

# Impact of Diabetes Education on Health Status of Diabetes Patients in Khartoum State

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## Abstract

Diabetes education, with its role in improvement in knowledge, attitude and practice, lead to better control of the disease, and is accepted to be an important part of diabetes management. The Study aimed to determine the effect of diabetes education on health status of type 2 diabetes patients attending Diabetes Mini Clinics at Primary Health Care centers in Khartoum state, Sudan. The study design was quasi-experimental. Sample of seventy-eight type 2 diabetes patients was selected from eleven reverence family health centers, which contain diabetes mini clinic. Seventy of participants continued until the end of the study. A pre –post questionnaire was used to collect the data, which entered and analyzed by using Statistical Package for the Social Sciences, percentage, mean and standard deviation and paired T. test were used to analyze the data. The level of statistical significance was set at *P*. value < 0.05. The results showed Diabetes education had positive effect on glycemic control (*P*. value =.001), diastolic blood pressure (*P*. value =.017), and quality of life (*P*. value =.001). The study recommended that coverage of primary health care centers with diabetes education service is very important and other studies is needed for more evaluation.

**Keywords:** Diabetes education, glycemic control, quality of life

## 1. Introduction and Background

Today the world is threatened by growing epidemic of type 2 diabetes mellitus in all ages. In Sudan and according to Sudan household survey report 2006, the prevalence of diabetes is about 14.50%. The deaths due to diabetes mellitus in Sudan reached 2.17% of all deaths, The age adjusted death rate is 38.76 per 100.000 of population according to WHO data published in 2011 (World life expectancy, 2013). Moreover, diabetes mellitus in Sudan is associated with a low quality of life, a high HbA1c and a high prevalence of micro and macro vascular complications. Patients with diabetes for 9 years showed a high prevalence complications, retinopathy in 43%, proteinuria in 22%, neuropathy in 37%, cardiovascular disease in 28%, peripheral vascular disease in 10% and cerebrovascular accidents in 5.5 % (Abdelgadir, 2006).

In Khartoum state, the prevalence of diabetes among adult is 19.20 %, (Khartoum State Household Survey repot, 2005). According to Khartoum State Statistical reports 2008 -2012 the number of diabetes mellitus patients attending primary health centers is growing in uprising trend from 4823 patients in 2008 to be 10379 patients in 2012 and Similar trend also reported in secondary and tertiary level of care due to diabetes and its complication (Ministry of health Khartoum State reports, 2008-2012). Among the diabetes type 2 diabetes is the commonest and it comprises to over 90% of all kinds of diabetes due to increasing obesity population and reduced physical activity. Type 2 diabetes can cause acute and chronic complications, which might affect the wellbeing status of the patients in their physical, mental, and social lives (Htet, 2009).

Diabetes education has been important part in diabetes management mainly type 2 diabetes. The aims of educating type 2 diabetes patients to optimize metabolic control; prevent acute and chronic complications; improve quality of life by influencing patient behavior and produce changes in knowledge, attitude and practice necessary to maintain or improve health (Snoek, 2003). Meta-analyses of Randomized clinical trials have shown that lifestyle interventions reduced progression from impaired glucose tolerance to type 2 diabetes and that glycemic control improved postprandial plasma glucose levels after meals (Hiss, Armbruster, Gillard, & McClure, 2007; Watanabe,

Okayama, Shimamoto and Ueshima, 2007; Sun et al., 2008). Moreover, in recent years, results of several studies suggest that continuous interventions (combined diet and exercise) can improve the plasma glucose level (Kim et al., 2009; Vadstrup, Frolich, Perrild, Borg & Roder, 2009; Eakin et al., 2010; Roek, Welschen, Kostense, Dekker, Snoek, & Nijpels, 2009). A few of these programs are currently part of the primary care, but they have not yet been specifically used to educate diabetic patients (Davies et al., 2007; Ellis, Speroff, Dittus, Brown, Pichert, & Elasy, 2005). Therefore the study determined the impact of diabetes education on health status of type 2 diabetes patients attending Diabetes Mini Clinics at Primary Health Care centers in Khartoum state by measures of health status (blood pressure, body mass index (BMI), glycemic control HbA1c and diabetes specific quality of life). Diabetes Mini Clinics (DMCs) are units were established in 2014 in the PHC centers in Sudan. These units provide continuous diabetes education by qualified health educators, screening and primary prevention programs. The continuous diabetes education by qualified diabetes educators is one of the intervention recommended by World Health Organization to control non communicable diseases (WHO PEN interventions, 2010). DMCs were established in 11 reference centers at time of study and will increase to cover 35 centers in Khartoum state in next coming years. The working hours in these clinics are 8 hours daily for 5 days a week. The results of this study can be used as a tool to evaluate diabetes education program at PHC level and its recommendations regarding diabetes education service can be taken in account in decision-making.

