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RESEARCH ARTICLE

QUALITY OF TYPE 2 DIABETES CARE BASED ON GLYCAEMIA IN SUB-SAHARA AFRICA: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Diabetes Mellitus is an increasing medical problem in Sub-Saharan Africa (SSA). Current evidence suggests an epidemic proportion of this condition in this developing region, largely due to increasing urbanization and epidemiological transition. There are suggestions that the quality of diabetes care in Africa is suboptimal. However, there is unclear evidence to substantiate these claims. There was the need to systematically assess and summarise the existing evidence on quality of care among patients with type 2 diabetes mellitus (T2DM), whilst identifying any gaps in information and exploring possible barriers to care in a SSA context. This will provide policy makers and health care providers with a systematic overview of the available evidence on the state of diabetes care in this region from which they can base decision making.

Aim and Objectives: The aim of the systematic review was to examine the existing quality of management of type 2 diabetes in SSA by addressing the following questions:
i.How good is the current control of type 2 DM in SSA based on indicator outcome of glycaemia?
ii.Have implemented strategies, treatment or interventions improved glycaemic control of type 2 DM in Sub-Saharan African countries?

Methods: This study was a systematic review of quantitative studies. The population comprised people with type 2 diabetes in sub-Saharan Africa. All ages, gender, ethnicities irrespective of race, residence, locality, immigration status, educational background and socio-economic status were included. The studies included cross-sectional studies, experimental, quasi-experimental studies, observational studies and review papers. Only full papers as opposed to abstracts were included in the review. Conference proceedings, editorials and case reports were excluded. Two databases were explored to develop search strategies – MEDLINE via Pubmed (1946 to February 2013) and EMBASE via Ovid (1974 to April 2013). Terms such as glycaemia and hyperglycaemia, and terms related to these were used in the search strategy. The search included searching reference lists of derived papers and contacting experts. Data on measures of glycaemic control as primary outcome of interest were extracted and summarised upon. Secondary outcomes included process measures like the frequency of blood glucose levels documentation. Duration of diagnosed diabetes and assessment of diabetes complications were considered. The interventions or implementation strategies within studies or data collected on these were also assessed. Study quality was assessed based on components in a quality assessment tool from the Effective Public Health Practice Project. **Results:** Thirteen published studies were identified and included in the review. Eleven of these were cross-sectional studies, one was a prospective cohort study and another combined cross-sectional and cohort study. Education on diabetes management and prevention of complications seemed to be the most consistent intervention carried out, followed by drug treatment with oral hypoglycaemic agents and Insulin, then dietary measures. Target levels of HbA1c were generally less than 7% in almost all the studies. This is in keeping with the IDF and ADA guidelines. Target glycaemic control were consistently seen in less than 50% of the patients within studies. **Conclusion:** This review found the quality of care of type 2 diabetes based on glycaemic control, to be sub-optimal in sub-Sahara African countries. Therefore, quality of care needs to be improved upon in this region. It is likely that several interventions, mainly secondary preventive strategies, and implementation strategies identified would improve quality of care in this region. Targeted interventions and strategies specific to the local populace would be beneficial.

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INTRODUCTION

The World Health Organisation (WHO) defines Diabetes mellitus as a metabolic disorder characterized by prolonged hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both (1). Type 2 diabetes is responsible for over 90% of diabetes cases in Sub-Saharan Africa (2,3). T2DM is usually due to insulin resistance or reduced insulin sensitivity, combined with reduced insulin secretion (4).T2DM may go unnoticed for years because visible symptoms are typically mild, non-existent or sporadic and severe long term complications may occur. T2DM may develop due to an interplay between genetic and environmental factors such as high calorie diet and low physical activity. Exposure to smoking, alcohol and some medications are also possible causes. This systematic review considered T2DM due to the magnitude of people T2DM affects compared to T1DM. Therefore, the public health implications of poor T2DM management and control are likely to be greater.

