Original Article

Factors associated with therapeutic target achievement in the control of complications in consequence of diabetes: A hospital-based study in west of Iran

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ABSTRACT

Background and aim: The goal of diabetes management is to enhance the performance of the surveillance system to perpetuate optimal blood sugar, blood pressure and cholesterol levels in the normal values. This paper aimed to identify factors associated with therapeutic target achievement in the control of complications in consequence of diabetes.
Methods: In this cross-sectional study, a secondary analysis was performed on data obtained in the surveillance center of patients referred to in Makoo city, West Azerbaijan Province. The main interested variables included Fasting Blood Sugar (FBS), HbA1c, triglycerides, cholesterol, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL) diastolic and systolic blood pressure, duration of diabetes, family history of diabetes, early and late complications of diabetes, treatment received, history of smoking.
Results: Average age of the patients with diabetes mellitus, insulin-dependent was 35.43 (SD = 17.25) and in patients of diabetes mellitus 53.37 (SD = 10.89), which was significantly different (p-value = 0.001). Frequency amount of fasting blood sugar in diabetes mellitus, insulin-dependent and diabetes mellitus, type II was 64.30% and 66.0%, respectively. Only 19.0% of patients with diabetes mellitus, insulin-dependent and 13.90% of diabetes mellitus, type II breached to the optimum level of blood glucose control.
Conclusions: This study found that a considerable proportion of subjects with diabetes mellitus, insulin-dependent and diabetes mellitus, type II did not achieve the goals of care guidelines of Iran on secondary prevention of complications related to diabetes, especially vascular complication.

1. Introduction

Comprehensive prevalence rate of diabetes is more than 6.40% and more than 280 million people are living with diabetes around the world. Global project for estimation of the burden of diabetes in 2010 presented that diabetes is accounted for over four million deaths in the world, annually [1]. Global project for estimation of the burden of diabetes in 2010 presented that the diabetes is accounted for over four million deaths in the world, annually (1); and it is predicted that the number of diabetic individuals will increase to over 592 million people by 2030 [2].

Oriental Middle East and North Africa are areas with a mean prevalence rate of diabetes about 10.90%. It is predicted that over 35 million patients with diabetes are living in these areas. Iran is one of the highest common in Middle East area with the prevalence rate of

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diabetes mellitus with 9.94% in the adult population [3].

Type 1 diabetes mellitus is a chronic non-communicable disease caused by the destruction of the pancreatic beta cells [4]. Resulting in decreased insulin secretion and ketosis-prone hyperglycemia. The prevalence rate of T1DM is estimated to be 35 million patient in throughout worldwide with variations in different geographical and racial groups [5]. Integral genetic and environmental factors combine to cause this complex disorder [6].

Global economic growth, improving living standards, changing lifestyles and nutritional habits, increasing median age of population and urbanization are becoming the most important medical problems worldwide [7]. The symptoms of diabetes mellitus latently begin and a significant portion of patients remain undiagnosed; even in countries with advanced systems of health care [8]. The direct cost of treatment of diabetes mellitus and its complications are estimated to be at least 548 US $ per patients by 2013 [3]. Five strategies are suggested to be effective in decreasing the burden of diabetes on the society-based level: (i) preventive action of modifiable risk factors, for example obesity; (ii) integration of screening and pharmaceutical or life style mediations aimed at individuals in the pre-diabetic stage; (iii) improving the diagnosis and blood glucose control of diabetics; (iv) improving the management of vascular complications such as kidney ailment, retinopathy, diabetic foot ulcers and other neuropathies; (v) improving the manageress of risk factors related with cardiovascular diseases [9].

Despite the clinical recommendations and attainability of evidence-based tradition guidelines and the expanded knowledge about entanglement of diabetes, treatment ambition such as lifestyle changes of patients with diabetes are not achieving properly [10]. Proper management of diabetes involves interventions on diet, exercise, and medication (insulin and oral medications) [11].

The goal of diabetes management is to enhance the performance of surveillance system to perpetuate optimal blood sugar, blood pressure and cholesterol levels in the routine values in order to prevent microvascular and macrovascular entanglements to increase survival time and improve the quality of life of the patients [12]. The diabetes surveillance system in Iran is basically governmental and health insurance system facilitates access to the second and third levels of the referral system. The private sector provides emergency care to patients in urban areas. Reimbursement policies of insurance institutes for drugs are administered according to Iran tariffs: 90.0% of the cost for inpatients and 70.0% for outpatients are paid by the insurance [13]. The aim of this paper was to estimate the proportion of patients who are able to control their blood sugar, blood pressure and lipoproteins and to identify the factors that are associated with target achievement in control of early and late complications of diabetes is the city.

