


Diabetic Foot Care: Assessing the Knowledge and Practices of Diabetic Patients at Aldaraga Centre, Gezira State, Sudan, 2021

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Introduction: Improving diabetic patients' foot care behaviours is crucial in the incidence reduction of diabetic foot ulceration-associated complications.

Objective: This study assessed the knowledge and practice of diabetic patients towards diabetic foot care and their general understanding of diabetes causes, complications, and treatment.

Methods: A cross-sectional study was conducted at Aldaraga Clinic Centre, Sudan, with a sample size of 100 diabetic patients. A questionnaire and checklist were used to collect data for this study. The data was analyzed through SPSS Version 16 software.

Results: The majority of respondents were females (62%), above 40 years old (66%), married, with a low educational level, and moderate-income (76%). The study revealed that most respondents did not attend any educational program about diabetes, indicating poor or no knowledge about diabetes mellitus. However, respondents had good knowledge of most signs and symptoms of diabetes, with the highest percentage (88%) for extreme thirst. Concerning the knowledge of respondents about complications of diabetes, it was generally poor, except for retinal diseases (70%). Participants' knowledge of signs and symptoms of hypoglycemia was found to be poor at 25%. The study showed that most respondents did not know what diabetes gangrene is. Foot infections were the most dominant cause of hospitalization among diabetic patients, often leading to amputations.

Conclusion: Enhancing foot care behaviours in diabetic patients is crucial to reduce diabetic foot ulceration risks. Patient-friendly educational interventions and regular physician reinforcement are urgently needed, including awareness programs, specialized diabetes centres, and health education through mass media to improve foot care practices and prevent complications like amputations.

Keywords: diabetic foot care, diabetic knowledge, diabetic patients

Introduction

Improving diabetic foot care is crucial in minimizing foot ulceration and its negative impact on diabetic patients. A common cause of hospitalization and amputation is foot infections among most individuals with diabetes. Globally, foot ulceration affects 15% of diabetic patients and could lead to severe complications and even death. The incidence of depression in patients with diabetic foot ulcers (DFUs) in a meta-analysis paper found that nearly half of patients with DFUs experienced depression, with the incidence ranging from 26% to 85%.¹ In Sudan, diabetes mellitus is a prevalent medical issue, and diabetic septic foot infection is a severe complication with significant morbidity and mortality.² Diabetes is a chronic health problem with preventable consequences. Globally, the number of people with Type 2 diabetes is expected to increase significantly by 2030. In the United States, there are millions of adults with Type 2 diabetes, affecting both men and women. However, in Sudan, the prevalence is more horrible since the DFU prevalence of 18.1%, with a significant association, resulting in a 3.16-fold increase in probability for those living with diabetes for more than ten years, even after adjusting for other risk factors.³

The incidence rate of foot ulcers and lower extremity amputations is high among diabetic patients, leading to significant morbidity and mortality. The economic and emotional impact on patients and their families is substantial.⁴

Diabetic septic foot (DSF) is a common problem that can lead to amputation. The management of foot ulceration should focus on infection control, treating peripheral ischemic arteries, addressing abnormal loading pressure, and managing limited joint mobility. Studies have shown that the development and prevalence of DSF range from 1% to 4% and 4% to 10%, respectively. Diabetic foot ulcers significantly affect the well-being and quality of life of individuals with diabetes.⁵

Causes of Diabetic Septic Foot

The causes of diabetes vary depending on the class of the type. Type 1 diabetes may have genetic factors and can be triggered by certain infections, such as the *coxsaekie B4* virus. Specific HLA genes influence individual susceptibility to these triggers. Lifestyle factors do not seem to be related to the incidence of type 1 diabetes.⁶

