

Diabetic patients in Saudi Arabia

The evaluation of glycemic control measures based on emergency department utilization and the percentages of adherence to the recommended follow-ups for microvascular complications

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ABSTRACT

الأهداف: دراسة العلاقة بين عدد مرات زيارة الطوارئ ومستوى التحكم بمرض السكري بين مرضى السكري.

الطريقة: أجريت دراسة مستعرضة من خلال مقابلات تمت بين شهري فبراير و أبريل عام ٢٠١٧م. البيانات تم جمعها من ٥٣٠ شخص تم تشخيصهم بالسكري. تم اختيار جميع المشاركين من عيادات السكري بمدينة الملك سعود الطبية، الرياض، المملكة العربية السعودية.

النتائج: وجدت هذه الدراسة علاقات موجبة ذات دلالة إحصائية قوية ($p < 0.05$) بين عدد زيارات الطوارئ وعمر المريض، ونسبة الهيموجلوبين السكري (HbA1c) ومستوى التعليم. ازدادت عدد الزيارات إلى الطوارئ بنسبة ٤٣٪ لكل وحدة زيادة في الهيموجلوبين السكر، نسبة الأرجحية = 1.43، (95% فترة الثقة = 1.26-1.62). المرضى الذين حصلوا على الشهادة الثانوية انخفضت لديهم احتمالات الزيارة للطوارئ بنسبة 43%، نسبة الأرجحية = 0.57 (95% فترة الثقة = 0.34-0.94)، بالنسبة لمدى التزام مرضى السكري بزيارات الطبيب لعمل الفحوصات والتحليلات اللازمة لمضاعفات السكري. معظم المشاركين لم يزوروا عيادات الكلى (96.2%) وأمراض العيون (78.3%) والعصبية (97.9%) خلال 12 شهرًا قبل إجراء المقابلات.

الخلاصة: تشير هذه النتائج إلى أن الزيادة في عدد الزيارات للطوارئ تشير إلى أن مستوى التحكم بالسكري سئ بين مرضى السكري. وكذلك تشير الدراسة إلى ضعف التزام مرضى السكري بزيارات الطبيب لعمل الفحوصات والتحليلات اللازمة لمضاعفات السكري المقدمة من توصيات الجمعية الأمريكية للسكري.

Objectives: To determine the association between emergency department (ED) visits, glycemic control and the quality of preventive diabetes care among diabetic patients in a Saudi community.

Methods: This study was an observational, cross-sectional study that collected data through interview-

based surveys between February and April 2017. Data were collected from 530 diabetic patients in the diabetes clinics at King Saud Medical City, the tertiary center of Riyadh, Kingdom of Saudi Arabia.

Results: This study found statistically significant relationships ($p < 0.05$) between ED visits and patient age, the glycated hemoglobin (HbA1c) and education level. Emergency department visits increased by 43% for each unit of increase in HbA1c (odds ratio [OR]=1.43, 95% confidence interval (CI)=1.26-1.62). Graduating from high school decreased the odds of visiting the ED by 43% (OR=0.57, 95% CI=0.34-0.94). Most of the participants were not followed for possible microvascular complications; the majority did not visit nephrology (96.2%), ophthalmology (78.3%) and neurology (97.9%) clinics within the 12 months prior to the interviews.

Conclusion: Emergency department visits can indicate poor glycemic control in diabetic patients. Additionally, the current practices of preventive diabetes care in Saudi Arabia are not sufficient, according to the diabetic standards of care recommended by the American Diabetes Association.

