Effect of Diabetes Education at Primary Health Care Level in Type 2 Diabetes Patients in Khartoum State

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Abstract Globally and day by day diabetes mellitus is growing and by 2035 diabetes patients will become 592 million according to international diabetes federation and 80% of them live in low and middle-income countries. In Sudan, the prevalence of diabetes is about 14.5% according to Sudan Household Survey report 2006, but diabetes in Sudan is associated with poor glycemic control and high prevalence of complication according to latest studies and this may be related to lack of knowledge and way of life. The study is done to show the effectiveness of diabetes education at primary health care level to produce changes in diabetes patients in their knowledge and lifestyle, which is very important for diabetes management. This study aimed to explore socio-demographic factors and disease factors of type 2 diabetes patients attending diabetes mini clinics at primary health care centers in Khartoum state-Sudan in 2015 and to determine the effect of diabetes education in knowledge and self-care practice of type 2 diabetes patients attending these facilities. The study was quasi-experimental study done at eleven diabetes mini clinics. Seventy eight of type 2 diabetes patients participated in this study, seventy of them continued till the end of the study with drop rate 10%, pre –post questionnaire was used, data were entered and analyzed by using Statistical Package for the Social Sciences for window version 20, percentage, mean and standard deviation and paired T. test were used to analyzed the data. The level of statistical significance was set at P. value < 0.05. Diabetes education had positive effect on Knowledge (P. value = .001), diet control and medication taking, P. value = .033 and .002 respectively. The study determined positive effect of diabetes education at primary health care centers on knowledge, self-care practice of diabetic patients. Moreover, the results of this study can be taken in account in policies making to improve the outcome in treating diabetes patients.

Keywords: *diabetes education, knowledge, self-care practice, Sudan*

1. Introduction

Diabetes mellitus mainly type 2 diabetes is growing epidemic. Globally the number of people with diabetes was 382 million in 2013 and this number is set to rise beyond 592 by 2035. The greatest number of people with diabetes is between 40 and 59 years of age and 80% of them live in low- and middle-income countries [1]. In 2010, an estimated 3.4 million people died from consequences of diabetes mellitus [2]. In Middle East; diabetes is common, it has a prevalence of 29% in United Arab Emirates and 23.7 in Saudi Arabia [3,4]. In Sudan, the prevalence of diabetes is about 14.50% [5]. According to WHO data published in April 2011, deaths due to diabetes mellitus in Sudan reached 2.17% of total deaths and age-adjusted death rate is 38.76 per 100.000 of population ranks Sudan 82 in the world [6].

Diabetes Mellitus in Sudan is associated with poor glycemic control, a high prevalence of complications, a low quality of life, and particularly with morbidity. Patients with a median duration of diabetes of 9 years showed a high prevalence of micro- and macro- vascular complications. Retinopathy was evident in approximately 43%, dipstick proteinuria in 22% and neuropathy in 37%. Cardiovascular disease was reported in 28%. Peripheral vascular disease was reported in 10% and cerebrovascular accidents in 5.5 % [7]. These may be due to lack of knowledge and way of life.

Since the 1930s diabetes education has been an essential component of diabetes management and is recognized as an integral part of chronic disease management. The objectives of educating people with type 2 diabetes are to optimize metabolic control; prevent acute and chronic complications; improve quality of life by influencing patient behavior and produce changes in knowledge, attitude and behavior necessary to maintain or improve health [8,9]. Effective diabetes education may produce changes in the knowledge of diabetes patients and understanding about their illness and management; it may even effect changes in lifestyle that is very important for diabetes management.

About change in knowledge a study showed statistically significant difference in average knowledge about nature, signs and symptoms of diabetes; normal range of blood glucose level; signs and symptoms of hypo- and hyperglycemia; before and after implementation of health education program among diabetic patients attending diabetic health centers in Sudan and also it found the deference in average patient's knowledge about: treatment of diabetes and foot problem was statistically significant, this findings agree with many studies like Abdo N and Mohamed M study which showed significant improvement in knowledge of the studied group towards all aspects of diabetes [10,11]. Another systematic review showed most studies measuring changes in diabetes knowledge demonstrate improvement with education, including those with follow-up of 6-12 months after the last intervention contact. Seven studies demonstrated improved knowledge for both the intervention and control groups, suggesting possible contamination due to the infeasibility of blinding participants [12].

