Original Article

The effect of telenursing follow-up on blood glycosylated hemoglobin and quality of life in the elderly with diabetes type 2

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Abstract:

BACKGROUND: Diabetes mellitus is one of the most common and costly diseases. Telephone nursing plays an undeniable and effective role not only in reducing costs but also in providing nursing care and improving the quality of life of patients. This study was conducted with the aim of investigating the effect of telephone follow-up by a nurse on hemoglobin glycated control and the quality of life of elderly patients with diabetes type 2.

MATERIALS AND METHODS: In this clinical trial study, 90 patients with type 2 diabetes referred to the hospitals affiliated with Shahid Beheshti University of Medical Sciences in 1401–1402 were divided into two control and experimental groups (45 patients in each group) by the simple random sampling method. Data collection tools were a demographic-clinical information questionnaire and an elderly quality of life assessment questionnaire (CASP-19). Before the intervention, questionnaires were completed by the sample. The nursing follow-up test group intervention lasted for 12 weeks. In the first month, participants were contacted twice a week, and in the second and third months, they were contacted once a week by phone. Patients in the control group received only follow-up and center care. Finally, the statistical software SPSS version 21 (SPSS Inc, Chicago IL) was used for data analysis. In this study, an independent sample t-test or Mann-Whitney analysis, paired t-test or Wilcoxon test, and Analyze of Covariance (ANCOVA) test were used based on the type of variable distribution (normal or non-normal).

RESULTS: The results of this study showed that by adjusting the variables of weight, baseline level of the quality of life score (before the intervention), age, gender, and physical activity, the difference in the mean changes of the quality of life score in the control and intervention groups in the nurse telephone follow-up intervention was significant ($P = 0.054$). In addition, the difference in the mean changes of HbA1C in the control and intervention groups was significant due to the nurse's telephone follow-up intervention ($P < 0.001$).

CONCLUSION: The findings of this study showed that telenursing training and follow-up in the intervention group improved the quality of life and decreased hemoglobin glycosylate in the elderly with type 2 diabetes. Therefore, telenursing can be effective in improving the quality of life of the elderly with type 2 diabetes and managing its complications.

Keywords:

Diabetes mellitus, elderly, hemoglobin glycosylate, quality of life, telenursing

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Introduction

In recent years, the elderly population in the world has been increasing due to improved living conditions, medical advancements, and increased life expectancy.[1,2] This trend is also observed in Iran, where the elderly population is growing.[1] As people age, their physiological, psychological, and social functions tend to decline.[3] Furthermore, the incidence of chronic, non-communicable

diseases such as diabetes increases and reaches its peak during old age. Geriatric diabetes has become a significant public health concern in the 21st century.[4] In Iran, it has been reported that approximately 22% of the elderly population suffers from diabetes mellitus.[5]

Diabetes is a chronic metabolic disorder[5,6] that affects the elderly, who have less self-care ability. This condition can lead to side effects such as serious health disorders caused by microvascular and macrovascular changes,[7] lack of blood sugar control, and even death or hospitalization.[6,8-10] The chronic nature of diabetes and its complications can significantly impact an individual's social and economic status,[7] as well as the quality of life of patients, which is an indicator of the health status of the elderly.[11,12] Improving the quality of life of elderly patients with diabetes can also reduce associated healthcare and medical costs.[13] Various factors such as gender, education level, and consequences of diabetes, including lack of blood sugar control, income level, age, duration of diabetes, and body mass index,[14] have been reported to affect the quality of life of elderly individuals with diabetes.[2]

One of the most important goals for treatment teams, including nurses, is to help patients with diabetes become independent in self-care and participate in their treatment. Despite receiving numerous trainings in medical centers and through media, patients still require retraining.[15] Education is a basic method for preventing, treating, and controlling chronic diseases, including diabetes, and plays a significant role in maintaining the health, recovery, and quality of life of patients.[16] Telephone training and follow-up is a type of patient education[17] that establishes therapeutic interaction with the patient and provides useful information to prevent, treat, and continuously control diabetes.[18]

