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Narrative Review of Diabetes Foot Ulcer Among Individuals Living with Type 2 Diabetes Mellitus in Bayelsa State Nigeria: Empirical Data on Epidemiology, Health Promotion and Primary Care

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ABSTRACT

Background: Diabetic foot ulcer (DFU) is a common complication among people living with diabetes mellitus (DM). Infection is a very common comorbidity in diabetes, which constitutes a risk factor for this complication. However, the knowledge of microbial spectrum associated with DM and/or DFU in Bayelsa State, Nigeria is unknown.

Objective: To identify empirical epidemiology, health promotion and primary healthcare data on infections and infectious disease management among individuals living with DM.

Method: The narrative review adopts a mixed-methods literature search approach.

Results: Empirical findings on the three themes i.e. epidemiology, primary healthcare preventive management and milestone achievements of health promotion in diabetes care are discussed. Addition fourth section of discussion is focused on DFU.

Conclusion: Implications for primary healthcare service are presented.

Abbreviations: DFU: Diabetic Foot Ulcer; DM: Diabetes Mellitus; LMICs: Low- and Middle-Income Countries; CVD: Cardiovascular Disease; DPN: Diabetes-Related Peripheral Neuropathy; LEA: Low Extremity Amputation

Introduction

The global epidemiology of people living with diabetes mellitus is four times more in some past decades and is the ninth major cause of death in the world today. About one (1) in eleven individuals worldwide suffer from diabetes mellitus, and ninety (90%) of such have T2DM. presently in the world today Asia is a major area of the emerging increasing rate of T2DM epidemics with China and India the most two epicenters [1]. In 2017 almost 462 individuals where affected due to type 2 diabetes millets corresponding to 6.28% of the world's population (4.4% of thoseaged15-49years, 15% of those aged 50-69, and 22% those aged 70 and above) or a prevalence rate of 6059 case per 100, 000. Recently there have been concerns that more than one- third of diabetes mortality occur in people of about 60 years of age and the disease burden is rising globally at a faster rate in developed countries [2]. Sub-Saharan Africa is the region with the highest projected increase rates of T2DM (129% by 2025), which will increase the already high prevalence of the disease and other infections associated the T2DM. In the region (sub-Saharan Africa), before now, T2DM was rare but is now fully acknowledged in the region. The epidemiology of T2DM has increased in the region but data from quality studies are not much to rely upon. The prevalence of T2DM is low in some rural populations but a high rate is mentioned in regions and countries, as those undiagnosed are still more in number.

It was also mentioned in some studies that the pathophysiology of T2DM in Blacks Africans is not the same with that in Europeans [3]. A study found that the global burden of diabetic foot ulcers (DFUs) is substantial, with an estimated 19.4 million DFUs occurring in 2017 [4]. This represents a 54% increase from 2000. The study also found that the prevalence of DFUs is highest in low- and middle-income countries (LMICs), with an estimated 13.1 million DFUs occurring in these countries in 2017. In another study from Nigeria [5], it was found that the prevalence of DFU in the United States is 6.7%. This means that approximately 6.4 million adults in the United States have DFU. The study also found that the prevalence of DFU is higher in men, (blacks, and Hispanics). It was also found that the prevalence of DFU was higher in men, older adults, and those with a longer duration of diabetes. The report pointed out that the prevalence of DFU was 6.3% among adults with diabetes aged 18 years or older. The study also found that the prevalence of DFU was higher in men, older adults, and those with a longer duration of diabetes. Yet, the level of knowledge among primary healthcare practitioners that is necessary to provide adequate diabetes care services remain poor [5,6].

Statement of the Problem

These studies suggest that DFU is a common complication of diabetes. The prevalence of DFU is higher in men, blacks, and Hispanics. DFU is also more common in older adults and those with a longer duration of diabetes. DFU is a preventable debilitating complication of diabetes, affecting approximately 15% of diabetic patients during their lifetime. Despite the advanced knowledge and practice in both diabetes and wound care management, DFU remain a major challenge, with high recurrent rate and also an economic burden on healthcare system (Wang, et al. [7]). However, the empirical evidence regarding burden of DFU is known to be vague or lacking (International Diabetes Federation, [8]), and such is the case in Bayelsa State of Nigeria. The efforts that have been made in DFU preventive medicine are also vague, hence could benefit from articulation. Further, the primary healthcare practices in terms of diagnosis and management of the infectious agents are relatively unknown.

