

ORIGINAL RESEARCH REPORT

Pattern of complications and comorbidities among diabetic patients in a tertiary healthcare center in Nigeria

Oluwatosin O. Kayode¹, Oluwakemi O. Odukoya², Ifedayo A. Odeniyi^{1,3},
Oluwarotimi B. Olopade¹, Olufemi A. Fasanmade^{1,3}

¹Department of Medicine, Lagos University Teaching Hospital, ²Departments of Community Health and Primary Care, ³Medicine, College of Medicine, University of Lagos, Lagos, Nigeria

ABSTRACT

Background: The prevalence of diabetes mellitus (DM) among Nigerian adults is increasing. Besides the well-recognized microvascular complications of diabetes, there is also a growing epidemic of macrovascular complications. Patients with diabetes may not only have diabetes-related complications but may also have nondiabetes-related comorbidities. **Aim:** To determine the pattern of chronic diabetic complications and coexisting morbidities in patients attending the diabetic outpatient clinic of a tertiary health care center in Nigeria and the factors associated with the presence of complications. **Materials and Methods:** This was a cross-sectional descriptive survey carried out among patients attending the follow-up diabetic clinic of a tertiary health care center in Nigeria over a 3-month period. A systematic random sampling method was used and 422 eligible patients were selected and interviewed using pretested interviewer-administered questionnaires, after written informed consent was obtained. Data were analyzed using Epi Info statistical package version 3.5.1. developed by Centers for Disease Control and Prevention (CDC) in Atlanta Georgia (USA). **Results:** Of the 422 patients interviewed, 400 (247 females and 153 males) had complete data for analysis. Eighty-eight patients had comorbidities, and the commonest was hypertension in 63 (71.6%). Out of the 61 patients who had complications, the majority, that is, 39 (63.9%) had eye complications. Factors significantly associated with the presence of diabetic complications were the duration of diabetes, marital status, and the presence of diabetic comorbidities. **Conclusion:** The frequency of diabetic complications and comorbidities is quite high in the patients studied. There is a need to improve the standard of care of patients and to ensure optimal blood glucose control. This will go a long way in reducing the frequency of complications and comorbidities.

Key words: Comorbidities, complications, diabetes mellitus, hypertension

Address for correspondence:

Dr. Oluwatosin O Kayode,
Department of Medicine, State
Specialist Hospital,
PMB 603 Akure, Ondo, Nigeria.
E-mail: tosinod2001@yahoo.co.uk

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease with an increasing burden, particularly in developing countries.^[1] In 1995 it was estimated that there were 135 million people in the world with DM.^[2] In 2006 the estimated number of people living with DM had increased to 246 million people worldwide.^[2] Globally, the prevalence of DM in 2013 was

estimated to be 382 million.^[1] The total number of people with diabetes is projected to rise from 382 million in 2013 to 592 million by 2035.^[1]

Eighty percent of people with DM live in low- and middle-income countries like Nigeria.^[1] DM is associated

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Kayode OO, Odukoya OO, Odeniyi IA, Olopade OB, Fasanmade OA. Pattern of complications and comorbidities among diabetic patients in a tertiary healthcare center in Nigeria. J Clin Sci 2015;12:29-35.

Access this article online

Quick Response Code:



Website:

www.jcsjournal.org

DOI:

10.4103/1595-9587.160765

with considerable morbidity and mortality.^[1] People with diabetes have higher mortality rates than those without diabetes.^[3-5] In many parts of Nigeria, where health-care services and accessibility are poor, DM is associated with considerably higher levels of disease burden.^[6]

The prevalence of DM among Nigerian adults has been increasing over time. A national survey carried out in 1997 showed a prevalence rate of 2.2%.^[7] In 1994, a study among urban adults in Jos metropolis revealed the prevalence of undiscovered DM to be 3.1%. By 2004, a second survey in Jos recorded a prevalence of 10.3%, while a 2003 survey in Port Harcourt recorded a standardized prevalence rate of 7.9%.^[8] It is currently estimated that there are 3,055,000 adults aged 20-79 years living with DM in Nigeria. This figure is expected to increase to 6,113,000 by the year 2030.^[9]

