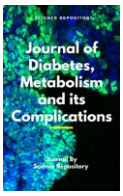

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Research Article

The Role of Diabetes-Related Self-Management in Type II Diabetes Mellitus and Impact on HbA1c

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ARTICLE INFO

Article history:
Received: 18 April, 2022
Accepted: 9 May, 2022
Published: 20 June, 2022

Keywords:
Diet
glycemic control
HbA1C
Healthcare
physical activity
self-management
type-2 diabetes

ABSTRACT

Background: The most important factor in controlling diabetes is self-management behaviour and its development is the first step toward helping the patients to successfully control their disease. The current study was conducted so as to investigate self-management behaviour and its Impact on HbA1c.

Methods: This study was carried out on 220 type-2 diabetic patients in 2020. The data was gathered through demographic and diabetes self-management questionnaire (DSMQ) and it included 16 items at four dimensions. The data analysed by independent t-test, One-way ANOVA, Multiple Linear Regression and Logistic Regression.

Results: There was a significant relationship between gender and physical activity, diet, and diabetic self-management (P-value> 0/001). Also, there was a significant relationship between economic status and glycemic control, diet, and diabetic self-management (P-value>0/05). In addition, family history of the disease and glycemic control, diet, and diabetic self-management were found to be meaningfully related (P-value> 0/05). Smoking and glycemic control on the one hand and diabetic self-management and BMI, on the other, experienced meaningful relationship (P-value >0/05). The most adverse effects were among patients who had unfavourable or minimum self-management: 10.7% kidney complications and 17.9% visual impairment (P-value>0/05). Dietary control is the strongest predictor of HbA1c in all diabetics and people with borderline self-management and diabetics without complications (P-value> 0/000).

Conclusion: Diabetes-related self-management predicted HbA1c levels and type-2 diabetic complications and intervention programmes crucial in increasing patients' awareness, learning, and participation.

Introduction

Diabetes is a pandemic which is currently on the rise on a global scale [1]. According to the International Federation of Diabetes 463 million adults between the ages of 20 and 79 suffered from type-2 diabetes in 2019 and it is estimated that this figure will have risen to 700 million by 2045. More than three quarters (79%) of these patients live in low-income or middle-income countries such as Iran [2]. In Iran Type-2 diabetes was reported to be 9.4% in 2019 [3]. Globally, more than 212 million diabetics are not aware of their condition and 352 million suffer from impaired glucose tolerance (IGT), putting them in danger of

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http://dx.doi.org/10.31487/j.JDMC.2022.01.01

diabetes and its complications such as cardiovascular diseases, stroke, kidney failure, foot ulcer, visual impairment, and neural damage [1, 4]. It is predicted that the annual management costs of this disease are bound to increase from $760.3 billion to $845 billion [5]. The high costs of type-2 diabetes (T2D) management has posed major challenges to healthcare systems of low- or middle-income countries in particular those with limited infrastructure for disease diagnosis and management. These countries spend 10% of all the costs of global diabetes; however, they are compelled to provide for the largest number of sufferers [6, 7]. Therefore, developing and implementing economical and efficient strategies to control and combat type-2 diabetes is of vital importance [8].

One course of action drawing researchers' attention is diabetes self-management. Self-management is an active and practical process directed by the patient and includes activities such as healthy diet, regular physical activity, foot care, sticking to prescribed medicine, and self-management of blood glucose in order to achieve disease management aims [9]. During this interactive, dynamic, and daily process, the individual, along with one's family, society, and healthcare workers, uses his/her capacity to alter lifestyle, control symptoms and cure oneself [10]. Diabetes self-management is influenced by various factors such as HbA1c, occupation, smoking, knowledge of and one's perception of diabetes, self-efficacy, social support, education, family income, age, ethnicity, BMI, diabetes duration, sex, place of residence, marital status, and kind of treatment [11-22]. Various studies have investigated the extent of self-management behaviour such as use of medicine, insulin, and urine and blood test among diabetics, concluding that adherence to these guidelines is low among diabetics. What necessitate urgent measures to control and combat diabetes are the prevalence of the disease, its complications, death, financial costs, and its individual and social burden [23]. The complications might adversely affect the quality of everyday life, empowerment, and the adoption of elf-management behaviour [24]. The contributions of self-management process include encouraging patients to do health-enhancing physical activity; controlling and curing the symptoms; influencing one's performance, emotions, and interpersonal relations; and sticking to a therapeutic diet [25]. Therefore, regarding the importance of self-management behaviour in controlling diabetes and its prevalence in Iran, this research was conducted to determine the status of self-management and its relevant factors among type-2 diabetics. In addition, this study aimed at investigating whether self-management can predict the reported complications and consequences among patients.