Objectives

This study aims to synthesize the empirical evidence of DFU epidemiology, health promotion milestone and primary healthcare practices in Bayelsa State, Nigeria. This is with a view to provide framework for investigation of the factors that contribute to the development and management of DFU, with the goal of improving patient outcomes and reduce healthcare cost.

Method of Literature Search

This followed a traditional narrative approach in continuation of previously published conceptual review [9].

Burden of DFU in Nigeria

Nigeria bears the highest burden of diabetes prevalence in Sub-Saharan Africa. It is estimated that someone with diabetes has 20% chance of developing DFU in his or her life time [5]. It is also estimated that 2.5% of persons with diabetes would develop DFU every year [10], while amputations and mortality rate could be higher (Figure 1). There is variations in reported DFU amputation rate; and figure show 35% as report from Southern Nigeria, which is much lower than the speculated 80% from United States [11], but higher than the 24% report from Northern Nigeria [10]. Further, Ugwu, et al. [5] reported the risk factors contributing to DFUs may include poor glycemic control, lack of care knowledge, and delayed or no hospital presentation (Figure 2), as well as the types of ulcer (Figure 3). Figures 2 & 3 recognize the fact that risk factors, including but not limited to neurological and vascular phenomena, contribute to the burden of DFU [11-14]. It was concluded that the major challenges of DFU management in Nigeria is delayed hospital presentation [5]. This assertion is supported by yet another report from neighbouring Delta State in Nigeria that even some people who have free medical care are involved in the delayed presentation at hospital [15]. However, limited access to specialized care and inadequate foot care education may also contribute to poor outcome [6]. To effectively address this challenge, patient-centre approaches is needed to effectively handle diabetic issues/ complication within our society [16].

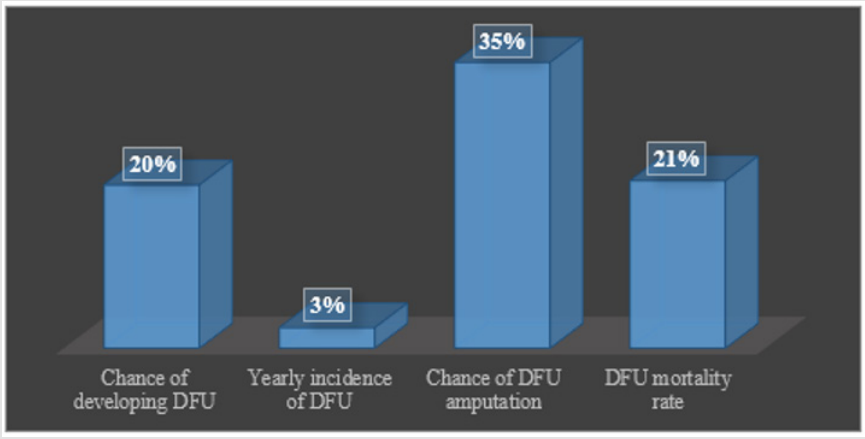

Figure 1: Reported burdens of DFU in Nigeria [5,10].

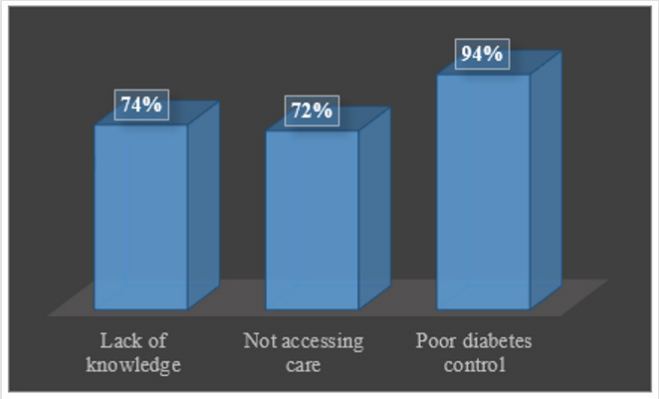

Figure 2: Risk factors in burden of DFU.

