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The Status of Diabetes Control in Kurdistan Province, West of Iran

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ABSTRACT

Background: Based on some estimation more than two million peoples in Iran are affected by Type 2 diabetes. The present study was designed to evaluate the status of diabetes control among Type 2 diabetes patients in Kurdistan, west of Iran and its associated factors.

Methods: In our cross sectional study conducted in 2010, 411 Type 2 diabetes patients were randomly recruited from Sanandaj, Capital of Kurdistan. Chi square test was used in univariate analysis to address the association between HgAlc and FBS status and other variables. The significant results from Univariate analysis were entered in multivariate analysis and multinomial logistic regression model.

Results: In 38% of patients, FBS was in normal range (70-130) and in 47% HgA1c was <7% which is normal range for HgA1c. In univariate analysis, FBS level was associated with educational levels (*P*=0.001), referral style (*P*=0.001), referral time (*P*=0.009), and insulin injection (*P*=0.016). In addition, HgA1c had a relationship with sex (*P*=0.023), age (*P*=0.035), education (*P*=0.001), referral style (*P*=0.001), and insulin injection (*P*=0.008). After using multinomial logistic regression for significant results of univariate analysis, it was found that FBS was significantly associated with referral style. In addition HgA1c was significantly associated with referral style and Insulin injection.

Conclusions: Although some of patients were under the coverage of specialized cares, but their diabetes were not properly controlled.

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Introduction

Diabetes is a widespread and growing problem fueled by changing demographics of populations, urbanization, and lifestyle factors. Diabetes is one of the most common chronic and endocrine diseases which cannot be cured and has fatal complications. This disease is the most common cause of amputation, blindness and chronic renal failure and is one of the important risk factors for heart disease[1].

Nowadays, 347 million people of the world are suffering from diabetes[2]. As it has been reported, the consequences of high fasting blood sugar has led to the death of 3.4 million people in 2004[3], from which 80% occurred in low- and middle-income countries[4]. Based on the WHO estimations, this disease will become the 7th leading cause of death by 2030[5].

Heart disease and stroke is common among diabetic patients and cardiovascular diseases are the main cause of death among 50% of diabetic patients. Diabetic retinopathy can also lead to blindness[6] and the disease can cause kidney failure [5]. People with diabetes are twice as much as other people at risk of dying[7,8].

Due to the increased prevalence of obesity and the reduced levels of physical activity the incidence rate of diabetes is rising [9]. Simple lifestyle measures have been proved to be effective in preventing or delaying the onset of type 2 diabetes. To help preventing type 2 diabetes and its complications, people should achieve and maintain healthy body weight; be physically active – at least 30 minutes of regular, moderate-intensity activity on most days. More activity is required for weight control; eat a healthy diet of between three and five servings of fruit and vegetables a day and reduce sugar and saturated fats intake; avoid tobacco use because smoking increases the risk of cardiovascular diseases [4,5]. Non-insulin dependent diabetes or type 2 is now an epidemic in America and in 2000 its prevalence was 7%[10]. There are evidences that

controlling blood sugar could reduce the risk of debilitating and even fatal complications of diabetes [11].

According to the latest investigations, there are more than two million people with non-insulin dependent diabetes in Iran and diabetes prevalence is about 5 to 7% among adults. Therefore, the investment on education and control of diabetes is very important in viewpoint of medical and social and economic issues [12,13]. Although complete prevention of complications is not possible, their occurrence can be delayed via careful control of blood glucose. In addition to medication and diet, some studies have demonstrated that demographic variables such as education, age and sex, are also effective in diabetes control [14].

Regular medical care can prevent many common complications of diabetes such as ischemic heart disease, stroke, retinopathy, nephropathy, and neuropathy. Several guidelines have been published about caring diabetic patients. However, a large group of diabetic patients do not receive cares according to these instructions[15]. American Diabetes Association (ADA) recommends that diabetic patients must check at least one test per month for glycosylated hemoglobin (HA1c). The ADA also recommends a minimum of two to four annual medical visits for all diabetic patients. One reason for this recommendation may be that some patients do not have regular clinical referrals for diabetes care. Moreover many outpatients may not receive the recommended services[16]. The ADA advises the HA1c of less than 7% as an indicator of the best diabetes treatment, because the amount of microalbuminuria in diabetic patients is higher than other populations that are associated with abnormal HA1c levels[17].

