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Prevalence of Diabetes Mellitus in the School: A Systematic Review of African Studies

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Keywords: diabetes mellitus, prevalence, school, primary, secondary, Africa.

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Prevalence of Diabetes Mellitus in the School: A Systematic Review of African Studies

Agofure Otovwe [α], Okandeji-Barry Oghenenioborue Rume [σ], Odjimogho Stella [ρ] & Efegbere Henry [ω]

Abstract- Introduction: Diabetes Mellitus (DM) is a metabolic disorder which results in increased glucose level in the blood. When poorly managed it results in morbidity, mortality and low quality of life among patients. The rising prevalence of DM among teachers and students in Africa is becoming disturbing. The authors systematically reviewed studies reporting the prevalence of DM among teachers and students in Africa.

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Results: Out of the 12 eligible studies, 6 were conducted among teachers while 6 were conducted among students. The mean age of the students was 14.82±1.84 years while the mean age of the teachers was 43.5±2.59 years. Most of the studies adopted the WHO/IDF diagnostic criteria and the ADA diagnostic criteria. The highest prevalence of DM among teachers was 13.5% while the highest prevalence of DM and prediabetes among students was 1.8% and 28.70% respectively.

Conclusion: The review has provided an overview of the prevalence of DM in the school environment in African countries. Consequently, it is hoped it would stimulate 1) more research activities of DM in the school environment 2) implementation of school based policies to mitigate the short and long term impact of DM 3) organization of school based diabetes prevention and management programmes within the school environment.

Keywords: diabetes mellitus, prevalence, school, primary, secondary, Africa.

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I. Introduction

The increasing prevalence of diabetes mellitus (DM) has assumed a pandemic proportion worldwide. Middle and lower income countries in sub-Saharan Africa are also experiencing a geometric increase of the disease. According to the International Diabetes Federation an estimated 15.5 million adults aged 20-79 years have diabetes in Africa. The number is expected to increase to 162.5% in year 2045. The estimated number of adolescents and children with type-1 DM in year 2017 was 50,200 in Africa showing the possible escalation of the disease in all age groups [1]. Some of the countries with the highest number of diabetes include Ethiopia with 2.6 million, South Africa with 1.8 million, Democratic Republic of Congo with 1.7 million and Nigeria with 1.7 million people [1]. Furthermore, DM results in micro vascular and macro vascular complications which confers enormous financial burden to families, health system and governments in the continent. This observed burden is related to health system costs incurred by the family and the society in managing the disease, indirect costs resulting from productivity losses due to patient disability and premature mortality, time spent by family members accompanying patients when seeking care, and intangible costs (psychological pain to the family and loved ones) [2].

Various population based studies have reported the prevalence of diabetes in Africa [3,4,5,6,7, 8,9]. A component of the entire population in Africa where diabetes seems to be on the increase is the school environment. The prevalence of DM on the school would be devastating both to teachers and students. For teachers living with DM would be very challenging in performing their daily duties especially as it relates to caring for children under their care. This is because students spend between 6-8 hours every day in school, thus conferring a lot of responsibility on the teachers. For students living with DM would struggle to adapt to the required personal and environmental changes required to manage the condition. This is because at this age they are carefree and are usually involve in a lot of activities such as physical activities, dietary habits such as eating sweets, taking soft drinks and snacks which could be inimical to their health as they could be committed to lifelong monitoring and regulating blood sugar levels through insulin therapy and other relevant

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medications [10]. School teachers belong to the group of literate working class and contribute to the level of awareness of the larger society on many issues. However, there is paucity of studies in Africa that have systematically reviewed and documented the prevalence of DM among teachers and students; hence, the focus of this review.

a) Objectives

- To highlight the prevalence of DM among teachers and students
- To underline the diagnostic criteria used in diagnosing

II. Materials and Methods

a) Study design

This is a systematic review of the prevalence of DM among teachers and students in both primary and secondary schools in Africa countries following the MOOSE guidelines for systematic reviews and observational studies [11]. The included studies were extracted by two of the authors AO and OOR using standardized data extraction forms. Characteristics of identified studies extracted were the study location, year of study, study design, sample size, diabetes mellitus diagnostic criteria, age, and prevalence of DM.

b) Study area

The study area comprised all regions of Africa including South, East, West, North and Central Africa.

