

Prevalence of diagnosed and undiagnosed diabetes mellitus in adults aged 19 years and older in Basrah, Iraq

Abbas Ali Mansour
Ahmed A Al-Maliky
Bashar Kasem
Abdulsatar Jabar
Khalid Abdulabass Mosbeh

Al-Faiha Diabetes Endocrine and
Metabolism Center (FDEMC) Basrah,
Iraq

Background: Six of the top ten countries in the world with the highest prevalence of diabetes mellitus are in the Middle East. The objective of this investigation was to evaluate the prevalence of diabetes in Basrah, Southern Iraq.

Methods: A population-based, cross-sectional, simple random study screened 5,445 persons aged 19–94 years in Basrah, with glycated hemoglobin measured in 88.3% of the population and fasting plasma glucose in 18.7%. Body mass index and other demographic parameters were also measured.

Results: Of the 5,445 persons screened, 8.7% had already been diagnosed with diabetes and 11% were found by screening to have undiscovered diabetes, giving an age-adjusted prevalence of diabetes of 19.7%, with 55.7% of those with diabetes being previously undiagnosed. In addition, 29.1% of the screened population had prediabetes, giving a prevalence of dysglycemia of 48.8%, with only 51.2% of the persons screened being normoglycemic. The prevalence of diabetes in both sexes peaked at age 46–60 years. Diabetes was slightly more prevalent in females than in males, and about 70.3% of diabetic individuals had a body mass index ≥ 25 kg/m².

Conclusion: The prevalence of diabetes in Basrah, Iraq, is very high, affecting one in five adults. The epidemic of diabetes will result in strain on the financial resources of health care systems.

Keywords: diabetes mellitus, screening, epidemiology, glycated hemoglobin, Iraq

Introduction

Worldwide, it is estimated that 366 million people have diabetes, with half unaware they have the disease.¹ Of the ten countries with the highest prevalence of diabetes, six are in the Middle East (Kuwait, Lebanon, Qatar, Saudi Arabia, Bahrain, and the United Arab Emirates). In the 20 Arab countries for which data are available, nearly 20.5 million people are living with diabetes and another 13.7 million are in the prediabetes stage, having impaired glucose tolerance. In contrast with developed countries, in which most people with diabetes are over the age of retirement, nearly three quarters (73.4%) of diabetics in Arab countries are under 60 years of age and hence in their most productive years, further increasing the burden of disability due to diabetes.¹

In 2009, an international committee for the diagnosis of diabetes recommended use of glycated hemoglobin (HbA_{1c}), an index of average plasma glucose over several weeks, as a marker for the disease.² This recommendation was also made by the American Diabetes Association (ADA) in 2010,³ which suggested that HbA_{1c} $\geq 6.5\%$ (48 mmol/mol) be considered diagnostic of diabetes. HbA_{1c} is considered equal to fasting plasma glucose (FPG) as a predictor of diabetes.⁴

Correspondence: Abbas Ali Mansour
Diabetes, Endocrine and Metabolism
Division, Basrah College of Medicine,
Hattin, PO Box 142, Basrah 61013, Iraq
Tel +964 78 0140 3706
Email aambaam@gmail.com

Assessments of FPG concentrations have been associated with methodological, procedural, and practical problems, and the oral glucose tolerance test is tedious to perform. Measurements of HbA_{1c} are considered an alternative diagnostic test, overcoming many of the problems associated with other tests.⁵ Moreover, a diagnosis of diabetes can be confirmed by measuring FPG and HbA_{1c} at the same time.⁶ A comparison of the association of diabetic retinopathy with the results of three diagnostic tests (HbA_{1c}, FPG, and 2-hour glucose) in 44,623 individuals showed that FPG (117 mg/dL [6.5 mmol/L]) and HbA_{1c} (6.5% [48 mmol/mol]) were associated with retinopathy, whereas 2-hour glucose concentrations were not.⁷

The ADA does not recommend testing both FPG and HbA_{1c}, because these tests are not completely (100%) concordant, which can lead to confusion. In contrast, the Japan Diabetes Society has recommended that individuals be simultaneously tested for FPG and HbA_{1c} for the diagnosis of diabetes.⁶ Early diagnosis is important for effective management, significantly reducing the risk of complications such as diabetic nephropathy and diabetic retinopathy, but not mortality.^{8,9} The objective of this investigation was to assess the prevalence of diabetes mellitus in Basrah, Southern Iraq.

