

Does the Acquisition of Knowledge Prevent Diabetes-Related Foot Problems?

Salma B Galal¹,
Kholoud Al-Ali²,
Nagafa Sharaf³,
Mona El-Baz³,
Khadiga Tag El-Din³ and
Iman Wahby³

Abstract

Introduction: Diabetes related foot problems are one of the complications leading to poor quality of life, hospitalization, disability, economic burden and mortality. Patients' self-management of diabetes needs support from health providers. Patient education and follow-up are important elements of communication for health providers.

Methods and objectives: This case control study compares 199 diabetes patients with diabetes-related foot problems (cases) and those without (196 controls) to find out whether the acquired knowledge or the follow up visits to the Family Health Centers prevent foot problems.

Results and conclusion: The results suggest that being on insulin therapy, forgetting to take medication and reduced attendance to the health care center are risks for foot problems. Although the level of knowledge acquired is satisfactory, there is a gap between knowledge level and attitude / practice. A relative high knowledge did not have impact on reduction of obesity or glycosylated hemoglobin (A1C).

Some knowledge items such as risk related to diabetes complications need to be stressed on. The education of people with diabetes needs to address more knowledge gaps and to link to patients' attitudes and practices.

Keywords: Attitude of diabetes patient; Practice of diabetes patient; Knowledge gap; Primary health provider; Diabetes foot complications

- 1 Egypt Research and Evaluation Network (EREN), Cairo, Egypt
- 2 Health Promotion Department, Ministry of Health, Kuwait
- 3 Community and Industrial Health Department, Faculty of Medicine (G), Al-Azhar University, Cairo, Egypt

Corresponding author:

Salma B Galal

✉ asra78@gmail.com

Egypt Research and Evaluation Network (EREN), Cairo, Egypt.

Tel: +20 2 26222236

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Introduction

Almost one tenth of the world population has diabetes. It was the cause of around 1.5 million deaths in 2012, with over 80% of them occurring in low- and middle-income countries. The Sustainable Development Goals set a target to reduce the deaths attributed to non-communicable diseases (NCDs) by one-third, including diabetes, by 2030 [1-3]. Arab countries have the highest diabetes prevalence rates [4]. With a diabetes prevalence rate of 23%, Kuwait has one of the highest rates of the world. Raising the awareness of people with type 2 diabetes as part of prevention is important to avoid or decrease micro vascular complications of diabetes leading to cardiovascular disease, blindness, kidney failure, and lower limb problems [5]. Normal body weight, healthy diet, physical activity, and non-use of tobacco can prevent or delay the onset of type 2 diabetes [1] and can also delay the complications of diabetes.

The Ministry of Health (MOH) in Kuwait is responsible for ~ 80% of healthcare services and emphasizes on health education for diabetes patients [6]. The elements of the Chronic Care Model (CCM) include clinical information systems, self-management education, decision support and delivery system design. One of the components of CCM is to "activate informed patients" [7], which are done in primary health care in Kuwait. The healthcare management of chronic diseases and in particular diabetes emphasizes on health education for patients. Knowledgeable diabetes patients who had information on disabling lower limb complications were more likely to perform self-management activities. Among Indian people with diabetes, poor knowledge was identified also as a significant risk factor for diabetes related foot problems [8]. However, is increasing the knowledge of patients enough for self-management of diabetes? A study by Moreo et al. [9] increased the adherence of diabetes' patients to medication and their outcomes such as glycosylated hemoglobin

(A1C) and body mass index (BMI) by improving health education and the performance of physicians towards diabetes patients in primary health care. According to CDC [10] BMI of 18-25 is normal, of 25-29.9 is considered overweight, and 30-34.9 obese. Subjects with BMI ≥ 35 were considered as severely obese.

The aim of this study is to identify the association between:

- the level of knowledge acquired by diabetes patients and their foot problems

Follow-up visits to health care providers and diabetes-related foot problems among patients attending Family Health Center.

Method and Subjects

Study design and setting

A quantitative case control study was carried out amongst 199 diabetes patients with foot problems (cases) and 196 without (controls) in the available five Family Health Centers in Kuwait Capital, Hawali, Farwaniya, Jahra and Ahmadi [11].

A pilot study was carried out on 18 patients with diabetes (8 cases and 10 controls) in other primary healthcare units. Accordingly, some questions were adjusted in the questionnaire. The patients of the pilot study were not included in the sample.

Sampling

The required number of cases was 168 calculated by EPI 5 Statistical Package. A similar number of control subjects were required for a case-control ratio of 1:1. Fifteen percent (15%) more were added.