Besides the well-recognized microvascular complications of diabetes, such as nephropathy and retinopathy, there is also a growing epidemic of macrovascular complications, including diseases of the coronary, carotid, and peripheral arteries.^[10] Diabetes and its complications have significant social and economic impact on individuals, families, health systems, and countries.^[11] This burden is not only related to the direct costs associated with the disease but also to indirect costs resulting from productivity losses. The productivity losses are due to patient disability resulting from complications and premature mortality, time spent by family members accompanying patients when seeking care, and intangible costs (psychological pain to the family and loved ones).^[11] People with diabetes require at least two to three times the health-care resources compared to people who do not have diabetes, and diabetes care may account for up to 15% of national health-care budgets.^[11]

Comorbidity, defined as the occurrence of one or more chronic conditions in the same person with an indexed disease, occurs frequently among patients with diabetes.^[12] Patients with diabetes may not only have diabetes-related complications but may also have nondiabetes-related comorbidities, such as hypertension, tuberculosis, and asthma.^[6,12] In fact, the risk of tuberculosis is three times higher among people with diabetes.^[13] There is depressed immunological function in DM that might predispose a patient to infections such as tuberculosis, as cell-mediated immunity plays a pivotal role.^[13-15]

Comorbidity among patients with diabetes is associated with considerable health-care consequences, and increases health-care utilization and medical-care costs.^[16-20] The presence of coexisting morbidities may also affect treatment outcomes among diabetic patients.^[14,18] Available data have revealed that not only will the number of patients with diabetes increase in the future, but also the number of diabetic patients with comorbidities.^[18,14]

The increase in the number of patients with comorbidities may have important implications for integrated diabetes-care programs in Nigeria. The number of comorbidities is very important in predicting the future health-care utilization of patients with diabetes.^[5,10]

The aim of this study was to assess the pattern of chronic diabetic complications and coexisting morbidities in patients attending the diabetic outpatient clinic of the Lagos University Teaching Hospital (LUTH), and to determine the factors associated with these conditions.

MATERIALS AND METHODS

A cross-sectional descriptive survey was carried out among patients attending the follow-up diabetic clinic at LUTH during January-March 2011 (both months inclusive). LUTH, a tertiary institution, is one of the main referral medical institutions in Lagos State, and sources of referral include private hospitals and primary and secondary health-care facilities in the state.

LUTH has the leading high-volume Diabetic Clinic in Lagos State and possibly in Nigeria, considering the population of Lagos State. By carrying out the study in a government hospital, we were able to ensure that we got perspectives/data from different strata of the Nigerian population. Patients below 18 years, type 1 diabetic patients, and those who had been attending the clinic for less than 1 year were excluded from the study. Using a confidence interval (CI) of 95%, a margin of error of 5%, and an estimated prevalence of comorbidities among diabetic patients of 50%, a minimum sample size of 384 was obtained. This was increased to 422 after accounting for a possible nonresponse rate of 10%.

A systematic random sampling method was carried out. Using the weekly patient registers, every second consenting and eligible patient was interviewed by two trained interviewers over a 3-month period. Four hundred and twenty-two eligible patients were selected and interviewed using pretested questionnaires administered by trained research assistants, after written informed consent was obtained.

The questionnaires elicited information on the sociodemographic characteristics of the patients such as the age, sex, marital status, and duration of diabetes. The duration of diabetes was estimated as the time between the diagnosis by a medical practitioner and the time of interview. Additionally, the questionnaires assessed information on the experience of symptoms and signs of complications and comorbidities of diabetes; these were provided as fixed questions (with possible answers "Yes" or "No"). The prior research on diabetes guided the inclusion of development of complications and comorbidities in the questionnaires.

Ethical clearance was obtained from the Ethics and Research Committee of LUTH. The information on the complications and comorbidities of the patients was elicited verbally and validated using the case notes. Four hundred questionnaires were adequately filled and analyzed using Epi Info statistical package version 3.5.1 developed by Centers for Disease Control and Prevention (CDC) in Atlanta Georgia (USA). Simple frequency tables were constructed to show the proportion of coexisting morbidities and complications among the respondents. Bivariate analyses were carried out to assess the factors associated with some complications. *P* values of ≤ 0.05 were considered to be statistically significant.

