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Diabetes Mellitus in Developing Countries and Case Series

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1. Introduction

Diabetes mellitus is a growing public health affecting people worldwide both in developing and developed countries, and poses a major socio-economic challenge [1], [2]. A chronic metabolic disorder of multiple aetiologies is assuming epidemic proportions worldwide [3]. It is also a complex disorder with profound consequences both acute and chronic. Genetic and environmental factors play a role in the development of the disease [4]. The cells of the body cannot metabolise sugar properly due to a total or relative lack of insulin. The body then breaks down its own fat, protein, and glycogen to produce sugar resulting in high sugar levels in the blood with excess by products called ketones being produced by the liver [5]. Diabetes causes disease in many organ systems, the severity of which may be related to how long the disease has been present and how well it has been controlled. The term diabetes mellitus describes a metabolic disorder of multiple aetiology characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action or both [6],[7],[8],[9].

Diabetes mellitus may present with characteristic symptoms such as thirst, polyuria, blurring of vision and weight loss [6]. The abnormalities of carbohydrate, fat, and protein metabolism are due to deficient action of insulin on target tissues resulting from insensitivity or lack of insulin [6].

The effects of diabetes mellitus include long-term damage, dysfunction, and failure of various organs [6]. Type 1 diabetes mellitus encompasses the majority of diabetes, which are primarily due to pancreatic islet beta cell destruction and are prone to ketoacidosis [9]. If diabetes is not taken care of, complications such as heart, kidney, and eye diseases, incurable wounds leading to amputations of the extremities and mental disorders follow. Besides this, diabetes related complications inevitably cause high cost of treatment and opportunities for the concerned people and their families especially for poor families the

disease and its complications cause severe economical burden. In developing countries, non-communicable diseases are evolving rapidly [8]. Diabetes mellitus places serious constraint on patients' activities [10]. Despite the high prevalence, serious long-term complications, and established evidence based guidelines for management of diabetes mellitus, the quality of care is still deficient in developing countries [11]. Diabetes mellitus is emerging as an epidemic all over the world, represents an important public health problem, and is of clinical concern [12], [13], [14]. Type 1 diabetes has been estimated to affect approximately 19,000 people in the worlds poorest countries but there is lack of good data on the disease prevalence in developing countries and in particular in sub-Saharan Africa[15].

Non-communicable disease such as diabetes mellitus, cardiovascular disease (especially ischaemic heart diseases and hypertension), stroke, cancer and chronic kidney and respiratory diseases have become the leading causes of mortality both in developed and developing nations of the world. The rising prevalence of these diseases is thought to be due to adoption of western lifestyles and urbanization [16]. With the current trend of transition from communicable to non-communicable diseases, it is projected that the later will equal or even exceed the former in developing nations thus culminating in double burden [17]. There is need for health care providers to intensify efforts in educating people living with type 2 diabetes about good personal and environmental hygiene. Emphasis is on early diagnosis of diabetes, good glycaemic and blood control and proper education, programmes for health workers caring for diabetic patients as well as public awareness talks [17]. The prevalence of diabetes mellitus varies between different countries. Diabetes mellitus is defined as a chronic disorder, which is characterised by an elevated level of glucose in the blood due primarily in inadequate secretion or utilization of insulin [18].

Gestational diabetes mellitus is pregnancy induced diagnosed typically in the second half of pregnancy. It occurs when beta cells reserve is unable to counter balance the insulin resistance caused by placental hormone. Systemic hypertension and diabetes mellitus are common chronic conditions that frequently coexist and can significantly affect the health care needs and clinical outcome of affected individuals [19].

The excess global mortality attributable to diabetes in the year 2000 was estimated to be 2.9 million deaths, equivalent to 5.2% of all deaths. Excess mortality attributable to diabetes accounted for 2-3 % of deaths in poorest countries [20]. Diabetes is a serious illness with multiple complications and premature mortality accounting for at least 10 % of total health care expenditure in many countries. Diabetes is often perceived as a disease of affluent countries. A serious chronic disease leads to a substantial reduction in life expectancy, decreased quality of life and increased costs of care [21].

Management of diabetes mellitus is multidisciplinary and this is not readily available in low resource settings. Dietary management is essential in the treatment and it alone may be adequate to achieve and maintain the therapeutic goals to normoglycaemia and normolipidaemia [22]. The care for diabetic patients includes a change in their life style, where the diet plan represents an important pillar of care so they can meet their goals. The management of people with diabetes mellitus is complex and good control significantly

reduces the risk of complications yet studies from around the world concisely demonstrate inappropriate variations in care [23].

2. Burden of diabetes mellitus in developing countries

Sub-Saharan Africa will face a double disease burden represented by increased rates of non-communicable diseases added to endemic, pandemic, and emergent infections such as malaria, tuberculosis, and HIV/AIDS. There is dearth of African data concerning the prevalence of type 1 diabetes mellitus [7]. Diabetes mellitus related cardiovascular disease complications are considered rare in Africa but are on the rise and are regularly associated with classic cardiovascular risk factors [24]. A missionary physician stated in 1901 that diabetes was very uncommon in the central region of Africa [25]. There is increased number of people suffering from non communicable diseases and this have been linked to unhealthy ways of living and lifestyle such as consumption of excess calories and reduction in the level of physical activities with the consequent development of obesity and insulin resistance [16].

Obesity, type 2 diabetes mellitus, and their associated long-term complications are emerging as critical, worldwide public health problems. Although few groups have been spared increased in the burden of these conditions, those undergoing rapid westernization, with the transition in diet and activity profiles have been especially affected. Among the most affected groups are those in Africa and the African Diaspora including the Caribbean, Europe, and North America [26]. The probably cause of obesity in developing countries has been attributed to the current lifestyle, where urbanization, better economic development and an increase in income have resulted in diet changes and less physical activity. The care for diabetic patients includes a change in their life style, where the diet plan represents an important pillar of care so they can meet their goals. Obesity increases the risk of developing not only type 2 diabetes, cardiovascular disease, stroke, osteoarthritis and some forms of cancer [27]. Obesity has been clearly linked with diabetic patients from all the major ethnic regions in Nigeria [16]. Over the past century, diabetes was considered a rare medical condition in Africa. However epidemiological studies carried out in the 90's have provided evidence of a different picture [28]. The number of people with diabetes is increasing due to population growth, aging, diet, lifestyle, urbanization, and increased prevalence of obesity and physical activity [12], [28], [29]. Diet and lifestyle are the biggest culprits at least in the case of type 2 diabetes but genetics also have a role to play. Although obesity is an important factor in the diabetes epidemic, it does not alone explain the vast increase in prevalence especially in the developing world [29].