2. Methods

2.1. Study design

The present study is a cross-sectional study in which patients' management in disease control and occurrence of complications in the result of diabetes in surveillance center of endocrine and metabolism- Makoo city, West Azerbaijan Province, Iran-was collected in the period of 2007–2013.

2.2. Target population

The target population included: 1) all patients with diabetes mellitus, insulin-dependent and diabetes mellitus, type II who were registered for at least six months in the endocrine and metabolism surveillance center; 2) all diabetes mellitus, insulin-dependent and diabetes mellitus, type II that had diagnosed as diabetic by specialists.

2.3. Studied variables

Clinical data for all patients were collected in their first presentation and in the counseling sessions according to care guidelines of Iran [14]. The interested variables included: age, gender, occupation, education, marital status; examining the patients' eye, lenses and organs, measurement of weight, height, Fasting Blood Sugar (FBS), HbA1c, triglycerides, cholesterol, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL) diastolic and systolic blood pressure, duration of diabetes, family history of diabetes, early and late complications of diabetes, treatment received, history of smoking. All patients referred to the Endocrine and metabolic surveillance Center due to diabetes passed an education program. The program consisted of six 2-h sessions learning how to consume carbohydrates, how to exercise during the week, type and method of receiving the drugs and controlling the microvascular and macrovascular complications of diabetes.

2.4. Ethical consideration

This study is conducted in accordance with the guidelines announced by the Helsinki Declaration in 1975, revised in 2008. The study protocol criticized and authorized by the Ethics Committee of the Tabriz University of Medical Sciences and the ethical code this research was 93183. Informed consent of all participating patients obtained. Identity information of all patients kept confidential.

2.5. Statistical analysis

Descriptive statistics of the patients presented with statistical indices for quantitative variables with normality assumption such as mean (±standard deviation), and for qualitative variables such as frequency (relative frequency).

To investigate the significance of associations between qualitative variables, we used Chi-square test and in case of limitation in the frequency of observations, we used the Fishers Exact test. Also, the Independent Samples T-test used to compare the means of qualitative variables with the assumption of equal variances. For the comparison of qualitative variables with more than two categories, One Way ANOVA test was used. Data were analyzed by SPSS (Version 18.0, Chicago, IL, USA). A p-value less than 0.05 were deemed as significant.

3. Results

3.1. Basic characteristics

In total, 280 patients with diabetes mellitus, insulin-dependent and diabetes mellitus, type II with a mean age of 50.67 (±13.63) years, and age range of 8−92 participated in the study. 23 (54.80%) of patients with diabetes mellitus, insulin-dependent and 140 (59.07%) of diabetes mellitus, type II were male. A significant association observed between gender and the type of diabetes (p-value = 0.001).

In terms of marital status, 207 (87.70%) of the patients were married and 169 (71.90%) of them were illiterate or primary education level. A total of 49.40% of men and 4.20% of women were smokers. The average age of diabetes mellitus, insulin-dependent was 35.43 (±17.25) significantly lower than the average age of diabetes mellitus patients 53.37 (±10.89) (p-value = 0.001).

An inverse correlation was found between the status of

education and optimum control of diabetes, as the highest proportion of suboptimum control belonged to illiterate and elementary schools (p-value = 0.001). According to independent samples T-test, the mean triglyceride, cholesterol, systolic blood pressure, diastolic blood pressure and body mass index were significantly higher in diabetes mellitus, insulin-dependent [Table 1].

In terms of the association between family history and diabetes, 16 (41.0%) of diabetes mellitus, insulin-dependent and 80 (36.40%) of diabetes mellitus, type II reported a history of diabetes in the family or relatives; which was not statistically significant (p-value = 0.59). The most frequently reported history of diabetes in first degree relatives was a mother 29 (31.20), sister 27 (29.0%) and 15 brothers (16.10%), respectively.

3.2. Management of diabetic patients

The distribution of early complications of diabetes mellitus, insulin-dependent and diabetes mellitus, type II is presented. Furthermore, the frequency distribution of HbA1C was [HbA1C = less than 7] 10 (29.40%), [HbA1C = 7−9.4] 17 (50.0%) and above [HbA1C= >9.5] 7 (20.60%).