Signs and Symptoms of Diabetes

The classic symptoms of untreated diabetes are the loss of weight, polyuria, polydipsia, and polyphagia. The symptoms may develop rapidly (in weeks or months); however, Type 1 diabetes usually develops much more slowly and may be absent. Long-term high blood glucose can cause glucose absorption in the eye's lens, leading to a change in shape and vision changes, so Blurred vision is a common symptom leading to a diabetes diagnosis. Several skin rashes that can occur in diabetes are collectively known as diabetes dermatoses.⁷ The term "type 1" has replaced several forms, such as adult-onset diabetes, obesity-related diabetes, and Non-Insulin Dependent Diabetes Mellitus (NIDDM). Beyond these two types, there is no agreement on the standard terminology.⁸

Type 1 Diabetes

Type 1 DM is characterized by a lack of insulin due to the pancreas's lack of effective beta cells. It can be immune-mediated or idiopathic. About 10% of diabetes cases in North America and Europe are Type 1. The Type 1 diabetes could affect both children and adults, although it was traditionally called "juvenile diabetes". Brittle diabetes refers to sudden and recurrent fluctuations in glucose levels in insulin-dependent individuals.^{9,10}

Type 2 Diabetes

Type 2 diabetes is the dominant form and represents approximately 90% of cases of diabetes mellitus.¹¹ The rise in prevalence is predicted to be much more significant in developing than developed countries (69 versus 20%). In developing countries, people aged 40 to 60 (working age) are affected most, compared with those older than 60 in developed countries.¹² This increase in type 2 diabetes is inextricably linked to changes towards a Western lifestyle (high diet with reduced physical activity) and the rise in the prevalence of overweight and obesity in developing countries.¹³

Gestational Diabetes

The gestational diabetes mellitus (GDM) resembles Type 2 diabetes, involving inadequate insulin secretion and low response. It occurs in about 2% to 5% of pregnant women and may improve or disappear after birth. Gestational diabetes can be fully treatable but requires careful medical supervision throughout pregnancy. About 20% to 50% of affected pregnant women develop Type 2 diabetes later in life.¹⁴ Untreated women and their fetuses face risks such as increased birth weight, congenital anomalies in the cardiac and central nervous systems, and skeletal muscle malformations. Additionally, increased fetal insulin can lead to respiratory distress syndrome by inhibiting fetal surfactant production.

Support to Diabetic Patients

In countries with a general practitioner system like the United Kingdom, diabetes care can be provided outside of hospitals, with hospital-based specialist care reserved for complications, difficult blood sugar control, or research; the general practitioners and specialists often collaborate in a team approach to patient care. Home telehealth support can be an effective method for managing diabetes.¹⁵

Epidemiology of Diabetes

Globally, there were approximately 285 million people with diabetes in 2010, with Type 2 diabetes accounting for about 90% of cases. The incidence rate of diabetes is rapidly increasing and is expected to double by 2030. While diabetes occurs worldwide, it is more common in developed countries, particularly Type 2 diabetes. However, the most significant increase in prevalence is projected to occur in Asia and Africa due to urbanization and lifestyle changes, including a Western-style diet. The exact mechanism of this increase is not fully understood, but it is believed to be influenced by environmental factors, particularly diet.¹⁶

The pathophysiology of the diabetic foot involves various biochemical abnormalities that can accelerate neuropathy and vascular changes in the foot. These abnormalities include hyperglycemia, which inhibits the production and activation of cellular endothelial nitric oxide synthase, and the Maillard reaction, which is associated with diabetic complications and ageing. Diabetic foot ulcers (DFUs) are caused by neuropathy, ischemia, or a combination of both.¹⁷

Presentation and Management of the Diabetic Foot

Diabetic foot ulcers (DFU) result from various factors, with increased plantar pressure due to neuropathy being a primary risk. Diabetic neuropathy involves sensory, autonomic, and motor components, detectable through tests like the 10-g monofilament test. Autonomic neuropathy leads to dry skin, while motor neuropathy causes claw toe deformity and muscle atrophy. Diabetic sensorimotor polyneuropathy occurs in 40% to 50% of diabetes patients within a decade of diagnosis.¹⁷

