Diabetes & Metabolic Syndrome: Clinical Research & Reviews 13 (2019) 672–677

Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Systematic Review

The prevalence of macro and microvascular complications of DM among patients in Ethiopia 1990–2017: Systematic review

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ARTICLE INFO

Article history:
Received 30 October 2018
Accepted 13 November 2018

Keywords:
Diabetes mellitus
Vascular complications
Non communicable diseases
Ethiopia

ABSTRACT

Background: The prevalence of diabetes mellitus (DM) has been growing rapidly in the world. It is smashing particularly the lower and middle income countries (LMICs) severely. Due to its acute and chronic complications many lives have fallen under its bad shadow. Therefore, we aimed to review the existing evidence on major types and specific complications of DM among diabetic patients in Ethiopia.
Methods: Both relevant quantitative and qualitative studies, conducted after 1990s, investigated and reported DM and complications from MEDLINE/PubMed, CINAHL, SCOPUS, DAOJ and Cochrane library databases were explored. In addition, System for Information for grey literature in Europe (SINGLE) database was investigated for the existence of unpublished grey literature. Total of 161 titles were identified and 17 studies met the inclusion criteria. Findings were narrated descriptively.
Results: In this review 17 studies were included, and both macro and micro complications were summarized. Among the diabetic complications retinopathy, nephropathy, metabolic syndrome, impotence and depression were the main findings among diabetic patients in Ethiopia.
Conclusion: The burden of DM and its microvascular and macrovascular complications have been increasing among diabetic patients in Ethiopia. The increased duration of the diseases, lower socio economic level, existence of other complications, old age attributed the diabetic complications. Therefore, close monitoring and follow up of diabetic patients is necessary to reduce the incidence and prevalence of diabetic complications among the patients.

1. Background

Non communicable diseases (NCDs) are becoming the leading causes of morbidity, disability and mortality. Consequently, Sustainable Development Goal (SDG) gave priority in tackling their burden. For the last forty years they resulted in 72.3% or 39.5 of million global deaths [1]. By having this trend NCDs becoming major tribulations of public health concern in most of LMICs as a result of the effects of globalization and epidemiologic transition. Among these DM is the prominent disease [2,3].

DM is a severe and chronic disease that occurs either when the pancreas unable to produce an adequate amount of insulin (a hormone that maintains blood glucose), or when the body cannot successfully utilize the insulin it produces. Increased blood glucose is a usual manifestation of uncontrolled diabetes, through time leads to serious damage to different organs and systems. For instance the cardiovascular, excretory, sensory system and among organs heart, blood vessels, eyes, kidneys and nerves affected by DM. More than 400 million people live with DM [4]. Consequently, SDG three targeted to reduce diabetes and severity among other three NCDs [5].

Globally the prevalence of DM has been increasing rapidly. According to IDF latest estimated data the global prevalence to be 151 million in 2000 [6], 194 million in 2003 [7], 246 million in 2006 [8], 285 million in 2009 [9], 366 million in 2011 [10], 382 million in 2013 [11] and 415 million [12].

In Sub Saharan African (SSA) the magnitude and severity is worsening. In contrast, the health system, organizations and individuals capacity to combat against its magnitude and complications is exceptionally low. Lack of organizational structure for chronic disease care, minimal staffing and capacity training provided to healthcare workers in the field, and a lack of resources, low communication with the public to address preventative strategies, poorly organized healthcare information systems, lack of involvement and integration with other community resources were problems identified by World Health Organizations (WHO).

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https://doi.org/10.1016/j.dsx.2018.11.046
1871-4021/

Moreover, the availability of evidence is lower than other parts of the world. These all drawbacks created opportunities lives to be attacked severely by diabetes [13,14].

According to IDF 2017 report, about 15.5 million adults aged 20–79 years were living with DM in Africa Region, representing a continental prevalence of 3.3%. The highest prevalence of diabetes in the Region is found in adults aged 55–64 years. The region has the highest proportion of undiagnosed diabetes, with over two-thirds (69.2%) of adults currently living with diabetes unaware of their condition. In 2017 DM national prevalence estimated to be 5.2 [2.2–7.7] million in Ethiopia. Badly Ethiopia ranked under top ten countries/territories for the number of people with impaired glucose tolerance (20–79 years) projected between 2017 and 2045 with 14.1 million uncertain interval of (11.1–30.1) million [15].