Materials and Methods

I Study Design and Setting

The current research is a descriptive-analytical study that was conducted in 2020 in Javanmard. Kermanshah.

II Study Participants and Sampling

The statistical population of this study consisted of 220 type-2 diabetics and the participants were selected randomly.

III Estimating Sample Size

The confidence level was set at 95%, p=0.5, and d=0.07 with the possibility of 10% withdrawal, based on this formula for 220 participants:

$$n = \frac{z^2_{1-\alpha/2}\mathrm{p}(1-\mathrm{p})}{\mathrm{d}^2}$$

IV Inclusion/Exclusion Criteria

i Inclusion criteria for health workers entail:

a. Diagnosis of type-2 diabetes along with medical record
b. Not suffering from psychological disorder
c. The patient's ability to cooperate and fill the questionnaire
d. Not having any medical complications which prevents self-management behaviour (such as exercise and regular physical activity)

ii Inclusion criteria for counseling recipients encompass:

Incomplete filling of the questionnaire

V Data Collection Tool and Technique

The data was gathered through demographic, clinical, and diabetes self-management questionnaires (DSMQ). The questions in demographic questionnaire included sex, age, marital status, education, place of residence, and financial condition. The clinical data focused on diabetes duration, family history of diabetes, BMI, smoking, the kind of treatment and HbA1c. The diabetes self- management questionnaire determines the individual's self-management behaviour with respect to blood sugar control within the previous 8 weeks. This questionnaire includes 16 items in four subgroups. The first dimension of self-management examines blood sugar and scores using questions 1, 4, 6, 10, and 12: (For example: I check my blood sugar levels with care and attention). The second is the diet's dimension using items 2, 5, 9, and 13: (For example: The food I choose to eat makes it easy to achieve optimal blood sugar levels). The third dimension is physical activity using items of 8, 11, and 15: (For example: I do regular physical activity to achieve optimal blood sugar levels). And the fourth dimension is the use of healthcare system using the items 3, 7, and 14: (For example: keep all doctors' appointments recommended for my diabetes treatment).

The patient's choice of each item is scored by 4-point Likert Scale between 0 (never) and 3 (a lot). The range of scores obtained using this technique is between 0 and 48 [26]. The tool's validity was checked by face and content validity. To determine face validity, the questionnaire was completed by 20 diabetic patients. Content validity of the questionnaire was confirmed by qualitative and quantitative methods. In qualitative content analysis, DSMQ was evaluated by 7 experts including 3 internal specialists and 4 health education and promotion experts. In quantitative content analysis, Content Validity Ratio (CVR) and Content Validity Index (CVI) were evaluated by 7 experts. Then, questions with CVR of 0.99 and CVI of 0.79 and higher were preserved in the questionnaire. In order to evaluate the tool's reliability, Cronbach alpha was calculated to measure internal consistency = 0.75).

VI Data Analysis

The data was analysed by SPSS 16 using descriptive statistics, mean, standard deviation, distribution of the frequency of the variables, independent t-test, One-Way ANOVA, and LSD post Hoc Test. Levene's test was employed to check the equality of groups' variances as well as logistic regression.

Results

220 type-2 diabetics participated in this study: 130 women and 90 men in three age groups of young (13.6%), middle age (35%), and old age (51.4%). 13.2% of the participants were single and 86.8% married. Three quarters were rural and 31.4% had high school diploma or higher degrees. The majority of the subjects (39.1%) belonged to middle-income families. Five percent of them smoked and 34.1 % of the patients had a family history of type-2 diabetes. 45% were overweight and the average BMI was 27.6. Almost 70% of the individuals took medicine. The frequency distribution of the variables of the study, based on demographic and clinical features and their relevance to self-management dimensions, are displayed in (Tables 1 & 2). Based on the results of (Table 1) (independent t-test and One-way ANOVA) there was a significant relationship between sex, physical activity, diet and diabetes self-management (P-value>0/0001). There was also a significant relationship between financial condition, glucose control, diet and diabetes self-management (P-value>0/05). Post Hoc test by LSD revealed that low-income families had a high average of glucose control (P-value>0/001). This test also disclosed that there was a relationship between poor economic condition and the other two groups of middle and optimal financial conditions. However, no significant relationship was witnessed between middle and high income families.