The most common method for the assessment of diabetes control is the measurement of blood glucose level. Suitable method for long-term control of diabetes is to measure HA1c; the normal rate is three to six percent in healthy individuals. In diabetic patients this rate increases two to three times depending on the amount and duration of hyperglycemia[18]. HA1c measurement is a precise and objective method for long-term control of blood glucose in diabetic patients. HA1c is a useful tool for assessing glycemic control and making decision for the treatment of patients. But this is not a recommended diagnosis method. In the last sequencing three months, HA1c levels make the average blood glucose level accessible, which is used as a diabetes control index[19].

The present study was designed to evaluate the status of diabetes control among diabetic patients using fasting blood sugar (FBS), estimated HgA1c and their associated factors.

Methods

In this cross-sectional study, 411 diabetic patients were selected using simple random sampling from 5255 patients who had active records in Tawhid Diabetes Center in Sanandaj City, west of Iran in 2010. Patients who died, those who were transferred to another centers and patients who did not have an active record were excluded from the study. Data collection was performed via an authors'- designed checklist. Independent variable like demographic and anthropometrics data including age, sex, education, occupation, body mass index, diabetes duration, period of referral to the center, referral style (regular or irregular) and insulin injection were collected based on records and interviews and examinations. Dependent variables like laboratory data on FBS, HgA1c results were carefully recorded. According to the American Diabetes Association definitions, FBS levels between 70 and 130 were identified as good control and the other ranges were considered as a measure of poor control. Moreover, the HgAlc levels below 7 were identified as measures of good control.

Based on the above definitions and using the chi-square test, univariate analysis was performed. The variables that resulted in a *P*-value less than 0.1 in the univariate analysis were entered into multivariate analysis model. Link function logit was used by Multinomial logistic regression. The crude and adjusted OR values were calculated for these variables. Based upon what was previously stated, each category of HgA1c and FBS variables in the multivariate model were analyzed in different levels. FBS levels between 70 and 110, which represent the best state, were chosen as the base. Values between 110 and 130 were chosen as the second group with an appropriate but less desired level. Values below 70 and above 130 were the values of the third group which were undesirable. For HgA1c, the values less than seven were selected as the base. Values between 7 and 8 were selected as the second group and values over 8 as the third group.

To estimate the parameters and significance levels more accurately, bootstrap technique and a sample size of 1000 were used. This paper explores an approach to assess the status of diabetes control among type 2diabetic patients using SPSS software version 20. In all other stages *P*-values below 0.05 were considered statistically significant.

The proposal of the present study was approved by the Ethical Committee of Kurdistan University of Medical Sciences.

Results

Overall, 411 patients including 306 (74.5%) females and 105 (25.5%) males were enrolled in the study. More than 70% of patients were unemployed and housewives. Mean and standard deviation of age, duration of diabetes, FBS, and HgA1c were 57.2±11.5 years, 6.7±4.5 years, 151 ±46.1 mg/dl, and 7.2 ±1.6 percent, respectively. In 38% of patients FBS was in normal range (70-130) and in 47% of patients HgA1c (%) was less than 7% which is normal range for HgA1c; this is due to strong good control.

In univariate analysis, there was no significant relationship between FBS level and variables such as gender (*P*=0.067), job status (*P*=0.647), age groups (year) (*P*=0.285), BMI (*P*=0.143), duration (years) (*P*=0.119). On the other hand FBS level was significantly associated with education level (P<0.001), referral style (*P*<0.001), Referral time (*P*=0.009), and Insulin injection (*P*=0.016). Between variables such as Patients with low education, unemployed patients, those who had an irregular visit and those who had low referral time and those who had insulin injection had bad situation in FBS level (Table 1).

