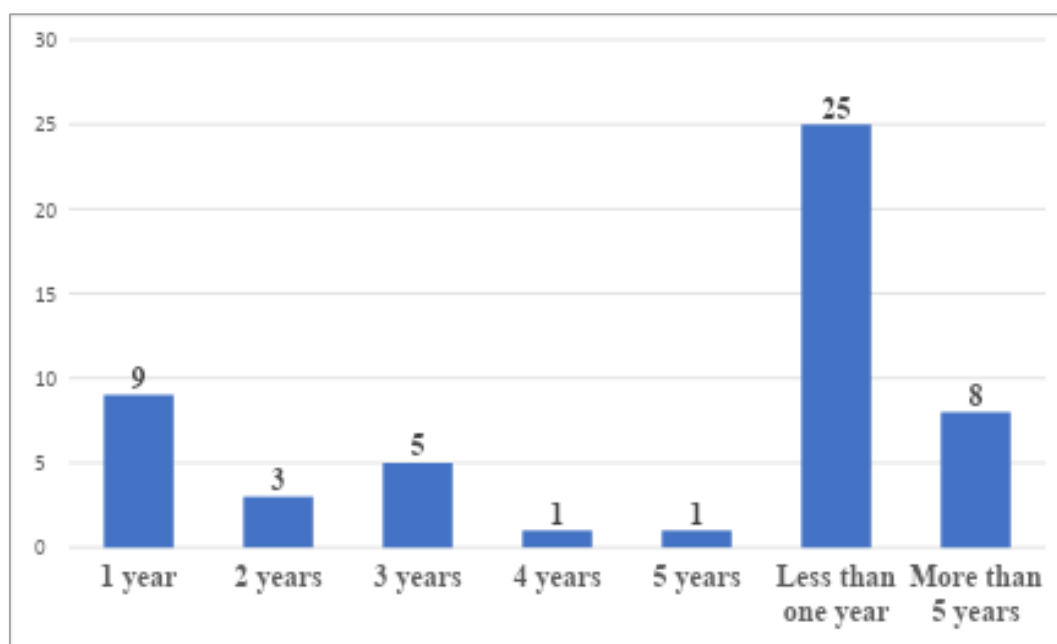


Figure 2. Distribution of the participants according to the duration of using insulin glargine, (n = 52).

Investigation regarding the diabetes history revealed that, most of the participants (48, 92.3%) were using diabetes treatment before starting insulin glargine. Most of the participants (49, 94.2%) reported that their HbA1C level before

using glargine was more than 6.5. Furthermore, all of the surveyed participants reported that their diabetes was controlled after using glargine, as displayed in Table 2.

Table 2. Distribution of the participants according to their diabetes history, (n = 52).

Variables	Frequency	Percent (%)
Use of diabetes treatment before staring glargine:		
Yes	48	92.3

Variables	Frequency	Percent (%)
No	4	7.7
HbA1C level before using glargine:		
Less than 6.5	3	5.8
More than 6.5	49	94.2
Glycemic control after glargine use:		
Controlled	52	100
Not controlled	0	0.00

Most of the participants (45, 86.5%) reported that they used to have hypoglycemia attacks before using glargine, which was frequent in (28, 53.8%) of them. After using glargine (28, 53.8%) reported attacks of hypoglycemia, while the rest of (24, 46.2%) reported no hypoglycemia attack after using glargine, as displayed in [Table 3](#).

Table 3. Distribution of the participants according to hypoglycemia attack before and after using of glargine, (n = 52).

Variables	Frequency	Percent (%)
Hypoglycemia before using glargine:		
Yes	45	86.5
No	7	13.5
If yes, how many times, (n = 45):		
Frequently	28	53.8
Rarely	17	32.7
hypoglycemia after using glargine:		
Yes	28	53.8
No	24	46.2

Investigation regarding development of diabetes complications revealed that (28, 53.8%) of the participants reported development of visual problems, (13, 25.0%) of the participants reported development of neurological problems and (6, 11.5%) of the participants reported development of renal problems, as displayed in [Table 4](#).