The telenursing method involves nurses providing follow-up care to patients through remote communication by using devices such as telephones, the internet, and video. This method facilitates effective care at home, reduces costs, and improves the relationship between the patient and the nurse. It also reduces the need for frequent in-person examinations, making it a convenient option for elderly patients.[17,19,20] Recent studies indicate that telephone follow-up by a nurse improves the outcomes for various diseases, including COVID-19,[21,22] cardiovascular diseases,[23] pulmonary diseases,[24] cancer,[25,26] and diabetes.[27-29] Overall, telenursing is a highly effective method of care that has a positive impact on patient outcomes.

As few studies have investigated the quality of life of elderly patients with diabetes, the need to carry out this study seems necessary. Education and counseling can help diabetic patients better manage their disease. Telenursing offers a way to provide patients with a large amount of information about controlling their disease and improving their quality of life in a limited amount of time. It also provides the opportunity for patients to ask questions from the comfort of their own homes. Considering the importance of the subject, this study was conducted to investigate the effect of telenursing on hemoglobin glycosylated (HbA1C) control and quality of life. Education through telenursing about the disease and nutrition and medications to the elderly with diabetes were given for a period of 3 months in selected health centers affiliated to Shahid Beheshti University of Medical Sciences.

Materials and Methods

Study design and setting
This study was a randomized clinical trial with two intervention and control groups. It was conducted on elderly patients with type 2 diabetes in Taleghani, Imam Hossein, and Shohadaye Tajrish Hospitals in Tehranfrom 2022 to 2023. This study was approved by the research ethics committee of Shahid Beheshti University of Medical Science (ethics code: IR.SBMU.PHARMACY.REC.1401.119).

Study participants and sampling
The eligible participants for the study included individuals who were 60 years old and older who had been diagnosed with diabetes by a specialist doctor, had access to a telephone at home, had no speech or hearing problems, and had an HbA1C level of more than 7. The patients were being treated with oral hypoglycemic drugs and were not suffering from an advanced form of cancer or any known mental disorders.

During the study, certain criteria were used to exclude participants from continuing to participate. This included unwillingness to continue, missing more than three telephone sessions, switching from oral hypoglycemic drugs to insulin therapy, and suffering from diabetic ketoacidosis or hyperosmolar non-ketonic hyperglycemic syndrome. The samples in each group were selected by a simple random sampling method. To calculate the required number of participants, the following equation was used:

$$n \geq 2 \frac{(z_{\alpha/2} + z_{\beta})^2 \sigma^2}{(\mu_1 - \mu_2)^2}.$$

Considering a first type error of 5%, a test power of 90%, and a predicted 10% dropout, a minimum of 45 participants per group and a total of 90 participants were needed, as per Raesi *et al*.'s[30] article.

Data collection tool and technique

Data were collected using a demographic information form that included details such as age, sex, marital status, level of education, employment status, comorbidities, smoking habits, place of residence, and physical activity levels. In addition, a specific questionnaire (CASP-19) was used to measure the quality of life of the elderly. Blood samples were taken to test for HbA1C levels.

The CASP questionnaire is a tool used to measure the quality of life for elderly individuals. It consists of 19 items across four dimensions: control (4 items), autonomy (5 items), self-actualization (5 items), and pleasure (5 items). Each item has four response options ranging from "most of the time" to "never" using a Likert scale. The lowest score for each item is "zero," and the highest score is "three." It is important to note that the scoring for six items (items 1, 2, 4, 6, 8, and 9) is the opposite of the other items. The maximum score for the questionnaire is 57, indicating full satisfaction across all four dimensions, while a score of zero indicates a lack of quality of life. The Persian version of the questionnaire has been validated in research conducted by Heravi-Karimooi *et al*.[31]

In this study, we assessed the reliability of the CASP-19 questionnaire and found it to be 0.82 by using Cronbach's alpha method.[31] HbA1C levels were measured by analyzing the blood sample with the high-performance liquid chromatography (HPLC) method by using the Labnovation LD-500 HbA1C Analyzer made in China. The validity of this device was previously evaluated in Iran.[32]