A physician interviewed around 40 diabetes patients with foot problems and 40 diabetes patients without foot problems in each center. One working day per week was randomly assigned for each center to collect data from the visiting patients. The working day rotated weekly between the five FHC till the required sample was recruited.

Only adult Kuwaiti citizens 20 years and over with diabetes were included. Excluded were other nationalities for language reason, newly diagnosed diabetes patients (< 1 year) and pregnant women.

Tools

A physician interviewed patients with a structured questionnaire (103 questions with measurements and laboratory tests) including patient's characteristics (sex, age, marital status, education, occupation, income), diabetes history, communication with the health providers, knowledge, attitude, practice, adherence to therapy and lifestyle. The communication focused on frequency of visits to FHC, patients' education on diabetes and foot checks. Appropriate physical activity was considered if the patient has practiced for 150 minutes of moderate or 75 minutes of vigorous activities per week [1].

Measurements and laboratory tests

Weight, height, blood pressure and laboratory tests were taken from the patients' files. The last weight and height were taken

from the patients' records. The Body Mass Index (BMI) was calculated as weight in kg / height² in meter.

Patients with systolic blood pressure ≥ 140 and / or diastolic pressure ≥ 90 mmHg are considered hypertensive [12] in addition to patients taking medication against hypertension.

The last A1C readings were taken from the patients' files. It was considered adequate if it was < 6.5% [13].

Knowledge, attitude, practice and adherence scales

Patients' knowledge was assessed through 22 structured questions. Each question had a value from 0-1-2, with a minimum of 0 score and a maximum of 44 for total scores. The patients' knowledge items were grouped into the following categories:

- General knowledge about diabetes and its complications
- Causes of foot complications
- Risk factors of foot complications
- Symptoms of peripheral neuritis
- Symptoms of peripheral circulatory insufficiency
- Signs to be observed on self-examination of the foot
- Specification of appropriate shoes
- Danger of walking bare foot and using hot water

The attitude score had 7 items. Each item value was from 1-2-3, with a minimum of 7 scores and a maximum of 21 for the total score. Three items were included on their perception of use of insulin and four concerning foot complications.

The practice score had 15 items. Each item values was either 0 or 1, with a minimum of 0 score and a maximum of 15 for the total score. The items were grouped in

- Foot care practice and
- Foot protection procedure

For validation of the knowledge, attitude and practice items, the split-half-reliability coefficient (Spearman) for knowledge items was $r = 0.93$, for attitude $r = 0.74$ and for practice items $r = 0.84$.

A modified Morisky et al. [14] adherence to the medication scale was used.

Ethical considerations

The Ethical Committee of the Kuwaiti Ministry of Health approved the research. The researchers obtained the oral consent from all interviewed patients after explaining the purpose of the study and their voluntary participation; anonymity of the information was provided.

Data analysis

Analysis was performed with SPSS version 17 statistical package. Cases were compared with controls. Chi-square was used for qualitative data, t-test for quantitative and logistic regression with 95% confidence interval to find the most important variable

affecting diabetes related foot problems. The level of significance chosen was 0.05.

Results

The most common problem in cases with foot complications were foot infection (43.5%) followed by ulcer (36.0%), gangrene (14.5%) and amputation (6.0%).

Table 1 shows that men are significantly more affected by foot problems than women. People with diabetic foot complications (cases) are significantly older; more often widowed, less educated and have less income than those in the control group.

Table 2 demonstrates that cases with diabetes-related foot problems have had the disease for a significantly longer time, are more likely to be on insulin therapy or combined with oral have more complications and the mean A1C is higher than in control group. There is no difference between the case and control groups regarding BMI; over half of both groups are obese and severely obese.

Table 3 illustrates that cases with diabetes related foot problems have significantly less frequent follow up visits, receive less oral instructions on general diabetes care and foot care and less printed material. They were educated on how to avoid foot problems. During their visit to healthcare providers, the physician primarily only looks at their foot or palpate the foot pulses if they complain. Neurological investigations such as the pin prick sensation test and vibration perceptions are performed less in the case group than the control group.

Table 4a shows some of the wrong knowledge, negative attitude and undone practice items. There was no difference between the case and control groups regarding wrong answers on the risk factors of foot complications. Some items in knowledge are well known to all. For example, almost all patients in both groups know that diabetes may cause eye, kidney and foot complications. In causes of foot complications, the control group had significantly more wrong answers than the case group. Both negative attitudes and not practicing healthy lifestyle are high in both groups.

Table 4b reveals that the knowledge score is significantly higher in the case group with diabetes related foot problems (32.3) than in the control group (29.7) conversely, attitude and practice scores are significantly lower.

