

Atherosclerotic cardiovascular disease among patients with type 2 diabetes in Basrah

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Abstract

AIM: To determine the frequency of atherosclerotic cardiovascular disease and its risk factors among patients with type 2 diabetes in Basrah, Iraq.

METHODS: Participants in this cross-sectional study were patients who had type 2 diabetes for at least 1 year, presenting at the Al-Faiha Diabetes Endocrine and Metabolism Center in Basrah (Southern Iraq) over the period from January to December 2008.

RESULTS: The series included 1079 patients (58.8% men), of whom 25.0% were smokers. The prevalence of symptomatic cardiovascular disease and hypertension was 16.0%, and 44.3% respectively. Those who were overweight or obese constituted 70.5%. Insulin was used in only 26.9% despite 56.1% having had diabetes for 6 years and more. The mean glycated hemoglobin (HbA1c) was $9.46\% \pm 2.0\%$ and only 5.5% achieved the target of HbA1c of $< 7\%$. We had 68.7% of patients with total cholesterol of ≥ 200 mg/dL, 21.5% with high density lipoprotein cholesterol of < 40 mg/dL, 84.1% with low density lipoprotein cholesterol of ≥ 100 mg/dL and 71.6% with triglyceride of ≥ 150 mg/dL.

CONCLUSION: Among adults with type 2 diabetes mellitus, there was increased frequency of cardiovascular disease and its modifiable risk factors. This finding necessitated urgent work to modify these risk factors in a population based setting.

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Key words: Cardiovascular risk factors; Diabetes mellitus; Type 2 diabetes mellitus; Cardiovascular disease

Core tip: Atherosclerotic cardiovascular complications are mainly responsible for the high morbidity and mortality in people with diabetes. We studied 1079 patients with type 2 diabetes mellitus to determine the frequency of atherosclerotic cardiovascular disease and its risk factors. The main finding of this study was an increased frequency of cardiovascular disease and its modifiable risk factors among patients with type 2 diabetes in Basrah, Iraq.

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INTRODUCTION

In 2004, the World Health Organization projected that by 2030, the global prevalence of diabetes would double, to affect an estimated 366 million individuals, representing 4.4% of the world population^[1].

Atherosclerotic cardiovascular complications are mainly responsible for the high morbidity and mortality in people with diabetes^[2-4]. Cardiovascular disease (CVD), which includes coronary heart disease (CHD), and stroke, accounts for up to 80% of all deaths among patients with

diabetes^[5], compared with one-third of all deaths in the general population^[6]. This CVD rate in people with type 2 diabetes also varies according to ethnicity^[7].

Atherosclerosis in diabetes is more precocious, aggressive and multi-focal than in the non-diabetic population^[8]. That is why it is recommended to decrease low density lipoprotein cholesterol (LDL-C) < 100 mg/dL (< 70 mg/dL in people with overt CHD with diabetes)^[9]. From a cardiovascular point of view, it has been suggested that diabetic patients should be considered as about 15 years older than the general population^[10]. The chance of cardiovascular events in diabetic patients is as high as in patients with a previous history of myocardial infarction but without diabetes^[11]. Risk factors for CVD in people with diabetes include age, duration of diabetes, smoking, abnormal lipid profiles, raised blood pressure and albuminuria^[12,13].

The aim of this study was to determine the frequency of atherosclerotic CVD and its risk factors among patients with type 2 diabetes in Basrah, Iraq.

MATERIALS AND METHODS

Participants in this cross-sectional study were patients who had type 2 diabetes for at least 1 year, presenting at the Al-Faiha Diabetes, Endocrine and Metabolism Center in Basrah (Southern Iraq) over the period from January to December 2008 and who had not received lipid lowering agents prior to enrollment. This center received patients from all over Basrah and it is the only qualified center treating diabetes in Southern Iraq. Participants gave written consents and the ethical committee of Basrah College of Medicine approved the study.

The definition of CVD included CHD and cerebrovascular accidents (CVA; stroke). CHD diagnosis was based on a history of admission to CCU with elevated cardiac biomarkers, electrocardiographic evidence of ST elevation, Q wave myocardial infarction or left bundle branch block, echocardiographic segmental wall motion abnormalities, abnormal angio-cardiography, percutaneous coronary intervention or coronary artery bypass surgery. The CVA was diagnosed on the basis of sudden neurological deficit that lasted for 24 h, with or without neuroimaging changes.

