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REVIEW

Prevalence of diabetes in Zimbabwe: a systematic review with meta-analysis

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Abstract
Objective Diabetes appears to be a growing problem in the African region. This study aims to estimate the prevalence of diabetes in Zimbabwe by collating and analyzing previously published data.
Methods Systematic review and meta-analysis of data reporting prevalence of diabetes in Zimbabwe was conducted based on the random effects model. We searched for studies published between January 1960 and December 2013 using MEDLINE, EMBASE and Scopus and University of Zimbabwe electronic publication libraries. In the meta-analysis, sub-groups were created for studies conducted before 1980 and after 1980, to understand the potential effect of independence on prevalence.
Results Seven studies were included in the meta-analysis with a total of 29,514 study participants. The overall pooled prevalence of diabetes before 1980 was 0.44 % (95 % CI 0.0–1.9 %), after 1980 the pooled prevalence was 5.7 % (95 % CI 3.3–8.6 %).
Conclusions This study showed that the prevalence of diabetes in Zimbabwe has increased significantly over the past three decades. This poses serious challenges to the provision of care and prevention of disabling co-morbidities in an already disadvantaged healthcare setting.

Keywords Prevalence · Systematic review · Meta analysis · Diabetes mellitus · Zimbabwe

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Introduction

The number of people with diabetes is increasing and is now estimated to affect 285–350 million people worldwide (Danaei et al. 2011). The 2013 International Diabetes Federation (IDF) estimates suggest that globally 382 million people have diabetes, equating to a global prevalence of 8.3 % (International Diabetes Federation 2013). Diabetes constitutes one of the leading causes of death across the globe, accounting for 8.4 % of global all-cause mortality hence making it the 8th leading cause of death globally (International Diabetes Federation 2013). However, diabetes is unequally distributed across the globe and some regions are more affected than others depending on the type of diabetes. Of the 381.8 million people with diabetes globally, only 5.2 % (19.8 million) live in sub-Saharan Africa (SSA), making it the region with the smallest diabetes population when compared to other regions (International Diabetes Federation 2013). However, SSA has the highest proportion of undiagnosed diabetes, as it is estimated that a large majority (62 %) of the African diabetes population aged 20–79 years are undiagnosed

(International Diabetes Federation 2013), suggesting that the number of people living with diabetes may have been underestimated.

Diabetes is broadly classified into three main types, namely insulin-dependent diabetes mellitus (T1DM), non-insulin-dependent diabetes mellitus (T2DM) and gestational diabetes. Gestational diabetes and T1DM are less common than T2DM and account for less than 10 %. Gestational diabetes appears during pregnancy and 70 % of women who have had gestational diabetes will develop T2DM at some point in their life time (American Diabetes Association 2013). Although data on T1DM in SSA are scarce, the few available data suggest that the prevalence of T1DM varies from 0.04 to 0.95/1,000 (Beran et al. 2005), with an incidence varying from 1.5/100,000 in Tanzania to 10.1/100,000 per year in Sudan (Swai et al. 1990; Elamin et al. 1992)

Noninsulin-dependent diabetes mellitus accounts for 90–95 % of cases of diabetes, and is strongly associated with high blood pressure, high cholesterol, lack of physical activity and weight gain (Steyn and Damasceno 2006). There has been a significant increase in T2DM prevalence in low-income countries, including SSA, over the past few decades (Danaei et al. 2011). The regional prevalence of T2DM in the adult population of SSA is estimated to be 4.9 % (International Diabetes Federation 2013) and it projects it will increase to 5.3 % (41.4 million people) in 2035 (International Diabetes Federation 2013). This estimate may in fact underestimate the burden of T2DM in SSA as a large majority (62 %) of the sub-Saharan African diabetes population aged 20–79 years will remain undiagnosed (International Diabetes Federation 2013). Additionally, the age of onset of T2DM diabetes appears to be decreasing in SSA (Alberti et al. 2007), with peak occurrence between the ages of 20 and 44 years, 40 years lower than the peak age of occurrence in high-income countries (Lopez et al. 2006).