Worldwide, there was an estimated of 171 million individuals with T2DM in 2000. This figure is predicted to increase to 366 million by 2030 (5). In their systematic review, Sobngwi and colleagues (6), noted the prevalence of diabetes from 1% in rural areas to 6 % in urban areas of Africa. In their systematic review on the epidemiology and public health implications of diabetes in sub-Saharan Africa, Hall *et al* (7) reported that the population prevalence proportion ranged from 1% in rural Uganda to 12% in urban Kenya. Diabetes Mellitus is an increasing medical problem in Sub-Saharan Africa. Current evidence suggests an epidemic proportion of this condition in this developing region, largely due to increasing urbanization and epidemiological transition(5,6,8,9).The availability of prevalence data on diabetes for sub-Saharan Africa is very limited. It was projected that there would be an increaseof 98% in patients with diabetes every decade and about 23.9 million people could have diabetes in SSA by 2030(5,6). Type 2 diabetes mellitus, with its attending complications, has a negative impact on the quality of life of an individual or his family and health care resources (finances, manpower and infrastructure) are usually strained(10). Treatment of patients and management of complications will imply additional costs to individuals, families and the government. The increased risk of morbidity and mortality in people with diabetes is mainly due to the fact that diabetes is associated with microvascular and macrovascular complications. For example, Mbanya and Sobngwi (11) showed that 16-55% of individuals with diabetes in Africa had retinopathy and newly diagnosed patients with T2DM accounted for 21-25% of this population. This suggests that individuals with complications at diagnosis have been undiagnosed for long periods with poor blood glucose control. This further shows that T2DM care in SSA is sub-optimal. The highest prevalence of retinopathy was observed in populations with the poorest blood glucose control (11). Nephropathy was associated with poor blood glucose control, high blood pressure and retinopathy while peripheral neuropathy usually occurred after diagnosis of T2DM (11). The same study reported that in Tanzania, the treatment of diabetic complications represented 30.8% of the total costs of outpatient care in a major hospital in the capital city. The yearly expenditure per patient was US $138 and this was 19 times more than each government spending on health at an average exchange rate (11).

Macrovascular complications occur mostly in patients with T2DM, or as part of metabolic syndrome X which comprises dyslipidemia, hypertension and central obesity. These can all act to increase the risk of cardiovascular disease (12). T2DM patients are at higher risks of developing cerebrovascular disease, coronary artery disease and cardiomyopathy (11,13,14). There is evidence to suggest an increased risk of cardiovascular events in African population with an increased prevalence of dyslipidaemia (11,15). Risk factors that may be contributing to the increasing prevalence of T2DM in SSA are similar to those effecting T2DM rates worldwide. In a modelling study explaining the increase in diabetes prevalence and plasma glucose in Mauritius (16), findings suggested that most of the change in prevalence was due to modifiable factors and not due to factors like change in mortality rates. Modifiable risk factors include cultural and social changes.Therefore, poor dietary habits, sedentary lifestyles, obesity and other unhealthy behaviours could increase the risk of developing T2DM, worsen the disease or increase the risk of complications. Non modifiable risk factors include an ageing population and ethnicity (17,18). There is the need to prevent or delay the risk or progression of complications associated with these changes (19, 20). Healthier dietary changes, increased physical activity, avoidance of cigarette smoking or tobacco, and structured education are interventions that have been recommended. Medications may also useful. These measures aim at controlling three important indicators of care in T2DM patients: blood glucose, blood pressure and lipids (20). However, studies have shown that in spite of recent (2007) achievements in blood glucose control in diabetic adults, less than 15% met the targets for all three indicators at the same time (21,22).These may suggest that the recommended interventions or strategies are poorly administered or utilized. Consequently, improvements in the quality of care among T2DM patients may be impaired.