Table 5 implies that there is no difference between the case and control groups regarding practicing exercise, foot care and cleaning. Significantly less people in the case group (45.2%) adhere to treatment than do in the control group (66.8%), likewise with the diet regimen (25.6% and 56.6% respectively).

Logistic regression analyses indicate that 'forgetting to take medication' had the highest risk with OR = 27 and insulin therapy OR = 7 for diabetes related foot complications (**Table 6**). 'Less frequent visits to the FHC' had a risk of OR = 5.8. The duration of diabetes (OR = 1.3), the knowledge score (OR = 1.5) and A1C (OR = 1.2) are further risks. While age, sex, education and income were excluded from the equation for not having an impact.

Discussion

In this study, diabetes patients with foot problems pay fewer follow up visits to FHC than in the control group. There is a gap between the relatively high knowledge score of diabetes cases with foot problems and their attitude and practice scores. Individuals in the case group have a higher knowledge score than in the control group. Those in the control group have higher attitude and practice scores than in the case group. Health education and high level of knowledge on diabetes and foot complications in the case and control groups appear to have little impact on reducing BMI and A1C reduction. There are some gaps in knowledge. Some topics on the knowledge scale are well known to both groups, such as diabetes may cause eye, kidney and foot complications, while risk factors such as 'elevated blood cholesterol' and smoking were less known. 'Forgetting to take medication' and being on insulin therapy are the highest risk factors in people with diabetes foot problems.

In Sri Lanka, Perera et al. [15] indicated that they found gaps in knowledge regarding the symptoms of poor control and the importance of regular follow-up. It seems that there are differences between countries regarding the knowledge gap, which may arise from health providers or from the patients. The need for regular follow-up visits is one of the common factors to stress on.

Moreo et al. [9] showed that diabetes patients decreased their weight and A1C through improved communication with primary healthcare physicians. It is possible that there are cultural differences as regards the response of people with diabetes to health education. Most likely raising awareness amongst patients alone is not enough it may be important to address the family members as well. Knowledge has to be tailored to each patient, specifically targeting knowledge deficiencies and which are linked to practice.

Patients with a low education level have a higher risk of developing foot problems as they seek less the health services and are not interested in changing their lifestyles [18]. Similar results are also found in the present study consequently reduced follow-up visits imply that they get less health education. Also Additionally, Yekta et al. [17] reported that low income affects the utilization of health services. The reason behind paying fewer visits to the FHC needs to be investigated. Are these economic, cultural, time bound or personal reasons? This is to encourage diabetes patients with lower education and income levels to increase their follow up visits.

The gap between knowledge, attitude and practice was mentioned by Serrano-Gil and Jacob [18] as life-style changes were not being achieved. It stands to reason that the health education given to a patient should target changing of attitude and practice. Computer-tailored interventions may improve behavioral changes in chronic diseases [18]. However, uneducated patients need direct communication with providers as they are computer-illiterate.

Insulin therapy is a risk factor for diabetes foot problems was

Table 1 Characteristics of diabetes patients with and without foot problems.

Characteristics of cases and controls	Diabetes patients		Significance test	P value
	With foot problems N = 199 %	Without N = 196 %		
Sex				
Females	45.7	56.6	$\chi^2 = 4.70$	0.03
Males	54.3	43.4		
Age (years)				
< 40	9.0	21.4	$\chi^2 = 58.0$	0.00
40-49	9.0	27.6		
50-59	33.7	34.2		
Mean age (years) \pm SD	57.6 \pm 10.3	49.2 \pm 11.4	T = 7.6	0.00
Min – Max	28.0 – 75.0	24.0 – 84.0		
Marital status				
Single	1.0	4.1	$\chi^2 = 20.9$	0.00
Married	78.4	82.1		
Widowed	19.1	7.1		
Divorced	1.5	6.6		
Education				
Primary / less	38.2	22.4	$\chi^2 = 12.1$	0.00
Intermediate / secondary / diploma	48.7	58.2		
University / higher	13.1	19.4		
Occupation				
Not working / housewife	34.7	34.2	12.6	30.1
Worker	1.0	15.3		
Clerk / Professional	23.1	33.2		
Military	5.0	5.1		
Retired	36.2	12.2		
Monthly income				
Low	19.1	9.7	$\chi^2 = 21.4$	0.00
Middle	68.3	60.2		
High	12.6	30.1		

referred to by Mitchell et al. [19] “Vasoconstrictor effects of low insulin doses in the peripheral microcirculation of healthy humans seem to be mediated via ET-B-receptors”. Since this study did investigate neither the dose nor the insulin brand composition, it is not possible to verify it here.

