Clinical and Experimental Health Sciences

Effect of Education and Monitoring on Developing Foot Care of Elderly with Diabetes Mellitus

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ABSTRACT

Objective: To determine the effect of education and monitoring on developing foot care in elderly with diabetes.

Methods: This study was a controlled experimental research. The study was performed with 45 elderly with diabetes in the control group and 45 in the intervention group who met inclusion criteria for the study. The participants were registered in one center and in a public hospital between the dates of September 2012-September 2013. Training and follow-up on foot care were carried out for the intervention group by performing four-foot examinations in both groups.

Results: Diabetic foot information and foot care behavior scores showed significantly greater increases in the intervention group compared to controls. A significant difference in total foot examination score was determined between groups and in time ($p<0.05$).

Conclusion: The results have shown that education and monitoring were effective in developing foot care in participants.

Keywords: Elderly, diabetes mellitus, foot care, monitoring, education, nursing

1. INTRODUCTION

Diabetes prevalence is growing worldwide and is becoming an epidemic and endemic problem with the social and economic burden. Its prevalence and its co-morbidities and mortality are higher in the elderly than in young people (1). Approximately one-quarter of people over the age of 65 years have diabetes, and this proportion is expected to increase rapidly in the coming decades (2). In 2019, the estimated number of people over 65 years of age with diabetes was 111 million. One in five adults in this age group is estimated to have diabetes. It is projected that by 2030 the number of people over 65 with diabetes will further increase to 195 million. By 2045, it will reach 276 million (1). Furthermore, nearly half of adults aged 65 years or older had prediabetes (3) Aging is considered a major risk factor for diabetes (4). Reasons like decreased independence in elderly with diabetes decreased self-care ability, and comorbidities affect diabetes management in a negative way (5).

With increasing age and duration of disease, both micro and macrovascular complications are more prevalent in the elderly. Together with complications, Peripheral Neuropathy (PN) and foot infections cause non-healing wounds in the elderly, increasing the risk of amputation in the lower extremities. More than 85% of amputations are preceded by an active foot ulcer. Diabetic foot represents the most common cause of hospitalization in patients with diabetes (6). Diabetic foot is one of the most serious and costly complications of diabetes. Lower limb amputation in people with diabetes is 10 to 20 times more common compared to those without diabetes. The 5-year relative mortality after diabetic foot ulcer is 48%. This is clearly higher than most cancers (1). Peripheral Arterial Disease (PAD) is an independent risk factor for subsequent ulceration and limb loss in diabetes. Up to 15-25% of patients with diabetes will develop a foot ulcer sometime during their lives (7).

In addition to increasing neuropathy and vascular disease prevalence with age, it is difficult for the diabetic elderly to take foot and nail care as a result of arthritis, restriction of joint movements, walking abnormalities, lack of movement, dementia and decreased vision (6). Diabetic foot problems often emerge because of insufficient care and follow-up. It was reported in previous studies that half of the foot injuries are reported to be preventable with regular training and foot care. The easiest and cheapest way to prevent foot complications is to observe regularly, which is one of the most

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effective methods (8, 9). Elderly with diabetes are in a high-risk group in terms of diabetic foot management (1). The risk of developing diabetic foot must be identified by nurses by performing an examination of the person with diabetes and relevant training must be planned and followed-up according to the risk category (10). The visual ability and reach-the-feet must also be evaluated in the examination (6). In addition to these precautions, glycemic control is also extremely important in the prevention of diabetic foot (1, 11).

With the increase in the elderly population, foot ulcers increase parallel to diabetes prevalence. No studies were detected in the literature conducted in our country on the follow-up and training intervention by determining the risk of the diabetic foot to prevent foot problems in elderly with diabetes**.** It is important to consider the age factor in the training regarding foot care by evaluating foot risk in elderly diabetics and monitoring the sustainability of foot care and training. We believe that the present study, which was planned with a sampling of elderly with diabetes, is an original nursing study, and will contribute to scientific evidence in this field. Therefore, the aim of the study is to determine the effect of training and monitoring on developing foot care in elderly with diabetes.

Hypothesis

$H_{1\text{-}1}$: The training and follow-ups have effects on improving the foot examination scores of the elderly with diabetes".

