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Original Article

Factors affecting blood sugar levels in type 2 diabetic patients referred to Imam Reza Clinic of Arak, Iran

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Abstract

Background and aims: An efficient diabetes control delays the emergence of the side effects of the disease. The present study aimed to assess factors associated with blood sugar indices in type 2 diabetic patients.

Methods: This cross-sectional study was conducted among 201 diabetic individuals who were referred to Imam Reza Clinic in Arak, Iran, in 2019. To this end, all type 2 diabetes mellitus patients subjected to fasting blood sugar (FBS), 2-hour postprandial (2hpp), and hemoglobin A1c (HbA1c) tests during the recent one month were selected using a convenience sampling method. Additionally, a demographic checklist and the Health Literacy for Iranian Adults questionnaire were filled out through face-to-face interviews.

Results: Based on the results, blood sugar levels, especially HbA1c were related to residence ($P=0.012$) and access to health clinics ($P=0.028$) so that those with easier access had lower blood sugar indices. Further, an inverse correlation was observed between the HbAlc value and health literacy ($P=0.013$). An increase in the education level improved blood sugar amount, although the relationship was not significant. Finally, the mean value of 2hpp was related to the family support level, thus better family support led to a lower amount.

Conclusion: The results suggested a relationship between access to health clinics, residence, family support, health literacy, and occupation with blood sugar levels in diabetic subjects.

Keywords: Diabetes mellitus, Fasting blood sugar, Hemoglobin A1c, 2-hour postprandial

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Introduction

Type 2 diabetes is considered a prevalent non-contagious and costly disease with high morbidity and mortality rates (1). Due to population growth and aging, decreased physical activities, obesity prevalence, and the expansion of urban life, type 2 diabetes cases are increasing worldwide (2). This disease is a general and growing health problem, with the morbidity rate estimated to be 300 million in the world by 2025 (3). The pandemic afflicts the less developed countries, along with the developed ones. Based on the results of a meta-analysis study, Iran, as a relatively large country in the East Mediterranean region with various ethnic groups (2), struggles with a high prevalence (3-20% in different provinces) of type 2 diabetes (1).

In addition to drug therapy and diet, there are other parameters in glycemic control in diabetes patients, including age, gender, education level, economic condition, family factors, and access to health services (3-5). Demographic and socioeconomic variables can affect blood sugar values in diabetic individuals in different ways (5,6). For instance, education level can affect their glycemic control by affecting literacy level. Various studies have been performed in Pakistan (7), India (8), Brazil (9), Ethiopia (10), and Iran (11,12) regarding the effective factors on blood sugar control in diabetics, including age, education level, and health literacy (12), and residence (7-13). Studying diverse populations and geographical areas has repressed various results in some cases. The intervention required to properly control blood sugar can be introduced by detecting the factors and identifying subgroups of diabetics with a higher risk of failure to control the level, as well as higher mortality and morbidity rates (13,14). The present study examined effective parameters on blood sugar values among type 2 diabetic individuals visiting a diabetes clinic in Arak, Markazi province, Iran.

Materials and Methods

This cross-sectional study was performed among 201 patients with type 2 diabetes who were referred to Imam Reza Clinic in Arak, Iran, in 2019. The subjects included 201 diabetic patients who had blood sugar tests in the past month to measure 2-hour postprandial (2hpp), fasting blood sugar (FBS), and hemoglobin A1c (HbAlc). They were selected by employing a convenience sampling technique and asked to complete a demographic checklist and the Health Literacy for Iranian Adults (HELIA) questionnaire. This questionnaire (Cronbach's alpha = 0.72-0.89, reliability = 0.77), which was first developed by Montazeri et al (15), assesses

individuals' health literacy in five domains of reading, access, understanding, appraisal, and decision-making, and behavior (15). The sample size was calculated at a minimum of 199 individuals using G*Power software with 80% power, α (type 1 error) = 0.05, and based on the information (68.33±14.95 as a result of size effect 0.2) of the study by Tavousi et al (16). Statistical analysis was performed using SPSS software (version 16). Descriptive and inferential statistics were conducted by applying mean (standard deviation, SD) and frequency (percentage), as well as Pearson correlation test, independent *t* test, and analysis of variance test (ANOVA), respectively. In all tests, a *P* value less than 0.05 was considered statistically significant.

Results

The mean ± SD age of the subjects was 57.05 ± 12.22 years. In addition, the mean blood sugar indices (FBS, 2hpp, and HbAlc) were obtained at 169.49±63.17, 247.65±85.04 mg/dL, and 7.48±2.69%, respectively. Based on data in Table 1, a significant difference was found between various occupational groups in terms of the indices. The mean blood sugar value was maximized in housewives and unemployed patients, while it was minimized among college students. Further, females had more HbAlc amount compared to males.

The results of the ANOVA test indicated a significant difference in the mean blood sugar indices of individuals with various marital statuses. Thus, smaller values were obtained among single subjects. The patients with a greater education level exhibited less mean blood sugar amounts, although the difference was not statistically significant (Table 1). Furthermore, blood sugar indices were not significantly different between various age groups.

