Original Article

Factors affecting the self-care in patients with type II diabetes using path analysis

Mohammad Ali Bigdeli[1] *Seyed Saeed Hashemi Nazari*[2] Soheila Khodakarim[3] Hamid Brodati[4]

1- MSc in epidemiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2- Assistant Professor of Epidemiology, Department of Epidemiology, School of Public Health, Safety Promotion and Injury Prevention Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3-Assistant Professor of biostatistics, Department of Epidemiology, Faculty of Public Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
4-MD,MPH, Health and Treatment Center of Abyek, University of Medical Sciences Qazvin, Iran.

Saeedh_1999@yahoo.com

Abstract

Background and purpose: Diabetes is the most common metabolic disorder which is caused by defects in insulin secretion, insulin action, or both .The most important factor in managing diabetes is self-care. Since diabetes self-care behaviors are multifactorial and these factors may directly or indirectly affect self-care, it is possible through the application of path analysis to estimate the direct, indirect and total effect of variables on self-care.

Materials and Methods: The present study was cross-sectional, and according to the hypothesized model, the sample size was determined to be 500 patients. To collect the study data, five questionnaires were utilized. Path analysis was then conducted to investigate the effects of variables of the study on self-care behaviors. The analyses were performed using SPSS 16.0 and MPlus6 .The following goodness-of-fit were also used: $\chi 2$, RMSEA, CFI and SRMR test-statistics. P value 0.1 or less than 0.1 was considered statistically significant.

Results: The estimated model demonstrated a good model fit, ($\chi 2$= 24.5, p=0.22), (RMSEA=0.02), (CFI = 0.92) and (SRMR=0.03).Total effect (p<.01), total indirect effect (p=0.08) and direct effect (p<.01) of duration of diabetes on self-care were significant. The increase in duration of diabetes has also resulted in an increasing level of self-care ability. The findings showed that the total effect of patient and doctor relationship on self-care was significant (p=0.01), but the total indirect effect was not significant (p=0.24). Patient-doctor relationship (p=0.01) as well as diabetes knowledge (p<.01) had also a direct effect on self-care.

Conclusion: Despite the limitations, each six hypothesized variable leading directly to self-care behavior had significant effect. The study findings indicated that several factors affect self-care behavior which is the most important and most vital step in metabolic control in diabetic patients.

Keywords: Self-Care; Path Analysis; Total Effect

1. Introduction

Diabetes is the most common metabolic disorder caused by defects in insulin secretion, insulin action, or both (1). Type 2 diabetes is the most common form of diabetes that constitutes about 90 percent of all diabetes cases worldwide. The recent estimates of International Diabetes Federation (IDF) indicate that 8.3% of adults – 382 million people – have diabetes (2). According to the latest study, the prevalence of diabetes in 2011 in Iran is estimated to be 11.37% in the age group of 25-70 years old (3). By the end of 2013, diabetes had caused 5.1 million deaths and cost 548 billion dollars in Healthcare expenditure (2). Much of this cost arises from the serious long-term complications associated with the disease including: coronary heart disease, stroke, adult blindness, limb amputations and kidney disease (4). Despite some evidences that strict blood glucose control could delay or prevent diabetes complications, a significant proportion of patients have been observed to experience uncontrolled blood sugar. Achieving optimal glycemic control in clinical practice is difficult and the reasons for poor control are complex (5). The most important factor in managing the disease is self-care behaviors, which means correct and timely injection of insulin, going on diet, regular exercise, and identification of symptoms of hyperglycemia, regular use of medications, foot care and improving the quality of life (6). Through successful self-care, patients could reduce total costs and rates of morbidity and mortality (7). According to the existing survey results, the leading cause of death in diabetes patients is the lack of self-care (6). Identifying the factors affecting self-care may help in developing effective interventions to increase the quality of life in patients with type II diabetes. Several studies have explored diabetes knowledge as a factor affecting self-care (8). The systematic review conducted by Mehammedsrage found that after increasing the duration of diabetes, the self-care ability had significantly increased. The above review also revealed that long duration (the mean duration of diabetes 9 years) had a significant relationship with adherence to recommended medications and monitoring of blood sugar testing (9). Also, improving doctor-patient communication increased the probability of performing diabetes self-care behaviors. Foot care, for example, had a four-fold increase, and diet self-care behavior was increased by nine folds (8). Since diabetes self-care behaviors are multifactorial, these factors may directly or indirectly affect self-care.

