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Original article

Diabetes in Mozambique: Prevalence, management and healthcare challenges

C. Silva-Matos [a], A. Gomes [b,c], A. Azevedo [b,c], A. Damasceno [d], A. Prista [e], N. Lunet [b,c,*]

[a] *Department of Non-Communicable Diseases, Mozambique Ministry of Health, Maputo, Mozambique*
[b] *Department of Hygiene and Epidemiology, University of Porto Medical School, Porto, Portugal*
[c] *Institute of Public Health–University of Porto (ISPUP), Porto, Portugal*
[d] *Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique*
[e] *Faculty of Physical Education and Sports Sciences, Universidade Pedagógica, Maputo, Mozambique*

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Abstract

Aim. – The growing trend towards and deficient management of diabetes in Africa are important public-health challenges requiring surveillance. For this reason, this study aimed to assess the prevalence and awareness of diabetes in urban and rural Mozambique, and to describe its management.

Methods. – In 2005, a representative sample of the national Mozambican adult population ($n = 2343$) was evaluated, according to the STEPwise approach to chronic disease risk factor surveillance (STEPS). Twelve-hour fasting blood glucose (FBG) was measured, using fingertip capillary whole blood, to estimate the prevalence of impaired fasting glucose (IFG; FBG $\geq$ 5.6 mmol/L and less than 6.1 mmol/L) and diabetes (FBG $\geq$ 6.1 mmol/L, or treatment with insulin and/or oral blood glucose-lowering drugs). Patients' awareness and management of diabetes were assessed by questionnaire.

Results. – The prevalence of diabetes and IFG was 2.9% [95% confidence interval (95%CI): 1.8–4.0] and 2.5% (95%CI: 1.3–3.7), respectively. Diabetes was more frequent among urban dwellers (OR = 2.92, 95%CI: 1.45–5.86), mostly due to urban–rural differences in age, education, body mass index (BMI) and waist circumference (adjusted OR = 2.27, 95%CI: 0.83–6.26). In all, 13% of those with diabetes were aware of their condition, 10.9% had undergone glycaemia determination during the previous year, and 9% were being treated with oral blood glucose-lowering drugs and 3% with insulin.

Conclusion. – Diabetes prevalence is low in Mozambique, but most diabetic patients were neither aware of their condition nor being treated pharmacologically, thus posing serious challenges to the provision of adequate care in an already disadvantageous context.

Keywords: Mozambique; Diabetes; Fasting hyperglycaemia; Epidemiology; Prevalence; STEPS; Africa

Résumé

Le diabète sucré au Mozambique : prévalence et enjeux de santé publique et de prise en charge.

Objectifs. – La tendance à l'augmentation de prévalence et l'insuffisance de prise en charge du diabète en Afrique constituent un problème majeur de santé publique qui nécessite une attention particulière. Nous avons évalué la prévalence du diabète et la conscience de la maladie dans les zones urbaines et rurales du Mozambique, et décrit sa prise en charge.

Méthodes. – En 2005, nous avons évalué un échantillon national représentatif de la population adulte du Mozambique ($n = 2343$), en accord avec le *STEPwise Approach to Chronic Disease Risk Factor Surveillance* (STEPS). La glycémie après un jeûne de 12 heures a été dosée sur sang capillaire total pour estimer la prévalence de l'hyperglycémie modérée à jeun (HMJ) (5,6 mmol/L $\leq$ FBG < 6,1 mmol/L) et du diabète (défini par une glycémie à jeun égale ou supérieure à 6,1 mmol/L ou un traitement par insuline et/ou antidiabétiques oraux). La conscience de leur maladie par les patients atteints et la prise en charge du diabète ont été évaluées par questionnaire.

* Corresponding author. Serviço de Higiene e Epidemiologia–Faculdade de Medicina da Universidade do Porto, Al. Prof. Hernâni Monteiro, 4200-319 Porto, Portugal. Tel.: +351 225513652; fax: +351 225513653.
E-mail address: nlunet@med.up.pt (N. Lunet).