Table 1: Frequency distribution of demographic characteristics of samples and its relationship with Glucose Management, Dietary Control, Physical Activity and Health Care Use toward self- management of type 2 diabetes.

variables	Subgroup	Glucose. Management Mean ± SD	P	Dietary .Control Mean ± SD	P	Physical. Activity Mean ± SD	P	Health .Care. Use Mean ± SD	P	Self-management Mean ± SD	P
Age	<45	5.40 ± 2.45	0.220	3.70±2.78		3.93±1.59	0.444	3.56±1.25	0.859	17.46±6.11	**0.544**
	45-59	4.76±2.48		3.20±2.77	0.720	4.35±1.47		3.45±1.26		16.54±6.32	
	60 &	5.39±2.64		3.45±3.15		4.35±1.81		3.43±1.10		17.57±6.65	
Gender	Male	4.87±2.46	0.322	3.15±2.78	0.022	4.40 ±1.27	0.000	3.57 ±1.18	0.836	16.76 ±6.18	**.015**
	female	5.38 ±2.63		3.56± 3.09		4.22 ±1.90		3.37 ±1.16		17.50 ±6.64	
Education	illiterate	5.48±2.65		3.57±3.15	0.399	4.50±1.89	0.607	3.53±1.16	0.196	18.03±1.69	**0.256**
	Primary	5.37±2.51		3.32±3.04		4.13±1.56		3.60±1.18		17.30±6.86	
	Lower of diploma	5.34±2.73		4.03±3.28		4.37±1.66		3.06±1.01		17.96±6.68	
	diploma and more	4.65±2.26		3.00±2.54		4.18±1.52		3.46±1.23		15.97±5.70	
Marriage status	single	5.10 ±1.98	0.071	3.93 ±2.96	0.847	3.89 ±1.87	0.428	3.55 ±1.18	0.795	17.37 ±5.37	**0.262**
	Married	5.18 ±2.65		3.31 ±2.97		4.35 ±1.63		3.44 ±1.17		17.17 ±6.61	
Residence	Urban	5.24 ±2.61	0.163	3.52 ±3.07		4.24 ±1.63	0.421	3.39±1.21	0.098	17.31±6.57	**0.174**
	Rural	4.96 ±2.44		3.03 ±2.61		4.45±1.78		3.65±1.04		16.85 ±6.13	
Economic situation	Weak	5.86±2.75	0.024	3.97±3.35	0.047	4.27±1.77	0.446	3.54±1.33	0.719	18.68±7.38	**0.035**
	moderate	4.96±2.37		2.93±2.57		4.45±1.64		3.45±1.06		16.59±5.60	
	good	4.74±2.50		3.42±2.97		4.10±1.58		3.37±1.14		16.46±6.31	

Table 2: Frequency distribution of clinical characteristics of samples and its relationship with Glucose Management, Dietary Control, Physical Activity and Health Care Use toward self-management of type 2 Diabetes.