c) Data sources and searches

A systematic collation of published data over the period of year 1990 to 2019 on prevalence of DM among teachers and students was retrieved between May and October 2019 to develop an all-inclusive distribution of DM in both primary and secondary schools in Africa. The authors searched electronic online bibliographic archives such as Pubmed, Google Scholar, Medline, Scopus, African Journal Online, Science Direct, and the Cochrane Library. Using MeSH headings, the terms ''diabetes mellitus,'' ''prevalence,'' "primary," secondary," "students" "teachers," "educator," "instructor," and ''Africa'' as well as variations thereof were searched for. We contacted the authors of articles in journals that were not available online. The last search was performed on 12 October, 2019. Studies included in the systematic review were those that were conducted in primary and secondary schools and utilized the fasting blood sugar (FBS), the random blood sugar (RBS) test. In all, a total of 12 studies involving 6360 teachers and students were evaluated. Thus, 6 studies comprising 2191 teachers and 6 studies comprising 4169 pupils and students were included in the systematic review.

d) Inclusion Criteria

Only school-based studies among teachers and students that were executed between 1990 and 2019 in Africa and in which FBS, RBS or self report through questionnaire was used to diagnose DM were included in the systematic review. Furthermore, included studies were prospective or cross sectional studies published in English language.

e) Exclusion Criteria

Excluded studies from the systematic review were those carried out before 1990, in the university and other tertiary schools, those published in other languages aside English, those carried out among other staffs of primary and secondary schools aside teachers and those without clear definition of how DM was diagnosed.

f) Ethical Consideration

This review was the preliminary phase of a larger study among teachers, students and community participants of which ethical approval was obtained from the Delta State Ethical Review Committee.

g) Study selection and Data Extraction

For teachers a total of 2408 potential articles were indicated in the initial literature search after removing duplicates, of which 22 full text articles were screened for eligibility and only 6 studies were included in the qualitative synthesis (Fig 1). For students 5538 potential articles were indicated in the initial literature search after removing duplicates, of which 31 full text articles were screened for eligibility and only 6 studies were included in the qualitative synthesis (Fig 2). Various data were extracted from eligible studies, such as the prevalence of DM, method of diagnosing DM, study design, sample size and African country in which the study was carried out. A summary of the data extracted is as shown in Table 1. We coded the data based on the name of the first author of the study and the year that the study was published.

h) Quality of the Studies Included

Two authors AO and OOR separately assessed the quality of the studies included using the NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies [12]. The studies were assessed with questions appropriate to the study design. We graded the quality of the study as good (G) if its rating was at least 70%, fair (F) if it's rating was at least 50%, and poor (P) if it's rating was less than 50% [3].

i) Data analysis

All the relevant information was entered into an Excel spreadsheet and data analysis was performed using SPSS (Version 20 for Windows, SPSS Inc., Chicago, IL).

