



Self-Management Status in Patients with Diabetes and Disease Control Indicators in Lamerd City, Iran

Fereidoun Jahangir^{1,2}, Esmail Kavi³, Behnam Masmouei¹, Mohammad-Rafi Bazrafshan^{3,*}, Hamed Delam⁴, Nasrin Shokrpour⁵, Mahmood Namjoonasab⁶, Hossein Forouzandeh⁷ and Elmira Zarei⁷

¹Department of Nursing, Hazrat Zahra (P.B.U.H) Abadeh School of Nursing, Shiraz University of Medical Sciences, Shiraz, Iran

²Department of Epidemiology and Biostatistics, Kerman University of Medical Sciences, Kerman, Iran

³Department of Nursing, School of Nursing, Larestan University of Medical Sciences, Larestan, Iran

⁴Student Research Committee, Larestan University of Medical Sciences, Larestan, Iran

⁵English Department, Shiraz University of Medical Sciences, Shiraz, Iran

⁶Non-Communicable Diseases Department, Lamerd Health Center, Shiraz University of Medical Sciences, Shiraz, Iran

⁷Cellular and Molecular Research Center, Gerash University of Medical Sciences, Gerash, Iran

*Corresponding author: Associate Professor, Department of Nursing, School of Nursing, Larestan University of Medical Sciences, Larestan, Iran. Email: seeder2007@gmail.com

Received 2019 December 07; Revised 2020 March 01; Accepted 2020 March 03.

Abstract

Background: Diabetes is a global epidemic with serious complication and there is a clear need for paying special attention to self-management as the cornerstone to optimal control of the disease.

Objectives: This study aimed to assess the self-management status and its correlation to disease control indicators in people with diabetes.

Methods: In a descriptive cross-sectional study, 220 patients were selected from the list of the referred patients available in Lamerd public health network from December 2014 to June 2015. In the first step, data about demographic information and disease control were collected from the patients' records. In the second step, the self-management status of each patient was assessed by the Diabetes Self-Management Questionnaire developed by Schmitt et al. To analyze the data, independent sample t-test and Pearson correlation coefficient were used.

Results: The mean age of the male and female participants was 56.43 ± 13.50 and 56.46 ± 10.49 years old, respectively. The mean duration of the disease was 6.67 ± 4.72 years for men and 7.07 ± 5.30 years for women. Twenty-one (25.9%) men and 60 (43.7%) women had a history of smoking. The results of the Pearson correlation coefficient showed that there was an inverse and statistically significant relationship between diabetes self-management status and weight, body mass index (BMI), waist circumference, glucose tolerance test (GTT), LDL, and cholesterol. The results of the t-test did not show significant differences between the level of HbA1C (HbA1C7) and self-management scores of the patients ($P > 0.05$).

Conclusions: Patients with better self-management status were in a better disease control condition with respect to weight, BMI, waist circumference, GTT, LDL, and cholesterol levels. Special attention to the control and management of LDL, cholesterol, HbA1C, BMI, and blood pressure levels is recommended in planning for these patients.

Keywords: Diabetes Mellitus, Glycated Hemoglobin A, Self-Care, Self-Management

1. Background

Diabetes is a global epidemic with serious complication and there is a clear need for paying special attention to the self-management as a cornerstone to optimal control of the disease. As predicted earlier (1, 2), diabetes is a global epidemic and an increasing condition in the first quarter of the 21st century. The number of people with diabetes in the world reached 422 million by 2014, while it was 382 million in 2013 (2). The speed of this increase has been more than what is expected by some researchers (300 million in the year 2025 as predicted by King et al.) (1). In Iran,

diabetes prevalence increased by about 35.1% from 2005 to 2011 (1). In 2011, the prevalence of glucose intolerance and diabetes in Iran was 11.3 and 14.6 percent, respectively, in the age group of 25 to 70 years old (1). It was estimated 3.78 million cases of DM (2.74 million diagnosed and 1.04 million undiagnosed) in Iran in 2009, and this number is expected to rise to 9.24 million cases (6.73 million diagnosed and 2.50 million undiagnosed) by 2030 (3).

