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Systematic review of diabetes mellitus prevalence and determinants of early detection in Africa

Dariya Mukamusoni[1], Eléazar Ndabarora[1]*.

[1] Kibogora Polytechnic, Department of General Nursing and Midwifery, BP 31 Rusizi, Rwanda.
[1]*Corresponding author address: Email: eleazarndaba@gmail.com; Tel: +250 785 371 340

HIGHLIGHTS

- We conducted a systematic review of literature on the prevalence of diabetes mellitus and determinants of early detection in Africa;
- Increasing prevalence of diabetes mellitus in Africa was found;
- Hindrances to early detection of diabetes mellitus were identified;
- There was paucity of studies on determinants of diabetes early detection;
- Operational studies and community-based sensitization and screening programs are highly recommended.

ABSTRACT

Several studies have reported dramatic increase of the prevalence of diabetes mellitus in Africa, and barriers to early detection and treatment, which are cost-effective strategies to prevent and control diabetes mellitus and combat its morbidity and premature mortality. The paper aimed to review the literature on the prevalence of diabetes mellitus and determinants of early detection in Africa. MeSH terms in the PUBMED Medline, LISTA (EBSCO), Cochrane, and Google Scholar in order to identify recent literature published from the year 2012 to 2017. Seven articles were reviewed, and high increase of the prevalence of diabetes mellitus in Africa was found. Evidences of cost-effectiveness with early detection and treatment were found; however, early detection is hindered by several factors that need to be addressed. In addition, the paucity of articles on early detection of diabetes mellitus and community-based prevention and control programs was observed. There is an increasing prevalence of diabetes mellitus in Africa, and there is paucity of evidences on the determinants of early detection and treatment program. Operational studies and community-based interventions aiming to community sensation and screening for diabetes mellitus are highly recommended.

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1. Introduction

Diabetes Mellitus constitutes a global public health concern, since it is one of the first three causes of non-communicable diseases (NCDs) which cause high morbidity, high mortality and high cost, particularly in Africa where health care systems work under resources-limited contexts (Shaw, Sicree, & Zimmet, 2010). Global estimates by the World Health Organization show that NCDs are responsible of at least 70% of total deaths, and more that 80% of them occur in lower-and-middle-income countries (LMIC) (Baxter *et al.*, 2016). Global estimates show that diabetes mellitus continue to increase dramatically. Only in Sub-Saharan Africa, the prevalence of diabetes is predicted to increase from 19.8 million to 41.5 million between 2013 and 2035 (Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). A systematic review of the prevalence of diabetes mellitus in sub-Saharan Africa between 1999-2011 has shown that the type 2 diabetes accounted for over 90% of diabetes in this sub-region with high morbidity and mortality from several complications due to delayed diagnosis and proper treatment (Hall, Thomsen, Henriksen, & Lohse, 2011). The same study identified barriers to accessing diagnosis and treatment including lack of diagnostic tools and glucose monitoring equipment and high cost of diabetes treatment.

African region has particular challenges in managing diabetes and its associated complications. These include lack of funding, lack of specialized health care providers in NCDs prevention and control, lack of needed medications, disparities in health care delivery, inaccessibility of health care facilities and lack of community sensitization, among many others. These issues make Africa carrying the heavier burden of diabetes in the entire World (Oladimeji, Fawole, Nguku, & Nsubuga, 2014). The other main issue has been that most of the interventions for diabetes prevention and control have been clinically-oriented, putting less emphasis on patient-centeredness and community-oriented health care (Shin & Varghese, 2014).

2. Methods

The main purpose of this systematic review was to identify and review published evidences on the prevalence of diabetes mellitus and determinants of early detection for diabetes prevention and control in Africa. Specific objectives were twofold: (1) to identify and synthesize studies conducted on the prevalence of diabetes mellitus and/or determinants of early detection in Africa, and (2) to make recommendations for future studies and interventions based on the findings of this review on the prevalence and early detection of diabetes mellitus.

The researchers used MeSH terms in the PUBMED and their synonyms were identified in order to maximize picking up recently published literature (in not more than five years) on the prevalence of diabetes mellitus and determinants of early detection in Africa, from the year 2012 to 2017. The following search terms were used: (prevalence OR incidence OR burden) AND (diabetes mellitus OR elevated blood sugar) AND (Africa OR Sub-Saharan Africa); determinants OR factors OR predictors) AND (Early detection OR screening OR diagnosis) AND (diabetes mellitus OR elevated sugar) AND (Africa OR Sub-Saharan Africa). Databases searched included: PubMed, Medline, LISTA (EBSCO), Cochrane and Internet engines such as Google and Google Scholar. Relevant articles and reports were retrieved through extensive literature search. There was no hand-searching performed. Only articles reported on the prevalence of diabetes mellitus and/or the determinants of early detection of diabetes mellitus in Africa, published in English language were included in the study. Two reviewers independently screened the titles and abstracts of all identified retrieved articles, and then an agreement on articles to be reviewed in details was reached. A Meta-analysis was not done, since the reviewed studies were different in their design, focus, and implementation process; only a systematic synthesis of seven studies done on the prevalence of diabetes mellitus was performed. Of these, five echoed the need of understanding the determinants of early detection in Africa. Ethical considerations were given particular considerations during the implementation if this study.

