



Investigating Factors Associated with Diabetes Complications among Type 2 Diabetic Patients

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ABSTRACT

Generally, diabetes is a chronic and prevalent disease worldwide. Moreover, it has many physical complications such as ocular, renal and cardiovascular complications. Considering the high prevalence of diabetes and its complications, the present study aimed to investigate the prevalence of chronic diabetes complications and its associated factors in patients referred to the Diabetes Center of Aran va Bidgol. The present research is a descriptive-analytical and cross-sectional study that was conducted in 2017. Statistical population consisted of diabetics referring to Diabetes Centers in Aran va Bidgol. Among all the patients referred to health centers, 340 patients were selected by simple random sampling. An increase in the amount of A1C increases the likelihood of renal complications in patients by 6.12 times which is about 6 times higher. Furthermore, the number of referrals has a negative impact on the likelihood of renal complications. An increase in the number of referrals to level 2 of services (specialists) reduces the probability of renal complications in patients to 0.47 times, that is, about 53%. Interventions such as higher number of referrals to level 2 of services (specialists) and controlling the amount of A1C can reduce the spread of complications associated with diabetes. Moreover, given that the patient age is a variable which positively affects the probability of cardiovascular complications and it cannot be controlled, it seems that the programs for assessing the risk of heart attack should be implemented in accordance with relevant guidelines and over 30 years of age.

Key words: Type 2 diabetes, Cardiovascular Complications, Renal Complications

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INTRODUCTION

Diabetes is a chronic and prevalent disease around the world. According to a report of the International Diabetes Federation (IDF) in 2010,

diabetes was estimated to be the cause of 8.8% of deaths at the ages of 22 and 97 [1]. The prevalence of diabetes in Iran has risen to over 10 present [2]. This disease has physical symptoms such as ocular, renal and cardiovascular complications. This disease is spreading and it is predicted that its outbreak will reach from 285 million people in 2010 to 437 million in 2030 [3]. It also imposes heavy costs on health systems [4]. More than 72%

of patients with diabetes have Type 2 diabetes [5]. The injectable insulin is prescribed and lifestyle modification and oral administration are considered for patients with type 2 diabetes if it is uncontrolled. Insulin injection will lead to better control of blood glucose, and thus better control of side effects of the disease.

In fact, the cardiovascular disease is the major cause of diabetes-related mortality and it is 2 to 5 times more common than normal people. In addition, the risk of stroke is high in these people [6]. The cost and burden of diabetes are very expensive for countries, so that diabetics, especially those with diabetes-related cardiovascular complications, have lower levels of health [7]. According to studies, cardiovascular risk factors are complex and multifactorial in type 2 diabetic patients. Obesity, high age, family history of diabetes, high severity of diabetes, lack of self-monitoring, lack of controlled blood glucose, unhealthy lifestyle and low quality of life are the most important risk factors for diabetes and its complications [8]. Measurement of Glycated hemoglobin (HbA1c) shows the average blood glucose level over the past six weeks to three months and it is considered to be the best and most widely used long-term blood glucose control [6, 9]. People without diabetes have 4% to 6% of Glycated hemoglobin, but diabetics with moderate severity under high control have Glycated hemoglobin of 6% to 7% [10]. Glycated hemoglobin values from 7% to 9% show moderate and severe disease and values higher than 9% are severe and hazardous. The treatment of type 2 diabetes aims to reduce the levels of blood glucose or range of Glycated hemoglobin to near the normal range (6 to 7 percent). Amounts of Glycated hemoglobin should be lower than 7%. Chronic increase in blood glucose is a major cause of acute, short-term and long-term complications of diabetes and can affect all body organs [11, 12]. Self-monitoring of blood glucose (SMBG) postpones the onset of cardiovascular complications [10] because the increased blood glucose is the major cause of diabetes complications [12]. Self-monitoring of blood glucose is an active spontaneous process such as controlling the food intake, exercising or regular heart checking for controlling cardiovascular complications of diabetes and its monitor by patients [13]. Studies have found that improving the self-monitoring of blood glucose can improve the health outcomes of diabetic patients and reduce complications of diabetes and reduce the

hospitalization for complications associated with diabetes [14]. The present study aimed to investigate the factors associated complications of diabetes in type 2 diabetes patients.