variables	Subgroup	Glucose. Management Mean ± SD	P-value	Dietary .Control Mean ± SD	P-value	Physical. Activity Mean ± SD	P-value	Health .Care .Use Mean ± SD	P-value	self-management Mean ± SD	P-value
Family history	**Yes**	4.64± 2.16	0.007	2.94 ±2.78	0.030	4.58 ±1.62	0.710	3.37 ± 1.22	.320	16.30 ±5.64	**0.021**
	No	5.45 ± 2.72		3.63 ±3.04		4.14±1.67		3.5 ± 1.14		17.66 ±6.81	
Treatment type	Insulin	2.69±5.25		3.33 ±2.86		4.29±1.57	0.311	3.53±1.19	0.537	17.33± 6.36	**.0976**
	Tablet	5.14± 2.56	0.955	3.40± 3.00	0.964	3.35± 1.71		3.40±1.18		17.17± 6.57	
	Non	2.25±2.17		3.58 ± 3.23		3.57±1.50		3.75±0.96		16.91±5.75	
Duration	1	4.95±2.60	0.626	3.42±2.76	0.410	4.32±1.55	0.901	3.22±1.18	0.338	16.77±6.39	**.0443**
	2	5.16±2.55		3.27±2.90		4.26±1.71		3.49±1.18		17.05±6.37	
	3	5.57±2.67		4.11±3.63		4.42±1.65		3.61±1.09		18.69±7.09	
Smoking	Yes	5.36 ±1.50	0.032	2.63±3.26	0.941	5.27±2.00	0.493	2.90±1.13	0.948	16.90±6.17	**0.896**
	No	5.16±2.61		3.44±2.95		4.24±1.64		3.48±1.17		17.21±6.48	
BMI	Normal	5.44±2.64	0.318	3.42±3.32	0.106	4.30±1.71		3.58±0.98		17.69±7.12	**0.04**
	Over weight	5.28±2.75		3.78±3.14		4.47±1.69	0.228	3.42±1.19	0.628	17.95±6.93	
	Obesity	4.78±2.17		2.28±2.21		4.01±1.59		3.40±1.29		15.61 ±4.65	

The findings also indicated that patients of low and middle income were reported to have high dietary performance on average (P-value>0/05). There was no significant relationship between other demographic variables and different dimensions of self-management (P-value> 0/05). Following the results in (Table 2), there was a significant relationship between family history of diabetes and glucose control, diet control, and diabetes self-management (P-value> 0/05). In addition, a significant relationship was seen between smoking and glucose control (P-value> 0/05). The results demonstrated that BMI is significantly related to diabetes self-management (P-value> 0/05). Post Hoc test by LSD showed a meaningful difference between obese people in terms of BMI and overweight people (P-value>0/05). However, One-way ANOVA failed to show a meaningful difference between average scores of glucose control, diet control, physical activity, healthcare use and diabetes self-management with treatment (P-value>0/05). The results also showed that most patients' self-management condition was Undesirable (63.6%). Another result of the study was the prevalence of kidney complications was 10.7% and visual impairment 17.9% among those patients who had unfavourable self-management. 75.34% of the participants reported no complications. However, among those who had boundary-level self-management, the prevalence of kidney complications and visual impairment was 6.3% and 11.3%, respectively.

The results obtained from logistic regression in (Table 3) highlight the significant effects of age, sex, and self-management on the occurrence of type-2 diabetes (P-value>0/05). Furthermore, the results demonstrated that people of 60 and beyond are 4.7 times more likely to develop type-2 diabetes compared to young and middle-aged individuals. Men are 3.1 times more at risk of this disease. And those with poor self-management are 2.8 times more likely to suffer the complications of type-2 diabetes compared to those with favourable self-management. According to (Table 4), Dietary Control is the strongest predictor of HbA1c in all diabetics and people with borderline self-management and diabetics without complications, and the results of the multiple regression model showed that by increasing a standard deviation in the HbA1c score, the Dietary Control of diabetics by 0.43 standard deviation and the HbA1c of individuals with borderline self-management by 0.49 standard deviation and the HbA1c of individuals without complications by 0.48 standard deviation decreases. The regression model also, explained 27% of the total variance for predicting HbA1c in diabetic individuals, 50% of the total variance for predicting HbA1c in individuals with borderline self-management, and 33% of the total variance for predicting HbA1c in non-complicating individuals.

Table 3: Results related to logistic regression in diabetic patients.

Variables	B	S. E	Wald	df	P-value	Exp(B)	Lower	Upper
Age	1.56	.59	6.91	1	.009	4.74	1.49	15.13
Gender	1.15	.51	5.14	1	.023	3.15	1.19	8.49
Education	-.26	.45	.34	1	.562	.77	.32	1.86
Marriage status	-.04	.46	.01	1	.928	.96	.39	2.36
Duration	.13	.38	.12	1	.734	1.14	.54	2.41
smoking	.34	.67	.25	1	.615	1.40	.37	5.26
Family history	.04	.31	.01	1	.905	1.04	.57	1.90
BMI	-.37	.35	1.16	1	.282	.69	.35	1.36
Self-management	1.04	.31	11.07	1	.001	2.82	1.53	5.21
Constant	-1.92	.73	6.98	1	.008	.15		

Table 4: Results related to multiple regression in diabetic patients.