The increased prevalence in diabetes, in particular T2DM, is thought to be due to rapid urbanization, industrialisation and changing diets that marginalize traditional foods in favor of Western diets, and are associated with decreased physical activity and increasingly sedentary lifestyles (Gill et al. 2009; Hjelm et al. 2003; Hjelm and Mufunda 2010). There are wide variations in the distribution of prevalence of diabetes mellitus by gender, with studies in Cameroon (Mbanya et al. 1997), South Africa (Michael et al. 1971) and Uganda (Lasky et al. 2002) finding women to have higher prevalence of diabetes mellitus compared to men. Conversely women in Ghana (Amoah et al. 2002), Nigeria (Ejim et al. 2011), Sierra Leone (Ceesay et al. 1997) and rural Tanzania (McLarty et al. 1989) were found to have lower prevalence of diabetes mellitus than their male counterparts. The age standardized prevalence rates were not provided in the studies, making it difficult for comparisons. The variations may be related to gender differences in the prevalence of central obesity, a risk factor for diabetes mellitus, which is more predictive than peripheral obesity (Lee et al. 2008). Central obesity has been found to be more common in men than in women in countries in Eastern Africa (Christensen et al. 2008; Msamati and Igbigbi 2000), and more common in women than men in countries in Southern Africa (Mbanya et al. 1997). Behavioral risk factors, such as smoking and alcohol consumption, which are more common among the men than women of SSA (BeLue et al. 2009; Townsend et al. 2006) may also contribute to the prevalence of diabetes mellitus among the men in some countries in SSA.

The major diabetes sequelae such as cardiovascular disease, neuropathy, retinopathy, microalbuminuria, diabetic foot and pregnancy complications place a substantial burden on the health system. Cardiovascular disease (CVD) is the most significant cause of death in the diabetic population (Kengne et al. 2005). Studies on the prevalence of chronic complications of diabetes among persons with diabetes in Africa found that prevalence of retinopathy ranged from 7 % in Kenya, to 63 % in South Africa, neuropathy ranged from 27 % in Cameroon to 66 % in Sudan and the prevalence of microalbuminuria ranged from 10 % in Tanzania to 83 % in Nigeria (Hall et al. 2011). The estimated number of deaths in Sub-Saharan Africa (SSA) due to diabetes was 522, 600 in 2013, with 76.4 % of who died aged under 60 years and women representing 62 % of the deaths (International Diabetes Federation 2013).

Elevated blood pressure, a strong risk factor for type 2 diabetes, is highly prevalent in Zimbabwe (Ministry of Health and Child Welfare 2009). The increased burden associated with hypertension brings with it an increase use of diuretics and other anti-hypertensive medications which may increase the risk of diabetes (Jha and Sharma 1984; Naafs 1985; Virtanen and Aro 1994). In addition, Zimbabwe is dealing with an HIV/AIDS epidemic (Blair Research Institute 1996) and the use of highly active antiretroviral therapy (HAART) to treat HIV has led to an increase in metabolic dysfunction, including insulin resistance, dyslipidemia and lipodystrophy (Larsson et al. 2006). This combination of abnormalities also known as antiretroviral-associated diabetes is more similar clinically to T2DM, rather than T1DM (Dagogo-Jack 2008). Diabetes increases the risk of contracting pneumonia (Kornum et al. 2008) and tuberculosis by decreasing immunity, and it also reduces the response to treatment (Dooley and Chaisson 2009). This is of particular significance for Africa, which has the highest estimated tuberculosis (TB) incidence in the world: 480 per 100,000 people per year (Dye 2006).

Health expenditure on diabetes in SSA for those aged 20–79 years was estimated to be 4 billion US Dollars, less than 1 % of the total global health expenditure on diabetes (International Diabetes Federation 2013). Health expenditure (as a percentage of total health expenditure) on diabetes varies between 3 and 7 % across SSA, with some countries such as South Africa and Nigeria spending 7 %, Zimbabwe and Malawi spend 6 and 3 %, respectively (Zhang et al. 2010). In the year 2000, it was estimated that the direct cost of treating diabetes in the WHO Africa Region ranged from Int$876 (US$ 2302) to Int$1220.6 (US$3207) per person (Kirigia et al. 2009). The IDF estimated that national funding for the healthcare of diabetics in Africa is just US$111 per person (Zhang et al. 2009), and a significant discrepancy exists between the cost and affordability. As diabetes develops during the peak-income earning period in an individual's life in SSA, it mainly affects the breadwinners of a family (Betz Brown et al. 2009). A study found that one in six patients said they could not work due to diabetes, and one in three said they could not work as much as they wanted to (Betz Brown et al. 2009).

Diabetes was ranked fourth (after hypertension, asthma and epilepsy) amongst the non-communicable diseases (NCDs) recorded in outpatient visits in Zimbabwean public hospitals in 2006 (Ministry of Health and Child Welfare 2009), National health survey data from which to examine the burden of diabetes in Zimbabwe are limited (Mufunda et al. 2006); one sub-national health survey conducted in three of the ten provinces estimated diabetes prevalence to be 10.2 %, with females more likely to report a history of diabetes compared to males (Hakim et al. 2005). Another study of central-hospital based data estimated that the prevalence of diabetes (expressed per 100,000 people) had increased from 150 to 550 from 1990 to 1997(Mufunda et al. 2006).