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Résultats. – La prévalence du diabète et celle de l'HMJ étaient de respectivement 2,9 % (intervalle de confiance à 95 % [IC 95 %] 1,8–4,0) et de 2,5 % (IC 95 % 1,3–3,7). Le diabète était plus fréquent chez les sujets des zones urbaines (OR = 2,92 ; IC 95 % 1,45–5,86) principalement du fait des différences de l'âge, de l'éducation, de l'indice de masse corporelle et du tour de taille entre les patients des zones rurale et urbaine (OR ajusté = 2,27 ; IC 95 % 0,83–6,26). Treize pour cent des diabétiques étaient au courant de leur maladie, 10,9 % avaient eu un dosage de la glycémie au cours de l'année précédente, 9 % étaient traités par antidiabétiques oraux et 3 % par l'insuline.

Conclusions. – La prévalence du diabète est faible au Mozambique, mais la plupart des patients atteints ne se savent pas diabétiques et ne reçoivent pas de médicaments, ce qui pose le défi d'une prise en charge médicale appropriée dans ce contexte défavorisé.

Mots clés : Mozambique ; Épidémiologie ; Hyperglycémie modérée à jeun ; Diabète sucré ; Prévalence ; STEPS ; Afrique

1. Introduction

Diabetes is associated with micro- and macrovascular complications and long-term morbidity and, thus, represents a major health concern worldwide [1]. It is estimated to affect 285 million people around the world, with a projected rise to 439 million by 2025 [1]. Over the past few decades, diabetes has also emerged as an important medical problem in Africa [2], where a steeper increase in the number of affected people is expected [1]. This will add to the morbidity and mortality burden of this impoverished region, placing even more strain on healthcare resources.

Africa's challenge regarding diabetes is not only the growing number of patients, but also the deficient management of the condition as a result of the lack of awareness, inadequate resources, and poor access and compliance to medication and treatment [3].

The African Declaration for Diabetes was announced in December 2006, and called for African governments, non-governmental organizations, international agencies, pharmaceutical companies and healthcare providers to propose an ambitious framework to ensure access to affordable high-quality health services for the prevention and care of diabetes [4]. It also alluded to the need for population-based epidemiological studies to estimate the current diabetes prevalence, and to determine healthcare access and pharmacological treatment in the African countries.

For this reason, the present study was carried out to estimate the prevalence of diabetes, and diabetes awareness and management, in a nationally representative sample population living in urban and rural Mozambique.

2. Methods

For this community-based, cross-sectional study, a sample of adults aged 25–64 years was assembled, using the sampling framework applied in the 1997 census [5] that was designed to be representative at a national level and by place of residence (urban and rural). A total of 95 geographical clusters were randomly selected out of 858 areas across 11 provinces. In each selected cluster, all dwellings were listed (except for restaurants, grocery and other stores, and derelict houses, which were not taken into account), and households were randomly selected and visited to identify 25 that were inhabited by individuals within the predetermined age range. All eligible subjects in the same household were then invited to participate in the study. Altogether, 55 refused, leaving 3323 subjects who were evaluated between September and November of 2005 [6].

The selection of 95 geographical clusters and 25 households per cluster was calculated to allow evaluation of approximately 2800 participants (taking into account the average number of subjects aged 25–64 years per household, and the possible failure to establish contact with all households and refusals). The yield of the selection procedure was larger than expected, with the final sample including 18% more participants than expected, which may have been due to the fact that, as there was no substitution for households where no one answered the door, the study inquirers were instructed to make several attempts to contact members of the selected households at different times and on different days to minimize the potential for selection bias.

Subjects were evaluated according to the World Health Organization (WHO) STEPwise approach to chronic disease risk factor surveillance (STEPS), which included a questionnaire on sociodemographic factors, clinical measurements and a subsequent blood sample for assessment of biochemical parameters, including fasting blood glucose (FBG), using standardized methods. The WHO STEPS instrument for non-communicable disease risk factors (version 2.1, with core and expanded items) [7] was used for data collection after translation into Portuguese.

Twelve-hour FBG levels were obtained in accordance with WHO standardized fingertip prick tests, using calibrated blood glucose meters and reagent strips (Accu-Chek® Advantage meter). Subjects were classified as having normoglycaemia (FBG < 5.6 mmol/L), impaired fasting glucose (IFG; $\geq$ 5.6 mmol/L and < 6.1 mmol/L) or diabetes (FBG $\geq$ 6.1 mmol/L, or being treated with insulin and/or oral antidiabetic drugs), according to WHO criteria [8].