In developing countries, the majority of individuals with diabetes are aged between 45 and 65 years while in developed countries, the majority are older than 64 years. Based on demographic changes by 2030, the number of people older than 64 years with diabetes will be more than 82 million in developing countries and more than 48 million in developed countries. The greatest relative increases are expected to occur in the Middle East crescent, sub-Saharan Africa and India [30]. Some 170 million men and women, who will reside in developing regions of the world in less than 30 years from now, will be suffering from

diabetes in their reproductive years of life [31]. In 2003, 194 million people 20 to 79 years of age had diabetes mellitus, almost three quarter of them are living in the developing world. Almost one million people die because of diabetes each year with two-thirds in developing countries. This growing problem will have a significant impact on national and individual economies as well individual health. However, it has proven difficult to determine just what that impact is [32]. Diabetes is an increasing problem in sub-Saharan Africa [33]. It is predicted that the prevalence of diabetes mellitus in adults will increase in the next two decades and much of the increase will occur in developing countries where the majority of patients are aged between 45 and 65 years. The incidence and prevalence of diabetes mellitus has continued to increase globally, despite a great deal of research with the resulting burden resting more heavily on tropical developing countries [17], [34]. Traditional rural communities still have very low prevalence at most 1-2% except in some specific high-risk groups, whereas 1-3% or more adults in urban communities have diabetes. The combination of the rising prevalence of diabetes and the high rate of long-term complications in Africa will lead to a drastic increase of the burden of diabetes on health systems of African countries [34] and may have a devastating human and economic toll if the trends remain unabated [35]. In comparison to previous estimates from sub-Saharan Africa, the prevalence of adult onset diabetes seems to be on the increase[36].

In the last decade, diabetes has become a health problem in developing countries and has been found in a wide variety of atypical forms. Its burden is huge in developing countries due to lack of basic means for reaching diagnosis and a reasonable glycaemic control. The prevalence of type 1 diabetes mellitus varies from country to country in the African sub-region. The low number of health care providers with the requisite knowledge, expertise, and experience in the care of children with diabetes is another major issue. Diabetes care in developing countries needs to address the specific background of the patient population, their needs, medical problems, and social constraints [35]. The region of sub-Saharan Africa contains 33 of the 50 poorest countries in the world and will experience the greatest risk in the prevalence of diabetes over the next 20 years [36].

Most African studies are hospital based and give data on patients that visit the hospital only. Type 1 diabetes has been estimated to affect approximately 19000 people in the world's poorest countries but there is lack of good data on the disease prevalence in developing countries and in particular in sub-Saharan Africa [15]. The present increase in the rate of both type 2 diabetes mellitus and type 1 diabetes mellitus indicate the great and urgent need for more epidemiological surveys in sub-Saharan Africa. Such a need is dictated by the prevalence of undiagnosed diabetes mellitus [7].

The prevalence of diabetes mellitus has significantly increased over recent decades in Tunisia to around 10% [37]. From various African studies in 6299 Africans aged 15 years and above in six Tanzanian villages, 0.87% had diabetes 1.1% males and 0.68% females [38]. In several Nigerian studies a prevalence of 1.6% in two suburban populations in northern Nigeria [39], 1.4% in a rural population in Kwara State [40], 1.6/1000 in children in Sagamu [41], 1.2/1000 in children in Port Harcourt, southern Nigeria [42], case fatality in of 3.4% in Ekiti [43], 17.2% in

adults in Port Harcourt [44]. Diabetes was the sixth leading cause of admissions in Enugu, 8.8% admissions into the medical wards at the university of Nigeria teaching hospital with a case fatality of 24% [45] and the leading cause of medical admissions in Nnewi, south east Nigeria [46]. In another Nigerian study in Dakace village about 10 km from Zaria, Zaria 2.0% and all the detected diabetics were males and above 45 years [1]. It was estimated that about 100,000 children less than 15 years developed type 1 diabetes mellitus with wide global variations in incidence rates. There are scanty data on the incidence, aetiology, and outcome of children diabetes mellitus from developing countries like Nigeria [4]. It is also one of the commonest reasons for medical admissions and death in Nigerian hospitals. The disease burden of diabetes mellitus in developing countries is unacceptably high thus necessitating an indebt look at the management techniques and patients' self-care habits due to the burden of diabetes care and the attendant complications, it affects all aspects of the society, and it has become a public health concern globally [47]. The increase in diabetes mellitus in Africa has been attributable in part to urbanization, urban residence, acculturation, abdominal obesity, globalization, westernization, sedentary lifestyle, behavioural habits, systemic arterial hypertension, physical inactivity, low intake of fruits and vegetables, high intake of animal fat and protein, industrialization, health transition, lifestyle changes, and the adoption of western lifestyle [1], [7], [47]. Variations in the type and epidemiology of diabetes between urban and rural areas have also been noted in Africa [47]. For a long-time, Africa was considered safe from many of the diseases that are called "diseases of affluence" which plague the western world. Similarly, there was a time when Africa was thought to be a continent relatively free of diabetes mellitus illness [48]. The disorder was previously thought to be rare or undocumented in rural Africa but over the past few decades, it has emerged as an important non-communicable disease in sub-Saharan Africa [2]. There is increased prevalence of diabetes in developing countries [47]. The high incidence of undiagnosed diabetics poses a major public health challenge in developing countries.