Regarding Self-care practice, there were many studies assessed self-care practice after health education one of these studies showed highly significant increase in the percentages of positive attitude of diabetic patients regarding different aspects –diet, exercise and follow up-of diabetes after the application of the health education message [11]. Moreover, Norris S study showed most studies that examined dietary changes were positive for self-reported changes, including improvements in dietary carbohydrate or fat intake, a decrease in caloric intake, and an increase in consumption of lower glycemic-index foods. Hanefeld et al. demonstrated an increase in activity at 5 years with a didactic intervention. Five studies found no changes in physical activity compared with control groups. It is unclear what factors might account for success in some studies and not in others [12].

Studies show that those theory-based educational programs that apply cognitive frameworks can have a positive effect on the results. A few of these programs are currently part of the primary care, but they have not yet been specifically used to educate diabetic patients [13,14]. Despite it long clinical success this approach has only been applied in few centers and used by health care professionals. The role and impact of health education in diabetes is not having clarity, this could be probably because of not enough cost effective interventional studies with the use of health educators in diabetic care. Therefore, this study will determine the Effect of diabetes education for type 2 diabetes patients attending Diabetes Mini Clinics at Primary Health Care centers in Khartoum state by measuring Indicators of Knowledge and self-care practices. Moreover, the study will be one of the tools to evaluate diabetes education program at PHC level and its recommendations regarding health care improvement of diabetic patients can be taken in account in policies making.

2. Materials and Methods

2.1. Study Design

The study was quasi experimental study without control group

Intervention: The intervention was in form of attending DMC and receiving individual diabetes education and practical sessions to improve patient knowledge and self-care practice (foot care, diet, exercise and medication taking). The period of the study was 5 month during this period the patients were attending the diabetes mini clinics 4 times the first one for pre questionnaire and the comprehensive educational massages, the second one after one month from the first for the rest of educational massages, and psychological supportive massages and the third one after one month from the second for revision of previous educational massages beside new other psychological supportive massages and the fourth visit for follow up and post questionnaire and it was after three month from the third one. Knowledge and self-care practice of patients was assessed before and after intervention. This intervention was done by qualified educators who had received training in diabetes educational program guidelines by the researcher. **Guidelines for diabetes educational program** prepared by the researcher based on previous studies and advices of experts and approved by Non-Communicable Diseases Control Program Directorate, Ministry Of Health, Khartoum State

2.2. Study Setting

This study done at eleven Diabetes Mini Clinics at Primary Health Care centers in Khartoum state Sudan. Khartoum State consists of seven localities with a total area of 22,736 square kilometers. It is most populated state in Sudan, its population is about 5,414.618 and the growth rate is 2.66 [15]. The primary health care services are delivered mainly through the health centers which were designed based on the national standards of the building structures. The centers divided to governmental and nongovernmental. The governmental centers are 214 and According to 2013 classification by local health system, they were categorized in to reference family health centers, family health centers (10 packs) and specialized centers. Reference family health centers (the area of the study) are provide specialized services and receive cases transferred from the family health centers. It provides family doctor serves in the center region holding and for each (50-60 thousands) of the population and within 5 kilometer. This level of centers offer service packs consisting of (16- 38) service (basic and specialized services) [16], Diabetes Mini Clinics (DMC) are one of the specialized services. This service provide in eleven reference centers distributed in Khartoum State.

2.3. Study Population

In this study there were two study populations, reference family health centers which contain Diabetes Mini Clinics (DMC) and type 2 diabetes patients who newly attended Diabetes Mini Clinics (DMCs) at Primary Health Care centers, Khartoum State, Sudan.

2.4. Study Sampling

The sample size of the centers was total coverage, eleven reference family health centers which contain

Diabetes Mini Clinics (DMC). The sample size of the patients was calculated by the following formula:

$$m = \frac{\left[z_\alpha \sqrt{2p(1-p)} + z_\beta \sqrt{p_1(1-p_1) + p_2(1-p_2)} \right]}{(p_1 - p_2)^2} \quad (1)$$

Where

m = Sample size

P=Combined proportion $= \dfrac{(p_1 + p_2)}{2}$.