Regarding access to clinics based on the ANOVA test, a significant difference was observed in the mean blood sugar indices so that the values were better among those having easier access (Table 2). Based on the results of the ANOVA test, the least HbAlc amount was detected among city residents. The individuals with various family support levels possessed significantly different mean 2hpp values, thus the level was more when family support was low.

Additionally, the mean score of health literacy and its aspect based on the HELIA was computed from 100 scores (Table 3). The correlation between the total score of health and its aspect and blood sugar indices (FBS, 2hpp, and HbAlc) was determined as well.

According to the Pearson correlation test results (Table 3), a significant inverse correlation was observed between HbAlc amount with the total score of health literacy and a score of four aspects (reading, access, understanding, and appraisal). In other words, a lower HbAlc value was found among the subjects having more health literacy (Table 3). Finally, 2hpp and FBS levels were significantly and inversely related to the domain of decision-making and behavior.

Discussion

The results of the present study demonstrated an inverse correlation between HbAlc with the total score of health literacy and a score of four aspects (reading, access, understanding, and appraisal) among type 2 diabetic patients. The individuals with higher health literacy represented a smaller HbAlc amount. In addition, an

Table 1. Demographic variables and blood sugar levels in patients with type 2 diabetes referring to Imam Reza Clinic of Arak

Variable		FBS		2hpp		HbA1c	
		Mean ± SD	*P* value	Mean ± SD	*P* value	Mean ± SD	*P*-value
Age	<45	60.51 ± 164.25	0.602	251.85 ±90.69	0.539	7.91 ± 1.58	0.628
	45-60	65.54 ± 174.27		256.42 ± 80.18		8.24± 1.67	
	>60	61.61 ± 165.72		242.02 ± 79.98		8.067± 1.58	
Occupational groups	Employed	170.93 ± 68.79	0.144	247.30 ±88.85	0.016 *	8.07± 1.49	0.002*
	Jobless	176.50± 103.94		221 ±111.72		8.30 ±3.81	
	Housewife	173.72±60.61		260.36 ±73.16		8.37 ±1.44	
	Retired	164.02±63		239.21 ±89.23		7.82± 1.91	
	College student	100.20±3.49		124.50±5.802		5.22± 0.17	
Gender	Female	171.97 ±60.47	0.472	253.07±76.57	0.535	8.29±1.46	0.097
	Male	165.33 ±67.67		245.32±90.07		7.84± 1.83	
Marriage	Unmarried	110.87±33.01	0.015*	167.85±67.65	0.019*	6.25±1.33	0.007*
	Married	172.40±62.77		253.59±80.59		8.18±1.56	
	Widow-divorced	152.90±37.76		233.37±65.41		8.50±2.11	
Education	Elementary or less	174.33±63.95	0.136	259.04±77.69	0.246	8.37±1.69	0.109
	Junior high school	178.48±68.32		246.11±76.76		8.17±1.63	
	High school	162.88±60.03		248.45±89.44		7.76±1.06	
	College	144.88±51.53		220.59±90.53		7.59±1.82	

Note. 2hpp: 2-hour postprandial; FBS: Fasting blood sugar; HbAlc: Hemoglobin A1c; SD: Standard deviation; *Significant *P* value; *P* value were obtained from independent *t* test for gender and ANOVA test for other variables.

Table 2. Socioeconomic variables and blood sugar levels in patients with type 2 diabetes referring to Imam Reza Clinic of Arak

Variable		FBS		Hpp2		HbA1c	
		Mean ± SD	*P* value	Mean ± SD	*P* value	Mean ± SD	*P* value
Ability to pay expenses	Good	167.19±59.28	0.837	241.27±92.08	0.668	8±1.64	0.204
	Average	168.45±60.43		250.89±78.84		7.99±1.39	
	Low	174.07±72.23		257.27±79.52		8.51±2.02	
Living alone	Positive	160.53±76.76	0.598	214.75±97.78	0.125	7.19±2.18	0.056
	Negative	169.62±62.94		252.59±81.07		8.16±1.57	
Glucometer at home	Positive	169.77±62.78	0.780	253±80.69	0.281	8.12±1.45	0.924
	Negative	166.75±64.85		237±83.79		8.09±2.18	
Patients' place of residence	City	164.22±62.06	0.218	243.58±85.25	0.227	7.89±1.58	0.012*
	Village	182.17±63.67		261.15±73.81		8.75±1.54	
	Suburb	178.3±67.41		271.57±67.62		8.44±1.74	
Access to clinics	Good	150±48.06	0.015*	222.21±79.35	0.019*	7.59±1.42	0.028*
	Moderate	173.61±62.11		257.89±77.32		8.24±1.51	
	Poor	190.56±85.15		269.54±96.25		8.63±2.27	
Family support	Good	153.85±48.89	0.023*	221.65±84.08	0.038*	7.76±1.51	0.353
	Moderate	168.2±61.2		254.13±77.58		8.21±1.63	
	Poor	192.86±78.2		268.94±85.2		8.26±1.69	

Note. ANOVA: Analysis of variance; 2hpp: 2-hour postprandial; FBS: Fasting blood sugar; HbAlc: Hemoglobin A1c; SD: Standard deviation; *Significant *P*-value; *P* value were obtained from independent t-test for living alone, glucometer at home and ANOVA test for other variables.