Regarding the weighted prevalence of both pre-diabetes and diabetes which are in an upward rising trend in Iran, the health care system infrastructure is not

wholly prepared for this trend in Iran; as a result, a high prevalence of diabetes complications is seen (4). Based on the registry of university-affiliated adult outpatient diabetes clinics in Iran during 2015 - 2016, the frequency of chronic vascular complications among patients with diabetes was relatively high in Iran as this study revealed that proportions of retinopathy, nephropathy, peripheral neuropathy, diabetic foot, and ischemic heart disease were 21.9%, 17.6%, 28.0%, 6.2%, and 23.9% in Iran, respectively (5). The high level of disease complication in people with diabetes in Iran highlights the need for paying more attention to control of the condition and self-management as a cornerstone to optimal control of the disease. It costs a lot for the patients and affects both life quality and life expectancy and imposes health and economic burdens on the national budget for the loss of productivity (6).

Self-management is a non-pharmacological intervention that is critical to optimal control (7), and management of many chronic diseases (8). It is the cornerstone of overall diabetes management (9). In a systematic review of randomized controlled trials conducted by Norris et al., it was revealed that self-management training had positive effects on knowledge, frequency and accuracy of self-monitoring of blood glucose, self-reported dietary habits, and glycemic control in studies with short follow-up (< 6 months); however, the effects of interventions on lipids, physical activity, weight, and blood pressure were variable (10). Some research revealed that diabetes self-management education could reduce the HbA1c level in patients with type 2 diabetes mellitus (11-15). Nevertheless, the results of a meta-analysis conducted by Cunningham et al. showed a non-significant effect of diabetes self-management education on HbA1c in African-Americans (16).

Although these studies are fundamental in understanding different approaches in education and training the people with diabetes, controversies in the results indicate that the relationship between diabetes self-management education and disease control outcome can come from different contexts, different qualities of education and different approaches, adopted for training the patients in these researches. Therefore, this debate can be an ongoing process. However, the relationship between diabetes self-management status of patients and metabolic control or other related outcomes can lead to a more durable conclusion. The national program for controlling and preventing diabetes in Iran has made great attempts to improve prevention and plan sustainable care for these patients from 2004 to date to reduce the problems associated with diabetes (4, 17). Despite the ongoing efforts of this institution to provide accurate estimates of diabetes

prevalence in different parts of the country, few studies have been carried out on the self-management and control of this disorder in people with diabetes in Iran.

2. Objectives

This study aimed to assess the self-management status and its correlation with disease control indicators in patients with diabetes.

3. Methods

In this descriptive cross-sectional study, the approval of the ethics committee (no. 94-01-93-9191) was obtained and then the study samples were selected from the patients' list existing in Lamerd city public health network from December 2014 to June 2015, using convenience sampling method. Written informed consent was obtained and the patients' information was kept confidential at all stages of the study. Firstly, data were collected from the patients' records. The results of blood sugar and other tests such as body mass index (BMI), HbA1c, glucose tolerance test (GTT), TG, total cholesterol, HDL, and LDL were considered acceptable as they represent the last status of the patient until the previous month. In case those blood lipids or HbA1c tests were out-of-date, or GTT was not recorded in the patient's record, the tests were performed again in the same lab. For example, in one case for confirmation of diabetes diagnosis who was in the list of diabetic patients but did not have any recorded test of GTT, the standard method was used for GTT measurement (18). To this aim, GTT was done in the morning after 8 - 12 hours of fasting before doing the test. A glucose solution (75 g) was given to the patients and asked them to drink it within 15 minutes; then, a blood sample was obtained for estimation of glucose status at half-hourly intervals for 2.5 hours after the glucose intake. For HbA1c measurements, venous blood samples were obtained and sent to the lab for glycated hemoglobin (A1c) test, which identifies the average plasma glucose concentration. In the second step, the patients' self-management status was assessed using the Diabetes Self-Management Questionnaire (DSMQ) developed by Schmitt et al. A community health worker, called *Behvarz* in Iran, filled out the questionnaires in a visit through asking the patients the related questions. Patients were included in the study if they were diagnosed with diabetes at least for 1 year, had a medical record in a health center, and resided in Lamerd city for more than 1 year. The exclusion criteria were patients who did not sign the written informed consent or were reluctant to continue their participation in the study. Considering the size of the required

sample (220 persons) with a 95% confidence interval and 80% power of the study, the samples were selected by using convenience sampling procedure from the patients' list of the public health networks in Fars province in Lamerd, Iran.