Resource limitations mean that there are no comprehensive population surveys evaluating the prevalence of diabetes throughout Zimbabwe, and estimates from the IDF have been based on a single 2005 sub-national survey (International Diabetes Federation 2013) and may thus not be nationally representative. Our study aimed to examine the prevalence of diabetes (excluding gestational diabetes) in the Zimbabwean population through a systematic review and meta-analysis of the cross-sectional studies conducted to date. Given that T1DM prevalence has consistently been reported to be less than 1 % in Africa (Elamin et al. 1997; Afoke et al. 1992; Beran et al. 2005), it is unlikely to markedly affect our pooled estimate. As T2DM accounts for over 90 % of people with diabetes in the world (International Diabetes Federation 2013), we assume that our overall estimate of diabetes prevalence is predominately driven by T2DM.

Methods

Search strategy

This systematic review and meta-analysis were performed according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Group (Moher et al. 2009). All searches were carried out on the electronic peer-reviewed databases (MEDLINE, EMBASE, and Scopus), for papers that reported diabetes prevalence in both males and females, and were published before January 1, 2014, without language or age restrictions. Prior to the independence in Zimbabwe on 18 April 1980, the nation had been known by several names including Rhodesia, Southern Rhodesia, and Zimbabwe-Rhodesia, and was racially segregated. Search strategies were tested with the key words ("diabetes mellitus"[MeSH Terms] OR "diabetes mellitus"[All Fields] OR "glucose intolerance"[All Fields]) AND "prevalence"[MeSH Terms] OR "prevalence"[All Fields]) AND ("Zimbabwe"[MeSH Terms] OR "Zimbabwe"[All Fields] OR "Rhodesia"[MeSH Terms] OR "Rhodesia"[All Fields] OR "Southern Rhodesia"[MeSH Terms] OR "Southern Rhodesia"[All Fields] OR "Zimbabwe-Rhodesia"[MeSH Terms] OR "Zimbabwe-Rhodesia"[All Fields]). Grey literature, Zimbabwean public health and university institute websites and reference lists of retrieved articles were also searched for relevant studies.

Inclusion and exclusion criteria

Two reviewers (MM and UG) read all the retrieved abstracts and titles. All studies which reported the prevalence of diabetes among Zimbabwean residents were included. Exclusion criteria included gestational diabetes, uncommon forms of diabetes, non-original research (review, editorial, and letter or commentary articles) and all studies targeting specific gender or age groups that were not considered representative of the nation as a whole. When there was more than one report relating to the same study sample, the most updated and relevant study was included. All source studies were original research written in English and contained the minimum information necessary to calculate pooled analysis of prevalence (number of the subjects and number of diabetes events). The full text of studies meeting these criteria were retrieved and screened to determine eligibility. Discrepancies between the reviewers' selection were resolved by discussion with the other authors.

Data extraction

A data abstraction form was designed to capture all relevant study characteristics required for analysis. Two

reviewers (MM and UG) selected the studies, extracted the data independently, cross-checked them and resolved disagreements by consensus. Studies were included if they were cross-sectional, described the prevalence of diabetes mellitus and were conducted in Zimbabwean populations. For all included studies, they recorded the following: authors, year of publication, study period, setting, sampling frame and method, sample size, age range, sex ratio of cases of diagnosed diabetes mellitus, prevalence, and diagnostic method.

Characteristics of studies

The studies reviewed spanned a 45-year period. The study populations, before and after 1980, were selected from urban and rural areas where Black Zimbabweans resided. The included studies used different diagnostic methodologies. One study (Hakim et al. 2005) used Fasting Blood Glucose (FBG) and Oral Glucose Tolerance Testing (OGTT), three studies used urine glucose tests (Carr and Gelfand 1961; Guidotti and Gelfand 1976; Wicks et al. 1973, one study (Wicks and Jones 1974) specified using the British Diagnostic Criteria for diabetes but did not state which methods, and two studies (Bardgett et al. 2006; Mudiayi et al. 1997) did not state their diagnostic methodology.