There are two types of DM. These are Type1 with synonyms T1DM, or usually named as "Insulin dependent DM" (IDDM) and type 2 with synonyms T2DM or DMT2, or usually named as "Insulin independent DM" (IIDM). The risk of type 2 diabetes is determined by interplay of genetic and metabolic factors. Ethnicity, family history of diabetes, and previous gestational diabetes combine with older age, overweight and obesity, unhealthy diet, physical inactivity and smoking to increase risk. Excess body fat, a summary measure of several aspects of diet and physical activity, is the strongest risk factor for type 2 diabetes both in terms of clearest evidence base and the largest relative risk. Overweight and obesity, together with physical inactivity, are estimated to cause a large proportion of the global diabetes burden. If left and uncontrolled DM can damage the heart, blood vessels, eyes, kidneys and nerves, leading to disability and premature death [1–3,14].

In general, the injurious effects of hyperglycemia are separated into macrovascular complications (coronary artery disease, peripheral arterial disease, and stroke) and microvascular complications (diabetic nephropathy, neuropathy, and retinopathy). It is important for physicians, researchers and every stakeholder to understand the relationship between diabetes and vascular disease because the prevalence of diabetes continues to increase in the world, and the epidemiological and clinical ways for primary and secondary prevention of these complications is also growing [16,17].

Ethiopia has been lacking basic preventive and curative medicines, technologies and procedures in the primary health cares for DM. Except urine strips for glucose and ketone measurement; neither medicines nor basic technologies in primary care facilities has not used been by the country. At national level there are no Standard criteria for referral of patients from primary care to higher level of care. These all devastate the complications of diabetes among the patients [18]. In addition, lack of access to affordable insulin remains a key impediment to successful treatment and results in needless complications and premature deaths [2,14]. Here, we give more focus on reviewing the complications of both type 1 and type 2 DM over the last twenty five years in Ethiopia.

Therefore, this review is important to describe and review previous works on complications of DM in Ethiopia. The summarized findings will help in identifying and quantifying the prevalence, reduce the severity and paves the way for effective and prophylactic interventions for saving lives of peoples.

2. Methods

The Cochrane Library (http://www.cochranelibrary.com/), ClinicalTrials.gov/Meta-Registry of trial Registries (www.clinicaltrials.org, www.controlled-trials.com)and National PROSPERO International prospective register of systematic reviews (http://www.crd.york.ac.uk/prospero) databases were searched. That was an effort to be sure whether systematic review or meta-analysis exists and for the availability of ongoing projects related to the current topic. MEDLINE/PubMed, Cochrane library, SCOPUS, CINAHIL and Directory of Open Access Journal (DOAJ) databases were searched by authors independently and systematically. In addition, SINGLE database was searched for existing grey literature. Also important data from World Health Organization (WHO) and International Federation of Diabetes (IDF) were searched and used. In addition, authors were communicated for full texts by email. After then by an analysis of the text words contained in the title and abstract, and of the index terms used to describe the article for studies reporting the magnitude and complications due to type 2 DM in Ethiopia. Following this, the search was undertaken across all included databases using all identified keywords and index terms. Also, the authors screened the reference lists of identified articles and linked with study investigators. Finally, the electronic databases search was done for the MEDLINE/PubMed database using the following Medical Science Heading (MeSH) terms. The search was restricted to the full text, free article, study category of humans and English language publications. The literature search was limited to studies published from 1990 to 2017 and the bibliographies of potentially relevant articles were also hand searched. The search process resulted in 171 articles containing the keywords used. Out of these, abstracts and/or full text articles were obtained for 161 studies. The titles and abstracts of all the searched studies were reviewed thoroughly to decide whether they met the inclusion criteria.

