Food and Nutrition Sciences, 2025, 16(7), 757-770
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Prevalence of Diabetes Mellitus (DM) and Prescribed Hygiene and Dietary Measures among Hospitalized Patients in Kisangani, Democratic Republic of the Congo

Lusamaki Mukunda Francois[1*], Buhendwa Mirindi Victor[1], Mosisi Moleka Pange[1], Kayisu Kalenga Antoine[2], Wabi Bajo[3], Eugene Basandja Longembe[4], Atoba Bokele[5], Kayembe Tshilumba[5], Batina Agasa Salomon[5]

[1]Department of Human Nutrition, Faculty of Medicine and Pharmacy (FMP), University of Kisangani (UNIKIS), Kisangani, Democratic Republic of the Congo
[2]Faculty of Agronomy Institute of Yangambi (IFA), Yangambi, Democratic Republic of the Congo
[3]Food Science and Nutrition Research, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia
[4]Department of Public Health, Faculty of Medicine and Pharmacy (FMP), University of Kisangani (UNIKIS), Kisangani, Democratic Republic of the Congo
[5]Department of Internal Medicine, Faculty of Medicine and Pharmacy (FMP), University of Kisangani (UNIKIS), Kisangani, Democratic Republic of the Congo
Email: *mukundalusamaki@gmail.com

How to cite this paper: Francois, L.M., Victor, B.M., Pange, M.M., Antoine, K.K., Bajo, W., Longembe, E.B., Bokele, A., Tshilumba, K. and Salomon, B.A. (2025) Prevalence of Diabetes Mellitus (DM) and Prescribed Hygiene and Dietary Measures among Hospitalized Patients in Kisangani, Democratic Republic of the Congo. *Food and Nutrition Sciences*, **16**, 757-770.
https://doi.org/10.4236/fns.2025.167042

Received: May 21, 2025
Accepted: July 7, 2025
Published: July 10, 2025

Abstract

Introduction: The prevalence of diabetes mellitus (DM) continues to increase worldwide. In Kisangani, cases of DM are continuously recorded in healthcare facilities. This study was aimed at determining the prevalence of DM and describing the hygiene and dietary measures recommended for patients admitted to selected Kisangani hospitals from 2018 to 2021. **Methods:** This facility-based descriptive and cross-sectional study was conducted in Kisangani, Tshopo province, Democratic Republic of the Congo (DRC), specifically in 7 general hospitals from August 15 to November 15, 2023. Data were collected retrospectively by documentary analysis, including all cases of diabetes mellitus admitted from 2018 to 2021 in the internal medicine departments of the selected hospitals. Every single record that contained a diagnosis of diabetes mellitus, whether it was presented alone or in conjunction with other pathology, was retained. The results were expressed as mean ± standard deviation and as a percentage and presented in tables and graphs. **Results:** Out of 6023 admitted patients, 374 cases of diabetes were diagnosed, either, a frequency of 6.2%. This frequency was higher in 2020 (8.0%) and 2021 (7.1%) but was low in 2018 (4.2%). Hygiene-dietary measures were prescribed in 41.4% of cases. **Conclusion:** Diabetes mellitus is

on the rise in the city of Kisangani, but few patients receive health and dietary advice from providers. Urgent measures should be taken to improve the dietary management of these patients.

Keywords

Diabetes Mellitus, Hospital Frequency, Health and Dietary Measures, Kisangani DRC

1. Introduction

Diabetes Mellitus is a chronic disease that significantly impacts the health and well-being of many individuals and societies worldwide. It is a complex multisystem metabolic disorder characterized by hyperglycemia, which leads to complications that reduce quality of life and increase mortality. Diabetes pathophysiology includes dysfunction of beta cells, adipose tissue, skeletal muscle, and liver. Type 1 diabetes (T1D) results from immune-mediated beta cell destruction. The more prevalent type 2 diabetes (T2D) is a heterogeneous disorder characterized by varying degrees of beta cell dysfunction in concert with insulin resistance [1].

Ranked among the four priority non-communicable diseases, alongside cardiovascular diseases, cancer and chronic respiratory infections [2] [3], DM represents one of the leading causes of death in adults [2]. Statistics on diabetes illustrate the increasing global burden on individuals, families, and nations. The latest International Diabetic Federation (IDF) Diabetes Atlas (2025) reports that 11.1%—or 1 in 9—of the adult population (20 - 79 years) is living with diabetes, with over 4 in 10 unaware that they have the condition [4]. The prevalence of DM was estimated at 108 million people in 1980, rising to 422 million in 2014 and 463 million by 2019. According to projections, this figure could rise to 578 million, or 10.9% of the global population, by 2030 [2]. In Africa, the number of people with diabetes among adults aged more than 18 years increased from 7 million to 25 million between 1980 and 2014, with an estimated prevalence of 7.1% in 2014 [5]. In the Democratic Republic of the Congo (DRC), the prevalence of diabetes mellitus (DM) varies by city, with Bukavu and Kisantu exhibiting rates of 7.3% and 4.8%, respectively [6] [7]. Muyer *et al.* [8] reported a 7% prevalence of DM in Kinshasa, while Nantakumar *et al.* [9] found a 17.9% prevalence of prediabetes and an 8.4% prevalence of diabetes mellitus in the same area. The study conducted for two decades at Universities Clinics in Kisangani reported 4.1% hospital prevalence of Diabetic Mellitus [10].

