Cost of Illness of Diabetic Foot Ulcer in a Resource Limited Setting: A Study from Northwestern Nigeria

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Abstract

Introduction Diabetic foot ulcer is a major complication of diabetes with a high economic cost of managing. Data from resource limited setting will bring to light how patients in these localities suffer financially in addition to poverty and lack of health insurance. This study estimated cost of illness among patients with diabetic foot ulcer in northwestern Nigeria.

Methods It was a hospital based cross-sectional study. Questionnaire was used to take the bio data and medical history. Direct medical, direct non-medical and indirect cost were estimated.

Result Majority of the patients were males with the mean age of 59.3 ± 15.1 yrs. About 60% of the patients earn less than \$100 monthly. The total cost of illness of diabetic foot ulcer was estimated at \$140,735.56 (median = \$1381.55[IQR 1002.42-]). Direct cost of illness was \$107,797.06 (median = \$1023.27[IQR 773.93–1568]), while the indirect cost was \$32,938.49 (median = \$209.90[IQR 128.74–357.08]). Out of pocket payment accounted for 90% of the payment.

Conclusion The cost of diabetic foot ulcer is very exorbitant and the patients affected are mostly poor, unemployed and the breadwinners of their families.

Keywords Diabetes mellitus · Foot ulcer · Cost of care · Nigeria

Introduction

Diabetes mellitus is a chronic condition characterized by disturbance in blood glucose metabolism. Diabetic foot ulcer is one of the major long term complications of poorly managed Diabetes. It results from damage to the peripheral nerves and blood vessels that supply the feet by the high blood glucose level in the body. In the United States, it is estimated that 15% of all diabetic patients are affected by this condition during the

course of their lives. In Great Britain, the prevalence of diabetic foot ulcer among patients with diabetes is 10% while in Jordan, it is 4.6%. In France, between 75,000 and 150,000 diabetic patients suffer from diabetic foot ulcer with an annual incidence of 40,000 and 80,000 [1–4]. In Nigeria, around 10% of people with diabetes suffer from foot ulceration, among newly diagnosed diabetics, about a quarter present with foot ulceration [5]. In 2005, people with diabetes related foot ulceration made up almost 12% of total hospital admissions [6].

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Foot ulceration is a cause of suffering for those with the condition and their loved ones, the costs are high in economic as well as human terms. Because Diabetic foot ulcer mostly affects men who are the bread winners and the work force of the community, there is a huge economic burden (direct and indirect) to the family and the community at large [7]. A systematic review by Tchero et al. that compared cost of diabetic foot for five European countries concluded that such cost is higher than the cost of treating major cardiac diseases [8]. This is alarming considering the rising prevalence of Diabetes mellitus and most insurance firms do not cover cost of treatment for its complications. In the United States in 2007, 33 % of the cost of treating diabetes and its complication (\$116 billion indirect cost) was attributed to the treatment of foot ulcers [9]. The economic burden of diabetic foot ulcer in Nigeria is expected to be enormous because many of the patients present to the hospital late as a result of ignorance and utilization of non-orthodox care which makes the management more complicated with increase hospital stay, and translating to increase cost of care. Ignorance, poverty, lack of access to specialized health care services, lack of National welfare schemes and health insurance coverage for Diabetics makes the problem worse compared to developed countries. Despite all these problems, there are very few studies that look at the economic aspect of diabetic foot care in Nigeria. Most studies focus on prevalence of the disease. The main aim of the study is to estimate the cost of illness among patients with Diabetic foot ulcer in a tertiary hospital in Nigeria.

Material and methods

The study was a hospital based cross-sectional study conducted in three tertiary health care facilities in Northwestern Nigeria. The three hospitals are located in the second most populous city in Nigeria and serve as referral centers for states in the northwestern Nigeria with an estimated population of over thirty five million people [10].

The study was carried out at the medical, orthopedic and emergency wards and outpatient clinics of all the hospitals and spanned a period of one year from October 2014 to September 2015. Patients with diabetic foot syndrome are admitted in these wards and are managed by physicians, endocrinologists, orthopedic surgeons and a chiropodist while the outpatient clinics of medicine and orthopedic serve as follow up centers for these patients.

Ninety patients with diabetic foot ulcer that were on admission as at the time of the study or seen in an outpatient clinic were selected, using simple random sampling technique. A structured open-ended questionnaire was used to collect the clinical, demographic details and cost of illness of each patient. Fees for consultation, surgery, investigations, hospital admission, drugs, nursing care and physiotherapy/

rehabilitation were captured as direct medical cost of illness. Direct non-medical cost of illness comprised of cost of transportation to and from the hospital and cost of feeding in the hospital. Value of job lost for the patient and care giver as a result of the sickness were captured under indirect cost of illness. Cost was estimated in the Nigerian currency (Naira) and was outlined as cost/patient/month. The cost was converted to the equivalent United States Dollar (USD) using a multiplication factor derived from the average monthly exchange rates of Naira to USD from Oct. 2014 to Sept. 2015 in the official website (<http://abokifx.com/>). Using an inflation calculator (<http://www.goo.gl/P7S&Bi>), the values were converted to the 2018 equivalent to factor the annual inflation.