Materials and methods

Setting and design

Basrah is a governorate located in Southern Iraq, 550 km from the Iraqi capital, Baghdad, with a total population of 3 million. A population-based, cross-sectional, simple random study was performed to screen for diabetes in Basrah between January 2011 and October 2012. Using a Google map, we screened people from the Dur Nuwab Al Dubat, Duran Naft, Dur Al-Dhabaat, Yaseen Khrebit, Al Hayy alMarkazi, Al Iskan, Al-Abelah, Dur Alhindia, Hateen, Al Hadi, and Al Gzaiza districts of Basrah. The study was approved by the ethics committee of the Basrah Directorate of Health and written informed consent was taken from each study participant.

Study subjects

Subjects were invited via the media and during home visits performed as part of a vaccination program to come to the center to be screened for diabetes. The main outcome measure was the prevalence of diabetes among adults. Prior to screening, the participants were informed about the importance of establishing a database for diabetes in Iraq. Participants were excluded if they were younger than 19 years of age or pregnant.

The participants were invited to undergo examination at the Al-Faiha Diabetes Endocrine and Metabolism Center in Basrah, Southern Iraq. Information was collected using a structured, interviewer-administered questionnaire, followed by a physical examination. Age, sex, education level, smoking, and family history of diabetes (first-degree and/or second-degree relatives) were recorded.

Body mass index (BMI) was calculated as kg/m². Participants were categorized according to World Health Organization BMI criteria as normal (<25 kg/m²), overweight (25–29.9 kg/m²), or obese (≥30 kg/m²).

Smokers were defined as those who reported smoking >100 cigarettes during their lifetime and were currently smoking every day or some days. Hypertension was defined as either a resting systolic blood pressure ≥140 mmHg or a resting diastolic blood pressure ≥90 mmHg recorded at a single visit or being prescribed an antihypertensive medication.

Laboratory tests

A blood sample was obtained after an overnight fast and parameters were measured at the center's laboratory. Plasma glucose concentrations were measured using an automated glucose oxidase method (Biolyzer[®] 300; Analyticon Biotechnologies AG, Lichtenfels, Germany). In subjects unable to fast, HbA_{1c} was measured by high-performance liquid chromatography (Variant[™] hemoglobin testing system; Bio-Rad Laboratories Inc., Hercules, CA, USA). This minority agreed to come the next day fasting to do proper oral glucose tolerance test with 75 g anhydrous glucose powder dissolved into 250–300 mL of water.

Diagnosis of type 2 diabetes

Subjects were classified according to ADA criteria, with normal FPG being <100 mg/dL (5.6 mmol/L), impaired fasting glucose being FPG ranging from 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L), and diabetes being FPG ≥126 mg/dL (7.0 mmol/L).² HbA_{1c} concentrations <5.7% were considered normal, those ranging from 5.7% (39 mmol/mol) to 6.4% (46 mmol/mol) were considered prediabetes, and those ≥6.5% (48 mmol/mol) were considered to indicate diabetes. On an oral glucose tolerance test, diabetes was diagnosed if 2-hour plasma glucose was 200 mg/dL (11.1 mmol/L), and the impaired glucose tolerance test was considered in those with plasma glucose 140–199 mg/dL (7.7–11 mmol/L). Persons with impaired fasting glucose or the impaired glucose tolerance test and prediabetes on HbA_{1c} were considered to have prediabetes according to the ADA classification. Study participants were asked if they

had ever been told by a physician that they had diabetes; if so, blood tests were performed to assess diabetes control. This group was defined as the known diabetes group.

Statistical analysis

Continuous variables are presented as the mean \pm standard deviation, and categorical data as frequencies and percentages. The data collected were analyzed by the chi-squared test as appropriate. All statistical analyses were performed using Statistical Package for the Social Sciences version 15 software (SPSS Inc., Chicago, IL, USA). A P -value <0.05 was considered to be statistically significant.

Results

Demographic characteristics of the study population are shown in Table 1. Of the 5,445 individuals screened, 52.6% were women and 47.3% were men. Their mean age was 46.7 ± 14.3 (range 19–94) years and their mean BMI was 27.4 ± 6.4 kg/m²; 40.5% had a family history of diabetes, 16.9% were smokers, and 11.2% were hypertensive.

Screening was by HbA_{1c} measurement in 88.3% of the study subjects, followed by FPG in 18.7%. Of the study subjects, 8.7% had been previously diagnosed with diabetes,

whereas 11% were found by screening to have diabetes, resulting in an age-adjusted prevalence of diabetes of 19.7%. Of those with diabetes, 55.7% were previously undiagnosed. In addition, 29.1% were found to have prediabetes, indicating that dysglycemia was present in 48.8% of the study population, with only 51.2% being normoglycemic (Figure 1).

