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The Effect of Self-Care on Glycated Hemoglobin and Fasting Blood Sugar Levels on Adolescents with Diabetes

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Abstract

Background: Type 1 diabetes is a chronic condition that causes many problems for adolescents and their families. Given the increasing prevalence of diabetes and the numerous complications of the disease that require long-term treatment and the need for daily blood glucose control, lifestyle modification and knowledge acquisition regarding self-care behaviors are essential throughout life.
Objectives: Considering the increasing prevalence of diabetes, this study evaluated the effect of self-care education on glycosylated Hemoglobin (HbA1c) level and blood glucose control in adolescents with diabetes in Ilam, Iran.
Methods: A randomized clinical trial was conducted on patients with type 1 diabetes in Ilam. Patients were assigned randomly to experimental (n = 21) and control (n = 24) groups. A total of seven self-care group training sessions were arranged by the researcher; each session lasted 90 minutes and each group included five people. Patient fasting blood sugar (FBS) and HbA1c levels were measured before and three months after the intervention and analyzed using the SPSS 16.0 software, including descriptive statistics and chi-square, Mann-Whitney, independent t, and paired t-tests.
Results: The findings of this study showed that there was no significant difference between the control and experimental groups regarding FBS and HbA1c findings before the intervention. However, compared to the levels before the intervention, the difference was significant in the experimental group yet insignificant in the control group.
Conclusions: These findings suggest that nurses should provide patients with this type of training to improve the health of patients with type1 diabetes.

Keywords: Self Care, Diabetes Mellitus, Type 1, Adolescents

1. Background

Type 1 diabetes is a chronic condition that causes many problems for adolescents and their families (1). The disease is considered a serious global health problem, in which one in every 300 to 400 adolescents has type 1 diabetes (2, 3). This type of diabetes affects all organs of the body, lifestyle, personality, and relationships between children and their families (4). Failure to control diabetes causes severe vascular complications (1); thus, appropriate treatment is needed to control the disease and prevent or delay its complications (5, 6). Controlling anthropometric and metabolic complications, such as body weight, blood pressure, blood glucose, and glycosylated Hemoglobin (HbA1c) levels, and lipid profile plays an important role in controlling diabetes (7).

Regarding the increasing prevalence of diabetes and the many complications of the disease that require long-term treatment and daily blood glucose control, lifestyle modification and acquisition of knowledge about special self-care behaviors are essential throughout life (8). Self-care is one of the most important methods to treat and control complications of diabetes, resulting in improved quality of life (9). In addition to preventing the aggravation of symptoms, adherence to self-care behaviors is very effective in reducing hospitalizations and mortality, improving feelings of health in chronic patients, and reducing therapeutic costs (10). Self-care refers to actions performed by the person on his/her own to improve and maintain their health as well as to prevent and limit illness, which require appropriate educational measures (11, 12). Improving self-care behaviors is the first step in helping patients to better control their illness, which indicates the importance of effective factors for the self-treatment of patients. Self-care also helps improves treatment of the illness and reduces

the incidence of complications (13).

Hemoglobin glycation arises from the attachment of non-enzymatic glucose to amino-protein groups. HbA1c production is an irreversible process that is proportional to the lifespan of red blood cells and the concentration of blood glucose in the most recent six to eight weeks (14, 15). Reliable indicators for assessing self-care status of patients with diabetes include fasting blood sugar (FBS, normal range 70 to 105 g/dL) and HbA1c (normal range 4% to 6%) levels, which are useful indicators of the average change in blood glucose levels (16-18). Blood HbA1c level is an important indicator of long-term blood glucose control over the past two to three months and is one of the most important indicators in clinical research (19). Furthermore, HbA1c level is also an independent risk factor for coronary heart disease and brain stroke in people with and without diabetes (14, 20, 21). Use of the HbA1c index prevents day-to-day variation in blood glucose levels; it can be measured at any time of the day, and does not require any specific preparation, such as fasting (22).