$H_{1\text{-}2}$: The training and follow-up have an effect on increasing the foot care behavior of the elderly with diabetes".

$H_{1\text{-}3}$: The training and follow-up have an effect on increasing the knowledge of diabetic foot care of the elderly with diabetes.

2. METHODS

2.1. Study design and setting

This study was conducted as a controlled experimental type study. The universe of the study consisted of 85 elderly with diabetes registered in an elderly center and 680 elderly with diabetes who applied to a diabetes education unit of a public hospital between September 2012 and 2013. Since 16 elderly with diabetes did not comply with the inclusion criteria among the 85 elderly people who had diabetes in the intervention group of the study, 69 were included in the intervention group. As the same number of the elderly with diabetes in the intervention group would be recruited in the control group, it took approximately four months to reach 69 people out of the 680 elderly with diabetes who were recorded in the diabetes education unit of the hospital for their routine treatment and care. A total of 78 elderly people with diabetes applied to the unit in this 4-month period, and 69 people were included in the control group as 9 people with diabetes were not eligible. The study was terminated for 9 elderly with diabetes who met the study termination criteria in the intervention group and 10 in the control group during the follow-up period. When the follow-up of 60 people continued in the intervention group, the data of 45 elderly people with diabetes, whose follow-up was completed, were transferred into the computer, and power analysis was made. The sampling power was found to be 100% in 95% Confidence Interval with Power Analysis in the 45-people sampling by considering the Diabetic Foot Knowledge (SD:1) and Foot Care Behavior (SD: 11) Scale (12, 13). The sampling of the study consisted of 90 elderly people with diabetes. For this reason, as the sufficient sample size was reached, 15 elderly with diabetes from the intervention group and 14 from the control group were excluded from the follow-ups (Figure 1).

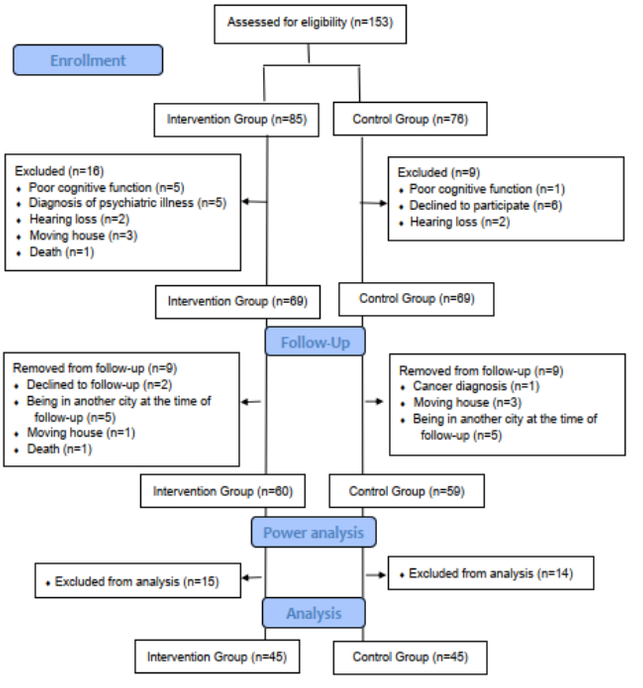

Figure 1. *Flow Diagram*

The inclusion criteria were as follows; having been diagnosed with Type 2 Diabetes, ≥65 years of age, not having received diabetic foot care training, having no problems in communication, having good cognitive functions according to Mini Mental Test, having no diagnosis of psychiatric disease, and accepting to participate in the study. The exclusion criteria were as follows; the desire to leave the study, not attending at least one of the four follow-ups of the study, being out of the city during the follow-up process, being diagnosed with a serious illness that requires treatment, or passing away.

2.2. Sampling and group allocation

Those who were registered in the Elderly Center constituted the Intervention Group, those who applied to the Diabetes Education Unit constituted the control Group. The Elderly Center is a center where the elderly are monitored in their own environment, the health and social problems of the elderly are determined during working hours, and solution services for these problems are provided under the

management of nurses. The center serves individuals who reside in the neighborhood to which it is attached. Home visits are made by nurses with three-month intervals at the latest in this center, although it is more frequent according to the needs of the elderly. As the number of the elderly with diabetes who were registered in the elderly center did not meet the sampling size determined according to power analysis, the intervention and control groups were taken from different centers. Because of the opportunity to be able to follow-up the elderly with diabetes registered in the center in their own environments, they were chosen as the intervention group. The elderly with diabetes admitting to the diabetes education unit of the hospital during the implementation period of the study constituted the control group. In this way, it was prevented that the intervention performed would affect the participants in the control group by taking the study groups in different centers.