Table 1: Association between demographic factors and other variables with fasting blood sugar (FBS mg/dl) in diabetic patients

Variables	Normal Group (69-129)	Abnormal Group (≤70 or ≥130)	*P* value
Gender			0.067
Male	32	73	
Female	124	182	
Educationlevels			0.001
Illiterate	92	187	
Literate	64	68	
Job status			0.647
unemployed	114	181	
Employee	42	74	
Age groups (year)			0.285
<40	18	15	
40-49	35	54	
50-59	48	87	
60-69	32	63	
≥70	23	36	
Body mass index (kg/m^2)			0.143
<19.3	4	4	
19.3-25	68	89	
<25	83	160	
Duration (year)			0.119
<5	65	85	
5-9	69	117	
≥10	21	51	
Referral time (month)			0.009
≤ 24	33	52	
25-48	76	87	
49-72	33	72	
≥73	14	43	
Referral style			0.001
Regular	93	52	
Irregular	63	203	
Insulin injection			0.016
Yes	10	36	
No	146	219	

Results in Table 2 also shows that in univariate analysis relationship between HgA1c level and the variables such as Job status (*P*=0.357), BMI (*P*=0.141), diabetes duration (*P*=0.163), and referral time (*P*=0.236) are not significant. However, HgA1c had a significant relationship with sex (*P*=0.023), age (*P*=0.035), education (P<0.001), referral style (*P*<0.001) and insulin injection (*P*=0.008). Younger, more educated and employed patients and people with regular visits had significantly better status of diabetes control (Table 2).

Table 2: Association between demographic factors and other variables with glycosylated hemoglobin (HbA1c) in diabetic patients

Variables	HbA1c (<7%)	HbA1c (≥7%)	*P* value
Gender			0.023
Male	39	66	
Female	153	153	
Education levels			0.001
Illiterate	115	164	
Literate	77	55	
Job status			0.357
unemployed	142	153	
Employee	50	66	
Age groups (year)			0.035
<40	21	12	
40-49	48	41	
50-59	63	72	
60-69	40	55	
≥70	20	39	
Body mass index (kg/m^2)			0.141
<19.3	4	4	
19.3-25	83	74	
<25	104	139	
Duration (year)			0.163
<5	78	72	
5-9	84	102	
≥10	28	44	
Referral time (month)			0.236
≤ 24	42	43	
25-48	84	79	
49-72	44	61	
≥73	22	35	
Referral style			0.001
Regular	120	25	
Irregular	72	194	
Insulin injection			0.008
Yes	13	33	
No	179	186	

In multinomial logistic regression, FBS levels between 70 and 110, which represent the best state, were chosen as the base. Values between 110 and 130 were chosen as the second group and values below 70 and above 130 formed the third group. Additionally, for HgA1c, the values below seven were selected as the base. Values between 7 and 8 were selected as the second group and values over 8 as the third group which indicated the worst condition (Table 3, 4).

Multinomial Logistic regression showed that FBS levels were independently associated with regular visits with adjusted OR=0.261 [95% CI: 0.117, 0.580]. This odds ratio compare regular to irregular visits for 110-130 relative to 70-110 (base) level given that the other variables in the model are held constant. Also FBS levels were independently associated with regular visits with adjusted OR=0.061 [95% CI: 0.029, 0.128]. This odds ratio compare regular to irregular visits for more than 130 and less than 70 mg/dl relative to 70-110(base) level given that the other variables in the model are held constant (Table 3).

Table 3: Multinomial logistic regression results and odds ratio (OR) of fasting blood sugar (FBS) in 2 groups compared with baseline group (70-109) in diabetic patients