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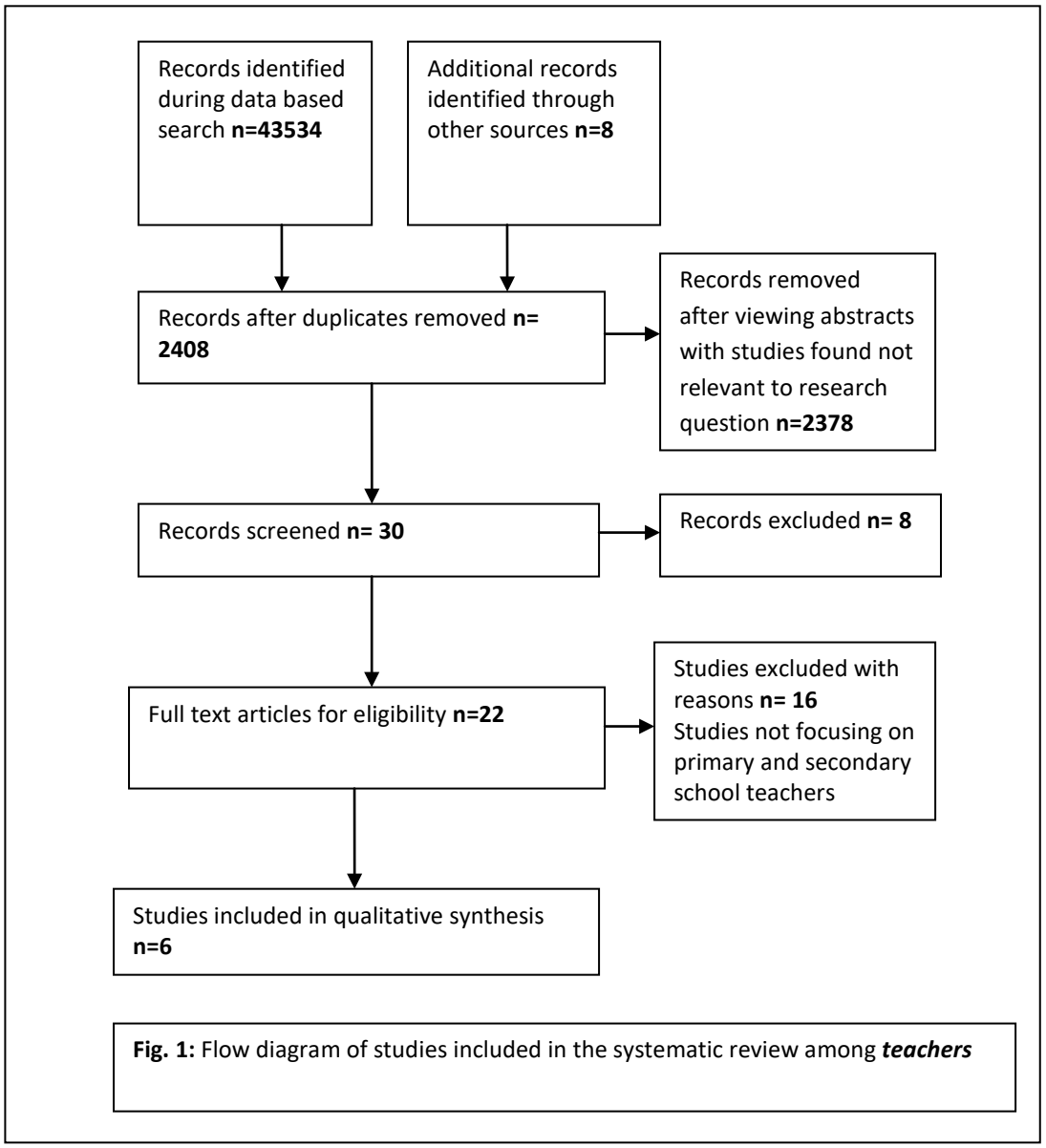

Fig. 1: Flow diagram of studies included in the systematic review among *teachers*

