Predictors of Diabetes Mellitus Type 2 Control

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ABSTRACT
Background: successful treatment of patients with type 2 diabetes mellitus (DM) is achieved by having a HbA1C of<7%.
Objectives: to determine the factors that affect successful control of diabetes mellitus type 2 at Diabetic centre, King Khalid hospital, Ministry of Health, Tabuk, KSA.
Subjects and Methods: a cross-sectional study was carried out at Diabetic centre, King Khalid hospital, Ministry of Health, Tabuk, KSA. A representative sample of adult diabetes mellitus type 2 patients (18-60 years) both sexes, who attend diabetic center clinics during month of November 2016 were included. Self-administer questionnaire was used for data collection. Last HBA1c level was addressed.
Results: almost one-third of the participants (n=342), aged between 41 and 50 years (35.1%) whereas 11.4% aged over 50 years. Male patients represent 65.8% of them. The duration of diabetes was more than 10 years in 45.6%. Diabetic complications were reported by 26% of diabetic patients. Regarding diabetes therapy, a combination of oral hypoglycemic and insulin was reported by 21.1% of them while insulin alone and oral hypoglycemic alone were reported by 42.1% and 36.8% of the participants, respectively. It is evident that DM was controlled among only 32.5% of the diabetic patients (HBA1C was less than 7%) while it was uncontrolled among almost two-thirds of them (67.5%). Logistic regression analysis revealed that patients aged between 41 and 50 years were at lower risk compared to those aged 20-30 years (OR=0.13, p=0.008). Females were less likely compared to males to have uncontrolled diabetes (OR=0.25, p=0.007). Patients having more than three children were at higher risk for uncontrolled diabetes opposed to those without children (OR=11.19, p=0.003). Patients having income ranged between 10001 and 15000 were more protective than whose income was ≤5000 SR/month to develop uncontrolled diabetes (OR=0.22, p=0.007). Patients without diabetic complications were less likely to have uncontrolled diabetes compared to those with complications (OR=0.24, p=0.004). Patients treated with either insulin alone or a combination of insulin and oral hypoglycemic (OHGs) were at higher risk for uncontrolled diabetes compared to those treated with OHGs alone (OR=3.51 and 3.07, p=0.007 and 0.027. respectively). Patient who never compliant with diabetic diet were more prone to uncontrolled diabetes (OR=15.09, p<0.001).
Conclusion: the study revealed relatively high prevalence of poor glycemic control as expressed by HbA1c≥7%. There is a strong need for public education programs and for promoting public awareness about control of blood glucose level in Saudi Arabia.
Keywords: Diabetes type 2, control, HBA$_1$c, predictors

INTRODUCTION

Proper management of type 2 diabetes depends mainly on a combination of life style modification, controlling of cardiovascular risk factors, and keeping normal level of blood glucose[1]. Intensive blood glucose lowering as compared to standard blood glucose lowering was not associated with reducing mortality. Successful treatment of patients with type 2 diabetes mellitus (DM) is achieved by having a glycated hemoglobin (HbA$_1$C) of < 7%[2].

A new strategy for managing patients with type 2 DM should address the accompanied risk factors and morbidities of obesity, hypertension, and dyslipidemia with equal or occasionally even greater aggressiveness than for hyperglycemia. Using of anti-diabetic agents that may address cardiovascular risk factors should be considered more strongly in treatment algorithms, although no drug therapy is likely to be

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successful without being accompanied by lifestyle changes[3, 4].

Reducing HbA$_1$c levels has been found to reduce the incidence of microvascular complications of diabetes and is associated with decreased risk of myocardial infarction and fatal cardiovascular events[5].

Diabetic patients should receive medical care from a physician-coordinated team. This team should involve patients' families and assess social factors in diabetic patients which assume to play an effective role in their glycaemic control [6].

This study aimed to determine the factors that affect successful control of diabetes mellitus type 2 at Diabetic centre, King Khalid hospital, Ministry of Health, Tabuk, Kingdom of Saudi Arabia (KSA).

