



Prevalence and Pattern of Complications Associated with Type 2 Diabetes Mellitus among Patients Presenting to a Tertiary Hospital in Zambia

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ABSTRACT

Objective: To establish the prevalence and type of complications associated with type 2 diabetes mellitus among patients reporting for care at the Ndola Teaching Hospital. **Design and Methods:** The study team conducted a medical record based retrospective study which primarily assessed clinicians' compliance to the recommended standards of management of diabetic patients. Further, the study examined the records for the presence and type of complications reported among the type 2 diabetic patients presenting for care. The study was undertaken at Ndola Teaching Hospital, a tertiary referral hospital in the Copper belt province of Zambia. The target population were adult male and female patients with type 2 diabetes. The period under review was from January 2022 to December 2022. The sample

size estimate was determined using the Cochrane formula and a systematic random sampling procedure was applied to select the population of interest. A data abstraction sheet was used to collect the relevant medical information suggesting baseline characteristics and DMT2 associated complications. The type of complications was recorded based on the clinical and laboratory examination findings. The data was analyzed using excel and SPSS version 26. **Results:** Up to 90 eligible patient files representing the study subjects, 65.6% were female and 34.4% were males. The age range of the sampled population was from 20 to 80 years with most of the patients falling between 50-64 years representing about 34% and the least age category of above 80 years representing 2.25% of the study subjects. The mean age was 54 years. A number of files were devoid of a targeted comprehensive physical examination assessment. For example, out of 90 patients sampled, (n=12, 13.3%) had comprehensive foot examination and only 28.9% had their eyes fully examined. The most common complications associated with DMT2 were retinopathy (n=19, 21.1%), nephropathy (n=15, 16.7%), neuropathy (n=12, 13.3%) and coronary artery disease (n=10, 11.1%). **Conclusion:** Neurovascular complications are relatively common among the type 2 diabetes mellitus patients presenting for care at Ndola Teaching Hospital and do signify the need to optimize the standard of care administered.

Keywords: Complications, Diabetes mellitus, Prevalence, Patterns

INTRODUCTION

Background to the Problem

Diabetes mellitus, a condition arising from a relative or absolute lack of the hormone insulin is one of the major endocrinopathies known and a growing disease burden globally. The disease is broadly classified into type 1 which usually develops in childhood or adolescence and the type 2 previously referred to as adult onset and commonly associated with excess body weight and physical inactivity and results from the body's ineffective use of insulin. More than 95% of people with diabetes have type 2 diabetes [1]. According to a World Health Organization (WHO) report, diabetes was the direct cause of 1.5 million deaths and 48% of all deaths due to diabetes occurred before the age of 70 years in 2019. Another 460 000 kidney disease deaths were caused by diabetes, and raised blood glucose caused around 20% of cardiovascular deaths [2]. In Zambia, DMT2 was becoming an emerging public health concern. As of 2008, estimates indicated that Zambia maybe one of the countries with a high prevalence of non-communicable diseases in the world [3]. A population-based survey conducted in Zambia in 2012 found the prevalence of T2DM to be 2.1% among men and 3.0% among women [4].

Diabetes mellitus type 2 requires consistent long term follow up with reviews involving comprehensive clinical assessments, laboratory works and appropriate therapeutic and lifestyle measures administered per the expected prescribed standard of care. However, delivery of adequate and appropriate clinical care to diabetic patients may be compromised by the non-availability or inconsistent provision of the necessary resources for optimal care. This may result in poor glycemic control increased morbidity and mortality among the affected clients. Neurological, cardiovascular and renal complications associated with type 2 diabetes may contribute significantly to poor clinical outcomes in the predisposed patients as suggested by findings in one European based study [5]. Routine measurements such as blood glucose, hemoglobin A1c (HbA1c), lipid determination, blood pressure measurement, annual eye and

albumin screening have proved to be effective in identifying and treating patients at risk. These goals are expected to lead to a reduction in the burden of diabetes and its complications. However, treatment is not consistently implemented in clinical practice guidelines. Such guidelines may help well to improve health care, because they specify optimal management for care providers and allow adherence to be monitored [6].