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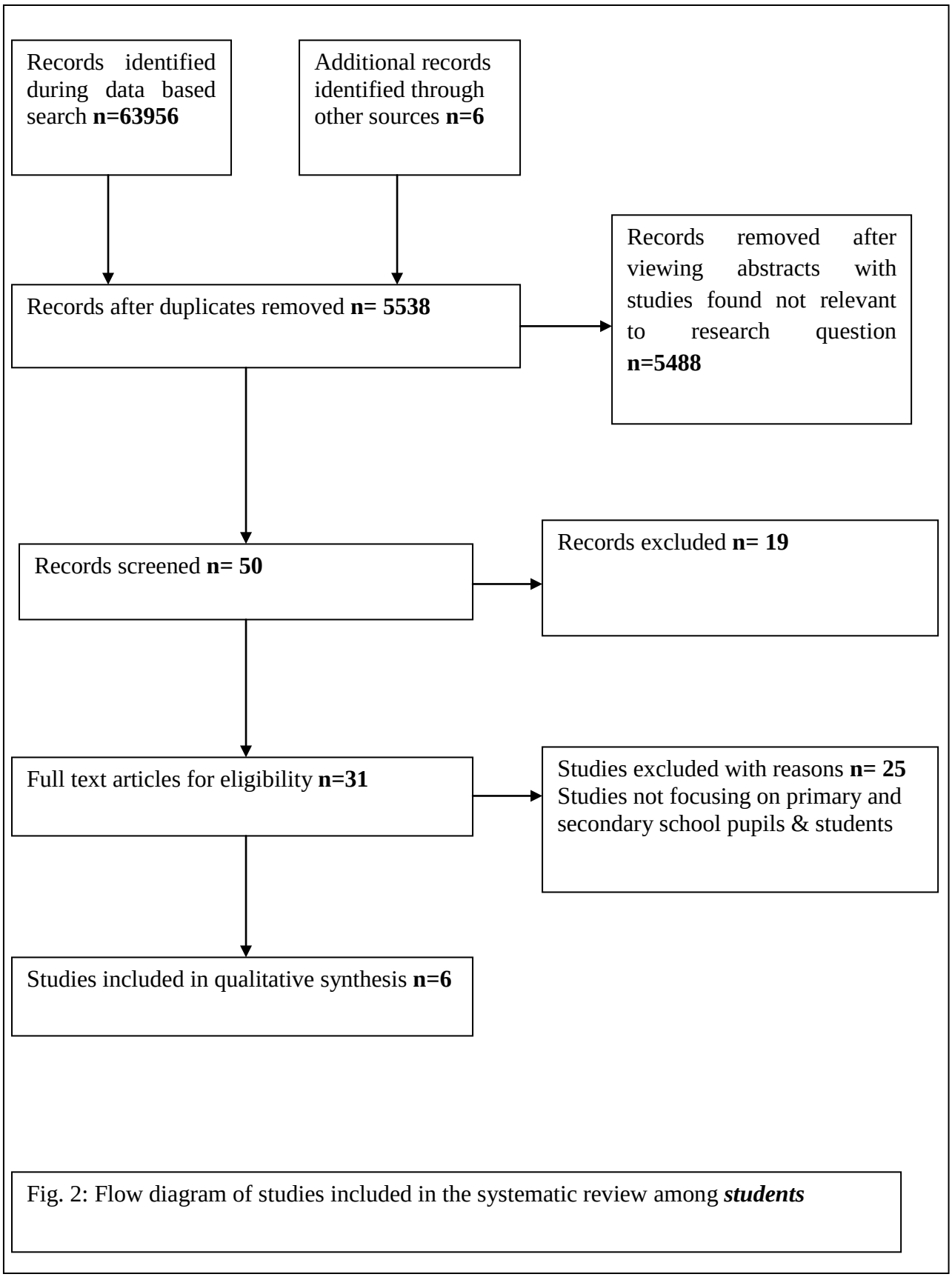

Fig. 2: Flow diagram of studies included in the systematic review among *students*

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III. Results

a) Study characteristics

All of the 6 eligible studies among teachers were carried out from year 2015-2017 and were school based cross sectional studies. The highest population of 517 teachers was associated with the study in South Africa [13], while the least population was a study in Nigeria among 83 teachers [14]. The ages of the teachers in the studies [13,14,15,16,17,18] ranged from 40-46 years with a mean age of 43.5±2.59 years. Only two studies reported mean glucose; one reported a mean glucose of 5.1±0.9 mmol/l [14] and the other reported a mean glucose of 4.65±2.3 mmol/l [13]. In addition, 50% of the studies were conducted in Secondary Schools and 33.3% in Primary schools. The highest prevalence of DM as reported by the study in South Africa [16] was 13.50%, while the least reported prevalence was 1.2% [14]. The diagnostic criteria adopted by the studies among teachers [13,14,15,16,18] were World Health Organisation and International Diabetes Federation harmonized definition of Diabetes mellitus and only one of the study adopted the International Diabetes Federation diagnostic criteria [17]. In addition, 50% of the study adopted the FBS for their diagnosis [16,17,18] while the other 50% adopted the RBS [13,14,15] (Table 1).

All of the 6 eligible studies among students were carried out from year 2006-2019 and were school based cohort [19] and cross sectional studies [20,21,22,23,24]. The highest population of 880 students was associated with the study in Nigeria [21]. The ages of the students in the studies ranged from 10-19 years with a mean age of 14.82±1.84 years. Four studies reported mean glucose with the highest mean glucose of 4.8±0.5 mmol/l [19,20,21,22]. All studies were conducted in Secondary Schools. The highest prevalence of prediabetes as reported by the study in Nigeria [23] was 28.70%, while the least reported prevalence was 6.4% [24]. In addition, the highest prevalence of DM was 1.8% [19] (Table 2).