2.1. Inclusion criteria

The included papers were: (1) articles published from 1990 to 2017; (2) articles addressing at least one of the complications macrovascular (coronary artery disease, peripheral arterial disease, and stroke) and microvascular complications (diabetic nephropathy, neuropathy, and retinopathy; (iii) articles published in the English language; and (iv) articles for which an abstract and full text were available for this review. (v) Original articles conducted in Ethiopia.

2.2. Data abstraction

A total of 17 studies were found to meet the inclusion criteria. Firstly, formatted on MS Word and converting to text files, the abstracts of these studies were imported to manually. The texts were then coded for different categories and codes. Important memos were also inserted during the coding process. The codes and categories were then used to sort specific themes from each file and from the whole database.

2.3. Data review and summary

Output data were carefully appraised and summarized using the major themes of the systematic review. Linking and sequencing the findings followed the summarization process. Findings were then presented using in different methods of reporting. After establishing the inclusion criteria 17 studies were found to be eligible. The main themes were micro and macro vascular complications.

3. Results

3.1. The magnitude of the DM in Ethiopia

According to the WHO report in 2016, in Ethiopia, the prevalence of DM was 3.8%. It attributed to 1% death among all causes of death [18]. Its prevalence has been increasing from time to time. In 2000 its prevalence was 1% or 26,985 [6], in 2003 1.9% or 29,562 [7],

in 2006 2.6% or 59,447 [8], in 2009 3084.8 or 2.5% [9], in 2011 1377.28 or 3.45% [10], in 2013 1852.23 or 4.36% [11]. This shows its burden and complications have been an important public health problem (Fig. 1). The prevalence has been increased sharply with 7.7% in 2017 [8].

3.2. Micro and macro vascular complications of DM

DM causes severe acute and chronic complication if left uncontrolled. These complications are categorized as micro vascular and macro vascular complications. Usually microvascular complications come first and lead to macro vascular complications. This character makes both complications not a distinct but they are the continuum in chronic DM patients [16]. However, they are interconnected and have a tendency of disturbing the general system of the DM patients.

3.2.1. Micro vascular complications

3.2.1.1. Diabetic retinopathy. Diabetic retinopathy is the most common microvascular complication of DM. In this review six studies measured the prevalence diabetic retinopathy [19–24]. Among them, only three studies independently assessed the diabetic retinopathy [19,20,22]. However, there was a high prevalence of diabetic retinopathy was observed among patients which ranged from 4.7% to 18.4% [21,25].

3.2.1.2. Metabolic syndrome. According to WHO definition of Metabolic Syndrome (MetS) patients were classified as having MetS as along with DM if they had any two of the following components: Obesity: BMI (>30 kg/m2), high serum triglycerides, (≥150 mg/dl), low serum high density lipoprotein cholesterol (<35 mg/dl for men and <39 mg/dl for women) and having hypertension (≥140/90 mmHg [26,27]. Regarding the prevalence and incidence of MetS was investigated by three studies [21,23,28]. In these studies, all symptoms were revealed as highly prevalent among diabetic patients.

3.2.1.3. Nephropathy. Diabetic nephropathy is the most serious complication of diabetes which leads to end-stage renal failure and other complication of DM. From this regard, five studies assessed the diabetic nephropathy [21,23,28–30]. More one of the study investigated the chronic kidney disease among DM patients. In this study, the prevalence of chronic kidney disease was 18.2% [29].

3.2.1.4. Erectile dysfunction, foot ulcer and depression. Erectile dysfunction, foot ulcer and depression are major macro vascular complications of diabetes. But there are few studies investigated these complications in Ethiopia. Concerning erectile dysfunction there are two studies. These studies revealed that erectile dysfunction was prevalent among diabetic patients [31,32]. In these studies erectile dysfunction ranges from 70% [31] to 85.5% [32].

However, there are was only one study assessed foot ulcer among DM patients in Ethiopia. In this study diabetic foot ulcer was 13.6% [33]. In addition, there was one study assessed depression among diabetic patients in Ethiopia. The study revealed the prevalence of depression was 44.7% [34] (Table 1).