All studies were cross-sectional. One study was from the 1960s (Carr and Gelfand 1961), three from the 1970s (Guidotti and Gelfand 1976; Wicks et al. 1973), one from 1990s (Mudiayi et al. 1997) and two from 2000s (Bardgett et al. 2006; Hakim et al. 2005). Four studies used hospital data to determine the prevalence of diabetes (Bardgett et al. 2006; Guidotti and Gelfand 1976; Mudiayi et al. 1997; Wicks et al. 1973). Sample sizes varied substantially with a median of 8,868 participants for the seven included studies. Studies before 1980 measured glucose in urine as a diagnostic test, whilst only one study after 1980 used measurement of blood glucose as their diagnostic test. Six of the seven studies did not state the age standardized prevalence of diabetes (Bardgett et al. 2006; Mudiayi et al. 1997; Wicks et al. 1973) so a fair comparison of prevalence rates between age groups of the studies was not possible. One study did not state the age range of the study population (Bardgett et al. 2006). Apart from two studies in rural areas (Guidotti and Gelfand 1976; Hakim et al. 2005), the studies were from urban populations (five studies), and mostly were done in Harare and Bulawayo, the two major cities in Zimbabwe.

Statistical analysis

MetaXL 1.4, a tool for meta-analysis in Microsoft Excel (2012), was used for all statistical calculations. A random effects model was used to address the heterogeneity in the pooled proportions (Barendregt and Mozurkewich 2011). The random effects model assumes that the observed heterogeneity is driven by real differences in the distribution. The model calculated pooled prevalence and 95 % confidence intervals (CIs). The Chi-squared (χ^2) or Cochran Q test is included in the forest plots and assesses whether observed differences in results are compatible with chance alone. A low p value or large Chi-squared statistic (relative to its degree of freedom) provides evidence of heterogeneity and variation in effect estimates beyond chance. Statistical heterogeneity was further quantified with the I^2 statistic (low is <25 %, moderate 25–50 %, high >50 %) (Higgins and Thompson 2002). Sub group analysis for the period of the study before and after 1980 was performed to understand the impact of independence on the prevalence of diabetes among the Zimbabweans. Sub-groups were defined as differences in year range of investigation, with one sub-group consisting of studies conducted before the 1980 independence from colonial rule, and the other studies conducted after 1980.

Results

Following application of inclusion and exclusion criteria, seven studies were included in the analysis (Table 1). Enrollment years of the studies were between 1960 and 2010. A flowchart of study selection is presented in Fig. 1. As shown in Fig. 1, our initial search yielded 244 citations. After screening titles and abstracts, 20 potential studies were retrieved in full text. Of these, 13 studies were subsequently excluded because they did not satisfy the inclusion criteria. Seven studies that were found to be eligible were included in our final analysis.

These seven studies contained a total of 29,514 subjects, and with the exception of one study (Wicks and Jones 1974) that did not report the gender ratio of the sample size, the sample was composed of 42.8 % males and 57.2 % females. The seven cross-sectional studies selected for the present systematic review are summarized in Table 1. Studies conducted before 1980 (Carr and Gelfand 1961; Guidotti and Gelfand 1976; Wicks and Jones 1974; Wicks et al. 1973) had diabetes prevalence ranging from 0 % (Guidotti and Gelfand 1976) to 2.66 % (Wicks and Jones 1974), and studies conducted after 1980 (Bardgett et al. 2006; Mudiayi et al. 1997; Hakim et al. 2005) had prevalence ranging from 3.2 % (Bardgett et al. 2006) to 10.2 % (Hakim et al. 2005). Only one study reported the gender differences in the prevalence of diabetes (Hakim et al. 2005) with females having a higher prevalence of diabetes at 10.2 % and males at 9.8 %. The remaining studies reviewed reported overall prevalence with no gender differences accounted for.

Table 1 Characteristics of the diabetes prevalence studies conducted in Zimbabwe between 1960 and 2005 included in the meta-analysis

References	Study period	Setting	Type 1 or 2 diabetes	Sampling method	Sample size (male/female ratio)	Age range (years)	Prevalence (cases)	Diagnostic criteria	Description of geographic area[a]
Carr and Gelfand (1961)	1960	Community-household	NR	NR	1,007 (570/437)	>14	0.1 % (1)	Urine (Clinistix Reagent Strips)	Highfield township near industrial area, population 25,000
Wicks et al. (1973)	1971	Community-household	NR	NR	1,078 (450/628)	>14	0.3 % (3)	Urine (Clinistix Reagent Strips)	Highfield township, population not given
Wicks and Jones (1974)	1971	Community-hospital	NR	NR	4,028 (unspecified)	>1 to >60	2.66 % (107)	British Diagnostic criteria 1964	Harare Hospital patient admissions
Guidotti and Gelfand (1976)	1.7.1973–1.7.1974	Community-hospital	NR	NR	5,456 (1,885/3,571)	>1	0 % (0)	Urine (Clinistix Reagent Strips)	Rural-All Souls' Mission in Mtoko
Mudiayi et al. (1997)	1987–1994	Community-hospital	NR	NR	12,280 (6,631/5,649)	12 to 98	7.4 % (903)	NR	United Bulawayo Hospital, Bulawayo and areas outside the city
Hakim et al. (2005)	May–July 2005	Sub-national-household	NR	Multi-stage	2,991 (778/2,213)	≥25	10.2 % (305)	WHO 1999 guidelines. Fasting blood glucose ≥7.0 mmol/L and OGTT (fasting >7.8 mmol/L and 2 h post priandal glucose ≥11.1 mmol/L)	Urban and Rural communities in Midlands, Mashonaland Central, and Matabeleland South
Bardgett et al. (2006)	January–August 1992	Community-hospital	NR	NR	1,305 (640/665)	NR	3.2 % (42)	NR	Mpilo Central hospital, main secondary hospital in Bulawayo for population of about 4 million
Bardgett et al. (2006)	January–August 2000	Community-hospital	NR	NR	1,369 (657/712)	NR	3.4 % (47)	NR	Mpilo Central hospital, main secondary hospital in Bulawayo for population of about 4 million