After allocating patients into groups, blood samples were collected from the left arm of the subjects after fasting for 12 hours to determine glycosylated hemoglobin (HbA1C). Before implementing the intervention, patients in both the intervention and control groups completed a demographic information questionnaire and a specific questionnaire that measures the quality of life of the elderly. At the beginning of the intervention, two face-to-face training sessions with the patient for 45 minutes were held by the researcher in the hospital Educational sessions on diet for diabetic patients, aerobic and stretching exercises, and tips on medication consumption were delivered to the elderly through lectures and educational videos.

The contents of the training sessions were as follows:
1. Exercise, type, and amount of activity
2. Education about the drug program, drug effects, side effects, and how to take drugs
3. Getting to know the diet, the type and amount and number of meals, and explaining the set meal plan.

Based on the individual characteristics, tolerance, and comorbidities of each patient, the diet and exercise program was prepared by the relevant specialist and provided to the patient. Phone follow-up was done for 12 weeks. In this way, phone calls for follow-up were made twice a week in the first month and once a week during the second and third months with the people of the intervention group. The duration of the conversation was 15 minutes on average, and the content of the conversations included evaluating the adherence of the intervention group to the diabetic diet, recommended exercise program, and drug therapy. In case of non-compliance, the status of the individual was analyzed. Helping the person to find the problem and finally providing a suggested solution and answering his possible questions were done. In addition, in each meeting, the content of the telephone conversation was recorded in the form. At the end, 1 month after completing the last telephone follow-up, the patients of the intervention group completed a special questionnaire for measuring the quality of life of the elderly, and a blood sample was taken to evaluate hemoglobin glycosylate after the intervention and sent to the laboratory for analysis. In the control group, there was no educational intervention and the patients only received the recommendations of healthcare providers or doctors at the referred center, but at the same time as the intervention group, a specific questionnaire measuring the quality of life of the elderly was completed by the participants themselves. If the subjects in both groups were not able to complete the questionnaires, the researcher read the questions to the elderly and then completed them. The blood samples of the control group were collected by a laboratory technician to evaluate hemoglobin glycosylate and fasting blood sugar after 12 hours of fasting from the left arm during two stages (face-to-face meeting and 1 month after the intervention in the hospital laboratory). To comply with the ethical principles and justice in the research, after completing the study, an educational pamphlet was given to the patients of the control group.

Ethical consideration

Ethical principles considered in this research, including assuring research groups to keep personal information confidential, free participation of the research group in research and confidentiality of public opinion by preparing an anonymous questionnaire, free exit of samples during the study, scientific and reliable assurance in recording information obtained from research about the time of data collection and analysis, and observance of ethical principles in the use of all sources and research. To adhere to ethical principles and ensure justice in the research, an educational booklet containing information on nutrition for diabetic patients, medication tips, and required exercises was given to control group participants after the study was concluded.

Statistical analysis

The statistical software SPSS version 21 (SPSS Inc, Chicago IL) was used for data analysis. In this study, a significance level of less than 5% was considered. Independent sample *t*-test or Mann-Whitney analysis was used to compare the means of quantitative variables in the two control and intervention groups based on the type of variable distribution (normal or non-normal). To compare the difference in the mean quality of life score and HbA1C level before and after the intervention in each of the control and intervention groups, a paired *t*-test or Wilcoxon test was used based on the type of variable distribution.

To compare the average changes of quantitative variables between the studied groups, we used Analyze of Covariance (ANCOVA). We adjusted for the baseline of the studied variable values and other variables such as weight, age, sex, and physical activity. The average changes of quantitative variables were calculated by subtracting the baseline values (before the intervention) from the values obtained after the intervention. We performed an intent-to-treat (ITT) analysis in the present study by replacing missing data. In this method, we replaced the missing values with the conditional mean calculated using the regression equation.