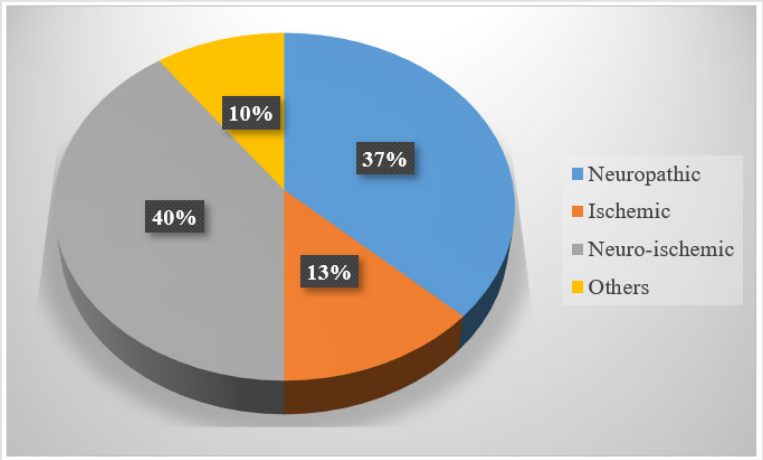

Figure 3: Distribution of DFU into types.

Epidemiology of DFU

The epidemiology of DFU encompasses the incidence, prevalence, and risk factors [12]. The prevalence of has been reported to be approximately 20% in individuals living with diabetes mellitus, while history of ulcers, PAD, and infections such as fungus are found between such patents toes as among the risk factors [17]. In a systematic review and meta-analysis carried out by Zhang et al, 2017, the reported prevalence of DFU could be viewed as comparably lower than the recent of 2023 (Table 1). The reports do indicate vagueness of data. For instance, the article of 2023 reported in ranges and lacks information on Oceania [18]. In Africa, a study that looked at 2003 to 2020 show that there is evidence of increasing prevalence, as well as variations reported levels within countries [19]. Figure 4 shows the different levels between some countries between 2019 and 2020. In Nigeria, studied prevalence and risk factors of diabetes foot ulcers in Kano, northwestern Nigeria, and found that the prevalence of DFU among diabetes patients in Kano, northwestern Nigeria, was 14.5%. The study also found that the risk factors for DFU included poor glycemic control, longer duration of diabetes, neuropathy, and peripheral artery disease [10]. Yet, in another report, the prevalence of DFU among diabetes patients in southwest Nigeria was 12.2%.

Table 1: Prevalence of DFU across continents.

Continent	Zhang, et al. [1]	Gamboa-Antiñolo [18] ‡
America	6.30%	13.00%
Asia	6%	15%
Europe	5.10%	9%
Africa	7.20%	20%
Oceania	3%	not indicated

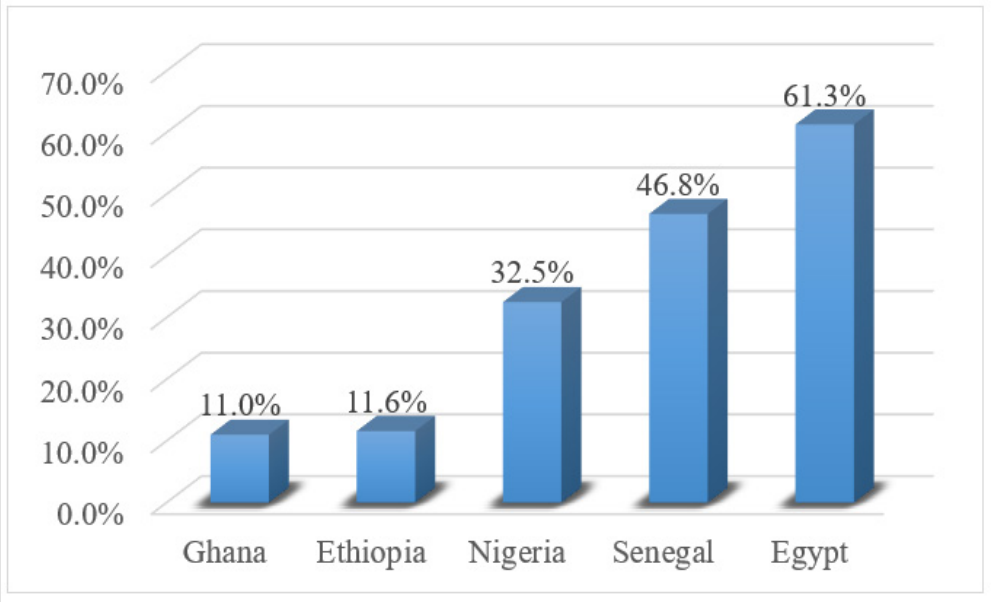

Figure 4: Prevalence of DFU in some African countries [19].