Diabetic patients were considered aware of their condition if they had been given the diagnosis by a health professional within the past 12 months, or if they reported the use of insulin or oral antidiabetic drugs. Participants were also asked if they had had their blood glucose measured during the previous year.

Non-pharmacological management of diabetes was assessed by asking the study participants if they had been advised by a health professional to change their diet ('special prescribed diet'), engage in exercise ('advice to start or do more exercise') or lose weight ('advice or treatment to lose weight') because of diabetes. Close-ended questions were used to determine whether there had been any appointments with a traditional healer within the past 12 months and/or the use of any herbal or traditional remedies for diabetes.

Anthropometric measurements were obtained with the subjects wearing light clothing and no footwear. Body weight was measured to the nearest 0.1 kg using a digital scale, and height to the nearest 0.1 cm in the standing position with a portable stadiometer. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2), and divided into categories as defined by the WHO [9] (< 25.0, 25.0–29.9 and ≥ 30 kg/m^2), and further categorized into BMIs < 25.0 kg/m^2 and greater or equal to 25 kg/m^2 for analysis. Waist circumference was measured to the nearest 0.1 cm, using a constant-tension tape, directly over the skin or over light clothing at the midpoint between the inferior margin of the last rib and the iliac crest in the mid-axillary line. For the study analysis, subjects were also classified as having abdominal obesity, according to the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (ATP III; women greater than 88 cm and men greater than 102 cm) [10] as well as the International Diabetes Federation (IDF) classification for sub-Saharan populations (women greater than 80 cm and men greater than 94 cm) [11].

Classification of the place of residence as either urban (any of the 23 cities and 68 towns) or rural (outside of cities or towns) and the definition of categories according to the highest level of education attained (< 1, 1–5 and greater or equal to 6 years) were based on the 1997 census [12]. Annual family income in meticals was converted into US dollars (USD), and categorized into groups of 0–64, 65–400 and greater or equal to 401 USD.

2.1. Statistical analysis

Data analyses were conducted, taking into account stratification and clustering at the primary sampling unit level, using STATA version 9.2 software. To ensure that the computed estimates reflected diabetes prevalence in Mozambique, sampling weights were computed taking into account the number of subjects evaluated in each stratum in relation to the number of participants expected per stratum, according to the population projections for the same period [13]. Data on blood glucose were available for 2343 subjects, who were thus included in the present study analysis. The 980 participants excluded from the analysis because of incomplete information or because of not respecting the recommended 12-h fasting time were more often men (47.4 *vs.* 41.2%; $P = 0.028$), but there were no statistically significant differences in age (mean age: 39.6 *vs.* 39.4 years; $P = 0.829$), education (1–5 years of education: 49.9 *vs.* 50.1%; $P = 0.408$) or place of residence (urban areas: 26.7 *vs.* 34.0%; $P = 0.300$).

Prevalence estimates with 95% confidence intervals (95%CI) were computed for IFG and diabetes according to sociodemographic characteristics. Odds ratios (ORs), adjusted for age, education, BMI and waist circumference, were used to estimate the strength of the association between place of residence and IFG and diabetes. Awareness of diabetes and its management were presented as prevalences and 95%CI.

2.2. Ethics

The present study protocol was approved by the National Mozambican Ethics Committee, and written informed consent was obtained from all participants.

3. Results

3.1. Characteristics of the study sample

Approximately three-fifths of the sample population were women, and two-thirds were living in rural areas and aged less or equal to 45 years, with just over 10% being greater than 54 years. Also, around one-fourth of participants had no formal education, while approximately three-fourths had less or equal to 5 years of formal education. Mean BMI was 23.6 kg/m^2, and mean waist circumference was 77 cm in both genders. Mean FBG was 3.8 mmol/L (Table 1).

3.2. Prevalence of impaired fasting glucose and diabetes

The overall prevalence of diabetes was 2.9% (95%CI: 1.8–4.0). More than twice as many urban men as their rural counterparts (5.5 *vs.* 2.4%; $P = 0.062$) were affected, and the difference was even greater between urban and rural women (4.9 *vs.* 1.2%; $P = 0.009$). However, there were no statistically significant gender differences. IFG was observed in 2.5% (95%CI: 1.3–3.7) of Mozambican adults, with no consistent or significant variation by either gender or place of residence (Table 2).