The data collection form had two parts of demographic information and disease control information like smoking; duration of the disease in terms of years; type of diabetes; hypertension; weight; height; BMI (kg/m^2); method of diabetes treatment; tests like HbA1c, FBG, blood lipid levels like triglyceride (TG), total cholesterol, HDL-c and LDL-C; and the number of visits by doctors and associate nurses during the previous year.

The Diabetes Self-Management Questionnaire (DSMQ), which was designed by Schmitt et al. in 2013, was used to assess the activities associated with self-care to control the blood sugar. The questionnaire was designed in 4 areas, including glucose control, dietary control, physical activity, and health care utilization, each with 5, 4, 3, and 3 items, respectively. One item in this questionnaire, which measured the overall rating of self-care, was only considered in the sum scale score, and the minimum and maximum scores were 0 and 3 in each item, respectively. In this questionnaire, negatively worded items are reversed, so that higher values reveal more effective self-care, and then all items are summed and transformed to a scale ranging from 0 to 10 (19). People were then categorized by a median split of the DSMQ total score into groups performing "Inadequate" ($\text{DSMQ} \leq 6$) versus "Adequate" diabetes self-care ($\text{DSMQ} > 6$) (20). This questionnaire was translated into the Persian language. For adaptation of the questionnaire to the local conditions, a panel of experts evaluated the validity of the instrument and clarity of translation. Then, for assessing the reliability, Cronbach's alpha was obtained 0.776 in a pilot study done on 20 individuals having the same features who were excluded from the samples. This is a bit lower than the English version of the DSMQ original scale, which revealed an overall internal consistency (Cronbach's alpha) of 0.84. Descriptive statistics like frequency, mean and standard deviation (SD) and inferential statistics like Pearson correlation coefficient test and Independent-sample *t*-test were used for the analysis of the data, using SPSS software, version 16. In this study, the significance level was considered 0.05.

4. Results

The characteristics of the 220 participants are shown in Tables 1 and 2. The majority of participants ($n = 71$) were 55-64 years old. Gender was not distributed evenly in the samples, with more female gender ($n = 139$). Only 5 participants

aged over 65 years old had inadequate self-management. The majority of the participants were married ($n = 183$) and uneducated ($n = 127$); only three subjects with inadequate self-management status had middle or secondary school education. The majority of the participants had diabetes type 2 ($n = 179$) and received only oral medication as their treatment modality ($n = 167$). The majority of the participants were unemployed or housewife ($n = 151$), had a family history of DM ($n = 127$), and were not smokers ($n = 139$). The clinical characteristics of the participants are shown in Table 2.

The result of the Pearson correlation coefficient test, as shown in Table 3, revealed that there was an inverse and statistically significant relationship between the DSMQ subscales scores and weight, BMI, waist circumference, GTT, and cholesterol. The increase in means in DSMQ scores can decrease the weight, BMI, waist circumference, GTT, and LDL in patients.

The results of Independent-sample *t*-test (Table 4) showed that no significant difference between the level of HbA1c was found in patients' self-management scores (all *P* values > 0.05). Most of the patients had HbA1c > 7 ($n = 157$). Also, there was no significant difference between the mean scores in the DSMQ in the male and female participants ($P > 0.05$) (Table 5).

5. Discussion

In the present study, the results, shown in Table 2, revealed that on average indicators like LDL, HbA1c, BMI, and blood pressure in patients were out of the normal range proposed by the American Diabetes Association in general (21). Then, most of them needed the recommended individualized interventions like diet, physical activity, behavioral therapy, and pharmacotherapy. There was an inverse and statistically significant relationship between the DSMQ scores and weight, BMI, waist circumference, GTT, and cholesterol; it means that patients with better self-management status were in a better disease control condition with respect to weight, BMI, waist circumference, GTT, and cholesterol. In the present study, there was a statistically significant and reverse relationship between the use of health care and amount of 2-hour blood GTT. Also, there was an inverse relationship between health care use and the amount of FBS; that is, with an increase in the health care use by patients, their amount of FBS improves. The results of the study carried out by Yuan et al. showed that diabetes self-management education programs could improve the clinical outcomes (BMI, HbA1c, blood glucose, blood pressure) in diabetic patients (15). In the present study, the level of self-management in diabetic