Variables risk factors for CVD

Potential risk factors for CVD included age, gender, smoking status, waist circumference (WC), body mass index (BMI), hypertension, duration of diabetes, glycated hemoglobin (HbA1c), insulin use, serum total cholesterol and high density lipoprotein cholesterol (HDL-C), triglycerides (TG), and LDL-C. Current smoker was defined as any person who had smoked cigarettes in the preceding three months, regardless of the number.

Hypertension was defined as systolic blood pressure of 140 mmHg or higher, diastolic blood pressure of 90 mmHg or higher, use of antihypertensive agents or a combination of these. Blood pressure was measured in a

seated position after 5 min at rest, three times. The average of the second and third readings was defined as the subject's blood pressure.

Diabetes mellitus was defined as plasma glucose level being 200 mg/dL or higher independent of fasting time, fasting plasma glucose of ≥ 126 mg/dL on two occasions, use of anti-diabetes agents or a combination of these^[14]. After failure of oral antihyperglycemic agents failed we started with basal human insulin neutral protamine Hagedorn at bedtime then basal prandial or pre-mixed twice.

Anthropometric measurements

The waist circumference, was measured in centimeters using a plastic anthropometric tape from the horizontal plane at the umbilical level. Measurement was made with the participant standing erect, abdomen relaxed, arms at the side and feet together with weight equally divided over both legs. Participants were told to breathe normally and to breathe out gently at the time of measurement and not to hold in their abdomen or hold their breath. BMI was calculated as body weight in kilograms divided by the squared value of body height in meters (kg/m^2).

Biochemical analysis

Fasting serum samples were analyzed in the same local laboratory. Blood (10 mL) was drawn into a tube after the subject had fasted for at least 10 h. Serum total cholesterol, HDL-C, and TG were measured by the enzymatic method. LDL-C concentrations were calculated using the Friedewald formula. Risk factors in the lipoprotein profile of participants would be a total cholesterol of equal or more than 200 mg/dL, LDL-C equal or more than 100 mg/dL, HDL-C less than 40 mg/dL and TG level equal or more than 150 mg/dL^[14,15]. HbA1c was measured using a fully automated glycohemoglobin analyzer which uses high performance liquid chromatography.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 15 (SPSS Inc, Chicago, Illinois, United States). Characteristics of the sample are reported as mean \pm SD or frequencies and percentages. Pearson's χ^2 was used to examine if there is an association between two categorical variables and Student's *t* test were used for continuous variables.

RESULTS

Table 1 shows the basic socio-demographic and cardiovascular risk factors. The series included 1079 patients (58.8% men, mean age 56.3 ± 11.37 years; age range, 26-94 years) with a mean qualification period of 6.0 ± 6.0 years and 25.0% were current smokers. The mean duration of type 2 diabetes was of 7.4 ± 6.5 years.

The prevalence of symptomatic CVD was 16.0% and hypertension was seen in 44.3%. The mean WC was 100.2 ± 12.3 cm and BMI 28.0 ± 5.4 kg/m^2 . Those who

Table 1 Sociodemographic and cardiovascular risk factors of 1079 patients *n* (%)

Variable		
Sex	Men	634 (58.8)
	Women	445 (41.2)
Age (yr)	mean \pm SD	56.3 \pm 11.37
	< 40	83 (7.7)
	40–49	220 (20.4)
	50–59	330 (30.6)
	\geq 60	41.3 (41.3)
Education (yr)	mean \pm SD	6.0 \pm 6.0
	Illiterate	455 (42.2)
	\leq 9	326 (30.2)
Current smoking	\geq 10	298 (27.6)
	Yes	270 (25.0)
Duration of diabetes (yr)	No	809 (75.0)
	mean \pm SD	7.4 \pm 6.5
	\leq 5	474 (43.9)
	6–10	361 (33.5)
Known cardiovascular disease	> 10	244 (22.6)
	Yes	173 (16.0)
Hypertension	No	906 (83.9)
	Yes	478 (44.3)
WC (cm)	No	601 (55.7)
	mean \pm SD	100.2 \pm 12.3
BMI	mean \pm SD	28.0 \pm 5.4
	< 25	318 (29.5)
	25–29	396 (36.7)
	\geq 30	365 (33.8)
Insulin use	Yes	290 (26.9)
	No	789 (73.1)
HbA1c (% total Hb)	mean \pm SD	9.46 \pm 2.0
	< 7	59 (5.5)
	\geq 7	1020 (94.5)
Total cholesterol (mg/dL)	mean \pm SD	206.8 \pm 42.6
	< 200	338 (31.3)
	\geq 200	741 (68.7)
HDL cholesterol (mg/dL)	mean \pm SD	46.5 \pm 13.0
	< 40	232 (21.5)
	\geq 40	847 (78.5)
LDL cholesterol (mg/dL)	mean \pm SD	122.6 \pm 35.9
	< 100	172 (15.9)
	\geq 100	907 (84.1)
Triglycerides (mg/dL)	mean \pm SD	193.5 \pm 98.3
	< 150	306 (28.4)
	\geq 150	773 (71.6)