SUBJECTS AND METHODS

A cross-sectional study was carried out at Diabetic centre, King Khalid hospital, Ministry of Health, Tabuk, KSA during month of November 2016.Tabuk is the capital city of the Tabuk Region in northwestern Saudi Arabia. It has a population of 534,893 according to 2010 census[7].A representative sample of adult type 2 diabetic patients (18-60 years) of both sexes, were included.

Successful control of type 2 diabetes mellitus (DM) has been defined according to American diabetes association (ADA) by achievement of targeted glycaemic control $HBA1C < 7$[8].

Sample size was calculated according to random sample size determination equation as 337. Data collection time was 4 weeks. Self administer questionnaires were given to the diabetic patients. Patients submitted the filled questionnaires to the treating physician, who added the last HBA1c level.

Self administered questionnaire in Arabic language were utilized by the researchers to collect data from patients attending diabetic clinics in diabetic centre. It included demographic data, diabetes history, and social factors. Glycated hemoglobin (HBA$_1$C) was recorded from the file of the patient. Three consultants from three different specialties (diabetologist, family medicine, community medicine) validated the questionnaire before use. The study was approved by the Ethics Board of Tabuk University.

Statistical Package for Social Sciences (SPSS) software version 23.0 was used for data entry and analysis. Descriptive statistics (number, percentage for categorical variables and mean, standard deviation and range for continuous variables).Multivariate logistic regression analysis was applied including significant variables from bivariate analysis to control for the confounding effect. P-value less than 0.05 was considered statistically significant.

RESULTS

Table 1 presents the demographic characteristics of the diabetic patients (n=342). Almost one-third of them (35.1%) aged between 41 and 50 years whereas 11.4% aged over 50 years. Male patients represent 65.8% of them. The majority of them (85.1%) were married. Most of them (74.6%) and had more than three children, had private houses (59.6%). Majority of them (93.9%) reside urban area. More than one-quarter of them (29.8%) had family members working in health field and 17.5% had university degree. The income was less than 5000 SR/month among 30.7% and more than 15000 SR/month among 6.2% of the participated diabetic patients.

Table 2 illustrates that the duration of diabetes was more than 10 years in 45.6%. Diabetic complications were reported by 26% of diabetic patients. Regarding diabetes therapy, a combination of oral hypoglycaemics and insulin was reported by 21.1% of them while insulin alone and oral hypoglycaemics alone were reported by 42.1% and 36.8% of the participants, respectively. Most of diabetic patients (78.1%) were satisfied with diabetic therapy and 21.9% have mentioned that they never compliant with diabetic diet regimen while 39.5% were always compliant with it. Majority of the participants (91.2%) were supported by their families in diabetes therapy. History of social upset was reported by 64% of diabetic patients. Prevalence of current smoking was 25.4% whereas that of ex-smoking 12.3%.

From figure 1, it is evident that DM was controlled among only 32.5% of the diabetic patients (HBA1C was less than 7%) while it was uncontrolled among almost two-thirds of them (67.5%).

Table 3 summarizes the results of logistic regression analysis for determinants of uncontrolled diabetes. Patients aged between 41 and 50 years were at lower risk compared to those aged 20-30 years (OR=0.13, 95% CI: 0.03-0.58, p=0.008). Females were less likely compared to males to have uncontrolled diabetes (OR=0.25, 95% CI: 0.09-0.69, p=0.007). Patients having more than three children were at higher risk for uncontrolled diabetes opposed to those without children (OR=11.19, 95% CI: 2.26-55.4, p=0.003). Patients having income ranged between 10001 and 15000 were more protective than whose income was ≤5000 SR/month to develop uncontrolled diabetes (OR=0.22, 95% CI: 0.07-0.65, p=0.007). Patients without diabetic complications were less likely to have uncontrolled diabetes compared to those with complications (OR=0.24, 95% CI: 0.09-0.64, p=0.004). Patients treated with either insulin alone or a combination of insulin and OHGs were at higher risk for uncontrolled diabetes compared to those treated with OHGs alone (OR=3.51 and 3.07 95% CI: 1.41-8.74 and 1.14-8.29, p=0.007 and 0.027. respectively). Patient who never compliant with diabetic diet were more prone to uncontrolled diabetes (OR=15.09, 95% CI: 3.99-57.1, p<0.001).