The study also revealed that the risk factors for DFU include poor glycemic control, neuropathy, peripheral artery disease, and previous history of DFU [5]. It is given that age and gender are non-modifiable risk factors in diabetes pathology. Nevertheless, it is worthy to note that a retrospective clinical observational study has reported DFU being lower in men than women [20]. Considering negative epidemiological determinants, co-morbidities and health seeking behaviour have been identified [8,13-15]. Besides the risk factors of diabetes, infection is one major determinant of DFU burden [21]. Yet, in the reports on "prevalence of risk factors for diabetes-related foot complications" recourse to diagnostic procedures are lacking in most systematic review and original research (International Diabetes Federation, [8]). Thus, there is an explicit need for research in this area.

Prevalence of Infections in Individuals with T2DM in Bayelsa State Nigeria

A cursory search on PubMed and Google Scholar for Diabetes infection//Nigeria//Bayelsa and diabetes infections in Bayelsa State Nigeria, respectively, show absolute dearth of literature. This is empirical evidence on the need for research work. However, in a study

carried out in Bayelsa State to assess the effect on the liver of type 2 diabetes with or without malaria comorbidity, and apparently non-diabetic individuals with or without malaria as control groups, the study shows liver functions and/or damage may be worse in diabetes with malaria than diabetes without the co-morbidity [22]. In another study carried out in Bayelsa state that investigated the incidence of cardiovascular disease (CVD) in chronic diabetes patients, comparing the prevalence in both male and females with respect to the duration of the illness. The result shows that the risk of developing CVD is more in females [23]. It is noteworthy that another study had reported higher prevalence of DFU in women than men (Aaron, et al. [20]). The significance of this point is in the knowledge that CVD is a major determinant of DFU [8,11,13,24].

Primary Healthcare Preventive Management of DM Infections

The IDSA model is based on the principle of microbiology spectrum in immunocompromised. It is known that individuals living with diabetes are susceptible to the spectrum of bacterial, fungal and viral infections [25]. Diabetes is associated with several types of infections such as soft tissue, skin infection, mucus membrane, urinary tract, respiratory and surgical or hospital associated infections. The main reason behind the frequent association to infection is due to immunocompromised state of the diabetic patient as uncontrolled high level of glucose affects their entire immunity, and the involvement of other factors that leads to the patient being immunocompromised. In the presence of diabetes, each type has its own microbe which enables the comprehension of the different types. People living with diabetes are at increased risk of infectious diseases such as urinary tract, as its overall estimation rate of incidence is 17.5/ 1000 person in a year [26]. Primary healthcare plays a crucial role in the management and prevention of infection, particularly among high-risk populations of individuals with diabetes. Preventive management strategies can be included in proper foot care and inspection, proper wound care and education on infection prevention and management. therefore, the purpose of this part of empirical review is to update on the spectrum of common and uncommon microbial infections in diabetes.

This is with a focused view to determine knowledge and practice of diagnostic pathology and PHC services. Literature search methods followed the scoping review design, albeit cursory without the conventional PRISMA. Search platforms included PubMed and Google Scholar, as well as diabetes atlas of the International Diabetes Federation. Inclusions criteria were diabetes and empirical infections. In the quick scoping review on PubMed, 14 eligible articles indicated a spectrum of common and uncommon infectious microbes [27-40], which are not limited to wounds but also in blood, foot and sinuses. 2/14 (14.28%) articles include diabetic foot cases, and both indicate oncomychosis [29,30]. It has been known that major infections common among with diabetes include bacteria, fungi and virus [21]. Therefore, Figure 5 expounds on the knowledge of diabetes infections, especially to emphasize fungi and uncommon infectious agents.

Figure 5: Spectrum of microbes found in individuals living with diabetes [19].

Implications for Primary Healthcare Service

The primary healthcare service is generally focused on educational health promotion, preventive medicine and treatment [41]. The concepts of health promotion and preventive medicine are most often interwoven around the impact of diabetes on immune system functions (Figure 6). However, the empirical data could be assessed to monitor the activities and achievements (Table 2). Several studies and clinical trials have shown the importance of dietary patterns, food, and nutrition in the prevention and management of T2DM. The quality of food (dietary fat and carbohydrate) consumed is more important than the quantity of these macronutrients. Food rich in vegetables, legumes, fruits, nuts and whole grains, moderate alcohol consumption, and extremely low in refined grains, red and processed meat, sugary and sweetening food products have shown to reduce the risk of diabetes and improve glycemic control and blood lipids in diabetes patients. Global health policies are made across several sectors in different countries to create healthful food environment / outcome. This is geared towards a corporate social responsibility to ensure food safety. Such crucial strategies include nutritional and agricultural policies that are in favors of production and distribution of healthy food (Lay, et al. 2014). The prevention and management of diabetes in Nigeria will require the collaboration of the government and the health sector to succeed.