Table 1. Characteristics of the Participants with Inadequate and Adequate Diabetes Self-Management in People with Diabetes in Lamerd in 2014 - 2015^a

Variable, Categories	Diabetes Self-Management		Chi-Square, χ^2	P Value
	Inadequate DSMQ ≤ 6	Adequate DSMQ > 6		
Age			13.2968	0.010
20 - 34	2 (22.22)	7 (77.78)		
35 - 44	8 (33.33)	16 (66.67)		
45 - 54	19 (35.19)	35 (64.81)		
55 - 64	15 (21.13)	56 (78.87)		
> 65	5 (8.47)	54 (91.53)		
Gender			0.0388	0.844
Male	19 (23.46)	62 (76.54)		
Female	31 (22.30)	108 (77.70)		
Level of education			7.0054	0.030
Uneducated	23 (18.11)	104 (81.89)		
Primary	24 (33.33)	48 (66.67)		
Middle and secondary	3 (14.29)	18 (85.71)		
Marital status			0.4683	0.494
Single	10 (27.03)	27 (72.97)		
Married	40 (21.86)	143 (78.14)		
Treatment			0.6672	0.716
Only oral anti diabetic agents	39 (23.35)	128 (76.65)		
Only insulin	3 (27.27)	8 (72.73)		
Combined (insulin, anti-diabetic agents, dietary modifications)	6 (17.65)	28 (82.35)		
Employment			0.0883	0.766
Self-employed or employee	17 (23.94)	54 (76.06)		
Unemployed or housewife	33 (22.15)	116 (77.85)		
Diabetes type			0.3509	0.554
Type 2	39 (21.79)	140 (78.21)		
Type 1	8 (26.67)	22 (73.33)		
Family history DM			0.7272	0.394
Yes	32 (25.20)	95 (74.80)		
No	18 (20.22)	71 (79.78)		
Smoking			0.4616	0.497
Yes	20 (25.00)	60 (75.00)		
No	29 (21.01)	109 (78.99)		

^aValues are expressed as No. (%).

patients was adequate and acceptable; however, most of them had HbA1C > 7 (n = 157). This revealed that although

Table 2. Clinical Characteristics of the Patients with Diabetes^a

Variables	Man	Woman
Age (years)	56.43 ± 13.50	56.46 ± 10.49
Duration of diabetes in years	6.67 ± 4.72	7.07 ± 5.30
Hypertension		
Systole (mmHg)	119.63 ± 13.51	118.46 ± 18.03
Diastole (mmHg)	73.29 ± 9.03	71.70 ± 12.58
BMI (kg/m ²)	25.61 ± 3.48	26.27 ± 4.16
HbA1C (%)	7.66 ± 1.47	8.02 ± 1.62
FBS (mg/dL)	167.18 ± 60.63	183.76 ± 70.45
GTT (mg/dL)	263.56 ± 83.70	270.32 ± 84.88
TG (mg/dL)	146.10 ± 63.48	177.04 ± 84.64
Total cholesterol (mg/dL)	180.42 ± 35.35	197.64 ± 45.81
HDL (mg/dL)	42.27 ± 10.27	47.99 ± 27.71
LDL (mg/dL)	100.37 ± 34.26	114.47 ± 44.63
The number of visits were carried out during the past year		
Doctor	3.32 ± 2.02	3.55 ± 2.34
Practical nurse	8.59 ± 4.95	8.13 ± 4.31

^aValues are expressed as mean ± SD.

our patients on average had adequate self-management overall, they needed more attention to the management of glucose. Educating patients in self-monitoring blood glucose (SMBG) can be beneficial; however, a considerable number of our patients were uneducated, which can limit the self-monitoring of blood glucose in these patients. However, educating the patients' relatives can be another alternative. Receiving social support can improve self-management behaviors (22). Another factor affecting the maintenance of self-management behaviors is providing the patients with feedback by the treatment team (23). Self-management education through telephone follow-up can be effective in this population (24). There is still a gap between the level of self-management and the ideal level of self-management and prevalence of health indicators in our patients. In future studies, it is suggested that measures should be taken to improve self-management in our patients, especially in glucose management and physical activity area.