Effective management of diabetes mellitus is based on pharmacological treatment, hygiene and dietary measures. Clinical trials demonstrated that the pharmacological approach combined with low glycemic index (GI) diets allows good glycemic control in diabetics [11] [12]. This type of diet helps to reduce insulin secretion and lower blood lipid concentrations in patients with hypertriglyceridemia [13].

In the DRC, effective DM management faces multiple, overlapping constraints, including human-resource shortages, supply-chain and diagnostic gaps, financial barriers, low health literacy and cultural factors. First, specialised diabetes care is scarce and few clinicians have formal nutritional counseling. Second, frequent shortages of essential diabetes medications combined with limited laboratory capacity force clinicians to rely on symptomatic diagnoses, therefore delaying appropriate treatment. Third, many patients cannot afford consultation fees, medications, recurring transport costs or varied food needed to follow nutritional recommendations, leading to irregular follow-up and cheaper high-glycemic staples. Finally, low health literacy and prevailing beliefs prevent both early consultation and adherence to dietary recommendations. Consequently, a significant proportion of individuals with diabetics remain undiagnosed [14].

Admission of patients with DM is common in general hospitals in Kisangani, however, there is insufficient data related to hospital frequency of DM and adherence to the hygienic and dietary measures. There is a limited culture of following and benefiting from hygiene and dietary measures is for good management of diabetes [11]. This may be due to the drawbacks of previously used study designs and small sized used by different authors in previous studies. Most of the previous studies employed a cross-sectional study and the data collected at one point in time. This might affect the prevalence rate result of the DM in the country. The current study was a facility-based cross-sectional study and data were collected retrospectively from patients in selected hospitals from 2018 to 2021. It aims to determine the prevalence of diabetes mellitus and describe the hygiene and dietary measures prescribed by diabetic care providers in Kisangani hospitals. The result of this study would help the health service providers in planning and prioritizing the DM issues in the country. It is also believable that this study contributes to the science and adequacy of information in the area.

2. Materials and Methods

2.1. Study Area

This study was conducted in the city of Kisangani, Tshopo province, which is located in the Northeast of the Democratic Republic of the Congo (DRC). Seven healthcare facilities, including two tertiary level hospitals: the University Clinics of Kisangani (CUKIS) and the Cinquantenaire Hospital of Kisangani (HCK), and five secondary level, including main general reference hospitals (HGR); the HGR of Makiso-Kisangani, HGR of Kabondo, HGR of Tshopo, HGR of Mangobo, and HGR of Lubunga. The study population consisted of patients admitted to the internal medicine departments of these seven healthcare facilities, while the target population consisted of all patients diagnosed as diabetic.

2.2. Study Design

A facility-based descriptive and cross-sectional study was employed by reviewing patients' documents admitted from 2018 to 2021 in selected Health facilities in

Kisangani city. Data collection (documentary analysis) was conducted during the period from August 15 to November 15, 2023.

2.3. Sampling

Convenience sampling technique targeting referral healthcare facilities at the secondary and tertiary levels in Kisangani city with high patient capacity and technical facilities was employed in this study. These healthcare facilities receive all referral cases in the city and have sufficient capacity for proper patient care. At the healthcare facility level, a comprehensive study of all diagnosed diabetic patients was conducted during the study period. Case selection in the facilities was made according to whether the patient's file contained all the required information, including the diagnosis of diabetes mellitus, anthropometric parameters and the prescription of hygiene and dietary measures, which were consulted during the study period.

2.4. Data Collection

Documentary review techniques were used for data collection. The patient files were consulted and, in some cases, missing information was searched in the patient register. The variables studied were socio-demographic profile of the patients, namely age, sex, weight, height, and main activity. In addition, the body mass index (BMI) of the patients was calculated. Pathologies associated with diabetes mellitus, such as a family history, hygiene and dietary measures, were also recorded. All data collected were recorded in a dedicated form.

2.5. Data Analysis

The collected data were encoded in Microsoft Excel 2007 and imported into Statistical Package for the Social Sciences (SPSS 20) software for analysis. The sample was described using proportions for categorical variables and the mean (±SD) for quantitative variables that showed a symmetrical distribution. For all records whose type of diabetes was not specified, the patients under 40 years of age were classified as type 1 diabetic, and those aged 40 years or older as type 2 diabetic. Statistical inferences were made using Pearson's chi-square and Fisher's Exact tests for categorical variables for significance level of $P < 0.05$, according to the conditions of their applications. The results were presented in tables and graphs.

2.6. Ethical Consideration

Access to patient files was obtained after receiving permission from the heads of the selected hospitals through ethical approval request after a detailed explanation of the research methodology and the significance of the study. All data were collected anonymously and were solely used for research purposes.