3. Challenges and problems of managing diabetes mellitus in developing and poor resource countries

3.1. Ignorance

There is poor health seeking behaviours in low resource countries because of inaccessible quality health care. Poor health seeking behaviour results in late presentation and is a possible reason why majority of patients in these setting present with complications [14]. For diabetic children, it is possible that some of the affected children succumbed to the illness at home out of parental ignorance and high cost of orthodox medical care. It has been found that some patient sign against medical advice [4]. Some because of finance, others to seek alternative therapy or spiritual help. In a study on childhood diabetes in Kano, northwest Nigeria, three parents/guardians signed against medical advice. They belonged to the lower socioeconomic groups, and their management was largely hindered by lack of funds for investigations and drug procurement [4]. For people with diabetes living at or below the poverty level, the purchase of appropriate footwear may not be feasible or of high priority,

(bare foot walking is a common practice in rural communities but may be culturally influenced as well) [49]. Due to this ignorance and poverty, patients present late even with diabetic complications. Patients with diabetic foot continue to insist on medical management to salvage the affected limb until they become surgical emergencies [50]. Such emergency cases come with very little health reserve and clinical information to permit anaesthesia and surgery. The urgent need to save life then becomes the only support to favour surgical intervention. Any delay to allow for more time than necessary for basic investigations, remarkably influences the outcome of the procedures. Diabetics undergoing surgery belong to the high-risk group of patients and the risks are worst in the presence of severe complications such as diabetic foot gangrene [50].

3.2. Economic and cost of management of diabetes mellitus

The cost of management of diabetes mellitus is complex and multidisciplinary therefore expensive in poor resource countries where majority of the population live below a dollar per day. Diabetes mellitus exacts three broad categories of economic costs.

- a. **Direct costs on health care:** This includes costs on purchase of medications, and glucometers for those that can afford it. Also the cost on visits to the health care facility and to see the professionals both general and specialist and money spent on hospitalisation both for the diabetes and diabetic complications [29].
- b. **Indirect health care costs:** These include care of nursing homes and informal care by relatives and carers. Societal expectations about the appropriate place for professional and informal care certainly have important economic consequences [29]. Relatives and friends who care for the patient, may lose productive hours at their work or business.
- c. **Productivity costs:** This includes the loss of earnings from mortality and morbidity that is time taken by otherwise economic individuals with diabetes to treat their condition and disability associated with diabetes and its complications [29]. In developing countries with scarce resources, it is still possible to put in place effective programs to combat diabetes. Some patients in developing countries travel great distances to medical care facilities, which meant that greater earnings needed to be sacrificed in order to attend to medical visits and check-up. This discourages individuals from seeking an early diagnosis and is loss lost to follow up [29].

This growing problem of diabetes mellitus will have significant impact on national and individual economies as well as on individual health. The indirect costs of diabetes such as lost productivity are at least as high and increased as more economically productive people are affected [32]. Good data on the direct medical costs of diabetes are not available for most developing countries [32].

3.3. Poverty

Health conditions in most African countries are poor and a large percentage of families live below the poverty line of one United States dollar per month [35]. Access to health services

is limited and living conditions are poor. The low number of health care providers with the requisite knowledge, expertise, and experience in the care of children with diabetes is another major issue where the facilities are available; there is lack of basic diagnostic and monitoring tools as well as irregular supply of insulin. Insulin is still not available on an uninterrupted basis in many parts of the developing world [15]. The prognosis is likely to be poor for patients with type 1 diabetes in sub-Saharan Africa and only wealthy patients own their own glucose meter. Some patients have their glucose concentrations monitored without charge in public health facilities. Patients with comorbidity with diabetes is associated with considerable consequences for health care and related costs and comorbidity has been shown to intensify utilization of health care facilities and to increase medical care costs on patients with diabetes [51].

3.4. Use of alternative and complementary therapy

There are many forms of treatment in the African region. Most of the time, the patients visits the local traditional healers before coming to the hospital [4]. Traditional healers are an integral part of the health care system [37]. Many traditional healers had heard of diabetes and knew at least the disease was characterised by excessive thirst and urination[37]. Traditional medicine or complementary and / or alternative medicine (CAM) refers to health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to treat, diagnose and prevent illness or maintain well being [52], [53]. It describes a diverse group of medical and health care system practices and products not currently considered an integral part of conventional medicine [3], [54], [55] and are consequently not taught as part of the medical curriculum [56]. Traditional medicine is often referred to as complementary therapy when used in combination with orthodox medicine and alternative therapy when used in place of orthodox medicine [54], [57]. CAM is also referred to as holistic or integrative and describes a heterogeneous collection of non-traditional therapies from chemical substances to prayer [58]. The frequency of utilization of CAM is increasing worldwide and is well documented in both African and global populations to be between 20 to 80%[56]. In chronic conditions in which health outcomes are closely linked to adherence to treatment in which diabetes mellitus is one of them, the use of CAM may potentially adversely affect outcome. Multiple therapy practices involving combined use of CAM particularly herbal medicines and prescription medications has also been identified as being prevalent in some populations. Many herbal remedies have not undergone careful scientific assessment and some have the potential to cause serious toxic effects and major drug-to-drug interactions. Cultural and economic reasons are largely responsible for use of CAM [56]. Researchers have given several reasons for the increased prevalence of CAM utilization. These include failure of modern medicine to cure the underlying problem and the perception that CAM is cheaper than conventional medicine. In countries like Nigeria, possible reasons for the use of CAM include the strong advertisement by alternative practitioners that CAM is a panacea to all diseases thus encouraging patients to try them. Another possible explanation is the cultural beliefs of Africans that illnesses

have a spiritual origin. Patients are thus interested in finding an explanation for their symptoms or the root cause of their problems and therefore consult with alternative practitioners. In Nigeria, the use of herbal remedies are perceived to be cheaper, may be on the increase due to the poor economic state and the increasing costs of orthodox medicines also cultural and economic reasons are largely responsible for the use of CAM [56]. The use of alternative therapy has become more popular in both developed and developing countries in recent times [56]. There advertising strategies on the media and especially using vehicles with megaphone from one neighbourhood to another, which do not necessarily inform but persuade customers, have also made the use more popular [57]. CAM is increasingly used in adults and children [59]. Over 80% of the populations in some African and Asian countries depend on traditional medicine for primary health care [60]. The use of CAM among diabetics is common [53], [55]. Although some of those therapies may be effective, others can be ineffective or even harmful. Patients who use CAM should keep their health care providers informed [55]. West Indians Africans, Indians, Latin Americans, and Asians mostly use CAM [54]. Prayer, acupuncture, massage, hot tub therapy, biofeedback, and yoga have been used as well as various plant remedies for treating diabetes [54]. Several CAM practices and herbal remedies are promising for diabetes treatment but further vigorous study is needed in order to establish safety, efficacy, and mechanism of action because many patients with diabetes may be using CAM and to consider potential interactions with conventional medicines being used [54]. The increasing cost and distrust of modern western medical care in recent years has promoted the use of alternative and traditional therapies and has attracted the interest of health professionals, researchers, government, and policy makers. The use of CAM has not been limited to resource poor settings alone but also among the elites. Claims and refutations by various individuals and professional groups of cure for chronic ailments with alternative therapy have been reported. Furthermore, inadequate access to modern health care services and a trend towards naturalness have strengthened the shift to alternative therapy. The unregulated or inappropriate use of alternative therapy has also been documented to have negative effects on its users. Alternative therapy medications are not so regulated in most countries. There is increased acceptance and use of traditional medicines in recent times [57].