Management of diabetic foot ulcers involves education on preventative measures and proper footwear, daily foot checks, and reporting any issues. Some studies recommended that routine C-reactive protein tests can be a valuable marker in preventing DFU prevalence since it was evident that there is a significant association between the test marker level and DFU incidence.¹⁸ Other management practices include controlling glucose, blood pressure, cholesterol, smoking, and weight, conducting risk assessments, implementing mechanical foot interventions, using antibiotics, and considering bypass surgery for peripheral arteries. Wound management focuses on keeping wounds dry and debriding dead tissue.¹⁹

Materials and Methods

Study Design and Area

A descriptive cross-sectional hospital-based study was conducted (July to August 2021). The study was conducted in the Aldaraga Clinic Centre at Wad Medani Town, the capital of the Al Gezira state in East-central Sudan. Wad Medani, the west bank of the Blue Nile, is nearly 85 miles (136km) South-east of Khartoum. It is linked to Khartoum by rail and is considered the centre of a cotton-growing region.

Study Population and Sample Size

Diabetic patients at Aldaraga Clinic Centre during the period of study. The sample comprises all available diabetic patients who attended the referring clinic during data collection (July to August 2021). Participants with diabetes aged 20 years and more were included; others were excluded.

Data Collection Tool and Analysis

The interview questionnaire was used to assess diabetic patients' knowledge regarding diabetes and diabetic foot care in the diabetic clinic at Aldaraga Centre in Gezira State, Sudan. The study sampling technique was convenient sampling. We used the Statistical Package for Social Science version 16 (SPSS) software program to analyze the data for this study.

Ethical Consideration

The Faculty of Medicine, University of Gezira, Sudan, first approved this study. The official letters for data collection approval were accepted by the head manager and medical director of Aldaraga Clinic Centre at Wad Medani. Participants were provided with explanations about the study questionnaire, including the study's title, purpose, participant selection criteria, study procedures, and potential benefits before inclusion. It was clear to participants that they had the right to

choose not to fill out the questionnaire. This study complies with the Declaration of Helsinki, as this research did not involve clinical interventions; only verbal consent was obtained from all participants per local regulations in Sudan.

Variables to Study

Known DM/Cause/Signs and Symptoms/ Gangrene /Foot Care.

Results

Results showed that most respondents (62%) were females, 38% were males, 66% were above 40 years, 18% were 20–30, and 16% were aged between 31 and 40 (Table 1).

It is clear from Table 1 that the highest percentage was for illiterate (26%), followed by postgraduate (22%), primary (20%), 18% graduate and 14% secondary schools, and the majority of respondents (84%) were married, 16% unmarried. Only 2% were widows. In addition, the majority (76%) have a moderate income, 16% with low incomes, and 8% with high incomes (Table 1).

Results showed that 45% of the duration of diabetes was for ages 1–5 years, 24% less than one year, 23% more than ten years, and 8% for 5–10 years (Table 2).

As shown in (Table 3), 40% of respondents defined diabetes as an increase in blood sugar, 30% did not know, 22% said that diabetes is a malfunction of the pancreas and insulin secretion, 40% thought it was an increase in sugar in the blood, frequent of urination and a chronic diseases respectively, only 2% thought that its fatigue and dehydration only 22% of sample size know the complete and correct definition of diabetes mellitus.

In Table 3, more than half of respondents (54%) got information about diabetes from different media (Radio, TV), 30% from health education, and only 6% got information about diabetes from newspapers.