DISCUSSION

Traditionally, glycemic control has been used to define thesuccessful therapy of type 2 diabetes mellitus. The American Diabetes AssociationGuidelines have established anHbA$_1$c target goal less than 7.0% for glycemic control[8]. This cut-off value was utilized in the present survey to define glycemic control.

The present study revealed that almost two-thirds of type 2 diabetic patients were uncontrolled as expressed by level of HbA^{1}c of 7% or over. In another study carried out in Riyadh (Saudi Arabia)[9], lower figures based on two readings of fasting and postprandial blood glucose, have been reported (44-49%).Another study carried out in Riyadh,reported that 77% of the patients had HbA1 values above 7%[10].In a more recent study, a rate of 73% of uncontrolled diabetes has been reported[11].

In Arabic countries, comparable figures have been cited.In Kuwait, 66.7% of the type 2 diabetic population had HbA1c ≥8%[12]. In Jordon[13] Poor glycaemic control (HbA1c ≥7%) was present among 65.1% of patients.

Internationally, In Netherlands, almost half of type 2 diabetes patients had levels ofHbA1c over 7.0%[14].In Trinidad, 85% had HbA1c ≥7%[15].In Pakistan [16], 46.7% of patients had HbA1c ≥7.5%. Furthermore, HbA1c was >8% in 24.5% of diabetics in a report from National Health and Nutrition Examination Survey 2I[17].In UK, 69% of diabetic patients had HbA1c>7.5% [18].

In the current study, patient`s age was significantly associated with glycemic control as those aged between 41 and 50 years were less likely to have uncontrolled diabetes controlled to younger patients. This finding is consistent with the reports from other studies [19-21],where younger patients were significantly associated with poor glycaemic control.

Finding an association between never adherence to diet regimen and poor glycemic control was proved in the current study. This finding is alarming, therefore, continuous education is recommended to encourage diet regimen and medication adherence among diabetic patients. Also in the present study low-socio-economic class patients manifested by low income and having more children were more likely to have poor glycemic control. They should be specifically targeted in any educational programs

In the current study, patients treated with a combination of oral hypoglycemics and insulin or insulin only was more likely to be associated with poor glycemic control. This is consistent with other studies[14, 22]. This may be due to the fact that patients who were treated by insulin or combination therapy of oral hypoglycemics and insulin required more aggressive therapy to achieve glycemic control as a result of having more progressive disease.

As expected, patients with history of diabetic complications in the current study were more likely to have uncontrolled diabetes. This finding is consistent with other studies[23, 24].

The study has some important limitations that should be mentioned. The cross sectional design which does not establish causalrelationship between the cause and outcome variables. The questionnaire used is self-reported which subjected to recall bias. Finally,

subjects were recruited from one health facility in Tabuk which could influence the generalizability of results.

In conclusion, the study revealed relatively high prevalence of poor glycaemic control as expressed by HbA1c≥7%. There is a strong need for public education programs and for promoting public awareness about control of blood glucose level in Saudi Arabia.

ACKNOWLEDGEMENTS

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Table (1): Demographic characteristics of the participants

Demographic data	Frequency N=342	Percentage
Age in years		
20-30	51	14.9
31-40	132	38.6
41-50	120	35.1
>50	39	11.4
Sex		
Male	225	65.8
Female	117	34.2
Marital status		
Single	36	10.5
Married	291	85.1
Divorced/widowed	15	4.4
Number of children		
No	36	10.5
≤3	51	14.9
>3	255	74.6
Housing		
Rural	21	6.1
Urban	321	93.9
Family member working in medical field		
Yes	102	29.8
No	240	70.2
Type of accommodation		
Private	204	59.6
Governmental	66	19.3
Rent	72	21.1
Education		
Illiterate/primary school	78	22.8
Intermediate	81	23.7
Secondary school	123	36.0
University/above	60	17.5
Income (SR/month)		
≤5000	105	30.7
5001-10000	99	28.9
10001-15000	117	34.2
>15000	21	6.2

Table (2): Medical and social history of the diabetic patients (n=342).