Table 2 shows the prevalence rates of diagnosed and undiagnosed diabetes according to subject age. The prevalence of diabetes in both sexes peaked at age 46–60 years (Figure 2), with 41.7% of men and 43.9% of women having diabetes. Prediabetes peaked at age 31–45 years in men and at age 46–60 years in women. The prevalence of diabetes was higher in women than in men (19.8% versus 19.6%; $P < 0.0001$), as was the prevalence of prediabetes (29.5% versus 28.6%; $P < 0.0001$).

Table 3 shows the characteristics of study subjects according to glycemically abnormality. The mean age and BMI of those with diabetes and prediabetes was higher than that in those with normoglycemia. Hypertension and family history of diabetes were higher in the combined diabetes and prediabetes groups than in the normoglycemic group. The prevalence of smoking was lower in the diabetes group, but 44.4% of smokers had prediabetes or diabetes.

Distribution of glycemically abnormality according to BMI category is shown in Table 4. Combined diabetes

Table 1 Baseline characteristics of the 5,445 screened individuals

Variables	Mean \pm SD or n (%)
Age, years	
Range 19–94	46.7 \pm 14.3
Sex	
Men	2,577 (47.3)
Women	2,868 (52.6)
Family history	2,205 (40.5)
Smoker	921 (16.9)
Hypertension	612 (11.2)
BMI, kg/m ²	27.4 \pm 6.4
Method of screening	
Fasting plasma glucose	1,017 (18.7)
HbA _{1c}	4,809 (88.3)
Fasting plasma glucose and HbA _{1c}	378 (6.9)
Oral glucose tolerance test	15 (0.3)
Glycemic abnormality	
Isolated impaired fasting glucose	276 (5.1)
Isolated prediabetes	1,263 (23.2)
Combined impaired fasting glucose/prediabetes	45 (0.8)
Normal glycemia	2,790 (51.2)
New diabetes	597 (11)
Known diabetes	474 (8.7)
All diabetes	1,071 (19.7)
All prediabetes	1,584 (29.1)
Total	5,445

Abbreviations: HbA_{1c}, glycated hemoglobin; SD, standard deviation; BMI, body mass index.

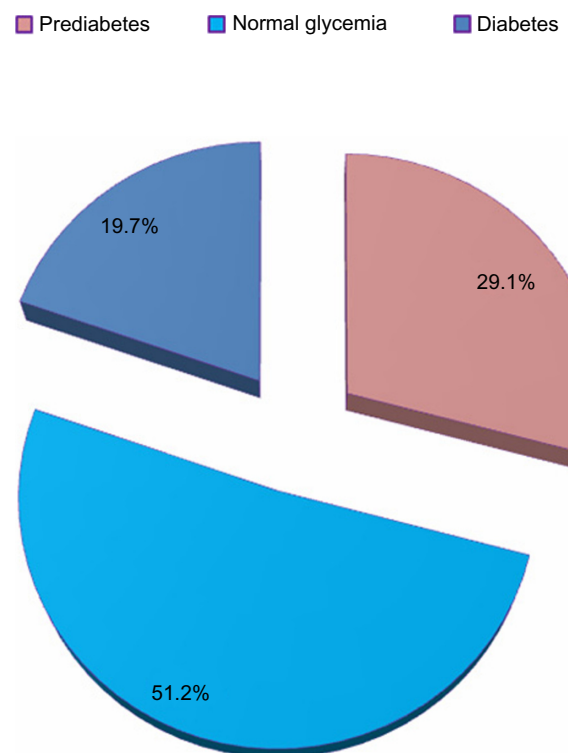


Figure 1 Glycemic abnormalities.