The Diabetes Foundation (DF) Report on Implementing National Diabetes Programmes in Sub-Saharan Africa(23) explains that the current approaches to management of diseases in SSA concentrate on acute infectious diseases. However, similar approaches cannot be used for chronic diseases like diabetes. Continuous self-management is essential for diabetic patients and there is also the need for regular long-term follow up and treatment. As mentioned earlier, there are currently several interventions that are aimed at improving the quality of care of diabetic patients in order to achieve improved outcomes (24). However, whether these interventions achieve desirable control of T2DM is still uncertain. Uncertainity here may be as a result of poor follow up of outcomes. For example, clinical outcomes like HbA1c and Fasting Plasma Glucose (FPG) as measures of glucose control which this systematic review took into cognisance. Furthermore, interventions may not work due to barriers like poor feasibility, efficacy or acceptability. There are current gaps between ideal and actual interventions in management among clinicians (24, 25). Poor self-management by patients and inadequate health care delivery due to clinician behaviour may contribute to inadequate control of these indicators (21,26). Changing patients' behaviour on healthy lifestyles may still remain a challenge. Achieving good quality of care for diabetic patients may involve some key areas that have been suggested in the Diabetes Foundation Report (23). These include preventive strategies – primary, secondary and tertiary, availability of diagnostic tools and infrastructure, drug procurement and supply, accessibility and affordability of medicines and care,

health care workers techniques to health care delivery, adherence to management strategies by patients, patient education and empowerment, community involvement and diabetes associations, and a positive policy environment (23). In view of the increasing prevalence, and health and economic implications in the management of patients with T2DM, it is important that effective strategies are implemented early. There are suggestions that the quality of diabetes care in Africa is suboptimal. However, there is unclear evidence to substantiate these claims (17). An insight into the extent of the disease burden is crucial for effective advocacy and action in this region. However, currently, there has been little effort to provide policy makers and health care providers with a systematic overview on the available evidence on the state of diabetes care in SSA (17). Consequently, there was the need to systematically assess the quality of care among patients with T2DM in existing studies with the objective of summarizing existing evidence, identifying the gaps and exploring the barriers to care in the SSA context. For example the IDF guidelines for type 2 diabetes reports that screening for T2DM has important implications for individual health and public health policy(27).While early detection and treatment of diabetes may minimize complications, there are no direct evidence as to whether or not this is beneficial to individuals. It was also documented that published national guidelines for management of type 2 diabetes come from relatively resource-rich countries and may be of limited practical use in less well-resourced countries like those in Africa.

Scoping of the literature showed that circumscribing the systematic review to a single research question and to a more specific region or type of setting may yield a very limited number of studies, thus rendering the systematic review implausible. Consequently, we set out to address more than one interrelated question on diabetes care. The aim of the review was to examine the existing quality of management of type 2 diabetes in SSA by addressing the following questions:

- How good is the current control of type 2 DM in SSA based on indicator outcome of glycaemia?
- Have implemented strategies, treatment or interventions improved control of type 2 DM in Sub-Saharan African countries?

METHODOLOGY

This study is a systematic review of quantitative research upon T2DM in SSA. A systematic review protocol was developed based on the PRISMA reporting guidelines (28). Being a systematic review with no primary data collection, ethical approval was not required.

Study Selection

Inclusion: The population comprised people with T2DM in SSA. All ages, gender, ethnicities irrespective of race, residence, locality, immigration status, educational background and socio-economic status were included. Cross-sectional studies, quasi-experimental studies, experimental studies, observational studies and reviews were included. All studies including glycaemia, blood glucose and/or blood sugar control as outcome indicators were included. Papers were limited to those in English. Only full papers as opposed to abstracts were included.

Exclusion: Case reports were excluded since these, in most cases may not be representative of the target populations under study. For pragmatic purposes, conference proceedings and editorials were excluded. Papers that did not fit the inclusion criteria upon consultation of their titles and abstracts were excluded. Studies presenting data that was only partially available was excluded.

Outcome Measures: The primary outcome measure was blood glucose levelsto assess control. The process measures were the frequency of documentation of glucose. Other secondary outcome measures considered included patients screened for diabetes and its complications such as retinopathies and foot abnormalities, monitoring of renal and cardiovascular events and patients educated on the management and prevention of complications. Those taking or administered medications including oral hypoglycaemics and Insulin were also considered.