### 1.1 Study Objective

The objective of the Study was to determine the effect of diabetes education on health status (blood pressure, body mass index (BMI), glycemic control and diabetes specific quality of life) of type 2 diabetes patients attending Diabetes Mini Clinics at Primary Health Care centers in Khartoum state, Sudan.

## 2. Methods

### 2.1 Study Design and Setting

The study was quasi-experimental study done at eleven Diabetes Mini Clinics at Primary Health Care centers in Khartoum state Sudan.

The intervention was attending DMC and receiving individual diabetes education and practical sessions to improve patient knowledge and practice beside psychological supportive messages. The period of the study was 5 month during this period the patients were attending the DMC 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. Health status (blood pressure, body mass index (BMI), glycemic control Hb A1c and diabetes specific quality of life) 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 Population

Type 2 diabetes patients who newly attended Diabetes Mini Clinics (DMCs) at Primary Health Care centers, Khartoum State, Sudan.

### 2.3 Inclusion and Exclusion Criteria

All Patients 18 years old and above, who were diagnosed clinically as type 2 diabetes and newly attending DMCs, on oral hypoglycemic drugs or insulin or both and who were willing to participate were included in the study. The study excluded patients, with severe diseases or complications such as diabetic ketoacidosis and diabetic septic foot, pregnant, had mental disorders because they could not get information, who could not verbally communicate with the interviewer due to the problem of hearing loss and who refused to participate in the study.

### 2.4 Sample Size and Sample Selection

The sample size of the patients was calculated by the formula (1)

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

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

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 Tool

The tools of data collection were pre and post questionnaires **which contain**; socio-demographic factors, disease factors, Blood pressure, Body Mass Index (BMI), glycemic control HbA1c and Including 17 questions of DDS-17, which contain 17 potential problem areas that a diabetes patients may experience. It used a 6 Likert-type scale rated on “not a problem”, “a slight problem”, “a moderate problem”, “somewhat serious problem”, “a serious problem”, and “a very serious problem” according to the patient perception. **Investigations:** A sample of 2.5 ml venous blood was withdrawn from antecubital vein using 5cc syringe and stored in tube containing Ethylene Diamine Tetra Acetic acid (EDTA) for measuring HbA1c. HbA1c was measured by boronate binding assay using Nycocard kit and reader 11. 5 ml of EDTA anticoagulated blood was added to reagent 1 (Buffer containing dye bound boronic acid and detergent), mixed well, and incubated for 3 minutes. Then 25 $\mu$ l of the mixture was added to the test device and allowed to soak completely in to the membrane (about 10 second). After that 25 $\mu$ l of the washing solution was applied to the test device, allowed to soak completely in to the membrane (about 10 second) and the result read within 5 minutes by Nycocard reader 11.

### 2.6 Validity and Reliability

For content validity, the questionnaire was done by reviewing previous literature and studies, and by consulting with thesis advisor. The questionnaire was in Arabic language then was translated to English. Pretest for questionnaire was done by pilot study with 10 patients with similar characteristics of target population, after analysis content reliability, Cronbach's alpha coefficients were taken for DSQOL ( $\alpha = .89$ ).

### 2.7 Data Collection

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. 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. By the end of the interview the measurements of blood pressure, height and weight were taken and the patients were sent to the lab for blood samples collection for HbA1c.

### 2.8 Data analysis

After data collection was completed, data were checked for completion, accuracy and consistency. Then collected data were entered and analyzed by using Statistical Package for the Social Sciences (SPSS) for Windows version 20. Scoring; Diabetes-specific quality of life was measure by Diabetes Distress Scale (DDS-17) scale with the dimensions of overall diabetes distress, emotional distress, physician related distress, regimen-related distress and interpersonal distress. To score, the researcher considered item score of 3 or higher as the level at which patient's diabetes quality of life was low or needed for improvement. Data were analyzed by both descriptive and inferential statistics. The level of statistical significance was set at  $P < 0.05$ . All the data of this study were 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 Health status (Blood pressure, Body Mass Index (BMI), HbA1c and Diabetes -specific quality of life (DSQOL)) before and after diabetes education

### 2.9 Ethical Consideration

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.