3. Results

3.1 Overview of the reviewed articles

A total of 276 articles were retrieved from extensive literature search. Out of these, 96 articles have reported on the prevalence of diabetes mellitus and/or determinants of early detection for diabetes globally. Those out of Africa were excluded and they remain 32 articles, out of which those which were relevant but have reported on diabetes rather than diabetes mellitus, namely type 1 diabetes and gestational diabetes were excluded and only seven remained (Figure 1). According to the specific objectives of the review, the findings are summarized under two main themes, these are: (1) prevalence of diabetes mellitus in Africa, and (2) determinants of early detection of diabetes mellitus in Africa. The following diagram summarizes the selection process of the reviewed articles.

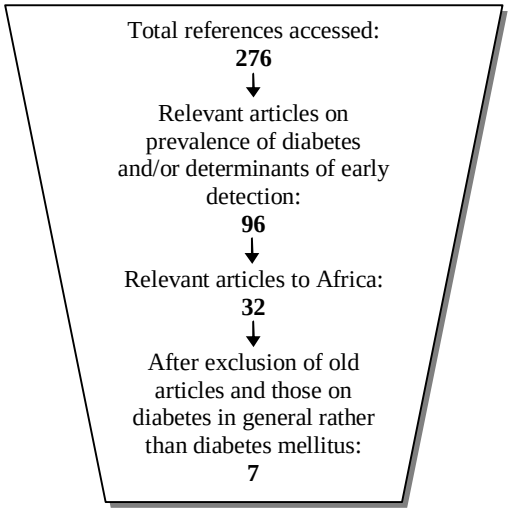

Figure 1: Flow diagram of articles selection

As summarized in Table 1, two articles reported the findings on Africa globally, one was from four countries in Southern Africa, namely Uganda, South Africa, Tanzania, and Nigeria, one article was from South Africa, and one article was from Tanzania. Systematic reviews were two articles and the remaining three were observational descriptive studies. One article (14.3%) was published from Zambia and Western Cape of South Africa, one article (14.3%) from Sierra Leone, two articles (28.6%) from Uganda, one article (14.3%) from Nigeria and two articles (28.6%) reported on Africa. Most of these articles were descriptive in nature, five (71.6%), and two (28.6%) were systematic review of literature.

Table 1: Summary of the seven reviewed articles

Articles	Number (%)
Article from country	
Zambia and South Africa	1 (14.3%)
Sierra Leone	1 (14.3%)
Uganda	2 (28.6%)
Nigeria	1 (14.3%)
Global (Africa)	2 (28.6%)
Study design	
Systematic Reviews	2 (28.6%)
Descriptive Studies & Others	5 (71.6%)

3.2 Studies done on the prevalence of diabetes mellitus

A systematic review that was conducted to assess the prevalence of diabetes mellitus in older people in Africa found an average of 13.7% (95% CI) from all 41 articles reviewed (Werfalli, Engel, Musekiwa, Kengne, & Levitt, 2016) (Table 2). The prevalence was higher in studies based on the oral glucose tolerance test (23.9%) than fasting blood glucose criteria (10.9%), and in non-STEPS than in STEPS studies (17.1% versus 9.6%). This study found that there was no difference in prevalence of diabetes mellitus across age groups, sex, sample size, year of publication, region, or population coverage. However, a study done in Sierra Leone, showed that the prevalence of Type 2 Diabetes Mellitus (T2DM) was 6.2% (43/694), with dramatic increase found in the older age whereby it increased from 0.8% to 3.9% among people aged between 30 and 39 years old, to 8.4% among people aged between 40 and 49 years, to 19% among people aged between 50 and 59, and 25.0% among people aged from 60 years and above (Sundufu, Bockarie, & Jacobsen, 2017).

A study conducted in Zambia and the Western Cape (WC) Province of South Africa showed that South Africa had the higher prevalence of diabetes mellitus than Zambia, 7.2% (n=12,496) and 3.5% (n=45,767) of the Age-standardized prevalence respectively(Bailey *et al.*, 2016). On the other hand, many respondents in Zambia (34.5%) were aware of their diagnosis before the study compared to 12.7% in WC of South Africa. The treatment practices were found poor whereby 66% in Zambia and 59.4% in WC of diabetic patients were not on any diabetes treatment, and 34.4% in Zambia and 32.7% in WC had a random blood glucose (RBG) concentration beyond the recommended level (P 7.8 mmol/L).

