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Obesity and Type 2 Diabetes in Sub-Sahara Africa

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Abstract There is a mounting body of evidence regarding the challenge posed by diabetes and obesity on the health systems of many Sub-Sahara African countries. This trend has been linked to the changing demographic profile together with rapid urbanization and changing lifestyles in both rural and urban settings in Africa. Africa is expected to witness the greatest increase in the number of people with diabetes from 19.8 million in 2013 to 41.4 million in 2035 if current trends persist. Excess weight alone currently accounts for at least 2.8 million deaths globally each year through increased risk for type 2 diabetes and cardiovascular complications. This review highlights recent literature on the problem of obesity and type 2 diabetes in Sub-Sahara Africa. It exposes the need for concrete interventions based on the now available wealth of evidence.

Keywords Sub-Sahara Africa · Type 2 diabetes mellitus · Epidemiology · Obesity · Complications · Risk factors · Complications · Quality of life

Introduction

Until recently, popular belief was that the main threats to the health of Africans were related to malnutrition and infectious disease such as malaria, tuberculosis, and HIV/AIDS [1–3]. This is no longer the case as there is increasing evidence and awareness that the health systems of these countries now have to deal with the additional challenge posed by the high and rising burden of noncommunicable diseases (NCDs) such as diabetes as well as their main drivers amongst which is obesity [4••]. This new trend has been linked to the changing demographic profile together with rapid urbanization and changing lifestyles in both rural and urban settings in Africa [5]. Data published in 2013 by the International Diabetes Federation (IDF) indicate a global diabetes prevalence of 8.3 % (382 million people) with an expected 55 % increase (to 592 million people) by 2035 if current trends persist. Africa is expected to witness the greatest increase, rising from 19.8 million people with diabetes in 2013 to 41.4 million in 2035 [4••]. This trend has been observed to be rising simultaneously with overweight and obesity. At present, excess weight alone accounts for at least 2.8 million deaths globally each year through increased risk for type 2 diabetes and cardiovascular complications [6]. This review paper explores recent literature on the problem of obesity and type 2 diabetes in Sub-Sahara Africa.

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Diabetes in Africa

Diabetes is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both [7]. It could either be Type 1, Type 2, gestational or present in other atypical forms (tropical and ketosis-prone) [8]. Type 2 diabetes is related to a number of modifiable as well as nonmodifiable risk factors. It can remain undiagnosed for many years and lead to several life-threatening complications. This is a major issue of concern in Sub-Sahara Africa (SSA) where up to 90 % of undiagnosed prevalent diabetes have been reported for some

countries [4••, 9]. Type 2 diabetes makes up over 90 %–95 % of all cases of diabetes in Low and Middle Income Countries (LMICs) [10]. Current knowledge has established the development of type 2 diabetes to be significantly associated with obesity, poor diet, physical inactivity, advancing age, family history of diabetes, ethnicity, and high blood glucose during pregnancy [4••].

In SSA, diabetes risk in offspring of people living with type 2 diabetes has been investigated in a Nigerian study [11] involving 52 cases and 50 controls. Cases were hyperinsulinemic despite being glucose tolerant, suggesting greater risk for future type 2 diabetes.

Diagnosis and Screening of Diabetes

The diagnosis of Diabetes usually involves symptoms of diabetes plus either casual plasma glucose concentration ≥200 mg/dl (11.1 mmol/l), a fasting Plasma Glucose ≥126 mg/dl (7.0 mmol/l), or a 2-hour postload glucose ≥200 mg/dl (11.1 mmol/l) during an Oral Glucose Tolerance Test (OGTT) conducted as per WHO recommendations using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water [12]. In 2010, a WHO expert committee further adopted cut-off points for using glycated hemoglobin (HbA1c) in the diagnosis of diabetes. It concluded that HbA1c can be used as a diagnostic test for diabetes providing that stringent quality assurance tests are in place and assays are standardized to criteria aligned to the international reference values, and there are no conditions present which preclude its accurate measurement. An HbA1c of 6.5 % was therefore recommended as the cutpoint for diagnosing diabetes though a value less than 6.5 % does not exclude diabetes diagnosed using glucose tests [13]. The practicality of using HbA1c for diabetes diagnosis in Africa still faces challenges; particularly the high cost of the test vis-à-vis blood glucose measurements, and also the high prevalence of hemoglobinopathies such as sickle cell anemia. However, because the OGTT is much more demanding in terms of time and logistics, HbA1c offers real hope for widespread use in both clinical and research settings even in remote areas of the continent.