4. Discussion

This systematic article review focused on the all types of DM and its complications in Ethiopia. We found 17 eligible papers published from 1 January 1990 to 31 December 2017 investigating both micro and macro vascular diabetic complications among diabetic patients in Ethiopia. The definition of each complication defined according to WHO, IDF and other international standard definition criteria. The shortcoming here is the prevalence was measured without any heterogeneity. For example, diabetic retinopathy was measured by clinical history, physical examination and/or ophthalmoscope assessments. This could cause the variation among the studies.

Currently, DM is affecting numerous Ethiopian populations regardless of environmental and social status. According to WHO report of 2016, neither medicines nor basic technologies and procedures were available in Ethiopia for DM prevention and control. With this information, we reviewed both macro and microvascular complications of all types of DM among patients. Patients with DM and associated microvascular complications appear particularly at higher risk of accelerated atherosclerosis which ultimately culminates in cerebrovascular and cardiovascular events and premature death. Among microvascular diseases, six studies assessed diabetic retinopathy [19–24]. The prevalence of retinopathy ranges from

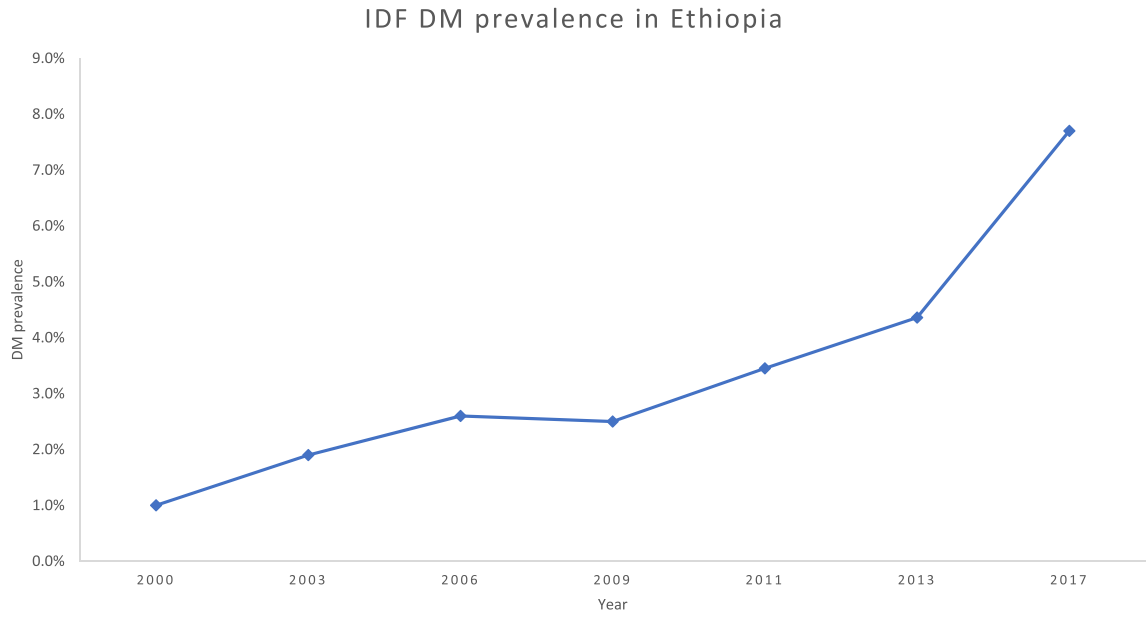

Fig. 1. Prevalence of DM in Ethiopia since 2000, IDF report.

Table 1
Summary of studies on diabetic complications in Ethiopia.