MATERIALS AND METHODS

The present study was conducted with descriptive-analytical and cross-sectional method in 2017. The statistical population consisted of diabetics referred to Diabetes Centers in Aran va Bidgol. 340 patients were selected by simple random sampling. Participating in comprehensive health centers of Aran va Bidgol, the researcher examined a questionnaire containing demographic questions about the patient age, gender, level of illiteracy and also questions about patients' disease information including examination and recorded tests in the patient file including the body mass index (BMI), blood pressure, hemoglobin A1c, the type of treatment (regimen, pill or insulin), the cause and type of complication according to patients' files. Patients with type 1 diabetes and those with incomplete data were excluded from the research. The patients' information and characteristics were secretly collected without any name and only with codes. Diagnosis of diabetes was based on the standard fasting blood glucose level above 126 mg/dl; and its complication and type were recorded according to the clinical and laboratory examination and final diagnosis by physicians. The present study investigated cardiovascular, nephropathy, neuropathy, ocular and amputation complications.

Data was analyzed using SPSS16 and binomial logistic regression test at the significant level of 0.05.

RESULTS

From 340 studied patients, 249 were female (73.2%) and 91 male (26.8%). The mean age was 56.4 ± 11.4 for males and 58.4 ± 12.6 for females. The mean age of diabetes was 12.3 ± 48.8 . 20.9% of them received insulin therapy, 61.9% received oral medication, 12.7% received both insulin therapy and oral medication and 4.4% had no treatment. Furthermore, 15% of patients had heart complications, 12.9% had renal complications, 7.7% had neuropathic complications, and 9.4% had ocular complications and all of them were without amputation. Table (1) presents other demographic information.

Table 1- Frequency distribution of demographic data in diabetics

| Variables | Level | Frequency(percent) |
|----------------------|---------------|--------------------|
| Education level | Illiterate | 136 (42.1%) |
| | Under diploma | 163 (50.5%) |
| | Diploma | 15 (4.6%) |
| | Academic | 9 (2.8%) |
| BMI | Thin | 5 (1.6%) |
| | Normal | 66 (20.8%) |
| | Overweight | 145 (45.7%) |
| | Obese | 101 (31.9%) |
| Refer to Level 2 | Zero | 135 (39.8%) |
| | Once | 132 (38.9%) |
| | Twice | 37 (10.9%) |
| | 3 and more | 35 (10.3%) |
| Blood pressure (sys) | ≤140 | 288 (93.8%) |
| | >140 | 19 (6.2%) |
| Blood pressure (dys) | ≤90 | 286 (97.9%) |
| | >90 | 6 (2.1%) |
| Number of caregivers | ≤4 | 247 (72.9%) |
| | >4 | 92 (27.1%) |
| Sexual problem | Yes | 12 (3.5%) |
| | No | 328 (96.5%) |
| A1C | ≤7 | 77 (31.2%) |
| | >7 | 170 (68.8%) |

Table 2- Coefficients of predictive variables in binomial logistic regression in predicting the risk of cardiovascular complications in diabetic patients

| Variables | B | S.E. | Wald | df | Sig. | Exp (B) |
|----------------------|---------|---------|-------|----|-------|--------------|
| Gender | -0.174 | 0.552 | 0.100 | 1 | 0.752 | 0.840 |
| Treatment method | -0.037 | 0.297 | 0.015 | 1 | 0.902 | 0.964 |
| Sexual problem | -0.744 | 0.915 | 0.661 | 1 | 0.416 | 0.475 |
| A1C | -0.107 | 0.455 | 0.056 | 1 | 0.814 | 0.898 |
| Number of caregivers | -0.504 | 0.546 | 0.853 | 1 | 0.356 | 0.604 |
| BMI | 0.081 | 0.278 | 0.085 | 1 | 0.770 | 1.085 |
| Education level | 0.080 | 0.364 | 0.049 | 1 | 0.825 | 1.084 |
| Age | 1.125 | 0.484 | 5.414 | 1 | 0.020 | 3.082 |
| Age of diabetes | -0.487 | 0.543 | 0.802 | 1 | 0.370 | 0.615 |
| Number of referrals | 0.204 | 0.238 | 0.734 | 1 | 0.392 | 1.226 |
| SYS | -0.702 | 1.099 | 0.407 | 1 | 0.523 | 0.496 |
| DYS | -19.455 | 2.203E4 | 0.000 | 1 | 0.999 | 0.000 |
| Constant | 17.692 | 2.203E4 | 0.000 | 1 | 0.999 | 48255259.238 |