Setting

The study was carried out at LUTH. LUTH is located in the Mushin Local Government Area of Lagos State. It occupies 92 acres of land and is an over-700-bed facility, making it one of the largest teaching hospitals in Nigeria.^[21] The hospital is one of the main referral medical institutions in the state. The endocrine, diabetes, and metabolism unit of the Department of Medicine runs two clinics for patients with DM. The estimated number of patients per week is about 120.

RESULTS

Of the 422 patients interviewed, 400 had complete data for analysis. The 22 patients who were excluded from analysis were those whose clinical case records were not available for validation of the information reported in the questionnaires. There were 247 (61.8%) females and 153 (38.2%) males. Their age range was 25-84 years, with a mean age of 37.5 ± 10.4 years. Most of the patients, that is, 197 patients (49.2%) were aged 40-59 years. A majority of the patients, that is, 276 patients (69%) were married. More than one-third 139 patients (34.8%) of the patients had education below the secondary level. About a quarter of the patients, that is, 111 patients (27.9%) were engaged in unskilled types of occupation. The duration of diagnosis of diabetes was less than 5 years in 136 (34%) of the study participants [Table 1].

Out of 400 patients, 88 (22%) had comorbidities, and the commonest was hypertension in 63 (71.6%). Sixty-one (15.3%) of the patients had diabetic complications. The majority of these had eye complications 39 patients (63.9%). Other complications included neurological complications 10 (16.4%), renal complications 6 patients (9.8%), stroke 3 patients (5%), peripheral arterial disease 2 patients (3.3%), and ischemic heart disease (IHD) 1 patient (1.7%) [Table 2].

Bivariate analyses showed a statistically significant association between presence of diabetic complications and the duration of diabetes, marital status, and the presence of diabetic comorbidities [Table 3].

Table 1: Sociodemographic characteristics of the respondents

Variable	Frequency	Percentage (%)
Gender <i>n</i> =400		
Female	247	61.8
Male	153	38.2
Age (in years) <i>n</i> =400		
20-39	53	13.3
40-59	197	39.2
≥ 60	150	37.5
Marital status <i>n</i> =400		
Divorced/separated	26	6.4
Married	276	69
Single	19	1.8
Widowed	79	19.8
Employment status <i>n</i> =400		
Employed	267	66.8
Unemployed	133	33.2
Employed <i>n</i> =267		
Semiskilled	99	24.9
Unskilled	111	27.9
Skilled	57	14.3
Highest educational level <i>n</i> =400		
No formal education	36	9
Primary education	103	25.8
Secondary education	104	26
Postsecondary education	157	39.2
Duration of diagnosis of DM (in years) <i>n</i> =400		
0-4	136	34
5-9	108	27
10-14	92	23
15 and above	64	16

DISCUSSION

In this study, most of the patients (49.2%) who had DM were aged 40-59 years. This is in keeping with the fact that the majority of the 382 million people with DM are within this age group.^[1] This age group constitutes part of the work force of the nation. DM-related morbidity and mortality in this age group reduce the productivity of the workforce and affects economic growth.^[22] There is also an increase in expenditure in health care, which is diverted from essential investments for economic growth.^[22] There is, therefore, a need to initiate and implement effective and evidence-based intervention strategies for the prevention and early detection of DM, as well as for the appropriate management of DM and its complications.^[23]

The commonest complication involved the eye, in 39 (63.9%) of the patients in this study. Worku *et al.* in 2008 reported a prevalence of visual disturbance of 33.8% in diabetic patients being followed up in a tertiary hospital in Addis Ababa, Ethiopia, while Ejigu *et al.* in 1997 reported a prevalence of 31.4% in another cohort of diabetic patients in a different referral hospital in Ethiopia.^[24,25] Mbanya and Sobngwi studied the prevalence of diabetic complications