Table 4. Distribution of the participants according to diabetes complications, (n = 52).

Variables	Frequency	Percent (%)
Visual problems:		
Yes	28	53.8
No	24	46.2
Neurological problems:		
Yes	13	25.0
No	39	75.0
Renal problems:		

Variables	Frequency	Percent (%)
Yes	6	11.5
No	46	88.5

Investigation regarding the side effects of insulin glargine revealed that; (10, 19.2%) developed hunger and weight gain, (5, 9.6%) developed sweating and weight gain and (5, 9.6%) developed sweating. Less than half of the participants (20, 38.5%) reported that they didn't develop any side effects after using of insulin glargine, as displayed in Figure 3.

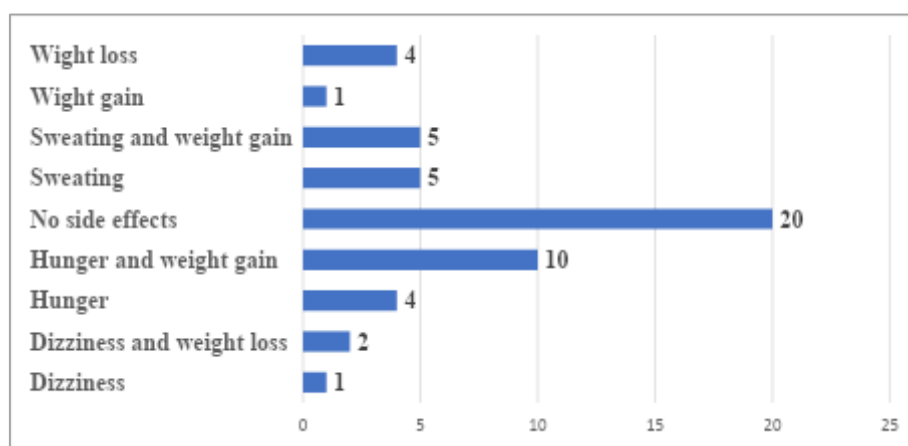


Figure 3. Distribution of the participants according to the insulin glargine side effects, (n = 52).

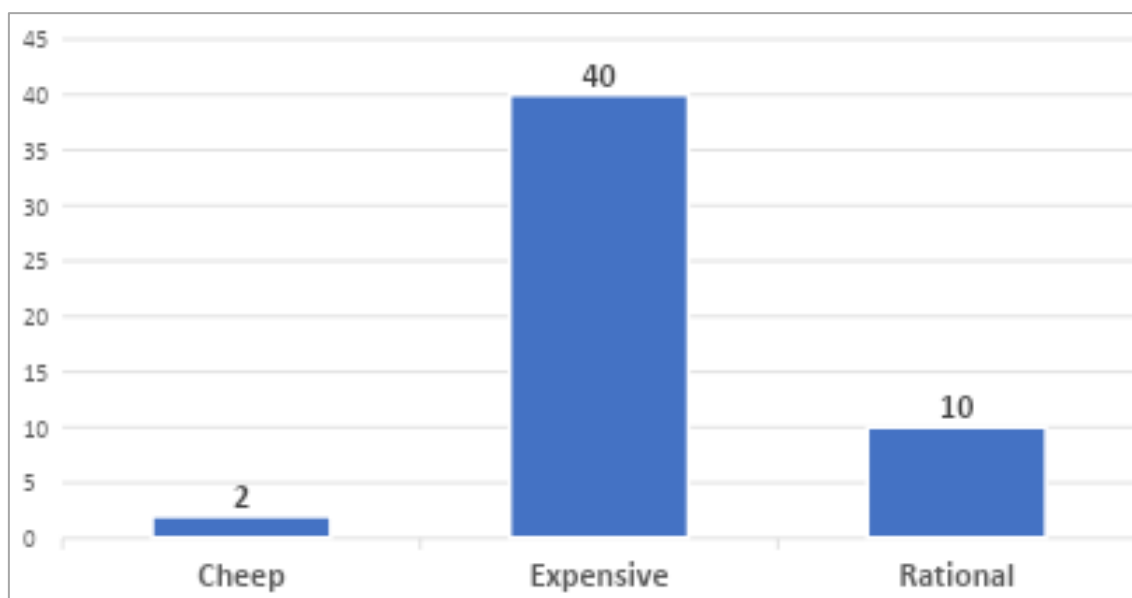


Figure 4. Distribution of the participants according to their opinion of insulin glargine price, (n = 52).