Statistical analysis of the data was done with the software package SPSS (Statistical Package for Social Sciences) for windows version 16.0. Descriptive statistics with differences and relationships were determined using Independent samples t-test, Pearson's chi square test and Fisher's exact test were appropriate. A *p* value less than 0.05 was regarded as statistically significant. All statistical significant variables were subjected to binary logistic regression analysis to explore determinants and predictors.

Ethical clearance was obtained from the Kano State Hospitals Management Board Ethics Committee with reference number HMB/GEN/488. A written informed consent was obtained from each patient. The study was in compliance with the Helsinki's declaration [11].

Results

During the period of the study, a total of ninety (90) patients with diabetic foot ulcer were recruited. The mean age of the patients was 59.3 ± 15.1 years. About 68% of the male participants are the breadwinners of their families. None of the female patients is a breadwinner. However, there was no statistically significant difference between the mean age of males and females patients ($p = 0.152$). The median monthly income was \$42.7 (IQR 16.1–204.5) with majority of the patients earn monthly income of less than \$100 (Tables 1, 2 and 3).

The mean duration of diabetic foot ulcer among the participants was 146 ± 126 days, while the mean duration of current or last hospital admission was 49 ± 7 days.

Total cost of treating diabetic foot ulcer for all the ninety (90) participants was \$140,735.56 with a median of \$1381.55 (IQR 1002.42–1885.69). The direct cost of illness made up 76.6% of the total cost. The total direct cost of illness was \$107,797.06 with a median of \$1023.27 (IQR 773.93–1568.87), out of which \$72,801.53 median \$694.12 (IQR 549.73–906.02) and \$34,995.46 median \$241.98 (IQR 192.51–419.92) were direct medical and non-medical cost respectively (Fig. 1).

Table 1 Socio-demographic characteristics of study participants

Characteristic	Frequency	Percentage
Age grouping (years)		
18–29	4	4.4
30–39	5	5.6
40–49	15	16.7
50–59	22	24.4
60–69	21	23.3
≥70	23	25.6
Gender		
Male	72	80
Female	18	20
Marital status		
Single	8	8.9
Married	55	61.1
Divorced	6	6.7
Widowed	21	23.3
Educational status		
Primary	25	27.8
Secondary	19	21.1
Tertiary	15	16.7
Uneducated	31	34.4
Occupation		
Unemployed	17	18.9
Farmer	4	4.4
Trader	34	37.8
Civil servant	21	23.3
Artisan	7	7.8
Professional	7	7.8
Monthly Income		
No income	21	23.3
With income	69	76.6

The total indirect cost of illness was estimated at \$32,938.49 with a median of \$209.90 (IQR 128.74–357.08). Cost due to lost job by the patients accounted for \$28,200.53 (85.6%) while cost due to lost job by the caregivers accounted for \$4737.97 (14.4%).

Self-payment for medical services was the most common mode of payment by all the participants, 52.2% followed by assistance from family members 37.8%. Insurance coverage was low 10.0%.

The duration of diabetic foot ulcer, duration of hospital admission, frequency of admissions, location of the ulcer, average monthly income and presence of other comorbidities like hypertension were found to be significantly associated with an increased total cost of treatment of diabetic foot ulcer $p < 0.05$. The distribution of the factors related to the value of cost of illness of diabetic foot ulcer is shown in Table 4.

Table 2 Characteristics of ulcer

Characteristic	Frequency	Percentage
Trigger factor		
Puncture	8	8.9
Spontaneous	28	31.1
Trauma	34	37.8
Bite	4	4.4
Unknown	16	17.8
Duration (days)		
0–60	32	35.6
61–120	15	16.7
121–180	14	15.6
181–240	5	5.6
>240	24	26.7
Site		
Dorsum	27	30.0
Plantar	40	44.4
Below knee	17	18.9
Above knee	6	6.7
Clinical aetiology		
Neuropathy	35	38.9
Vascular	16	17.8
Mixed	39	43.3
Size (cm ²)		
0–20	13	14.4
21–40	19	24.1
41–60	18	20.0
61–80	16	17.8
>80	24	26.7

Discussion

The cost of treatment of diabetic foot ulcer is enormous especially in the context of our population in the developing countries where majority of the sufferers of this ailment are unemployed. The lack of insurance coverage among majority of the participants enhanced the problem. The situation is even worse when the breadwinner of the family is the one affected as it incapacitates him and reduce his earning and in some circumstances rendered him jobless.