Table 2: Presence and type of comorbidities/ complications

Variable	Frequency	Percentage (%)
Presence of comorbidities <i>n</i> =400		
Yes	88	22
No	312	78
Type of comorbidities <i>n</i> =88		
Hypertension	63	71.6
Tuberculosis	6	6.8
Asthma	4	4.5
Ulcer	4	4.5
Others	11	12.5
Presence of diabetic complications <i>n</i> =400		
Yes	61	15.3
No	339	84.7
Type of complication <i>n</i> =61		
Eye	39	63.9
Neurological	10	16.4
Renal	6	9.8
Stroke	3	5.0
Peripheral arterial disease	2	3.3
Ischemic heart disease	1	1.7

Table 3: Factors associated with diabetic complications

Factor	Odds ratio	95% CI	P value
Advancing Age	0.97	0.93-1.02	0.224
Unskilled worker	0.53	0.21-1.41	0.206
Unemployed	1.49	0.57-3.91	0.407
Increasing Duration of DM	1.09	1.03-1.64	0.003*
Presence of comorbidity	5.84	2.61-13.10	0.000*
Female sex	0.67	0.29-1.55	0.355
Currently married	0.33	0.13-0.81	0.016*
Below secondary education	1.27	0.47-3.39	0.637

*statistically significant <0.05, DM=Diabetes mellitus

in Africa and reported that visual disturbance was present in 16-55% of people with diabetes.^[26]

The population in these studies included both type 1 and type 2 patients. In this study the prevalence of visual disturbance was higher, and this could be because only type 2 patients were included in this study. Type 2 patients may present at the time of diagnosis with complications that could include visual disturbances. The age of the subjects, duration of diabetes, and glycemic control have been found to be the major determinants of visual disturbances.^[22] These factors could also account for the differences in the prevalence of visual disturbances in the various studies. Presently, eye screening is not done routinely for all the patients attending the clinic.

The prevalence of peripheral neuropathy in this study was 10 (16.4%). Diabetic peripheral neuropathy is one of the most common complications of diabetes, occurring in 28-55% of diabetic patients.^[23] Abbas and Archibald^[27] looked at published data regarding the diabetic foot in Africa encompassing the years 1960-2003 and they

reported a prevalence of peripheral neuropathy, which differed in various countries and ranged 4-84%.

The frequency of symptoms of peripheral neuropathy varied between 9.5 and 36.4% in a review by Sobgnwi *et al.* It is the main risk factor in the pathogenesis of foot ulceration in diabetic patients. Although neuropathy is often the initiating factor for foot ulceration, ischemia is critically important in determining healing.^[23] Foot ulcerations have been associated with considerable long-term disability from amputation and premature mortality.^[27]

Nephropathy was reported in 6 (9.8%) of the subjects in this study. Diabetic nephropathy is emerging as a major cause of end-stage renal disease (ESRD) in sub-Saharan Africa.^[28] The prevalence of nephropathy reported by Worku *et al.* was 48 (15.7%), while Ejigu reported a prevalence of 23.3%. Afifi *et al.* in Egypt^[29] performed a 6-year multiple cross-sectional study between 1996 and 2001, investigating the prevalence of diabetic nephropathy. The prevalence of diabetic nephropathy gradually increased from 8.9% in 1996 to 14.5% in 2001. There is no doubt that diabetic nephropathy is assuming an increasingly important role as a cause of chronic kidney disease in Africa.^[23]

In our study the most frequent macrovascular complication of diabetes was stroke (4.95%), followed by peripheral arterial disease (PAD) (3.3%) and IHD (1.7%). A study carried out in Sudan reported that IHD (at 28%) was the most frequent macrovascular complication of diabetes, followed by PAD (10%) and stroke (5%).^[30] In a study carried out in Tanzania, 4.4% of type 2 diabetic patients presented with stroke at diagnosis of diabetes.^[31] In another study carried out in Zambia, out of 600 diabetic patients, Rolfe reported a 1.2% stroke rate.^[32]