The present study showed the self-management status of diabetic patients in Lamerd city in the south of Fars province, one of the underprivileged areas in Iran. It was revealed that most of the patients in this area are uneducated or have primary education. In another study, it is

recommended that self-management education should be provided through telephone follow-up as an effective strategy for this population (24). However, further studies incorporating innovative strategies in disadvantaged areas are recommended.

5.1. Conclusions

Patients with diabetes need to have a consistent and targeted self-management and follow-up to successfully control their illness. The present study yielded significant results in evaluating the self-management of patients with diabetes and showed that people with higher DSMQ scores had a better health status in terms of diabetes indices such as weight control and BMI, oral GTT, LDL, and levels of HbA1C. Therefore, self-care education can reduce the severity of the disease. Moreover, the findings of this study showed the diabetes self-management status in patients in Lamerd city in the south of Fars province, one of the underprivileged areas in Iran. More research in such areas is suggested.

Acknowledgments

This study is a result of a research project (no. 94-01-93-9191) approved by Shiraz University of Medical Sciences. The authors would like to acknowledge all the participants for their contribution and Shiraz University of Medical Sciences for financial support of the study.

Footnotes

Authors' Contribution: Mohammad-Rafi Bazrafshan and Fereidoun Jahangir developed the study design and drafted the manuscript; Esmaeil Kavi, Behnam Mas-mouei, Hamed Delam, Nasrin Shokrpour, Mahmood Namjoonasab, Hossein Forouzandeh, and Elmira Zarei revised the manuscript and contributed to the interpretation of the results; Mohammad-Rafi Bazrafshan supervised the findings of this work and contributed to the interpretation of the results. All authors provided critical feedback and helped shape the research.

Conflict of Interests: The authors declare no conflicts of interest.

Ethical Approval: The Ethics Committee of Shiraz University of Medical Sciences approved this study (no. 94-01-93-9191).

Funding/Support: This study was financially supported by the Shiraz University of Medical Sciences in Iran (no. 94-01-93-9191).

Table 3. Pearson Correlation Between Diabetes Self-Management Scores and Disease Management Factors in Patients with Diabetes

Variables	Glucose Control	Dietary Control	Physical Activity	Health Care Utilization	Total
Systole	-0.004	-0.019	-0.007	0.010	-0.008
Diastole	-0.043	-0.061	-0.083	0.024	-0.62
Weight	-0.079	-0.127	-0.169 ^a	-0.100	-0.155 ^a
High	-0.103	-0.099	-0.033	-0.059	-0.083
BMI	-0.085	-0.156 ^a	-0.207 ^b	-0.169 ^a	-0.209 ^b
Waist	-0.030	-0.168 ^a	-0.145 ^a	-0.065	-0.145 ^a
Hip size	0.017	-0.139 ^a	-0.013	-0.06	-0.084
FBS	-0.102	-0.125	0.007	-0.204 ^b	-0.114
GTT	-0.10	-0.148 ^a	-0.031	-0.155 ^a	-0.136 ^a
TG	0.002	0.032	0.016	-0.004	0.013
Cholesterol	-0.039	-0.051	-0.005	-0.046	-0.058
HDL	0.076	0.037	0.085	0.077	0.088
LDL	-0.170 ^a	-0.188 ^b	-0.027	-0.246 ^b	-0.209 ^b

^aThe significance level less than 0.05.

^bThe significance level less than 0.01.