Table 1: Demographic and Clinical Characteristics of Studies included in the systematic review among teachers

Country	Year	Study Design	Sample Size	Mean Age	Mean Glucose	Types of schools	Prevalence of DM (%)	Diagnostic Criteria		Reference	Quality
								WHO/IDF	IDF		
South Africa	2016	Cross sectional	489	46.3 years	-	Secondary	10.1%	RBS≥11.1 mmol/l		Laurence et al. [15]	Good
Nigeria	2017	Cross-sectional	118	43 years	-	Secondary	2.8%		FBS≥7.0mmol/l or 126mg/dl	Ilesanmi et al. [17]	Fair
Tanzania	2016	Cross sectional	229	40 years	-	Primary	8.3%	FBS≥7.0mmol/l or 126mg/dl		Chiwanga et al. [18]	Good
Nigeria	2016	Cross sectional	83	46 years	5.1±0.9 mmol/l	Secondary	1.2%	RBS≥11.1 mmol/l		Akintunde & Oloyede [14]	Fair
South Africa	2015	Cross sectional	455	-	-	Primary, Secondary,Intermediate	13.5%	FBS≥7.0mmol/l		Dalal et al. [16]	Fair
South Africa	2015	Cross sectional	517	45±7.9 years	4.65±2.3 mmol/l	Primary	2.0%	RBS≥200mg/dl		Senekal et al. [13]	Good

Table 2: Demographic and Clinical Characteristics of Studies included in the systematic review among Students

Country	Year	Study Design	Sample Size	Mean Age	Mean Glucose	Types of schools	Prevalence of Prediabetes (%)	Prevalence of DM (%)	Reference	Quality
Cameroon	2019	Cohort	815	18 years	0.89±0.34 g/l	Secondary	-	1.8%	Kandema et al. [19]	Good
South Africa	2006	Cross-sectional	338	12.7±1.9 years	4.26±0.63 mmol/l	Secondary	-	0.0%	Somers et al. [20]	Fair
Nigeria	2019	Cross sectional	880	15.01±2.1 years	-	Secondary	17.3%	-	Jaja & Yarhere, [21]	Good
Nigeria	2012	Cross sectional	820	13.6±2.2 years	-	Secondary	-	0.3%	Okpere et al. [22]	Fair
Uganda	2018	Cross sectional	688	15.4±1.7 years	4.8±0.5 mmol/l	Secondary	6.4%	-	Nakiriba et al. [23]	Fair
Nigeria	2015	Cross sectional	628	14.2±1.7 years	95.3±10.9 mg/dl	Secondary	28.70%	0.6%	Oluwayemi et al. [24]	Good

Okpere et al., was diagnosed through self report

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Two of the selected studies [19,23] adopted the American Diabetes Association definition of DM. Another study adopted WHO [24] and the Expert Committee on the Diagnosis and Classification of DM [20]. Another study adopted the International Society for Paediatrics and Adolescent Diabetes guidelines for classification of diabetes mellitus [21] (Table 3).

Table 3: Diagnostic criteria adopted by the selected studies among students

	ADA	ECDCDM	ISPAD	WHO
Oluwayemi et al. [23]	FBG≥126mg/dl			
Kandema et al. [19]	FBS≥126mg/dl			
Somers et al. [20]		FBS≥7.0mmol/l		
Jaja & Yarhere [21]			FBS≥7.0mmol/l or 126mg/dl	
Nakiriba et al. [24]				FBS≥7.0mmol/l or 126mg/dl

Okpere et al., 2012 was not reflected because blood glucose test was not carried out due to lack of permission from school authorities

FBS-Fasting blood Sugar, RBS-Random Blood Sugar, WHO-World Health Organisation, IDF-International Diabetes Federation, ADA-American Diabetes Association, ECDCDM-Expert Committee on the Diagnosis & Classification of diabetes mellitus, ISPAD-International Society for Paediatrics and Adolescent Diabetes guidelines for classification of diabetes mellitus

The prevalence of DM among the teachers was as high as 13.5% [16] with the least as 1.2% [14] (Fig. 3). For the students, prevalence of DM was 1.8% [19] and least was 0.0% [20]. However, three studies reported the prevalence of prediabetes to be 28.70% [23], 17.30% [21] and 6.40% [24] (Fig 3).