2.7. Limitation of the Study

The results of this study are limited to patients who consulted the internal medicine

departments of HGRs and CUKIS, whose files were available in the archives between the years 2018 and 2021.

3. Results

3.1. Socio-Demographic Profile, Clinical and Biological Parameters of Patients

Table 1 shows demographic parameters of the patients studied. The result reveals that the majority of the DM patients were male (56.4%), while more than three-forth had a family history of DM. Among the patients, those diagnosed with type 2 diabetes were accounted for 83.4% of cases. In 68.8% of patients, the disease had been diagnosed less than 5 years ago. The patients' average body mass index (BMI) was 27.7 ± 5.4 kg/m^2, while their average age was 55.3 ± 13 years. The research indicated that the mean body temperature was 37.5 ± 1.3˚C. Additionally, the mean blood glucose concentration was recorded at 263 ± 109.8 mg/dl. Only 155 patients (41.4%) benefited from the lifestyle and dietary measures (HDM) and difference was significant for all measures ($P < 0.05$).

Table 1. Distribution of cases according to sex, age and main activity (n = 374).

Variables	Parameters		*P*-value
Sex (n = 374)	**Male (%)**	**Female (%)**	
	211 (56.4)	163 (43.6)	<0.004©
Family history	**Yes (%)**	**No (%)**	
	268 (71.6)	106 (29.4)	<0.001©
Duration of disease	**≤5 years (%)**	**>5 years (%)**	
	250 (68.8)	124 (33.2)	<0.001®
Type of diabetes mellitus	**Type 1 (%)**	**Type 2 (%)**	
	62 (16.3)	312 (83.7)	<0.001©
Main activities (n = 374)	**Effective**	**%**	
Civil servant	139	37.2	
Commerce/business	72	19.3	
Housewife	60	16.0	
Other*	52	13.9	
Not specified	51	13.6	
Anthropometric, biological and clinical parameters	$\bar{x}$ **± SD**	**Min - Maxim**	
Ages (years)	55.3 ± 13	[18 - 98]	
BMI (Kg/m^2)	27.7 ± 5.4	[16.4 - 44.9]	
Systolic blood pressure (mmHg)	137.2 ± 21.9	[70 - 220]	
Diastolic blood pressure (mmHg)	93.4 ± 16.4	[40 - 129]	
Temperature (˚C)	37.5 ± 1.3	[34.5 - 40.2]	
Blood sugar (mg/dl)	263 ± 109.8	[121 - 600]	

Continued

Associated pathologies/complications (n = 374)	Effective	%	
Malaria and other infections	158	42.2	
High blood pressure	137	36.6	
Kidney failure	61	16.3	
Heart disease	43	11.5	
Others**	45	12	
MHD prescription (n = 374)	**Yes (%)**	**No (%)**	
	155 (41.4)	219 (58.6)	0.004©
Prescribed MHD (n = 155)	**Yes (%)**	**No (%)**	
Ban on sugary foods	149 (96.1)	6 (3.9)	<0.001©
Low-sodium diet	123 (79.4)	32 (20.6)	<0.001©
Vegetable consumption	51 (32.9)	104 (67.1)	<0.001©
Avoid high GI foods	14 (9.0)	141 (91.0)	<0.001©
Weight reduction	61 (39.4)	94 (60.6)	<0.002©
Regular physical	98 (63.2)	57 (36.8)	<0.001©
Activity walking	37 (23.9)	118 (76.1)	<0.001©

® = Pearson chi-square test; © = Fisher's Exact tests; * = Pastor, farmer, resourceful, taxi driver; ** = Retinopathy, diabetic foot and neuropathy; MHD = Hygiene and dietary measures.

In relation to the prescribed measures, 149 of the 155 patients, representing 96.1%, were advised to refrain from consuming sweet-flavored items, including cookies, candies, chocolates, and sugary beverages. Furthermore, 79.4% of the patients were prescribed a low-sodium diet, and 63.2% were advised to engage in regular physical exercise, defined as at least three sessions per week, each lasting thirty minutes. Out of 155 patients, merely 14, representing 9.0%, were advised to limit their intake of foods characterized by a high glycemic index (GI). The result revealed that the diet prescriber did not clearly define which specific foods were included in this recommendation.

3.2. Prevalence/Magnitude/Frequency of Diabetes Mellitus

The results of the prevalence of diabetes mellitus among patients admitted to the internal medicine departments of selected healthcare institutions from 2018 to 2021 are presented in Table 2.

The prevalence/magnitude/frequency of diabetes mellitus was studied over a period from 2018 to 2021, during which 6013 patients were admitted to the internal medicine department of various healthcare institutions. Among them, 374 (6.2%) cases of diabetes DM were diagnosed. The percentage varied over the years, starting at 4.2% in 2018, increasing to 8.0% in 2020, and subsequently decreasing

to 7.1% in 2021. The frequencies/prevalence observed varied considerably across the healthcare facilities over the four-year study period ($P < 0.05$): specifically, the rate was 9.4% at the university clinics, 7.7% at the Makiso-Kisangani General Hospital, and 6.7% at the Cinquantenaire Hospital in Kisangani. Conversely, the Kabondo HGR exhibited a low prevalence rate of merely 3.6%.