In order to answer the questions regarding the relationships between a set of independent variables and a dependent variable, path analysis was used. This analysis is based on simple regression techniques, but through looking at these relationships, it takes the researcher a step beyond the traditional regression analysis. Multiple regression (as a statistical technique on its own) makes no assumptions about how variables are causally or not causally related to one another. At the same time, path analysis provides a framework for the researcher to think more carefully about how X variables are related to Y, as well as how X variables are related to each other. Path models depict theorized, directional relationships among a set of variables. Path

analysis is literally an analysis of the paths or lines in a model that represents the influence of one variable on the other. Therefore, using the capabilities of path analysis, it is possible to estimate the direct, indirect and total effects of one variable (the independent variable) on the other variables (the dependent variable). The purpose of this study was, then, to test a hypothesized model of individual and social factors affecting self-care including age, education, diabetes knowledge, doctor and patient relationship, duration of diabetes, the number of annual visits to the doctor, depression, and waist-to-hip ratio.

2. Materials and Methods

The present study was a Cross-sectional research and the study population included all type II diabetic patients who referred to primary health centers in Abyek district. The study was conducted in the time range of June – November, 2014. Inclusion criteria were: having no diabetes type I, diagnosis of type II diabetes for more than one year, showing willingness through signing informed consent form to participate in the research, lack of disability, and advanced diabetes complications. Exclusion criteria were: being hospitalized during the study and unwillingness to continue collaboration during investigation. Patients were selected using sex stratified random sampling. The sample size was determined on the basis of the ratio of the number of participants to the number of model parameters. Kline indicated that 20:1 is a desirable goal of subjects to parameters, but 10:1 might be more realistic (10). According to the hypothesized model in this study which incorporates 29 parameters, 16:1 sample was

determined, and with regard to the potential missing data, the sample size was determined to be 500 patients. The details of study including the objectives and the benefits were all explained to the participants. Informed consent was also obtained, and the participants were assured that the information would be used for research purposes only, and will be kept confidential.

To collect the study data, five questionnaires were utilized. The literate patients filled out the questionnaires by themselves. However, the questionnaires of the illiterate participants were filled out through conducting interviews with them.

A questionnaire specifically designed for collecting the demographic information was used by the researcher. It included the date of birth, gender, marital status, job and education, date of diagnosis, household income, family history of diabetes, type of treatment, annual visit to the doctor, diabetes complication, and waist to hip ratio. The patients' years of education was also filled for all the participants. The self-care behavior of patients was assessed using a revised Summary of Diabetes Self-Care Activities (SDSCA) scale (11). The SDSCA scale has 12 questions which assess five aspects (diet, exercise, blood sugar testing, foot care and smoking) during the previous seven days (12). Answers range from 0 (never) to 7 (every day during the past week self-care activities carried out). Higher scores indicate that patients have better self-care during the past seven days. Items were summed to create the self-care score. Zareban et al. reported a Cronbach's alpha of 0.89 (12). Grading item 4 of the questionnaire is done in reverse order (11).

The questionnaire consists of 20 three-choice questions (true, *false*, don't know) to assess diabetes-related knowledge, and includes items on diet, blood glucose monitoring, exercise, medication taking and complications of diabetes. The range of scores is from 0 to 40. The internal reliability of the questionnaire was 0.71, as measured by Cronbach's alpha based on a study conducted by Collins et al. in Birmingham (13).

This instrument has 9 items that assess the physician– patient relationship based on a five-point Likert Scale ranging from "not agreed at all" to "fully agreed". Higher scores indicate better communication between physician and patient (14). In a study conducted by Zahednezhad et al. in 2010 on diabetes patients, a Cronbach's alpha of 0.92 was reported (15).

The tool consists of 9 items, and the scores range from 0 to 27. This questionnaire is the most appropriate tool for screening and diagnosing depression in chronic diseases. This scale is composed of three-point Likert. Scores 1 to 4 show minimal depression, 5 to 9 mild depression, 10 to 14 moderate depression, and 15 and above moderately severe and severe depression (16). PHQ-9 score ≥ 10 had a sensitivity of 88% and a specificity of 88% for major depression (17). In a study conducted by Rahimian and Mohajeri-Tehrani, a Cronbach's alpha of 0.87 was reported (16).