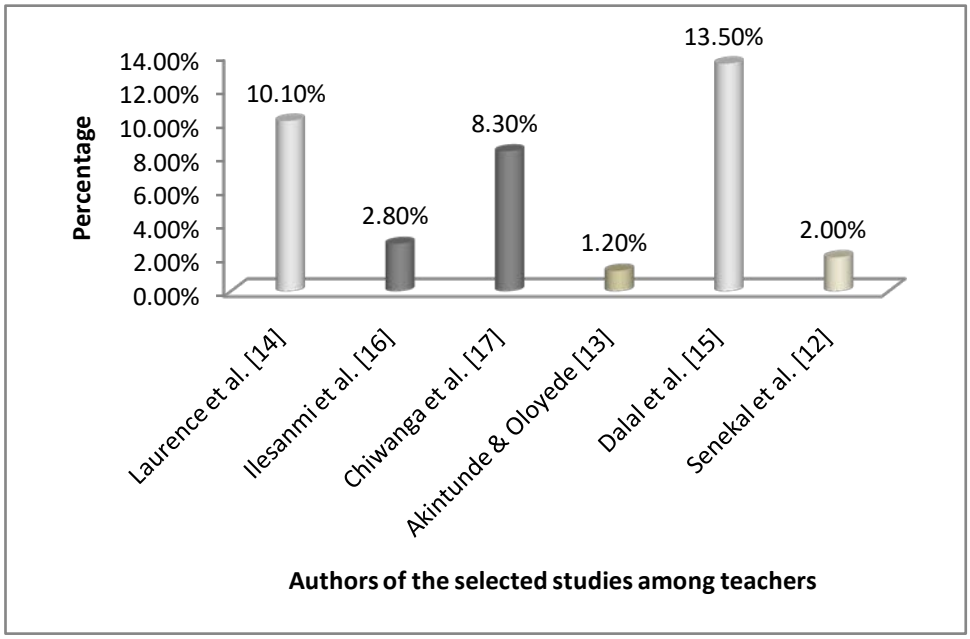

Figure 3: Prevalence of diabetes mellitus among the teachers

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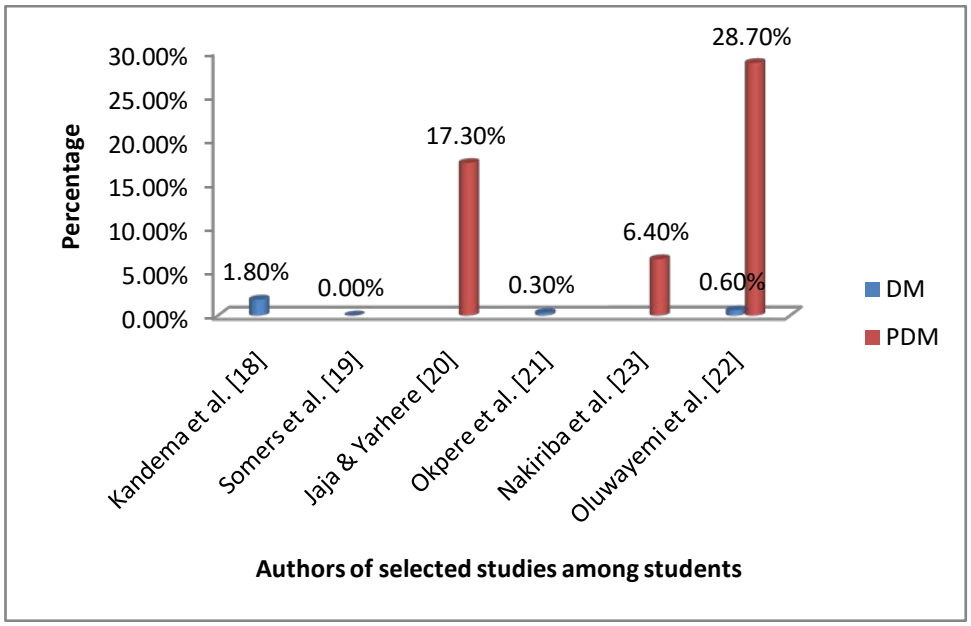

Figure 4: Prevalence of diabetes mellitus and pre-diabetes mellitus
Key: DM-Diabetes mellitus, PDM-Pre-diabetes mellitus