Table 2. Prevalence/magnitude frequency of diabetes mellitus by year and by health facility.

Year	2018		2019		2020		2021		Total		*P*
GRH	Cases	DM (%)	Case	DM (%)	Case	DM (%)	Case	DM (%)	Case	DM (%)	
Mangobo	170	9 (5.3)	120	7 (5.8)	108	8 (7.4)	179	12 (6.7)	577	36 (6.2)	
Tshopo	237	8 (3.4)	163	7 (4.3)	112	6 (5.3)	290	17 (5.8)	802	38 (4.7)	0.008®
Makiso	190	7 (3.7)	210	17 (8.1)	230	21 (9.1)	173	17 (9.8)	803	62 (7.7)	
Lubunga	137	9 (6.5)	103	6 (5.8)	100	7 (7.0)	283	19 (6.7)	623	41 (6.5)	
Kabondo	324	8 (2.5)	315	12 (3.8)	223	10 (4.5)	365	14 (3.8)	1227	44 (3.6)	
HCK	313	14 (4.5)	336	16 (4.8)	299	26 (8.7)	331	30 (9.1)	1279	86 (6.7)	
CUKIS	141	8 (5.7)	202	17 (8.4)	219	26 (11.8)	150	16 (10.7)	712	67 (9.4)	
Total	1512	63 (4.2)	1449	82 (5.7)	1291	104 (8.0)	1771	125 (7.1)	6023	374 (6.2)	

® = Pearson chi-square test; GRH = General Reference Hospital; DS: Diabetes mellitus; HCK: Hospital of Cinquantenaire Kisangani; CUKIS: University Clinics of Kisangani.

3.3. Evolution of Cases over the Years

The evolution of cases of diabetes mellitus over the years in Kisangani is presented in Figure 1 and Figure 2.

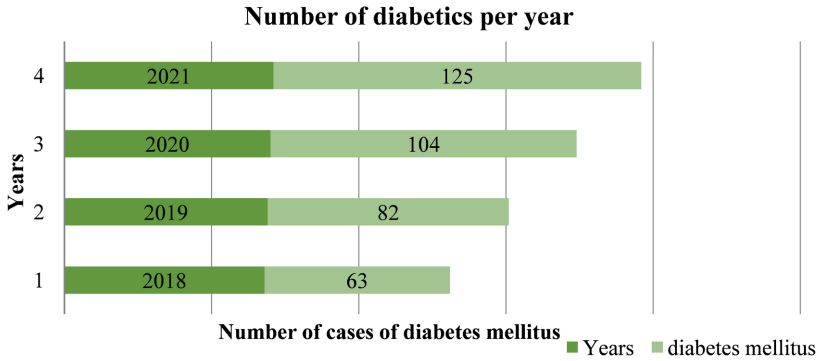

Figure 1. Number of diabetic cases admitted per year.

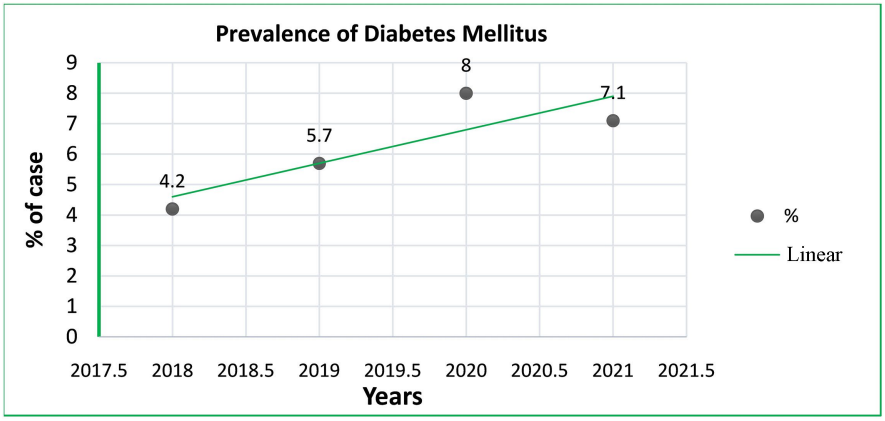

Figure 2. Evolution of case of diabetes mellitus.

The analysis reveals an alarming trend: cases of diabetes are increasing steadily each year. In 2018, there were 4.2%, which increased to 5.7% in 2019, 8% in 2020 and finally to 7.1% in 2021.