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Diabetes mellitus (DM) is a cluster of metabolic diseases defined by hyperglycemia, which result from imperfections in insulin secretion, action or both.¹ The sequela of chronic, untreated diabetes may be long-term impairment of different organs, especially the kidneys, eyes, nerves, blood vessels and heart.¹ Worldwide, the prevalence of diabetes has approximately doubled (from 4.7% to 8.5%) in the adult population since 1980, with an estimated 415 million diabetic patients and 5 million diabetes-related deaths in 2015.^{2,3} In Saudi Arabia, the overall adults' prevalence of DM is 23.7%, and as declared by the International Federation of Diabetes, Saudi Arabia is one of the 10 most affected countries in the world.^{4,5} Furthermore, diabetes is considered the leading cause of vision loss in the industrialized world, as well as the chief cause of renal failure, which requires dialysis or renal transplantation in the United States (US), Japan and Europe.⁶ The US alone spends more than \$218 billion each year on medical expenses related to diabetes.⁷ As diabetes is a chronic disease, people who are diagnosed with diabetes require regular clinical follow ups to mitigate and manage the potential complications.⁸ The American Diabetes Association (ADA) guidelines recommend that all diabetic patients obtain education and ongoing support for the self-management of diabetes.⁸ Each patient should be engaged in improving their own self-care regimen, including the self-monitoring of blood glucose, compliance with multiple medications, adherence to the prescribed diet and exercise, proper foot care and risk elimination such as smoking cessation and annual immunizations.^{9,10} Although these recommendations are accepted globally, they are not implemented in many populations of diabetic patients.^{11,12} Therefore, it is still difficult to estimate successful self-care accurately.¹³ Moreover, when diabetic patients select the emergency department (ED) for their care, it costs many resources and does not translate into the preventive care that clearly is necessary for this chronic condition.¹⁴⁻¹⁷ Prior studies worldwide found a positive relation between diabetic patients' visits to the ED and poor diabetes management.^{18,19} There is limited current literature about the relation between ED visits, glycemic control and the quality of diabetes care in the Saudi community. This study aimed to illustrate

the relationship of ED visits and glycemic control together with determination of the preventive diabetes care among diabetic patients in a Saudi community.

Methods. This study was an observational, cross-sectional study that collected data through interview-based surveys between February and April 2017. Data were collected in the diabetes clinics at King Saud Medical City, the tertiary center in Riyadh, Kingdom of Saudi Arabia. Ethical approval was obtained from the Institutional Review Board of Al-Imam Muhammad Ibn Saud Islamic University and a written informed consent was taken from all participated patients.

Participants, data collection and processing. All participants had diagnosed diabetes. Exclusion of patients was based on their diagnosis of gestational diabetes, psychiatric illness, or if they were medically unstable and hence incapable of answering questions or were unwilling to participate. This study was completed by 530 participants, aged between 18-70 years. Participants answered questions about demographics (age, gender, marital status, nationality, education level, employment and body mass index), diagnosis (type of DM, age at time of DM diagnosis and presence of other comorbid diseases), treatments (oral hypoglycemic agent, insulin and others), diabetic microvascular complications (retinopathy, nephropathy and neuropathy), follow-ups for these particular complications (ophthalmic, nephrology and neurology clinics) and the frequency and quantity of ED admissions in the 12 months prior to the interviews. In addition, each patient's medical file supplied data on glycemic control (glycated hemoglobin [HbA1c] and fasting blood sugar), lipid profile (total cholesterol level, triglycerides, low-density lipoprotein and high-density lipoprotein) in mmol/L unit and kidney function tests (creatinine and urea). These lab tests, regular measurements, and follow-ups for surveillance and management were used to predict which diabetic patients were at risk for inadequate care based on the 2016 ADA recommendations.²⁰

Data analysis. The Chi-square test was utilized to examine the bivariate relationships between all-out categorical variables and ED visits. The t-test was used to compare continuous variables across the 2 groups of interest (visited the ED in the past 12 months, or not). Collinearity was assessed with the Pearson correlation.

The independent predictors of ED visitation were determined by binary logistic regression test. Only 3 variables (age, level of education and HbA1c) showed significant association with the visitation of ED in the initial univariate test, and were then included in a step-wise manner to the binary logistic regression

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analysis model. Models were compared using the likelihood ratio test with the least parsimonious model. Odds ratios (OR) and 95% confidence intervals (CI) were calculated. Significance of regression coefficients was assessed using the Wald test. Lastly, 2-tailed hypothesis testing was performed, and $p < 0.05$ was considered statistically significant. Statistical analysis was completed using the Statistical Package for Social Science (SPSS) Version 25, (IBM Corp., Armonk, NY, USA).