The prevalence of peripheral arterial disease varies 4.4-28% and depends on the diagnostic criteria used (absence of pulse on clinical examination and/or Doppler evidence of vascular lesion).^[23] IHD was considered to be rare in Africa two decades ago, yet is now regularly seen.^[33] The rapid urbanization of communities across Africa, unhealthy diets, physical inactivity, smoking, and obesity have led to an increasing prevalence of macrovascular disease including IHD.^[23,33]

IHD may be present at the clinical onset of diabetes in up to 5% of patients.^[34] Type 2 diabetes is an independent risk factor for the development of IHD.^[33] Due to autonomic neuropathy, DM patients may not feel pain. They may not present with symptoms of IHD such as central chest pain radiating to the arms, jaw, and neck. They may present with transient episodes of painless myocardial ischemia, silent myocardial infarction, arrhythmias, and sudden cardiac death.^[33]

Hypertension is a common cardiovascular disease in Africans and carries high mortality and morbidity rates.

Hypertension and diabetes frequently coexist. The frequency of hypertension in the diabetic population is almost twice as compared to the nondiabetic general population.^[34,35] In our study the prevalence of hypertension was 71.6%. This is higher than the reported prevalence rates of hypertension in Nigerians with DM, which range 29-40%.^[36] The prevalence of (24.9%) was reported by Worku *et al.* in their own diabetic subjects.

There is a considerable evidence for a higher prevalence of hypertension in diabetic persons.^[25] The prevalence rate of hypertension among type 2 diabetics is higher than that of age- and sex-matched patients without diabetes, ranging 32-82%.^[3] The prevalence rate of hypertension was 70.4% in a study carried out in Morocco.^[37]

The prevalence rate of hypertension reported in this study (71.6%) among patients with type 2 diabetes is comparable to the 66.4% and 70.4% rates reported in the Cameroonian^[38] and Moroccan diabetic populations, respectively. This prevalence rate is lower than the 82% prevalence rate reported in Afro-Caribbean individuals living in the UK^[39] and is much higher than the 32% and 39% rates reported among diabetics in the Turkish and Taiwanese^[40,41] populations, respectively. The explanation for differences in the frequency of each country could be due to different methods of surveillance, population characteristics, and ethnic variations.^[38]

About 6.8% of our study subjects had tuberculosis (TB) as a comorbidity. Patients with diabetes have been shown to be at a higher risk of developing TB than those without diabetes.^[42]

The incidence of TB is greatest among those with conditions impairing immunity, such as human immunodeficiency virus (HIV) infection and diabetes. Diabetes may lead to increased susceptibility to TB due to its effects on phagocyte (macrophage and lymphocyte) function. Diabetes is known to affect chemotaxis, phagocytosis, activation, and antigen presentation by phagocytes in response to *Mycobacterium tuberculosis*. This leads to a diminished ability of the body to contain the organism.^[13]

A recent study showed that countries that saw an increase in diabetes prevalence also had a significant increase in the number of people with TB.^[43] Several studies have looked at the association between diabetes and TB in developed countries and found that people with diabetes are around 2.5 times more likely to develop TB.^[44-48] A recent review showed that when people with diabetes were screened for tuberculosis, more people were found to have previously undiagnosed TB than in the general population.^[46]

People with diabetes who have adequate glucose control are less likely to develop TB.^[42] In addition, TB treatment leads to decreasing blood glucose levels, suggesting that the integrated management of TB in people with high blood

glucose could lead to better diabetes control.^[42] Screening for TB in people with diabetes and screening for diabetes in people with TB could offer opportunities to increase detection and prevent diabetes or TB-related complications.

In this study, the prevalence of asthma in type 2 diabetes was found to be 4.5%. A study by Ehrlich *et al.* in California found that the incidence of asthma was greater in those with a diagnosis of diabetes than in those without diabetes.^[49] This increased risk may be a consequence of declining lung function in patients with diabetes.^[49] Decrements in the lung function of patients with diabetes are believed to be due to biochemical alterations in the connective tissue constituents of the lung, particularly collagen and elastin, as well as microangiopathy due to the nonenzymatic glycosylation of proteins induced by chronic hyperglycemia.^[49,50] There are also reduced pulmonary elastic recoil and inflammatory changes in the lungs.^[50]

The factors associated with having diabetic complications include having comorbidities, increasing duration of diabetes, and being currently married. Worku *et al.* also found that the longer the duration of DM, the more frequent was the occurrence of the complications. A DM patient with a coexisting morbidity is 5.84 times more likely to have a complication of diabetes. The risk of complications and comorbidities is related to glycemia.^[51,52] Poor glycemic control is associated with an increasing risk of complications and comorbidities.

