Epidemiology of diabetes in Morocco: review of data, analysis and perspectives.

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Abstract— Diabetes is considered as the most widespread chronic disease of the world, and the number of people with diabetes is increasing worldwide. Morocco, like other developing countries, is not escaping the trend of diabetes and the disease is one of the main public health problems. Therefore, mapping and assessing the current situation of diabetes in Morocco can be an important basis for diabetes prevention and treatment policy. In this paper, we reviewed the diabetes literature in Morocco to provide a comprehensive overview of this disease. We conducted a systematic literature search in PubMed, Scopus, Google Scholar, websites of the World Health Organization and associated organizations, etc. for articles and reports related to type 2 diabetes in Morocco published from January 2000 to Decembre 2018. The related literature was searched by using the keywords including diabetes mellitus, prevalence and epidemiology of type-2 diabetes, cardiovascular risk factors and Morocco.

Literature search has shown that there are few data available on the prevalence of type 2 diabetes in Morocco. The national prevalence of diabetes in adults aged 20 years and older varied from 6.6% in 2000 to 12.4% in 2016. Some regional studies in Morocco have reported prevalence of 13.5% in general population and 19% among females. Older age and higher body mass index were the most strongly associated risk factors for diabetes. In terms of quality of management of this chronic disease, over half of people with diabetes did not achieve the recommended care targets. In addition, Retinopathy and Neuropathy were the most observed complications of diabetes in Morocco, respectively. Taken at whole, these studies indicate clearly that although variations in prevalence of diabetes between region and subgroup exist, diabetes represent an important and common health problem in Morocco.

Index Terms— Diabetes complications, diabetes management, epidemiology, Morocco, Prevalence, risk factors, Type 2 diabetes.

1 INTRODUCTION

Diabetes is increasingly becoming a major chronic disease burden all over the world. It is rapidly increasing in developing as well as developed countries; however, it is observed to be more increasingly in the Middle East and North Africa region (MENA) [1].

The International Diabetes Federation (IDF) estimates that 40 million adults (18-99 years) or 10.5% of the adult population are affected by diabetes in the MENA region, and this is expected to rise to 84 million by 2045 [2]. Also, 373.557 of deaths among adults population (20-99 years) in MENA region were attributable to diabetes and the Health expenditure due to diabetes (18-99 years) amounted to $20.5 billion [2].

In 2013, a systematic review of the epidemiology of diabetes in the MENA region and its impact on individuals and societies showed that the MENA countries have one of the highest rates of diabetes in the world [3]. This increase is attributable to a range of factors that include rapid economic development and urbanization, changes in lifestyle that have led to reduced levels of physical activity, changes in dietary habits with increased intake of refined carbohydrates, and a rise in obesity; and the ageing of their populations [4].

In this systematic review [3], the authors recommended an increase in the number of higher-quality studies using more standardized methods that would allow comparison of diabetes prevalence over time, between countries and among population sub-groups. They also concluded among others, that Enhanced research on the epidemiology of diabetes needs to be combined with more effective primary prevention of diabetes (particularly in areas such as diet, exercise and obesity).

While diabetes has been well reviewed in the MENA region and systematic reviews show a clear increase in the prevalence of diabetes, the diabetes situation in Morocco has not yet been systematically assessed. Mapping the situation can be an important base for policy on diabetes prevention and treatment. Therefore, the main objective of this review was to fill this gap by providing a comprehensive overview of type 2 diabetes in Morocco.

This review will initially address the trend in prevalence of T2DM in Morocco, followed by the etiology of the disease, complication and risk factors of T2DM, and finally will discuss the quality of management of diabetes in Morocco.