Negligence of certain screening tests in diabetes mellitus type 2 patients has been associated with adverse outcomes including the development of significant micro and macro vascular diseases, worsening of biochemical profile and causes mortality [7]. In resource limited settings like Zambia, the care of patients with diabetes mellitus type 2 is often constrained by inadequate human resource, high patient load, inadequate and inconsistent laboratory and pharmacy supplies. This study therefore seeks to establish the prevalence and pattern of complications associated with type 2 DM among patients presenting for care at a tertiary hospital in Zambia

LITERATURE REVIEW

Diabetes mellitus is defined as a chronic disease that develops when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glucose. Hyperglycemia, which is a condition suggesting raised blood sugar, is a common result of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels [1]. Diabetes mellitus is one of the major metabolic diseases encountered and presenting significant challenges to the health sector in both the developed and developing world populations due to its increasing prevalence. It is the most common non-communicable disease worldwide and the fourth to fifth leading cause of death in developed countries [8]. Diabetes mellitus is likely to present a major health threat especially in the developing world due to poorly performing economies and corresponding resource limitations in the health sector. Diabetes is a complex, chronic illness requiring continuous medical care with multifactorial risk-reduction strategies beyond glycemic control. Ongoing diabetes self-management education and support are critical to preventing acute complications and reducing the risk of long-term complications. Significant evidence exists that supports a range of interventions to improve diabetes outcomes [9].

Several long-term studies have shown that improved glucose control as a result of this partnership can delay the onset and progression of many long-term complications in diabetes, such as blindness, amputations and kidney disease, and thereby result in the avoidance of costs related to such complications [10]. Taking control of diabetes to improve quality of life has put the spotlight on the need for additional support and education for patients with type 2 diabetes. The epidemic of Type 2 diabetes mellitus and its complications poses a major health threat epidemic in nearly every population and it is proposed that without effective prevention and control programs, the prevalence will continue to increase globally most likely as a result of rising overweight and obesity rates, lifestyle, dietary changes, and an ageing population. The occurrence of diabetes mellitus has not only affected developed countries but is on the rise in low- and middle-income countries. However, the health systems in low- and middle-income countries have mainly targeted healthcare provision for acute episodic conditions and not medical care for chronic conditions [11]. The complications of diabetes mellitus have traditionally been divided into macro vascular complications (for example, cardiovascular disease (CVD)) and micro vascular complications (for example, complications affecting the

kidney, the retina and the nervous system). In most developing countries, patients with diabetes mellitus are at a particularly increased risk of developing kidney complications and stroke, but have a reduced risk of coronary heart disease compared with patients in developed countries [12]. A WHO report has indicated that 24 million adults are living with diabetes in Africa and the figure is projected to rise by 129% to 55 million by 2045 [13]. Several studies have shown poor compliance to management guidelines by doctors caring for patients with diabetes. A study conducted in Uganda, a low-income developing country, reported only 14% of patients who had their lipid profiles done annually. In addition, only 24.4% of patients were screened for diabetic nephropathy, no patient was screened for micro albuminuria and similar poor results for retinopathy, peripheral vascular disease and cardiac complications were identified [14]. A similar study done in South Africa showed that screening for chronic complications was poor in the majority of patients [15].

The chronic complications associated with longstanding diabetes can be devastating to the affected and contribute to high morbidity and mortality. A study was conducted in Basque country to determine the incidence of diabetes-related complications, the prevalence of coexistent chronic conditions and to report multimorbidity in people with type 2 diabetes. The prevalence for diabetes-related chronic pathologies were: ischaemic heart disease (11.5%), renal failure (8.4%), stroke (7.0%), heart failure (4.3%), peripheral neuropathy (1.3%), foot ulcers (2.0%) and diabetic retinopathy (7.2%). The prevalence of multimorbidity was 90.4% [5]. The study concluded that although incidence rates of diabetes complications were not as high as in other places, they present a high prevalence of diabetes related and unrelated diseases [5]. Studies have shown that most of the complications of DM can be slowed down or even prevented by better management on the part of the health care team, as well as the patient [16]. The complications are minimized through tight glycaemic control and regular screening in accordance with available guidelines. In the year 2018, the Diabetes Association of Zambia under IDF developed screening guidelines that recommend tests to be conducted quarterly for glycated hemoglobin (HbA1c), monthly for blood pressure, blood glucose, body mass index and waist circumference measurement, as well as a yearly dilated eye examination, lipid profile, serum creatinine, electrocardiogram and urine test for micro albumin.