Globally, people developed unique indigenous healing traditions adapted and defined by their culture, beliefs and environmental which dissatisfied the health needs of their communities over centuries. Over 80% of the population in some Asian and African countries depend on traditional medicine for primary health care [2]. Herbal medicine is an integral part of traditional medicine and traditional medicine has a broad range of characteristic and elements, which earned it the working definition from the World Health Organization. Traditional medicines are diverse health practices, approaches, knowledge and beliefs that incorporated plant, animal and/ or mineral based medicines, spiritual therapies, manual techniques, and exercise, which applied singularly or in combination to maintain wellbeing as well as treatment, diagnosis or prevent illness. In a study in Lagos, Nigeria, 16.2% of respondents' use herbal medicine to decrease blood sugar [52]. Some other

attractions to alternative therapies may be related to the power of the underlying philosophies they share, which involve closeness to nature, spirituality and the fact that these therapies often go along with the cultural beliefs of the people [61], [62]. In another Nigerian study, 46% of diabetics used herbal medicine [63]. CAM is an emerging aspect of the management of chronic disease worldwide. The main forms of CAM usage in diabetes mellitus include bitter leaf *vernonia amygdalina*, aloe Vera, garlic, ginger and local herbs. There is an increasing use of CAM in diabetes mellitus and this cut across the two main types of diabetes mellitus as CAM usage has been reported in type 1 and 2 diabetes mellitus. In the African setting for most chronic ailment there are often underlying explanations, which are founded on cultural and spiritual beliefs thus, necessitating the use of traditional medicines, which are of herbal nature. Of increasing importance in the Nigerian scenario is the use and claim of the glucose lowering effects of bitter leaf *vernonia amygdalina*. This is a small shrub with a dark green stem that grows widely in tropical and subtropical Africa and is widely used for its medicinal properties. One reason commonly adduced for its usage stems from the fact that it is bitter tasting and thus is able to neutralize the sweetness present in the blood of people with diabetes mellitus. Use of CAM is suggested by well meaning family members or neighbours or other people that had diabetes mellitus and used.

4. Case series

4.1. Case 1

A 42-year-old woman a known diabetic of three years went to seek spiritual help for her ailment at a spiritual healing home in Nigeria. She was told to observe a seven days fasting with some herbal concoction. On the fifth day of the fasting programme, she went comatose and was rushed to the hospital. Her blood sugar was 42 mmol/l with ketones in urinalysis, foul smelling breath. The electrolytes, urea, and creatinine were deranged. Respiratory rate was 40 breaths/minute, pulse rate 120 beats/minutes, pale, anicteric, afebrile, and dehydrated. Blood pressure was 90/40 mmhg. A diagnosis of diabetic ketoacidosis was made. She was placed on intravenous ampiclox, metronidazole, intravenous access was established, and normal saline set up and Insulin therapy commenced, the blood pressure, pulse rate and respiratory rate was measured every 30 minutes. She was managed and recovered consciousness two days later.

Case discussion: Use of alternative therapy is common in Nigeria and other African countries. Most of the components of these herbal remedies are not known therefore if it contains dangerous toxic substances that can have negative effects on the patient as seen in case 1.

4.2. Case 2

A 64-year-old man not a known diabetic presented with two weeks history of pains, swelling and sore on the right leg. At the onset of the illness, the patient applied several herbs on the leg, which started with severe pains and swellings, burst and gave rise to the

swelling. On presentation he was ill looking, conscious, and alert, blood pressure 120/70 mmhg, pulse rate 100 beats /minute, pale, dehydrated with a sore on the right shin, which was discharging foul smelling substance. The leg was gangrenous. Haemoglobin concentration was 7%, electrolytes, urea, and creatinine were within normal ranges, random blood sugar was 36 mmol/l. On urinalysis there was glucose +++ in urine. A diagnosis of diabetic foot was made. The patient was placed on subcutaneous soluble insulin, haematinics, intravenous antibiotics, and analgesics. Wound swab microscopy, culture, and sensitivity were done. He was counselled for below knee amputation and to provide two units of blood as blood products were not available at the centre. He said he should be given time to think about the amputation. In the evening, he attempted suicide when his wife who raised alarm stopped him. He became depressed but later gave consent and the amputation was done.

Case 2 discussion: Diabetic foot results in a large increase in the use of general practice care and in the use of medical specialist care and hospital care [51]. This is the case in developing countries where most of the populace are poor and do not have access to quality medical care. There are also limited specialist doctors. Patients with diabetes do not only have diabetes related co-morbidity but also have non-diabetes related co-morbidity such as depression and musculoskeletal diseases [51]. Depression can progress to attempted and actual suicide especially when an arm or limb needs to be amputated. Individuals with type 2 diabetes mellitus are known to have a higher prevalence of depression [63]. Depression is common in patients with diabetes mellitus [64]. Diabetes may increase risk of depression because of the sense of threat and loss associated with receiving this diagnosis and the substantial lifestyle changes necessary to avoid developing debilitating complications [65]. Patients with diabetes are more likely to experience depression than the general population and the presence of depression is associated with poor quality of life, increase in hyperglycaemia, health care utilization, risk of complications, functional impairment, and risk of mortality. The relationship between depression and worst outcomes in diabetes could be explained in part through depression relationship to poorer self-care and treatment adherence [66]. The patient was not depressed or attempted suicide until he was counselled for amputation. Amputation is the removal of a body extremity by trauma or surgery. As a surgical measure, it is used to control pain or a disease process in the affected limb such as malignancy or gangrene. The prevalence of depression is roughly twice as high among diabetic patients as among the general population. Depressed patients with diabetes have poorer glycaemic control, more severe diabetes symptoms and disability, added complications and higher health care use relative to patients with diabetes but on depression [67]. Psychological problems from limb amputation persistently retard rapid rehabilitation. Some diabetic foot ulcer patients shy away from attending the hospital for fear of amputation and eventually some of them die due to infections [68].