Table 1 The Demographic Distribution of Participants

Group	Categories	Frequency (N-100)	%
Sex	Male	38	38.0
	Female	62	62.0
Age	20–30 years	18	18.0
	31–40 years	16	16.0
	41 years and more	66	66.0
Educational level	Illiterate	26	26.0
	Primary	20	20.0
	Secondary	14	14.0
	Graduate	18	18.0
	Postgraduate	22	22.0
Marital status	Married	82	82.0
	Unmarried	16	16.0
	Widow	2	2.0
Income level	Low	16	16.0
	Moderate	76	76.0
	High	8	8.0

Table 2 Distribution of Respondents by Degree of Duration

Duration of Diabetes	Frequency (N-100)	%
Less than one year	24	24.0
1-5 years	45	45.0
5-10 years	8	8.0
Greater than 10 years	23	23.0

Table 3 Respondent’s Knowledge About the Definition of Diabetes Mellitus and Sources of Information

Factor	Criteria	Frequency (N-100)	%
Definition of diabetes	Malfunction of pancreas and insulin secretion	20	20.0
	Increase of sugar In the blood	40	40.0
	Increase of sugar in blood/ increase in urination	4	4.0
	Fatigue/dehydration	2	2.0
	It chronic disease	4	4.0
	Do not know	30	30.0
Source of information	Health education	30	30.0
	Radio and TV.	54	54.0
	Newspapers.	6	6.0
	All the above	10	10.0

In Table 4, results showed that 64% of respondents thought that lifestyle is the leading cause of diabetes, 52% believed that it is a hereditary disease, 22% said that some viral infections may cause diabetes, and 18% said that misusing some drugs is the leading cause of diabetes mellitus. Also, most respondents have a good knowledge of most signs and symptoms of diabetes. The highest percentage (88%) came for Extreme thirst, 70% for frequent urination, 60% for Extreme hunger, and 48% for weight loss.

Table 4 Causes, Signs, and Symptoms of Diabetes

Factor	Causes and Symptoms	Frequent	%
Causes of diabetes	Hereditary	52	52.0
	Life style	64	64.0
	Some drugs	18	18.0
	Some viral infections	22	22.0
Signs and Symptoms	Frequent urination	70	70.0
	Frequent thirst	88	88.0
	Extreme hunger	60	60.0
	Loss of weight	48	48.0

The results of Table 5 showed that the majority of respondents, 74%, were using oral pills for treatment. Twenty percent insulin injection, and only 6% of respondents used herbal medicine. Results also showed that the knowledge of respondents about the complications of diabetes was knowledge of retinal diseases 70%, cardiovascular 46%, 42% for MI, renal diseases 38%, and 28% of them knew that diabetes might cause nervous system diseases, and only 10% knew the Gangrene.

As shown in Table 6, the highest percentage for business and rapid heart, sweating 30% followed by fatigue and shivering 28%, while 26% of respondents did not know any signs and symptoms of hypoglycemia, but 12% said that

Table 5 Diabetes Treatments and Complications

	Treatment and Complications	Frequency (N=100)	Per cent
Diabetes treatment	Oral pills	74	74.0
	Insulin injection	20	20.0
	Herbal	6	6.0
Diabetes complication	Cardiovascular	46	46.0
	Myocardial infarction	42	42.0
	Renal diseases	38	38.0
	Retinal diseases	70	70.0
	CNS diseases	28	28.0
	Gangrene	10	10.0
	Do not know	10	10.0

Table 6 Signs and Symptoms of Hypoglycemia

Category	Sign and Symptoms	Frequency (N=100)	%
Hypoglycemia	Shiver	28	28.0
	Dizziness	30	30.0
	Fatigue	28	28.0
	Hunger	12	12.0
	Rapid heart/ sweating	30	30.0
	Do not know	26	26.0
Hyperglycemia	(Dizziness)	54	54.0
	Rapid heartbeat	32	32.0
	Urination	10	10.0
	Sweating	12	12.0
	Thirst	10	10.0
	Hunger	14	14.0
	Numbness	20	20.0
	Do not know	26	26.0

hunger is the main sign of hypoglycemia. The overall knowledge of respondents about signs and symptoms of hypoglycemia was poor.