NR not reported in original document

[a] Geographic area refers to the geographic location where study took place in Zimbabwean urban or rural areas

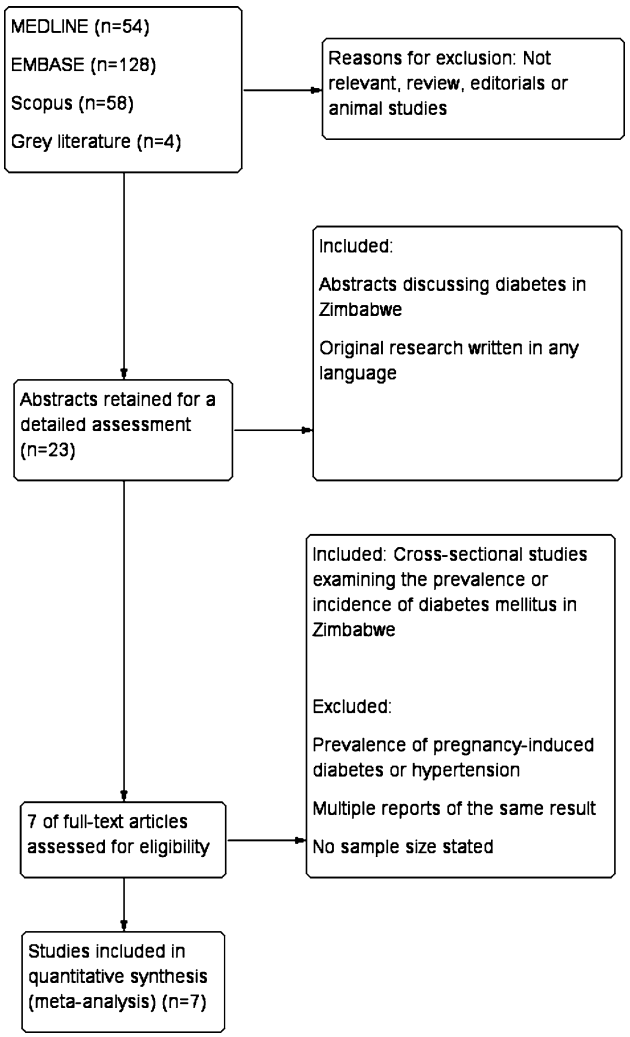

Fig. 1 Flow diagram illustrating the number of included and excluded studies in the systematic review on diabetes mellitus in Zimbabwe

The sample sizes of the studies varied and most studies did not state their sampling procedure, participation rate, mean age and definition of prevalent diabetes. Hospital-based data, used in four of the studies (Bardgett et al. 2006; Guidotti and Gelfand 1976; Mudiayi et al. 1997; Wicks and Jones 1974) did not collect information on risk factors.

The test for overall prevalence before and after 1980 also indicates statistical significance ($p < 0.0001$). The forest plots depicted in Fig. 2 represent a meta-analysis of studies that measured the prevalence of diabetes in Zimbabwe before and after 1980. Individual studies with their unadjusted prevalence are represented by a black square and a horizontal line, which corresponds to the point estimate and 95 % confidence interval of prevalence. The size of the black square reflects the weight of the study in the meta-analysis. Heterogeneity was significant ($p < 0.01$) in both groups and the I^2 statistic was 99 % in studies prior 1980, and 97 % in studies post 1980. Before 1980 the estimated pooled prevalence of diabetes in Zimbabwe was 0.44 % (95 % CI 0.0–1.9 %), and after 1980 the estimated pooled prevalence was 5.7 % (95 % CI 3.3–8.6 %).