## 3. Results

Data were collected from 78 diabetes patients from 11 diabetes mini clinics before the health education. Three months after the intervention data were collected from 70 patients who complete there sessions with drop of 8 patients.

### 3.1 Socio-Demographic Factors ( $n = 70$ )

Most of the participants age between 40 and 59 years, 72.9% were female and majority of them were married. About education attainment, most of them were educated. Among the participants 50% were unemployed, 50% having family income less than 1000 SDG and 82.9% from urban area (Table 1).

Table 1. Socio-demographic factors of 70 participants of type 2 diabetes patients attending Diabetes Mini-Clinics at Primary Health Care centers Khartoum State, Sudan 2014-2015 ( $n = 70$ )

Socio-demographic factor		Number	%
Age(years)	20-29	1	1.4
	30-39	3	4.3
	40-49	26	37.1
	50-59	26	37.1
	$\geq 60$	14	20
<b>Mean <math>\pm</math> SD = 53.41 <math>\pm</math> 9.849</b>			
Sex	Male	19	27.1
	Female	51	72.9
Marital status	Single	3	4.3
	Married	62	88.6
	Divorced/Separated	2	2.9
	Widow	3	4.3
Education attainment	Illiterate	11	15.7
	Primary school	12	17.1
	Secondary school	26	37.1
	University graduate	20	28.6
	Khalwa	1	1.4
Occupation	Dependent/unemployed	36	51.4
	Free work	7	10
	Employee	24	34.3
	Farmer	1	1.4
	Laborer	2	2.9
Average family income/month(SDG)	<1000	35	50.7
	1000-2000	20	29
	>2000	14	20.3
Geographical origin of subject	Rural	12	17.1
	Urban	58	82.9

### 3.2 Disease Factors ( $n = 70$ )

Around 75% of patients had family history of diabetes mellitus. 44.1% of patients had diabetes for 1-4 years and 37% had it for more than 9 years. About 50% of the patients treated with one hypoglycemic drug and around 50% of them had no complication while the rest had complication such as heart disease, eye disease, kidney disease, neuropathy, dental problem and amputation. (Table 2)

Table 2. Disease factors of 70 participants of type 2 diabetes patients attending Diabetes Mini-Clinics at Primary Health Care centers Khartoum State, Sudan 2014-2015 (n =70)

Disease factors	Number	%
<b>family history of diabetes</b>		
No	18	25.7
Yes	52	74.3
Father	20	38.5
Mother	26	50
Siblings	29	55.8
Offspring	4	7.7
<b>Duration of diabetes (years)</b>		
1-4	30	44.1
5-9	13	19.1
≥10	25	36.8
<b>Mean ± SD = 7.64 ± 5.855</b>		
<b>Medication</b>		
1 OHA	37	52.9
2 OHA	22	31.4
OHA+ Insulin	1	1.4
Insulin	10	14.3
<b>Complication(multiple response )</b>		
No complication	37	52.9
Heart disease	5	15.2
Eye disease	20	60.6
Kidney disease	8	24.2
Neuropathy	4	12.1
Dental problem	3	9.1
Amputation	1	3.0

### 3.3 Health Status (n = 70)

Includes Blood pressure, Body Mass Index (BMI), HbA1c and Diabetes –specific quality of life. For BMI, 45.7% was obese before and after education. There was no statistically significant change in mean BMI before and after ( $P$ . value =.861). For blood pressure, the mean of average was measured for Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP). The mean of average SBP was  $127.57 \pm 20.0$  mmHg before the health education  $124.79 \pm 16.99$  mmHg after health education. There was no significant change in average SBP after the intervention ( $P$ . value =.377), but the mean of average DBP was  $81.86 \pm 7.62$  mmHg before the health education and  $78.64 \pm 7.51$  mmHg after health education with significant change ( $P$ . value =.017). About HbA1c level, the controlled was 7.1% before health education and 24.4% after. The mean level of HbA1c was  $8.97 \pm 1.98$  before and  $7.9 \pm 1.75$  after the intervention, this change was statistically significant ( $P$ . value =.001) (Table 3)