Several methods are used for training patients with diabetes, such as the follow-up care model (23), walking instruction (24), meal planning using the "MyPlate" method (6), counseling (25), family-centered care (26), aerobic and preparatory exercises (27), telephone follow-up by nurses, (28) and self-care training (29). The results of previous studies have shown that self-care levels differ among patients with diabetes. Parham et al. reported that 92% of patients did not follow the recommended diet, 83% did not control their blood glucose levels, 50% did not control their diabetic foot ulcers, and 26% did not exercise (30). Mahmoodi et al. reported that patients, who followed drug treatment and diet therapy had the lowest HbA1c levels. Also, in this study, the largest barriers to self-care were high costs, high work engagement, depression, forgetfulness, a lack of awareness of the self-care plan, a lack of willingness to perform the program, an unawareness of blood glucose test results, and a lack of belief in the efficacy of self-care (31). Heerman et al. reported that the self-care status of patients with diabetes was undesirable. Patients may not fully and regularly conduct self-care practices, such as diet, physical activity, foot care, blood glucose control, and drug treatments, which can lead to weakness in the process of training (32).

Healthy and non-healthy behaviors in adults differ from adolescents. Therefore, recognizing the structure and attitude of adolescents in practicing a particular lifestyle will provide health-care workers the opportunity to more accurately assess lifestyle, develop new and innovative preventive approaches, and improve the ability of adolescents to modify these behaviors (33). During adolescence, many self-care behaviors may not be performed because the patient fears rejection and feels different from peers (34); in addition, in early adolescence, diabetic children encounter hormonal changes and natural resistance of the body to insulin. However, having a sense of independence, a tendency towards peer pressure, and opposition to parents may result in a lack of proper observance of diabetic diet (35). These factors may cause more complications and high HbA1c levels in adolescents with diabetes (3).

2. Objectives

Considering the increasing prevalence of diabetes and the importance of adolescent health, this study was conducted to determine the effect of self-care training on HbA1c level and FBS in patients with type1 diabetes in Ilam, Iran.

3. Methods

The present study was conducted in 2017 on patients with type 1 diabetes in Ilam, Iran. The sample size was 50 individuals assigned by random allocation to the experiment and control groups, each consisting of 25 subjects. The subjects were randomly divided to two groups of 25 by drawing odd or even-numbered balls from a bag. If the subject drew an even number, he/she was placed in the experimental group; those with odd-numbered balls were placed in the control group. The researcher's assistant ensured random allocation; that is, the assistant recorded the subject assignments to the experimental or control groups in the patient's profile and disease records (36).

The criteria for entering the study included a definite diagnosis of type 1 diabetes by an endocrinologist, a minimum of six months since the diagnosis, lack of disabling diabetes complications, such as kidney failure or blindness, a lack of severe stress before the intervention, HbA1c level of 7% to 9%, FBS level between 140 to 250 mg, 10 to 18 years of age, willingness to participate in the study, providing informed written consent for participation in the study, not participating simultaneously in any diabetes therapy or other educational interventions, and the ability to communicate verbally. The exclusion criteria included traveling or hospitalization during the intervention, an absence from more than two self-care training sessions, and patient unwillingness to participate in the study.

A demographic questionnaire and a laboratory information registration form were used to collect information. The demographic questionnaire included questions on age, gender, education, history of diabetes in the family, number of family members, and household income.

Before the intervention, the demographic questionnaire was completed through patient interviews. Fasting Blood Sugar and HbA1c tests were performed and entered in the laboratory data entry form. All blood samples were collected under the same conditions and all tests were performed in the same laboratory by the same person. The precision of these tools was investigated and approved in different studies (37) and their reliability was tested and confirmed by simultaneously sending separate blood samples to the lab with different names.