4.3. Case 3

A 49-year-old man known diabetic for more than two years with poor drug compliance on oral hypoglycaemic agents presented with complaints of fever, vomiting, polydipsia,

weakness, and anorexia. A thorn pierced the big toe at the farm of two weeks prior to presentation. There was no feeling of pain at the time of impact and an ulcer developed after one week, which was worsening and not healing. The ulcer started discharging purulent fluid. He is a known hypertensive of five years duration not compliant with medications. On examination the patient was febrile temperature 38 [0] C, dehydrated, ill looking with periorbital oedema. There was right foot swelling with hypopigmentation, the right big toe was gangrenous and tied with a dirty bandage. Haemoglobin estimation was 10%. Electrolytes, urea, and creatinine were deranged. A diagnosis of diabetic nephropathy with diabetic foot was made. The patient was counselled for disarticulation of the big toe and was referred to a tertiary centre for possible dialysis and expert management.

Case 3 discussion: Diabetes mellitus is a chronic disease with a long-term macrovascular and microvascular complications including diabetic nephropathy, neuropathy and retinopathy [1]. Macrovascular complications such as stroke, heart disease, peripheral vascular disease and foot problems. Microvascular complications are diabetic eye diseases (retinopathy and cataracts), renal disease, erectile dysfunction, and peripheral neuropathy [68]. From various African studies, clinical diabetic nephropathy in Sudan 11.6% [69], 19% in 1971 in Nigeria [70], 46% in Kenya [71] and 6% in Ethiopia [72]. The exact cause of diabetic induced complications are not fully understood, the underlying factor that appears to make those with diabetes more prone to many health problems is prolonged and frequently elevation of blood sugar [14]. Diabetes mellitus is a complex metabolic disease that can have devastating effects on multiple organs in the body. It is the leading cause of end stage renal disease in the United States of America and is a common cause of vision loss, neuropathy, and cardiovascular diseases [73]. One of the most potentially serious complications regards neuropathy is when it is most severe can lead to amputation [74]. The effects of diabetes mellitus include long-term damage, dysfunction, and failure of various organs including the kidneys [69]. The prevalence of clinical nephropathy has been reported to be between 15 % and 40% generally in the developed countries [72].

4.4. Case 4

A 62-year-old woman known diabetic of eight years duration presented with injury to her left big toe after placing it over a hot object, which she did not know she stepped on a hot object. The toe was already gangrenous at the time of presentation. She had a right above knee amputation two years prior to presentation for gangrenous diabetic foot. She was counselled for disarticulation of the left toe. She refused and signed against medical advice.

Case 4 Discussion: Diabetes is an important cause of amputation of the lower limb resulting from of non-traumatic origin as well as blindness and kidney failure. Problems of the foot are the most frequent reason for hospitalization amongst patients who have diabetes. Many hospital visits due to diabetes related foot problems are preventable through simple foot care routine. Amongst people who have diabetes, amputations are reported to be 15 times more common than amongst other people. 50% of all amputations occur in people who have diabetes [74]. Diabetic ulcers are the most common foot lesions leading to lower extremity

amputation [68]. Management of the diabetic foot requires a thorough knowledge of the major risk factors for amputation, frequent routine evaluation, and preventive maintenance. The aetiology of lower extremity diabetic ulcer includes injury complicated by underlying neuropathy, ischemia, or both [68]. Lower limb amputation remains one of the commonest surgical procedures. In a ten-year review from 1997-2006 of lower limb amputation at a Nigerian private tertiary hospital, 64 amputations were done due to gangrenous diabetic foot [75]. Foot lesions cause pain, morbidity, have substantial economic consequences beside the direct costs relating to loss of productivity, individual patients and family costs and loss of health related quality of life. The lifetime risk of a person with diabetes developing a foot ulcer could be as high as 25% and it is believed that every 30 seconds a lower limb is lost somewhere in the world because of diabetes. People with diabetes are prone to developing foot ulcer amputation and other lower extremity. Diabetic foot problems are a common occurrence throughout the world, resulting in major economic consequences for patients, their families, and society. Because foot ulcer are most likely to be of neuropathic origin they are eminently preventable in the developing countries that will experience the greatest increase in the prevalence of type 2 diabetes in the next 20 years [76]. People at the greatest risk of the ulceration can easily be identified by careful examination of the feet, education and frequent follow up is indicated in these patients [76]. Diabetic foot complications constitute an increased public health problem and are a leading cause of admission, amputation, and mortality in diabetic patients and yet since neuropathy is the major cause, they should be in many cases preventable. Early diagnosis, education, and treatment are crucial. Diabetic foot problem are common all over the globe and have major economic consequences to society, diabetic patients and their families [76]. The recurrence rates of foot ulcers are > 50% after 3 years, an important thing to remember when assessing the economic impact of diabetic foot disease. Cost of diabetic foot diseases therefore includes not only the immediate episode but also social services home care and subsequent ulcers [76]. Diabetic foot ulcers are associated with significant morbidity and mortality in individuals with diabetes mellitus. Diabetic foot ulcer is the leading cause of non-traumatic lower extremity amputations worldwide. Preceding events of diabetic foot ulcers include trauma, wearing ill-fitting shoes and burns [77]. When foot ulceration presents late and is most frequently associated with neuropathy and infections. The region of sub-Saharan Africa contains 33 of the 50 poorest countries in the world and will experience the greatest risk in the prevalence of diabetes over the next 20 years. Diabetic foot complications constitute an increasing public health problem and are a leading cause of admission, amputation and mortality in diabetic patients and yet since neuropathy is the major cause, they should be in many cases preventable. Early diagnosis, education, and treatment are crucial. Educational programs must meet the specific needs of the patient, understanding their social background. An integrated approach to foot care can improve patients' outcomes even in rural areas. A review of the epidemiology of diabetic foot problems in Africa highlighted not only the frequency of neuropathy but also the increasing frequency of peripheral vascular disease, presumably in result of increasing urbanization. Diabetic foot is the most frequent cause of prolonged hospital admission in diabetic patients and is significantly a contributor to the considerable morbidity associated with the diabetic foot. Foot complications in Africa are

mainly because of infection in the neuropathic foot rather than due to peripheral vascular disease. Although neuropathy is often the initiating factor for foot ulceration, ischemia is critically important in determining healing despite a relative low prevalence rate of peripheral vascular disease in diabetic patients with foot ulcers in Africa; amputation is a frequent outcome mainly due to uncontrolled infection. Several factors have been identified as greatly increasing the risk factors of neuropathy. Poverty and barefoot walking, inappropriate footwear, poor foot hygiene and delay in seeking medical attention [78].