RESEARCH DESIGN AND METHODS

This was a retrospective and medical records-based study which primarily assessed clinicians' compliance to the recommended standards of management of diabetic patients. The study examined records for the presence and type of complications reported among the type 2 diabetic patients presenting for care. The study was undertaken at Ndola Teaching Hospital being a tertiary referral hospital in the Copper belt province of Zambia with an expected large pool of patients presenting for care in the medical department. The target population were adult male and female patients with type 2 diabetes. The period under review was from January 2022 to December 2022. The sample size estimate was determined using the Cochrane formula and a systematic random sampling procedure was applied to select the population of interest. A data abstraction sheet was used to collect the relevant medical information suggesting baseline characteristics and DMT2 associated complications. The main focus areas included the cardiovascular, renal, eye, musculoskeletal and nervous system. The type of complications were recorded based on the clinical and laboratory examination findings. The data was analyzed using excel and SPSS version 26. Ethical approval was sought and granted by the TDRC Research Ethics Committee in Ndola.

RESULTS

A retrospective review of charts from January 2022 to December 2022 was undertaken for all patients with Type 2 DM who attended the outpatient clinic of NTH. Out of 210 files, a sample of 90 eligible patient files constituted the study subject. Out of the 90 eligible patient files representing the study subjects, 65.6% were female and 34.4% were males (figure 1).

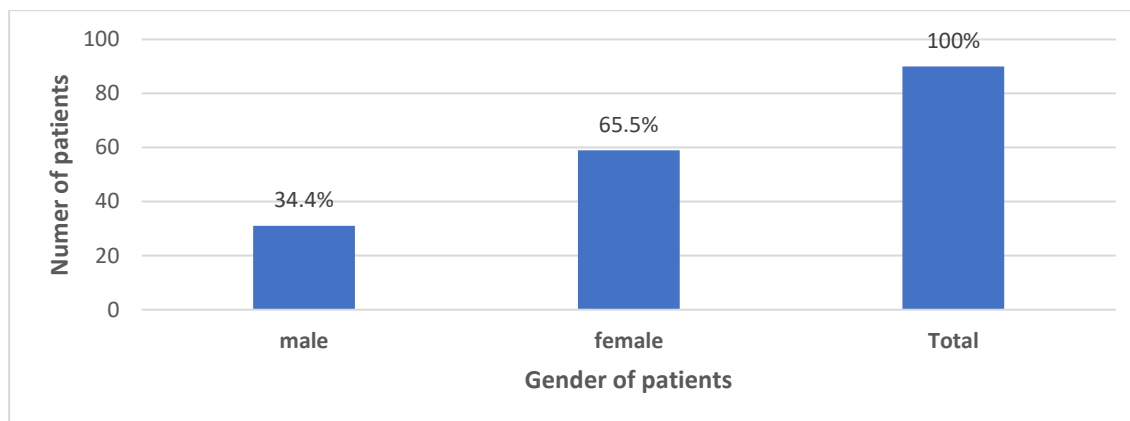


Figure 1: Gender distribution of DMT2 patients sampled at NTH.

The results further suggested that the age range of the sampled population was from 20 to 80 years with most of the patients falling between 50-64 years representing about 34% and the least age category of above 80 years representing 2.25% of the study subjects. The mean age was 54 years (figure 2).