Information sources and search strategy: Two databases were explored - MEDLINE and EMBASE since both are large medical and biomedical databases relevant to the review topic. To enable an extensive search of relevant literature in database to the period of the review, the search in Medline contained articles from 1946 to February 2013 while that from Embase contained articles from 1974 to April 2013. The search was based on population, indicators, comparators and outcomes (PICO) in relation to the review questions. It was carried out using terms from PICO deconstruction of the review questions. The search was carried out by two reviewers. Search strategy developed in one search database (Medline via PubMed) was adapted for a second database (Embase via Ovid) and refined due to possible differences in database MeSH headings or dictionaries. The reference lists of the database-derived papers were searched for relevant studies. Relevant papers were also obtained from an expert on the research topic. The study titles and available abstracts were first reviewed and assessed against the inclusion criteria to determine eligibility before being completely screened. Two reviewers independently assessed papers for eligibility. Figure 1 shows the flow chart of number of papers identified and screened to those considered eligible and included for review.

Data Extraction and Quality Assessment

The data was extracted from each study based on 1) study type 2) participant characteristics, 3) country and setting (tertiary, secondary or primary hospital), 4) interventions and implementation strategies assessed, prevalence of complications amongst undiagnosed and newly diagnosed T2DM patients or data collected on these 5) outcomes measures. Tables 1 and 2. Data extraction included that of summary statistics within papers. Tables were modified based on the nature of available evidence. Study quality was assessed based on the strength of evidence from a combination of components in a quality assessment tool from the Effective Public Health Practice Project – EPHPP (29, 30).However, this tool had its limitations considering the type of studies included in the review. For example, it was difficult assessing blinding techniques and withdrawal to follow-up in cross-sectional studies. Quality assessment was used to help interpret and explain differences in results across studies.

Data Synthesis: A narrative synthesis was used in summarising and explaining findings.

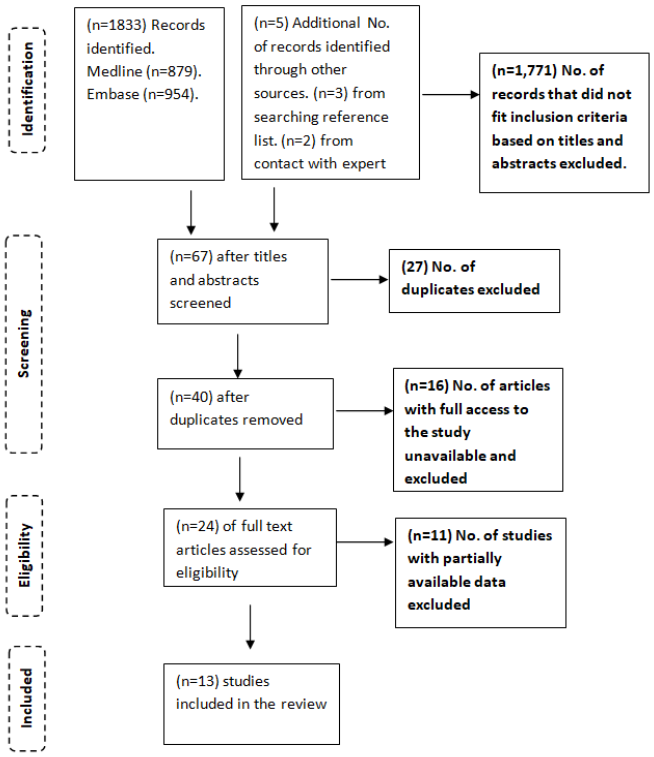

Figure 1. Flow chart of study selection process

Extracted data was systematically grouped and summarised into the types of study and clinical outcomes based on glycaemic control.

RESULTS

Types and characteristics of studies: Table 4 shows the types and characteristics of studies. Thirteen studies were considered eligible and included in the review (Figure 1). Eleven of the 13 papers reviewed were solely cross-sectional studies (31-41). One study combined a cross-sectional and a cohort observational study (42). Another study was solely a cohort (prospective) study (43). The cross-sectional/Cohort study was accepted for publication in 1999. The cohort study was received for publication in 2010. One cross-sectional study was received in 2008 while the others were carried out from 2002 onwards. One study (40) was carried out with patients from six countries representing the west, central, eastern and southern parts of sub-Saharan Africa. The other studies were undertaken in Ethiopia (31), Cameroun (34), Nigeria (32-41), Eritrea (37) and South Africa (38-43). There were no studies on primary preventive measures or screening studies. Studies describing mainly secondary preventive measures of T2DM were available for selection. Except for three studies, all were carried out in tertiary hospitals or medical centres. Two studies took place in primary health centres while one study was at specialized clinics. Varying methods involving retrospective review of patients' records, data collection and assessment during the study to prospective methods were used across the studies. One cross-sectional study was comparative (41). Populations specifically included type 2 diabetic patients in some studies while other studies consisted of mixed diabetic populations that were predominantly type 2 diabetics. The sample size of the studies was within the range of 62 (38) to 2352 (40). While some studies predominantly consisted of males, other studies had more female patients.