Neurological investigations of the foot are carried out more in the case group than the control group. It should be considered that neurological investigations need to be performed on all diabetes patients [5] especially for those on insulin therapy, regardless of whether they complain of foot problems.

Conclusion

Although people with diabetes related foot problems have a satisfactory level of knowledge there are important gaps

in knowledge regarding risk factors associated with foot complications. Are these knowledge deficits from the health education content given to patients or from the patient’s side? Gaps are obvious between relatively high levels of knowledge and attitude / practice. To improve the self-management of patients, health education has to target attitude and practice and to be linked to the applicability by patients. The reasons behind less frequently visited FHC necessitate more in-depth research. Cases are likely on insulin therapy. More investigations are needed on the effect of insulin on foot complications.

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Table 2 Disease history and measurements of diabetes patients with and without foot problems.

Variable	Diabetes patients		Significance Test	P value
	with foot problems N = 199	without N = 196		
	%	%		
Duration of diabetes (years)				
< 5	8.0	29.6	$\chi^2 = 77.9$	0.00
5-	11.1	21.9		
10-	15.6	26.0		
≥ 15	65.3	22.4		
Mean duration (years) ± SD	17.3 ± 8.5	8.9 ± 5.8	T = 11.4	0.00
Min – Max	1.0 – 35.0	1.0 – 29.0		
Treatment of diabetes				
Insulin	10.6	17.3	$\chi^2 = 107.8$	0.00
Combined oral and insulin	69.3	18.9		
Oral	17.1	60.2		
Diet alone / herbs	3.0	3.6		
Chronic diabetes complication (neuropathy, retinopathy, nephropathy, hypertension and dyslipidemia)				
Yes	89.5	32.0	$\chi^2 = 145.5$	0.00
No	10.5	68.0		
Body Mass Index (kg/m²)				
Severe obese ≥ 35	22.1	24.5	$\chi^2 = 1.2$	0.74
Obese (30-34.9)	30.7	26.5		
Overweight (25-29.9)	36.7	36.2		
Normal (18-25)	10.6	12.8		
Mean BMI (kg/m²) ± SD				
Min – Max	31.5 ± 6.0	31.2 ± 6.4		
	22.2 – 57.7	20.1 – 64.6		
Hypertension				
Yes	62.8	28.6	$\chi^2 = 46.6$	0.00
No	37.2	71.4		
A1C (%)				
Mean ± SD	15.7 ± 8.3	9.2 ± 2.5	t = 10.5	0.00
Minimum - maximum	6.0 – 21.0	3.8 – 15.9		

Table 3 Visits to FHC, health education given and foot examination of diabetes patients with foot problems and controls.

Diabetes patients				
Instructions and foot examination	with foot problems N = 199%	without N = 196%	Significance Test	P value
Frequency of follow-up visits				
≥ once / month	15.0	48.0	$\chi^2 = 52.7$	0.00
Once / 2 months	41.0	20.0		
Once / 3 months	40.0	28.0		
less frequent	4.0	4.0		
Oral instructions given on general diabetes care				
No	38.2	25.5	$\chi^2 = 7.3$	0.01
Yes	61.8	74.5		
Oral instructions given for avoidance of foot problems				
No	22.1	13.3	$\chi^2 = 5.3$	0.02
Yes	77.9	86.7		
Oral instructions given on foot care				
No	70.9	43.4	$\chi^2 = 30.5$	0.00
Yes	29.1	56.6		
Printed material given on diabetes foot care				
No	70.9	43.4	$\chi^2 = 30.5$	0.00
Yes	29.1	56.6		
Health education meetings on diabetes and foot care				
No	81.9	57.7	$\chi^2 = 27.6$	0.00
Yes	18.1	42.3		
Did the physician look at your foot? Visual inspection of foot				
No	4.5	11.7	$\chi^2 = 75.4$	0.00
On complaining only	52.3	16.3		
Each year	26.1	61.7		
Each visit	17.1	10.2		
Palpation of pedal pulses				
No	14.6	14.3	$\chi^2 = 44.3$	0.00
On complaining only	44.7	19.9		
Each year	27.6	58.7		
Each visit	13.1	7.1		
Foot pin prick sensation				
No	50.3	33.7	$\chi^2 = 11.9$	0.00
Yes	49.7	66.3		
Vibration perception				
No	69.8	40.8	$\chi^2 = 3.7$	0.00
Yes	30.2	59.2		

Table 4a Some knowledge, attitude and practice items of diabetes patients with and without foot problems.