The educational interventions in the experimental group included seven group training sessions, lasting 90 minutes each; the groups contained five people and were led by the researcher. The training sessions consisted of two parts; theoretical and practical. The theoretical part included oral presentations, providing educational pamphlets to patients, interpreting the results of the laboratory tests, and telephone follow-up of the training materials. In the practical sessions, the correct method for insulin injection, blood glucose control with a glucometer machine, and follow-up on HbA1c testing was taught. The subjects were prepared and presented to the patients based on previous printed related articles (38-40) (Table 1). After the intervention (three months), the HbA1c and FBS levels were recorded in the laboratory data form and compared with the results before the intervention.

Sampling was started after confirmation of this study in the research council of Ilam University of Medical Sciences. The points that were observed as ethical research included the random allocation of patients to the control and experiment groups, no cost imposition to the patients, explanation of the research goals to the patients and their parents, the right to withdraw from the study at any time, and compliance with the provision of the DECLARATION of Helsinki and Belmont Statement. Of the 50 patients, who were included in the study, four patients in the experimental group (three who were absent in training sessions and one who was hospitalized) and one patient in the control group (who was unwilling to participate in the study) were excluded from the study; therefore, the self-care and control groups included 21 and 24 patients, respectively. Data analysis was performed using descriptive indexes (mean and standard deviation) and chi-square tests (to compare the two groups in terms of gender and education), Mann-Whitney tests (to compare the two groups in terms of age and duration of diabetes), independent t-tests (to compare the two groups in terms of the HbA1c level), and paired t-tests (for intra-group comparison of HbA1c levels of each group before and after the intervention) (39) using SPSS for Windows, version 16.0.

Table 1. Training Session Content

Sessions	Topic of Discussion	Content
1st	Definition of diabetes	Teaching parents and their children about diabetes and the symptoms of high and low blood glucose levels, definition of self-care and diverse patient self-care methods, and explaining the early and late complications of diabetes to parents and their children (hypoglycemia, hyperglycemia, retinopathy, nephropathy, neuropathy, and diabetic ketoacidosis)
2nd	Diet	Providing training about diet to patients with diabetes, identification of different foods and their impact on blood glucose levels, the effect of eating healthy foods on blood glucose levels, and teaching parents and their children to design a diet plan
3rd	Use of drugs	Definition of insulin, explanation of various oral and injection methods to reduce blood glucose to patients, explaining the importance of daily blood glucose control, and scientific education on insulin injections to parents and their children
4th	Physical activity and FBS	Teaching parents and their children about the effect of regular physical activity on FBS level, how patients with diabetes should exercise, and how to interpret blood glucose test results
5th	Complications	An explanation of diabetes complications, the appropriate measures to prevent these complications, and how to control diabetes
6th	Review	An overview of the previously stated content, reviewing the items independently
7th	Review	An overview of the previously stated content, reviewing the items independently

4. Results

Table 2 shows the demographic characteristics of the patients in the self-care and control groups. There was no significant difference in the demographic data between the self-care and control groups ($P > 0.05$).

Table 3 shows the FBS and HbA1c levels before and after interventions in patients with type 1 diabetes in Ilam during year 2017. There was no significant difference between the FBS and HbA1c groups before and after the intervention ($P > 0.05$). However, after the intervention, the patients in the experimental group had lower FBS and HbA1c levels. This level was significant before FBS and HbA1c before the intervention ($P < 0.05$). There was no significant difference in FBS and HbA1c levels before and after the intervention ($P > 0.05$).

Table 2. Demographic Characteristics of Patients with Type I Diabetes in the City of Ilam During Year 2017[a]

	Group		P Value
	Experimental	Control	
Gender			0.82
Male	11 (52.4)	12 (50)	
Female	10 (47.6)	12 (50)	
Education			0.90
Primary school	4(19)	5 (20.8)	
Elementary high school	13 (61.9)	15 (62.5)	
Secondary high school	4 (19)	4 (16.7)	
Family income, Rial			0.54
Less than 10 million	4 (19)	3 (12.5)	
10 - 30 million	11 (52.4)	15 (62.5)	
More than 30 million	6 (28.6)	6 (25)	
Family history of diabetes			0.57
Yes	7 (33.3)	9 (37.5)	
No	14 (66.7)	15 (62.5)	
Average number of family members			0.46
Number of family members	12.85 (2.17)	14 (2.48)	

[a]Values are expressed as No. (%).