2.3. Description of the interventions

Intervention Group

The diabetic foot risk group was determined by carrying out foot examination to the participants in this group, and foot care training and follow-up were performed. A total of four interviews were carried out in the initial, first, third and sixth months. In the first meeting, foot examination was carried out, and individual training was provided to the participants, and the training booklet was given by considering the age factor for diabetic foot care, which lasted 30-45 minutes. Education was performed by using mixed learning methods consisting of lecture, question-answer, demonstration, and practice. Education Booklet included information on: the healthy foot, diabetic foot complications, how diabetes affects your feet, frequently occurring foot problems, surveillance of early foot problems, how to check your feet and problems to look for, nail and skincare, how to choose a shoe and footwear, preventing foot injuries, regular check-up, compliance with diabetes treatment plan, blood glucose, blood pressure and blood lipids monitoring, daily physical movement and quitting smoking (14-19). The foot examination was repeated in the other three interviews, and incomplete information about foot care training was completed, and incorrect information was corrected. Diabetic Foot Knowledge Subscale (DFKS) and Foot Self-Care Behavior Scale (FSCBS) were applied in each interview.

Control Group

When routine follow-ups of the participants in this group were performed in a hospital, foot examination was performed and no interventions were carried out. Foot examination, DFKS and FSCBS application frequency were the same as in the Intervention Group. After the 4th interview, recommendations were made for consultation by providing individual foot care training.

2.4. Measurement instruments

Diabetic foot care and training form, mini mental testing readjusted for the elderly in literate and illiterate individuals and uneducated, participant characteristics form, foot examination form, DFKS and FSCBS were used.

Diabetic foot care and training form: It was determined whether the participant had received previous individual training on diabetic foot care and applications at least for two hours by examining the foot by diabetic training nurse and following-up according to the pre-defined risk group (8, 9, 20).

The Revised Standardized Mini Mental Examination Test: The test evaluates cognitive functions like orientation, record memory, attention and calculation, remembering and language (21). The validity and reliability study of the test was conducted for Turkey (22). Twenty-two points and below show possible cognitive disorders for literate people, and 18 points and below show possible cognitive disorders for illiterate people. The Cronbach Alpha value was 0.59 in the present study.

Participant characteristics form: The form was created by the researchers by scanning the literature. Form consists of five sections questioning socio-demographic characteristics (age, gender, education level, people they live with, etc.), habits (smoking, alcohol, and exercise), characteristics of the disease (diabetes diagnosis time, type of treatment, presence and type of complications, etc.), other chronic diseases and measurements (height, weight, body mass index, HbA1C value, fasting-postprandial blood glucose and blood lipid levels) (23, 24). The data on chronic diseases other than diabetes were obtained by the researcher from file records and with face-to-face interviews, and were grouped according to International Disease Codes (25). Body Mass Index was evaluated as underweight (below 18.5), normal (18.5-24.9), slightly obese (25.0-29.9), obese (30.0-39.9), and excessively obese (40.0 and above) (26). Fasting and postprandial blood glucose measurements were taken with glucometer and capillary blood taken at each follow-up, HbA1c was recorded three times in total in 3-month average glucose levels, and blood lipid levels were recorded twice.

Diabetic foot evaluation form: The form was created by the researchers by scanning the literature. The physical examination of the foot in each follow-up is divided into six sections, and the scoring is made between 0 and 19. In physical examination, each problem (1) was scored, and the total score was scored between 0 and 19. (27, 28).

Presence of foot ulcer: During the examinations, the presence of ulcers was checked. If the patient had an ulcer, (1) point was given, if not (0) point was given.

Evaluation of structural anomalies of the feet and footwear: Deformities like hammertoe or claw toe, hydrocele, callus, fungi, hallux valgus, amputation and Charcot deformity were evaluated. If there were an anomaly in one of both feet, (1) point was given; if not (0) point was given. The width and foot bed, supporting the foot arch, and the suitability to the feet were evaluated, and each item was scored as (1) in there was compliance to each part, if not, (0) point was given (8, 29).