Table 3. Dimensions of health literacy and blood sugar levels among patients with type 2 diabetes referring to Imam Reza Clinic of Arak

Variable	FBS		2hpp		HbA1c	
	Pearson correlation	*P* value	Pearson correlation	*P* value	Pearson correlation	*P* value
Total health literacy score	-0.107	0.130	-0.136	0.064	-0.187	0.013*
Reading skills	-0.134	0.058	-0.151	0.039*	-0.165	0.029*
Access	-0.058	0.412	-0.091	0.213	-0.188	0.013*
understanding	-0.028	0.694	-0.076	0.304	-0.0154	0.042*
Assessment	-0.123	0.082	-0.122	0.095	-0.208	0.006*
Decision and behavior	-0.151	0.032*	-0.183	0.012	-0.12	0.113

Note. 2hpp: 2-hour postprandial; FBS: Fasting blood sugar; HbAlc: Hemoglobin A1c. *Significant
P-value: Pearson correlation test.

inverse relationship was found between 2hpp with the domains of reading and decision making and behavior, as well as FBS with the aspect of decision making and behavior. In other words, the FBS value was less when the score of the domain was greater.

Olesen et al conducted a cross-sectional study among 1399 type 1 diabetic patients visiting diabetes clinics in Denmark to examine the relationship between health literacy and blood sugar control (17). They reported the mean HbAlc amount of 7.8% and referred to the smaller level among those with higher health literacy, which is consistent with the results of the present study. Schillinger et al found that individuals possessing lower health literacy tend to have a greater blood sugar value. Further, the side effects of diabetes, including retinopathy are more among those with low health literacy (18). According to Tefera et al (19), the probability of achieving target glycemic control in patients having higher health literacy is two times more than that of other patients.

Blood sugar levels were related to residence and access to health clinics, thus easier access led to fewer blood sugar indices. Furthermore, city residents exhibited a smaller HbAlc amount. No significant relationship was detected between lifestyle, age, and economic condition, as well as the presence of a glucometer at home with the blood sugar value. The results indicated better blood sugar indices among single subjects compared to the married ones, and a lower HbAlc value in males than females. Additionally, the highest and the lowest 2hpp and HbA1c s were related to the housewives and college students, respectively. An improvement in the education level enhanced blood sugar amount, although the relationship was insignificant. Further, the mean 2hpp value was related to the family support level, which was less in the patients with better family support.

Heidari et al suggested a significant relationship between blood sugar control, economic conditions, and family structure and support. In other words, a smaller HbAlc amount was observed among the patients living in less crowded families (below four members), under better economic conditions, and with greater family support. Blood sugar is better controlled among those having

higher education levels (13). Some researchers reported a correlation between the elementary education level (< four years) and poor blood sugar control (9). Based on the results of a study in Pakistan, the inadequate knowledge of diabetes self-care, as well as an unhealthy lifestyle, leads to a low control over blood sugar (7). According to Mohaghegh et al (20), perceived social support is positively and significantly related to a health-promoting lifestyle. Therefore, an increase in social support allows have a healthy lifestyle and consequently prevents and treats many chronic diseases.

Fekadu et al reported a relationship between age and education level with poor blood sugar control in type 2 diabetic individuals visiting a hospital located in Ethiopia. In other words, the 40-60 age range and elementary education level are the predictors of failure to control blood sugar in individuals (21). The results of another study indicated a lower rate of uncontrolled type 2 diabetes among those possessing more education level and city residents (10).

Esmailnasab et al also found that the education level and occupation are related to FBS in patients with type 2 diabetes although no relationship was obtained between gender and age. A greater education level improves blood sugar control, and housewives control blood sugar poorer than the employed individuals (6).

The findings of the present study support those of the previous research on the role of demographic variables and health literacy in controlling blood sugar in type 2 diabetic patients. Furthermore, the subgroups with more risk of poor blood sugar control can be identified, and the required interventions can be made accordingly.

The generalizability of the results is potentially limited since this cross-sectional study included only the diabetic individuals who referred to the Imam Reza Clinic of Arak.

Conclusion

In general, the results represented a relationship between access to health clinics, residence, family support, health literacy, occupation, and marital status with blood sugar amounts in patients with type 2 diabetes.

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Authors' contribution

PM designed and wrote the initial draft of the article. FR performed the statistical analysis. MA collected the data, and BS participated in designing and revising the manuscript. All authors approved the final report.

Conflict of interests

The authors declare no conflict of interests regarding the research and the publication of this article.

Ethical approval

This research was registered with code 2987 and approved by the Ethics Committee of Arak University of Medical Sciences (ethical code: IR.ARAKMU.REC.1397.187) in October 2018.

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