Table 4. Independent-Sample *t*-Test for Comparison of the Mean Scores in Diabetes Self-Management Questionnaire (DSMQ) in Patients with HbA1C Less Than 7 and More Than 7

HbA1C	Mean and Std. Deviation		Mean Difference	<i>t</i>	df	P Value	Confidence Interval (95%)	
	HbA1C < 7 (N = 59)	HbA1C > 7 (N = 157)					Lower	Upper
Glucose control	6.38 ± 1.64	6.91 ± 1.88	-0.531	-1.910	214	0.057	-1.080	0.017
Dietary control	7.52 ± 2	7.58 ± 2.05	-0.056	-0.182	214	0.856	-0.670	0.557
Physical activity	6.99 ± 2.13	6.97 ± 2.64	0.019	0.052	214	0.95	-0.711	0.75
Health care utilization	7.62 ± 1.7	7.43 ± 1.86	0.187	0.705	213	0.442	-0.33	0.709
Total	33.91 ± 6.31	34.66 ± 7.76	-0.744	-0.659	214	0.510	-2.968	1.480

Table 5. Independent-Sample *t*-Test for Comparison of the Mean Scores of Patients in Diabetes Self-Management Questionnaire (DSMQ) and Gender

Gender	Mean and Std. Deviation		Mean Difference	<i>t</i>	df	P Value	Confidence Interval (95%)	
	Male (N = 81)	Female (N = 139)					Lower	Upper
Glucose control	6.60 ± 1.61	6.41 ± 2.16	0.18	0.68	218	0.496	-0.35	0.73
Dietary control	7.32 ± 1.99	7.65 ± 2.05	-0.33	-1.16	218	0.245	-0.89	0.22
Physical activity	6.55 ± 2.56	7.20 ± 2.42	-0.645	-1.32	218	0.0633	-1.32	0.03
Health care utilization	7.16 ± 1.85	7.41 ± 1.70	-0.249	-1.01	218	0.312	-0.73	0.23
Sum Scale	6.92 ± 1.38	7.13 ± 1.62	-0.21	-0.97	218	0.33	-0.63	0.21

References

- King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: Prevalence, numerical estimates, and projections. *Diabetes Care*. 1998;21(9):1414-31. doi: [10.2337/diacare.21.9.1414](https://doi.org/10.2337/diacare.21.9.1414). [PubMed: 9727886].
- Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Res Clin Pract*. 2014;103(2):137-49. doi: [10.1016/j.diabres.2013.11.002](https://doi.org/10.1016/j.diabres.2013.11.002). [PubMed: 24630390].
- Javanbakht M, Mashayekhi A, Baradaran HR, Haghdoost A, Afshin A. Projection of diabetes population size and associated economic bur-