The average age within studies varied between 48years to 56 years with age ranges also varying. In the Cross-sectional/ Observational Cohort study (42), the main outcome measure was glycaemic control based on HbA1c level. The main intervention was diabetes education. In the Prospective Cohort study (43), the outcome measures were blood glucose control based on HbA1c and changes in body mass index (BMI). The interventions included diabetes education, lifestyle modifications and the use of oral hypoglycaemic drugs. A clinical algorithm was used to carry these out. Across the cross sectional studies (31-41), data on interventions and implementation strategies were collected using questionnaires, interviews or review of records. Data on education on diabetes seemed to be the most consistent, followed by drug treatment with oral hypoglycaemic agents and Insulin, then dietary measures. Patient self-monitoring, the use of treatment algorithms, review of charts, clinic visits and laboratory assessments were some of the strategies implemented for diabetes control. The mean duration of diabetes, degree of adherence to therapeutic measures, diabetic complications (e.g retinopathies, neuropathies) and cardiovascular risk factors (such as frequency of cigarette smoking) were secondary outcome measures assessed. The studies generally did not consider clinical guidelines. To assess diabetes control, reference values of indicator outcomes were based on the ADA and IDF guidelines.

Glycaemic Control: Identified studies for glycaemic control are summarised in the Table below:

The frequency of documentation of glycaemic levels as process measures was investigated in one study (31) within one year. All the papers reviewed identified clinical outcomes of glycaemic level measured as HbA1c, fasting blood glucose (FBG) or post prandial blood glucose (PPG) either as single measures or in combination with each other. Seven studies considered HbA1c, eight FBG and three PPG. Target levels of HbA1c were generally less than 7% in almost all the studies. Good and acceptable glycaemic control was nearly all the time referred to <7% HbA1c. The mean HbA1c levels ranged from 7.5% (43) to 9.6% (42) across studies. FBG target levels were generally less than 7.2 mmol/L. Values above this were often suggestive of poor control. Except for one study (35) with mean FBG level of 5.4mmol/L, the mean FBG levels ranged from 8.1mmol/L (33) to 10.5mmol/L (36). The mean PPG levels were between 7.9mmol/L (35) to 10.7mmol/L (40). No study reported target levels based on PPG. Target glycaemic control were consistently seen to be less than 50% of the patients except in one study (33) were the target FBG level was achieved in 52.6% of patients. However, in the same study, target HbA1c level was found in only 32.4% of the study population. Examples of percentage populations with achieved HbA1c levels (<7%) include 40% (34) and 20.1% (42). Twenty nine percent of patients had target HbA1c level of less than 6.5% in one study. All but three studies were carried out at tertiary institutions. Two were from primary health centres and one had specialized clinics as the study setting.

DISCUSSION

The quality of care of type 2 diabetes in sub-Saharan Africa based on glycaemic control indicator was found to be suboptimal in this review.