Ethical considerations

As part of the research process, we obtained permission to conduct the study in medical centers. We also made sure to obtain written informed consent from the research participants, assuring them that their information would be kept confidential and that they could withdraw from the study at any stage.

Results

The study included a total of 90 patients who met the inclusion criteria. They were randomly divided into two groups: intervention (45 patients) and control (45 patients). At the end of the research, 85 patients (41 in the intervention group and 44 in the control group) completed the study. The reasons for patients leaving the study in both groups are shown in Figure 1. Based on the ITT analysis, the final analysis included 45 patients from the intervention group and 45 patients from the control group.

Table 1 reports the demographic characteristics that were studied. The mean ± SD age of individuals in the control group was 74.7 ± 10.7, while in the intervention group, it was 70.9 ± 8.5 years. However, there was no significant difference between the two groups ($P = 0.06$). The research findings showed that 51.1% of individuals in the intervention group and 35.6% of individuals in the control group were men. However, there was no significant difference between the two groups in terms of gender ($P = 0.20$). At the beginning of the research, there was a statistically significant difference between the two groups in terms of marital status, education, smoking, employment status, concomitant diseases, history of chronic diseases, place of residence, and daily physical activity.

The results of the Wilcoxon test in the intervention group demonstrated a statistically significant increase ($P < 0.001$) in the quality of life score after the telenursing follow-up, with mean ± SD scores of 32.16 ± 11.61 before and 36.64 ± 9.62 after the intervention. Both the control and intervention groups showed a significant increase in the mean ± SD quality of life score after the intervention ($P = 0.02$), according to the results of the Mann-Whitney test. The Kruskal-Wallis test, after adjusting for weight, baseline level of quality of life score (before intervention), age, gender, and physical activity, showed the significance of the telenursing follow-up intervention on the quality of life score of the study subjects. Furthermore, the results of this test indicated that the difference in the average changes in the quality of life score in the control and intervention groups was significant ($P = 0.054$) [Table 2].

The results of the paired *t*-test indicate that the mean of HbA1C decreased in the intervention group after the telenursing follow-up. The values were 8.55 ± 1.10 and 8.34 ± 1.09 before and after the intervention, respectively; however, this difference was not statistically significant ($P = 0.08$). In contrast, the results of this test in the control group showed that the mean values of HbA1C before and after the intervention were 8.68 ± 1.38 and 9.09 ± 1.61, respectively; the difference was statistically significant ($P = 0.002$) and indicated an increase in the HbA1C levels after the intervention.

After the intervention, an independent *t*-test was carried out to compare the HbA1C levels of the control and intervention groups. The results showed a significant decrease of 9.09 ± 1.61 and 8.34 ± 1.09, respectively ($P = 0.03$). In addition, a Analyze of Covariance (ANCOVA) was conducted to adjust for variables such as weight, baseline HbA1C level, age, gender, and physical activity. The results of this test indicated that the telenursing follow-up intervention had a significant impact on the HbA1C levels of the study subjects. Specifically, the mean change in HbA1C in the control and intervention groups was significantly different due to the telenursing follow-up intervention ($P < 0.001$) [Table 3].