IFG was 1.4 times more frequent in urban males than in their rural counterparts. There was a noteworthy 2.3-fold difference between urban and rural diabetic men (Table 2). In urban dwellers, the prevalence increased with age up to 45–54 years for IFG, and throughout all age ranges for diabetes. Diabetes prevalence rose with education, and was highest among those with greater or equal to 6 years of formal education (6.6 in urban and 1.8% in rural dwellers), whereas no consistent pattern was perceptible for IFG (Table 2). In urban areas, the prevalences of IFG and diabetes (4.7 and 6.2%, respectively) were highest in those with an annual family income of 65–400 USD, with a gentler rise seen in rural areas with increasing earnings (Table 2).

Also, diabetes was more than three times more prevalent in urban dwellers who were either overweight/obese or had abdominal obesity (by either ATP III or IDF criteria) in comparison to their leaner counterparts, whereas this was not observed in rural subjects. Such a pattern was also not evident for IFG (Table 2).

Regarding the relationship between place of residence and diabetes the OR was 2.92, favouring urban areas, whereas the association with IFG was non-significant (OR = 1.09, 95%CI: 0.40–2.94). However, the association was attenuated after adjusting for sociodemographic variables, and was even weaker after adjusting for the confounding effect of BMI (OR = 2.26, 95%CI: 0.85–5.98), to the point of non-significance (Table 3). Adjusting for BMI had similar results as adjusting for waist

Table 1
Characteristics of the study sample.

		n	Unweighted distribution (%)[a,b]	Weighted distribution (%)[a,b,c]
Gender	Female	1401	60	59
	Male	942	40	41
Place of residence	Urban	1218	52	34
	Rural	1125	48	66
Age (years)	25–34	894	38	40
	35–44	649	28	27
	45–54	495	21	20
	55–64	305	12	12
	Mean	2343	40	39
Education (years)[d]	< 1	645	28	33
	1–5	1147	49	50
	≥ 6	546	23	17
Annual family income (USD)[d]	< 65	412	19	27
	65–400	801	36	40
	≥ 401	980	45	33
Body mass index (kg/m^2)[d]	Mean (SD)	2309	23(4)	22(4)
Waist circumference, women (cm)[e]	Mean (SD)	1295	77(11)	75(9)
Waist circumference, men (cm)[e]	Mean (SD)	929	77(9)	76(8)
Fasting blood glucose (mmol/L)	Mean (SD)	2343	3.8 (1.7)	3.8 (2.1)

USD: United States dollars; SD: standard deviation.
[a] Percentages, unless otherwise specified.
[b] Within each variable, the sum of proportions may not be 100% due to rounding.
[c] Sample weights take into account the number of subjects evaluated in each stratum in relation to the number of participants expected per stratum, according to population projections for the same period.
[d] Sum of the number of participants in each category is less than 2343 due to missing data.
[e] number of participants is less than 1401 for women and less than 942 for men due to missing data [13].

Table 2
Prevalence of impaired fasting glucose and diabetes in urban and rural areas, according to sociodemographic characteristics, overweight/obesity and abdominal obesity.