As shown in Table 6, 54% of respondents knew dizziness as a symptom of hyperglycemia, 32% said Rapid heartbeat, 26% did not know any of these symptoms, 20% said it was numb, 16% thirsty, and 14% hungry. Also, the respondent's knowledge of hyperglycemia signs and symptoms was poor.

The majority of respondents in Table 7 state that they do not know what diabetes is; 32% of them defined it as a healing wound due to diabetes, and 10% know that it is limb swelling due to poor circulation (correct definition), in addition, half of respondents (50%) do not know the causes of diabetes Gangrene, 38% said it is due to poor circulation, 30% said it is due to limb numbness.

As shown in Table 8, percentages of the respondents did not know any diabetes gangrene signs and symptoms; 26% knew of swelling and redness, 20% knew the mentioned symptoms, and 12% knew of smelly puss as signs of gangrene.

As shown in Table 8, the knowledge of respondents about prevention methods was poor, where 32% knew all forms of prevention, 22% knew about patient education, 14% about care, comfortable shoes, and taking treatment in the correct methods, and 18% did not know any of the mentioned prevention methods. Despite the importance of patients' knowledge and practice toward DFU management, medical practitioners' laboratory tests, such as C-reactive protein markers, could help patients increase awareness of DFU prevention and treatment.¹⁸

Most of the respondents (88%) in Table 9 had regular follow-ups, and 84% had good knowledge about the importance of taking diabetes treatment to avoid complications.

Table 7 Definition and Causes of Diabetes Gangrene

	Categories	Frequency (N=100)	%
Definitions	Slow-healing wound due to diabetes	32	32
	Limbs Swelling due to poor circulation	10	10
	Do not know	58	58
Causes of diabetes Gangrene	Limbs numbness	12	12
	Poor circulation	20	20
	Limbs numbness and poor circulation	18	18
	Do not know	50	50

Table 8 Signs, Symptoms, and Prevention Methods Knowledge of Diabetes of Gangrene

Factor	Symptoms and Prevention	Frequency (N-100)	%
Gangrene symptoms	Swelling and redness	26	26.0
	Smelling pus	12	12.0
	All the above answers	20	20.0
	Do not know	42	42.0
Methods of prevention	Patients education	22	22.0
	Feet care and comfortable shoes	14	14.0
	Taking treatment with the proper methods	14	14.0
	All the above-mentioned	32	32.0
	Do not know	18	18.0

Table 9 Knowledge About the Importance of Regular Follow-Up and Diabetes Treatment to Avoid Complications

Indicator	Knowledge		Practice	
	No	Yes	No	Yes
1. Use warm water for foot washing	90%	10%	84%	16%
2. Checking water temperature before using	40%	60%	58%	42%
3. Drying feet after washing	78%	22%	84%	16%
4. Talcum powder usage for keeping feet dry	90%	10%	90%	10%
5. Keeping the skin of feet soft to prevent dryness	56%	44%	79%	21%
6. Daily change of socks	60%	40%	66%	34%
7. Lotion not to be applied the inter-digital spaces	80%	20%	80%	20%
8. Trimming nails of feet straight with care	38%	62%	56%	44%
9. Inspection of feet once daily by respondents	66%	34%	78%	22%
10. Wearing comfortable coated shoes	43%	58%	73%	27%
11. Checking the shoes from the inside before wearing	68%	32%	86%	14%
12. Not walking with bare feet	14%	86%	40%	60%
13. Warning signs for which consultation is required	48%	52%	62%	38%

Table 10 Assessment of Diabetes Patient's Knowledge and Practice Regarding Foot Care

It is Essential to Have Regular Follow-Up	Frequency (N=100)	Per cent
Yes	88	88.0
No	12	12.0
Importance of treatment	Frequency	Per cent
Yes	84	84.0
No	16	16.0

Table 10 shows that diabetic patients' foot care knowledge is poor. At the same time, the practice is inferior, especially when concerning using warm water for foot washing (10% knowledge and training), drying feet after washing talcum powder to keep feet dry (22%, 16%), checking the shoes from inside before wearing (32%, 14). This result is similar to a study in which 29.3% of respondents had good knowledge. Forty percent had satisfactory knowledge, and 30% had poor knowledge about foot care. Whereas only 14% of respondents had good practice for foot care, 54% had sufficient practice, and 32% had poor practice.