Discussion

The results of this study indicate that telenursing training and follow-up in the intervention group led to improved
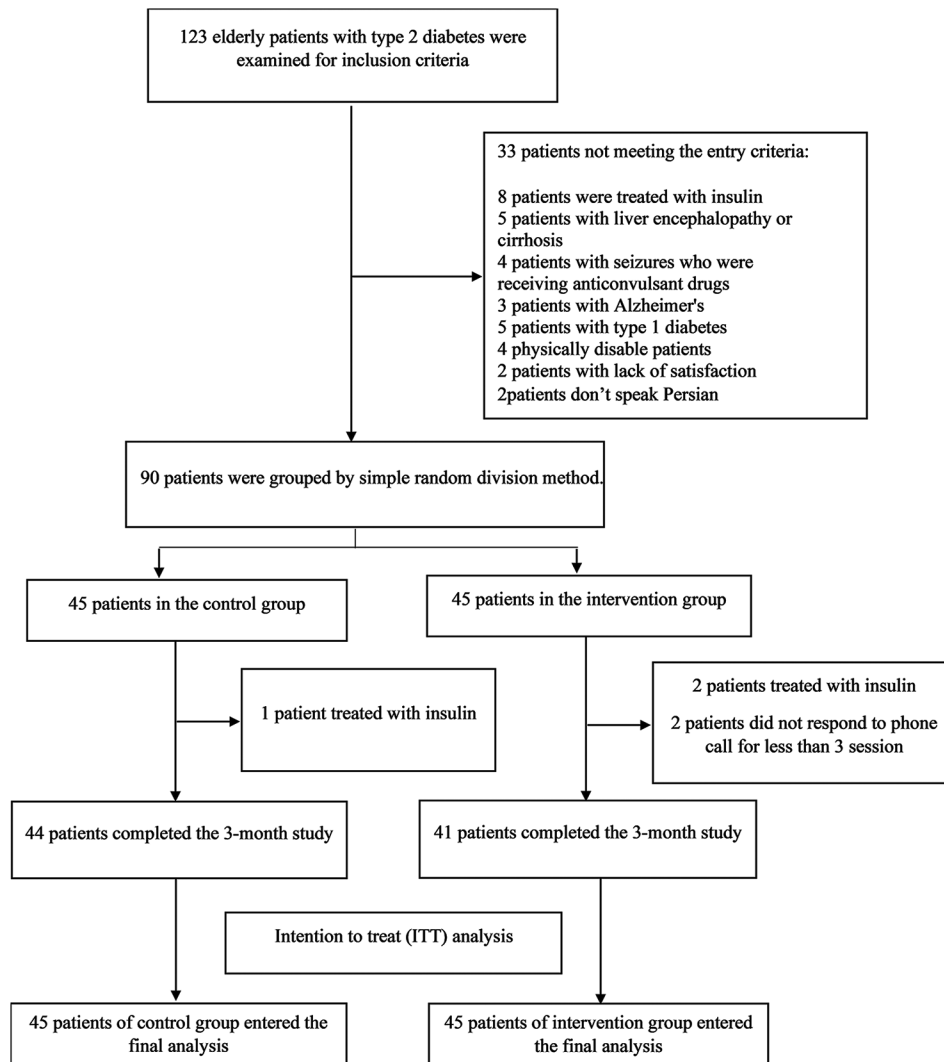
Figure 1: Flowchart of the study

quality of life and reduced levels of glycosylated hemoglobin in the elderly with type 2 diabetes as compared to the control group.

The present study found that there was no significant difference in the mean age between the control and intervention groups. While previous studies have emphasized the importance of age in teaching patients,[33,34] Moghaddam *et al*.[35] demonstrated that age significantly impacts the quality of life dimensions of elderly individuals with type 2 diabetes. Therefore, in this study, the age of the participants was homogenized, and the age distribution in both groups was made homogeneous. Gender plays a significant role in the quality of training.[34] Therefore, in this study, the samples were homogenized based on gender, and the participants were divided into groups with homogeneous gender distribution. The findings revealed that the majority of participants in both groups do not engage in physical activity or exercise during the week. Despite

the importance of physical activity in controlling and managing type 2 diabetes, various studies have shown that diabetic patients are less mobile than others.[36-38]

Due to the high prevalence of diabetes in the elderly, they need to engage in physical activity to the extent of their tolerance daily to improve their health and prevent diseases,[39] even if they are not able to do physical activity to the recommended extent. The study found that the quality of life of participants in both the intervention and control groups was at an average level before the implementation of the telenursing program, as indicated by their average quality of life scores. The results of Daneshvar *et al*.'s[40] study, which examined the quality of life of diabetic patients and compared it with non-diabetic patients, were in line with the results of the present study. The results of their study showed that patients with diabetes had significantly lower scores in the areas of quality of life, including physical performance, limitations in playing roles due to physical