Peripheral neuropathy: The presence of any peripheral neuropathy was determined with PN symptoms in physical examination *(complaints, place, time, etc.)* and findings *(sense of vibration, sharp-cunt perception, Achilies tendon reflex, sensory examination)* scores (30). Even if there were no PN complaints or symptoms according to peripheral neuropathy symptom and finding score, in case there were PN findings ≥6 points (moderate or severe), or in case there were moderate complaints and mild PN findings (3-5 points), it was evaluated as PN (31). If there was neuropathy (1) point was given; if not, (0) point was given.

Circulation: It was evaluated with intermittent limping, feet pulses and Ankle-Brachial Index (ABI) (8, 31, 32). If there was intermittent-limping (1) point was given; if not, (0) point was given; if there was not any of the 4 pulses (1) point was given; if there was, (0) point was given; if ABI was not normal in any of the right or left side, (1) point was given; if normal, (0) point was given.

Self-care knowledge on foot care: Answering "Yes" to any of the 6 questions in any follow-up was deemed to show a deficiency in self-care knowledge (29). If there was knowledge deficiency, (1) point was given; if not, (0) point was given.

Diabetic foot risk and management categories: It was evaluated according to the results of the examination of the feet (8). If the diabetic foot risk group was low (0) point was given; if high, (1) point was given.

Diabetic foot knowledge subscale: The scale consists of five items (33). The validity and reliability were conducted by Kır Biçer and Enç (34). Cronbach Alpha value was 0.67 in the initial measurement, 0.68 in the first month, 0.71 in the third month, and 0.70 in the sixth month.

Foot self-care behavior scale: The scale was developed by Borges and Ostwald (35) in 2008. The validity and reliability were conducted by Kır Biçer and Enç (36). Cronbach Alpha value was 0.79 in the initial measurement, 0.88 in the first month, 0.91 in the third month, and 0.92 in the sixth month.

2. 5. Data collection and procedure

Data collection was performed by the researchers by face-to-face interviews and physical examination. The diabetic foot risk group was determined by performing foot examination to the elderly with diabetes in the Intervention and Control Group. Although the frequency of follow-ups varied according to the risk group (8), a total of four interviews were conducted as the initial interview, and in the first, third and sixth months. The participants who could not come to the Elderly Center were visited at home.

2.6. Ethical considerations

The study was approved by the Ethical Committee of the hospital. Permission was obtained from the institutions in which the application was made. Before beginning the study, the researchers explained its purpose to those who fitted the inclusion criteria, and informed voluntary consent was obtained in writing from those who consented to participate.

2.7. Statistical data analysis

The analyses of the data were made in the Statistical Analysis System Institute, Cary, North Caroline-SAS 9.3 Package Program. The fitness of the points to normal distribution was checked with skewness and kurtosis; the homogeneity of the groups was evaluated with ***t***-test, Chi-Square or Fisher's Exact Test. Variance analysis was used in repeated measurements to compare the mean scores according to measurement times. In significant variables, the group or measurement time(s) that yielded the significance was determined with Duncan's Test. The level of significance was taken as $P<0.05$.

3. RESULTS

3.1. Participant characteristics

The mean age of the participants was 71.49±4.35 in the intervention group, and 70.93±4.89 in the control group. No significant differences ($P>.05$) were detected between the two groups except in cigarette smoking, diabetes treatment types, and diabetes-related complications.

3.2. Findings related to participants' diabetic foot information subscale (DFKS), foot self-care behavior subscale (FSCBS) and foot examination scores

There was a significant difference in the mean DFKS points in the intervention and control group, and changed over time ($P<0.001$). The change increased in every measurement from the initial follow-up in the intervention group compared to the control group (Table 1). This result confirmed the hypothesis that "training and follow-up have an effect on increasing the knowledge of diabetic foot care of the elderly with diabetes".