$p_1 - p_2$ = Difference of proportions of two groups (effect size)

z_α = Value of standard normal deviation of type 1 error (probability of study)

z_β = Value of standard normal deviation of type 11 error (power of study)

From review of literature, the sample size was computed by using proportions of controlled diabetic patient before intervention (p_1 = 14%) [17] and expected after intervention (p_2 =34%) with 20% expected improvement, this percentage used in other study done in Egypt [11], p =24%, z_α=1.96 and z_β =.84.

$$m = \frac{\left[1.96\sqrt{2 \times .24 \times .76} + .84\sqrt{.14 \times .86 + \;.34 \times .66} \right]}{(.14 - .34)^2}$$

m = 70 expected drop was 10% therefore sample size was 77 patients

Seventy seven patients were selected proportionally from 11 centers contain DMC based on the average number of diabetes patients attending health centers per month. Within the centers the samples were selected by systematic Random sampling.

2.5. Data Collection

Data collection was done with pre and post questionnaires which contain socio-demographic factors, disease factors, 20 items to assess Knowledge about diabetes (included definition, cause, risk factors, symptoms, signs, diagnosis, management and complications, these 20 items with three choices of answer: "Yes", "No" and "Don't know", these questions were constructed by the researcher based on national Guide for diabetes health educator [18]) and 9 questions to assess self-care practice during the last seven days. If the patient was sick during the past 7 days, he or she might think back to the last 7 days that he wasn't sick. The patient rated from 0 day to 7 days in each item according to their practice.

After approval from ethical review committee, data collection was done in December 2014 (pre questionnaire) and May 2015 (post questionnaire). Before data collection, permissions from Khartoum State Ministry of health and medical directors of each center were taken. Training of 11 diabetes educators on diabetes education program guidelines and data collection was done by the researcher. Data collection was carried out during work- time from 8 am to 2 pm on weekdays. The patients who met the inclusion criteria were selected. Before interview, the purpose, process, confidentiality and ethical issues and benefits of the study was explained. After getting the informed signed consents, the interviewers were interviewed using questionnaire. The whole process for interviewing took 30 minutes approximately for each patient

2.6. Data Analysis

Data analysis was done using collected data entered and analyzed by using Statistical Package for the Social Sciences (SPSS) for Windows version 20. Data was analyzed by both descriptive and inferential statistics. The level of statistical significance was set at $P < 0.05$. and data of this study was summarized as mean and standard deviation for the continuous variables and as frequency and Percentage for categorical variables. Paired t-test was used to compare between knowledge and self-care practice (Diet, exercise, medication taking and foot care) before and after diabetes education

3. Results

3.1. Socio-demographic Factors

Of the total 70 participants, mean age was 53.41 ± 9.849 years. Most of them were 40-49 years old (37.1%) and 50-59(37.1%), and just 1.4 % for 20-29 years old. About 72 .9% were female, 88.6 were married. About 37.1% were educated from secondary school and 28.6% were being university graduated. Among the participants 51.4 % were unemployed and half of them having family income less than 1000 SDG. About 82.9% from urban area.

3.2. Disease Factors

There were 74.3% of participants had family history of diabetes. Among them, 38.5%, 50%, 55.8%, 7.7% whose father, mother, siblings and offspring had diabetes, respectively. About 44.1% had diabetes for 1-4 years; the mean duration of diabetes was 7.64 ± 5.855. About 52.9% of the patients treated with one hypoglycemic drug and the rest were treated with two hypoglycemic drugs, combined therapy and insulin about 31.4%, 1.4% and 14.3% respectively. The patients with no complications were 52.9% while 47.1% had complication such as heart disease, eye disease, kidney disease, neuropathy, dental problem and amputation about 15.2%, 60.6%, 24.2%, 12.1%. 9.1% and 3.0% respectively.

3.3. Knowledge

Most of the participants answered correctly after the intervention and the percentage reach 100% in the item about Neuropathy and kidney problem as shown in Table 1.

About level of knowledge, 7.1% had high level of knowledge before the intervention and it reach 22.9% in post assessment. The average score of knowledge about diabetes was 54.9±14.41 before the intervention and 68.1±11.71 after. There was statistically significant difference in mean score of knowledge (P. value =.001) as shown in Table 2.