		Impaired fasting glucose						Diabetes					
		Urban			Rural			Urban			Rural		
		%	(95%CI)	*P*	%	95 %CI	*P*	%	95 %CI	*P*	%	95 %CI	*P*
All participants		2.5	(1.1–3.9)	–	2.5	(0.8–4.2)	–	5.2	(3.4–7.0)	–	1.7	(0.8–2.6)	–
Gender	Female	2.0	(1.0–3.0)	0.064	2.6	(1.0–4.1)	0.754	4.9	(2.8–7.0)	0.700	1.2	(0.1–2.4)	0.286
	Male	3.2	(1.1–5.4)		2.3	(0.0–4.6)		5.5	(2.6–8.4)		2.4	(0.6–4.1)	
Age (years)	25–34	1.9	(0.7–3.2)	0.267	0.6	(0.0–1.3)	0.156	2.6	(1.3–3.9)	0.057	0.9	(0.0–1.9)	0.047
	35–44	3.4	(0.4–6.5)		2.8	(0.6–5.0)		6.5	(3.2–9.8)		1.8	(0.3–3.2)	
	45–54	3.4	(0.9–5.8)		4.0	(0.0–8.8)		6.6	(1.8–11.4)		3.8	(0.6–7.0)	
	55–64	1.1	(0.0–2.5)		5.1	(0.0–13.1)		8.7	(2.4–14.9)		0.6	(0.0–1.5)	
Education (years)	< 1	2.3	(0.0–5.1)	0.450	0.8	(0.0–1.6)	0.006	4.6	(0.0–9.1)	0.311	1.6	(0.4–2.9)	0.955
	1–5	3.0	(1.2–4.9)		4.0	(1.2–6.9)		4.0	(2.0–6.0)		1.8	(0.5–3.0)	
	≥ 6	2.0	(0.8–3.2)		0.7	(0.0–2.0)		6.6	(3.8–9.4)		1.8	(0.0–4.2)	
Annual family income (USD)	< 65	2.6	(0.0–6.7)	0.063	1.6	(0.0–3.3)	0.491	4.5	(0.0–10.9)	0.630	1.4	(0.0–3.1)	0.766
	65–400	4.7	(1.8–7.6)		2.5	(0.5–4.5)		6.2	(2.5–9.8)		2.1	(0.3–3.9)	
	≥ 401	1.9	(0.8–3.0)		3.6	(0.0–8.5)		4.6	(3.2–6.1)		1.6	(0.0–3.5)	
Body mass index (kg/m^2)	< 25	2.3	(0.8–3.8)	0.258	2.6	(0.6–4.5)	0.465	3.0	(1.4–4.6)	< 0.001	1.6	(0.7–2.6)	0.326
	≥ 25	3.1	(1.4–4.8)		1.3	(0.0–3.3)		9.9	(6.1–13.7)		2.6	(0.0–5.3)	
Abdominal obesity	No	2.6	(1.1–4.1)	0.791	2.5	(0.6–4.3)	0.485	4.0	(2.1–5.9)	< 0.001	1.8	(0.8–2.8)	0.550
ATP III[a]	Yes	2.3	(0.3–4.2)		4.8	(0.0–12.4)		13.9	(6.6–21.2)		–	–	
Abdominal obesity	No	2.7	(1.1–4.4)	0.547	2.5	(0.5–4.5)	0.946	4.0	(1.7–6.3)	0.015	1.8	(0.8–2.9)	0.707
IDF[b]	Yes	2.1	(0.6–3.6)		2.6	(0.2–5.0)		9.0	(5.4–12.7)		1.4	(0.0–3.4)	

95%CI: 95% confidence interval; USD: United States dollars.
[a] Abdominal obesity according to the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (ATP III): women > 88 cm and men > 102 cm.
[b] Abdominal obesity according to the International Diabetes Federation (IDF) classification for sub-Saharan populations: women greater than 80 cm and men greater than 94 cm.

Table 3
Odds ratios for the association of impaired fasting glucose and diabetes with gender, place of residence, age, education, annual family income, body mass index (BMI) and abdominal obesity.

		Impaired fasting glucose			Diabetes		
		Odds ratio (95 %CI)			Odds ratio (95 %CI)		
		Crude	Adjusted[a]	Adjusted[b]	Crude	Adjusted[a]	Adjusted[b]
Gender	Female	1	1	1	1	1	1
	Male	1.05 (0.68–1.63)	0.69 (0.36–1.32)	0.71 (0.32–1.54)	1.45 (0.76–2.76)	1.25 (0.65–2.37)	1.68 (0.82–3.47)
Place of residence	Rural	1	1	1	1	1	1
	Urban	1.09 (0.40–2.94)	0.87 (0.15–5.24)	0.86 (0.17–4.37)	2.92 (1.45–5.86)	2.79 (1.12–6.94)	2.26 (0.85–5.98)
Age (years)	25–34	1	1	1	1	1	1
	35–44	2.41 (1.13–5.15)	2.70 (1.21–6.01)	2.70 (1.20–6.06)	1.96 (0.95–4.03)	2.00 (1.08–3.68)	1.87 (1.03–3.40)
	45–54	2.98 (0.72–12.43)	4.06 (0.75–22.09)	4.03 (0.68–23.92)	3.05 (1.29–7.23)	3.49 (1.58–7.71)	3.03 (1.36–6.73)
	55–64	3.43 (0.51–22.9)	4.70 (0.57–38.4)	4.66 (0.52–41.32)	1.82 (0.71–4.69)	2.13 (0.81–5.62)	1.83 (0.72–4.66)
Education (years)	< 1	1	1	1	1	1	1
	1 to 5	4.50 (1.70–11.94)	6.14 (1.65–22.79)	6.07 (1.51–24.37)	1.18 (0.52–2.67)	1.10 (0.52–2.33)	0.99 (0.46–2.11)
	≥ 6	2.17 (0.94–5.02)	3.81 (1.02–14.21)	3.75 (0.92–15.22)	2.53 (1.35–4.72)	1.85 (1.00–3.45)	1.52 (0.79–2.91)
Annual family income (USD)	< 65	1	1	1	1	1	1
	65–400	1.74 (0.55–5.49)	1.64 (0.50–5.42)	1.63 (0.48–5.50)	1.61 (0.46–5.58)	1.51 (0.45–5.03)	1.46 (0.44–5.53)
	≥ 401	1.51 (0.41–5.61)	1.38 (0.17–11.09)	1.36 (0.15–12.65)	2.03 (0.69–5.99)	0.97 (0.28–3.40)	0.80 (0.22–2.89)
BMI (kg/m^2)	< 25	1	–	1	1	–	1
	≥ 25	1.08 (0.43–2.70)	–	0.82 (0.29–2.30)[c]	3.88 (2.37–6.37)	–	2.97 (1.73–5.12)[c]
Abdominal obesity ATP III[d]	No	1	–	–	1	–	–
	Yes	1.21 (0.42–3.48)	–	–	3.85 (1.76–8.43)	–	–
Abdominal obesity IDF[e]	No	1	–	–	1	–	–
	Yes	0.87 (0.65–2.18)	–	–	2.28 (1.24–4.18)	–	–