WC: Waist circumference; BMI: Body mass index; HbA1c: Hemoglobin A1c test; HDL: High density lipoprotein; LDL: Low density lipoprotein.

were overweight or obese constituted 70.5%. Insulin was used in 26.9% despite the fact that 56.1% had diabetes for 6 years and more. The mean HbA1c was 9.46 % \pm 2.0% and only 5.5% achieved the target of HbA1c of < 7%. We had 68.7% of patients with total cholesterol of \geq 200 mg/dL, 21.5 % with HDL-C of < 40 mg/dL, 84.1% with LDL-C of \geq 100 mg/dL and 71.6 % with TG of \geq 150 mg/dL.

In Table 2, the sociodemographic and cardiovascular risk factors are shown according to gender. There were no differences between the two groups in the age or duration of diabetes. Qualification levels were statistically higher among men, as was the smoking rate ($P < 0.0001$). Among the 25% current smokers, 87.8% were men. Established CVD and hypertension levels were higher in

Table 2 Sociodemographic and cardiovascular risk factors of 1079 patients according to gender *n* (%)

Variable		Men	Women	P value
Age (yr)	mean \pm SD	56.6 \pm 11.5	55.8 \pm 11.0	0.276
	< 40	44 (53.0)	39 (47.0)	0.650
	40–49	133 (60.5)	87 (39.5)	
	50–59	191 (57.9)	139 (42.1)	
	\geq 60	266 (59.6)	180 (40.4)	
Education (yr)	mean \pm SD	8.2 \pm 2.8	3.0 \pm 4.7	< 0.0001
	Illiterate	160 (35.2)	295 (64.8)	< 0.0001
	\leq 9	228 (69.9)	98 (30.1)	
Current smoker	\geq 10	246 (82.6)	52 (17.4)	
	Yes	237 (87.8)	33 (12.2)	< 0.0001
Duration of diabetes (yr)	mean \pm SD	7.6 \pm 6.9	7.1101 \pm 6.02	0.149
	\leq 5	267 (56.3)	207 (43.7)	0.314
	6–10	222 (61.5)	139 (38.5)	
	> 10	145 (59.4)	99 (40.6)	
Known cardiovascular disease		125 (72.3)	48 (27.7)	< 0.0001
Hypertension		265 (55.4)	213 (44.6)	0.048
WC (cm)	mean \pm SD	100.15 \pm 12.45	100.46 \pm 12.16	0.681
BMI	mean \pm SD	27.7 \pm 5.0	28.5 \pm 5.9	0.029
	< 25	190 (59.7)	128 (40.3)	0.193
	25–29	243 (61.4)	153 (38.6)	
	\geq 30	201 (55.1)	164 (44.9)	
Insulin use	Yes	129 (44.5)	161 (55.5)	< 0.0001
HbA1c (mean \pm SD)	mean \pm SD	9.32 \pm 2.0	9.61 \pm 2.05	0.100
	< 7	35 (59.3)	24 (40.7)	0.928
Total cholesterol (mg/dL)	\geq 7	599 (58.7)	421 (41.3)	
	mean \pm SD	206.2 \pm 42.6	207.7 \pm 42.6	0.658
	< 200	221 (65.4)	117 (34.6)	0.003
HDL cholesterol (mg/dL)	\geq 200	413 (55.7)	328 (44.3)	
	mean \pm SD	45.85 \pm 14.58	47.76 \pm 9.84	0.040
	< 40	173 (74.6)	59 (25.4)	< 0.0001
LDL cholesterol (mg/dL)	\geq 40	461 (54.4)	386 (45.6)	
	mean \pm SD	122.2 \pm 35.5	123.2 \pm 36.5	0.723
	< 100	106 (61.6)	66 (38.4)	0.447
Triglycerides (mg/dL)	\geq 100	528 (58.2)	379 (41.8)	
	mean \pm SD	201.0 \pm 107.1	181.3 \pm 80.60	0.004
	< 150	179 (58.5)	127 (41.5)	0.913
	\geq 150	455 (58.9)	318 (41.1)	

WC: Waist circumference; BMI: Body mass index; HbA1c: Hemoglobin A1c test; HDL: High density lipoprotein; LDL: Low density lipoprotein.

men ($P < 0.0001$ and $P = 0.048$ respectively). There was no difference in the WC but the BMI was higher among women ($P = 0.029$). Insulin was used more commonly among women ($P < 0.0001$), but no differences were seen in the mean HbA1c. No significant differences were seen between the two groups regarding total cholesterol or LDL-C. The HDL-C was higher among women ($P = 0.040$) while TG was higher among men ($P = 0.004$). Subgroup analysis of the two groups showed total cholesterol \geq 200 mg/dL and HDL-C < 40 mg/dL was more common among men ($P = 0.003$ and $P < 0.0001$ respectively).