- den through 2030 in Iran: Evidence from micro-simulation markov model and bayesian meta-analysis. *PLoS One*. 2015;**10**(7). e0132505. doi: [10.1371/journal.pone.0132505](https://doi.org/10.1371/journal.pone.0132505). [PubMed: [26200913](https://pubmed.ncbi.nlm.nih.gov/26200913/)]. [PubMed Central: [PMC4511591](https://pubmed.ncbi.nlm.nih.gov/PMC4511591/)].
4. Noshad S, Afarideh M, Heidari B, Mechanick JI, Esteghamati A. Diabetes care in Iran: Where we stand and where we are headed. *Ann Glob Health*. 2015;**81**(6):839–50. doi: [10.1016/j.aogh.2015.10.003](https://doi.org/10.1016/j.aogh.2015.10.003). [PubMed: [27108151](https://pubmed.ncbi.nlm.nih.gov/27108151/)].
 5. Esteghamati A, Larijani B, Aghajani MH, Ghaemi F, Kermanchi J, Shahrami A, et al. Diabetes in Iran: Prospective analysis from first nationwide diabetes report of national program for prevention and control of diabetes (NPPCD-2016). *Sci Rep*. 2017;**7**(1):13461. doi: [10.1038/s41598-017-13379-z](https://doi.org/10.1038/s41598-017-13379-z). [PubMed: [29044139](https://pubmed.ncbi.nlm.nih.gov/29044139/)]. [PubMed Central: [PMC5647418](https://pubmed.ncbi.nlm.nih.gov/PMC5647418/)].
 6. Caporale JE, Elgart JF, Gagliardino JJ. Diabetes in Argentina: Cost and management of diabetes and its complications and challenges for health policy. *Global Health*. 2013;**9**:54. doi: [10.1186/1744-8603-9-54](https://doi.org/10.1186/1744-8603-9-54). [PubMed: [24168330](https://pubmed.ncbi.nlm.nih.gov/24168330/)]. [PubMed Central: [PMC3826662](https://pubmed.ncbi.nlm.nih.gov/PMC3826662/)].
 7. Brady TJ, Sacks JJ, Terrillion AJ, Colligan EM. Operationalizing surveillance of chronic disease self-management and self-management support. *Prev Chronic Dis*. 2018;**15**. E39. doi: [10.5888/pcd15.170475](https://doi.org/10.5888/pcd15.170475). [PubMed: [29625631](https://pubmed.ncbi.nlm.nih.gov/29625631/)]. [PubMed Central: [PMC5894302](https://pubmed.ncbi.nlm.nih.gov/PMC5894302/)].
 8. H Broom D. Diabetes self-management: multiple technologies of self. *Aust J Prim Health*. 2003;**9**(3):61. doi: [10.1071/py03025](https://doi.org/10.1071/py03025).
 9. Ruggiero L, Glasgow R, Dryfoos JM, Rossi JS, Prochaska JO, Orleans CT, et al. Diabetes self-management. Self-reported recommendations and patterns in a large population. *Diabetes Care*. 1997;**20**(4):568–76. doi: [10.2337/diacare.20.4.568](https://doi.org/10.2337/diacare.20.4.568). [PubMed: [9096982](https://pubmed.ncbi.nlm.nih.gov/9096982/)].
 10. Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: A systematic review of randomized controlled trials. *Diabetes Care*. 2001;**24**(3):561–87. doi: [10.2337/diacare.24.3.561](https://doi.org/10.2337/diacare.24.3.561). [PubMed: [11289485](https://pubmed.ncbi.nlm.nih.gov/11289485/)].
 11. Brown SA, Garcia AA, Kouzekanani K, Hanis CL. Culturally competent diabetes self-management education for Mexican Americans: the Starr County border health initiative. *Diabetes Care*. 2002;**25**(2):259–68. doi: [10.2337/diacare.25.2.259](https://doi.org/10.2337/diacare.25.2.259). [PubMed: [11815493](https://pubmed.ncbi.nlm.nih.gov/11815493/)]. [PubMed Central: [PMC2134805](https://pubmed.ncbi.nlm.nih.gov/PMC2134805/)].
 12. Goudswaard AN, Stolk RP, Zuithoff NP, de Valk HW, Rutten GE. Long-term effects of self-management education for patients with Type 2 diabetes taking maximal oral hypoglycaemic therapy: A randomized trial in primary care. *Diabet Med*. 2004;**21**(5):491–6. doi: [10.1111/j.1464-5491.2004.01153.x](https://doi.org/10.1111/j.1464-5491.2004.01153.x). [PubMed: [15089797](https://pubmed.ncbi.nlm.nih.gov/15089797/)].
 13. Brown SA, Blozis SA, Kouzekanani K, Garcia AA, Winchell M, Hanis CL. Dosage effects of diabetes self-management education for Mexican Americans: The Starr County Border Health Initiative. *Diabetes Care*. 2005;**28**(3):527–32. doi: [10.2337/diacare.28.3.527](https://doi.org/10.2337/diacare.28.3.527). [PubMed: [15735182](https://pubmed.ncbi.nlm.nih.gov/15735182/)]. [PubMed Central: [PMC1994143](https://pubmed.ncbi.nlm.nih.gov/PMC1994143/)].