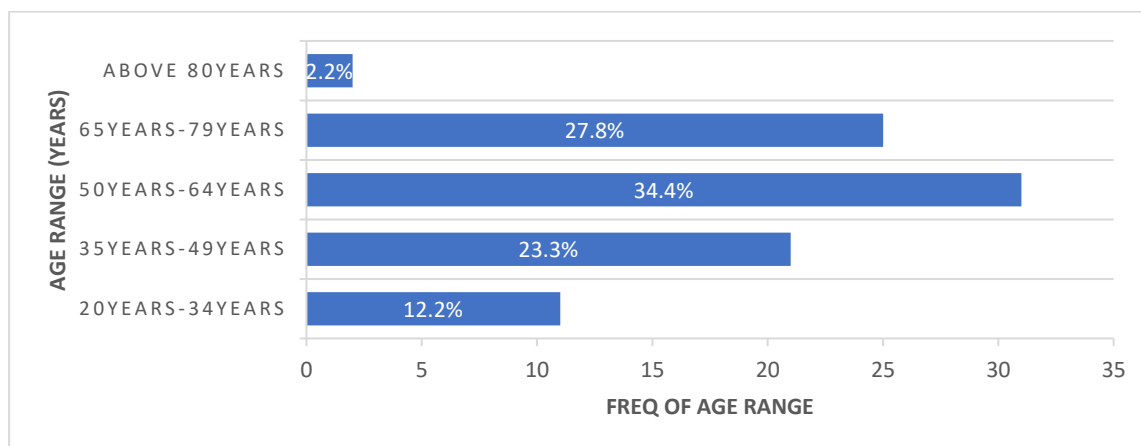


Figure 2: Age range of DMT2 patients sampled at NTH.

A number of files were devoid of a targeted comprehensive physical examination assessment. For example, out of 90 patients sampled, (n=12, 13.3%) had comprehensive foot examination and only 28.9% had their eyes fully examined. Further, the findings revealed that the most common complications associated with DMT2 were retinopathy (n=19, 21.1%), nephropathy (n=15, 16.7%), neuropathy (n=12, 13.3%) and coronary artery disease (n=10, 11.1%) (figure 3).

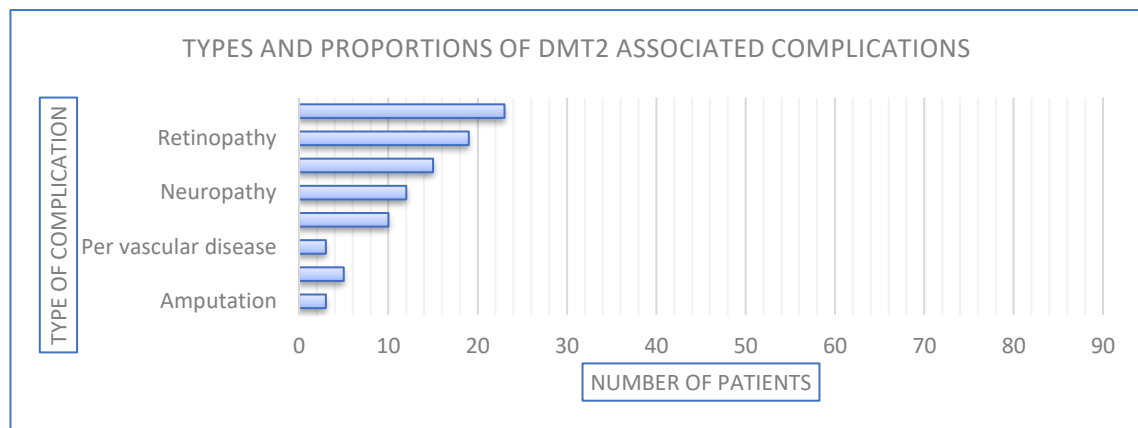


Figure 3: Types of complications in DMT2 patients sampled at NTH.