In this study, being married reduces the chances of having complications, compared to those who are single/separated/divorced/widowed. In a study carried out in the US, unmarried persons were more likely than married persons to have poor glycemic control.^[53] When glycemic control is poor, diabetes imposes additional burdensome care requirements, health-care costs, and high risk of disabling complications.^[52]

Limitation of the study

A limitation of the present study is that we could not assess whether the complications of diabetes were as a result of comorbid conditions or were not. However, this would be a common weakness of any study evaluating the complications and comorbidities among diabetic patients in our setting.

CONCLUSION AND RECOMMENDATION

The frequency of diabetic complications and comorbidities is quite high in the patients studied. There is a need to improve the standard of care of patients and to ensure optimal blood glucose control. This will go a long way in reducing the frequency of complications and comorbidities. Presently eye screening is not done routinely for all the patients attending the clinic. Early eye examination at

both the first presentation of elevated blood glucose and periodically is of utmost importance.

Early diagnosis of peripheral neuropathy and the education of diabetic patients on appropriate foot care may also go a long way in reducing the prevalence of foot ulceration and amputation. The establishment of foot clinics may lead to a reduction in major amputations, as seen in Western countries. The design and implementation of strategies for an appropriate population-based prevention program and early diagnosis of DM should be made a public health and economic priority.