Table 1. *Comparison of mean scores of the diabetic elderly in intervention and control group in terms of diabetic foot knowledge and foot care behavior during follow-up process*

Measures	DFKS		FSCBS	
	$\overline{x}$ ±SD		$\overline{x}$ ±SD	
	Intervention (n=45)	Control (n=45)	Intervention (n=45)	Control (n=45)
1	2.51±1.27	1.56±1.34	48.69±9.98	45.18±11.24
2	3.18±1.08	1.82±1.27	61.13±7.21	46.53±11.51
3	4.16±0.85	2.40±1.56	66.82±4.95	48.93±11.18
4	4.73±0.50	2.60±1.14	70.64±3.16	50.78±10.76
Test	*p*		*p*	
Time	<0.001		<0.001	
Group	<0.001		<0.001	
Time x Group	0.006		<0.001	

DFKS: Diabetic Foot Knowledge Subscale, FSCBS: Foot Self-Care Behavior Scale, SD: Standard Deviation

There was a difference in terms of the mean FSCBS scores between the intervention and control group, and changed over time (P<0.001) (Table 1). This result confirmed the hypothesis that "training and follow-up have an effect on increasing the foot care behavior of the elderly with diabetes".

The mean foot examination points were compared according to the measurement times in the Intervention and Control Group (Table 2). Although there was a difference in terms of the structural abnormalities of the foot, neuropathy, lack of self-care knowledge, and diabetic foot risk score (P<0.05); there were no differences in terms of footwear, neuropathy, and circulation score (P>0.05). The lack of self-care knowledge score decreased more between the 1st-2nd measurements and the 3rd – 4th measurements in the Intervention Group compared to the Control Group. The total score of foot examination was similar (P=0.005), changed over time (P=0.001), and the change was similar (P>0.05). In the mean foot examination points; there was a significant difference between the 1st – 2nd and the 3rd – 4th measurements in both groups after the first measurement, more pronounced in the Intervention Group, and it was determined that there was an increase in the Intervention Group in the 4th measurement, less pronounced in the Intervention Group. These results confirmed the hypothesis that "The training and follow-ups have effects on improving the foot examination scores of the elderly with diabetes".

3.3. Findings related to physiological measurements

The differences between mean systolic blood pressure, FBG and PBG between groups and the change over time were not significant (P>0.05). In the mean diastolic blood pressure, the difference between groups was significant (P=0.005), and there was no significant difference in change over time (P>0.05). The diastolic blood pressure was low in the Intervention Group compared to the Control Group (Table 3). The difference between groups and the change over time in the mean HbA1c score was not significant (P>0.05) Table 4). The difference between the groups in the first interview and 4th follow-up for mean triglyceride, cholesterol and LDL values and the change over time was not significant (P>0.05). The mean HDL was found to be lower in two follow-ups in the Intervention Group compared to the Control Group, and the difference was found to be significant in the 4th follow-up (P=0.05) (Table 5).

Table 2. *Comparison of mean scores of the diabetic elderly in intervention and control group in terms of foot examination during follow-up process*

	Measures	Foot Examination Findings: Foot ulcer	Structural abnormalities of the foot	Footwear	Neuropathy	Circulation	Deficiency of self-care information	Diabetic foot risk	Total
		$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD
Intervention (n=45)	1	0.00±0.00	2.62±1.19	0.07±0.33	0.31±0.47	0.84±0.60	1.00±0.00	0.89±0.32	5.74±1.51
	2	0.00±0.00	2.51±1.14	0.07±0.33	0.31±0.47	0.84±0.60	0.58±0.50	0.87±0.34	3.40±1.79
	3	0.00±0.00	2.40±1.25	0.00±0.00	0.27±0.45	0.84±0.56	0.44±0.50	0.84±0.37	3.18±1.75
	4	0.00±0.00	2.16±1.28	0.00±0.00	0.76±0.44	0.71±0.59	0.38±0.49	0.84±0.37	3.44±1.67
Control (n=45)	1	0.22±0.15	2.80±0.81	0.02±0.15	0.29±0.46	0.78±0.56	1.00±0.00	0.96±0.21	5.87±1.29
	2	0.22±0.15	2.82±0.83	0.16±0.37	0.29±0.45	0.76±0.58	0.98±0.15	0.98±0.15	3.93±1.62
	3	0.22±0.15	2.71±0.84	0.04±0.21	0.27±0.45	0.67±0.60	0.96±0.21	0.91±0.29	3.69±1.61
	4	0.22±0.15	2.71±0.84	0.04±0.21	0.73±0.45	0.69±0.56	0.96±0.21	0.93±0.25	4.16±1.46
Test		*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
	Time	X	0.282	**0.042**	**0.001**	0.602	**0.001**	0.655	**0.000**
	Group	X	**0.002**	0.189	0.728	0.125	**0.001**	**0.008**	**0.005**
	Timex Group	X	0.673	0.302	0.998	0.831	**0.001**	0.951	0.667

SD: Standard Deviation, X: Since there were no foot ulcers in the Intervention Group during follow-up period, the change could not be compared in terms of foot ulcer according to intra and intergroup time.