 14. Balamurugan A, Ohsfeldt R, Hughes T, Phillips M. Diabetes self-management education program for Medicaid recipients: A continuous quality improvement process. *Diabetes Educ*. 2006;**32**(6):893–900. doi: [10.1177/0145721706294787](https://doi.org/10.1177/0145721706294787). [PubMed: [1702156](https://pubmed.ncbi.nlm.nih.gov/1702156/)].
 15. Yuan C, Lai CW, Chan LW, Chow M, Law HK, Ying M. The effect of diabetes self-management education on body weight, glycemic control, and other metabolic markers in patients with type 2 diabetes mellitus. *J Diabetes Res*. 2014;**2014**:789761. doi: [10.1155/2014/789761](https://doi.org/10.1155/2014/789761). [PubMed: [25136645](https://pubmed.ncbi.nlm.nih.gov/25136645/)]. [PubMed Central: [PMC4127232](https://pubmed.ncbi.nlm.nih.gov/PMC4127232/)].
 16. Cunningham AT, Crittendon DR, White N, Mills GD, Diaz V, LaNoue MD. The effect of diabetes self-management education on HbA1c and quality of life in African-Americans: A systematic review and meta-analysis. *BMC Health Serv Res*. 2018;**18**(1):367. doi: [10.1186/s12913-018-3186-7](https://doi.org/10.1186/s12913-018-3186-7). [PubMed: [29769078](https://pubmed.ncbi.nlm.nih.gov/29769078/)]. [PubMed Central: [PMC5956958](https://pubmed.ncbi.nlm.nih.gov/PMC5956958/)].
 17. Farzadfar F, Murray CJ, Gakidou E, Bossert T, Namdaritabar H, Alikhani S, et al. Effectiveness of diabetes and hypertension management by rural primary health-care workers (Behvarz workers) in Iran: A nationally representative observational study. *Lancet*. 2012;**379**(9810):47–54. doi: [10.1016/S0140-6736\(11\)61349-4](https://doi.org/10.1016/S0140-6736(11)61349-4). [PubMed: [22169105](https://pubmed.ncbi.nlm.nih.gov/22169105/)].
 18. Kumar V, Gill KD. To perform glucose tolerance test. *Basic concepts in clinical biochemistry: A practical guide*. Springer; 2018. p. 63–6. doi: [10.1007/978-981-10-8186-6_15](https://doi.org/10.1007/978-981-10-8186-6_15).
 19. Schmitt A, Gahr A, Hermanns N, Kulzer B, Huber J, Haak T. The Diabetes Self-Management Questionnaire (DSMQ): development and evaluation of an instrument to assess diabetes self-care activities associated with glycaemic control. *Health Qual Life Outcomes*. 2013;**11**:138. doi: [10.1186/1477-7525-11-138](https://doi.org/10.1186/1477-7525-11-138). [PubMed: [23937988](https://pubmed.ncbi.nlm.nih.gov/23937988/)]. [PubMed Central: [PMC3751743](https://pubmed.ncbi.nlm.nih.gov/PMC3751743/)].
 20. Schmitt A, Hermanns N, Kulzer B, Reimer A, Schall S, Haak T. *The Diabetes Self-Management Questionnaire (DSMQ) can detect inadequate self-care behaviour and help identify patients at risk of a negative diabetes prognosis*. Research Institute of the Diabetes Academy Mergentheim (FIDAM), Diabetes Center Mergentheim (DZM), Germany; 2017.
 21. American Diabetes Association. 6. Glycemic targets: Standards of medical care in diabetes-2019. *Diabetes Care*. 2019;**42**(Suppl 1):S61–70. doi: [10.2337/dci9-S006](https://doi.org/10.2337/dci9-S006). [PubMed: [30559232](https://pubmed.ncbi.nlm.nih.gov/30559232/)].
 22. Koetsenruijter J, van Eikelenboom N, van Lieshout J, Vassilev I, Lionis C, Todorova E, et al. Social support and self-management capabilities in diabetes patients: An international observational study. *Patient Educ Couns*. 2016;**99**(4):638–43. doi: [10.1016/j.pec.2015.10.029](https://doi.org/10.1016/j.pec.2015.10.029). [PubMed: [26549171](https://pubmed.ncbi.nlm.nih.gov/26549171/)].
 23. Hilli Y, Löff H, Malmberg J, Hess D. Young and motivated for self-care? An interview study with young adults suffering from type 1 diabetes. *Clinical Nursing Studies*. 2018;**6**(4):36. doi: [10.5430/cns.v6n4p36](https://doi.org/10.5430/cns.v6n4p36).
 24. Namjoo Nasab M, Ghavam A, Yazdanpanah A, Jahangir F, Shokrpour N. Effects of self-management education through telephone follow-up in diabetic patients. *Health Care Manag (Frederick)*. 2017;**36**(3):273–81. doi: [10.1097/HCM.0000000000000172](https://doi.org/10.1097/HCM.0000000000000172). [PubMed: [28738397](https://pubmed.ncbi.nlm.nih.gov/28738397/)].