Screening for diabetes presents a unique opportunity for early treatment thereby preventing the onset of complications. However, such a measure would be more beneficial only in identified high-risk groups. Mass screening such as has been done in the fight against other conditions such as HIV/AIDS [4••] may not be feasible and/or cost effective in the case of diabetes. The identification of high-risk groups for diabetes screening interventions would have to be based on SSA-specific data because these groups may not be identical across different populations. A recent study from Nigerian [14•], reported type 2 diabetes in an overweight 9-year-old child with a family history of diabetes. This may open the discussion about screening for type 2 diabetes in obese children in SSA. Obesity in children in SSA, especially in urban areas is becoming a common problem.

Epidemiology of Diabetes

Diabetes is slowly beginning to receive considerable attention as a public health issue in Africa especially following its recognition as a challenge to global health requiring concerted action [15]. An increasing number of studies (though still limited) have been carried out in Africa to quantify the burden of this pandemic and provide data to inform relevant policies for preventive and therapeutic efforts. Type 2 diabetes incidence and prevalence in many parts of Africa have been shown to be on the rise [14•, 16, 17]. The highest prevalence rates have been reported for the island of Réunion (15.4 %), followed by Seychelles (12.1 %), Gabon (10.7 %), and Zimbabwe (9.7 %). However, more than one-half of all the people living with diabetes in Africa come from only 4 countries, mainly because of their large population sizes: Nigeria (3.9 million); South Africa (2.6 million); Ethiopia (1.9 million); and United Republic of Tanzania (1.7 million) [4••].

In 2013, 8.6 % of all deaths were attributable to diabetes and of this proportion, up to 76.4 % occurred in people younger than 60 years. This is contrary to the previously held belief that diabetes was a disease of the old and also raises the need for screening to target all segments of the population. Women appear to bear a greater burden, as in 2013 there were 50 % more deaths from diabetes in women compared with men. Currently, there are growing concerns about the diabetes burden in indigenous populations because these populations may be experiencing a very rapid lifestyle transition. Active subsistence lifestyle is rapidly giving way to sedentary "western" lifestyles. The Mbororo community in Cameroon, once nomadic cattle herders, has been compelled to settle down to farming as a result of deforestation and urbanization. Indigenous populations are generally neglected in terms of healthcare and research; therefore, data about these populations are very scanty. A study from South Africa reported a diabetes prevalence of about 5 % among the QwaQwa people [18]. There is currently an increasing global awareness of the vulnerability of indigenous peoples as a result of socioeconomic disadvantage, limited access to care, and marginalization from the majority of the population [19].

Risk Factors

Studies from Africa, similar to other populations, show the contribution of all the classical risk factor for type 2 diabetes. Several of these studies report family history [16, 20], ethnicity [21, 22], poor diet [23–25], physical inactivity [20, 23, 24],

obesity [20, 23, 24, 26, 27], age [20, 24, 26], rural/urban residence [24, 28], social inequalities [24], cigarette smoking [24], and alcohol intake [24] as risk factors for type 2 diabetes in Africans.

Complications

There is a paucity of recent data on diabetes complications in Sub-Saharan Africa. Studies conducted elsewhere [29–31] have reported complications even in people with undiagnosed prevalent diabetes. The scenario should be no different for Africa. Diabetes complications cause damage to the eyes, kidneys, feet, and heart, and can lead to early death if left untreated. Diabetic ketoacidosis, hyperosmolar nonketotic coma, and hypoglycemia are reported as being the 3 main metabolic complications of diabetes in SSA [32].

Chronic complications include retinopathy, nephropathy, neuropathy, cardiovascular disease, foot ulceration, and amputation. Cardiovascular diseases (eg, angina, myocardial infarction, stroke, peripheral artery disease, and congestive heart failure) remain the most common cause of death and disability among people living with diabetes.

Foot care for people with diabetes has not been given sufficient attention in many healthcare systems in Africa. Only a few studies have examined this aspect of diabetes complication despite the fact that people with diabetes face up to a 25 times greater risk of amputation [33]. Kengne et al. [34] examined records from 1841 patients hospitalized at the diabetes and endocrine unit of the Yaoundé Central Hospital between 2000 and 2007. They reported a 13 % prevalence of foot ulceration and an amputation rate of 16 %.