Variables	OR (95% CI)		Bootstrap	
	Unadjusted	Adjusted [a]	*P* value	Bias
Fasting blood sugar 110-129 (mg/dl)				
Gender				
Female	1.00	1.00		
Male	1.25 (0.54, 2.88)	0.95 (0.39, 2.32)	0.941	0.040
Educational level				
Literate	1.00	1.00		
Illiterate	1.86 (0.96, 3.59)	1.36 (0.67, 2.79)	0.446	0.028
Referral time (month)				
≥73	1.00	1.00		
49-72	0.80 (0.22, 2.85)	0.59 (0.16, 2.25)	0.440	0.071
25-48	0.86 (0.27, 2.75)	0.56 (0.16, 1.95)	0.317	0.113
≤24 months	1.5 (0.42, 5.41)	0.86 (0.22, 3.46)	0.871	0.184
Referral style				
Irregular	1.00	1.00		
Regular	0.24 (0.11, 0.50)	0.26 (0.12, 0.58)	0.010	-0.008
Insulin injection				
No	1.00	1.00		
Yes	0.31 (0.08, 1.24)	0.27 (0.06, 1.16)	0.032	-1.524
Fasting blood sugar ≥130 (mg/dl)				
Gender				
Female	1.00	1.00		
Male	2.04 (1.01, 4.12)	1.35 (0.60, 3.04)	0.446	0.009
Educational level				
Literate	1.00	1.00		
Illiterate	2.89 (1.65, 5.04)	1.55 (0.80, 3.01)	0.158	0.001
Referral time (month)				
≥73	1.00	1.00		
49-72	0.69 (0.25, 1.91)	0.61 (0.19, 1.94)	0.475	-0.068
25-48	0.39 (0.15, 0.99)	0.25 (0.08, 0.77)	0.050	-0.110
≤ 24	0.66 (0.23, 1.93)	0.36 (0.10, 1.26)	0.119	-0.030
Referral style				
Irregular	1.00	1.00		
Regular	0.06 (0.03, 0.12)	0.06 (0.03, 0.13)	0.010	-0.075
Insulin injection				
No	1.00	1.00		
Yes	1.32 (0.56, 3.12)	0.94 (0.33, 2.66)	0.881	-0.101

[a] Adjusted for gender, educational level, referral time, referral style, and insulin injection

On the other hand, there was association between HgA1c and BMI with adjusted OR=0.330 [95% CI: 0.151, 0.723] and regular visit with adjusted OR=0.043 [95%CI: 0.012, 0.093]. For BMI, the odds ratio for 7-8 relative lower than 7 (base) would be expected to increase by a factor of OR=0.330 given that the other variables in the model are held constant. For Referral style, the odds ratio for 7-8 relative lower than 7 (base) would be expected to increase by a factor of OR=0.04 given that the other variables in the model are held constant (Table 4). The results from bootstrap technique used in this model shows that estimation of parameters was exact and had precision.

Discussion

Diabetes is an important metabolic disease with an increasing prevalence that has become a major challenge for health authorities in different countries worldwide - both in developing and developed countries[18]. In the present study, FBS was in normal range in 38% of patients (70-130) and HgA1c(%) was less than 7% in 47% of patients which might be due to strong good control. Overall, 92.0% of patients were older than 40 years which is the routine feature of type 2 diabetics. Sex ratio was almost three to one which might be due to: giving more importance to the health in women, involvement of men in work in hours of service delivery or high incidence in women[19].

In comparison with similar studies, the mean HgA1c was calculated to be 7.2% ±1.6% [20,21]. In the present study, 46.7% of patients had desirable levels of HgA1c (<7%) that was consistent with recently reported other studies [18-22] as well as the study conducted by Rotchford et al.[23]; nevertheless, it was a little more than the levels found in other studies. However, our results were not in line with the study undertaken by Little RR et al.[24] prob-

ably due to differences in socioeconomic status, quality of care and services, as well as self-controlling of diabetic patients.