Discussions

Concerning demographic data, it observed that most respondents were females 62%, above forty 66%, married, with a low educational level and with a moderate income 76%.

The general knowledge of diabetic respondents having diabetes mellitus, the study revealed that most respondents did not attend any educational program about diabetes, so it was clear from the results that the majority had either no

knowledge or poor knowledge about diabetes mellitus. Diabetes is a type of metabolic disease in which the patient has high blood sugar concentration, either due to the pancreas failing to produce enough insulin or because cells do not respond to the secreted insulin. This high blood sugar has the primary symptoms of polyuria (Frequent urination), polydipsia (increased thirst), and polyphagia (increased hunger). The knowledge about causes was good.⁶ Type 1 diabetes is partly inherited and triggered by specific infections. Type 2 diabetes is due primarily to lifestyle-intervened factors and genetics. Also, most respondents have a good knowledge of most signs and symptoms of diabetes. The highest percentage, 88%, came for extreme thirst, 70% for frequent urination, 60% for excessive hunger, and 48% for weight loss. This result is similar to the study conducted by Cooke, D.W. (2008), who stated that the typical symptoms of untreated diabetes are the loss of weight, polyuria, polydipsia, and polyphagia.⁷

Concerning the knowledge of respondents about complications of diabetes, it was observed that it is generally poor, except for the understanding of retinal diseases 70%; this partially differs from a previously conducted study, in which nearly 50% knew the complications of diabetes.²⁰

The highest percentage regarding symptom knowledge of hyperglycemia was for dizziness and rapid heartbeats, sweating, 30%, followed by fatigue and shivering, 28%. Some respondents (26%) did not know any signs and symptoms of hypoglycemia, while 12% said that hunger is the main sign of hypoglycemia.

Respondents' knowledge of signs and symptoms of hyperglycemia was poor, and only 25% knew about this issue.

The study revealed that the respondent's knowledge about hyper and hypoglycemia signs and symptoms was poor. The study showed that most respondents do not know what diabetes gangrene is; 32% of them defined it as slow-healing wounds due to diabetes, and only 10% knew the correct definition, which is limb swelling due to poor circulation. Most respondents had poor knowledge about the definition of diabetes Gangrene, which occurs when tissue dies (necrosis) because its blood supply is interrupted. Lack of understanding of diabetes mellitus (DM) and diabetic foot care (DFC) could have severe consequences for individuals living with diabetes.²¹ This lack of knowledge may lead to inadequate self-care practices, failure to recognize warning signs or symptoms, and neglect of proper management techniques.²² As a result, diabetic patients may experience worsened health outcomes, increased risk of complications such as foot ulcers or amputation, and overall diminished quality of life.^{23–25} Therefore, emphasizing education and raising awareness about diabetes and proper foot care is crucial to prevent potentially devastating consequences for diabetic patients. The importance and novelty of this study came from addressing of diabetic patients' education and campaigns to increase awareness towards DFU consequences and prevention to decrease prevalence of hospitalization and foot amputation in Gezira State, Sudan.

Conclusion

Diabetic patients often face hospitalizations and amputations due to foot infections, highlighting the critical importance of proper foot care. However, this study reveals an inadequacy in diabetic patients' knowledge and practices regarding foot care. Urgent action is required, including patient-friendly educational interventions and consistent guidance from physicians, to mitigate the risk of diabetic foot ulcers and amputations. To address this issue comprehensively, implementing awareness programs, establishing dedicated diabetes centres, and utilizing various media platforms for health education are recommended to enhance the current situation.

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Disclosure

The authors report no conflicts of interest concerning this work.

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