Diabetic foot ulcers are estimated to affect 15% of all diabetics during their lifetime and precede almost 85% of all amputations. Diabetes by virtue of its complications like neuropathy and vasculopathy and other factors affect the musculoskeletal and soft tissue mechanics in a manner that elevates planter pressure and makes tissue damage more likely, causing non-resolving neuroischemic ulcers at the weight bearing sites [79]. There is rising incidence of diabetic foot in Nigeria, which has recently become an important indication for lower limb amputation in Nigeria [80]. In a 15-year review in Nigeria, amputation following diabetic foot was the third indication of amputation 12.3% of diabetic gangrene [81]. Diabetics undergoing surgery belong to the high-risk group of patients. The risks are worst in the presence of severe complications such as diabetic foot gangrene. Foot problems are a major cause of hospital bed occupancy by diabetic patients. Early counselling and psychotherapy are necessary to avoid delayed consent for amputation [50]. Factors associated with poor outcomes include delays in seeking medical attention and ulcers that have progressed to gangrene at the time of presentation. In Africa, foot complications are the main cause of prolonged hospital stays for people with diabetes and are associated with substantial mortality, constituting a major public health problem [49]. In Tanzania, the highest mortality rates are observed in people with severe gangrenous ulcers not treated with aggressive surgery. Diabetic foot infection is a limb threatening complications and several studies have shown it to be the immediate cause of amputation in 25-50% of people with diabetes [49]. In sub-Saharan Africa, peripheral neuropathy is the principal underlying risk factor in the pathogenesis of foot ulcers in people with diabetes [49]. Foot infections usually begin in foot ulcers that are sequelae of existing neuropathy, macrovascular diseases, or certain metabolic disturbances. Risks of infection are exacerbated by the decrease in cellular immunity caused by acute hyperglycaemia and circulatory deficits caused by chronic hyperglycaemia. Diabetic foot infection is a limb threatening complication and several studies have shown it to be the immediate cause of amputation in 25-50% of people with diabetes [49]. In developing countries, increasing prevalence of diabetes and emergence of resistant strains of bacteria are among several factors related complications to the burden of infection related complications. Infection complications are noted among the commonest surgical presentations in diabetes foot. The diabetic patient has a greater susceptibility to infections that arise from several aspects of an altered immunity foot infections are a common problem in developing countries where diabetes mellitus is an emerging problem. The high incidence of undiagnosed diabetics poses a major public health challenge in developing countries. Amputations remain one of the key indications of severe diabetic foot disease.

5. Conclusion

Diabetes mellitus is a public health problem in developing countries and education should be a high priority intervention for all developing regions. Proper education regarding footwear and foot care is necessary in diabetics.

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6. References

- [1] Dahiru T, Jibo A, Hassan AA, Mande AT. Prevalence of diabetes in a semi-urban community in northern Nigeria. *Nig J Med*. 2008. 17 (4): 414-416.
- [2] Mbanya JCN, Motala AA, Sobngwi E, Assah FK Enora ST. Diabetes in sub-Saharan Africa. *Lancet* 375. 2010.: 2254-2266. www.lancet.com
- [3] Ogbera AO, Dada O, Adeleye F, Jewo PI. Complementary and alternative medicine use in diabetes mellitus. *West Afr J Med*. 2010. 29(3): 158-162.
- [4] Adeleke SI, Asani MO, Belonwu RO, Gwarzo GD, Farouk ZL. Childhood diabetes mellitus in Kano, North West Nigeria. *NIG J Med*. 2010. 19(2): 145-147.
- [5] French G. Clinical management of diabetes during anaesthesia and surgery. *Update Anaesth*. 2000. 11(13): 1-3.
- [6] Definition, diagnosis, and classification of diabetes mellitus and its complications. Report of a World Health Organization consultation. Part 1: Diagnosis and classification of diabetes mellitus. WHO department of non-communicable disease surveillance. Geneva. 1999. www.who.int
- [7] Kasiam LO, Long-Mbenza B, Nge OA, Kangola KN, Mbungu FS, Milongo DG. Classification and dramatic epidemic of diabetes mellitus in Kinshasa hinterland: the prominent role of type 2 diabetes and lifestyles changes among Africans. *Nig J Med*. 2009. 18(3): 311-320.
- [8] Gohl D. Subjectively perceived barriers and resources for diabetes self-management by participants of a peer education project in Cambodia. Master Thesis. 2008. retrieved www.charite.de
- [9] Alebiosu CO. Clinical diabetic nephropathy in a tropical African population. *West Afr J Med*. 2003. 22(2): 152-155.
- [10] Issa BA, Baiyewu O. Quality of life of patients with diabetes mellitus in a Nigerian teaching hospital. *Hong Kong J Psych*. 2006. 16: 27-33.
- [11] Balaji A. Quality of care among type 2 diabetes mellitus patients residing in an urban slum of Chennai Corporation: a community based cross sectional study. *J Indian Med Assoc*. 2011. 109(7): 462-4.