Results. Table 1 contains the descriptive characteristics of participants besides the t-test analyses and the chi-square analyses. In this study, the number of included DM patients is 530. The mean age for patients was 52.62 ± 13 years. Males constituted 69.6% (n=369) of the study population while females constituted 30.4% (n=161). Type I diabetic patients comprised 10.9% of the study population (n=58) while type II diabetic patients constituted the remaining 89.1% (n=472). The average body mass index (BMI) was 28.95 ± 7.24 . Most of the patients were Saudi (n=384, 72.5%). More than half of these patients had not visited the ED during the 12 months prior to the study (n=355, 67%), and the average number of the visits during that time was 1 ± 2 . The mean HbA1c was higher than the target (8.69 ± 2.41). Almost half of the patients had hypertension (n=250, 47.2%) and less than 20% of the patients had another comorbidity (most commonly dyslipidemia and chronic kidney disease).

Tables 2 and 3 provide the t-test analyses along with the chi-square analyses of the variables of interest versus visiting the ED. Statistically significant relations emerged between ED visits and patient age, HbA1c

Table 1 - Characteristics of the study population (N=530).

Variables	n (%)
Demography	
Age (years), mean \pm SD	52.7 \pm 13
Gender (male vs. female)	369 vs. 161 (30.4 vs. 69.6)
Nationality (Saudi vs. other)	384 vs. 146 (72.5 vs 27.5)
Obese	277 (52.2)
Married	479 (90.4)
Employed	24 (45.9)
Graduated high school	150 (28.3)
Body mass index, mean \pm SD	29 \pm 7.2
DM	
DM duration (years), mean \pm SD	12 \pm 10
Type of diabetes (Type I vs. Type II)	58 vs. 472 (10.9 vs. 89.1)
On oral hypoglycaemic	303 (57.2)
On insulin	260 (49.1)
ED visits within the 1 year prior to study	
Visited the ED	175 (33)
Mean visits \pm SD	1 \pm 2
Blood test performance, mean \pm SD	
Total cholesterol level (mmol/L)	4.4 \pm 1.3
Triglycerides (mmol/L)	1.6 \pm 1.1
LDL (mmol/L)	2.7 \pm 1.2
HDL (mmol/L)	1.1 \pm 0.4
Glycated Haemoglobin (HbA1C) (%)	8.7 \pm 2.4
Fasting blood glucose (mmol/L)	10.8 \pm 4.7
Serum Creatinine (Log10)	1.9 \pm 0.3
Urea (Log 10)	0.8 \pm 0.3
Diagnosis	
Hypertension	250 (47.2)
Dyslipidaemia	88.5 (16.7)
Chronic kidney disease	40.3 (7.6)

SD - standard deviation, DM - diabetes mellitus, ED - emergency department, LDL - low-density lipoprotein, HDL - high-density lipoprotein - vs - versus

Table 2 - The relationship between continuous demographics characteristics and visiting the emergency department (N=530)

Variables	Visited the ED in the past 1 year (n=175)		Never visited the ED in the past 1 year (n=355)		P-value
	Mean	SD	Mean	SD	
Age (years)	51	14	54	13	0.011
Body mass index	28.5	6	29.4	8.3	0.553
DM duration (years)	13	10	11	9	0.172
Total cholesterol level (mmol/L)	4.5	1.4	4.4	1.2	0.375
Triglycerides (mmol/L)	1.8	1.1	1.5	1	0.122
LDL (mmol/L)	2.7	1.6	2.6	1.1	0.847
HDL (mmol/L)	1.1	0.4	1.1	0.3	0.503
Glycated Haemoglobin (HbA1c) (%)	10.1	2.7	8	1.9	<0.001
Serum Creatinine (Log 10)	2	0.3	1.9	0.3	0.277
Urea (Log 10)	0.8	0.3	0.8	0.3	0.901