The analyses of the data were performed through SPSS 16.0 and MPlus6 Software. χ^2 and ANOVA were used to compare the participants' self-care behaviors by demographics categorical and continuous variables, respectively. Pearson correlation coefficient test was also used for examining the correlation of self-care behaviors with continuous variables. At the same time, path analysis was conducted using Mplus6 software to investigate total effect, total indirect effect, specific indirect effect, and direct effects variables in the model including the number of annual visits to the doctor, diabetes knowledge, doctor and patient relationship, waist-to-hip ratio, age, depression and duration of diabetes on self-care behaviors. The direct effects are those influences unmediated by any other variable in the model (18). In other words, direct effects are depicted as an arrow emanating from an independent variable (exposure) leading and pointing to a dependent variable (outcome) (19). Specific indirect effect or set of indirect effects is a compound of all paths that traverse a particular intervening variable. Similarly, the total effect is the sum of all indirect effects and the direct effect, and the total indirect effect is the sum of all indirect effects of a variable (20).

Based on the results of conducted studies, it was then hypothesized that depression, diabetes knowledge, waist-to-hip ratio, annual visits to the doctor, duration of diabetes and doctor and patient relationship would directly affect diabetes self-care. Education through doctor and patient relationship and diabetes knowledge would also indirectly influence diabetes self-care. Likewise, the duration of diabetes through annual visits to the doctor and depression would directly and indirectly affect diabetes self-care (Fig.1). Also, to gauge goodness-of-fit of the model, the following indices were used: Chi-square statistic, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and standardized Root Mean

Square Residual (SRMR) test-statistics. A non-significant Chi-square statistic, CFI exceeding 0.90, RMSEA and SRMR values less than 0.08 indicated a good model fit. A P value equal to 0.1 or less than 0.1 was also considered statistically significant.

Figure 1. Hypothesized model of direct and indirect factors affecting self-care behaviors
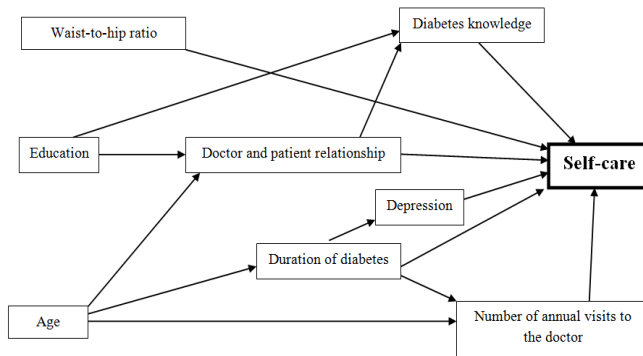
3. Results

464 patients from among a total of 500 patients participated in the current study (the response rate was 92.8%). The mean age of patients was 59.78±11.67. Most of the patients (59.7%) were in the age range of 50-69 years. 73.9% of the patients were female, and 26.1% were male, while 78.7% of them were married and 54.3% of them were illiterate.The mean duration of diabetes was 6.87±5.1 years. The most monthly household income (50.6%) was 188 to 313 dollars. 82.5% of the patient were treated with oral hypoglycemic agents, 10.6% with insulin, and 4.3% were merely treated through diet. 23.3% of the patients had also complications, such as hypertension, coronary disease, stroke and kidney disease, while 51.7% of them had reported the symptoms of depression. 58.2% had also family history of diabetes, and 73.5% were examined by a physician 4 times or more per year. The mean of self-care scores according to the demographic variables is presented in table 1. It is observed that self-care had a significant association with the duration of diabetes (p=0.02), as well as the type of treatment (p=0.02). The findings showed not any significant relationship between self-care and age group (p=0.5), gender (p=0.83), marital status (p=0.38), education (p=0.73), household income (p=0.22) and the complications of diabetes (p=0.79). As a result of an increase in the duration of diabetes, self-care ability had also significantly improved. Hence, the patients with insulin treatment had significantly reported the highest self-care scores.