Discussion

This is the first study to our knowledge, to systematically evaluate the literature and conduct meta-analyses on the prevalence of diabetes in Zimbabwe. The estimated prevalence rate of diabetes in Zimbabwe was found to be 0.44 % before 1980 and increased to 5.7 % after 1980. Studies have found that diabetes prevalence varies across the African region, with limited data available to explain the different trends (Mbanya et al. 2010; Levitt 2008). In urban Tanzania rates increased from 0.3 % in the 1980s to 4.6 % in 1996 according to the 1998 WHO criteria, and in urban Cameroon from 1.5 % in the 1990s to 6.6 % in 2003 (Mbanya et al. 2010; Levitt 2008).

Changes in the diagnostic criteria for diabetes may also contribute to discrepancies in prevalence rates (World Health Organization 1999; The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus 1997; Alberti and Zimmet 1998). Some of the earlier studies used older diagnostic criteria such as Clinistix urine glucose test (Carr and Gelfand 1961; Guidotti and Gelfand 1976; Wicks et al. 1973). Urinary glucose testing was found to be a better screening tool to identify sugar rather than quantitate it (Kohler 1978). A study found that in 169 samples, Clinistix had 24 doubtful cases, four false positives, and seven false negatives (Dyerberg et al. 1976).

Studies done before 1980 and after 2003 involved widely differing diagnostic criteria since the criteria and guidelines changed over time. American Diabetes Association (ADA) guidelines diagnose diabetes by means of two fasting glucose measurements, bypassing the OGTT which World Health Organization (WHO) additionally recommends (World Health Organization 1999; The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus 1997). Using fasting glucose as the main diagnostic test for diabetes is more convenient, less expensive, and more reliable (reproducible) than an oral glucose tolerance test (The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus 1997). Some studies did not state the types of tests done and cut off points used to diagnose diabetes, whether venous plasma or capillary whole blood was used in their tests, or the methodology and equipment used to measure blood glucose. Therefore, the different procedures and measurements for glucose may have affected the prevalence of diabetes over the study period.

As diagnostic methods used before 1980 may have not detected all diabetes cases, these values may underestimate

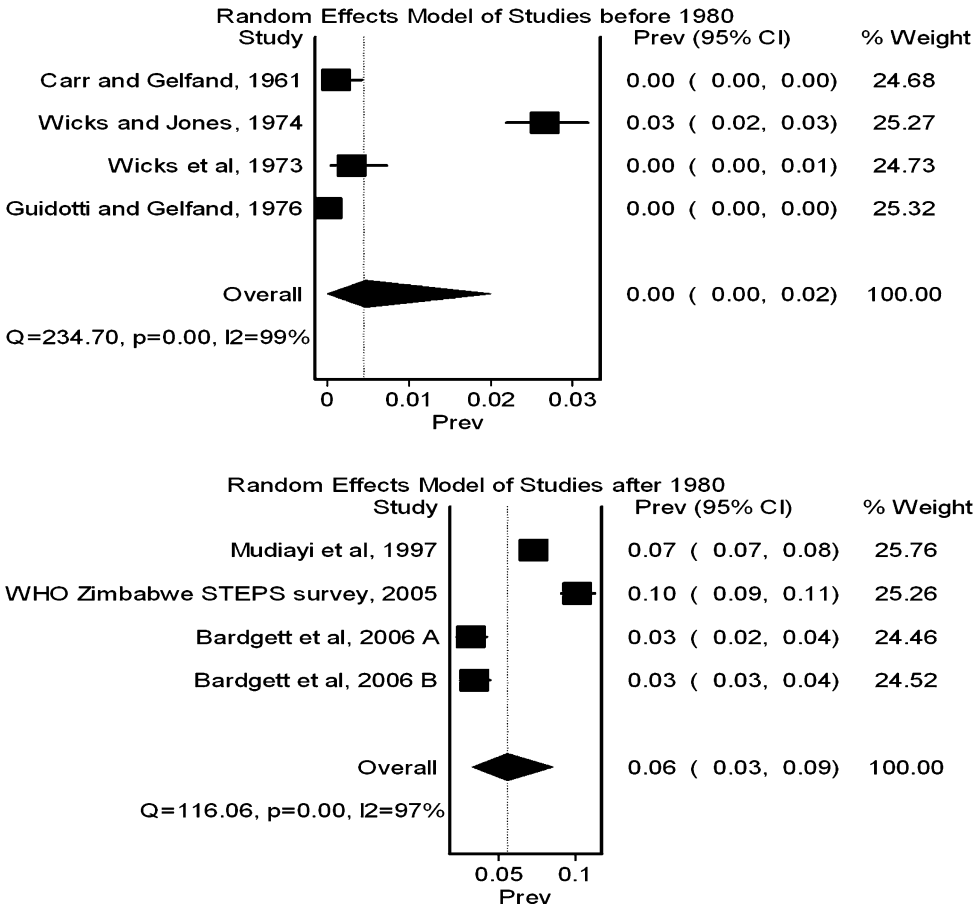

Fig. 2 Forest plot of the meta-analysis of the diabetes prevalence studies conducted in Zimbabwe before 1980 and after 1980 using the Random Effects Model