The chi-square test showed a statistically significant association between the level of FBS and the age, so that high blood sugar level was observed in the elderly (p-value = 0.027). Based on Scheffe test, a significant association was observed between blood pressure control and age, as the elderly subjects more suspected to the suboptimum level of blood pressure, with increasing age self-care

Table 1
Distribution of anthropometric parameters of participants by diabetes mellitus, Type II and diabetes mellitus, insulin-dependent [Makoo, West Azerbaijan Province, Iran].

Variables	diabetes mellitus, insulin-dependent	diabetes mellitus, Type II	p-value
	N (percent)	N (percent)	
FBS (mg/dl)			0.64[b]
100>	8 (19.0)	33 (13.9)	
126−100	7 (16.70)	48 (20.1)	
126<	27 (64.3)	157 (66.0)	
TGs (mg/dl)			0.05[b]
150>	24 (57.1)	90 (37.8)	
449−150	17 (40.50)	132 (55.5)	
450<	1 (2.40)	16 (6.7)	
CL (mg/dl)			0.001[b]
200>	32 (76.2)	118 (49.6)	
219−200	2 (4.8)	37 (15.5)	
220<	8 (19.0)	83 (34.9)	
HDL-C (mg/dl)			0.27[a]
40>	16 (38.1)	69 (29.0)	
40<	26 (61.9)	169 (71.0)	
LDL-C (mg/dl)			0.06[a]
100>	11 (26.2)	101 (42.4)	
100<	31 (73.8)	137 (57.6)	
SBP (mmHg)			0.20[b]
120>	34 (82.9)	158 (67.5)	
139−120	2 (4.9)	31 (13.2)	
159−140	4 (9.8)	28 (12.)	
160<	1 (2.4)	17 (7.3)	
DBP (mmHg)			0.35[b]
80>	35 (85.4)	187 (80.3)	
89−80	3 (7.3)	9 (3.9)	
99−90	3 (7.3)	29 (12.4)	
100<	–	8 (3.4)	
BMI (kg/m^2)			0.001[a]
25>	24 (68.5)	52 (24.8)	
30−25	8 (22.9)	82 (39.)	
30<	3 (8.6)	76 (36.2)	

[a] p-value was calculated t-independent.
[b] p-value was calculated One-way ANOVA.

from physiologic indexes statistically has been decreased (p-value = 0.001).

The most frequently observed late complications of diabetes were: neuropathy 203 (72.50%), retinopathy 75 (26.75%), nephropathy 49 (17.50%) and diabetic foot ulcers 11 (3.92%). A statistically significant difference was observed between type I diabetes and diabetes mellitus in terms of hyperlipidemia so that the frequency of hyperlipidemia in mellitus patients was higher [Table 2]. The average pulse rate of patients with diabetes mellitus, insulin-dependent was 84.76 (±12.91) beats per minute that had no significant difference with the average pulse rate of patients with diabetes mellitus, type II 81.63 (±10.80) (P-value = 0.111).

The method of received treatment of the patients: 210 (81.70%) oral treatment, 41 (16.0%) injection and the rest were used both of the methods. In terms of drug consumption; 162 (57.85%) used Glibenclamide, 81 (28.90%) used Metformin and 39 13.25% Insulin.

4. Discussion

This paper depicted the situation of management of diabetic patients based on analysis of the demographic characteristics, anthropometric indexes, and health parameters. Findings showed that a considerable proportion of subjects with diabetes mellitus, Type II, compared to diabetes mellitus, insulin-dependent, had higher triglycerides, cholesterol, systolic blood pressure, diastolic blood pressure, and body mass index.

According to the study findings, the majority of the patients was illiterate or had an elementary education. The level of education was significantly associated with control of diabetes. In recent studies, low income, occupation and education level were associated with lower rates of diagnosis, and effective management of diabetes as well as the diagnosis and treatment of high blood pressure, non-alcoholic fatty liver disease and Hypercholesterolemia [15,16].

Recent studies in various countries of the world showed a lack of proper control of anthropometric parameters [17]. Janghorbani et al. in a study in Isfahan city, Iran found that body mass index was not a prognostic factor in the determination of glucose and lipids control [18].