Table 1. The mean score of self-care behaviors based on demographic variables

Variables	Category	N (%)	Mean±SD of self-care per day	p-value
Age group	Less than 50 years	83(17.9%)	3.73± 1.20	
	50–69 years	277(59.7%)	3.73± 1.13	0.50
	70 years and over	104(22.4%)	3.88± 1.15	
Gender	Male	121(26.1%)	3.76± 1.17	0.83
	Female	343(73.9%)	3.77± 1.14	
Marital status	Married	365(78.7%)	3.80± 1.15	
	Single	6(1.3%)	3.59± 0.9	0.38
	divorced	4(0.9%)	3.79± 1.61	
	Widowed	89(19.2%)	3.63± 1.13	
Education	Illiterate	252(54.3%)	3.80± 1.18	0.64
	Under diplomas	206(44.4%)	3.71± 1.11	
	diplomas	6(1.3%)	4.08± 1.21	
Duration of diabetes	Less than 5 years	200(43.1%)	3.59± 1.12	
	5–9.9 years	151(32.5%)	3.84± 1.17	0.02
	10 years and over	113(24.4%)	3.97± 1.11	
Monthly household income (Dollars)	Less than 188 Dollars	204(44%)	3.78± 1.16	
	188 to 312 Dollars	235(50.6%)	3.75± 1.10	0.73
	313 to 624 Dollars	20(4.3%)	3.58± 1.12	
	625 Dollars and more	5(1.1%)	4.76± 2.34	
Type of treatment	Diet alone	20(4.3%)	3.57± 1.22	
	Oral hypoglycemic alone	383(82.5%)	3.71± 1.14	0. 02
	Insulin alone	49(10.6%)	4.20± 1.13	
	Insulin and oral hypoglycemic	12(2.6%)	3.93± 1.07	
Complications of diabetes	yes	108(23.3%)	3.81± 1.16	0.79
	No	356(76.7%)	3.75± 1.14	

Table 2. Correlation matrix between study variables

Variables	1	2	3	4	5	6	7	8	9
Self-care	-								
Age	0.02	-							
Number of years of education	0.006	0.5**-	-						
Duration of diabetes	0.17**	0.12**	0.02	-					
Waist-to-hip ratio	-0.10*	0.03	-0.02	-0.05	-				
Number of annual visits to the doctor	0.12**	-0.07	0.07	0.12**	-0.08	-			
Depression	0.09*	0.05	-0.01	0.08	-0.1*	0.09	-		
patient and Doctor relationship	0.12**	-0.1*	0.10*	0.04	-0.07	0.05	0.07	-	
Diabetes knowledge	0.12**	0.01	0.01	0.02	0.06	0.02	-0.05	-0.007	-

* Significant at $P \leq 0.1$ ** Significant at $P < 0.01$

Pearson correlation test was used to investigate the relationship between self-care behaviors and independent variables (Table 2). It is illustrated that there was a positive significant correlation between self-care behaviors and the duration of diabetes, the number of annual visits to the doctor, depression, doctor and patient relationship, diabetes knowledge, and negative significant correlation with waist-to-hip ratio. However, there was not any correlation between self-care behaviors and the age and number of years of education.

The estimated model demonstrated good model fit, ($\chi2 = 24.5$, p=0.22), (RMSEA=0.02) ,(CFI =0.92) and (SRMR=0.03). Some non-significant relationships were excluded from the hypothesized model, and at last the following variables remained in the model: diabetes knowledge, depression, relationship between doctor and patient, waist-to-hip ratio, duration of diabetes, age, the number of annual visits to care physician and self-care behaviors (Figure 2). The final model demonstrated good model fit, ($\chi2 = 19.1$, p=0.2), (RMSEA=0.02) , (CFI =0.93) and (SRMR=0.03). Except for the direct effect of the doctor-patient relationship on waist-to-hip ratio, the other relationships in the model were significant. The standardized effects of variables affecting self-care are reported in figure 2 and Table 3. Total effect and total indirect effect of age on self-care was found to be not significant. Age through doctor and patient relationship and duration of diabetes had an indirect effect on self-care. Also, the indirect effect of age on self-care through the number of annual visits to the doctor was not significant. At the same time, there were negative direct effects of age on both doctor and patient relationship and number of annual visits to the doctor. A negative correlation existed between the patient's age and doctor-patient relationship in addition to the number of annual visits to the doctor. Also, the duration of diabetes had a direct effect on the number of annual visits to doctor, in a way that as the duration of diabetes increased, there was also an increase in the number of annual visits to the doctor. Hence, both annual visits to doctor and doctor-patient relationship had direct effect on self-care.