Table 3: Coefficients of predictive variables in binomial logistic regression in predicting the risk of renal complications in diabetics

| Variables | B | S.E. | Wald | df | Sig. | Exp (B) |
|----------------------|--------|-------|-------|----|-------|---------|
| Gender | 0.156 | 0.565 | 0.076 | 1 | 0.783 | 1.168 |
| Treatment method | -0.212 | 0.313 | 0.462 | 1 | 0.497 | 0.809 |
| Sexual problem | 0.683 | 1.167 | 0.343 | 1 | 0.558 | 1.980 |
| A1C | 1.812 | 0.681 | 7.069 | 1 | 0.008 | 6.120 |
| Number of caregivers | -0.419 | 0.594 | 0.497 | 1 | 0.481 | 0.658 |
| BMI | -0.411 | 0.314 | 1.719 | 1 | 0.190 | 0.663 |
| Education level | -0.183 | 0.387 | 0.224 | 1 | 0.636 | 0.832 |
| Age | 0.533 | 0.537 | 0.984 | 1 | 0.321 | 1.704 |
| Age of diabetes | 0.279 | 0.586 | 0.226 | 1 | 0.634 | 1.322 |
| Number of referrals | -0.756 | 0.320 | 5.563 | 1 | 0.018 | 0.470 |
| SYS | 0.202 | 0.797 | 0.064 | 1 | 0.800 | 1.224 |
| DYS | 0.953 | 1.372 | 0.482 | 1 | 0.487 | 2.593 |
| Constant | -5.127 | 2.888 | 3.152 | 1 | 0.076 | 0.006 |

Tables 2 and 3 present the effects of demographic variables and other research variables with the risk of diabetes complications (cardiovascular and

renal complications) in the binomial logistic regression analysis.

According to Table 2, a binomial logistic regression was fitted for predicting the risk of cardiovascular complications in diabetics. Independent variables included gender, treatment method, A1C, number of caregivers, BMI, education level, age, age of diabetes, number of referrals, and systolic and diastolic blood pressure. According to the table above, the patient age variable was significant ($\text{sig} < 0.05$). The patient age is a variable that affects the probability of cardiovascular complications. This variable has positive effect, in other words, an increase in the patient age increases the probability of cardiovascular complications in patients by 3.08 that is about three times higher.

According to Table 3, we fitted a binomial logistic regression to predict the risk of renal complications in diabetics. Independent variables included gender, treatment method, A1C, number of caregivers, BMI, educational level, age, age of diabetes, number of referrals, and systolic and diastolic blood pressure. According to the table above, A1C and number of referrals to level two of services (specialists) became significant ($\text{sig} < 0.05$). A1C is a variable that affects the probability of renal complications. This variable has positive effect, in other words, an increase in A1C increases the probability of renal complications in patients by 6.12 that is about 6 times higher. Moreover, an increase in the number of referrals by the level 2 of service (specialists) reduces the probability of renal complications. This variable has negative effect, in other words, an increase in the number of referrals by the level 2 of service (specialists) reduces the probability of renal complications in patients by 0.47 that is about 53%.

DISCUSSION

Diabetes is one of the major metabolic diseases, which, has become one of major challenges facing the health authorities in different countries, either developed or advanced, due to its increasing prevalence. In the present study, 15% of patients had cardiovascular complications, 12.9% had renal complications, 7.7% had neuropathic complications, 9.4% had ocular complications and all of them were without amputation.

According to a study by Abbasian and Delvarianzadeh on complications of diabetes in Shahrud City, 21.8% of patients had digestive disorders, 33.5% had retinopathy, 13.9% had

nephropathy, 77.3% had neuropathy, 18.6% had cardiovascular disease, 12.7% had problems in the limbs (foot ulcer, the lower limb amputation), and 5.9% had Goiter [15].