A study conducted in Nigeria [35•] reported the following prevalence of diabetes complications: retinopathy (19.6 %), neuropathy (15.7 %), diabetic foot syndrome (11.8 %), stroke (9.8 %), Erectile dysfunction and nephropathy together constitute 5.9 %. Lester [36] examined the clinical status of 121 Ethiopians living with diabetes for over 20 years following diagnosis of diabetes and found: neuropathy (36.4 %), nephropathy (29.8 %), and retinopathy (45.5 %). Sobngwi et al. [37] studied a group of 64 people living with diabetes in Cameroon and reported a 37.5 % and a 53.1 % prevalence of retinopathy and microalbuminuria, respectively.

Obesity in Africa

Obesity results from an imbalance in energy intake vs expenditure leading to an accumulation of excess fat with negative effects on health. It is routinely estimated as a ratio of body weight to height, or body mass index (body weight in kilograms/square of height in meters) wherein values ≥ 30 kg/m^2 indicate obesity. The current nutrition transition in Africa characterized by greater consumption of diets rich in refined sugars and saturated fats is contributing to the rising prevalence of overweight and obesity [38••].

In many parts of Africa, being overweight or obese is usually viewed as desirable rather than a health concern. In a study among Kenyan slum residents [39•], more than one-half of them underestimated their weights and over one-third of women and men reported preference for body sizes that would otherwise be classified as overweight or obese.

Epidemiology of Obesity in Africa

Recent findings are unanimous on the rising trends of obesity in countries of SSA and this has been attributed to the ongoing nutrition transition [40, 41••]. South Africa currently has the highest prevalence of obesity in SSA with a prevalence of up to 31.8 % in Black women [42].

Using the WHO STEPwise approach to chronic disease risk factor surveillance, 21.9 % of Malawians aged 25–64 years were found to be overweight (BMI >24.9) with women being significantly fatter than their male counterparts (28.1 % vs 16.1 %) [43]. Using the same approach, Okpechi et al. [44] found a prevalence of overweight or obesity of 33.7 % in a population-based cross-section study in Abia State, Nigeria. In a study conducted among 4934 slum residents in Kenya, Ettarh et al. [39•] found that 43.4 % of women and 17.3 % of men in the study population were overweight or obese.

Determinants of Obesity in Africa

The current nutrition transition has been emphasized as the major driver of the current obesity epidemic in SSA [41••]. This does not, however, exclude the role of urbanization and declining physical activity levels which are occurring simultaneously. African populations have traditionally been associated with higher levels of occupational (eg, farm work)- and transportation (mainly trekking)-related physical activity, with relatively low levels of leisure time activity or sedentary behavior. However, over about the past 2 decades, with rapid urbanization and "westernization" of lifestyles, African cities have witnessed a marked proliferation of motorized transportation. A prominent example is the widespread use of motor cycles for transportation. Use of motorcycles for urban transportation is widespread and engrained in SSA communities so much such that this activity has been attributed local names in different communities. It is referred to as "bendskin" in Cameroon, "Boda-Bodas" in Uganda and Kenya, "Okada" in Nigeria, PiiPii in Liberia, Zémidjan in Benin, "Kabu-kabu" in Niger, "Vélo-taxi" in Senegal, "Oléyia" in Togo [45]. This, together with the transition to sedentary occupations is contributing to lower activity levels across the entire population,

to a greater extent in urban compared with the rural communities. In Cameroon, Assah et al. [46] found that urban dwellers had a significantly lower physical activity energy expenditure level compared with rural dwellers (44.2±21.0 vs 59.6±23.7 kJ/kg/day, $P<0.001$). They also found a higher prevalence of the metabolic syndrome in urban the population (17.7 % vs 3.5 %, $P<0.001$). However, it is not yet clear how much exposure in terms of dose and/or duration is required for significant modifications to occur [37].

Obesity and Diabetes in Africa

The Pathogenic Relationship

Published studies indicate a simultaneous rise in overweight/obesity and diabetes prevalence in most SSA countries [47] (Fig. 1). Most people with diabetes are obese at the time of diagnosis [12]. Studies conducted in African countries have reported a significant association between type 2 diabetes and obesity (Ghana [48, 49], Togo [16], Rwanda [50], South Africa [51], and Nigeria [52]). Many studies of people living with diabetes in Africa have consistently reported excess body weight in >50 % of studied samples. However, there is lack of agreement regarding which of the anthropometric variables used to measure obesity can best predict the development of diabetes. One case–control study conducted in a Ghanaian sample [49] suggests that measures of central rather than general obesity appear to be significantly related to type 2 diabetes in Africans. There are little or no longitudinal studies with hard endpoints data in Africans that can shed more light on predictive value of these different measures of obesity. This means that there are no African-specific cut-points for estimating obesity risk, hence, the continued use of Caucasian cutpoints for Africans. Further research is needed to establish cutpoints based on African data.