Author	Study design	Study participants	Settings	Sample size	Measurement	Findings
Dawit Worku et al., 2011 [28]	Cross sectional	Diabetic patients	Hospital	305	Record review	Acute diabetic complication was documented in 93 (30.5%) patients where DKA was the commonest accounting for 71% followed by hypoglycemia was 19.4%. About 160(52.5%) had one or more of the chronic complications, the major ones being neuropathy in 90(29.5%) nephropathy in 48 (15.7%) visual disturbance in 103 (33.8%), skin infection, hypertension and impotence covered the remaining.
Fisseha T et al., 2014 [29]	Cross sectional	DM patients	Hospital	214	Interviewer-administered questionnaire & done clinical assessment.	CKD, defined as eGFR <60 ml/min/1.73 m2, was present in 18.2% according to Modification of Diet in Renal Disease (MDRD)
Shitaye A et al., 2015 [20]	Comparative cross sectional	T1DM patients	Hospital	544	Record review	The prevalence of the retinopathy was 8.6%. The prevalence was increased with duration of diabetes and urban has higher prevalence than rural dwellers.
Tesfa DH, 2015 [35]	Cross sectional	Outpatients attending hospital	Hospital	385	Random blood sugar test	The prevalence of DMT2 was found to be 7.07%. No complications were measured in figure.
Cheneke et al. *2016* [36]	Cross sectional	T2DM patients	Hospital	148	HbA1, random blood sugar (RBS), socio-demographic data and clinical information were collected from every diabetic patients	The diabetic control was so poor. Consequently, the mean HbA1 and RBS level of the participants were 7.6% and 280 mg/dL (15.5 mmol/L), respectively Among 136 patients whose clinical history was reviewed, 52.9% had one or more documented history of major microvascular complications: visual disturbance accounting for 21.3%, nephropathy 19.1% and peripheral neuropathy 13.2%.
Shibeshi et al., *2016* [19]	Cross sectional	Pediatric diabetic patients 9 = 17 years	Hospital	86	Record review	Background retinopathy was 4.7% with a mean age of 14.25 ± 1.89 years and two of them also had maculopathy. In addition, about 52.3% have poor glycemic control.
Tesfa DH et al., 2016 [34]	Cross sectional	T2DM patients	Hospital	264	Depression was measured by administering a validated nine-item Patient Health Questionnaire (PHQ-9)	The prevalence of depression was 44.7%. Poor social support, lower income and presence of other diabetic complications escalated the depression among patients.
Chisha Y, 2017 [25]	Cross sectional	Diabetic patients	Hospital	400	Patients record review	13% **diabetic retinopathy** was assessed. Increased blood pressure (SBP >140 mmHg), increased age (>60 years), family history of DM and long duration of diabetes (>=6 years) increased the magnitude of diabetic retinopathy.
Hintsa S, 2017 [30]	Case control	Diabetic patients	Hospital	420 84 cases & 336 controls	Thorough review of the chronic care follow up chart	Increased age of patient, duration of diabetes after diagnosis (for one year increase, not-adhered to blood glucose measurement at home, having Systolic Hypertension poor glycemic control attributed to **diabetic nephropathy**
Seid et al., 2017 [31]	Cross sectional	Male diabetic patients	Hospital	249	Pretested structured questionnaire interviewer	The prevalence of erectile dysfunction was 69.9%, with 32.9% suffering from mild, 31.7% moderate, and 5.2% severe erectile dysfunction
Tesfamichael GM, 2017 [33]	Cross-sectional	Adult diabetic patients	Hospital	279	Face to face interview and observation	**Diabetic foot ulcer** was found to be 13.6%. Rural residence], type II DM, overweight, poor foot self-care, and diagnosed neuropathy
Woyesa et a 2017 [37]	Cross sectional	Type 2 diabetic patients	Hospital	319	An interviewer administered structured questionnaire, reviewed the records of the study subjects and 5 ml blood specimen was collected from each study subjects after overnight fasting.	The prevalence of hyperuricemia and metabolic syndrome were 33.8%(n = 106) and 70.1% (n = 220) respectively
Yigazu and Desse 2017 [23]	Cross sectional	T2DM patients	Hospital	174	Pretested structured questionnaire was used to collect data about sociodemographic characteristic	The majority, 103 (59.2%), of patients had poor glycemic control. About 40.8% have diabetic complications. They accounted for Neuropathy 43.7%, Retinopathy 14.1%, Retinopathy + Neuropathy 39.4% and Retinopthy + Neuropathy + Nephropathy 2.8%
Azeze et al. *2018* [22]	Cross sectional	Newly diagnosed type 1 or type 2 DM patients	Hospital	377	Medical history, an ophthalmic examination and screening with retinal photographs, and regular follow up. Defined diabetes retinopathy as by both direct and indirect ophthalmoscopy assessments done by retinal specialists confirmed by fundus photography	The incidence rate of diabetes retinopathy was 2.65% per 1000 person-years observation. In addition, 18.57% DM patients developed diabetes retinopathy
Birarra and Gelayee, 2018 [38]	Cross sectional	T2DM patients	Hospital	256	Standardized interview questioner was used. While the data of HDL, fasting plasma glucose (FPG), and TG were recorded from patient files and chart. The components of MetS was identified and determined according to NCEP-ATP III, IDF and WHO* definitions	According to WHO MetS was 45.7%. There was increased risk of developing diabetic complications. But none of the figures indicated each of both macro and micro complications.
Bizuayehu W et al., 2018 [32]	Cross sectional	Diabetic patients	Hospital	422	Interviewer-administered structured questionnaire	The prevalence of erectile dysfunction was 85.5%. Increased age and having other diabetic complication increased the likelihood of erectile dysfunction.