4. Discussion

4.1. Patient Socio-Demographic Profile, Clinical and Biological Parameters

The data regarding gender of the study subjects reveals that more than half of the DM patients were male (56.4%) and the difference between the two sexes was significant ($P < 0.001$). This finding agrees with the report of Yakusu *et al.* [15], where 66.2% of DM patients were reported to be male at CUKIS. However, the current finding contradicts with the results of Risasi Etutu Junior *et al.* [3] at the Kinshasa provincial hospital, where 60% of cases were female. The International Diabetes Federation [16] indicates that the number of male diabetic patients is slightly higher than that of women, which agrees with this result. The average age of the patient was 55.3 ± 13 years, which agrees with the average age of 56.3 years reported by Yakusu *et al.* [15] among diabetics in CUKIS. This result can be explained by the pathophysiology of DM, a chronic disease that often manifests clinically after the age of forty. In addition, 3/4 of the patients had a family history of DM, and most cases were type 2 diabetes mellitus, with type 1 DM representing only 16.3% of patients ($P < 0.001$).

It is well known that the proportion of type 1 diabetes mellitus (T1DM) cases often does not exceed 25% of diabetes mellitus cases [17]. However, we recognize that classifying as T1DM if patients were under 40 and type 2 diabetes mellitus (T2DM) if 40 or older is imprecise. In fact, for some patients, the healthcare staff did not document the specific DM type at all, forcing us to rely on age as a proxy. This approach may have led to misclassification, potentially affecting our analyses of prescription patterns and dietary recommendations, which differ between T1DM and T2DM. We therefore consider this as a key weakness of this study and recommend targeted training for clinicians to ensure that DM type is recorded accurately at admission.

The average Body Mass Index of the patients was 27.7 kg/m^2 (16.4 to 44.9) of

indicating that the majority of patients were overweight or obese. It has been reported that overweight and obesity are risk factors for DM [18]. The mean blood glucose level of the patients was 263 ± 109.8 mg/dl. Although these measurements were taken at different times of the day, it reflects persistent hyperglycemia in diabetic patients. Chronic hyperglycemia is a key feature of impaired glycemic control. This condition puts patients at increased risk of metabolic and vascular complications, such as neuropathy, retinopathy, cardiovascular disease, and renal damage [19] [20]. High and uncontrolled blood glucose levels can lead to structural and functional alterations of blood vessels, nerves, and other tissues, thus contributing to the progression of diabetic complications [21] [22]. The comorbidity of diabetes mellitus and hypertension was 36.6% and 42.2% for malaria and infections.

The previous studies reported that about 20% DM patients had cardiac disease, whereas 16.3% had a nephropathy. A comorbidity rate of diabetes mellitus and hypertension of 21.1% and 39.6% for infections was also reported [10].

4.2. Magnitude of Diabetes Mellitus

The prevalence of Diabetic Mellitus varies significantly among the five health facilities surveyed in Kisangani, ranging from 3.6% at HGR Kabondo, 4.7% at HGR Tshopo, 6.8% at Cinquantenaire Hospital of Kisangani, 7.7% at HGR Makiso-Kisangani to 9.4%) at CUKIS ($P < 0.008$). This inter-facility variation likely reflects differences in patient socioeconomic status (higher income patients tend to frequent CUKIS, HGR Makiso-Kisangani or Cinquantenaire Hospital of Kisangani, where fees and perceived quality and availability of specialised care are higher) as shown in **Table 2**.

The overall hospital-based prevalence of 6.2% in this study was lower than 8.4% for DM and 18.0% for prediabetes reported by Nantakumar *et al.* [9] in Kinshasa. However, Nantakumar *et al.* conducted a community-level screening of diabetes mellitus in which assymptomatic cases and those who never visited a clinic were captured. By contrast, our study included only patients already admitted to hospitals, undercounting other categories. It then appears that the number of asymptomatic diabetics is higher in the general population than in those who consult health structures. Therefore, it is a dangerous situation in terms of health, because uncontrolled hyperglycemia for a long period predisposes the patient to short- and long-term complications. Since these people do not benefit from the necessary early medical and hygiene-dietary interventions. However, Muyer *et al.* [7] documented a 4.8% DM prevalence in Kisantu, a peri-urban city of Bas Congo, despite using a community-level screening. We believe that environmental and lifestyle factors, such as more sedentary habits and greater consumption of fatty or refined and sugary foods in urbanised Kinshasa, may explain why their prevalence (8.45%) differs from that of Kisantu (4.8%).

4.3. Evolution of Cases by Year

The higher number of cases 8.0% and 7.1% were recorded in 2020 and 2021 respec-

tively. In addition, **Figure 1** shows that the number of diabetes cases increased each year, with 63 cases in 2018, 82 in 2019, 104 in 2020 and 125 cases in 2021. A previous study conducted at CUKIS revealed a hospital prevalence of DS of 4.1% [8]. However, in this study, the frequency of cases found is twice as high (9.4%) in the same healthcare facility. The situation in Kisangani is consistent with data from Saeedi *et al.* [2] and the International Diabetes Federation [16], which shows an increasing trend in cases of DM worldwide, estimated at 108 million in 1980, 422 million in 2014, 463 million in 2019, and possibly reaching 578 million in 2030 [2]. In Africa, between 1980 and 2014, the number of reported diabetes mellitus cases increased from 7 million to 25 million. This number is estimated to reach 34.2 million by 2040. It is predicted that 63% of cases of diabetes mellitus remain undiagnosed [16]. This increase in cases in the hospital incidence of diabetes mellitus found in this study can be attributed to population growth, nutritional transition, sedentary lifestyle, genetic factors, and population aging. These data highlight the critical importance of taking preventive measures and effective management of this growing disease.