In Nigeria a cross-sectional health facilities-based survey among tuberculosis (TB) patients was conducted and found the overall prevalence of diabetes mellitus of 9.4% with the prevalence of those who were newly diagnosed of 5.5% (Ekeke *et al.*, 2017). The prevalence varied per age group with 2.2% of the patients aged ≤ 25 years and 16.9% in patients aged between 56–65 years old. This study found that the risk factors for increase were the age above 40 years (OR: 2.8), rural residence (OR: 2.3), and private facility care (OR: 2.0). In Uganda a cross-sectional hospital-based survey was conducted (Dickson, 2016). The study found the overall prevalence of diabetes mellitus of 2.5% in the hospital. The type two diabetes mellitus was the most predominant (79%). The study also found the increase of the prevalence of diabetes mellitus among those aged >30 years old. The difference in proportion and the risk factors for diabetes mellitus were tested using the Chi-square test. These risk factors included family history (74%, $p<0.001$), smoking (48%, $p=0.002$), and hypertension (45%, $p<0.001$).

A systematic review and meta-analysis of the prevalence of diabetes mellitus among patients with HIV in Africa was conducted (Prioreschi *et al.*, 2017). The incidence rates of T2DM ranged from 4 to 59 per 1000 person years. However, there was no significant differences between T2DM prevalence in HIV-infected individuals versus uninfected individuals (RR=1.61, 95% CI), or between HIV-treated patients versus untreated patients (RR=1.38, 95% CI to 2.87, 95% CI). On the other hand a study conducted in Uganda found that the prevalence of diabetes mellitus was 7.4%, and prevalence of pre-diabetes was 8.6% (Mayega *et al.*, 2013). The abnormal glucose regulation (AGR) was 2 times higher among obese persons versus normal BMI persons (Adjusted Prevalence Rate Ratio (APRR) 1.9, 95% CI), mainly among people aged 35-60 years, reason why they need systematic screening. It was found that the direct medical cost to detect one person with AGR was 2 US dollars and 2.7 with WHO cut-offs, which is the reasonably affordable cost, as far as the community screening is concerned. Based on other cost for health care, individual and countries can afford this cost.

3.3 Studies done on determinants of early detection for diabetes mellitus

Although all the reviewed studies none of them has focused on the determinants of early detection of diabetes mellitus, a good number of them made this recommendation (Table 2). The study conducted in Zambia and South Africa recommended timely diagnosis for diabetes mellitus and treatment (Bailey, *et al.*, 2016). The study conducted in Sierra Leone recommended that that there should be ability to diagnose, monitor and treat diabetes in rural and urban areas (Sundufu, *et al.*, 2017). Specifically the study conducted in Uganda recommended systematic mass screening of the general population at high risk, these are people aged from 35 years and above (Mayega, *et al.*, 2013). This study showed that the cost for screening is far less that the cost of the health care given when the diagnosis is done with delay.

4. Discussion

All reviewed articles showed that there is a high and increasing prevalence of diabetes mellitus in Africa. These findings conquer with those found in previous years. For example the systematic review on prevalence of diabetes mellitus in Africa has concluded a dramatic increase of the DM in Africa, and highlighted the challenges that health systems encounter in relation to prevention and control of diabetes and non-communicable diseases in general (Hall, *et al.*, 2011). These findings also conquer with those found in developed countries, as an example of the study conducted in Canada.

Available evidences show that early detection for diabetes is one of the cost-effective strategies to prevent and control of diabetes mellitus, both at individual and family and at country levels (Mittal & Singh, 2010; Reuven, Dreiher, & Shvartzman, 2016). Delayed diagnosis is most of the times associated with severe complications which lead to premature deaths and/or increased morbidity (Baxter, *et al.*, 2016; Mbanya, *et al.*, 2010). Also most of the studies carried out and implemented interventions in African context have put more emphasis on the clinical aspects and little is known about determinants of early detection of diabetes and community participation and little is done at the grassroots, mainly the community levels, in order to prevent and control diabetes mellitus earlier (Bailey, *et al.*, 2016). The increasing prevalence of diabetes mellitus in older age was observed in all corners of African continent. For example in Western African countries namely Benin, Burkina Faso, Gabo Verde, Cote d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo (Sundufu, *et al.*, 2017). In Eastern, Central Africa and Southern Africa, early detection of diabetes mellitus is a priority in order to effectively prevent and control this health threat (Bailey, *et al.*, 2016; Mbanya, *et al.*, 2010).