(*continued on next page*)

Table 1 (*continued*)

Author	Study design	Study participants	Settings	Sample size	Measurement	Findings
Wolde HF et al., 2018 [21]	Retrospective	Newly diagnosed T2DM patients	Hospital	341	Record review	The incidence rate of vascular complications was 40.6 cases/1000 person years of observation. Hypertension at baseline, LDL-C > 100 mg/dl, triglyceride >150 mg/dl, HDL-C ≥ 40 mg/dl and male sex were significantly determines vascular complications. The incidence of retinopathy was 18.4%, nephropathy was 14.4%, neuropathy was 18.9%, stroke was 17.0%, CHD was 16.7 cases per 100 person year of observation

4.7% to 18.6%. This prevalence is relatively greater the finding from the Saudi Arabia Kingdom which was 14.5% [17]. However, it is relatively within a similar range with the study conducted in India in which the prevalence of diabetic retinopathy was 18.0% (95% CI, 16.0–20.1) [39]. This might be due to sociodemographic and economic difference of the countries.

Another micro vascular complication is nephropathy or chronic kidney disease. From this regard, five studies assessed the diabetic nephropathy [21,23,28–30]. It ranges from 2.5% to 18.2%. However, the included studies also revealed that most DM patients had metabolic syndrome. This is in line with several findings from different settings.

The usual complication but the rare study conducted in Ethiopia was diabetic foot ulcer. Only one study assessed the prevalence of diabetic foot ulcer among diabetic patients in Ethiopia with the prevalence of 13.6% [33]. This prevalence was twice with the study conducted in Nigeria [40].

One of the macro vascular complications among DM patients is neuropathy. Among this impotence or erectile dysfunction and depression were assessed by studies. These studies revealed that erectile dysfunction was prevalent among diabetic patients [31,32]. In these studies erectile dysfunction ranges from 70% [31] to 85.5% [32]. This finding is similar a study conducted in New Delhi, India [41]. Again depression was investigated and was found to be 44.7% among diabetic patients. This prevalence was a little bit higher than the study done in Palestine. The difference might be due to the way the researchers measured or defined the depression scale [42].

In this review, all studies were conducted in hospital levels. The potential weakness of such studies is that they may not represent the general population. There might not be sufficient controls, inadequate data about the study participants [43].

In addition, most of the studies used a cross-sectional study design. The main limitation of this design is the poor establishment or ascertainment of epidemiological cause-effect relationship or temporal association [44].

5. Conclusion

The prevalence of both microvascular and macrovascular complications has been increasing among diabetic patients in Ethiopia. The increased duration of the diseases, lower socio economic level, existence of other complications, old age attributed the diabetic complications. Therefore, close monitoring and follow up of diabetic patients is necessary to reduce the incidence and prevalence of diabetic complications among the patients.

Conflicts of interest

The author declared that there is no conflict of interest exists.

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