Source of funding

No financial support exists.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- International Diabetes Federation. IDF Diabetes Atlas 6th ed. Brussels, 2013.
- Levitt NS. Diabetes in Africa: Epidemiology, management and healthcare challenges. *Heart* 2008;94:1376-82.
- Ogbera A, Chinenye S, Onyekwere A, Fasanmade O. Prognostic indices of diabetes mortality Ethnicity and Dis, 2007;17:721-5.
- Onen C. Diabetes morbidity and mortality in Botswana: a retrospective analysis of hospital based data on diabetic patients, 1980–1994. *Int Diab Dig* 1998;13:96-9.
- Fuller JH. Mortality trends and causes of deaths in diabetes patients. *Diabete Metab* 1993;13:96-9.
- Ogbera A, Fasanmade O, Ohwovoriole A. High costs, low awareness and a lack of care—the diabetic foot in Nigeria. *Diabetes Voice* 2006;51:30-2.
- Akinkugbe OO. Non-communicable diseases in Nigeria—final report of a national survey. Lagos: Federal Ministry of Health—National Expert Committee on Non-Communicable Diseases; 1997. p. 65-8.
- Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diab Res and Clin Pract*;2010:4-14.
- Mohan V, Seedat YK, Pradeepa R. The rising burden of diabetes and hypertension in southeast Asian and African Regions: Need for effective strategies for prevention and control in primary health care settings. *Int J Hypertens* 2013;2013:409083. 1-14.
- Nyenwe EA, Odia OJ, Ihekweba AE, Ojule A, Babatunde S. Type 2 diabetes in adult Nigerians: A study of its prevalence and risk factors in Port Harcourt, Nigeria. *Diab Res and Clin Pract* 2003;62:177-85.
- Puepet FH, Zoakah AI, Chuhwak EK. Prevalence of overweight and obesity among urban Nigeria adults in Jos. *Highland Med Res J* 2002;1:13-6.
- Beckman JA, Creager MA, Libby P. Diabetes and Atherosclerosis Epidemiology, Pathophysiology, and Management. *JAMA* 2002;287:2570-81.
- Dooley KE, Chaisson RE. Tuberculosis and diabetes mellitus: Convergence of two epidemics. *Lancet Infect Dis* 2009;9:737-46.
- Struijs JN, Baan CA, Schellevis FG, Westert GP, Geertrudis AM. Co-morbidity in patients with diabetes mellitus: Impact on medical health care utilization *BMC Health Services Research* 2006;6:84.
- Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: Systematic review of 13 observational studies. *PLoS Medicine* 2008;5:e152.
- Carral F, Aguilar M, Oliveira G, Mangas A, Doménech I, Torres I. Increased hospital expenditures in diabetic patients hospitalized for cardiovascular diseases. *J Diabetes Complications* 2003;17:331-6.
- Norlund A, Apelqvist J, Bitzén PO, Nyberg P, Scherstén B. Cost of illness of adult diabetes mellitus underestimated if co-morbidity is not considered. *J Intern Med*. 2001;250:57-65.
- Westert GP, Satariano WA, Schellevis FG, van den Bos GA. Patterns of co-morbidity and the use of health services in the Dutch population. *Eur J Public Health* 2001;11:365-72.
- O'Brien JA, Shomphe LA, Kavanagh PL, Raggio G, Caro JJ. Direct medical costs of complications resulting from type 2 diabetes in the U.S. *Diabetes Care* 1998;21:1122-8.
- Barcelo A, Aedo C, Rajpathak S, Robles S. The cost of diabetes in Latin America and the Caribbean. *Bull World Hlth Org* 2003;81:19-27.
- Available from: <http://www.luthnigeria.org> [Last accessed on 18th Sept. 2010].
- Bajaj JS. Prediabetic State: Changing times, evolving paradigm, a ringside view over five decades. *Med Update* 2010;20:27-34.
- Tesfaye S, Gill G. Chronic diabetic complications in Africa. *Afric J Diabetes Med* 2011;19:4-8.
- Worku D, Hamza L, Woldemichael K. Patterns of Diabetic Complications at Jimma University Specialized Hospital, Southwest Ethiopia. *Ethiop J Health Sci* 2010;20:33-9.
- Ejigu A. Brief communication: Pattern of chronic complications of diabetic patients in Menilik II hospital, Ethiopia. *Ethiop J health dev*, 2000;14:113-6.
- Sobngwi E, Mauvais-Jarvis F, Vexiau PJ, Mbanya JC, Gautier JF. Diabetes in Africans: Part 1: Epidemiology and Clinical Specificities. *Diab Metab (Paris)* 2001;27:628-34.
- Abbas Z, Archibald L. The diabetic foot in sub-Saharan Africa: A new management paradigm. *Diab Foot J* 2007;10:128-36.
- Alebiosu CO, Ayodele OE. The increasing prevalence of diabetic nephropathy as a cause of end-stage renal disease in Nigeria. *Trop Doct* 2006;36:218-9.
- Afifi A, El Setouhy M, El Sharkawy M, Ali M, Ahmed H, El-Menshawry O, Masoud W. Diabetic nephropathy as a cause of end-stage renal disease in Egypt: A six-year study. *East Mediterr Health J* 2004;10:620-6.
- Elbagir MN, Eltom MA, Mahadi EO, Berne C. Pattern of long-term complications in Sudanese insulin-treated diabetic patients. *Diabetes Res Clin Pract* 1995;30:59-67.
- Walker RW, McLarty DG, Kitange HM, Whiting D, Masuki G, Mtasiwa DM, *et al.* Stroke mortality in urban and rural Tanzania. Adult Morbidity and Mortality Project. *Lancet* 2000;355:1684-7.
- Rolfe M. Macrovascular disease in diabetics in Central Africa. *Br Med J (Clin Res Ed)* 1988;296:1522-5.
- Kengne AP, Amoah AG, Mbanya JC. Cardiovascular complications of diabetes mellitus in sub-Saharan Africa. *Circulation* 2005;112:3592-601.
- Nambuya AP, Otim MA, Whitehead H, Mulvany D, Kennedy R, Hadden DR. The presentation of newly-diagnosed diabetic patients in Uganda. *QJM* 1996;89:705-11.
- Paul B, Sapra B, Maheshwari S, Goyal RK. Role of Losartan therapy in the management of diabetic hypertension. *J Assoc Physicians India* 2000;48:514-8.
- Ikem RT, Kolawole BA. Diabetes register: An audit of newly presenting patients in a diabetes out-patient clinic. *Afr J Endocrinol Metab* 2002;3:52-4.
- Berraho M, El Achhab Y, Benslimane A, El Rhazi K, Chikri M, Nejari C. Hypertension and type 2 diabetes: A cross-sectional study in Morocco (EPIDIAM Study). *Pan Afr Med J* 2012;11:52.
- Ducorps M, Bauduceau B, Mayaudon H, Sonnet E, Groussin L,