the prevalence rate and suggest that laboratory data are important to estimate the prevalence rate of diabetes. Additionally, the most recent sub-national investigation of diabetes in Zimbabwe is now 9 years old (Hakim et al. 2005). Therefore, our meta-analysis is relevant to ascertaining the prevalence of diabetes in Zimbabwe and assessing the methods and diagnostic tools used in measuring prevalence.

In our review and meta-analyses of diabetes prevalence seven studies were included and we found that there was a high degree of heterogeneity in the reported prevalence of diabetes in Zimbabwe. Five out of the seven included studies covered communities in predominately urban areas in Zimbabwe thus limiting the generalizability. In 1980, 28 % of Africans lived in cities, but now 40 % of the continent's 1 billion people live in cities, a proportion similar to China (McKinsey Global Institute 2010a). With an average annual rate of change in number of urban dwellers of more than 3 %, SSA is undergoing the fastest rate of urbanization worldwide (United Nations Population Fund 2007). Urban residence is associated with a two to five times increased risk of diabetes or impaired fasting glycaemia (Mbanya et al. 1997, 1999). Processed foods have become easily available in SSA, particularly in urban areas, as a result of foreign direct investment from transnational food companies (Tuei et al. 2010; Madu et al. 2003). This has resulted in a shift from traditional diets towards the higher fat and more refined carbohydrate Western diet in urban areas in developing countries (Popkin 2001). Unhealthy diets consisting mainly of high fat and high energy foods contribute directly to increased energy imbalances, and subsequently obesity and diabetes. Urban compared with rural residence was found to be associated with lower physical activity energy expenditure, and higher prevalence of metabolic syndrome (Assah et al. 2011), these changes have initiated a health transition that has introduced new patterns of illness to urban areas in SSA. It has been shown that lifestyle changes associated with urbanization, increase in the prevalence of inactivity, obesity and diabetes can change over a relatively short period of time, particularly among women and lower socioeconomic groups (Linetzky et al. 2013). In the sole WHO STEPwise approach to surveillance (STEPS) survey undertaken in Zimbabwe in 2005 10.4 % of women compared to 3.9 % of men were found to be obese with a BMI >30 (Hakim et al. 2005), which could contribute to the

higher prevalence of diabetes seen in women (Hakim et al. 2005). The rate of diabetes in rural areas may reflect the rapid changes in lifestyle and physical activity, such as the increased use of motorized vehicles and mechanized labor, in rural populations (Assah et al. 2011; Misra and Khurana 2008; Ng et al. 2009). Further investigation is required to isolate the diabetes risk factors that are specific to rural inhabitants in Zimbabwe. As there are great disparities in the distribution of healthcare resources between cities and rural areas in Zimbabwe, most of the studies have focused on urban areas resulting in rural areas being under represented

Zimbabweans with diabetes were found to die within 5 years of diagnosis (Gill 1990), perhaps reflective of later diagnosis or limitations in treatment access. This could also contribute to a lower prevalence rate. A major study from Zimbabwe in 1980 (Castle and Wicks 1980) recorded follow-up of 107 newly diagnosed diabetic patients (both T1D and T2D) and found in-patient mortality was 8 percent, and the survivors had a mortality rate of 41 percent within 6 years of follow-up. No further evidence exists on the survival time of Zimbabweans or Africans in SSA diagnosed with diabetes, as increased survival rates could increase prevalence rates. Moreover, the exact estimate of mortality is also difficult in SSA because of limited death registration (Mathers and Loncar 2006) and complications arising from diabetes likely noted as cause of death rather than diabetes itself. Studies have reported that diabetes was listed as the underlying cause of death for only 7.7 % of diabetic men and 13.4 % of diabetic women (Gu et al. 1998; Morgan et al. 2000). SSA is experiencing an increase in life expectancy of its population (men 48–56 years and women 52–59 years from 1990 to 2012), and an increase in the prevalence of chronic NCDs (World Health Organization 2014; Smith and Mensah 2003), as women have a slightly longer life expectancy this could increase the prevalence of diabetes.