95%CI: 95% confidence interval.
[a] For gender, place of residence, age (categorical: 25–34, 35–44, 45–54, 55–64 years), education (categorical: < 1, 1–5, ≥ 6 years), annual family income (categorical: < 65; 65–400; ≥ 401 USD).
[b] For gender, place of residence, age (categorical: 25–34, 35–44, 45–54, 55–64 years), education (categorical: < 1, 1–5, ≥ 6 years), annual family income (categorical: < 65; 65–400; ≥ 401 USD) and BMI (continuous).
[c] A categorical variable for overweight/obesity was used instead of BMI.
[d] Abdominal obesity according to the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (ATP III): women > 88 cm, men > 102 cm.
[e] Abdominal obesity according to the International Diabetes Federation (IDF) classification for sub-Saharan populations: women > 80 cm, men > 94 cm.

circumference (OR = 2.27, 95%CI: 0.83–6.26). In addition, the association with anthropometric indicators was stronger for diabetes than for IFG, even after adjusting for sociodemographic characteristics. The ORs for waist circumference were higher using ATPIII *vs.* IDF cutoff points, with a greater difference seen in diabetics (OR = 3.08, 95%CI: 1.18–8.02 *vs.* 1.95, 95%CI: 0.78–4.89, respectively, adjusted for gender, place of residence, age, education and annual family income).

3.3. Diabetes awareness and management

Just over one-tenth of our diabetic patients were aware of being so, while 10.9% of them reported having had at least one glycaemia determination over the past year. Dietary changes were prescribed to 13% of diabetic patients while, in the remainder, the use of non-pharmacological measures — namely, exercise and weight loss — was ascertained in fewer than one-tenth of patients. Oral blood glucose-lowering drugs were being used by 9% of patients and insulin by 3%. None of those taking insulin were treated with oral blood glucose-lowering drugs, and all lived in urban areas. Appointments with traditional healers were confirmed in 5.7% of known diabetics, whereas 7% had used herbal/traditional remedies (Fig. 1).

4. Discussion

In the present study, diabetes was found in 2.9% of the Mozambican adult population and 2.5% had IFG. Urban–rural differences were also found, as is to be expected in a country undergoing epidemiological transition, with urban areas presenting twice as many cases of IFG/diabetes, which were largely explained by regional differences in sociodemographic characteristics and the prevalence of obesity. However, awareness of diabetes was poor and most patients were not being treated pharmacologically.

The overall diabetes prevalence in Mozambique is in agreement with the 3.3% estimated by the IDF for 2010 [1,2]. Similar values have been reported in other WHO STEPS surveys, which provided results that were more directly comparable with the present study (using standardized, easily applicable protocols), including, in particular, Zimbabwe (regional sample size: 3081 adults; prevalence of diabetes: 2.4%) [14] and Benin (regional sample size: 2568 adults; prevalence of diabetes: 4.6%) [15]. In contrast, studies conducted in the Seychelles and Mauritius yielded much higher prevalences (9.4% and 15.0% in national and regional samples, respectively) [16,17].