Table 3. *Comparison of mean scores of the diabetic elderly in intervention and control group in terms of systolic blood pressure, diastolic blood pressure, FBG, and PBG during follow-up process*

	Measures	Systolic Blood Pressure	Diastolic Blood Pressure	FBG	PBG
		$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD
Intervention (n=45)	1	130.44±13.81	75.78±12.34	136.56±38.87	186.58±71.18
	2	128.89±14.50	77.56±8.83	140.12±55.95	191.911±91.83
	3	126.00±13.21	78.22±8.87	124.09±22.27	156.07±42.01
	4	129.11±13.28	78.22±9.36	127.11±31.10	164.31±53.33
Control (n=45)	1	128.33±13.48	79.56±6.01	133.62±42.86	182.31±72.06
	2	128.22±11.34	79.78±6.90	138.47±65.58	173.98±79.07
	3	126.89±13.11	79.78±3.98	137.22±72.63	177.96±91.97
	4	129.78±13.40	80.44±7.06	144.21±57.05	182.82±77.90
Test		*p*	*p*	*p*	*p*
	Time	0.392	0.562	0.729	0.34
	Group	0.828	**0.005**	0.236	0.565
	Time x Group	0.865	0.830	0.442	0.224

FBG: Fasting blood glucose PBG: Postprandial blood glucose, SD: Standard Deviation

Table 4. *Comparison of mean scores of the diabetic elderly in intervention and control group in terms of hba1c during follow-up process*

		HbA1c
	Measures	$\bar{x}$ ±SD
Intervention (n=45)	1	7.29±1.16
	2	7.05±1.23
	3	7.50±1.50
Control (n=45)	1	6.96±1.67
	2	6.82±1.70
	3	6.96±1.67
p		
Test	Time	0.592
	Group	0.094
	Time x Group	0.848

SD: Standard Deviation,

Table 5. *Comparison of Mean scores of the diabetic elderly in intervention and control group in terms of triglyceride, cholesterol, HDL and LDL in initial interview and fourth follow-up*

Measures	n	Blood Lipids	Intervention Group	Control Group	*p*
			$\bar{x}$ ±SD	$\bar{x}$ ±SD	
Initial interview	22	Triglyceride	163±63	129±44	0.245
	22	Cholesterol	202±32	177±40	0.251
	22	HDL	44±10	51±16	0.523
	22	LDL	123±31	203±30	0.279
Fourth interview	44	Triglyceride	168±63	144±66	0.098
	44	Cholesterol	193±29	189±38	0.117
	44	HDL	42±11	54±51	**0.051**
	44	LDL	122±30	109±32	0.122

4. DISCUSSION

4.1. Discussion of Findings Related to Participants' Diabetic Foot Information Scores

It is important to evaluate problems that might occur after diagnosis, to provide training and regular follow-up and preventive behaviors to prevent diabetic foot development (37). It was reported that 50-85% of amputations can be prevented with early diagnosis, regular follow-up, and training (38).

The significant increase in the mean DFKS score in the Intervention Group compared to the Control Group was at the highest between the second and third measurements, and the least between the third and fourth measurements. In previous studies, it was reported that individuals with diabetes were inadequate in terms of their knowledge on foot care, and had low behavioral scores and poor attitudes (39-42). Guided by Bandura's Social Cognitive Theory, the foot self-care application increased in the 6th week and the following three months after the foot self-care training applied to Type 2 diabetes individuals with low risk of foot ulcers (37). In the present study, which examined the effect of training in developing foot care knowledge and self-care practices, it was determined that there was a significant increase in the knowledge and self-care practices of the Intervention Group in one and a half and third months (43). In a study that examined the effect of foot care training, it was revealed that there was a significant difference between pre-test and post-test foot care knowledge score and patient foot examination and footwear use (44). In another study, individuals with diabetes were given foot care training in a four-week period, were followed up for six months, and the foot care knowledge increased in the Intervention Group in the first month and continued during the follow-up.