Some items of the knowledge, attitude and practice (KAP)*	Diabetes patients		P
	with foot problems N = 199 %	without N = 196 %	
Knowledge of patients on diabetes	wrong%	wrong%	
Normal range of fasting blood sugar	37.2	22.4	0.00
May cause cardiovascular disease	13.1	14.3	0.7
Causes of foot complications:-			
Peripheral neuritis	25.1	42.9	0.00
Peripheral circulatory insufficiency	20.6	35.2	0.00
Low level of immunity & recurrent infections	28.6	42.3	0.00
Risk factors of foot complications:-			
Elevated blood cholesterol	39.7	33.2	0.18
Hypertension and atherosclerosis	28.6	28.6	0.99
Smoking	36.2	32.1	0.4
Symptoms of periperal neuritis:-			
Burning sensation	12.1	18.4	0.08
Loss of pain sensation	11.1	34.2	0.00
Loss of heat and cold sensation	20.6	34.7	0.00
Attitude of patients towards			
Simple injury in the foot may end up to the amputation of fingers, foot or leg	44.8	47.4	0.1
Using insulin once requires its use for life	79.4	70.4	0.04
Practice of patients			
Do you dry the feet thoroughly after each wash?	26.6	17.3	0.03
Do you examine your feet on an ongoing basis?	53.3	31.6	0.00
Foot protection procedure			
Are you careful not to wear open shoes or slippers?	67.3	53.3	0.00
Did you test the temperature of warm water before you put your foot in it?	53.3	27.0	0.00

*Only some items of KAP were displayed in this table

Table 4b Mean score and quartiles of knowledge, attitude and practice in diabetes patients with and without foot problems.

Knowledge, attitude and practice scores	Diabetes patients		Significance Test	P Value
	with foot problems N = 199 %	without N = 196 %		
Knowledge quartile and mean score				
Low (< 25%)	0.0	2.0	$\chi^2 = 10.9$	0.00
Intermediate (25-75%)	28.1	39.8		
High (> 75%)	71.9	58.2		
Mean knowledge score \pm SD	71.9	58.2	t = 3.2	0.00
Attitude quartile and mean score				
Low (< 25%)	22.1	8.7	$\chi^2 = 14.5$	0.00
Intermediate (25-75%)	55.8	61.2		
High (> 75%)	22.1	30.1		
Mean attitude score \pm SD	4.5 \pm 2.8	5.3 \pm 2.1	t = 3.2	0.00
Practice quartile and mean score				
Low (< 25%)	22.1	2.6	$\chi^2 = 37.9$	0.00
Intermediate (25-75%)	48.2	51.0		
High (> 75%)	29.6	46.4		
Mean practice score \pm SD	7.8 \pm 4.8	10.4 \pm 4.3	t = 5.7	0.00

Table 5 Compliance and adherence of diabetes patients with and without foot problems.

Compliance / adherence	Diabetes patients		Significance Test	P Value
	with foot problems N = 199 %	without N = 196 %		
Adherence to treatment				
No	53.8	33.2	$\chi^2 = 17.1$	0.00
Yes	45.2	66.8		
Diet regimen				
No	74.4	43.4	$\chi^2 = 39.2$	0.00
Yes	25.6	56.6		
Cessation of smoking				
No	13.6	26.5	$\chi^2 = 10.4$	0.00
Yes	86.4	73.5		
Practicing of exercises				
No	57.8	57.7	$\chi^2 = 0.0$	0.9
Yes	42.2	42.3		
Foot care and cleaning				
No	14.1	13.3	$\chi^2 = 0.05$	0.8
Yes	85.9	86.7		

Table 6 Logistic regression of risk factors among diabetes cases and controls.

Factors	β	Wald	p	Odd ratio	95% CI for odds	
					Lower	Upper
Duration of diabetes	0.3	7.3	0.01	1.3	1.1	1.6
Insulin therapy	1.9	5.4	0.02	7.1	1.3	36.8
smoking	-0	4.5	0.03	0.8	0.7	0.9
Follow up visits	1.8	9.1	0.00	5.8	1.8	18.4
Forget to take medication	3.3	5.7	0.02	27.2	1.8	409.7
Practice score	-0	5.2	0.02	0.7	0.6	0.9
Attitude score	0.1	0.3	0.60	1.2	0.6	2
Knowledge score	0.4	7.6	0.01	1.5	1.1	2.1
A1C	0.2	4.5	0.02	1.2	1.0	1.5
Constant	-14	31.6	0.00	0.00		

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