4.4. Prescribed Lifestyle and Dietary Measures

The result of the study reveals that the lifestyle and dietary measures were prescribed in only 41.4% of patients. In the management of the DM, hygiene and dietary measures are recommended for all patients; however, in the DRC, these measures are based on principles adapted to local realities while being inspired by international recommendations. In particular, limiting the consumption of fast sugar and sugary foods, promoting the consumption of complex carbohydrates and dietary fiber, controlling fat and protein intake, balanced meal distribution, and integrating physical activity and stress management [17]. However, the prescribers did not comply with this principle, some mentioned only hygieno-dietetic measures in the patient's file without any detail, and others mentioned some food and physical activity on the patient sheet. This could hamper the patient's support for the prescribed regime, since he did not have clear explanations on the principles of the regime and his importance in the management of his illness. We then propose that the service provider be trained in dietetic management to improve prescription. In addition, as some hospitals do not have nutritionists, it is therefore important that the government can hire nutritionists in all hospitals so that they ensure dietary advice for patients. It is also possible that some patients received dietary advice verbally, but nothing was recorded in the medical file, which would have led to the patient being considered as not having received dietary advice. Indeed, it has been established that the pharmacological approach in glycemic control in diabetics is more effective when combined with low rather than high glycemic index (GI) diets [11] [12] [23]. Similarly, regular physical activity can reduce tissue resistance to insulin and thus increase sensitivity in diabetic patients [24]-[26].

Among the prescribed MHDs, the prohibition of the consumption of sweet foods

(biscuits, candies, chocolate, sugary drinks) was recommended to 96.1% of the patients. This result is in line with the international recommendation for the management of DM which prohibits the consumption fast sugar and sugary foods at diabetic patients given that the ability to regulate blood sugar is impaired and blood sugar peaks can be difficult to control, thus increasing the risk of long-term complications such as diabetic retinopathy, diabetic neuropathy, diabetic nephropathy and cardiovascular diseases [27]. The concept of glycemic index (GI) was prescribed in only 14 files out of 155 patient files, or 9.0% ($P < 0.001$). This finding suggests a lack of information among prescribers regarding a new food classification. It should be noted that the concept of glycemic index has replaced that of fast sugar/slow sugar, which classified sweet-tasting foods as having a rapid hyperglycemic effect [28]. However, some foods such as white rice, cassava and potato are known to have a high glycemic index, regardless of their taste [28] [29].

Clinical recommendations in the diabetic diet indicate that carbohydrates should provide 50% - 60% of total energy intake (TEI) and preferably complex carbohydrates; the consumption of foods with a low glycemic index (GI) and glycemic load (GL) is to be favored; the intake of dietary fiber is 25 - 40 g/day, proteins 15% of TEI, lipid < 30% providing mono and polyunsaturated fatty acids, the consumption of fruits is strongly recommended; vegetables, nuts, fiber, whole grains, and unsaturated oils are to be favored. It is advisable to give three meals and two snacks, depending on the patient's nutritional status [30].

It should be noted that the concept of glycemic load, which takes into account both the glycemic index and the quantity of carbohydrates in the meal, was not found in any file. This concept has a great importance in dietary prescription, as a low or medium glycemic index diet is considered beneficial for the prevention and management of diabetes mellitus, coronary heart disease, and obesity [24] [31]. This dietary approach reduces insulin secretion and lowers blood lipid concentrations in patients with hypertriglyceridemia [13] [26]. In addition, the consumption of vegetables, fruits, and whole grains helps maintain blood glucose levels around normal values in diabetics due to their low or medium glycemic index, attributable to their high dietary fiber content.

The increasing incidence of type 2 diabetes mellitus (T2DM) could become a major health problem in Kisangani if strategies related to diet, physical activity, or both, which can prevent or delay T2DM and its complications in at-risk individuals, remain unknown [24]. Furthermore, it should be noted that other lifestyle and dietary measures, such as those related to sleep, stress, alcohol and tobacco, were also not present in the patients' records, which highlights an additional aspect of the inadequacy of the lifestyle and dietary measures provided.

5. Conclusion

The finding indicated that DM is increasing in the city of Kisangani, which raises concerns about the future control of this disease. This upward trend requires the urgent implementation of effective preventive measures to control the growing

prevalence of DM. Less than fifty percent of patients benefited from lifestyle and dietary measures and less than ten percent had the recommendation of a low GI diet. It is necessary to conduct a study on the glycemic indices of local foods. It is also recommendable to raise awareness among healthcare providers and patients on the importance of consuming a low glycemic index diet in the management of diabetes mellitus.