Table 1. Distribution of type 2 diabetes patients who have correct answer about diabetes knowledge in each item before and after the diabetes education in Khartoum State/ Sudan, 2015 (n =70)

Items	Before		After	
	Number	%	Number	%
Definition Diabetes is chronic increase in blood sugar due to decrease in insulin	51	72.9	68	97.1
Insulin is a hormone secreted by pancreas	51	72.9	65	92.9
Diabetes is more common above age of 40 years	27	38.6	12	17.1
Types Type 2 diabetes is the most common type of diabetes	35	50	61	87.1
Causes Genetic factor has no effect in occurrence of diabetes	32	45.7	46	65.7
Symptoms Urination and hunger are not symptoms of diabetes	43	61.4	50	71.4
Diagnosis Fasting blood sugar is important in diabetes diagnosis	62	88.6	68	97.1
Management Diet is important in management of diabetes	66	94.3	68	97.1
Exercise has important role in diabetes management	63	90	65	92.9
Walking is not important for diabetic patients	44	62.9	59	84.3
Stop smoking is important for diabetic patients	56	80	66	44.3
Treatment of diabetes by pills or insulin or both	33	47.1	57	81.4
Regular follow up is important for diabetic patients	69	98.6	68	97.1
Complication Hypoglycemia is not common in diabetic patients	31	44.3	39	55.7
High dose of treatment can cause hypoglycemia	40	57.1	55	78.6
Palpitation and sweating are symptom of hypoglycemia	57	81.4	67	95.7
Neuropathy and kidney problem are complication of diabetes	62	88.6	70	100
Diabetes has no effect in eyes	45	64.3	56	80
Teeth problem can be prevented by controlling blood sugar	59	84.3	68	97.1
Infection are not common in diabetic patients	45	64.3	54	77.1

Table 2. Level of Knowledge distribution of type 2 diabetes patients before and after the diabetes education in Khartoum State/ Sudan, 2015 (n =70)

Level of Knowledge	Before		After		Paired T test	P. value
	Number	%	Number	%		
High	5	7.1	16	22.9		
Low	65	92.9	54	77.1		
Mean ± SD	54.9±14.41		68.1±11.71		-5.558	.001

Table 3. Self-Care Practice by item in the last 7 days distribution of type 2 diabetes patients before and after the diabetes education in Khartoum State/ Sudan, 2015 (n =70)

Item	Before				After			
	Number of days (%)				Number of days (%)			
	0	1-2	3-6	7	0	1-2	3-6	7
Take vegetable or fruit	7.1	17.1	22.9	52.9	0	8.6	31.4	60
Take sweetened food*	21.4	37.1	31.4	10	30	47.1	20	2.9
Take diabetes sugar	67.1	10	4.3	18.6	58.6	8.6	12.9	20
Take oily food*	47.1	30	15.7	7.1	62.3	23.2	11.6	2.9
Exercise (30min)	45.7	15.7	18.6	20	18.6	18.6	35.7	27.1
Physical activity (30min)	74.3	7.1	14.3	4.3	55.7	15.7	12.9	15.7
Recommended drug	11.6	2.9	87	76.8	1.4	2.9	5.7	90
Correct dose and time	12.9	5.7	12.9	68.6	4.3	2.9	12.9	80
Check diabetes foot	24.3	10	12.9	52.9	2.9	5.9	16.2	75

Remark*: negative statement.

3.4. Self-Care Practice

The positive item show improvement in practice and it reach 90% in taking the recommended drugs daily but the change was limited in practice generally. About negative item, took sweetened food daily decrease from 10% before the intervention to 2.9% after and for took oily food daily decrease from 7.1% before to 2.9% after shown in Table 3.

Regarding self- care practice in the last 7 days, Table 4 revealed that limited increase in percentage of patients who had good diet control, Exercise, Medication taking and Foot care after health education.

The change in mean average of diet control and medication taking were statistically significant after the intervention P. value = .033 and .002 respectively. The change in mean average of exercise and foot care were not statistically significant after education P. value = .09 and .10 respectively shown in Table 4.