Socio-Economic Burden

The rise in diabetes-related complications have both human and economic costs [4••]. Up to 90 % of diabetes cases remain undiagnosed in some sub-Saharan Countries where resources are often lacking and the healthcare policy may not prioritize screening for the condition [53]. In addition, the interaction between diabetes and major infectious diseases has a large impact on public health within developing countries. This is the case in Sub-Saharan Africa where 33 out of the 40 (82 %) of the world's most heavily indebted poor countries are situated [54]. This situation has adversely affected progress toward the Millennium Development Goals (MDGs) [55••, 56, 57]. The burden of noncommunicable diseases in Africa is already proportionately greater than that in Western countries [58]. Diabetes mainly affects the productive age-group implying that its socioeconomic consequences and complications could possibly bankrupt the economies of many developing nations including countries in SSA [59]. There is a considerable difference in diabetes-related spending between high- and low and middle income countries. On average, the estimated health spending because of diabetes in 2013 was USD 5621 per person with diabetes in high-income countries, compared with USD 356 in low- and middle-income countries (including Africa). Even so, many countries are far below this average for SSA countries (Table 1). Despite the growing number of people living with diabetes, diabetes care-related expenditure for 2013 was least for Sub-Saharan Africa with only USD 4 Billion, making up less than 1 % of the global total even when added to that of South East Asia [4••]. Table 1 presents the mean diabetes related expenditure and per capita GDP for selected SSA countries. The amount spent on diabetes care appears to be directly proportional to GDP per capita.

Diabetes-related costs mainly include greater use of health services, productivity loss and disability, which can be a considerable burden to the individual, families and society. The financial burden is largely linked to the fact that out-of-pocket payments often have to be made for healthcare costs as there are hardly any insurance schemes available.

Quality of Life

Findings in the published literature regarding the quality of life of people with type 2 diabetes in SSA are varied. Oguntibeju et al. [52] reported a fair quality of life (mean score of 31.85±7.98 out of a total score of 75) in 100 persons living with diabetes in Nigeria. Another study still from Nigeria [35•] involving 102 people with diabetes reported a poor quality of life with a high prevalence of psychopathologies largely because of the presence of complications and co-morbidities. Improving care would have a positive impact on the quality of life of people living with diabetes.

Management Challenges and Opportunities

Limited financial resources amongst other factors constitutes a major barrier to adequate diabetes care delivery in Africa [61]. Maintaining blood glucose levels, blood pressure and cholesterol close to normal can help delay or prevent diabetes complications.

A major issue of public health concern is the worsening of the obesity pandemic. Obesity is now officially considered as a disease elsewhere but this is not so in many parts of Africa where being overweight or obese is still considered a sign of well-being. Whether or not an obesity perception change from "normal" to "pathologic" would motivate healthy weight maintenance, is yet to be verified in Africa. It is, however, clear that awareness of excess weight and its role in raising