- [12] Zafar J, Bhatti F, Aktar N, Rasheed U, Humayun S, Waheed A, Younus F et al. Prevalence and risk factor for diabetes mellitus in a selected urban population of a city Punjab. *J Pakistan Med Assoc.* 2011. 61(1): 40-7.
- [13] Grover S, Avasthi A, Bhansali A, Chakrabarti S, Kulhara P. Cost of ambulatory care of diabetes mellitus: a study from north India. *Postgrad Med J.* 2005. 81(956): 391-395
- [14] Nwafor A, Owhoji A. Prevalence of diabetes mellitus among Nigerians in Port Harcourt correlates with socio-economic status. *J Appl Sci Environ Manag.* 2001. 5(1): 75-77.
- [15] Beran D, Yudkin JS, de Courten M. Access to care for patients with insulin requiring diabetes in developing countries: case studies of Mozambique and Zambia. *Diabetes Care.* 2005. 28(9): 2136-2140.
- [16] Okafor CI, Ofoegbu EN. Indications and outcome of admissions of diabetic patients into the medical wards in a Nigerian tertiary hospital. *Nig Med J.* 2011. 52(2): 86-89.
- [17] Chijioke A, Adamu AN, Makusidi AM. Mortality pattern among type 2 diabetes patients in Ilorin, Nigeria. *JEMDSA.* 2010. 15(2): 1-4.
- [18] Wirth DP, Mitchell BJ. Complementary healing therapy for patients with type 1 diabetes mellitus. *J Sci Explo.* 1994. 8(3): 367-377.
- [19] Omotoso ABO, Opadijo OG, Araoye MA. Hypertension and diabetes mellitus in Nigerians: a review of 572 patients. *Nig J Med.* 1999. 8(3): 108-111.
- [20] Roglic G, Unwin N, Bennett PH, Mathers C, Tuomilehto J, Nag S, Cannolly V, King H. The burden of mortality attributable to diabetes: realistic estimates for the year 2000. *Diabetes Care.* 2005. 28(9): 2130-2135.
- [21] O'Connor PJ, Crain AL, Rush WA, Hanson AM, Fisher LR, Kluznik JC. Does diabetes double the risk of depression? *Ann Fam Med.* 2009. 7(4): 328-335.
- [22] Edo AE, Adediran OS. Carbohydrates in diabetic diet in Nigeria: is it evidence based? *Nig J Gen Pract.* 2006. 7(9): 19-23.
- [23] Alberti H, Boudriga N, Nabli M. Primary care management of diabetes in a low /middle income country: a multi-method, qualitative study of barriers and facilitators to care. *BMC Family Practice.* 2007. 8:63. www.biomedcentral.com/1471-2296/8/63
- [24] Kengne AP, Amoah AGB, Mbanya J. Cardiovascular complications of diabetes mellitus in sub-Saharan Africa. *Circulation.* 2005. 112(23): 3592-601.
- [25] Cook AR. Notes on the diseases met with in Uganda, central Africa. *J Trop Med.* 1901. 4: 175-178.
- [26] Gucciardi E, Wang SC, Demelo M, Amaral L, Stewart DE. Characteristics of men and women with diabetes: observations during patients' initial visit to an education centre. *Can Fam Physician.* 2008. 54 (2): 219-227.
- [27] Evaristo-Neto AD, Foss-Freitas MC, Foss MC. Prevalence of diabetes mellitus and impaired glucose tolerance in a rural community of Angola. *Diabetol Metab Syndr.* 2010. 2:63. www.dmsjournal.com/content/2/1/63
- [28] Jeffrey S, Freeman DO. The increasing epidemiology of diabetes and review of current treatment algorithms. *J Am Osteopathic Assoc.* 2010. 110. 7(Suppl 7). Retrieved www.jaoa.org
- [29] 1998 press release. Global burden of diabetes. Press release WHO/63.1998 in www.who.int

- [30] Narayan KMV, Zhang P, Ramachandran A, Kanaya A, Imperatore G, Williams D, Engelgau M. How should developing countries manage diabetes: CMAJ. 2006. 175(7): 733-736.
- [31] Levitt NS. Diabetes in Africa: epidemiology, management, and health care challenges. Heart. 2008. 94(11):1376-1382.
- [32] Sobngwi E, Mauvais-Javis F, Vexiau F, Mbanya JC, Gautier JF. Diabetes in Africans. Part 1: Epidemiology and clinical specificities. Diabetes Metab. 2001. 27(6): 628-34.
- [33] Majaliwa ES, Elusiyan BE, Adesiyun OO, Laigong P, Adeniran AK, Kandi CM et al. Type 1 diabetes mellitus in the African population: epidemiology, and management challenges. Acta Biomed. 2008. 79(3): 255-259.
- [34] Owoaje EE, Rotimi CN, Kaufman JS, Tracy J, Cooper RS. Prevalence of adult diabetes in Ibadan, Nigeria. East Afr Med J. 1997. 74(5): 299-302.
- [35] Bouguerra R, Alberti H, Salem LB, Rayana CB, Atti JE, Gaigi S et al. The global diabetes pandemic: The Tunisian experience. Eur J Clin Nutr. 2007. 61(2): 160-165.
- [36] McLarty DG, Kitange HM, Mtinangi BL, Makane WJ, Swai AB, Masuki G et al. Prevalence of diabetes and impaired glucose tolerance in rural Tanzania. Lancet. 1989. 1 (8643): 871-875.
- [37] Bakari AG, Onyemelukwe GC, Sani BG, Hassan SS, Aliyu TM. Prevalence of diabetes in suburban northern Nigeria, results of a public screening survey. Diabetes Int. 1999. 9:59-60.
- [38] Erasmus RT, Ebonyi E, Fakeye C. Prevalence of diabetes mellitus in a rural Nigerian population. Nig Med Parct. 1988. 15:128-38.
- [39] Fetugua M, Ogunlesi TA, Adeganbi AF, Olanrewaju DM. Clinical presentation of childhood diabetes mellitus in Olabisi Onabanjo University Hospital, Sagamu. Nig Hosp Pract. 2007. 1(3): 70-3.
- [40] Anochie IC, Nkanginieme KEO. Childhood diabetes in Port Harcourt, southern Nigeria. Diabetes Int. 2002. 12: 20-21.
- [41] Ajayi EA, Ajayi AO. Pattern and outcome of diabetic admission at a federal medical centre: a five-year review. Ann Afr Med. 2009. 8(4): 271-275.
- [42] Unachukwu CN, Uchenna DI, Young E. Mortality among diabetes In-patients in Port Harcourt, Nigeria. Afr J Endo Metab. 2008. 7(1): 1-5.
- [43] Ike SO. The pattern of admissions into the medical wards of the university of Nigeria teaching hospital, Enugu. Nig J Clin Pract. 2008. 11(3): 185-192.
- [44] Osuafor TO, Ele PU. The pattern of admissions in the medical wards of Nnamdi Azikiwe University Teaching Hospital (NAUTH). Orient J Med. 2004. 16(1): 11-15.
- [45] Asumanu E, Ametepi R, Koney CT. Audit of diabetic soft tissue and foot disease in Africa. West Afr J Med. 2010. 29(2): 86-90.
- [46] Azevedo M, Alla S. Diabetes in sub-Saharan Africa: Kenya, Mali, Mozambique, Nigeria, South Africa, and Zambia. Int J Diabetes Dev Countries. 2008. 28(4): 101-108.
- [47] The diabetic foot in sub-Saharan Africa: a new management paradigm. Wounds International. www.woundsinternational.com
- [48] Ezike HA. Anaesthetic challenges in the surgical management of diabetic foot disease in Enugu. Niger Med J. 2008. 49(3): 59-62.