Table 1: Characteristics of patients in the intervention and control groups before the study

Variable		Total	Control group	Intervention group	P
Age		9.8±72.8	74.7±10.7	70.9±8.5	0.06
Weight		18.8±82.0	83.0±19.3	81.0±18.5	0.60
Gender	Female	(56.7) 51	64.4) 29)	48.9) 22)	0.20
	Male	(43.3) 49	35.6) 16)	51.1) 23)	
Marital status	Married	(63.3) 57	55.6) 25)	71.1) 32)	0.19
	*Single	(36.7) 33	44.4) 20)	28.9) 13)	
Education	Under diploma	(71.1) 64	77.8) 35)	64.4) 29)	0.24
	Diploma and academic	(28.9) 26	2.2) 10)	35.6) 16)	
Employment status	Employed	(7.8) 7	(4.4) 2	(11.1) 5	0.66
	Housewife	(40.0) 36	(44.4) 20	(35.6) 16	
	Retired	(45.6) 41	(44.4) 20	(35.6) 21	
	unemployed	(6.7) 6	(6.7) 3	(6.7) 3	
Comorbidities	Kidney disease	(30.0) 27	(22.2) 10	(37.8) 17	0.44
	Cardiovascular disease	(28.9) 26	(33.3) 15	(24.4) 11	
	Neurological disease	(16.7) 15	(17.8) 8	(15.6) 7	
	Other disease	(24.4) 22	(26.7) 12	(22.2) 10	
Smoking	Yes	(27.8) 25	(17.8) 8	(37.8) 17	0.06
	No	(72.2) 65	(82.2) 37	(62.2) 28	
Place of residence	private house	(64.4) 58	(57.8) 26	(71.1) 32	0.44
	With children	(0.20) 18	(24.4) 11	(15.6) 7	
	Nursing home	(15.6) 14	(17.8) 8	(13.3) 6	
Physical Activity	Yes	(38.9) 35	(42.2) 19	(35.6) 16	0.66
	No	(61.1) 55	(57.8) 26	(64.4) 29	

*Single, divorced, widowed. Qualitative variables are displayed as frequency (percentage) and quantitative variables as mean±SD. The distribution of qualitative variables in two groups was obtained using Chi-square or Fisher's exact analysis and comparing the mean of quantitative variables in two groups using independent sample t-test or Mann-Whitney analysis

Table 2: Comparison of the quality of life score in two intervention and control groups before and after the intervention

Variable		Control group	Intervention group	P*	P**
Quality of life score	Before	8.20±33.73	32.16±11.61	0.46	0.054
	After	8.27±33.69	36.64±9.62	0.02	
↓P		0.97	<0.001		

↓Wilcoxon analysis was used. *Mann-Whitney *U* analysis is used. **Analyze of Covariance (ANCOVA) was used after adjusting the effect of variables such as weight, baseline level of quality of life score (before intervention), age, gender, and physical activity

Table 3: Comparison of HbA1C values in two intervention and control groups before and after the intervention

Variable		Control group	Intervention group	P*	P**
HbA1C	Before	1.38±8.68	1.10±8.55	0.97	<0.001
	After	1.61±9.09	1.09±8.34	0.03	
↓P		0.002	0.08		

↓Paired *t*-test analysis was used. *Independent sample *t*-test analysis was used. **Analyze of Covariance (ANCOVA) was used after adjusting the effect of variables such as weight, baseline level of glycosylated hemoglobin (before the intervention), age, gender, and physical activity

problems, limitations in playing roles due to emotional problems, vitality, performance social, physical pain, and general health compared to non-diabetic people.