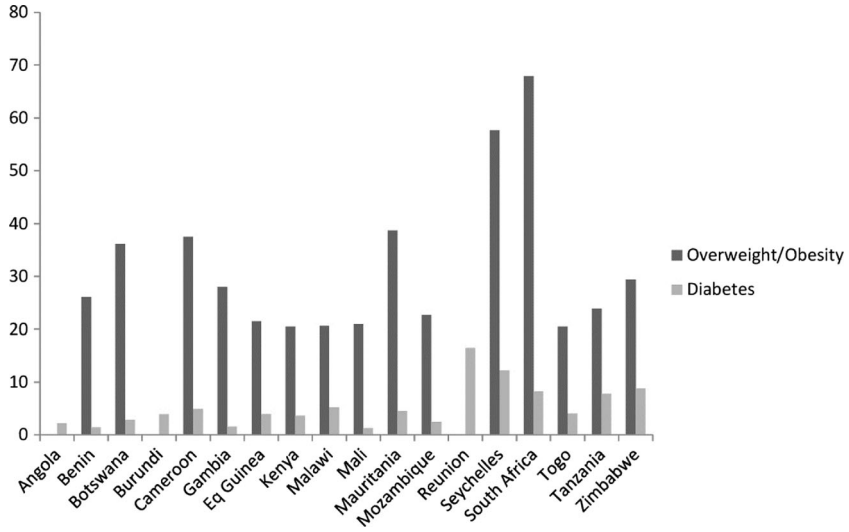

Fig. 1 Comparison of overweight/obesity and diabetes prevalence in SSA

diabetes risk is limited in this population, thus, presents a potentially beneficial avenue for public health intervention.

Many patients in SSA lack access to the medicines, technologies, and good-quality care they need. Here, essential medicines for diabetes and other NCDs remain significantly less accessible than those for acute infectious diseases [62]. This is so despite the recognition that tackling the diabetes problem has to start from improving access to care and support for people living with diabetes.

Table 1 Mean diabetes related expenditure and per capita GDP in selected SSA countries

Country	Mean diabetes-related expenditure per person with diabetes (USD)	GDP per capita (Current International Dollar)
Angola	349	6006.3
Benin	66	1557.2
Botswana	678	16104.9
Burundi	41	551.3
Cameroon	116	2311.7
Gambia	50	1916.5
Equatorial Guinea	2009	29742.5
Kenya	61	1736.9
Malawi	54	753.4
Mali	84	1194.8
Mauritania	96	2560.9
Mozambique	64	1007.2
Seychelles	511	26728.6
South Africa	935	11254.8
Togo	74	1033.9
Tanzania	63	1574.8
Zimbabwe	54	-

Source: IDF Diabetes Atlas, 6th edition [4••] and World bank data [60]

In an attempt to contain the obesity epidemic, state-of-the-art technologies and procedures have been developed and are being used in other parts of the world. One of such is the Roux-en-Y gastric bypass surgical technique which has been shown to be quite beneficial in inducing significant and durable weight reduction in cases of morbid obesity [63–65]. However, its use in the African setting has been very limited largely because of its high financial cost.

The world is taking necessary steps to curb the problem of obesity and diabetes as their prevention was included as a target in the Global Action Plan for the prevention and Control of NCDs [66]. SSA would need to adopt policies and interventions that steer in that direction.

Prevention

Studies across the world has clearly demonstrated that weight loss, diet, and exercise can prevent or delay diabetes onset in people with impaired glucose regulation [67–69]. Increasing physical activity levels exert an independent effect on the prevention and control of diabetes [70]. These behavioral risk factors offer excellent opportunities for primary prevention public health interventions. In SSA, where resources to care for diabetes and its complications are limited, the value of cost-effective primary prevention interventions cannot be overestimated [71]. Education on healthy lifestyle should start from policy makers, employing a multi-sectorial approach that brings together different stakeholders who can in their respective fields contribute in the general fight for the control of diabetes and its risk factors.

Given the major role played by the nutrition transition, Vorster et al. [72•] have raised the need to steer this transition in a positive direction. They report that this would be feasible only if some basic principles in planning public health promotion strategies, policies and interventions are followed.

They equally raise the need for concerted action from African countries to study the nutrition transition as well as implement interventions on epidemiologic, clinical, and molecular (genetic) levels.

Opportunistic identification of people with risk factors for undiagnosed type 2 diabetes is feasible and cost-effective [73]. Early diagnosis and management would enable the prevention of potentially harmful and costly complications. The IDF [4••] has recommended and is heading a multi-sectorial all-of-society approach to diabetes prevention, care, and support in the post-2015 development agenda.

Conclusions

This paper has explored recent literature regarding obesity and type 2 diabetes in Sub-Sahara Africa. If current trends of these conditions persist in SSA, without significant efforts to address the challenges posed, then the future is not looking too hopeful. Lack of adequate financial resources because of the low incomes in many of these countries further aggravates the situation. However, simple cost effective measures such as healthier diets and regular exercise could significantly help control the problems of obesity and diabetes. There is an urgent need to consider health in all policies and promote all-of-government approaches to tackle these problems.

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Compliance with Ethics Guidelines

Conflict of Interest Jean Claude Mbanya, Emmanuella N. Atanga, and Jude Saji declare that they have no conflict of interest. Felix K. Assah reports personal fees from the government of Cameroon.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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