Table 4. Level of Self-Care Practice by component in the last 7 days distribution of type 2 diabetes patients before and after the diabetes education in Khartoum State/ Sudan, 2015 (n =70)

Component	Before %	After %	Paired T test	P. value
Diet control				
Good/high	2.9	7.1		
Need for improvement/low	97.1	92.9		
Mean ± SD	45.7±25.2	55.4±24.0	-2.170	.033
Exercise				
Good/high	7.1	11.4		
Need for improvement/low	92.9	88.6		
Mean ± SD	15±29.9	25±34.8	-1.721	.09
Medication				
Good/high	44.3	67.1		
Need for improvement/low	55.7	32.9		
Mean ± SD	70±33.6	85.7±23.1	-3.286	.002
Foot care				
Good/high	7.1	15.7		
Need for improvement/low	92.9	84.3		
Mean ± SD	7.1±25.9	15.7±36.7	-1.622	.109

4. Discussion

Diabetes mellitus is a disorder that needs a multidisciplinary approach for its management including education. The educational part of diabetes care has an important role in prevention and treatment of diabetes complications and disabilities. This study conducted to assess the effect of diabetes education on knowledge and self-care practice of type 2 diabetes patients attending DMCs at PHC centers, Khartoum State, Sudan.

The study results indicated a significant difference in mean score of knowledge of type 2 diabetes patients attending DMCs at PHC centers before and after diabetes educational program(P. value =.001). This finding supported by many studies, in Sudan quasi-experimental study showed deference in average knowledge was statistically significant before and after implementation of health education program among diabetic patients attending Diabetic Health Centers [10]. In Middle East area a study done in Egypt by Abdo N and Mohamed M which showed significant improvement in knowledge of the studied group towards all aspects of diabetes [11]. Moreover, the systematic review of Norris, showed most studies measuring changes in diabetes knowledge demonstrate improvement with education. A number of studies demonstrated that regular reinforcement or repetition of the intervention seemed to improve knowledge levels at variable lengths of follow-up: Bloomgarden et al. (nine visits in 18 months), Korhonen et al. (one visit every 3 months for 12 months), Campbell et al. (regular reinforcement with visits and telephone calls over 12 months), and Rettig et al. (12 visits in 12 months). Knowledge was measured using a variety of instruments, often specifically developed for the study [12].

Self- care practice in the last 7 days revealed that limited increase in percentage of patients who had good diet control, Exercise, Medication taking and Foot care after health education. The change in mean average of diet control and medication taking were statistically significant after the intervention P. value = .033 and .002 respectively. While the change in mean average of exercise and foot care were not statistically significant after education P. value = .09 and .10 respectively. This finding corresponded to studies assessed self-care practice after health education one of these studies showed highly significant increase in the percentages of positive attitude of diabetic patients regarding diet after the application of the health education message [11]. Another study found only walking regularly and trying to regulate blood glucose levels to prevent diabetic retinopathy, improved significantly [19]. Norris's study showed only two studies failed to show improvement in diet: one had an 18-month follow-up and an intervention delivered every 3 months, and the other noted improved dietary habits during the intervention but no significant difference at 6 months. Studies measuring physical activity outcomes had variable results. Among studies with shorter follow-up duration, Wood noted an increase in physical activity at 4 months, Glasgow et al. found an increase in the number of minutes of activity 3 months after an intensive intervention, and Wierenga found improved physical activity after five intervention sessions at 4 months [12].

5. Conclusions

The study concluded that diabetes education had positive effect on Knowledge (P. value =.001), diet control and medication taking P. value = .033 and .002 respectively, but no effect on exercise and foot care.

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Ethics Approval and Consent to Participate

The study was carried out after approval of research proposal by Sudan Medical Specialization Board (SMSB) and Khartoum State Ministry of Health research ethical committee. Witten permission from Khartoum State Ministry of Health and medical directors of centers was taken. Interviewees were received full explanations about the study including the purpose, process and benefit of the study. Informed signed consent was taken from interviewees.

Competing Interests

Authors had declared no competing interests

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Authors' Contributions

NA and HS performed the study and provided leadership. NA coordinated the data collection and analysis under supervision of HS. NA wrote the manuscript and it reviewed by HS.

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