Model		Total Patient		Undesirable self-management		Borderline self-management		Complicated		No complicate	
		Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
1	(Constant)		.000		.000		.000		.000		.000
	Glucose- Management	-.104	.242	.128	.147	-.196	.086	-.131	.381	-.100	.370
	Dietary Control	-.434	.000	.052	.560	-.494	.000	-.325	.031	-.481	.000
	Physical Activity	.032	.588	.056	.543	.150	.099	-.067	.484	.090	.235
	Health Care Use	-.027	.643	-.017	.848	-.027	.760	-.059	.537	-.018	.816
	R	.523		.136		.711		.449		.577	
	R Square	.274		.018		.505		.201		.333	

Discussion

This study was conducted to investigate self-management behaviour and its Impact on HbA1c. The majority of the participants were female, middle aged, married, rural, non-smoking, and had high school diploma or higher degrees. Most of them, who were overweight, belonged to middle-class family in terms of financial condition. Diriba *et al.* also focused on married participants from middle class families [27]. Yekta *et al*. also carried out research predominantly on married women [28]. Zheng *et al.* selected non-smoking rural patients as the primary participants [29]. A high percentage of the participants in Kong *et al.* were also obese [11]. The findings suggest that there is a positive correlation between sex, physical activity, diet control and the patients' self-management. In this study the female diabetics scored higher compared to men in dimensions of diet control and general self-management. However, men's average score was higher in physical activity dimension. It is highly likely that female diabetics who are in charge of their family members pay meticulous attention to food, cooking, and healthy diet. They may also prefer health-inducing carbohydrates using fresh and colourful fruit and vegetables. They generally play a more active role in diabetes self-management and constantly strive for successful dieting.

In this study the decrease in physical activity on the part of female diabetics can be attributed to emergence of disability and diseases or fear of social participation due to physical impairment or lack of safe space. Therefore, providing safe women-only space as well as appropriate transportation vehicles can pave the way for their physical activity. Kookhazade *et al.* and Cariber *et al*. also found significant relationship between sex and physical activity [30, 31]. Mazloom *et al.* also achieved similar results in the relationship between sex, self-management, and physical activity [32]. These findings are consistent with the ones in this research. However, Salehi *et al*. did not find such correlations [33]. In this study, there was a positive correlation between patients' financial condition and diabetes self-management, diet control, and glucose control. Better self-management was associated with those who came from low-income families, which can be accounted for by two possibilities. Such patients are probably guided by healthcare centers providing them with adequate knowledge regarding diabetes and its complications. And these patients feel compelled to follow diabetes control guidelines and try to adopt a traditional and healthy diet. Or they might have a more active lifestyle and a more demanding job.

Additionally, fear of the complications of the disease and its costs have made them enhance their self-management approach. Rahimian *et al*. and Adwan *et al.* showed results consistent with this section of the current research [34, 35]. They concluded that there was a correlation between diabetes self-management and the patients' financial condition; however, there was a positive correlation between income and self-management. What is more, the results revealed that there was a significant relationship between family history of diabetes and glucose control, diet control, and self-management. In other words, patients with no family history of diabetes had superior performance in terms of glucose control, diet control, and diabetes self-management. This might be the case due to the fact that these people might undergo necessary training to control and curb diabetes and be inclined to manage their disease through glucose control and dieting. They are also assumed to receive more social support from family and friends. One study inconsistent with this finding is that of Yekta *et al.* in which there was no significant relationship between self-management and family history of diabetes [28]. This study also demonstrated that there was a relationship between general diabetes self-management and BMI,

differences of which were between obese and overweight people. What this finding justifies is the fact that obese and overweight people might conclude excess weight can contribute to the complications of diabetes and, consequently, should make profits from self-management techniques.