Medical history	Frequency	Percentage
Duration of diabetes (years)		
<1	15	4.4
1-5	60	17.5
6-10	111	32.5
>10	156	45.6
Diabetic complications		
Yes	89	26.0
No	253	74.0
Diabetic therapy		
Oral hypoglycaemics	126	36.8
Insulin	114	42.1
Oral hypoglycaemics and Insulin	72	21.1
Satisfaction with diabetes therapy		
Very satisfied	84	24.6
Somewhat satisfied	174	50.8
Neutral	57	16.7
Somewhat unsatisfied	27	7.9
Compliance with diabetic diet		
regimen	135	39.5
Always	132	38.6
Sometimes	75	21.9
Never		
Family support in therapy		
Yes	312	91.2
No	30	8.8
History of social upset		
Yes	219	64.0
No	123	36.0
History of smoking		
Yes	87	25.4
No	213	62.3
Ex-smoker	42	12.3

Table 3: Determinants of uncontrolled diabetes type 2: Multivariate logistic regression analysis

	AOR	95% CI	p-value
Age in years			
20-30 (n=51)[a]			
31-40 (n=132)	0.25	0.06-1.06	0.059
41-50 (n=120)	0.13	0.03-0.58	0.008
>50 (n=39)	0.50	0.08-2.95	0.443
Sex			
Male (n=225)[a]			
Female (n=117)	0.25	0.09-0.69	0.007
Number of children			
No (n=36)[a]			
≤3 (n=51)	83.5	11.67-597.6	<0.001
>3 (n=255)	11.19	2.26-55.4	0.003
Income (SR/month)			
≤5000 (n=105)[a]			
5001-10000 (n=99)	0.51	0.20-1.30	0.158
10001-15000 (n=117)	0.22	0.07-0.65	0.006
>15000 (n=21)	1.82	0.30-10.91	0.513
Diabetic complications			
Yes (n=89)[a]			
No (n=253)	0.24	0.09-0.64	0.004
Diabetic therapy			
Oral hypoglycaemics (n=126)[a]			
Insulin (n=114)	3.51	1.41-8.74	0.007
OHGs and Insulin (n=72)	3.07	1.14-8.29	0.027
Compliance with diet regimen			
Always (n=135)[a]	0.34	0.09-1.27	0.253
Sometimes (n=132)	3.92	1.84-8.33	<0.001
Never (n=75)	15.09	3.99-57.1	<0.001

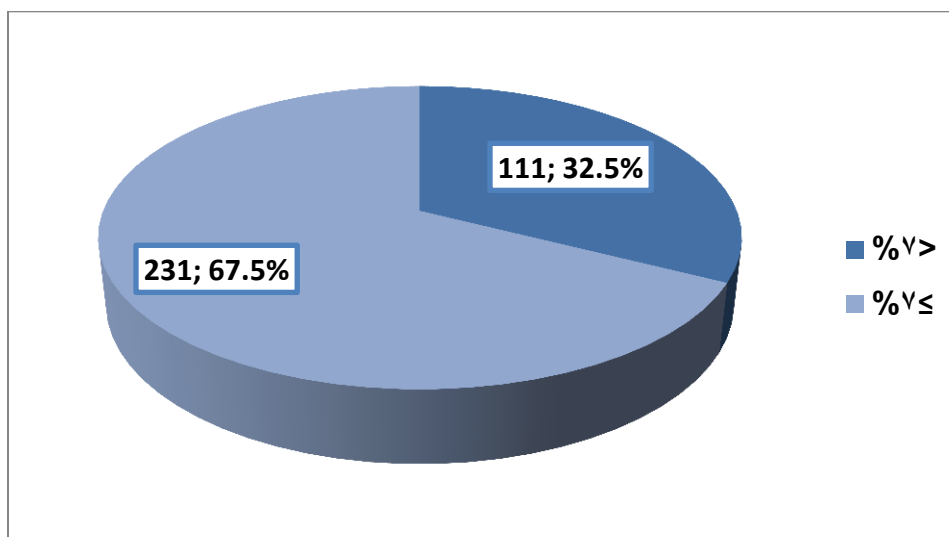AOR: Adjusted odds ratio   CI: Confidence intervals

Figure (1): Prevalence of controlled diabetes among type 2diabetic patients (HBA$_1$C %) at Diabetic centre,King Khalid hospital, Ministry of Health, Tabuk, KSA