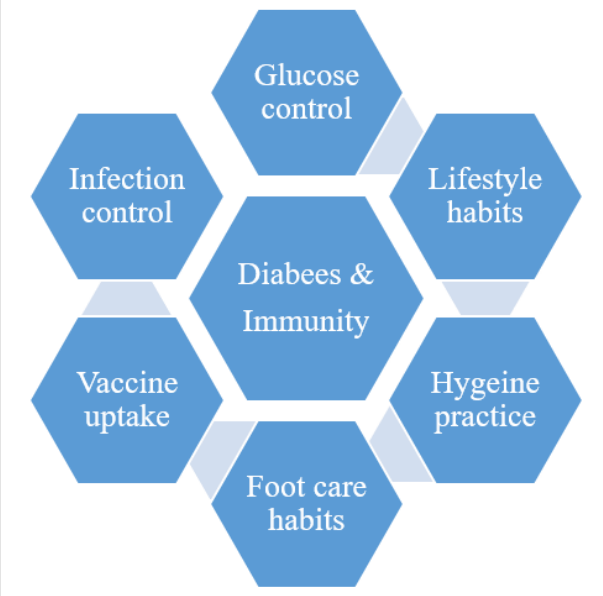

Figure 6: Concept of immune system and diabetes for primary healthcare [24].

Table 2: Recommended care plan (CDC [50]).

Frequency	Activity
Daily	blood glucose test
	foot care
	Lifestyle
	Medication
Quarterly or biannual	HbA1c test
	GP consultation
Yearly	Vaccination
	full medical check*

Note:

1. Lab tests - lipid profile, RFT;
2. Others - eye, foot, periodontal, & hearing.

It is imperative to carryout preventive programs such as sensitization, enlightenment campaigns on the risk factors of diabetes mellitus, cut across all the communities in Nigeria. The government needs to improve health care funding at all levels to curb the burden of disease [42].

Milestone Stone Achievements on DFU Health Promotion and Challenges

The milestone achievements are quite articulate by the International Diabetes Federation in Figures 1 & 2, on pages 6 & 7 of the PDF. However, suffice to add quote: In most countries, where data are available, and the incidence of lower-limb amputation due to diabetes seems to be decreasing, there is still a dearth of systematic reviews quantifying diabetes-related foot complications. International databases using similar definitions should be promoted to enable direct comparisons between and within countries. In a review focused on

the African continent, the prevalence of diabetes-related peripheral neuropathy (DPN) ranged mostly between 30.0% and 70.0%. In the largest study, which was undertaken in Senegal and included 37,173 people living with diabetes, DPN was present in 72.0%. For peripheral arterial disease (PAD), the most frequent prevalence values ranged from 20.0% to 55.0%" (International Diabetes Federation, [8]).

Empirical Evidence of Challenges to DFU Management at Primary Healthcare Level

DFU is a common and major neuropathic complication of T2DM, which often leads to amputation. Case report from Bayelsa-neighboring state of Delta had highlighted some barriers to DFU management [15]. It is common knowledge that the PHC plays a crucial role in the management of diseases including T2DM [43]. In Nigeria, the PHC is the tier that services rural communities [41,44]. Effective primary healthcare for T2DM can lead to improve outcome, reduce the disease complications, and ensure good quality of life [45-47]. However, while knowledge of intervention for comorbidities in diabetes is available [48], the factor of individual physicians and/or practices remains a concern, as well as quality of services constitute other determinants of healthcare outcomes [49,50].

Conclusion

Diabetic foot ulcers are a significant health concern for individuals living with T2DM in Bayelsa state, Nigeria. The burden of diabetic foot ulcer in Nigeria is high, with most patients presenting late to hospitals with advanced ulcer, resulting in prolong hospitalization, high low extremity amputation (LEA) rate, and mortality. Poor knowledge of foot care, dependence on self-medication, and orthodox medicine contribute to the poor outcomes. To address this growing healthcare crisis, intensive public enlightenment programs and foot care education for diabetic patients are essential. A multidisciplinary approach led by an endocrinologist can improve diabetic foot outcome. In Bayelsa state, Nigeria, preauthorizing preventive measures such as regular foot examinations, proper wound care, and managing blood sugar levels can help reduce incidence of diabetic foot ulcers. By understanding the risk factors and taking proactive steps, individuals with T2DM can reduce their risk of developing foot ulcers and improve their overall quality of life.

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