Table 2 Prevalence of dysglycemia according to subject sex and age

Variable	Age, years, n (%)					Total
	19–30	31–45	46–60	61–75	76+	
Men						
n (%)	408 (15.8)	990 (38.4)	723 (28.1)	381 (14.8)	75 (2.9)	2,577 (100.0)
Prediabetes	78 (10.6)	279 (37.8)	201 (27.2)	153 (20.7)	27 (3.7)	738 (28.6)
Diabetes	15 (3.0)	153 (30.4)	210 (41.7)	102 (20.2)	24 (4.8)	504 (19.6)
Normal glycemia	315 (23.6)	558 (41.8)	312 (23.4)	126 (9.4)	24 (1.8)	1,335 (100.0)
Women						
n (%)	345 (12.0)	987 (34.4)	1,008 (35.1)	465 (16.2)	63 (2.2)	2,868 (100.0)
Prediabetes	54 (6.4)	270 (31.9)	333 (39.4)	168 (19.9)	21 (2.5)	846 (29.5)
Diabetes	21 (3.7)	150 (26.5)	249 (43.9)	123 (21.7)	24 (4.2)	846 (19.8)
Normal glycemia	270 (18.6)	567 (39.0)	426 (29.3)	174 (12.0)	18 (1.2)	1,455 (51.8)
Both sexes						
Prediabetes	132 (8.3)	549 (34.7)	534 (33.7)	321 (20.3)	48 (3.0)	1,584 (29.1)
Diabetes	36 (3.4)	303 (28.3)	459 (42.8)	225 (21)	48 (4.5)	1,071 (19.7)
Normal glycemia	585 (21.0)	1,125 (40.3)	738 (26.5)	738 (10.8)	42 (1.5)	2,790 (51.2)

Note: P-value <0.0001.

and prediabetes was more common in overweight and obese people. About 70.3% of those with diabetes had a BMI ≥ 25 kg/m².

Discussion

There is some uncertainty about the prevalence of diabetes mellitus in the Iraqi population. Iraq has undergone rapid economic development in the last 10 years. In December

2011, the International Diabetes Federation reported that, of the ten countries with the highest prevalence of diabetes in adults aged 20–79 years, six were in the Middle East, ie, Kuwait (21.1%), Lebanon (20.2%), Qatar (20.2%), Saudi Arabia (20.0%), Bahrain (19.9%), and the United Arab Emirates (19.2%).¹ Iraq is considered as having a medium prevalence (9.3%) of diabetes in the Middle East based on surveys from 2006 to 2007.^{1,10–12} Diabetes was also found

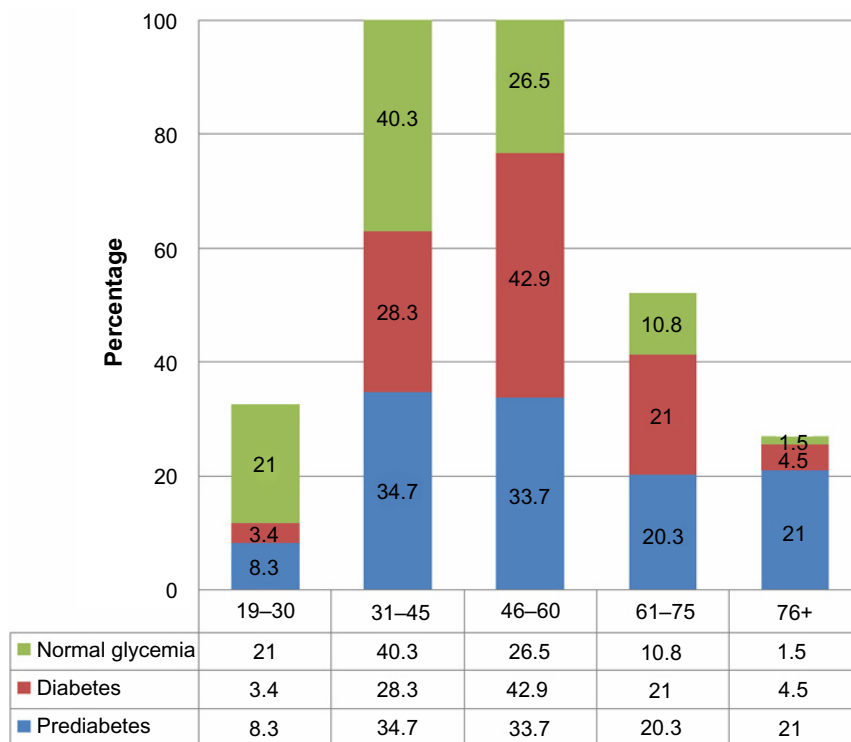


Figure 2 Prevalence of dysglycemia by age in both men and women.