IV. Discussion

This systematic review highlighted the prevalence of DM among teachers and students in schools to stimulate necessary actions in preventing the disease and reducing diabetes related complications in the school. This review became necessary as most previous review on DM focused on patients diagnosed in clinical settings and the general population [3,25,26,27,28]. The prevalence of DM among the teachers was 13.50% [16], 10.10% [15], and 8.3% [18]. This observed prevalence of DM among the teachers is in line with the trend of DM among adults in Africa. Type-2 DM is the most prevalent form of diabetes in Africa and these findings corroborates other community and population based findings on prevalence of DM in Africa [3,4,5,6,7,8,9]. The clinical significance of the findings is that just as the healthcare system and the general population is currently contending with the increasing rate of DM and its complications; teachers could also be contending with the morbidity associated with DM including its effect on individual, family and work. This may possibly be devastating to the school as teachers would not have to only focus on the pupils and students under their care; but would have to spend time even within school hours to manage DM. This could result in emotional and mental stress, loss of manpower and low productivity. The prevalence of DM among teachers is peculiar because teachers are change agent in impacting knowledge not only within the school environment but also in the community especially in developing countries of Africa.

The prevalence of prediabetes recorded among students in the selected studies suggests a likely escalation of type-1 DM among students in Africa in the not too distant future. This is because for countries like Nigeria with a high population of adolescents and youths making up about 62.15% of the general population [29]; thus an escalation of DM would be devastating to families, healthcare system and the nation. The highest recorded prevalence of type-1 DM of 1.8% or 18 per 1000 in the review was higher than that obtained in studies of over twenty years ago in Nigeria 0.33 per 1000 and 0.95 per 1000 among Sudanese children [30,31]. This increasing prevalence suggests the possible escalation of DM among this population in Africa which has been forecasted [1]. The clinical significance and implication is that African schools like their American and European counterpart would be dealing with children with type-1 DM in the school. This is coupled with the current prevalence of type-2 DM among teachers. Thus, the issue of DM in the school environment should be given the desired attention through creating awareness programmes among staffs and students including training and retraining of teachers on how to handle a DM situation in the school.

In diagnosing diabetes, various diagnostic guidelines have been developed and updated over the years [32,33,34,35]. However, despite the evolvement, improvement and recommendation by various organizations concerned with DM diagnosis various studies still adopt the diagnostic criteria that are convenient for their study. In the review among teachers studies that adopted the WHO/IDF definition of DM reported prevalence of DM to be 10.1% [16], 1.2% [15], 8.3% [19], 13.5% [16], and 2.0% [13] while the sole study that adopted the IDF criteria reported a prevalence of 2.80% [17] Table 1.

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The studies carried out among students showed more variation in their diagnostic criteria. Two studies used ADA definition and they reported prevalence of prediabetes of 28.70% and DM 0.6% [23] and 1.8% [19]. Furthermore, one study used the Expert Committee on the Diagnosis and Classification of DM and it reported a prevalence of 0% [20]. Similarly, one of the studies utilized the International Society for Paediatrics and Adolescents Diabetes guidelines reported the prevalence of prediabetes to be 17.3% [21] and the study that adopted the WHO guidelines reported a prevalence of prediabetes to be 6.4% [24] Table 2.

The prevalence of prediabetes and DM among students and teachers has brought to the forefront the issue of DM in the school and the need for implementing prevention and management programmes in both primary and secondary schools so as to stem the tide of DM among this cohorts.

Limitation of the study

The review was a retrospective study of previous published studies. Therefore, the authors relied solely on the report of the selected studies in writing the review.

V. Conclusion

The systematic review highlighted the prevalence of DM in teachers and students both in primary and secondary schools in Africa. Therefore, it is pertinent for stakeholders in the education ministry in collaboration with the health ministry to implement prevention programmes such as screening and creation of awareness of DM in the school environment. This would help in achieving health promoting schools which is a prerequisite for achieving the Sustainable Goal 3.

Contributions

OA: Contributed to the concept, design, data searches and extraction, analysis, manuscript preparation and writing

OOR: Contributed to the design, data searches and extraction, analysis, manuscript preparation and review

OS: Contributed to the design, analysis, manuscript preparation and review

EH: Contributed to the design, analysis, manuscript preparation and review

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