There were no significant differences in foot lesions during the follow-up period (45). Similarly, in a study which trained patients 9 times about foot care and overall diabetes care, it was found that there was a significant increase in the knowledge in the application group (46). In the study conducted by Kır Biçer and Enç, the mean foot care knowledge score in the 6-month follow-up process of individuals with diabetes in the planned training program continued to increase as of the beginning in the experimental group, there was no change in the Control Group, and there was a significant difference between the follow-up according to the groups (34).

According to the results of the study, which reported a significant increase in foot care knowledge of individuals with diabetes after six weeks of foot care training (38) and after six months (47). On the contrary, in another study, it was reported that foot self-care knowledge did not increase in 6 months after application. The researchers emphasized that this difference was due to the small number of sampling (48).

In two studies (49, 50), it was shown that being able to obtain the knowledge would last for a longer period like 1-7 years. In our study, on the other hand, the increase in the mean diabetic foot knowledge score was at the highest level between the second and third measurements, and between the third and fourth measurements at the lowest level; and in line with these results, it is possible to speculate that the intervention was effective in increasing foot care knowledge in the first three months. This is because it is considered that the elderly with diabetes must be examined for foot examination every time they arrive for follow-ups to monitor changes, and foot care training would be provided according to the foot examination findings. No studies were detected in the literature in which foot care training and foot examination studies were conducted in each follow-up (37, 43, 46); and it was determined that foot care training was not repeated in every follow-up, and that foot care knowledge was evaluated during the initial training process (43, 45, 47).

4.2. Discussion of Findings Related to Participants' Foot Care Behavior Scores

It was reported in previous studies that self-care behaviors can be provided by increasing diabetes knowledge (51). In our study, the foot care behavior score increased at significant levels more in the Intervention Group. Effective management and control of diabetes require behavioral compliance. Studies showed that training practices increase the level of knowledge, positively affect the level of belief, and provide positive health behaviors (52, 53), three weeks after the training (24), and six months after the training (54) and foot self-care behaviors developed. The results of our study were found to be similar to studies supporting the effect of self-care practices in improving the performance of foot care behaviors (38, 47, 48).

In our study, compared to the Control Group, the increase in the mean FSCBS scores was at the highest level between the $1^{st} – 2^{nd}$ and $3^{rd} – 4^{th}$ measurements, and the intervention was effective in acquiring foot care behavior as soon as in the first month. This might be because of the foot examination in each follow-up and the training given according to the examination findings. DFKS and FSCBS scores increased in the Intervention Group as well as in the Control Group, more pronounced in the Intervention Group. This increase may stem from the fact that participants in the Control Group regularly applied to the hospital with their own wishes for treatment and care of their diseases. In addition, it is considered that the follow-up process creates awareness and curiosity providing the opportunity to learn from experts on foot problems they experience in the elderly with diabetes in the Control Group.

4.3. Discussion of Findings Related to Participants' Foot Examination Findings and Diabetic Foot Self-care Lack of Knowledge

In the present study, the mean foot examination scores of the elderly with diabetes and the lack of self-care knowledge about foot care decreased in time in both groups. In the Intervention Group, the decrease in self-care knowledge scores between the 1^{st}-2^{nd}, and 3^{rd}-4^{th} measurements greater than in the Control Group. In the literature, it was shown that training that focuses on foot self-care in patients in the long term improved self-care and foot care implementations, reducing lower-extremity amputation and foot ulceration in those who were at high risk for foot ulceration (37, 56).

There was a significant difference between structural abnormalities of the foot and the diabetic foot risk in the Intervention and Control Group in terms of mean scores. This difference may be the result of the variable nature of the scores of structural abnormalities of the foot, which can vary by increasing the knowledge and behavior scores of the participants with foot care training and follow-ups. Pieber et al. (57) conducted a study in which they provided training on diabetes and foot care for four weeks, followed up their patients, and compared the results with initial scores, the determined significant decreases in callus formation and inadequate nail care. Positive improvements were detected in foot care in the study, which compared foot examinations before the training, and after three and six months of the training (54). Routine foot care was provided to individuals with foot ulcers, and the risk of recurring foot ulcers decreased in one year (38). In two studies with a follow-up period of 6 months (32) and 18 months (46), no difference was detected between the groups in terms of foot lesions. It was reported that this might be due to the differences in foot examination findings of the participants involved in the sampling.