However, in the present study, the prevalence of diabetes may have been underestimated as oral glucose tolerance tests

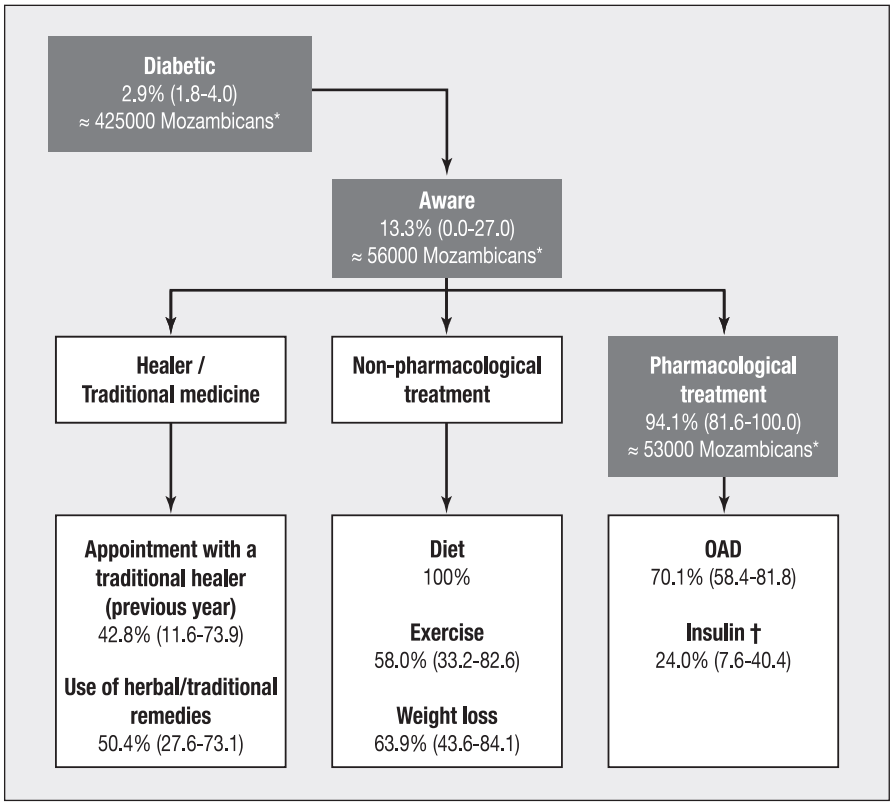

Fig. 1. Diabetes prevalence, and diabetes awareness and management (95% confidence interval), in the Mozambican population aged 25–64 years. The numbers of Mozambicans with known and treated diabetes (*) were estimated by multiplying prevalence figures by the population aged 25–64 years projected for 2005 [13]. None of the patients treated with insulin (†) reported using an oral antidiabetic drug (OAD).

(OGTTs) were not performed, and subjects were classified on the basis of fasting glucose measurements only [2,18]. Many of those who were within the 'grey' area of blood glucose (FBG $\geq$ 5.6 mmol/L and less than 6.1 mmol/L) would have been classified as diabetic after OGTTs, but may have been misclassified without such tests. However, OGTTs are relatively expensive and time-consuming, and impractical for large-scale epidemiological studies despite being recommended for diagnosis [19]. On the other hand, the fact that only a single determination of glycaemia was performed may have overestimated the prevalence [20].

An additional limitation of our present survey was the loss of a large number of subjects due to missing valid data on fasting glucose. However, the participants finally included in the analyses were similar to those excluded in terms of the sociodemographic variables known to be associated with diabetes. For this reason, the validity of the present findings is not likely to have been compromised.

IFG and diabetes prevalence both increased with age in both urban and rural areas, as expected. Steeper rises occurred in urban settings, with a more premature peak at age 45–54 years. This asymmetry between urban and rural age distributions has been reported in other studies recently conducted in Africa [21].