5. Conclusion

There is an increasing prevalence rate of diabetes mellitus in Africa. There are factors hindering diabetes early detection including lack of readiness of the health systems in terms of planning and funding community-based interventions aiming at community sensitization, early detection and treatment, availability of material and consumables and enough and competent human resources. Operational studies on determinants of diabetes mellitus early detection and community-based sensitization and screening programs are highly recommended.

Conflict of interest

We declare that there is no conflict of interest associated with this work.

Table 2: Summary of findings on prevalence of diabetes mellitus and determinants of early detection in Africa

Article	Country	Study design and focus	Main findings	
			Prevalence of diabetes mellitus	**Determinants of screening**
Bailey, *et al.* (2016)	Zambia and South Africa	-A population-based cross-sectional study -Prevalence, risk factors, diagnosis and management of diabetes mellitus	o Age-standardized prevalence in Zambia: 3.5% (n=45,767) and WC South Africa: 7.2% (n=12,496); o Unaware of their diagnosis: 34.5% in Zambia and 12.7% in WC o 66.0% in Zambia and 59.4% in WC were not on any diabetes treatment, and 34.4% in Zambia and 32.7% in WC had a random blood glucose (RBG) concentration beyond the recommended level (P7.8 mmol/L).	o Did not focus on determinants of screening; o Recommended timely diagnosis for diabetes and treatment
Prioreschi, *et al.* (2017)	Global (Africa)	-A systematic review and meta-analysis -Incidence and prevalence of T2DM with HIV infection	o Incidence rates of T2DM ranged from 4 to 59 per 1000 person years o There was no significant differences between T2DM prevalence in HIV-infected individuals versus uninfected individuals (RR=1.61, 95% CI), or between HIV-treated patients versus untreated patients (RR=1.38, 95% CI to 2.87, 95 CI).	o Did not focus on screening but recommended it to be systemically done
Sundufu, *et al.* (2017)	Sierra Leone	-A descriptive study with comparison of findings from studies across West Africa -Prevalence of diabetes	o Prevalence of diabetes was 6.2% (43/694); o Dramatic increase found in the older age: 3.9% (patients ages 30 to 39), 8.4% (patients ages 40 to 49), 19% (patients ages 50 to 59), and 25.0% (patients aged from 60 years). o Prevalence increase also noticed in Benin, Burkina Faso, Gabo Verde, Cote d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.	o Did not focus on screening patterns o Recommend increase in ability to diagnose, monitor and treat diabetes in rural and urban areas.
Werfalli, *at al.* (2016)	Global (Africa)	-A systematic review -Prevalence of type 2 diabetes among older people in Africa	o The overall prevalence from all 41 articles was 13.7% (95% CI), o It was higher in studies based on the oral glucose tolerance test (23.9%) than fasting blood glucose criteria (10.9%), and in non-STEPS than in STEPS studies (17.1% versus 9.6%). o No identified difference in prevalence across age groups, sex, sample size, year of publication, region, or population coverage.	o Did not focus on the determinants of diabetes screening
Dickson (2016)	Uganda	-A cross-sectional hospital-based survey -Prevalence of diabetes and its associated risk factors	o The overall prevalence in the hospital was 2.5%; o T2DM was the most predominant (79%); o Those aged >30 years, the prevalence increased; o Risk factors for diabetes included family history (74%, $p<0.001$), smoking (48%, $p=0.002$), and hypertension (45%, $p<0.001$).	o Did not focus on diabetes screening
Ekeke, *et al.* (2017)	Nigeria	-A cross-sectional health facilities-based survey among TB patients -Prevalence of diabetes and associated risk factors	o Overall prevalence was 9.4% and the prevalence of those newly diagnosed was 5.5%; o Prevalence varied per age group; 2.2% of patients aged ≤ 25 years and 16.9% in patients aged between 56–65 years o Risk factors for increase were the age above 40 years (OR: 2.8), rural residence (OR: 2.3), and private facility care (OR 2.0).	o Did not focus on diabetes screening but recommended systematic DM screening among the patients.
Mayega, *et al.* (2013)	Uganda	-A cross-sectional survey -Prevalence of diabetes among and associated factors	o Prevalence of diabetes was 7.4%, and prevalence of pre-diabetes was 8.6%; o The abnormal glucose regulation (AGR) was 2 times higher among obese persons versus normal BMI persons (Adjusted Prevalence Rate Ratio (APRR) 1.9, 95%CI), mainly among people aged 35-60 years, reason why screening they need systematic screening; o The direct medical cost to detect one person with AGR was 2 US dollars and 2.7 with WHO cut-offs.	o Did not focus on determinants of diabetes screening, but Recommended systematic mass screening for high-risk persons (35 years and above)

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