Before 1980, racial segregation in Zimbabwe would have affected access to healthcare services for black Zimbabweans, and this is not addressed in any of the studies. Racial discrimination affects health outcomes by inhibiting patients' engagement with the healthcare system Burgess et al. 2008) which results in less utilization of some preventive services (Ryan et al. 2008), delays in obtaining medical care or prescriptions (Burgess et al. 2008), less adherence to physician recommendations or treatments (Ryan et al. 2008), and an increase in missed medical appointments (Ryan et al. 2008). These factors could possibly explain the very low prevalence of diabetes prior to independence.

At independence on 18 April 1980, Zimbabwe possessed a diversified economy that provided universal education, health service, and investment in peasant farming. As a consequence, the average standard of living rose during the 1980s (Bratton and Masunungure 2008). However, economic structural adjustment, recurrent droughts, widespread HIV/AIDS, a declining national income, a huge national debt, and a weakening health system all contributed to the deterioration of Zimbabwe's economy since 1990. The land expropriations of the early 2000s gave rise to the large-scale physical displacement of farm workers and their families, while Operation Murambatsvina displaced up to 700,000 city dwellers from informal dwellings in 2005 (Bratton and Masunungure 2008). Between 2000 and 2005, the gross national income (GNI) per head declined by 54 % (World Bank 2008) placing Zimbabwe among the world's poorest countries (World Bank 2008).

Economic decline has driven the exodus of Zimbabweans, with over 3 million of the total population of 13.5 million estimated to be living outside the country (Murithi et al. 2011). Diabetes prevalence has been shown to be patterned by socioeconomic status (SES), with low-income men and women having greater probabilities of diabetes than high-income men and women (Sims et al. 2011), the socioeconomic changes during the period of study may have contributed to the increase in diabetes prevalence. The scarcity of studies from 1980 to present is likely a reflection of these factors, as well as lesser attention to diabetes, as the emergence of HIV during this period had taken public health precedence (Delamothe 2009). Many diseases with a high prevalence in Africa, with the exception of HIV/AIDS and malaria, are under-researched, despite them affecting Africa's economic development and welfare (McKinsey Global Institute 2010b). This bias represents a major challenge for health funding and research of NCDs in Zimbabwe.

Limitations

The main limitations of this study include the low number of studies on diabetes prevalence in Zimbabwe available for analysis, and the cross-sectional design of studies which precludes any causal association between diabetes and risk factors. Certain variables that may influence the prevalence of diabetes were therefore not able to be taken into account in the study, including lifestyle factors, body mass index and family history of diabetes (Wong et al. 2013).

With regard to the methodological features of the studies, only one study used multi-stage cluster sampling and stated the sample size calculation (Hakim et al. 2005), whilst the other studies did not state their sampling methods or size calculations, which could have resulted in selection bias that would compromise their internal validity. In addition to this, the inclusion of studies conducted

before 1980 that used old diagnostic testing makes inference of results difficult.

Suggestions for further research

This pooled analysis of prevalence of diabetes is an attempt to fill the lack of national data. However, the estimates of prevalence of diabetes do not adequately represent the rural areas in Zimbabwe and those without access to healthcare services. Due to the nature of diabetes, with a long pre-symptomatic period, it is not possible to survey the associated symptoms (Levesque et al. 2013). Despite these limitations this study makes a strong case for the need of health surveys to increase the focus and understanding of diabetes (Levesque et al. 2013).

Populations with undiagnosed diabetes are difficult to quantify, but the IDF estimates that the number of cases of undiagnosed diabetes in the Zimbabwean population aged 20–79 years is 451.01/1,000 person (International Diabetes Federation 2013). Measuring disease prevalence is a challenge in countries where information systems remain poorly developed, with significant shortcomings and poor coverage (Levesque et al. 2013).

Health systems in sub-Saharan Africa are currently organized for the treatment of acute rather than chronic conditions (Whiting et al. 2003). Health information systems need to be developed that monitor and provide reliable surveillance for pre-diabetic and diabetic patients. A consensus must be reached, on the adoption of common, essential indicators that can be easily collected and stored from health centers. However, the issue of data quality needs to be addressed, through training and educating nurses on diabetes treatment and management. Further surveys and public health campaigns are required to assess the level of awareness among the general population in urban and rural areas about causes, risks and complications of diabetes in Zimbabwe. In a resource limited setting it may be prudent to leverage from existing infrastructure, such as the use of existing screening centers for communicable diseases such as HIV to screen for non-communicable chronic diseases such as diabetes.

Conclusions

The findings of this study suggest that diabetes prevalence in Zimbabwe has increased over the past few decades, highlighting the need to raise the priority of diabetes on the public healthcare agenda in Zimbabwe. Further research and analysis are required before prescribing direct policy recommendations and a nationwide prevalence study is urgently needed to determine accurate rates across different populations (urban and rural) in Zimbabwe.

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