The total effect, total indirect effect, and direct effect of duration of diabetes on self-care were also significant. Likewise, a positive correlation was observed between the duration of diabetes and self-care ability of the patients. The duration of diabetes through annual visits to the doctor indirectly affected self-care. At the same time, the severity of depression rose as the duration of diabetes experienced an increase. Also, the severity of depression had a negative direct effect on waist-to-hip ratio, as a result of which, the waist-to-hip ratio had negative direct effect on self-care in a way that any increase in

waist-to-hip ratio resulted in a decline in self-care ability. It was then documented that the total effect of doctor-patient relationship on self-care was significant, but the total indirect effect was not significant. Similarly, the doctor-patient relationship had a direct effect on the patients' self-care. Hence, as the doctor-patient relationship increased, a reduction was observed in waist-to-hip ratio, but the association was not significant. Also, the diabetes knowledge had a direct effect on self-care, and any increase in Diabetes knowledge resulted in the self-care ability to increase.

Figure 2. Final model of direct and indirect factors affecting self-care behaviors
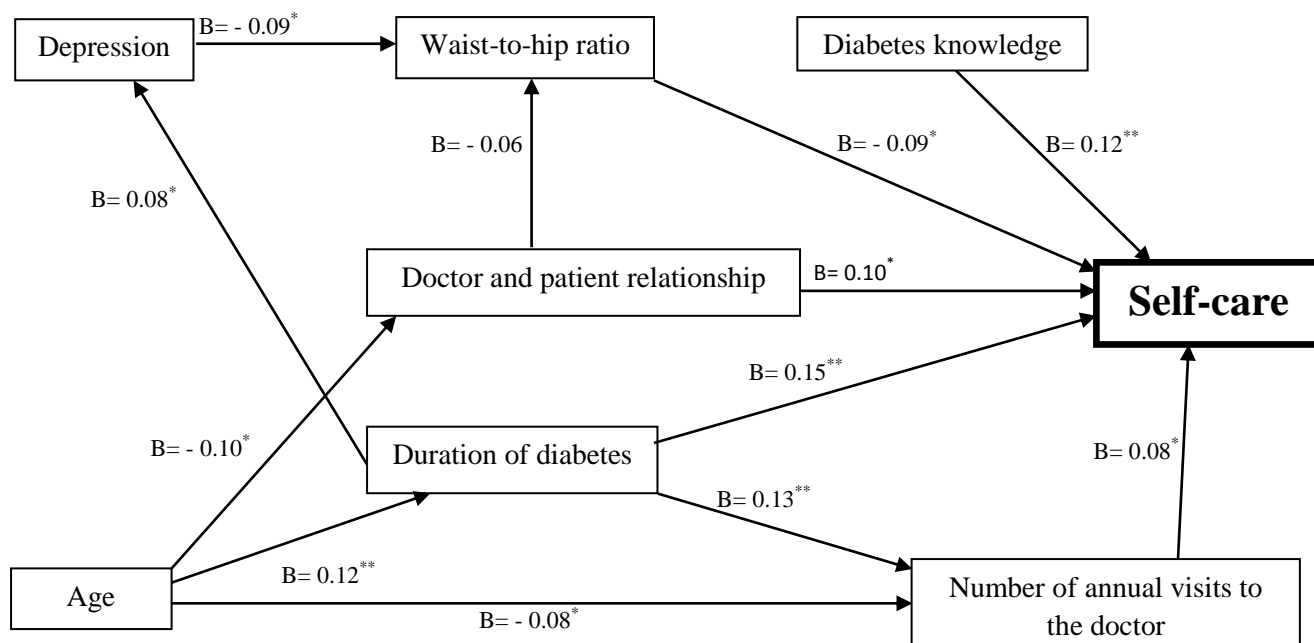
Table 3. Standardized effects of variables associated with self-care behaviors

Independent variable	Total effects		Total indirect effects		Specific indirect effects		Direct effects	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Age	0.001	0.93	0.001	0.93	-0.01[1] 0.01[2] -0.008[3]	0.09 0.03 0.17	-	-
Depression	0.009	0.14	0.009	0.14	0.009[4]	0.14	-	-
Waist-to-hip ratio	0.09-	0.04	-	-	-	-	0.09-	0.04
Duration of diabetes	0.16	<.01	0.01	0.08	0.01[5] 0.001[6]	0.1 0.24	0.15	<.01
Diabetes knowledge	0.12	<.01	-	-	-	-	0.12	<.01
Doctor and patient relationship	0.11	0.01	0.006	0.24	0.006[7]	0.24	0.1	0.01
Number of annual visits to the doctor	0.08	0.05	-	-	-	-	0.08	0.05