DISCUSSION

Diabetes mellitus is a major public health problem in Africa and Zambia in particular. The disease requires specific management strategies such as long-term follow up as a standard of care. The management goals of diabetes are to maintain normal blood glucose levels along with preventing the development of complications by a systemic and standardized screening program. Local guidelines developed by Ministry of Health, Zambia National formulary committee have shown that tight glycemic control and appropriate monitoring can prevent or delay the development of diabetic complications. The finding that diabetic retinopathy was a highly prevalent microvascular complication reflected similar findings in other settings. For example, surveys conducted in Kenya and South Africa showed that the prevalence of diabetic retinopathy was 7% and 63% respectively [17]. Loss of vision caused by diabetes was found to attribute to impaired ability to self-monitor blood glucose and administer insulin [17]. Therefore, early identification of retinopathy and appropriate management may slow the progression to visual impairment and blindness, which can be achieved by doing routine examination. The findings in our study indicate that only 47.8% of the patients received an annual eye examination. With a proportion of 16.1%, diabetic nephropathy was the second leading complication in this study. The results are within the estimated prevalence in Africa which is between 11% to 83.7% [18]. As many as 7% of DMT2 patients may already have microalbuminuria at the time of diagnosis [19]. A study done in India reported 25.6% incidence of microalbuminuria in patients with DMT2 [20], while the united kingdom prospective study reported the incidence of microalbuminuria in patients with DMT2 to be 2% per year with the 10-year prevalence after diagnosis being 25% [21]. If appropriate interventions are not commenced early in the course of the disease, DMT2 patients with microalbuminuria usually progress to proteinuria and apparent nephropathy [22]. Diabetic nephropathy is a major distress in a resource limited area such as Zambia as therapeutic choices are limited once a patient gets to the stage of renal failure. To screen for diabetic nephropathy ADA recommended the investigations like Urine ACR and sCr converted into eGFR [23]. 91.1% of the patients in this study had a sCr done once during the study period, 2.2% had eGFR calculated while 1.1% had a urine ACR. A study conducted in Uganda, a low-income developing country reported only 24.4% of patients were screened for sCr-eGFR and no patient was screened for micro albuminuria [24]. Studies done in the united states showed better results with 84.8% sampled patients having at least one serum creatinine ordered and 43.3% received urine ACR during the 1 year follow up period [25]. The study has further revealed that neuropathy was the third

common complication representing 13.3%. Approximately 30–50% of patients with diabetic neuropathy reportedly develop neuropathic pain [26], which most commonly takes the form of spontaneous burning pain of the feet [27]. In the holistic management of DMT2, examination of the foot and health education on foot care is important and should aim at recognizing persons at risk for ulceration and amputation. Foot complications, specifically ulcers and amputations, are the number one reason for hospitalization in patients with diabetes. Thus, early recognition and proper management of patients at risk for developing foot ulcers and lower-extremity amputations are crucial [28]. Gaps occur in the care and management of diabetes, especially in the area of foot care as revealed in one study where only 46% of patients with diabetes reported ever having foot screenings with their primary care provider [29]. It is advised that a proper foot examination for patients with diabetes should include a thorough history and assessment for risk factors, inspection for any abnormalities, a neurological assessment (i.e., using a 10-g monofilament test to assess pinprick sensation and a tuning fork to determine sensitivity to vibration), and a vascular evaluation of foot pulses [30]. Other notable DMT2 complications among the sampled patients in this study included coronary artery disease (11.5%), peripheral vascular disease (3.3%), stroke (5.6%) and amputation which was the least with 3%.

LIMITATIONS

The study focused on the screening practices at a referral hospital. It could not provide information on screening practices at primary health care facilities where the bulk of patients with diabetes and other chronic illnesses are managed. Study may therefore not assure generalizability. Additionally, access to files was limited due to some patients going home with files.

CONCLUSION

Neurological and cardiovascular complications are relatively common among the type 2 diabetes mellitus patients presenting for care at Ndola Teaching Hospital. Diabetes requires regular and structured follow up and surveillance by health professionals to minimize complications and maximize quality of life. Non-adherence to diabetes treatment and monitoring strategies is likely to subject patients to sub-optimal care and ultimately lead to poor clinical outcomes. It is therefore hoped that the findings from this study will contribute to enhanced awareness and the need for clinicians to ensure adherence to the prescribed standard of care for managing DMT2 patients in the quest to improve patient outcomes.