1- METHODS

2.1 Search strategy and selection criteria

We conducted a systematic literature search in PubMed, Scopus, Googlescholar, EMBASE, websites of the World Health Organization and International Diabetes Federation etc. for articles and published reports related to type 2 diabetes in Morocco published from January 2000 to December 2018, without language restriction. We used a combination of search terms related to diabetes and morocco

We included:

- Population-based epidemiological studies;
- Studies reporting diabetes prevalence and if the sample size was ≥50 participants;
- Those reporting on risk factors for diabetes (e.g., age, family history, ethnicity, urbanization and migration, adiposity, lifestyle patterns, genetic susceptibility, socioeconomic status (SES);
- Studies describing diabetes-related microvascular (retinopa-

thy, neuropathy, nephropathy) or macrovascular (cardiovascular and peripheral vascular disease) complications;
- And studies characterizing quality of diabetes care.
We excluded: studies focused on type1 diabetes and gestational diabetes.

2- RESULTS

Among publications, reports identified and extracted from databases and other sources, duplicates and articles irrelevant to the inclusion criteria were excluded from this review. Finally, 15 original full text articles and 5 reports related to type 2 diabetes in Morocco and met the selection criteria were included in this review.

3.1 Prevalence and risk factors of Diabetes in Morocco

The prevalence of T2D was estimated between 2000 and 2018 at the national and regional levels (Table1).

Data derived from one national survey [5], which used the 1998 WHO criteria and five reports [6],[7],[2],[8], [9] showed that standardized prevalence rates among adults population aged 20 years and above were between 6.6% in 2000 [5], and reached up to 12.4% in 2016 [9].
According to the national investigation of risk factors of cardiovascular diseases achieved in 2000 [5], the prevalence of diabetes was clearly higher in urban (9%) than in rural areas (4.4%). It did not vary significantly between the two sexes, both in urban (8.8 versus 9.2%) and in rural areas (4.8 versus 4.1%). In this study, the prevalence of diabetes increased with age, being 2.3% among those aged 20– 34 years and 13.1% among those aged 65 years and above.
Other research and regional studies carried out in different regions of the country reported high rates that increase over the years. For example, the prevalence of T2DM in the south-

TABLE 1: **DIABETES PREVALENCE IN MOROCCO.**

Author and year	Year of survey	Sampling			Age (years)	Females %	Diagnosis		Diabetes prevalence % (95% CI)
		Frame	Strategy	Size			Method	Criteria	
Tazi et al., 2003[5].	2000	National	Census	1802	>20	58.1	FPG	WHO	6.6
Rguibi et al., 2004 [10].	2001–2002	Local/urban	Random sampling	249 (women only)	>15	100	Venous FPG	ADA 1997	11.9
Ujcic-Voortman J K et al., 2009 [14].	2004	Local/urban	Random samling (immigrant)	314	18-70	46	HbA1c NFPG >11.0 mmol l_1		8.0
Ramdani et al., 2012 [12].	2008	Urban and rural	Random samling	1628	> 40	64.18	FPG	WHO 1998	10.2
Sellam and Bour, 2016[43].	2013	Urban	Random sampling	624(Women only)	20-49	100	FPG	WHO 2003	6.2
Benghanem Gharbi et al. 2016 [13].	2009-2011	Urban and rural	Random samling	10524	26-70	51.3	FPG	WHO	13.4
El Boukhrissi et al., 2017[11].	2015	urban	Random sampling	800(Women only)	20- 69	100	FPG	ADA	19
IDF,2018 [2].	2017	Urban and rural	estimation	Total population	20-79	-	-		7.3
IDF, 2017 [8].	2015	Urban and rural	estimation	Total population	20-79				7.7
IDF,2013 [7].	2013	Urban and rural	estimation	Total population	20-79				7.29
IDF,2011 [6].	2012	Urban and rural	estimation	Total population	20-79				7.35
WHO, 2016[9].	2016	Urban and rural	estimation	Total population	>20	-	-	WHO	12.4

FPG: fasting plasma glucose; WHO: World Health Organization; ADA: American Diabetes Association.

ern region was 11.9% in 2001-2002 among a sample of 249 urban no pregnant women aged 15 years and over from Laayoune city, in the South of Morocco [10]; the corresponding data in 2015 among 800 women were 19% in the region of Meknes, in the North of Morocco [11]. The frequency of type 2 diabetes in the east of Morocco has been 10.2% [12]. A study conducted in two cities in central Morocco (Khemisset and El Jadida) which aims the determination of the prevalence of chronic kidney disease, hypertension, diabetes, and obesity in the adult population of Morocco showed that diabetes was at 13.4% of the population surveyed [13]. One study among Moroccan immigrant showed a prevalence of 8% [14]. All studies reviewed confirmed the growing trend of diabetes and that advancing age was positively associated with increasing prevalence of diabetes.