Table 1. Summary of Type of Study Design and Interventions or data collected

Ref/Date of Study	Type of Study	Country	Sample Size	Population Characteristics	Intervention/ Implementation strategies/ Data collected	Outcomes Observed/ documented	Main Outcome(s)	Study Limitation
1.Gudina *et al*/2009	Cross-sectional	Ethiopia	329	-M:F = 1.46:1 Mean (SD) = 48.4 (15.1) -TH	-Diabetes health education -Review of charts for treatment of diabetes/hypertension and causes of admission -Drug treatment (OGLA: Glibenclamide, Insulin, Herbal for DM and ACE for HTN)	-follow-up visits -Mean duration of DM -Assessment of Diabetes related complications -Clinical outcomes	FBG	- Poor chart keeping. -study design unable to assess chronic complications
2.Okafor/ Ofoegbu 2011	Cross-sectional	Nigeria	233	42.1% males attending diabetic clinic in a TH	Degree of adherence to therapeutic measures	-Duration of DM -Clinical outcomes	FBG	No consideration of effect of disease duration and duration of follow-up of patients. Use of higher therapeutic glycaemic goal (7.2mmol/L)
3.Chineye *et al*/2008	Cross-sectional	Nigeria	531 (95.4% T2DM)	39.4% Males, Multicentre study including 7 tertiary health centres	-Clinic visits and clinical assessment -Patient self-monitoring of glycaemia -Diabetes education received by patient -Use of medications -On the spot assessment of HbA1c -Clinic records of FBG and fasting serum lipids -Eye examination, lower limb examination. -cerebral stroke, neuropathy, myocardial infarction, renal failure	-Mean duration of DM -Frequency of clinic visits and assessment -Frequency of assessing glycaemic levels. -Adherence to dietary measures and exercise -Assessment of diabetic complications and cardiovascular risk factors	HbA1c, FPG, PPG	
4. Joseph *et al* 2009/10	Cross-sectional	Cameroun	205	Male=43.6%. Mean Age=57 Age Range= 29-85 Tertiary health centre	Regular chronic care with follow-up appointments	-Drug treatment rates -Mean duration of diagnosed diabetes -Assessment of cardiovascular risk factors and diabetic complications -Glycaemic, lipid and BP control	HbAIc	Selective non-random sample of participants that may not be representative of the population
5. Isezuo SA/2002	Cross-sectional	Nigeria	254	Males=154(60.6%) Outpatients and Inpatients in a TH	Laboratory assessment of components of the metabolic syndrome	Metabolic syndrome-Blood glucose, Dyslipidemia, hypertension, obesity, microalbuminuria, hyperuricaemia	FBG	Data collection methods not clearly stated
6.Christopher OA.	Cross-sectional	Nigeria	218	Males=58.7% Mean Age=52±5.8yrs. Range=36-62yrs	-Use of medications including oral hypoglycaemics and insulin -Dietary measures -Obesity, Dyslipidemia, HTN,	Duration of diabetes. Drug therapy. BMI, HTN, Dyslipidemia, Microalbuminuria	BP, HDL-C, TG	Statistical methods not clear
7.Erasmus *et al*	Cross-sectional +Cohort Observational	South Africa	-708 -281	Age=56.3±0.44 yrs	-Diabetes education -Drugh therapy, Insulin and non-insulin	-Duration of diabetes -Glycemic control -Obesity	HbA1c	

Continue ….

8. Berhane *et al*	Cross-sectional	Eritrea	429	Age=57.4±11.8	-Dietary treatment -Medications, tablets or Insulin	-Assessment of complications -HTN, -Glycaemic control -Lipid levels	HbA1c	Poor standardized HbA1c levels with irregularities in percentages
9.Vezi/Naido 2002/03	Cross-sectional	South Africa	62	Age (Range) in years Males:49 (34-72) Females:50(33-69)	-Routine clinical examination and follow-up viits	-Assessment of liver, renal and thyroid function tests, -Glycaemic, hypertensive and lipid levels -Obesity	HbA1c	-Methodology not clear
10. Marloes *et al* 2005	Cross-sectional	South Africa	247		-Review of medical records -Diabetes education -Medical treatment, diet, OHAs, Insulin -Regular visits	-Duration of diabetes -Assessment of cardiovascular risk factors and diabetes complications -Glycaemic and hypertensive levels	FBG	Potential for non-standardization of Instruments (ie questionnaire) used and non standard measurement of reported outcome
11.Isezuo *et al*, 2003	Cross-sectional	Nigeria	120		Oral hypoglycaemic medications	-Duration of diabetes and HTN -Glycaemic, hypertensive and lipid levels -Obesity	Differences in clinical outcome (ie FBG) between groups	Unclear sampling method. Poorly discussed population characteristics
12.Price *et al*	Cohort	South Africa	80	Mean Age (SD) = 56±11	Treatment algorithm including Lifestyle modification, education and medications-OHAs, metformin and glibenclamide	-Duration of diabetes -Glycaemic levels -Obesity	HbA1c	No quantitative data reflecting changes in dosing of oral hypoglycaemic drugs.
13. Sobngwi *et al*	Cross-sectional Multi centric	Tanzania, Kenya, Cameroun Ghana, Senegal, Nigeria	2352	Adult population registered for management of DM Mean age=53.0±16.0	-Access to HbA1c measurement -Awareness of HbA1c. -Medications including OADs and Insulin. -Treatment for hyperlipidaemia especially with Statins -Treatment of hypertension	-Duration of diabetes -Assessment of Cardiovascular risk factors and diabetes complications -Clinical outcomes	FBG, HbA1c	Lack of standardization of biological measurement except for HbA1c. Study was limited to best level of care.