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest regarding the publication of the manuscript.

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AUTHOR CONTRIBUTIONS

The concept, design, analyses and interpretation of study findings were conducted by Nyirenda C and Namfukwe T. All coauthors contributed towards the content, review and ultimate write-up of the manuscript

References

- [1] World Health Organization (2022), 'Diabetes'. Newsletter, September 2022
- [2] Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019. Results. Institute for Health Metrics and Evaluation. 2020 (<https://vizhub.healthdata.org/gbd-results/>).
- [3] Mwila K.F, Bwembya P.A and Jacobs C.(2017). Experiences and challenges of adults living with type 2 diabetes mellitus presenting at the University Teaching Hospital in Lusaka, Zambia. *BMJ Diabetes research & care*, 7.
- [4] Nsakashalo-Senkwe M, Siziya S...and Babaniyi O.(2011). Combined prevalence of impaired glucose level or diabetes and its correlates in Lusaka urban district, Zambia. *A population based survey*, 4(1).
- [5] Alonso-Morán, E., Orueta, J.F., Esteban, J.I.F. *et al* (2014). The prevalence of diabetes-related complications and multimorbidity in the population with type 2 diabetes mellitus in the Basque Country. *BMC Public Health* **14**, 1059. <https://doi.org/10.1186/1471-2458-14-1059>
- [6] Wesselink S.F.O, Lingsma H.F, Robben B.M.P and Mackenbach J.P. (2015). Guideline adherence and health outcomes in diabetes mellitus type 2 patients. *BMC Health Service Research*, 1(22), 15.
- [7] Mutyambizi C, Pavlova M...and Groot W.(2018). Cost of diabetes mellitus in Africa. *Globalisation and Health*, 14(3).
- [8] Jelenik H.F, Osman W.M, Khandoker A.H, Khalaf K, Lee S,ALMAHMEED W and Alsafar H.S.(2017). clinical profiles omorbidities and complicationsof type 2 diabetes mellitus in patients from united arab emirates. *Bmj open diabetes research and care*(5), 123-130.
- [9] Ankina F, Corney J, Healey B and Minear J (2010). national perfomance measures for diabetes mellitus care. *disease management and health outomes*, 12(5), 85.
- [10] Srivastava AK.(2010). diabetes mellitus: complications and therapeutics. *medical sciencs monitor:international medical journal of experimental and clinical research*, 12(7), 130-147.
- [11] Cetafa S and william T (2019). standards of medical care in diabetes. *diabetes care*, 43(2020), 19.
- [12] Zheng Y, Ley S.Hand Hu F.B. (2018). Global etiology and epidemiology of type 2 diabetes mellitus and its complications. *Macmillan Publishers limited*, 14(88), 12.
- [13] World Health Organization (2022). African region tops world in undiagnosed diabetes: WHO analysis. 14 November 2022; *Brazaville*
- [14] Kibirige D, Atuhe D and Mwebeza R. (2016). suboptimal glycaemic and blood pressure control and screening for diabetic complications in adult ambulatory diabetic patients in Uganda. *Diabetes Metab Discord*, 13(1), 40-70.
- [15] Rampersad K, Rangiah S and Kendon M.(2018). Compliance with local diabetic guidelines at a district hospital in KwaZulu-Natal, South Africa. *South African Family practise*, 60-62.
- [16] Bailey S.L, Beyers N, Faussett P.G, Muyoyeta M, Toit E, Yudkin J.S...Floyd S (2013). diabetes mellitus in Zambia and Western Cape Province of South Africa: prevalence, risk factors, diagnosis and management. *Diabetes Research and Clinical Practice*, 1(05), 50.
- [17] Igbojiaku OJ, Harbor OC, Ross A (2013). Compliance with diabetes guidelines at a regional hospital in KwaZulu Natal, South Africa. *Afr J Prm Health Care Fam Med*; 5(1), Art. #447, 5 pages. <http://dx.doi.org/10.4102/phcfm.v5i1.447>