Only 19.0% of patients with diabetes mellitus, insulin-dependent and 13.90% of diabetes mellitus, Type II reached the desirable level of glycemic control. However, in other countries,

Table 2
Frequency occurrence of complications in result of diabetes in terms of diabetes mellitus, insulin-dependent and diabetes mellitus, Type II [Makoo, West Azerbaijan Province, Iran].

Variables	diabetes mellitus, insulin-dependent	diabetes mellitus, Type II	p-value[a]
	N (percent)	N (percent)	
Neuropathy			0.38
No	8 (11.90)	194 (81.50)	
Yes	37 (88.10)	44 (18.50)	
Hyperlipidemia			0.001
No	5 (11.90)	138 (58.0)	
Yes	33 (78.60)	100 (42.0)	
Retinopathy Gastrointestinal			0.57
No	6 (14.30)	176 (73.90)	
Yes	29 (69.0)	62 (26.10)	
Lesions in organs Retinopathy			0.78
No	13 (31.0)	195 (81.90)	
Yes	36 (85.70)	42 (17.60)	
Gastrointestinal			0.21
No	6 (14.30)	230 (96.60)	
Yes	39 (92.90)	8 (3.4)	

[a] Chi-square test.

more than 70.0% of diabetics do not reach the desired level of glycemic control [19]. In Poland, 11.50% of diabetic patients achieved the therapeutic goals of metabolic control of HbA1C [20]. In Iran, an average of 7.70% of patients reaches HbA1c below 7.0 [18]. That requires service accessibility and insurance coverage for the general population to decrease prices and also likely due to the lack of awareness of patients of the importance of the test in order to better control of the disease. This is probably due to the low education of the patients or likely in the result of insufficient cooperation of physicians.

In this study, no statistical difference was observed in cholesterol control between diabetes mellitus, insulin-dependent and diabetes mellitus, Type II. The least amount of diagnoses and treatment among anthropometric parameters has belonged to Hypercholesterolemia [19].

The amount of LDL in 73.80% of type I and 57.60% of type mellitus patients was more than 100 mg/dl. In a study in Germany, 50.0% of patients have achieved a desirable level of LDL control [21]. In America, 40.0% were less than 70 mg/dl [22].

The high majority of diabetic patients with diabetes mellitus, insulin-dependent and diabetes mellitus, Type II had the amount of HDL above 40 mg per dl. Recent studies found the controlled levels of HDL-C 44.10% optimum [23], and in 58.0% of the total population of the United States of America [24].

According to our data in this study; 69.80% was achieved an acceptable level of control of systolic blood pressure and 81.0% of diastolic blood pressure. In the study of Janghorbani et al., 35.30% was reached to a desirable level in accordance with the instructions of the Ministry of Health in Iran [18]. Blood pressure control in Eastern Europe was 20.0% [25], and in Denmark, 13.0% of patients achieved control level of 130/80 mm Hg [26]. In the USA, about 60.0% of patients have reached to blood pressure values lower than 130 mm Hg [22]. The results of recent studies in Iran compared to different countries of the world, there was a need to strengthen surveillance in order to control the metabolic syndrome with effective drugs and to reduce morbidity and mortality efficiently.

The most frequent occurrence of late complications in diabetes patients was respectively, neuropathy, retinopathy and nephropathy. According to the trial results, better glycemic control was associated with lower risk of retinopathy, nephropathy, and neuropathy [27].

5. Conclusion

The importance and priority of the national guidelines and using new incentive programs for the management of blood pressure, blood sugar and lipid disorders in low- and middle-income countries are obvious.

6. Study limitations

Because the study was conducted in referral centers, patients with certain socio-economic level may visit these centers due to their public governmental services that are associated with selection bias and biased information.

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Conflicts of interest

None declared.

Author contribution

Study design and supervision: H B, S Gh; analyzing and critical review: M Z, T B, S H and H A N: data gathering and writing.
Patient Consent: The persons take part voluntarily and they were given the assertion that their information would dwell confidential. After obtaining their written informed consent, we asked them to intact the research questionnaires.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.04.031.

References

[1] Roglic G, Unwin N. Mortality attributable to diabetes: estimates for the year 2010. Diabetes Res Clin Pract 2010;87(1):15—9.

[2] Guariguata L, et al. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract 2014;103(2):137—49.

[3] Atlas ID. sixth ed. Brussels, Belgium: International Diabetes Federation; 2013 [International Diabetes Federation].

[4] Dahlquist G. Environmental risk factors in human type 1 diabetes—an epidemiological perspective. Diabetes Metabol Res Rev 1995;11(1):37—46.