SD - standard deviation, DM - diabetes mellitus, LDL - low-density lipoprotein, HDL - high-density lipoprotein, ED - emergency department

and education level ($p < 0.05$ for all). Those 3 variables were then included in a binary logistic regression, the results showed 2 of them were statistically significant. Hemoglobin A1c was significantly associated with visiting the ED, with a 43% increase in the odds of visiting the ED with each one-unit increase in HbA1c (OR=1.43, 95% CI=1.26-1.62). Graduation from high school decreased the odds of visiting the ED by 43% (OR=0.57, 95% CI=0.34-0.94).

Table 4 provides information about participant follow-ups for possible microvascular complications in the 12 months prior to the study. The large majority of both type 1 and type 2 DM patients did not follow up with nephrology (96.2%), ophthalmology (78.3%), or neurology (97.9%) clinics, combining both types of diabetes during the 12 months in question.

Discussion. This study determined that there is an independent positive relationship between HbA1C and ED visits, which continue its significance in

accordance to the adjustment achieved by analysis of logistic regression. Every unit of increase in HbA1c had an adjusted OR of 1.43. This finding agrees with the results of other studies. Chiou et al (2009) analyzed 7 years of data (1999-2006) from type 2 diabetic patients who received care under a diabetes disease management program provided by the Louisiana State University Health Care Services Division (LSU HCSD) in New Orleans, Louisiana, US.¹⁸ The authors stated that the better (lower) levels of HbA1c of DM patients were associated with lower visits into the ED (OR=0.8173, 95% CI=0.7444 -0.8974).¹⁸ Moreover, Moss et al (1999) studied a sample of 2990 diabetic patients in an 11-county area of southwest Wisconsin, US, to evaluate the risks of admission. They discovered that elevated HbA1c was significantly associated with the increment of hospitalization risk (OR= 1.27, 95% CI=1.16-1.39) for a one-unit increment.¹⁹ The medical records from the ED visits demonstrated that these patients had higher risks of cardiovascular, neurological,

Table 3 - The relationship between categorical demographics characteristics and visiting the emergency department (N= 530).

Variables	Visited the ED in the past 1 year (n = 175)		Never visited the ED in the past 1 year (n = 355)		P-value
	n	(%)	n	(%)	
Gender (male vs. female)	116 vs. 59	(31.4 vs. 36.6)	253 vs. 102	(68.6 vs. 63.4)	0.241
Nationality (Saudi vs. other)	134 vs. 41	(34.9 vs. 28.1)	250 vs. 105	(65.1 vs. 71.9)	0.136
Obese (yes vs. no)	88 vs. 87	(50 vs. 47.1)	178 vs. 177	(50 vs. 52.9)	0.771
Married (yes vs. no)	155 vs. 20	(67.6 vs. 60.8)	324 vs. 31	(32.4 vs. 39.2)	0.322
Employed (yes vs. no)	71 vs. 94	(31.8 vs. 35.7)	152 vs. 169	(68.2 vs. 64.3)	0.365
Graduated high school (yes vs. no)	37 vs. 128	(26.8 vs. 36.6)	101 vs. 222	(73.2 vs. 36.4)	0.04
Type of diabetes (type I vs. type II)	24 vs. 151	(41.4 vs. 32)	34 vs. 321	(58.6 vs. 68)	0.151
On oral hypoglycaemic (yes vs. no)	92 vs. 83	(30.4 vs. 36.6)	211 vs. 144	(69.6 vs. 63.4)	0.133
On insulin (yes vs. no)	95 vs. 80	(36.5 vs. 29.6)	165 vs. 190	(63.5 vs. 70.4)	0.091
Hypertension (yes vs. no)	75 vs. 80	(30 vs. 34.9)	175 vs. 149	(70 vs. 65.1)	0.249
Dyslipidaemia (yes vs. no)	26 vs. 119	(35.1 vs. 32.2)	48 vs. 272	(64.9 vs. 67.8)	0.619
Chronic kidney disease (yes vs. no)	(12 vs. 129)	(36.4 vs. 32.2)	(21 vs. 272)	(63.6 vs. 67.8)	0.621

vs - versus

Table 4 - Preventative care behaviours for the past year among diabetic patients in Saudi Arabia.