Numerous studies suggest that individuals with diabetes suffer from a lower quality of life as compared to people without the condition, primarily due to the various personal, social, financial, and family difficulties that come with it, along with the higher mortality rate. As diabetes impacts multiple organs in the body, including the heart, eyes, and stomach, it has a significant negative impact on all aspects of patients' quality of life.[41,42] However, research has shown that a telenursing program can have a positive impact on the quality of life of elderly individuals with type 2 diabetes. After receiving educational intervention, there was a significant difference in the mean quality of life scores between the control and intervention groups. This indicates that the implementation of a telenursing program has a significant positive impact on the quality of life of patients. The effectiveness of telenursing in improving patients' quality of life has been emphasized in several studies.[43-47] A study conducted by Rady Magbool *et al*.[47] demonstrated that telephone follow-up, after providing health education packages to diabetic patients aged 18–65 years for 4 months, had a significant positive effect on their quality of life. This included improvements in areas such as healthy nutrition, physical activity, adherence to medication, stress prevention, and self-care. Through telephone training, patients can share their questions, problems, and concerns with the nurse, which reduces the negative social impact caused by the disease and the feeling of dependence on others and the doctor, ultimately creating a sense of well-being and improved health.[48,49] The telenursing program has proven effective

in enhancing the quality of life of patients with type 2 diabetes, as supported by the findings of this study and previous research.

Apart from the positive impact on the quality of life of patients with type 2 diabetes, the study found that the implementation of the telenursing program resulted in a notable difference in HbA1C levels between the control and intervention groups. This indicates that the telenursing intervention successfully reduced HbA1C levels in patients with diabetes. Similar findings have been reported in other studies, which have highlighted the effectiveness of telenursing in improving HbA1C levels. This shows that telenursing is an effective method of managing diabetes and can help in achieving better health outcomes.[50-52]

In a clinical trial conducted by Shahsavari *et al.*,[51] the effect of telenursing on body mass index (BMI) and HbA1C levels in patients over 50 years old with type 2 diabetes was investigated. Prior to the study, all patients received self-care training for 3 days. Subsequently, telephone follow-up was conducted for 12 weeks with the intervention group. The results showed that in the intervention group, BMI decreased from 29.28 to 28.35 by the end of the study, and there was a significant reduction in HbA1C levels from 8.96 to 7.56.

In contrast to the findings of this study, Wang *et al.*[53] conducted research on the impact of telenursing monitoring on diabetic patients in Hong Kong and found no significant difference in HbA1C levels between the control and intervention groups. The disparity between the two studies can be attributed to the duration and frequency of phone calls. Nevertheless, based on the results of this and previous studies, telenursing follow-up programs have proven effective in reducing HbA1C levels in diabetic patients. However, variations in the implementation of educational programs and cultural differences may explain differences in the degree of reduction of HbA1C levels across studies. It appears that new technologies have a more positive impact on patient compliance with treatment regimens than traditional medical interventions. Therefore, communication systems such as the use of telephones are needed to educate and monitor patients with diabetes.

Therefore, communication methods, such as telephone usage, are crucial for educating and monitoring patients with diabetes.

Limitation and recommendation

The study encountered limitations, including non-compliance with diet, medication, and exercise among some participants. In addition, non-responsive phone calls, delayed completion of questionnaires, and postponed laboratory visits for blood sampling were other research limitations. Identifying the elderly was challenging due to their hearing and vision impairments. Furthermore, the study exclusively relied on telephone communication due to limited participant access to information technology.

To better confirm the results of this research, it is suggested that the research variables be repeated in other statistical societies and different from the present research society. This research can be done in other age groups as well so that the results can be generalized by comparing the possible results. As it is clear from the review of the research literature that in addition to the effect of the nurse's telephone follow-up, other factors also affect the quality of life and HbA1C level of the people, it is suggested that future researchers consider other factors as well, which can be effective on these variables.

Conclusion

The study's findings indicate that telenursing follow-up and training in the intervention group improved the quality of life and reduced hemoglobin glycosylate levels in elderly patients with type 2 diabetes. Therefore, telephone monitoring by nurses can be an effective approach in enhancing the quality of life for elderly patients with type 2 diabetes and managing its complications.

Ethical approval
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Furthermore, we took written informed consent from each participant. The study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Conflicts of interest

There are no conflicts of interest.

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