In addition, urban Mozambicans with larger abdominal waist circumferences or higher BMIs had a greater prevalence of diabetes than either their leaner counterparts or rural obese subjects, as expected. However, the lack of any differences among rural Mozambicans was somewhat unforeseen, but may be explained by differences in body-mass composition as well as body-fat distribution, possibly as the result of distinctively different patterns of food consumption and energy expenditure. As shown in an earlier report by our group using the same dataset [22], BMI correlates poorly with waist circumference and is higher in agricultural labourers, who engage in more vigorous physical activity, which suggests that, in such a subgroup, muscle mass is perhaps contributing more than adipose tissue to the BMI. However, the use of ethnic-specific cut-off points for abdominal obesity, as proposed by the IDF, may have counteracted these shortcomings. Indeed, in our sample, the cutoff points according to the WHO criteria showed a stronger independent association with diabetes and IFG than did the ethnic-specific cut-off points. In addition, misclassifications due to undetected non-compliance with the fasting protocol may help to explain the approximately 5% prevalence of IFG/diabetes among leaner Mozambicans in both urban and rural areas. Type 1 diabetes could also partially account for such cases among the non-obese, although this is less likely, given the short survival time and, consequently, low prevalence of type 1 diabetes in this population [2], consistent with the low rate of insulin use and lack of diabetic patients being treated with insulin in rural areas.

In fact, after adjusting for the most relevant confounders, the urban–rural divergence disappeared. This is consistent with what is known of diabetes and its aetiopathogeny, in which abdominal

obesity and physical inactivity are the main modifiable risk factors [23].

The African conundrum with diabetes lies not only in its apparently rising frequency, thereby becoming an important contributor to the non-communicable diseases that overburden healthcare systems, but also in the poor standards of healthcare and management offered to such patients. Low levels of self-management practices as well as a lack of consistent compliance with lifestyle changes and medication have been reported in many sub-Saharan populations [3,24]. African health systems have traditionally been planned around the concept of acute care, with chronic diseases being somewhat neglected in the allocation of funds. This has led not only to the lack of adequately trained staff, guidelines and policies for diabetes care, but also to the scarcity of resources, such as calibrated equipment for routine monitoring and accessible healthcare facilities nationwide. Furthermore, in many African countries, medication and self-monitoring have to be paid for by the patients, thus consuming around 60% of a family's available income [25]. Further issues related to supply and adequate storage of insulin have further hindered adequate treatment of these patients, resulting in poor glycaemic control and lack of screening for complications, an important cause of morbidity and mortality [26].

Although only a small proportion of adult Mozambicans were diabetic, just over one-tenth was aware of it. Indeed, the high ratio of newly discovered to previously known diabetic cases may well be a reflection of poor public awareness and access to medical services, as well as relatively short survival times. Also, just under one-tenth of known diabetic patients were receiving pharmacological treatment, in clear contrast to other African nations such as Cameroon [27] and Mauritius [17], where more than half of such patients use pharmacological treatment.

In addition, an even smaller proportion of patients use insulin regularly — a possible reflection of the lack of access to this medication. Its availability even in the public healthcare institutions is, at best, erratic because of supply and distribution problems, and its proper use requires regular glycaemia determinations to optimalize the dosage programme. For this reason, the IDF has sponsored initiatives to engage strategies to overcome this hurdle, and insulin delivery is now a priority in the Mozambican Ministry of Health's strategy to deal with non-communicable diseases, as seen by its incorporation on the essential drug list [26].

Traditional healing systems remain an important source of healthcare in many African populations, and several local initiatives in African countries include local healers, who have been instructed and trained in how to provide basic, adequate care for diabetic patients, as an integral part of their healthcare strategy [3]. However, this is not the case in Mozambique, which may, in part, explain the low proportion of patients in our present study who resorted to such healthcare providers. Nevertheless, it does not explain the poor management observed in this patient population.

Recently, increased collaborations with the World Diabetes Foundation and IDF African Region have led to the involvement of Mozambique in a number of key regional initiatives, especially the development of treatment guidelines adapted to the sub-Saharan context, and the creation of the Rapid Assessment Protocol for Insulin Access (RAPIA) [26]. Further collaborations with Diabetes UK and the African regional office of the WHO have led to changes in access to healthcare and the implementation of best practices [28]. These encouraging signs suggest that diabetes care in Mozambique is changing. However, the continuous monitoring of trends is essential to assess the extent of these changes, as Mozambique attempts to stem its rising tide of diabetes.

Disclosure

The authors have no conflicts of interest to disclose.

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