The difference between the Intervention and Control Group in terms of footwear, neuropathy and circulation scores was not significant. No studies were found in the literature in which diabetics were followed up according to risk groups by performing foot examination and foot care training as in our study. However, it was determined that there were studies in which it was reported that massage (58, 59), and exercise

(60) were effective together with foot care examination in individuals with diabetes.

A significant difference was detected between the Intervention and Control Group in terms of the foot examination total scores, and it was determined that there was a decrease in the first measurement in both groups, more pronounced in the Intervention Group, and there was a decrease in the fourth measurement, less in the Intervention Group. The fact that there were decreases in foot examination score after the first measurement was associated with the follow-up period being 1 month between the first 2 measurements, and the increase in the 4th measurement was associated with the period between the last two follow-ups being 3 months resulting in remembering the instructions given in the training.

It was determined in studies that there were positive improvements in foot care in the 3rd and 6th months after the training intervention (54), and there were significant decreases in callus formation and inadequate nail care at the end of the 6-month follow-up (57). In our study, the total score of foot examination consisted of factors that might vary with foot care training, follow-up, increased foot care knowledge, and behavior scores. The fact that there was a decrease in foot examination total score in the Intervention Group compared to the Control Group was considered as the results of training and follow-up on foot care in our study. The reason why there were decreases in the foot examination scores of the elderly with diabetes in the Control Group was the awareness that was raised when questions were asked about foot care knowledge and behavior to carry out four-foot examinations.

4.4. Discussion of findings related to participants' physiological measurement

In our study, there were no significant differences in the inter – and intragroup comparison in terms of the mean scores of systolic blood pressure, FBG, PBG and HbA1c, but the difference between the groups in terms of the mean diastolic blood pressure scores was significant. The mean diastolic blood pressure was lower in the Intervention Group. This result is considered to be because of the evaluation of blood circulation when foot examinations were made, and the explanation of the results in blood pressure scores that were different from the normal values to diabetic participants, as well as directing them to the specialist physician for evaluation. The mean HDL scores in the Intervention Group were lower in both the beginning and in the 6-month than in the Control Group, and the difference was significant in the 6th month. The reason for this significant difference in the Control Group might be considered as taking into account the warnings for regular referral to the Diabetes Training Unit, and the warnings made in terms of protecting and improving health. In a previous study, no significant relations were found between metabolic control variables and foot care training (54), and in another study, it was found that there was a significant decrease in HBA1c in the final test of the experimental group (35). It is speculated that increased compliance to self-care behaviors, diabetes knowledge, and treatment can be achieved with glycemic control (51). In the present study, the importance of blood sugar, blood pressure, and blood fat checks was emphasized in terms of foot health in the training given to the Intervention Group. It also found that there was a significant difference between the Intervention and Control Group in metabolic control variables other than Diastolic Blood Pressure and HDL value. The reason for this might be considered as that the majority of the elderly with diabetes in the Intervention Group do not go to the hospital regularly for treatment and care and because their metabolic control variables are not at the desired levels.

5. CONCLUSION

The results showed that training and follow-up are effective in increasing the knowledge on foot care, behavior and foot examination scores of the elderly with diabetes. In this respect, the following are recommended; identifying the risk of developing diabetic foot by examining the diabetic elderly by nurses, monitoring and scientifically evaluating the changes in foot care knowledge and behavior with individual foot care training and follow-up according to risk groups, including caregivers of diabetic elderly in training, re-conducting the study to increase the level of evidence, determining the effects of different interventions like exercise and reflexology in addition to training and follow-up interventions, creating evidence-based guidelines, and in this way, minimizing the complications of the foot due to diabetes.

6. Limitations of the Study

Among the limitations of the study are the small sampling size and six-month short-term training and follow-up period. In addition, one-on-one training is effective but time-consuming, thus making it difficult to conduct daily in crowded clinics. To overcome this drawback, the effectiveness of foot care training could be evaluated by conducting training on larger groups.

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