Table 2. Summary of Glycaemic Control:

Ref/dates of study	Setting	Country	Sample size	Population characteristics			Outcomes and results					
				% male	Age (Years)		Glycaemic control indicators			Process outcomes (frequency of documentation)		
					Mean (SD)	Range	HbA1c levels (%) Mean (SD)	FBG levels (mmol/l) Mean (SD)	Post-prandial glucose levels (mmol/l) Mean (SD)	HbA1c Levels (%)	FBG Level (mmol/)	Post-prandial glucose levels (mmol/l)
1.Gudina *et al* 2009	TH	Ethiopia	329	M:F 1.46:1	48.4 (15.1)	15-82		>7.2=67% 9.5(3.5)			98.5%	
2.Okafor/Ofoegbu, 2011	TH	Nigeria	233	42.1				10.3(5.4) >7.2=65.7%				
3.Chineye *et al*, 2008	TH	Nigeria	531	39.4	57.1 (12.3)		8.3(2.2) <7=32.4% <6.5=20.4%	8.1(3.9) ≤7.2=52.6% <6=33.9%	10.6(4.6)	49.5%	98.5%	58.4%
4.Joseph *et al*, 2009/10	TH	Cameroun	205	43.6	57	29-85	7.9(2.2) <7=40%					
5.Christopher OA, 1999-2001	TH	Nigeria	218	58.7	52(5.8)	36-62		5.4(1.2)	7.9(0.3)			
6. Isezuo SA, 2002	TH	Nigeria	254	60.6				10.5(5.4)				
7.Erasmus *et al*-Accepted 1999	TH	South Africa	708-Cross-sectional. 281-Cohort		56.3 (0.44)		9.6(0.1) <7=20.1% 7.1-0.9= 50.5% ≥11=29.4% Cohort: <7 Start: 18.9% End:19.9%					
8.Berhane *et al*-Received 2008	TH	Eritrea	429		57.4	11.8	<6.1=7.0% 6.1-6.9= 5.7% 7.0-7.9= 16.1% 8.0-9.5= 34.3% >9.6=64.1%					
9.Vezi/Naidoo 2002-2003	TH	South Africa	62		M-49 F-50	34-72 33-69	Males=9.8 Females: =11.3					
10.Marloes *et al* 2005	PHC	South Africa	247		58.2 (10.9)	30-85		<7= 17.6% 7.0-8.0= 9.8%				
11.Isezuo *et al* 2003	TH	Nigeria	120					11.1(3.1)-Normotensives 10.3(3.2) Hypertensives				
12.Price *et al* Received 2010	PHC	South Africa	80		56 (11)		Month: 0/10.8(4.0) 6/8.1(2.2) 18/7.5(2.0) 24/8.4(2.3) 48/9.7(4.0)					
13.Sobngwi *et al* 2008	Specialized Clinics	Tanzania Kenya Cameroon Ghana Senegal Nigeria	2352				8.2(2.4) <6.5=29%	8.3(3.9)	10.7(4.7)			