The percentage of patients with hypertension, current smoker status and levels of HbA1c, LDL-C, and HDL-C outside the target levels according to the studied variables are summarized in Table 3. Men were more likely to be current smokers and have HDL-C < 40 mg/dL, whereas women were more likely to be hypertensive. There were no differences in risk factors between age groups. Illiterates were more likely to be hypertensive and have HbA1c

Table 3 Percentages of patients with type 2 diabetes (*n* = 1079) with cardiovascular risk factors outside target range

Variable (%)	Current smoking	Blood pressure ($\geq 140/90$ mmHg)	HbA1c ($\geq 7\%$)	LDL cholesterol (≥ 100 mg/dL)	HDL cholesterol (< 40 mg/dL)
All	25.0	44.3	86.1	84.1	27.6
Gender					
Men	37.4	41.8	84.4	83.3	32.8
Women	7.4	47.9	87.8	85.2	18.7
<i>P</i> value	< 0.0001	0.048	0.267	0.447	< 0.0001
Age (yr)					
< 40	27.7	45.8	87.2	84.3	33.9
40-49	26.8	39.5	87.3	81.4	26.2
50-59	21.2	45.5	84.4	83.9	27.4
≥ 60	26.5	45.5	86.4	85.4	27.3
<i>P</i> value	0.291	0.469	0.905	0.610	0.727
Education (yr)					
Illiterate	19.3	52.3	86.6	87.9	26.1
≤ 9	31.0	35.3	90.7	82.8	27.8
≥ 10	27.2	41.9	79.4	79.5	29.2
<i>P</i> value	0.001	< 0.0001	0.020	0.007	0.693
Duration (yr)					
≤ 5	25.3	28.7	85.4	84.6	24.6
6-10	26.3	58.4	85.2	84.8	28.5
> 10	22.3	55.8	88.6	82.0	31.7
<i>P</i> value	0.545	< 0.0001	0.672	0.596	0.207
BMI (kg/m^2)					
< 25	25.8	31.1	84.0	84.9	28.4
25-29.9	23.2	47.0	84.6	81.6	26.6
≥ 30	26.3	52.9	89.7	86.0	27.9
<i>P</i> value	0.579	< 0.0001	0.254	0.216	0.873
WC (cm)					
< 80	25.9	15.5	88.6	81.0	23.7
≥ 80	25.0	45.9	85.9	84.2	27.7
<i>P</i> value	0.879	< 0.0001	0.656	0.466	0.585
Insulin use					
Yes	18.3	40.0	92.8	79.7	26.3
No	27.5	45.9	80.7	85.7	28.0
<i>P</i> value	0.002	0.085	< 0.0001	0.019	0.624

WC: Waist circumference; BMI: Body mass index; HbA1c: Hemoglobin A1c test; HDL: High density lipoprotein; LDL: Low density lipoprotein.

$> 7\%$. Those with a duration of diabetes greater than 5 years and those with high BMI and WC ≥ 80 cm were more likely to be hypertensive. Insulin was used less in those who were smokers, and had LDL-C ≥ 100 mg/dL but was used more in those with HbA1c $\geq 7\%$.

DISCUSSION

The prevalence of symptomatic CVD in our study was 16.0%; Current smokers were 25.0%; Hypertension was seen in 44.3% and 70.5% were overweight or obese. In Kuwait, 59.3% of patients with type 2 diabetes were hypertensive, 26.3% were overweight, 65.0% were obese, history of CVD was present in 10.0% of patients and 13.3% were smokers^[16]. Among centers for diabetes, at the University of Jordan, Amman, in patients with type 2 diabetes approximately 70.0% of the patients had hypertension^[17].

In a cohort study of diabetic patients in Lebanon, 43.8% patients were obese, 35.0% were current smokers and hypertension was present in 53.2%^[18]. Among 1846 patients with diabetes in Spain, obesity and high blood pressure were present in $> 50.0\%$, and established CVD in 24.0%^[19]. Of patients with type 2 diabetes in a district

of Madrid, Spain, only 13.0% had a BMI < 25 kg/m²^[20].