Acknowledgements

We thank Mr. Baruti Mantega and Mr. Loani Mangbako Danny for their participation during data collection.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Abel, E.D., Gloyn, A.L., Evans-Molina, C., Joseph, J.J., Misra, S., Pajvani, U.B., *et al.* (2024) Diabetes Mellitus—Progress and Opportunities in the Evolving Epidemic. *Cell*, **187**, 3789-3820. https://doi.org/10.1016/j.cell.2024.06.029

[2] Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., *et al.* (2019) Global and Regional Diabetes Prevalence Estimates for 2019 and Projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th Edition. *Diabetes Research and Clinical Practice*, **157**, Article ID: 107843. https://doi.org/10.1016/j.diabres.2019.107843

[3] Risasi Etutu Junior, R., Lukusa Mbaya, A. and Motuta Amisi, C. (2021) Profil épidémiologique, clinique et facteurs de risque de diabète sucré. Cas de l'Hôpital Provincial Général de Référence de Kinshasa. *Congo Research Papers*, **1**, 100-118. https://hal.science/hal-03750935/document

[4] International Diabetes Federation (2025) Diabetes around the World in 2024.

[5] Mawaw, P.M., Yav, T., Mukuku, O., Lukanka, O., Kazadi, P.M., Tambwe, D., *et al.* (2019) Increased Prevalence of Obesity, Diabetes Mellitus and Hypertension with Associated Risk Factors in a Mine-Based Workforce, Democratic Republic of Congo. *Pan African Medical Journal*, **34**, Article No. 135. https://doi.org/10.11604/pamj.2019.34.135.20226

[6] Katchunga, P.B., Malanda, B., Mweze, M.C., Dupont, B., M'Buyamba-Kabangu, J.R., Kashongwe, Z., *et al.* (2012) Connaissances de la population générale sur l'hypertension artérielle et le diabète sucré au Sud-Kivu, République démocratique du Congo. *Revue d'Épidémiologie et de Santé Publique*, **60**, 141-147. https://doi.org/10.1016/j.respe.2011.10.005

[7] Muyer, M.T., Muls, E., Mapatano, M.A., Makulo, J., Mvitu, M., Kimenyembo, W., *et al.* (2012) Diabetes and Intermediate Hyperglycaemia in Kisantu, DR Congo: A Cross-Sectional Prevalence Study. *BMJ Open*, **2**, e001911. https://doi.org/10.1136/bmjopen-2012-001911

[8] Muyer, M.-C., Muls, E., Buntinx, F., Mapatano, A. and Bieleli, E.O.W. (2008) Diabetes Mellitus in Sub-Saharan Africa, a Systematic Review of the Literature. *Louvain Médical*, **127**, 153-165.

[9] Nantakumar, A., *et al.* (2021) Estimating the Prevalence of Asymptomatic Type 2 Diabetes in Kinshasa, Democratic Republic of Congo. *East African Journal of Public Health*, **15**, 44-53.

[10] Batina, A. (1996) Diabete sucré de l'adulte Zaïrois: Classification, facteurs de risque cardiovasculaire, complication évolutive. Mémoire de Spécialisation, Université de Kisangani.

[11] Livesey, G., Taylor, R., Hulshof, T. and Howlett, J. (2008) Glycemic Response and Health—A Systematic Review and Meta-Analysis: Relations between Dietary Glycemic Properties and Health Outcomes. *The American Journal of Clinical Nutrition*, **87**, 258S-268S. https://doi.org/10.1093/ajcn/87.1.258s

[12] Barclay, A.W., Petocz, P., Mcmillan-price, J., Flood, V.M., Prvan, T., Mitchell, P., *et al.* (2008) Glycemic Index, Glycemic Load, and Chronic Disease Risk—A Meta-Analysis of Observational Studies. *The American Journal of Clinical Nutrition*, **87**, 627-637.

[13] Wolever, T., Jenkins, D., Jenkins, A. and Josse, R. (1991) The Glycemic Index: Methodology and Clinical Implications. *The American Journal of Clinical Nutrition*, **54**, 846-854. https://doi.org/10.1093/ajcn/54.5.846

[14] Mense, K., Mapatano, M.A., Mutombo, P.B. and Muyer, M.C. (2014) Une étude castémoins pour déterminer les facteurs de non-observance du suivi médical chez les patients diabétiques à Kinshasa, en 2010. *Pan African Medical Journal*, **17**, Article No. 258. https://doi.org/10.11604/pamj.2014.17.258.2892

[15] Yakusu, I., Tshilumba, K., Agasa, B., Bome, B., Bassandja, O., Babanya, T., *et al.* (2023) Profil épidémiologique, clinique et thérapeutique de complications métaboliques aigues de diabete sucré aux cliniques universitaires de Kisangani, RD Congo. *Jaccr Africa*, **7**, 269-283.