Table 3 University of Texas classification $n = 90$

Stage (n)	Grade			
	0	I	II	III
A (5)	0	1	3	2
B (25)	2	8	9	6
C (31)	0	3	17	11
D (29)	0	2	19	8

Fig. 1 Distribution of components of direct cost of illness. DM = Direct medical. DNM = Direct non-medical

Majority of the participants in this study are middle aged males who are educated. This finding is similar to reviews from other places where they found the risk of diabetic foot ulcer to be greater in men [12, 13]. A study in Southeastern Nigeria found a male to female ratio of 1.9:1. Another study done in Saudi Arabia, found men to represent 68.57% of the subjects [14, 15]. Most of the study subjects were middle-aged. This is the age group that most of these

men are economically active to cater for their needs and that of their families. Diabetic foot ulcer can also affect their economic productivity which increases the indirect cost of their illness. Majority of the participants that participated in a study done in India were middle aged similar to what was obtained in this study [16]. The high number of poor people in our study is in keeping with the poverty level of our population where 60% of the populace live below the poverty line [17]. Reviews from other developing countries like India show a better result where only 19% of the study subjects earn less than \$206.95 monthly. This is not surprising as India is moving towards being developed [10, 16, 18]. Also a review of studies from these developing countries show variation in the cost spent on managing diabetic foot with no homogeneity unlike what was obtained in developed nations [19].

The cost obtained from this study was however higher than what was found in a similar study done in Lagos, Southwestern Nigeria in 2006 where the total cost of illness of diabetic foot ulcer was estimated at 180,581.60 Nigerian naira or \$1003.26 [20]. The higher cost from our study could be attributed to inflation that has been rising over the years and it could also be attributed to improvement in the health care system with use of high tech machines for diagnosis and treatment which will cost more. The estimated cost from our study is much lower than what was found in advanced countries like the United States. Holzer et al. in 1998 estimated the

Table 4 Factors associated with cost of illness of diabetic foot ulcer

Factor	X ²	p-value
Average monthly income	27.9	<0.0001*
Aetiology	10.9	0.273
Other comorbidities	9.6	0.038*
Admissions/year	23.3	0.021*
Emergency visits/year	15.7	0.171
Outpatient visits/year	27.9	0.06
Duration of diabetic foot ulcer	30.7	0.002*
Duration of admission	24.3	0.016*
Size of ulcer	16.5	0.409
UT classification	11.5	0.510
Location of ulcer	12.1	0.028*
Glycated haemoglobin	3.9	0.085

* Significant- p-value

UT- University of Texas

total cost of treating a case of diabetic foot ulcer per annum to be \$4595, Ramsey et al. in 1999 estimated \$26,940, Harrington et al. in 2000 estimated \$26,490, and Stockl et al. in 2004 estimated \$5610.64 [21–24]. All these variations in the total cost depend on the centre where care was sought and the type of equipments and expertise use in managing cases. Healthcare cost is generally higher in the United States and United Kingdom. However, the majority of the patients in those countries are under insurance cover unlike patients in this part of the world where this study was carried out who either pay for health care through out of pocket spending or by assistance from families and friends. Despite this, the care received is substandard when compared to that received in developed countries due to poor investigative and therapeutic facilities. Direct medical cost made up the largest part of the direct cost of illness and the total cost of treating diabetic foot ulcer. Costs of drugs and surgery were the topmost. This finding is similar to what was obtained in Lagos south western Nigeria by Ogbera et al. where drugs or medications accounted for the majority of the total costs incurred by the patients (46.9%) [20]. Harrington in 2000 from his study also found that 73.7% of the total cost of illness was attributable to direct cost of illness [23]. Apelquist et al. got 61% while Stockl et al. got 77% as contribution of direct medical costs to the total cost of illness [24, 25]. A cost of illness model used to estimate the numbers of diabetic individuals in the United States who have diabetic foot ulcer found that cost of illness is mostly driven by the prices of primary and secondary care and antibiotics for patients with foot ulcer [26]. On the contrary, some studies attributed hospitalization charges to account for the largest share of the total cost of treating diabetic foot ulcer. A study done in Europe by van Acker et al. found that hospitalization accounted for more than 41% of the total cost of illness [27]. In 2011, in Canada, the resource utilization associated with diabetic foot ulcer for acute institutional care was \$3586.6million of which \$320.50 million was for admission (89%), \$19.1 million for emergency and clinic visits (5%) and an additional \$19.0million for interventions [28]. A retrospective pharmacoeconomic study using direct and indirect costs from the perspective of French social security system found that hospitalization represented 70% of the average cost for foot ulcers [29]. Medication on the other hand only represented 10% of the total costs. Also in a Medicare analysis done in the United States between 2007 and 2010, hospitalization was found to contribute 62.5% of the total costs of illness while prescription drug contributed only 5.9% [30]. Patients in our study tend to rely on traditional medication and orthodox drugs, for treatment rather than surgical care because of lack of affordability of surgical management. They also utilize the primary and secondary health care centers at the initial stage, and there is usually a delay in referral to the tertiary health centers which are the only institutions that optimally manage diabetic foot ulcers. These factors contribute to longer stay of