Kayode, *et al.*: Complications and co-morbidities among diabetic patients

- Castagné C. Prevalence of hypertension in a black African diabetic population. *Arch Mal Coeur Vaiss* 1996;89:1069-73.
39. Baskar V, Kamalakannan D, Holland MR, Singh BM. Does ethnic origin have an independent impact on hypertension and diabetic complications? *Diabetes Obes Metab* 2006;8:214-9.
40. Satman I, Yilmaz T, Sengül A, Salman S, Salman F, Uygun S, *et al.* Population-based study of diabetes and risk characteristics in Turkey: Results of the Turkish diabetes epidemiology study (TURDEP). *Diabetes Care* 2002;25:1551-6.
41. Tseng CH. Higher risk of hypertension in indigenous type 2 diabetic patients in Taiwan. *J Hypertens* 2006;24:1817-21.
42. Stevenson CR, Forouhi NG, Roglic G, Williams BG, Lauer JA, Dye C, *et al.* Diabetes and tuberculosis: The impact of the diabetes epidemic on tuberculosis incidence. *BMC Public Health* 2007;7:234.
43. Goldhaber-Fiebert JD, Jeon CY, Cohen T, Murray MB. Diabetes mellitus and tuberculosis in countries with high tuberculosis burdens: Individual risks and social determinants. *Int J Epidemiol* 2011;40:417-28.
44. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: A systematic review of 13 observational studies. *PLoS Med* 2008;5:e152.
45. Ottmani SE, Murray MB, Jeon CY, Baker MA, Kapur A, Lönnroth K, *et al.* Consultation meeting on tuberculosis and diabetes mellitus: Meeting summary and recommendations. *Int J Tuberc Lung Dis* 2010;14:1513-7.
46. Jeon CY, Harries AD, Baker MA, Hart JE, Kapur A, Lönnroth K, *et al.* Bi-directional screening for tuberculosis and diabetes: A systematic review. *Trop Med Int Health* 2010;15:1300-14.
47. Leung CC, Lam TH, Chan WM, Yew WW, Ho KS, Leung GM, *et al.* Diabetic control and risk of tuberculosis: A cohort study. *Am J Epidemiol* 2008;167:1486-94.
48. Pablos-Méndez A, Blustein J, Knirsch CA. The role of diabetes mellitus in the higher prevalence of tuberculosis among Hispanics. *Am J Public Health* 1997;87:574-9.
49. Ehrlich SF, Quesenberry CP Jr, Van den Eeden SK, Shan J, Ferrara A. Patients diagnosed with diabetes are at increased risk for asthma, chronic obstructive pulmonary disease, pulmonary fibrosis, and pneumonia but not lung cancer. *Diabetes Care* 2010;33:55-60.
50. Shah SH, Sonawane P, Nahar P, Vaidya S, Salvi S. Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease. *Lung India* 2013;30:108-12.
51. Inzucchi SE, Bergenstal RM, Buse JB, Diamant M, Ferrannini E, Nauck M, *et al.* Management of hyperglycaemia in type 2 diabetes: A patient-centered approach. Position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia* 2012;55:1577-96.
52. Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS. Racial and ethnic differences in glycemic control of adults with type 2 diabetes. *Diabetes Care* 1999;22:403-8.
53. Ali MK, McKeever Bullard K, Imperatore G, Barker L, Gregg EW; Centers for Disease Control and Prevention (CDC). Characteristics associated with poor glycemic control among adults with self-reported diagnosed diabetes-National Health and Nutrition Examination Survey, United States, 2007-2010. *MMWR Morb Mortal Wkly Rep* 2012;61(Suppl):32-7.