Table 3 Associations between subject characteristics and glycemc abnormalities

	Prediabetes	Diabetes	Normal glycemia	Total	P-value
Age, years, mean \pm SD	49.3 \pm 14.2	52.6 \pm 12.5	42.9 \pm 13.8	46.7 \pm 14.3	<0.0001
Sex, n (%)					
Men	738 (28.6)	504 (19.6)	1,335 (51.8)	2,577	0.001
Women	846 (29.5)	567 (19.8)	1,455 (50.7)	2,868	
BMI, kg/m ² (mean \pm SD)	28.1 \pm 6.6	28.3 \pm 5.6	26.8 \pm 6.6	27.4 \pm 6.4	0.01
Hypertension, n (%)	201 (32.8)	210 (34.3)	201 (32.8)	612	<0.0001
Family history, n (%)	627 (28.4)	603 (27.3)	975 (44.2)	2,205	<0.0001
Smoking, n (%)	267 (29.0)	138 (15.0)	516 (56.0)	921	<0.0001
Total	1,584 (29.1)	1,071 (19.7)	2,790 (51.2)	5,445 (100.0)	

Abbreviations: BMI, body mass index; SD, standard deviation.

to affect 21.9% of Iraqis living in Sweden in 2010.¹³ In the present study of adults in Basrah, Southern Iraq, we found that one in five subjects had diabetes.

We found that the peak age of diabetes in both sexes was in the fourth through sixth decades of life. Studies in Saudi Arabia found that the age-adjusted prevalence of type 2 diabetes mellitus was 30.0%–31.6%, with the highest prevalence in those aged 46–60 years.^{14,15} High diabetes prevalence rates have been observed in other Gulf region countries, including Bahrain (25.7%) and Oman (16.1%).^{16,17} In Lebanon, the combined prevalence of previously diagnosed and newly diagnosed diabetes was 15.8%, with 17.6% in men and 13.4% in women.¹⁸ In Iran, 5.5% of individuals have diabetes, with one third of adults in Tehran having impaired glucose tolerance or diabetes,^{19,20} while in Jordan the age-standardized prevalence of diabetes and impaired fasting glucose was found to be 17.1% and 7.8%, respectively.²¹

In developed countries, in which most people are of European descent, diabetes affects mainly those older than 65 years of age. Similar findings were observed in Iran, where diabetes was more common among older people, with 10.9% of those aged >60 years having the disease.²² However, in most developing countries, the peak incidence of diabetes is between 45 and 64 years. We also observed an association between diabetes and BMI, with 70.3% of Iraqis with diabetes having a BMI \geq 25 kg/m², compared with 85.7% of Saudis with diabetes.¹⁴

Slightly more than half of those with diabetes in our study were undiagnosed at the time of screening, similar to findings in the United Arab Emirates.²³ Reported rates of undiagnosed diabetes in the Middle East and North Africa region have been found to vary, with rates of 29% in Iraq, 50% in Algeria and Iran, 56% among women in Pakistan, and 86% in Tunisia.²⁴

We found that diabetes was more prevalent in women than in men, similar to findings in Iran, but in Jordan there was no difference between sexes.^{19,21} In contrast, the prevalence was higher in men in Saudi Arabia and Lebanon.^{14,18}

Study limitations

The present study had several limitations. First, the boundaries between rural and urban areas became blurred following the 2003 Iraq war. Many people from rural areas migrated to cities, especially when the government of Iraq could no longer control migration. Thus, dividing people into those living in rural and urban areas is no longer feasible. Second, we measured FPG only once. Duplicate measurements of FPG are required for a diagnosis of diabetes due to day-to-day variations.²⁵ For epidemiological studies, however, estimation of diabetes prevalence and incidence using a single elevated HbA_{1c} or FPG measurement is considered acceptable.^{26,27}

Third, this work has the limitations inherent to cross-sectional studies.

Table 4 Glycemc abnormalities according to BMI categories

BMI kg/m ² groups n (%)	Prediabetes	Diabetes	Normal glycemia	Total
<18.5 kg/m ²	48 (19.8)	18 (7.4)	177 (72.8)	243 (100.0)
18.5–24.9 kg/m ²	405 (25.4)	300 (18.8)	888 (55.7)	1,593 (100.0)
25–29.9 kg/m ²	534 (30.1)	360 (20.3)	882 (49.7)	1,776 (100.0)
\geq 30 kg/m ²	597 (32.6)	393 (21.4)	843 (46.0)	1,833 (100.0)
Total	1,584 (29.1)	1,071 (19.7)	2,790 (51.2)	5,445 (100.0)

Note: P-value <0.0001.

Abbreviation: BMI, body mass index.

Conclusion

The prevalence of diabetes in Basrah, Iraq, is very high, affecting one in five adults. This epidemic of diabetes will result in strain on the financial resources of health care systems.

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Author contributions

All authors contributed equally to the collection and/or analysis of data, interpretation of the results, and the conclusion of this research.

Disclosure

The authors have no conflicts of interest to report in relation to this work.

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