the patients before definitive care which is mostly surgical treatment. After surgery, most of these patients stay longer than necessary in the hospital because they live in rural areas which are far from these tertiary centers making follow-up to be difficult. This however is not cost effective from this study as it increases the cost of illness and lower the success outcome. In developed countries where most of these comparative studies were done, the best treatment option (usually surgical) is initially given to any patient that presented with diabetic foot ulcer regardless of affordability as most of these patients are under insurance cover. Rehabilitative care contributed the least from our study as it is poorly done here as opposed to a study from the United States done in 1992 where the cost of rehabilitation was \$14,000 to \$21,000 per patient out of the total direct cost of illness of \$20,000 to \$160,000 per patient [31]. The indirect cost was contributed by Cost due to lost job by the patient. This finding is not astonishing since most of the participants in this study were men and still within the working class, this could have accounted for the large contribution by the loss of working hours, which contributed to the total cost of treatment of diabetic foot ulcer second only to cost due to drugs. Some of these male patients were dismissed from their working places as a result of the illness while others have to voluntarily leave their jobs or change to other less lucrative jobs as a result of the sickness. This mostly affects those patients that had amputation. Studies from other parts of the world found that indirect cost contributed 55% of the total cost of illness. The duration and location of leg ulcer and duration and number of hospital admissions increase the cost of illness of diabetic foot ulcer. The longer the duration of ulcer, the longer the patient stays in the hospital and pay for admission, drugs and other medical services. This is even complicated if the patient is on the lower scale of average monthly income (less than \$100 per month), as the patient cannot afford the high cost of definitive surgical care and tends to stay longer in the hospital or at home spending more money on admission and buying drugs which at the long run increases the cost of care. On the other hand, patients with higher income could afford reconstructive surgeries which are expensive but have a better outcome and low risk of amputation. Presence of co-morbidities like hypertension, dyslipidaemia, etc. also increases the cost of illness as these patients have to buy drugs for these ailments which also need to be adequately controlled for a successful healing of the diabetic foot ulcer. Hopkins et al. found comorbidities to significantly escalate the cost of diabetic foot ulcer in the Canadian study [28]. In a Medicare study in 1995, \$3609 per patient per year was spent to treat foot ulcer, 74% of the spending was for inpatient hospital stay, 11.9% for outpatient services, 11.4% homecare and 4% for hospice. The length of hospital stay was found to be associated with increased cost [32]. This finding conform with our study where frequent hospital admissions and prolonged hospital stay were found

to be associated with increased cost. Hicks et al. found that the increased in cost over years was significantly due to increased cost per patient hospitalization over time (\$11,483 vs \$13,258 $p < 0.001$) [33]. The study also attributed the increase in cost to hospital charges. Driver et al. in a study done in United States found that the costs for the treatment of the highest grade ulcers are eight times higher than for treating low grade ulcers [9]. This also corroborate with our finding. Patients with high grade diabetic foot ulcers require more frequent emergency department visits, are more commonly admitted to hospital and require longer length of stays. All these factors increase the amount spent by patients with diabetic foot ulcer, making the cost of illness of this condition to be high across the globe with peculiar differences.

The study has brought out how young and middle aged individuals that form the working class of developing countries suffer from a chronic condition that consumes a large amount of their resources in addition to deterring them from contributing to the nation's economy. The lack of insurance coverage significantly add to the financial suffering of these individuals. There is need to reduce the human and economic burden of diabetic foot ulcer disease to individuals affected and their families by primary prevention of diabetes mellitus and secondary prevention of foot ulcers, through routine diabetes training for healthcare providers and routine exposure to modern diabetes and foot management techniques. Management of the diabetic foot by guideline-based care improves survival, reduces diabetic foot complications, is cost-effective, and even cost saving compared with usual care. Thus policy makers and clinicians working in the field of diabetic foot management should see the cost of guidelines implementation as an attractive option. There is need to strengthen and improve the national insurance scheme to capture more individuals especially those in the non-formal sector and to include surgical procedures in its system of services provided so as to reduce excessive out of pocket spending and to shorten the stay of patients that require surgery in the hospital.

Compliance with ethical standards

Conflict of interest All authors declared no conflict of interest.

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