- [18] Noubiap JJ, Naidoo J, Kengne AP (2015). Diabetic nephropathy in Africa: A systematic review. *World J Diabetes*. 2015 Jun 10;6(5):759-73. doi: 10.4239/wjd.v6.i5.759. PMID: 26069725; PMCID: PMC4458505.
- [19] Fereidony M, Mohammad S, Bigane O, Bashiri Y, Monireh D and Bagheri N.(2018). investigating factors associated with diabetes complications among type 2 diabetic patients. *journal of research in medical and dental science*, 6(3), 301-306.
- [20] Sana MA, Chaudhry M, Malik A, et al (2020). Prevalence of Microalbuminuria in Type 2 Diabetes Mellitus. *Cureus*. Dec; 12 (12): e12318. DOI: 10.7759/cureus.12318. PMID: 33520516; PMCID: PMC7837669.
- [21] Rampersad K, Rangiah S and Kendon M (2018). Compliance with local diabetic guidelines at a district hospital in KwaZulu-Natal, South Africa. *South African Family practise*, 60-62.
- [22] Society for endocrinology, metabolism and diabetes of South Africa (2015). Guidelines for the diagnosis and management of type 2 diabetes.
- [23] American Diabetes Association Professional Practice Committee (2022). Addendum. 11. chronic kidney disease and Risk Management: Standards of Medical Care in Diabetes-2022. *Diabetes Care* 2022; 45(Suppl. 1): S175-S184. *Diabetes Care*. 2022 Sep 1; 45(9):2182-2184. doi: 10.2337/dc22-ad08a. Erratum for: *Diabetes Care*. 2022 Jan 1;45 (Suppl 1): S175-S184. PMID: 35639487; PMCID: PMC9472512.
- [24] Kibirige D, Atuhe D and Mwebeza R. (2016). Suboptimal glycaemic and blood pressure control and screening for diabetic complications in adult ambulatory diabetic patients in Uganda. *Diabetes Metab Discord*, 13(1), 40-70.
- [25] Kerstin Folkerts, Natalia Petruski-Ivleva, Erin Comerford, Michael Blankenburg, Thomas Evers, Alain Gay, Linda Fried, Csaba P. Kovesdy, (2021). Adherence to Chronic Kidney Disease Screening Guidelines Among Patients with Type 2 Diabetes in a US Administrative Claims Database, *Mayo Clinic Proceedings*, Volume 96, Issue 4, Pages 975-986, ISSN 0025-6196, <https://doi.org/10.1016/j.mayocp.2020.07.037>. (<https://www.sciencedirect.com/science/article/pii/S0025619620309332>)
- [26] Abbott CA, Malik RA, van Ross ER, Kulkarni J & Boulton AJ Prevalence and characteristics of painful diabetic neuropathy in a large community-based diabetic population in the U.K. *Diabetes Care* 34, 2220–2224 (2011). [PMC free article] [PubMed] [Google Scholar]
- [27] Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, Bril V, Russell JW, Viswanathan V. Diabetic neuropathy. *Nat Rev Dis Primers*. 2019 Jun 13;5(1):42. doi: 10.1038/s41572-019-0097-9. PMID: 31197183; PMCID: PMC7096070.
- [28] American Diabetes Association (2016). Summary of revisions. In *Standards of Medical Care in Diabetes—2016*. *Diabetes Care*; 39(Suppl. 1): S4–S5
- [29] Institute for Preventative Health. National Foot Health Assessment. Available from http://www.ipfh.org/images/research_materials/2012_National_Foot_Health_Assessment_June_2012.pdf. Accessed 15 February 2016
- [30] Gallman EC, Conner RS, Johnson E (2017). Improving the Detection of Foot Abnormalities in Patients with Diabetes. *Clin Diabetes*. Jan;35(1):55-59. doi: 10.2337/cd16-0017. PMID: 28144047; PMCID: PMC5241764.