[16] Mutyambizi, C., Pavlova, M., Chola, L., Hongoro, C. and Groot, W. (2018) Cost of Diabetes Mellitus in Africa: A Systematic Review of Existing Literature. *Globalization and Health*, **14**, Article No. 3. https://doi.org/10.1186/s12992-017-0318-5

[17] Brink, S.J., Lee, W.R.W. and Pillay, K. (2011) Le diabète de l'enfant et de l'adolescent: Manuel de forMation de base à l'usage des professionnels de santé des pays en développement. https://www.novonordisk.com/content/dam/nncorp/global/en/sustainable-business/pdfs/changing-diabetes-in-children/CDiC_Basic_HCP_training_manual_fr.pdf

[18] O'Hara, H., Taylor, J. and Woodside, J.V. (2023) The Association of Specific Dietary Patterns with Cardiometabolic Outcomes in Women with a History of Gestational Diabetes Mellitus: A Scoping Review. *Nutrients*, **15**, Article No. 1613. https://doi.org/10.3390/nu15071613

[19] American Diabetes Association (2020) 5. Facilitating Behavior Change and Well-Being to Improve Health Outcomes: Standards of Medical Care in Diabetes—2021. *Diabetes Care*, **44**, S53-S72. https://doi.org/10.2337/dc21-s005

[20] Yoo, H., Choo, E. and Lee, S. (2020) Study of Hospitalization and Mortality in Korean Diabetic Patients Using the Diabetes Complications Severity Index. *BMC Endocrine Disorders*, **20**, Article No. 122. https://doi.org/10.1186/s12902-020-00605-5

[21] Forbes, J.M. and Cooper, M.E. (2013) Mechanisms of Diabetic Complications. *Physiological Reviews*, **93**, 137-188. https://doi.org/10.1152/physrev.00045.2011

[22] American Diabetes Association (2017) 9. Cardiovascular Disease and Risk Manage-

ment: *Standards of Medical Care in Diabetes*—2018. *Diabetes Care*, **41**, S86-S104. https://doi.org/10.2337/dc18-s009

[23] Kong, N.W., Ning, H., Zhong, V.W., Paluch, A., Wilkins, J.T., Lloyd-Jones, D., *et al.* (2021) Association between Diet Quality and Incident Cardiovascular Disease Stratified by Body Mass Index. *American Journal of Preventive Cardiology*, **8**, Article ID: 100298. https://doi.org/10.1016/j.ajpc.2021.100298

[24] Hemmingsen, B., Gimenez-Perez, G., Mauricio, D., Roqué i Figuls, M., Metzendorf, M. and Richter, B. (2017) Diet, Physical Activity or Both for Prevention or Delay of Type 2 Diabetes Mellitus and Its Associated Complications in People at Increased Risk of Developing Type 2 Diabetes Mellitus. *Cochrane Database of Systematic Reviews*, **2017**, Art. No. CD003054. https://doi.org/10.1002/14651858.cd003054.pub4

[25] Lee, I., Shiroma, E.J., Lobelo, F., Puska, P., Blair, S.N. and Katzmarzyk, P.T. (2012) Effect of Physical Inactivity on Major Non-Communicable Diseases Worldwide: An Analysis of Burden of Disease and Life Expectancy. *The Lancet*, **380**, 219-229. https://doi.org/10.1016/s0140-6736(12)61031-9

[26] Liu, A.G., Most, M.M., Brashear, M.M., Johnson, W.D., Cefalu, W.T. and Greenway, F.L. (2012) Reducing the Glycemic Index or Carbohydrate Content of Mixed Meals Reduces Postprandial Glycemia and Insulinemia over the Entire Day but Does Not Affect Satiety. *Diabetes Care*, **35**, 1633-1637. https://doi.org/10.2337/dc12-0329

[27] Cnop, M., Foufelle, F. and Velloso, L.A. (2012) Endoplasmic Reticulum Stress, Obesity and Diabetes. *Trends in Molecular Medicine*, **18**, 59-68. https://doi.org/10.1016/j.molmed.2011.07.010

[28] Jenkins, D.J.A., Dehghan, M., Mente, A., Bangdiwala, S.I., Rangarajan, S., Srichaikul, K., *et al.* (2021) Glycemic Index, Glycemic Load, and Cardiovascular Disease and Mortality. *New England Journal of Medicine*, **384**, 1312-1322. https://doi.org/10.1056/nejmoa2007123

[29] Augustin, L.S.A., Kendall, C.W.C., Jenkins, D.J.A., Willett, W.C., Astrup, A., Barclay, A.W., *et al.* (2015) Glycemic Index, Glycemic Load and Glycemic Response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). *Nutrition, Metabolism and Cardiovascular Diseases*, **25**, 795-815. https://doi.org/10.1016/j.numecd.2015.05.005

[30] Madhu, S., Chawla, R., Makkar, B., Ghosh, S., Saboo, B. and Kalra, S. (2020) RSSDI-ESI Clinical Practice Recommendations for the Management of Type 2 Diabetes Mellitus 2020. *Indian Journal of Endocrinology and Metabolism*, **24**, 1-122. https://doi.org/10.4103/ijem.ijem_225_20

[31] Jung, C. and Choi, K.M. (2017) Impact of High-Carbohydrate Diet on Metabolic Parameters in Patients with Type 2 Diabetes. *Nutrients*, **9**, Article No. 322. https://doi.org/10.3390/nu9040322