This is in view of the fact that within studies, less than 50% of patients met the targets for these clinical outcome. Although studies were carried out more in tertiary health centres than primary health centres, from the studies, it may be inferred that glycaemic control were better achieved in the tertiary centres. Most of the studies were cross-sectional studies, were sometimes difficult to interpret and were assessed to be of moderate to low quality mainly due to methodological discrepancies and poor reporting. Although multiple interventions and implementation strategies were documented in settings where healthcare was mainly developing, these may have still improved clinical outcomes. Due to the differences in genetic make-up, study settings, health care facilities, disparities in the interventions and implementation strategies, clinical guidelines for management and target levels, it is unlikely that interventions would be equally effective across the regions studied. In addition, baseline measures were unlikely to be equal and may have been impacted by other diseases of high prevalence within these regions. Similar findings on interventions, process and clinical outcomes have been reported in studies elsewhere. For example, a treatment algorithm which had been previously validated was used by Price *et al* (43) in this review. This is in keeping with many national guidelines that include treatment algorithms, which are based on available evidence and local availability and prescribing regulations (44).The IDF updated guideline includes a generic algorithm which is intended for adaptation by countries for local use (44).

Oral hypoglycemics such as glibenclamide and metformin as well as Insulin were commonly used in some of the reviewed studies (33,35,37,39,41,42). Regular clinic visits, patient self-monitoring and clinic records and charts, although inconsistent in this review may be effective measures implored in developed societies and poor utilisation of these interventions may have effectively contributed to the suboptimal clinical outcomes seen in this study. Clinical outcomes documented in this review were similar to the review done in the Co-operation council for the Arab States of the Gulf (45). However, the main clinical outcome of glycaemic levels were generally lower when compared to some reports from studies from the UK (46-48), USA (49,50) and Australia (51). It is of note that these countries operate systems with higher levels of care and some of the clinical outcomes of this review met the upper limits of the UK Quality and Outcomes Framework targets. These include HbA1c levels of 8% (52). Process outcomes were probably more frequently documented in other countries than the studies in this review. Mean duration of diabetes, and assessment of cardiovascular risk factors and diabetic complications are process measures and outcomes also obtainable in developed societies (46,49).

Although this study did not actively seek barriers to improved care in these regions, it may suffice here to say that the suboptimal indicator levels seen in this review may have, to a large extent, been contributed by these barriers. From the studies, these would include poor adherence to therapeutic measures, poor health seeking behaviours, poor affordability and accessibility of quality health care services, lack of effective use of medications and health care facilities, and difficulties making lifestyle changes. These are mainly patients' related factors. From the reviewed studies, clinician factors would include poor registration of patients, poor chart keeping, poor emphasis on diabetes education and oversight in testing or managing risk factors.

However, compared to other reviews on interventions and barriers to diabetes management (53), patients' and clinicians' attitudes and beliefs, cultural factors and organisational factors were not explicitly stated. The heterogeneity of the reviewed studies was a major limitation. The populations varied and there were disparities in outcome measures. Different study settings were used with varying health care systems. The absence of a universally accepted definition of high quality care and diabetes care in particular as well as the diversity in diabetes care programmes prevented meaningful comparisons to be made. The critical appraisal of complex interventions was difficult and building on evidence was limited. Only few sub-Saharan countries were included in the review. Most of the clinical outcomes were of varied definitions with no standardisation. Primary prevention programmes were generally not included in the reviewed studies. A large number of the studies reviewed were cross-sectional studies and they were of moderate to low quality. There were mostly methodological discrepancies. However, no study was excluded based on difficulty assessing quality. There was a relatively low number of papers returned by the different searches from each database and consequently fewer papers eligible for review.

CONCLUSION

This review found the quality of care of type 2 diabetes based on glycaemic control to be sub-optimal in sub-Saharan African countries. Therefore, quality of care needs to be improved upon in this region. High quality studies were not identified in the study and this may have impaired quality assessmentof the studies. Better quality of research in this region would therefore be necessary if future research needs to be of relatively high standard. This study noted several interventions, mainly secondary preventive strategies that may improve quality of care in this region. It is likely that the implementation strategies identified in this review could contribute effectively in improving quality of care. Other forms of interventions like primary preventive strategies can be useful and may need to be investigated. Targeted interventions and strategies specific to the local populace would be beneficial. Barriers to good diabetes management should also be taken into consideration when looking at factors impeding quality of care. It would be important to consider the interventions and implementation strategies reviewed in the various health care systems in this region to improve quality of care. National, regional and international organisations involved in diabetes care and setting guidelines could aim at standardizing process and clinical outcomes that would be useful in making comparisons and quality of care auditing.

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