In patients with type 2 diabetes mellitus at primary care settings from the North Catalonia Diabetes Study, CVD prevalence was 22.0%, hypertension 74.5%, smoking 14.9% and obesity 44.9%^[21]. Overall, 27.0% of diabetic American Indians reported a history of CVD and 57.0% had hypertension^[22]. Zhang *et al*^[23] found that in 3469 type 2 diabetic in-patients in China hypertension was seen in 41.8%, CHD in 25.1%, cerebral vascular disease in 17.3%.

In our study the mean HbA1c was $9.46\% \pm 2.0\%$ and only 5.5% achieved the target HbA1c of $< 7\%$ while in Kuwait it was 16.2%^[16], in Spain 41%^[20], in Germany 46.6%^[24] and in Lebanon, 32% of patients with type 2 diabetes had HbA1c of $\leq 7\%$ ^[18]. The association between HbA1c and CVD in type 2 diabetes is well known with a relative risk of 1.18 (95%CI: 1.10-1.26) for CVD with a 1% increase in HbA1c^[25].

The insulin was used in our study by 26.9 % of patients despite the fact that 56.1 % had diabetes for 6 years and more. In Lebanon, only 20.0% of patients were taking insulin^[18].

In this study, majority of our patients had lipid profiles outside of the target range. In one study on lipid

profile in apparently healthy volunteers in Mosul, Iraq, 42% of the study population had TG > 150 mg/dL, 58% had LDL-C > 100 mg/dL, and 50 % had HDL-C < 40 mg/dL^[26]. There was no difference in the prevalence of elevated LDL-C by the studied variables except for less use of insulin, a finding that was also seen in Kuwaiti patients^[16]. In Kuwait, 86.2% overall and 63.2% of the patients with type 2 diabetes had LDL-C > 100 mg/dL and HDL-C outside the target levels^[16]. The North Catalonia Diabetes Study showed dyslipidemia in 77.7%^[21]. In Jordan, patients with type 2 diabetes had high LDL-C (\geq 100 mg/dL) in 91.5%, low HDL-C in 83.9%, high TG in 83.1% and high total cholesterol in 77.2%^[17]. In Augsburg Diabetes Family Study, total cholesterol was seen as < 200 mg/dL in 44.1%, and LDL-C was < 100 mg/dL in 16.0% of the participants^[24].

In this study the smoking rate among men was higher than in other studies. Established CVD and hypertension were found more in men, while BMI was higher among women. In Kuwait, hypertension was more prevalent among women than men and smoking was only present among men^[16]. The BMI, and HDL-C were significantly higher in women than men, while TG and total cholesterol was higher among men in Kuwait.

In conclusion, our study demonstrated that among adults with type 2 diabetes mellitus, there was increased frequency of cardiovascular disease and its modifiable risk factors. This finding suggests a need for urgent work to modify these risk factors in the population-based setting.

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COMMENTS

Background

Atherosclerotic cardiovascular complications are mainly responsible for the high morbidity and mortality in people with diabetes. Cardiovascular disease (CVD), which includes coronary heart disease, and stroke, accounts for up to 80% of all deaths among patients with diabetes, compared with one-third of all deaths in the general population. The CVD rate in people with type 2 diabetes also varies according to ethnicity.

Research frontiers

The prevalence of symptomatic CVD was 16.0% and hypertension was seen in 44.3% of patients. Those who were overweight or obese constituted 70.5%. Only 5.5% achieved the target of hypertension, duration of diabetes, and glycosylated hemoglobin (HbA1c) of < 7%. The authors found 68.7% of patients with total cholesterol of \geq 200 mg/dL, 21.5% with high density lipoprotein cholesterol (HDL-C) of < 40 mg/dL, 84.1% with low density lipoprotein cholesterol (LDL-C) of \geq 100 mg/dL and 71.6 % with triglycerides (TG) of \geq 150 mg/dL.

Innovations and breakthroughs

Potential risk factors for CVD included age, gender, smoking status, waist circumference, body mass index, hypertension, duration of diabetes, HbA1c, insulin use, serum total cholesterol and HDL-C, TG and LDL-C. This study demonstrated that among adults with type 2 diabetes mellitus, there was increased

frequency of cardiovascular disease and its modifiable risk factors.

Applications

This finding suggests a need for urgent work to modify these risk factors in the population-based setting.

Peer review

Well written study report provides epidemiological data from a cohort of type 2 diabetes patients in Iraq.

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