Furthermore, considering their BMI, and families and their own concern might propel them to take diabetes self-management and healthcare more seriously. To the researchers' dismay there was no compatible research finding elsewhere. This result was inconsistent with that of Yekta *et al*. where they found no significant relationship between self-management and patients' BMI [28]. The results showed a correlation between smoking and glucose control. What can be inferred is that smokers suffering from type-2 diabetes, despite smoking, have perceived the complications and the irreversible effects of diabetes and seek to prevent the development of the condition and its complications by glucose control. The existing evidence suggests that there is strong epidemiological link between smoking and blood sugar, leading to type-2 diabetes. Smoking is generally not considered to be a healer in preventing diabetes. In fact, smoking is an unhealthy option in conflict with self-management behaviour and treatment methods [36]. This argument highlights the necessity of educational intervention. This finding contrasts with what Rahimian *et al*. and Kong *et al*. came across in which non-smokers scored higher in self-management compared to smokers [11, 36].

The patients' self-management in the area of glucose control, diet adherence, and general self-management was unfavourable, and in the dimensions of physical activity as well as healthcare was remotely acceptable. Taghipour *et al*. and Kordi *et al*. found diabetes self-care below the standards. Vosooghi *et al*., Parham *et al*., and Mazloom *et al*. complained about substandard level of self-care, which is in line with the present research findings [32, 37-40]. However, Diriba *et al*., Huang *et al*., and Bagherinejad *et al*. were satisfied with their patients' various dimensions of self-management [27, 41, 42]. It seems that the difference in patients' self-management reported in various studies lies in a combination of factors such as difference in self-management training, difference in knowledge of and attitude toward self-management, and the different tools employed to measure self-management, which can lead to reported differences not only among different countries but also within one country. This study showed that patients with substandard self-management are more likely to suffer from kidney complications and visual impairment. The prevalence of such complications among diabetics is a critical issue since these complications are irreversible and can do irreparable damage to vital organs.

In addition to disability, these patients need to incur enormous costs of healthcare [43]. Olfatifar *et al*. reported visual impairment as a consequence of diabetes and Amer *et al*. found similar complications besides kidney failure, which were both consistent with the findings of this research [44, 45]. The final results of this study were that Dietary Control is the strongest predictor of HbA1c in all diabetics and people with borderline self-management and diabetics without complications, and with increasing Dietary Control score, HbA1c decreases in these people. In the study of Shayeghian *et al*., Self-care activities such as diet in diabetes were predictors of HbA1c levels [46]. Also, Saad *et al*. found the most statistically significant predictors of glycemic control to be diet self-management behaviour and oral hypoglycemic agents use [47].

Limitation and Recommendation

In this study, instead of direct observation, self-management data was gathered through self-report, which might contribute to biased reporting. Recommendation for future studies is the implementation of diabetes self-management educational interventions for diabetic patients.

Applications

Given that there is a relationship between diabetes self-care and diabetes complications through educating diabetic patients about self-care behaviours and determining the relationship between self-care and complications such as kidney complications and visual impairment and stroke and foot ulcers, Patients and their families can take big steps to improve their quality of life and lower the direct and indirect costs of complications of type 2 diabetes.

Conclusion

In this research within most of its dimensions, self-management among type-2 diabetics was at an unfavourable level leaving behind visual impairment as well as kidney complications. Lack of disease awareness and negligence in controlling blood sugar or being fed up with the chronic nature of diabetes have all contributed to poor self-management. The healthcare centers designed for diabetics need to devise educational intervention so as to raise patients' awareness with respect to self-management. Such aims can be fulfilled by considering self-management in the continuous process of training as well as social support. Last but not least, further research needs to be conducted with larger populations, in different socioeconomic settings, and with enhanced research methods.

Conflicts of Interest

None.

Acknowledgement

This study is the result of research project with ethical code of IR.SBMU.PHNS.1398.185 from Shahid Beheshti Medical Sciences University. Researchers would like to appreciate all people who have helped in this research.

Ethical Statement

Approval obtained to conduct the research from the relevant authorities and the ethics committee in the faculty research, and the goals and nature of the study clearly and accurately explained to the participants.

Consent

Participants should feel free to take part or not in the research, and an informed consent obtained ahead. Privacy and confidentiality assured for all participants.

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