[5] Barrett JC, et al. Genome-wide association study and meta-analysis find that over 40 loci affect risk of type 1 diabetes. Nat Genet 2009;41(6):703—7.

[6] Zhang J, et al. Polymorphisms in the vitamin D receptor gene and type 1 diabetes mellitus risk: an update by meta-analysis. Mol Cell Endocrinol 2012;355(1):135—42.

[7] Engelgau MM, et al. The evolving diabetes burden in the United States. Ann Intern Med 2004;140(11):945—50.

[8] Rguibi M, Belahsen R. Prevalence and associated risk factors of undiagnosed diabetes among adult Moroccan Sahraoui women. Publ Health Nutr 2006;9(6):722—7.

[9] Javanbakht M, et al. Projection of diabetes population size and associated economic burden through 2030 in Iran: evidence from micro-simulation Markov model and Bayesian meta-analysis. PLoS One 2015;10(7). e0132505.

[10] Selby JV, et al. Understanding the gap between good processes of diabetes care and poor intermediate outcomes: translating Research into Action for Diabetes (TRIAD). Med Care 2007;45(12):1144—53.

[11] Babazadeh T, et al. Association of self-care behaviors and quality of life among patients with type 2 diabetes mellitus. Iran: Chaldoran County; 2017.

[12] Group AC. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. N Engl J Med 2008;2008(358):2560—72.

[13] Cheraghali A, et al. Evaluation of availability, accessibility and prescribing pattern of medicines in the Islamic Republic of Iran. 2004.

[14] Khosravi-Boroujeni H, et al. Does the impact of metabolic syndrome on cardiovascular events vary by using different definitions? BMC Public Health 2015;15(1):1313.

[15] Farajzadegan Z, et al. Social capital—a neglected issue in diabetes control: a cross-sectional survey in Iran. Health Soc Care Community 2013;21(1): 98—103.

[16] Mansour-Ghanaei F, et al. Prevalence of non-alcoholic fatty liver disease in patients with diabetes mellitus, hyperlipidemia, obesity and polycystic ovary syndrome: a cross-sectional study in north of Iran. Diabetes & Metabolic Syndrome. Clinical Research & Reviews; 2019.

[17] Yu N-C, et al. Trends of ABC control 2006—2011: a national survey of diabetes health promotion institutes in Taiwan. Diabetes Res Clin Pract 2013;99(2): 112—9.

[18] Janghorbani M, Papi B, Amini M. Current status of glucose, blood pressure and lipid management in type 2 diabetes clinic attendees in Isfahan, Iran. J diabetes investig 2015;6(6):716—25.

[19] Gakidou E, et al. Management of diabetes and associated cardiovascular risk factors in seven countries: a comparison of data from national health examination surveys. Bull World Health Organ 2011;89(3):172—83.

[20] Baıa MM, et al. Management and treatment goals in Polish patients with type 2 diabetes of short duration: results of the ARETAEUS2-Grupa study. Pol Arch Med Wewn 2013;123(11):573—81.

[21] Rückert I-M, et al. Blood pressure and lipid management fall far short in persons with type 2 diabetes: results from the DIAB-CORE Consortium including six German population-based studies. Cardiovasc Diabetol 2012;11(1):50.

[22] DeGuzman PB, et al. Sub-optimal achievement of guideline-derived lipid goals

in management of diabetes patients with atherosclerotic cardiovascular disease, despite high use of evidence-based therapies. Diabetes Vasc Dis Res 2012;9(2):138–45.

[23] Pérez CM, et al. Are adults diagnosed with diabetes achieving the American Diabetes Association clinical practice recommendations? Puert Rico Health Sci J 2012;31(1):18.

[24] Cheung BM, et al. Diabetes prevalence and therapeutic target achievement in the United States, 1999 to 2006. Am J Med 2009;122(5):443–53.

[25] Andel M, et al. A multinational, multi-centre, observational, cross-sectional survey assessing diabetes secondary care in Central and Eastern Europe (DEPAC Survey). Diabet Med 2008;25(10):1195–203.

[26] Eliasson B, et al. The gap between guidelines and reality: type 2 diabetes in a National Diabetes Register 1996–2003. Diabet Med 2005;22(10):1420–6.

[27] Association AD. Standards of medical care in diabetes—2011. Diabetes Care 2011;34(Supplement 1):S11–61.