The association between gender and the prevalence of diabetes is inconsistent in the studies from morocco. In our review, the national survey conducted in 2000 revealed that no appreciable difference in the prevalence of diabetes between men and women.

Our review noted that T2DM prevalence is higher in urban than in rural areas. The national wide epidemiological survey in 2000 reported that the prevalence of diabetes among urban residents was greater than that among rural residents: 9% versus 4.4%.

Higher BMI, waist circumference, hypertension, family history of diabetes, food intake are known to increase diabetes risk. Most studies in the present review reported positive associations of these factors with diabetes prevalence.

for instance, a study among women in the southern region revealed that the prevalence of diabetes increased with age, obesity (particularly central fat distribution), hypertension, hypertriglyceridaemia , family history of diabetes and decreased with education level [10]. In this study diabetes was more common among older (>35 years) than younger women (<25 years) (10.3 versus 0%), among obese compared with normal weight women (9.0 versus 2.1%;) and among women with central obesity compared with those with peripheral fat distribution (9.5 versus 0%) and also the diabetic group tended to have higher mean intakes of sucrose, energy derived from sucrose and less physical activity [10].

In the eastern region of morocco Ramdani et al., revealed that the relative frequency of DM was slightly higher in women than in men (10.7% vs. 9.3%, but not significant); the relative frequency of DM was higher in urban (10.9%) than in rural areas (7.9%) and It was also more elevated in obese subjects (15.9%) than in normal ones (9.7%) [12].

3.2 Diabetes complications in Morocco

The studies summarized in Table 2 summarize the most recent data on the prevalence of common complications in diabetic patients from Morocco.

Six studies on the prevalence of complications of diabetes were reviewed (Table 2). The most common complication was retinopathy, their prevalence ranged from 16.8% [15] to 78.4% [16]. Nephropathy prevalence ranged from 4.8% [17] to 48.6% [16]. The prevalence of diabetic neuropathy ranged from 3.6% [15] to 45.6% [17]. High prevalence of cardiopaty was reported by sleihi et al., in 2015.

3.3 Quality of diabetes management in Morocco.

The main goal of diabetes management is to achieve and maintain glycemic control and prevent the occurrence of complications.

TABLE 2
DIABETES COMPLICATIONS IN MOROCCO

Studies	Year	Sample size	Prevalence of complication (%)			
			RT	NP	NR	CR
[17]	2012-2013	1196	69.4	4.8	45.6	50.8
[44]	2009	356	21	34	39	17
[21]	2017	80	23.8	11.3	13.8	1.3
[42]	2012-2014	302	34.1	26.8	38.1	11.3
[15]	2006-2011	2401	16.8	12.8	3.6	5.4
[16]	2008-2010	1029	78.4	48.6	21.7	-

RT: Retinopathy; NP: Nephropathy; NR:Neuropathy; CR: Cardiopaty

Our review showed that a high proportion of patients in Morocco had poor glycemic control (HbA1C>7%). For instance, a study conducted in Fez in some primary health centers involving 1002 patients with type2 diabetes found that 80% of the study population had poor glycemic control [18]. Similarly, high proportions of type 2 diabetic patients with poor glycemic control were reported by the International Diabetes Management Practice Study (DMPS) in Morocco, which reported that 69.1 had HbA1C > 7% and only 0.4% of patients achieved the three targets (HbA1c <7%, systolic blood pressure <130 mmHg and diastolic <80 mmHg and LDL-cholesterol <1.00 g / l) [19]. In line with this, the second International Diabetes Management Practice Study (IDMPS) achieved in 2011 showed that only 26.8% of T2DM patients had achieved the target HbA1c of <7% and only 2.7% achieved the triple target [20].