Measures of care (past 1 year)	Response	Type I	Type II	Total
		n (%)	n (%)	n (%)
Visited at least one of the clinics	No	38 (65.5)	381 (80.7)	418 (78.8)
	Yes	20 (34.5)	91 (19.3)	112 (21.2)
Visited Nephrology clinic	No	53 (91.4)	457 (96.8)	510 (96.2)
	Yes	5 (8.6)	15 (3.2)	20 (3.8)
Visited Ophthalmology clinic	No	39 (67.2)	376 (79.7)	415 (78.3)
	Yes	19 (32.8)	96 (20.3)	115 (21.7)
Visited Neurology clinic	No	55 (94.8)	464 (98.3)	519 (97.9)
	Yes	3 (5.2)	8 (1.7)	11 (2.1)

renal and ophthalmic problems, precipitating more frequent and longer admissions compared with a non-diabetic population.²¹ Jiang et al¹⁹ (2003) highlighted the importance of greater age as a risk for multiple admissions and hospitalizations, though our study did not find this effect to be significant after adjusting for confounders as in Moss et al²²(1999).

Raman et al²³ (2012) studied a group of 1414 diabetic patients in Sankara Nethralaya, India, and found that the prevalence of any type of microvascular complication was 30.2% (OR= 30.2, 95% CI=24.5-35.9). The current ADA preventive care guidelines recommend follow ups for possible microvascular complications, including nephropathy, retinopathy and neuropathy. In the Raman et al²³ (2012) study, more than 75% of the interviewed diabetic patients had not attended any of these specialty clinics in the 12 months prior to the interview. These results agree with the findings of other studies, conducted in different settings as well as in different countries, all of which support the implementation of the preventive measures recommended by the ADA. For instance, in a prospective study of diabetic patients in Alabama, US, between January 2012 and May 2015, Keenum et al²⁴ (2006) found that only one-third of their patients clung to the recommendations for eye care follow ups. In Tanzania, Mtuya et al²⁵ (2016) found that 75.4% of the participants did not attend the recommended referral eye care appointment during 2012. The reasons for these poor rate of follow ups was attributed to low financial status, unclearness of referral process, unawareness of the potential of treatments of these complications by DM patients.^{25,26}

Study limitations. The limitations of this study include its use of interviews, which created a reliance on self-reported data that is at risk for misclassification. In addition, this study included data collected from only one tertiary center; however, as this center is the largest of the kingdom, it is likely that the patient group was representative of the larger population of interest, and the chance of bias of selection is low. This study further limited by the questionnaire was not formally validated. Also, as with all cross-sectional studies, this study suggests relations but cannot demonstrate causation. Consequently, further prospective cohorts and interventional trials should be conducted to verify the outcomes we report. This study was advantageous from the perspective of sample size, which reflected a representative cross-section of diabetic patients in the capital city of Saudi Arabia. The data is recent and thus applicable to the current population. Lastly, this research fills a gap in the contemporary literature about

the relation between ED visits, glycemic control and the quality of diabetes care among DM patients in the Saudi community.

In conclusion, this study demonstrated that ED visits by diabetic patients can indicate poor glycemic control, quantified by HbA1c. Additionally, the current practice of preventive diabetes care (namely, the frequency of follow-ups to monitor for possible microvascular complications) does not satisfy the current ADA recommendations. There is a need for further prospective studies on a large cohort of patients to substantiate these results and to elucidate the factors that drive the current poor practices of diabetes care.

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