[1] **The effect of age on self-care through "*doctor and patient relationship*"**
[2] **The effect of age on self-care through "*duration of diabetes*"**
[3] **The effect of age on self-care through "*the number of annual visits to the doctor*"**
[4] **The effect of depression on self-care through "*waist-to-hip ratio*"**
[5] **The effect of duration of diabetes on self-care through "*the number of annual visits to the doctor*"**
[6] **The effect of duration of diabetes on self-care through "*depression*" and "*waist-to-hip ratio*"**
[7] **The effect of doctor and patient relationship on self-care through "*waist-to-hip ratio*"**

4. Discussion

The findings of this study support the direct and indirect effects of social factors on self-care behaviors. The current study not only investigated the effects of social factors on self-care, but also examined the role of individual factors such as age, duration of diabetes, obesity and depression on the patients' self-care. The review of previous studies showed that the direct and indirect effect of these variables has less been examined in local level. According to the mean of total self-care score (3.77±1.15), the self-care ability of diabetic patients is moderate. This result could be due to the characteristics of the patients in the present study (73.9% were female, 54.3% illiterate, 43.1% with duration of diabetes less than 5 years, and 50.6% with the monthly household income in the range of 188-313 Dollars). In the study of Anbari et al. (21) and Sorani et al. (22), the self-care ability of diabetes patients was reported as low to moderate.

The major finding of the current study was, therefore, the significant increase in self-care ability while there was an increase in the duration of diabetes. It was also found that the patients with a longstanding history of diabetes tend to have more self-care behavior because of receiving more training over the years. Similarly, the experience and attitude change

over time resulted in an increase in the ability of self-care. Chio et al. reported that the long duration of diabetes (with a mean duration of 14.29 years) was associated with high self-care ability (23). Likewise, Xu and Pan in their study found that the long duration of diabetes (with a mean duration of 9 years) had a positive correlation with adherence to recommended medications and monitoring of regular blood glucose (24).

In the current study, the total effect of doctor-patient relationship on self-care behaviors was found to be positively significant. It was then inferred that the existence of a good communication between a physician and a patient may help build trusting relationships, and could help in promoting self-care in patients with type II diabetes (8). These results are then reminiscent of the study of Gao et al., where there was found a significant direct effect of doctor-patient communication on self-care (25). In the study of XU et al., the physician–patient relationship was found to be indirectly affecting diabetes self-care via self-efficacy, beliefs, and diabetes knowledge. The influence of physician–patient relationship on diabetes self-care can be achieved through changing the patients' diabetes knowledge, self-efficacy and beliefs (8).

 Another finding in this study was the direct effect of diabetes knowledge on self-care behaviors. In the study of XU et al., Diabetes Knowledge did not have a direct effect on diabetes self-care, instead it affected diabetes self-care indirectly through beliefs and self-efficacy (8). In the study of Osborn et al., Diabetes knowledge had a direct effect on diabetes self-care (26). The found that as the

diabetes knowledge of patients increased, they usually experienced a change in their attitudes and behaviors, and theses behavior adaptations caused improvement in self-care behavior.

 The results of the current study also showed that any increase in waist-to-hip ratio resulted in the patient's self-care ability to decrease. People with a high waist-to-hip ratio are usually none-compliant with their diet and do not usually exercise, as a result of which they have poor self-care behavior.

 It was finally concluded that a negative correlation existed between doctor and patient relationship and the patients' age level. This was probably due to the low communication ability of elderly people, and also the short visit time of the patients in crowded physicians' offices which is usually encountered in Iran. In such brief appointments with physicians, it is actually difficult for elderly patients to fully understand and follow the orders and prescriptions of doctors.

 There are certain limitations to this study that should be considered while interpreting the findings of the research. First, a cross-sectional design was used to describe the relationship between variables. The main characteristic of cross-sectional design is that all data are collected at one time-period, thereby limiting the ability to identify cause-and-effect relationships between variables. A better alternative was prospective research which could be conducted to investigate the longitudinal effects of these constructs on self-care behaviors. Second, the findings have limited generalizability because this study was conducted in rural primary health centers where most of the patients were low-income and

illiterate, thus, this study should be replicated in other communities. Despite the above-mentioned limitations, every six hypothesized variables leading directly to the self-care behavior had significant effect. It indicates that several factors affect self-care behavior which is the most important and most vital step in metabolic control in diabetic patients, and considering these factors in improving the self-care of patients ultimately affect blood glucose control and the patients' quality of life.

Conflict of Interests
The Authors have no conflict of interest.

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