- [49] Struijs JN, Baan CA, Schellevis FG, Westert GP, Geertrudis AM. Comorbidity in patients with diabetes mellitus: impact on medical health care utilization. *BMC Health Serv Res*. 2006. 6:84. doi 10.1186/1472-6963-6-84.
- [50] Oreagba IA, Oshikoya KA, Amachree M. Herbal medicine use among urban residents in Lagos, Nigeria. *BMC Complementary Alternative Med*. 2011. 11:17
www.biomedcentral.com/1472-6882/11/117
- [51] Al-Kindi RM, Al-Mushrafi M, Al-Rabaani M, Al-Zakwani I. Complementary, and alternative medicine use among adults with diabetes in Muscat region, Oman. *Sultan Qaboos Uni Med J*. 2011. 11(1): 62-68.
- [52] Dham S, Shah V, Hirsch S, Banerji MA. The role of complementary and alternative medicine in diabetes. *Current Diab Rep*. 2006. 6(3): 251-8.
- [53] Complementary and alternative medical therapies for diabetes. www.nccam.nih.gov
- [54] Amira CO, Okubadejo NU. Frequency of complementary and alternative medicine utilization in hypertensive patients attending an urban tertiary care centre in Nigeria. *BMC Complementary and alternative medicine*. 2007. 7: 30
www.biomedcentral.com/1472-6882/7/30
- [55] Abodunrin OL, Omojasola TP, Rojumboka OO. Utilization of alternative medical services in an urban centre of north central Nigeria. *Nig Health J*. 2011. 11(2): 51-55.
- [56] Shapiro S, Rapaport R. The role of complementary and alternative therapies in paediatric diabetes. *Endocrinol Metab Clin North Am*. 2009. 38(4): 791-810.
- [57] Dannemann K, Hecker W, Haberland H, Herbst A, Galler A, Schafer T, Brahler E et al. Use of complementary and alternative medicine in children with type 1 diabetes mellitus-prevalence, pattern of use and costs. *Pediatr Diabetes*. 2008. 9(3): 228-350.
- [58] WHO media centre. Traditional medicine. 2008. Fact sheet N° 134.
www.who.int/mediacentre/factsheets/fs/34/en
- [59] Kaptchuk TJ, Eisenberg DM. The persuasive appeal of alternative medicine. *Ann Intern Med*. 1998. 129 (12):1061-1065.
- [60] Astin JA. Why patients use alternative medicines: results of a national study. *JAMA*. 1998. 279(19): 1548-1553.
- [61] Nguyen TT, Wong TY, Islam FM, Hubbard L, Miller J, Haroon E et al. Is depression associated with microvascular disease? *Depress anxiety*. 2008. 25(11): E158-62.
- [62] Abrahamian H, Hofmann P, Prager R, Toplak H. Diabetes mellitus and co-morbid depression treatment with milnacipran results in significant improvement of both diseases (results from the Austrian MDDM study group). *Neuropsychiatr Dis Treat*. 2009. 5: 261-266.
- [63] Mezuk B, Eaton WW, Albrecht S, Golden SH. Depression and type 2 diabetes over the lifespan: A meta-Analysis. *Diabetes Care*. 2008. 3(12): 2383-2390.
- [64] Gonzalez JS, Peyrot M, McCart LA, Collins EM, Serpa L, Miniaga MJ, Safren S. Depression and diabetes treatment nonadherence: A meta-Analysis. *Diabetes Care*. 2008. 13(12): 2398-2403.
- [65] Lin EHB, Katon W, Rutter C, Simon GE, Ludman EJ, Korff MV et al. Effects of enhanced depression treatment on diabetes self care. *Ann Fam Med*. 2006. 4(1): 46-53.

- [66] Ikeh EI, Puepet F, Nwadiaro C. Studies on diabetic foot ulcers in patients at Jos University Teaching Hospital, Nigeria. *Afr J Clin Experimental Microbiol.* 2003. 4(2): 52-61.
- [67] El Mahdi EM. Pattern of diabetes mellitus in the Sudan. *Trop Geog Med.* 1989. 41(4): 353-357.
- [68] Osuntokun BO, Akinkugbe FM, Francis TI, Osuntokun O, Taylor GO. Diabetes mellitus in Nigerians: a study of 832 patients. *West Afr Med J Niger Pract.* 1971. 20(5):295-312.
- [69] Abdullah MS. Diabetic nephropathy in Kenya. *East Afr Med J.* 1978. 55(11): 512-8.
- [70] Lester FT. Clinical features complications and mortality in type 2 (non-insulin dependent) diabetic patients in Addis Abeba (1976-1990). *Ethiopia Med J.* 1993. 31(2): 109-126.
- [71] Harper W. Diabetes Mellitus. www.drharper.ca
- [72] Diabetes and amputation. www.diabetes.co.uk
- [73] Obalum DC, Okeke GC. Lower limb amputation at a Nigerian private tertiary hospital. *West Afr J Med.* 2009. 28(1): 24-7.
- [74] Boulton AJM. An Integrated Health Care Approach Is Needed: The Global Burden of Diabetic Foot Disease. *Diabetic Microvascular Complications Today.* 2006. 23-25.
- [75] Edo AE, Eregie A, Ezeani UI. Diabetic foot ulcers following rat bites. *Afr J Diabetes Med.* 2010. 18(2): 19.
- [76] Tesfaye S, Gill G. Chronic diabetic complications in Africa. *Afr J diabetes Med.* 2011.9(1): 37-40 www.africanjournalofdiabetesmedicine.com
- [77] Gaur DS, Varma A, Gupta P. Diabetic foot in Uttaranchal. *JK Sci.* 2007. 9(1): 18-20.
- [78] Solagberu BA. Diabetic foot in Nigeria-a review article. *Afr J Med Med Sci.* 2003. 32(2): 111-8.
- [79] Thianni LO, Tade AO. Extremity amputation in Nigeria-a review of indications and mortality. *Surgeon.* 2007. 5(4): 213-7.