Table 3. Health status distribution of type 2 diabetes patients attending Diabetes Mini-Clinics at Primary Health Care centers Khartoum State, Sudan 2014-2015 before and after the diabetes education (n=70)

Health status	Before		After		Paired T test	P. value
	Number	%	Number	%		
BMI (kg/m2)						
<18.5 (Underweight)	1	1.4	0	0		
18.5-24.99(Normal range)	16	22.9	17	24.3		
25.0-29.99(Overweight)	21	30	21	30		
≥ 30 (Obese)	32	45.7	32	45.7		
Mean ± SD =	29.17±5.32		29.35±7.07		-.176	.861
Blood Pressure (mmHg)						
SBP Mean ± SD	127.57±20.0		124.79±16.99		.889	.377
DBP Mean ± SD	81.86±7.62		78.64±7.51		2.444	.017
HbA1c level (%)						
< 6.5 (glycemic controlled)	5	7.1	17	24.3		
≥ 6.5 (glycemic uncontrolled)	65	92.9	53	75.7		
Mean ± SD	8.97±1.98		7.9±1.75		3.312	.001

### 3.4 Diabetes –Specific Quality of Life (DSQOL) (n = 70)

Diabetes- specific quality of life (DSQOL) was measured by Diabetes Distress Scale (DDS-17) which included emotional burden, physician related distress, Regimen-related distress and Interpersonal distress. Regarding emotional burden, 35.7% of participants had high level before education and the percentage increase to be 54.3% after intervention. In Physician-related distress the percentage of high level increase from 47.1% to 70% after education. Dealing with Regimen-related distress and Interpersonal distress the percentage of high level increase from 34.3 % to 54.3% and 57.1% to 74.3% respectively. (Table 4) About the change in Level of Diabetes –specific quality of life (DSQOL) by dimension before and after health education table 4.6 showed statistically significant difference in all dimensions, emotional burden, physician related distress, Regimen-related distress and Interpersonal distress, P. value=.005,.029,.001 and.010 respectively. (Table 4)

Table 4. Level of Diabetes –specific quality of life by dimension distribution of type 2 diabetes patients attending Diabetes Mini-Clinics at Primary Health Care centers Khartoum State, Sudan 2014-2015 before and after the diabetes education (n =70)

Dimension	Before %	After %	Paired T test	P. value
<b>Emotional burden</b>				
Good/high	35.7	54.3		
Need for improvement/low	64.3	45.7		
<b>Mean ± SD</b>	64.3±37.1	80.6±27.7	-2.916	.005
<b>Physician-related distress</b>				
Good/high	47.1	70.0		
Need for improvement/low	52.9	30.0		
<b>Mean ± SD</b>	65.4±39.8	79.6±35.4	-2.237	.029
<b>Regimen-related distress</b>				
Good/high	34.3	54.3		
Need for improvement/low	65.7	45.7		

<b>Mean ± SD</b>	59.7±38.1	80.9±26.9	-3.852	.001
<b>Interpersonal distress</b>				
Good/high	57.1	74.3		
Need for improvement/low	42.9	25.7		
<b>Mean ± SD</b>	68.6±41.3	84.8±29.3	-2.640	.010

Regarding level of overall Diabetes –specific quality of life (DSQOL) of participants before and after the health education 28.6% of high level increased to be 52.9%. The change in mean level of overall (DSQOL) was statistically significant difference  $P$ . value=.001. (Table 5)

Table 5. Diabetes –specific quality of life distribution of type 2 diabetes patients attending Diabetes Mini-Clinics at Primary Health Care centers Khartoum State, Sudan 2014-2015 before and after the diabetes education (n =70)

<b>Level of overall (DSQOL)</b>	<b>Before %</b>	<b>After %</b>	<b>Paired T test</b>	<b>P. value</b>
Good/high	28.6	52.9		
Need for improvement/low	71.4	47.1		
<b>Mean ± SD</b>	64.1±29.96	81.3±19.84	-3.887	.001