Investigation regarding participants' opinion of insulin glargine price revealed that most of the participants (40, 76.9%) reported that the price of glargine is expensive, as

displayed in Figure 4.

Most of the participants (51, 98.1%) reported satisfaction after using insulin glargine, as displayed in Figure 5.

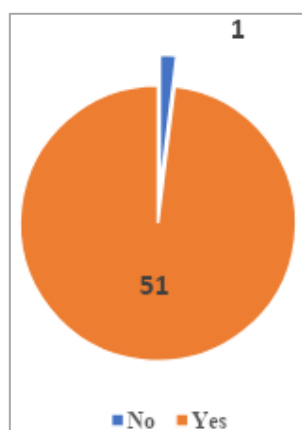


Figure 5. Distribution of the participants according to their satisfaction of using insulin glargine, ($n = 52$).

4. Discussion

This study aimed to evaluate the effectiveness of insulin glargine in controlling diabetes in Sudanese patients. Results of our study revealed a high satisfaction rate and reduction in HbA1C levels post-insulin glargine use. This result aligns with findings from previous studies conducted in Japan and East Asia [24, 25], indicating consistent efficacy of insulin glargine in glycemic control across different populations.

Our study revealed a significant reduction in hypoglycemic events was noted after using insulin glargine, this finding is supported by a meta-analysis which included 2,304 patients [26]. Many side effects were reported in our study including hunger, weight gain, and sweating, these side effects were also reported in a systematic review which included 15 randomized controlled trials [27].

Participants' overall satisfaction with diabetes control after insulin glargine use suggests a positive perception of this treatment modality among the study population. However, the perceived high cost of insulin glargine underscores the potential financial barriers to accessing optimal diabetes care in Sudan.

5. Conclusion

This study provides valuable insights into the effectiveness of insulin glargine in controlling diabetes among Sudanese patients, highlighting its role in reducing HbA1C levels and hypoglycemia events while achieving a high satisfaction rate among users. To address the challenges identified, we recommend increasing awareness of insulin glargine's benefits among healthcare providers and patients, as well as mitigating financial barriers by incorporating insulin glargine into national health insurance programs. Future research should adopt more robust study designs with larger, more representative sample sizes to validate and expand upon these findings, ensuring that evidence-based recommendations can guide diabetes management practices

effectively.

6. Study Strength and Limitations

Strengths of this study include its focus on a specific population, use of a modern data collection method, and adherence to ethical principles. However, its limitations include the relatively small sample size, potential for selection bias with convenience sampling, and reliance on self-reported data, which may be subject to recall and social desirability biases. Previous studies demonstrated strengths such as larger sample sizes, diverse study populations, robust study designs, and rigorous data collection methods. However, they may have limitations related to generalizability to Sudanese patients given the unique issues and circumstances facing the health system in Sudan.

Abbreviations

AAU	Alzaiem Alazhari University
DM	Diabetes Mellitus
HbA1C	Hemoglobin A1C
IRB	Institutional Review Board
MOH	Ministry of Health
NPH	Neutral Protamine Hagedorn
SPSS	Statistical Package for the Social Sciences
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TZDs	Thiazolidinediones
GLP-1	Glucagon-Like Peptide-1
DPP4	Dipeptidyl Peptidase-4
SGLT2	Sodium-Glucose Co-Transporter-2

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Author Contributions

Hiba Salah Abdelgadir: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing

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Ahmed Mahjoub Awad: Writing – review & editing

Declarations

Consent for Publication

Not applicable.

Clinical Trial Number

Not applicable.

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Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

Authors declare that there is no competing interest.

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