In a study by Heshmati *et al.*, 14.5% had renal complications, 26.8% had ocular complications, 65.8% had neuropathy, 38.8% had cardiovascular complications, and 50.5% had other complications [16]. In a research by Kaviani *et al.*, the most common complications of Type 2 diabetes were cardiovascular diseases (41.5%) and then retinopathy (37.4%). In a study by Liu *et al* (2007) in China, the prevalence of cardiovascular, cerebrovascular, neuropathic, nephropathic, ocular lesions and leg problems in patients with type 2 diabetes was 30.1%, 6.8%, 17.8%, 10.7%, 14.8%, and 0.8% [17].

Furthermore, in a study by Chi *et al.* on the morbidity associated with chronic complications of diabetes in China, cardiovascular problems were the most common chronic complications of Type 2 Diabetes [18].

In the present study, we investigate factors associated with complications of diabetes (cardiovascular, renal, neuropathic, ocular and amputation complications). Some factors only had significant association with cardiovascular and renal complications, but the neuropathic, ocular and amputation complications were not significantly associated with variables. In a study conducted by Dr. Nezakati *et al* in Shahrud, the patients' age also played a significant role in the rate and severity of nephropathy, so that its incidence increased at higher age [19]. In other studies, the prevalence of neuropathy increased in patients with type 2 diabetes at higher age, but it was not statistically significant [20]. Janmohamed *et al* found that there was a direct relationship between the age and incidence of renal nephropathy; and most age groups had a lower incidence of kidney failure. There was an increasing trend just for age groups above 70 [21, 22].

In the present study, A1C was a variable that affected the likelihood of renal complications. This variable had positive effect; in other words, an increase in the value of A1C increased the likelihood of renal complications in patients by 6.12 times that was about 6 times higher. Furthermore, the number of referrals to level two of services (specialists) affected the probability of

renal complications. This variable had negative effect, in other words, an increase in the number of referrals to level two of services (specialists) reduced the probability of renal complications in patients by 0.47 times that was about 53%. Ascending prevalence of kidney failure in people with academic education was more rapid, and it might be due to poor follow-up or low percentage of observations in this group [22]. There was also a significant relationship between duration of diabetes and renal complications, so that an increase in the disease duration increased kidney problems [20]. In our study, the number of referrals and the amount of A1C had significant relationship with renal complications. In the present study, the patient age was a variable affecting the probability of cardiovascular complications. This variable had positive effect, and thus an increase in patient age enhanced the probability of cardiovascular complications in patients by 3.08 times that was about three times higher. In a research by Heshmati *et al.*, the cardiovascular complication had a significant association with education level, pill and insulin consumption, family history of diabetes and BMI. Grobbee *et al* also found that the cardiovascular disease and high blood pressure were the most common problems in diabetics; and on the other hand, the obesity was also one of the risk factors for cardiovascular diseases [23]. In a study on patients with Type 2 diabetes, the BMI was associated with cardiovascular complications. [16].

According to a study by Delpisheh *et al.*, there was an increased risk of diabetes complications in H1C of more than 7%. [24].

Pinto *et al* found that high levels of Glycated hemoglobin and obesity were two risk factors for cardiovascular complications in diabetics [25]. Tao *et al.* also indicated that the patient age and duration of diabetes were predictors of cardiovascular complications [26]. According to the research literature, the type of treatment (medication or insulin) and gender were also predictors of cardiovascular complications in diabetes [27]. Some studies also found that the gender could affect cardiovascular complications [28]. The factors namely the patient gender at the age of diagnosis of diabetes, type of treatment and duration of diabetes did not significantly contribute to the prediction of cardiac complications [29].

CONCLUSION

Findings of the present study indicated that diabetes complications were relatively high in the studied population; and interventions such as number of referrals to level two of services (specialists) and control of A1C value could reduce the spread of complications associated with diabetes. Considering that the age is a variable which positively affects the probability of cardiovascular complications and it cannot be controlled, it seems that the risk measurement of heart stroke should be implemented according to relevant guidelines in over 30 years of age.

Authors' Contribution

Mohsen Fereidony conceived of the study, and participated in its design and statistical analysis. Monireh Dehghani-Arani conceived of the study, and participated in its design, coordination, revised the manuscript. Nahid Bagheri, Mohammad Shoghiyan-davar, ommol-banin Bigane, Yousef Bashiri performed the statistical analysis and drafted the manuscript.

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