Another study conducted among 80 of diabetics Moroccan pilgrims in 2017 showed that, the majority of patients admitted did not receive any form of diabetic education. It was reflected in the high prevalence of poorly controlled diabetes. In this study, 71.79% of patients had poor glycemic control (HbA1c>7), 55% had hypertension; and 26.3% had dyslipidemia [21].

In line with this finding, Sleihi et al., in 2015 showed that High blood pressure was present in 49.3% of patients and 77.9% of patients were overweight or obese. Among 1196 diabetics observed, 1017 patients had an HbA1c test in the last three months and 79.8% of them were in glycemic imbalance [17].

A study of 2401 diabetic patients followed at the Reference Center of Diabetes and Chronic Diseases (RCD) in Oujda (Morocco) during the period 2006-2011 revealed that hypertension, overweight and obesity are present in 42.3%, 43.4% and 28.5% respectively, and 80.6% had a high HbA1c (HbA1c >7) [14].

3- DISCUSSION

Diabetes is a common health problem in Morocco. We ob-

served a variation in national diabetes prevalence over the years and between different regions and studies reviewed confirmed the growing trend of diabetes in Morocco.

The present systematic review showed that studies on the prevalence of diabetes at the national level are scarce. Based on the survey conducted by health authorities in 2000, the prevalence of diabetes was about 6.6% in a population aged at least 20 years [5]. However, estimated prevalence in 2016 by the WHO was 12.4 among the population aged 20 years and above in Morocco [9]. Based on the International Diabetes Federation (IDF) reports [6],[7], [8], the rate of diabetes was lower than that reported by the WHO but clearly confirms that the prevalence of T2DM has increased dramatically during the past two decades at national level. Compared with diabetes prevalence found in the Middle East and North Africa, diabetes prevalence in Morocco is lower than that reported in Bahrain (25.7%) [22], Saudi Arabia (23.7%) [23], United Arab Emirates (17.1%) [24]. But, are similar to the prevalence found in Algeria (8.2%) [25], and in Iran (6.9%) [26].The comparison between these prevalence's should be done with caution because of different diagnostic criteria have been used, different methods have been adopted, and different approaches for obtaining representative samples have been performed.

The increase in T2DM prevalence was observed also at the regional level and among samples from a particular population (women, immigrants, etc.). For example, among Saharian women aged 53 years and plus [10], the incidence was only at the level of 11.9% in 2003 but rose to 19% in 2015 among women in the region of Meknes.

A similar trend was noted in two cities in central Morocco (Khemisset and El Jadida), where the prevalence was 13.4% in 2011 [13]. The data obtained from each region reports variation regarding prevalence of T2DM. However, differences in reported prevalence of T2DM within each region can be attributed to the study design, population and diagnostic methods used to obtain these data.

The present review showed similar diabetes prevalence in gender, both in urban and rural area, these findings are in accordance with previous studies in other countries [24], [27], [28], [29].

For the relation between age and diabetes, our review show that diabetes was more frequent among the older age groups and the incidence of DM increases with age, with the same manner as reported in literature.

Even if urbanizing of many rural areas in Morocco carries with it many advantages in term of access to improved medical services, access to education and other "modern" conveniences, the prevalence of T2D was related to urbanization in Morocco. Almost all the studies reviewed which distinguished between urban and rural areas observed a higher diabetes prevalence in urban than in rural areas. For example, the national wide epidemiological survey in 2000 found that the prevalence of T2DM in urban communities was 9%, which was nearly double the prevalence of T2DM in rural areas (4.4%) [5]. In Algeria, a study in the western region of Algeria, the prevalence of T2DM was reported to be at the level of 10.5% and was greater in urban (15.3%) than in rural (12.9%) areas [30]. Similar results were reported in Tunisia [27] and in Saudi Arabia [23]. Another systematic review in North Africa found that urban residence was significantly associated with T2D and its prevalence ranged from 2.6% in rural Sudan to 20.0% in urban Egypt [31]. A possible explanation for the higher urban prevalence of T2D in Morocco could be due to the changes caused by the nutrition transition, including increased fat and caloric intake and decreased physical activity [32].