Table 3. Comparison of Fasting Blood Sugar and HbA1c Levels Before and After the Intervention in Patients with Type 1 Diabetes in Ilam City, During Year 2017[a]

	Group		P Value[b]
	Experimental	Control	
HBAC			
Before	8.17 (0.53)	8.29 (0.57)	0.45
After	7.65 (0.59)	8.30 (0.54)	0.000
P Value[c]	0.000	0.31	-
FBS			
Before	219.66 (24.87)	223.33 (25.39)	0.84
After	136.14 (36.76)	226.50 (33.22)	0.000
P Value	0.000	0.59	-

[a]Values are expressed as mean (SD).
[b]P value independent t (for comparison of two groups in terms of the rate, fb HbA1c.
[c]P value t pair (for intrapartum comparison of each group before and after the intervention in terms of the rate, fb HbA1c).

5. Discussion

The findings showed that self-care training resulted in reduced FBS and HbA1c levels. Several studies have evaluated the effect of self-care education on FBS and HbA1c levels in patients with type 1 and type 2 diabetes. In many studies, the implementation of this kind of care resulted in reduced FBS and HbA1c levels. Azizi et al. assessed patients with type 1 diabetes to determine the effect of self-care education on controlling disease complications based on drug and HbA1c levels in adolescents with diabetes. They reported that the implementation of five, 90-minute sessions controlled the complications and drug use and HbA1c levels in the experimental group (38). Hassan Ali et al. conducted a study to determine the usefulness of a participatory care model for metabolic control in adolescents with diabetes, and showed a significant difference in HbA1c and insulin levels between the two groups (41). Gray et al. (42) and Greco et al. (43) showed that educational interventions resulted in reduced patient HbA1c levels, consistent with the results of the present study.

Cheraghi et al. assessed the effectiveness of training on FBS reduction in children with type 1 diabetes. In this study, four group training sessions lasting 30 to 45 minutes each were conducted to empower children to manage their blood glucose levels. The findings of this study showed significantly decreased mean FBS and HbA1c levels after the intervention (44). In addition, Heydari et al. determined the effect of an empowerment-based training model on HbA1c levels in adolescents with type 1 diabetes in Zanjan, showing increased knowledge, self-efficacy, and self-esteem scores, and decreased HbA1c levels after a 2.5-month intervention (45); this finding was consistent with the results of the present study, indicating that self-care training reduced blood glucose and HbA1c levels in patients with type 1 diabetes.

Because many parts of daily care of people with diabetes are performed by the individual or one of their family members, training sessions on self-care skills for diabetics are very necessary (46).

Regarding the effect of training on HbA1c and FBS levels in patients with type 2 diabetes, Ahmadi et al. (2002) studied the effect of self-care training on HbA1c levels in this population, reporting that nine, 60-minute sessions for 12 weeks resulted in reduced HbA1clevels (39).

A study by Shahbadaghi et al. that assessed the effect of empowerment training on patients with type 2 diabetes showed that six sessions of an empowerment program resulted in reduced HbA1cand FBS levels, a finding consistent with the results of the present study regarding the effect of self-care education on HbA1c and FBS levels in patients with type 1 diabetes. In fact, the continuity of self-care and receiving primary care are associated with better blood glucose control in patients with diabetes; thus, the implementation of empowerment training programs is effective in increasing patient self-care skills (47).

The limitations of the present study included the small number of samples; therefore, additional studies with a

larger sample are necessary. This study was also conducted in a limited society and a specific culture; thus, this study should be replicated in other societies and cultures in order to provide researchers with complete and accurate information.

As self-care training resulted in reduced HbA1c and FBS levels in patients with type 1 diabetes, nurses should include such training in the treatment plan of patients in order to provide the necessary knowledge for improving their health.

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Footnotes

Conflicts of Interest: The authors declare that there were no conflicts of interest.

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