Table 4: Multinomial logistic regression results and odds ratio (OR) of glycosylated hemoglobin (HbA1c) situation in 2 groups compared with baseline group (<7) in diabetic patients

Variables	OR (95% CI)		Bootstrap	
	Unadjusted	Adjusted [a,b]	*P* value	Bias
7<HbA1c<8				
Gender				
Female	1.00	1.00		
Male	0.64 (0.36, 1.16)	0.65 (0.34, 1.23)	0.158	-0.030
Educational level				
Literate	1.00	1.00		
Illiterate	0.75 (0.41, 1.39)	0.80 (0.39, 1.62)	0.525	-0.011
Age group (year)				
≥70	1.00	1.00		
60-69	1.88 (0.79, 4.44)	1.82 (0.76, 4.38)	0.188	-0.025
50-59	1.70 (0.75, 3.88)	1.56 (0.66, 3.69)	0.277	0.016
40-49	1.94 (0.78, 4.86)	1.84 (0.70, 4.84)	0.168	0.001
<40	6.75 (1.55, 29.45)	6.32 (1.30, 30.76)	0.089	1.023
Referral style				
Irregular	1.00	1.00		
Regular	0.84 (0.36, 1.96)	0.69 (0.28, 1.69)	0.386	-0.042
Insulin injection				
No	1.00	1.00		
Yes	0.43 (0.19, 0.97)	0.39 (0.17, 0.90)	0.010	-0.122
HbA1c ≥8				
Gender				
Female	1.00	1.00		
Male	0.49 (0.30, 0.82)	0.79 (0.42, 1.46)	0.416	-0.025
Educational level				
Literate	1.00	1.00		
Illiterate	0.44 (0.26, 0.73)	0.76 (0.39, 1.49)	0.327	0.024
Referral time (month)				
≥70	1.00	1.00		
60-69	1.80 (0.85, 3.80)	1.43 (0.61, 3.32)	0.376	0.001
50-59	2.07 (1.00, 4.17)	1.53 (0.68, 3.46)	0.376	-0.150
40-49	2.95 (1.37, 6.35)	1.39 (0.55, 3.49)	0.515	-0.004
<40	9.45 (2.47, 36.12)	3.84 (0.83, 17.66)	0.084	1.174
Referral style				
Irregular	1.00	1.00		
Regular	12.00 (6.49, 22.17)	11.29 (5.79, 21.99)	0.010	0.095
Insulin injection				
No	1.00	1.00		
Yes	0.30 (0.15, 0.61)	0.19 (0.08, 0.46)	0.010	-0.130

[a] Adjusted for gender, educational level, age group, referral style, and insulin injection when 7<HbA1c<8
[b] Adjusted for gender, educational level, referral time, referral style, and insulin injection when HbA1c ≥8

In the present study, no significant difference was observed between mean age in normal and abnormal FBS groups which is consistent with the latest report from Iran. HA1c had a significant relationship with stratified age [21].

Although in Univariate analysis, HA1c had a significant relationship with sex, age, education levels, job and referral style, however, multinomial logistic regression showed that HgA1c had a significant relationship with BMI and regular visit which is consistent with Heydaris' report in which BMI above 25 increased the risk of premature type 2 diabetes by 2.4 folds[25]. Another study confirmed our results in which mean BMI in non-diabetic and diabetic groups was significantly different[26].

Multinomial logistic regression showed that BMI and the way that people go to Diabetes Center (referral style) were the most important factors in disease control. Meanwhile, younger diabetic patients had better control probably due to a lower BMI. Obesity in various studies has been mentioned as a risk factor for diabetes and lack of control [5,7]. In the present study, in spite of studies conducted by Carter et al. in the U.S [27] and Kazemnejad in Kashan (a province in central part of Iran) [28] no correlation was found between diabetes duration and HA1c.

In the present study, a positive correlation was found between FBS and HgA1c (r=0.54). Danaei has reported that increasing HA1c had increased FBS by approximately 10mg/dl [21]. Similar results have been reported [22]. The result of other study in Kurdistan Province shows that diabetes risk factors and metabolic syndrome have more prevalence.[29]

Conclusion

FBS and HgA1c are relatively controlled in type 2 diabetic patients in western part of Iran. Clinical and nutri-

tional activities leading to the control of obesity and decrease of body mass index are suggested to be integrated with diabetes controlling programs. High prevalence of metabolic syndrome and inappropriate control of diabetes need the good planning and interventions for prevention and control of such diseases. This correlation demonstrates the diagnostic and predictive values of FBS in control of diabetic patients for whom it is not possible to measure HA1c.

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Conflict of interest statement

There is no conflict of interest.

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