#### 4. Discussion

Health education is one of the treatment tools that has great effect on diabetic patients through improve their Knowledge and changing their attitude and practice. This study conducted to assess the effect of diabetes education on health status of type 2 diabetes patients attending DMCs at PHC centers, Khartoum State, Sudan. Regarding BMI, about 45.7% of the diabetic patients was obese before and after education. There was no statistically significant change in mean BMI before and after ( $P$ . value =.861). This supported by many studies that showed shorter follow-up period had negative results regarding BMI (Norris, Engelgau, & Narayan, 2001; al-Shahrani, Hassan, Al-Rubeaan, Al-Shargawi, & Ahmed, 2012; Sachmechi, Wang, Kim, Reich, Payne, & Salvador, 2013). But another study of a cluster randomized controlled trial with two intervention arms demonstrated differences from baseline for body mass index (BMI) (Adachi et al., 2010), the same result supported by two other studies which showed significant change in mean BMI after three month from diabetes education (Rashed, 2012; Yuan, Lai, Chan, Chow, Law, & Ying, 2014).

For blood pressure, there was no significant change in mean SBP after the intervention ( $P$ . value =.377), but the mean DBP showed statistically significant change ( $P$ . value =.017). This supported by the study that done in Saudi Arabia which showed change in blood pressure was statistically significant after diabetes education (al-Shahrani, Hassan, Al-Rubeaan, Al-Shargawi, & Ahmed, 2012). While another study done in Jamaica demonstrated the opposite finding (Sachmechi, Wang, Kim, Reich, Payne, & Salvador, 2013). This corresponded to studies examining blood pressure control revealed mixed results. Some studies demonstrated a decrease in systolic blood pressure (–4 mmHg) and diastolic blood pressure (–3 to –8 mmHg), whereas others showed no significant change (Norris, Engelgau, & Narayan, 2001).

About the level of HbA1c, the change in mean HbA1c level of type 2 diabetes patient was statistically significant ( $P$ . value =.001) after the educational diabetes program. This was supported by studies which found that a decrease from the baseline HbA1c after diabetes education was statistically significant (al-Shahrani, Hassan, Al-Rubeaan, Al-Shargawi, & Ahmed, 2012; Sachmechi, Wang, Kim, Reich, Payne, & Salvador, 2013; Adachi et al., 2010; Rashed, 2012; Yuan, Lai, Chan, Chow, Law, & Ying, 2014; Zibaenezhad et al., 2015). Moreover, a study was done at Zagazig University Diabetes Clinic; Egypt showed glycosylated hemoglobin level significantly declined reflecting the effectiveness of the health education message in changing the studied patient's behaviors (Abdo & Mohamed, 2010). But systematic review showed most studies focusing on changes in lifestyle generally failed to show improvements in glycemic control compared with control groups (Norris, Engelgau, & Narayan, 2001).

Regarding quality of life of participants before and after the diabetes education, the change in mean level of overall (DSQOL) was statistically significant difference ( $P$ . value=.001). This result supported by Hossien's study which

concluded Intervention caused an increase in scores of the six dimensions and Quality of life QOL of case group after intervention (Hossien & Mohammad, 2008). Other systematic review explored a variety of interventions can improve HRQL among adults with diabetes, but the magnitude of effects varied with the interventions (Zhang, Norris, Chowdhury, Gregg, & Zhang, 2007). Moreover, Kaplan et al. noted an increase in quality of life at 18 months for an intervention subgroup that received intensive counseling on both diet and physical activity. But another Two studies of brief interventions failed to demonstrate improved quality of life (Norris, Engelgau, & Narayan, 2001).

#### 4.1 Study Limitations

The study was quasi-experimental study without control group and the duration of the study is just 5 months, more time is needed to assess the effect of health education

### 5. Conclusion and Recommendations

This study concluded that there was no statistically significant change in mean BMI before and after diabetes education. For blood pressure, there was no significant change in average SBP after the intervention, but the mean of average DBP was statistically significant changed. About HbA1c level, the change in the mean was statistically significant after diabetes education. Regarding level of overall Diabetes –specific quality of life, the change in mean level of overall, (DSQOL) was statistically significant difference after the intervention.

Based on the findings, the study recommended that expansion in health education services improve diabetes patient's life and may decrease the complications may they face. Further studies to evaluate the effect of continuous diabetes education for diabetic patients for long time and to evaluate the effect on complication of diabetes is needed

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#### Competing Interests Statement

The authors reported no conflict of interest.

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