Higher Body Mass Index (BMI) is known to increase diabetes risk [33] and the effect of weight loss on the glycemic regulation and the reduction of mortality and morbidity due to diabetes has been demonstrated [34].

Most studies in the present review reported positive associations of BMI, with diabetes prevalence [5], [10], [12]. In line with this the first national health survey in Kuwait indicates that 48% obese males and 77% obese females were also diabetics [35], confirming a significant association between obesity and diabetes in the Kuwaiti population. Biologically, abdominal fat may trigger metabolic changes related to insulin resistance [36].

Despite the limited risk factors investigated, it was found in this review that they are similar to the risk factors reported in other countries.

In this review, we evaluated the quality of diabetes management according to the percentage of diabetics with good glycemic control (HbA1c <7%), normal hypertension (systolic blood pressure <130 mmHg and diastolic <80 mmHg) and LDL cholesterol <1.00 g/l).

In this review, studies on the quality of diabetes management show a significant gap between the international recommendations and the current standards for diabetes care in Morocco.

For example the International Diabetes Management Practices Study (IDMPS) conducted in Morocco in 2010 [19] and in 2016 [20] and whose purpose was to assess the therapeutic management of type 2 diabetes mellitus (T2DM) in real-life medical practice showed that The clinical burden of diabetes is high in Morocco and the majority of patients do not achieve the recommended glycaemia target. Similar results were reported by other studies in Morocco [14], [21], [17], [18]. In this point despite the free availability of drugs in Moroccan health centers, patients do not achieve the recommended glycaemia target. One possible explanation is that the drugs available (premixed insulin and metformin) have poor efficacy in achieving good glycemic control in line with Giugliano and colleagues investigations reporting that patients treated with premixed insulin had a higher likelihood of not achieving the target HbA1c compared with patients treated with a basal + prandial regimen [37].

A cross-sectional study conducted among general practitioners exercising in health centers in the province of Khouribga Morocco in 2010 showed that, According to the doctors interviewed, the low socioeconomic status and illiteracy of patients, the lack of means of follow-up and treatment, insufficient number of diabetologists, and coordination problems with other health structures of the second line as well as lack of diabetes training were major problems in good management for diabetics [38].

In order to improve the services provided and overcome inadequate distribution of endocrinologists at the national level,

the Ministry of Health has trained general practitioners in diabetes management and set up integrated centers for chronic disease management [39].

Our review showed a lack of therapeutic education: It is almost absent in the care of diabetics while an optimal management of diabetes passes through a good knowledge of the disease and practical advice, and this through the education of the patient [40],[41].

Limitations

We have to notice that this review has some limitations. Firstly, available data on the prevalence of diabetes in Morocco over the past two decades are limited and it was therefore impossible to describe trends in the prevalence of diabetes over time. Secondly, the reviewed studies used different diagnostic criteria; different methods of sampling and the variable dates of the studies make it impossible to compare the prevalence between studies. Despite these limitations, this current review still provides valuable information on one of the most important chronic diseases and its complications in Morocco.

4- CONCLUSION

The review shows that the prevalence of T2DM in Morocco is increasing over time in an alarming way presenting a major challenge for public health system. The review also identified that the majority of patients with diabetes mellitus did not achieve the recommended glycemic goal, suggesting that there is a huge gap between evidence-based diabetes management and real-life practice. Thus, there is an urgent need to implement prevention, health promotion, and control of diabetes.

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6- DECLARATION OF CONFLICTING INTERESTS

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