

## **Diabetes Education Program Increases Knowledge, Reduces Obesity and better Glycemic Control in Central Hospital Nampula**

Article by Madhumati Varma  
MMSC-Diabetology, Texila American University  
Email: madhumativarma@gmail.com

### **Abstract**

*Background: The patient of diabetes in Central hospital Nampula has the prevalence of obesity, poor knowledge regarding diabetes, completely depends on the diabetic pharmacological treatment and lack of awareness of complication of diabetes. There is a need of lifestyle modification, increase knowledge of diabetes to improve obesity, glycaemic control, reduce its complication.*

*Methods: This is clinical intervention study, 648 of the participants of diabetes mellitus taken for study in out-patient diabetic clinic in hospital central Nampula, according to inclusion and exclusion criteria, participated in the pre-test at baseline and post-test after the second follow up session of education, during each session of education body mass index and fasting blood sugar were recorded. Education commenced with instruction in groups of each session followed by individual advice sessions for each patient with different specialists.*

*Results: The present study found that educational intervention of diabetes was highly effective to increase knowledge of diabetes with compare of pre-test and Post-test score ( $P < .001$ ), fasting blood sugar and body mass index significantly decreased from baseline in the second follow up ( $P < .001$ ). Age was significantly correlated with body mass index and fasting blood sugar ( $P < .001$ ), Posttest with body mass index and fasting blood sugar were significantly correlated ( $P < .01$ ). A post hoc Turkey test on body mass index when compared with fasting blood sugar found significantly ( $P = .05$ ) at baseline, at first follow up ( $P = .005$ ) and at second follow up ( $P = .005$ ).*

*Conclusion: The present study found that educational intervention was highly effective in controlling body mass index, fasting blood sugar and improves knowledge of diabetes among participants of diabetes mellitus.*

**Keywords:** Diabetes Mellitus, blood sugar, body mass index, effect education, control, participants

## **Introduction**

### **Background**

#### **World wide**

The Global report from the World Health Organization (WHO), published in 2016, estimated that 422 million of the adult population lives with diabetes the number of diabetic patients has dramatically increased 4 times over in the adult population, compared to 108 million in 1980. Diabetes Mellitus is a chronic metabolic disorder, which is caused by partial deficiency or total deficiency of insulin. Diabetic mellitus type-1 has complete deficiency of insulin and diabetes type-2 has partial deficiency of insulin with receptor of insulin not functioning properly to facilitate enter glucose into cells for utilization and formation of units of energy. WHO has estimated that the number of diabetic patients will double by 2030. Diabetes is increasing more rapidly in low and medium income groups than higher income groups as well as in developing countries compared to Europeanian countries, has less prevalence of diabetes. The top five countries with the highest prevalence of diabetes. Include the following: India, China, USA, UK, Brazil and Indonesia. Diabetes Type 1 most common in Scandinavian populations, Sardines, and Kuwait, and less common in Asia, Latin and European population.

## **Mozambique**

Mozambique is located on the East coast of Africa (Wikipedia 2016). There are 274,700 diabetic patients and 9716 deaths due to diabetes, according to a report of 2015 (IDF 2015). This country is the setting for this study. There is the prevalence of obesity, poor knowledge regarding diabetes and lack of awareness of complication of diabetes. Most of the population uses traditional healers for treatment of diabetes. There are unhealthy dietary habits, sedentary lifestyle in urban population and increased economic growth amongst professions related to office work, which is one of the risk factors that causes diabetes and its complications. Among the group of patients that seek care in public hospitals, many are poor and cannot afford the cost of medication or healthy foods. There is an 80 dollar expenditure allotted to each patient of diabetes from the country's Ministry of Health. Additionally, the ministry of health provides free medication for all chronic diseases, including diabetes and hypertension. Currently, there is no study that has been done on the effects of education in various modalities of diabetes in clinical practice. Accordingly, there is an extreme need to educate patients of diabetes to improve diabetic control and reduce its complication.

## **Objective and hypothesis, problem, purpose, question statement**

### **Problem**

The population of this study are diabetic patients in the Central Hospital Nampula in Mozambique, who are from low and medium income groups. This group of patients has limited sources of incomes and, completely depends on the diabetic pharmacological treatment of the government hospital pharmacy, which gives medication free of cost. In the country of Africa, there is a generally poor health education regarding the facility of diabetes. There are no professional diabetic health educators and patients receive advice from doctors and dieticians regarding their diets and directions on how to take their medicine to continue treatment at home. Due to the large size of patient loads in outpatient consultations with diabetes, it is not possible to sit with each patient and provide specific health education about diabetes. Also, these groups of patients do not access of the internet to improve their own self-education from different sources. It is clear that when diabetic patients only utilize pharmacological treatments that it is not sufficient to control diabetes and complication (Association, 2002).

### **Objective**

1. There is a need for lifestyle modification, increase knowledge of diabetes and its complication, to improve ability to patient detects small complication and present physician, adherence of treatment.

2. There are different categories of patients, and levels of controlled diabetic patients, there for the different types diabetes requires different types of education, which can be depending on associated complications and diseases.

There following are the clinical categories patients:

1. Good controlled over blood sugar and without complication.
2. Fair/not controlled blood sugar with or without complication.
3. Good control of blood sugar and without complication, but other disease example HIV treatment, CVA etc.

### **Question statement**

To conduct the study, used dependent variable fasting blood sugar and independent age, body mass index, pre-test and post-test scores.

**Positive hypothesis**, the positive correlation between controls of fasting blood sugars change of lifestyle modification includes diet and exercise. The positive correlation between controls of fasting

blood sugars to improve body mass index. The knowledge of diabetes could help in controlling diabetes and blood sugar in case implemented knowledge of diabetes in life style.

**Null hypothesis,** The various reasons which can responsible for uncontrolled fasting blood sugar, negatively correlated to nonadherence of treatment, economic crisis to buy medicine, laboratory unable to provide results of fasting blood sugar, traditional healer involved in treating diabetes as a choice of patients.

## Method

This study was conducted on regular patients of the diabetic of outpatient department the Central Hospital of Nampula. The study investigated the effects of three sessions of the diabetes education program (baseline, first follow-up and second follow-up) on each patient at one-month intervals. The inclusion and exclusion criteria for participation in the education program are listed below.

### Inclusion and exclusion criteria for the study

**Table 1.** Inclusion and exclusion criteria for the study

Inclusion criteria	Exclusion criteria
Diabetic patients of consultations of Central hospital Nampula	Participates completed 3 sessions
Mozambican citizen	Not willing to participate
Any age	Usability of participants to attend session each month

### Conceptual framework

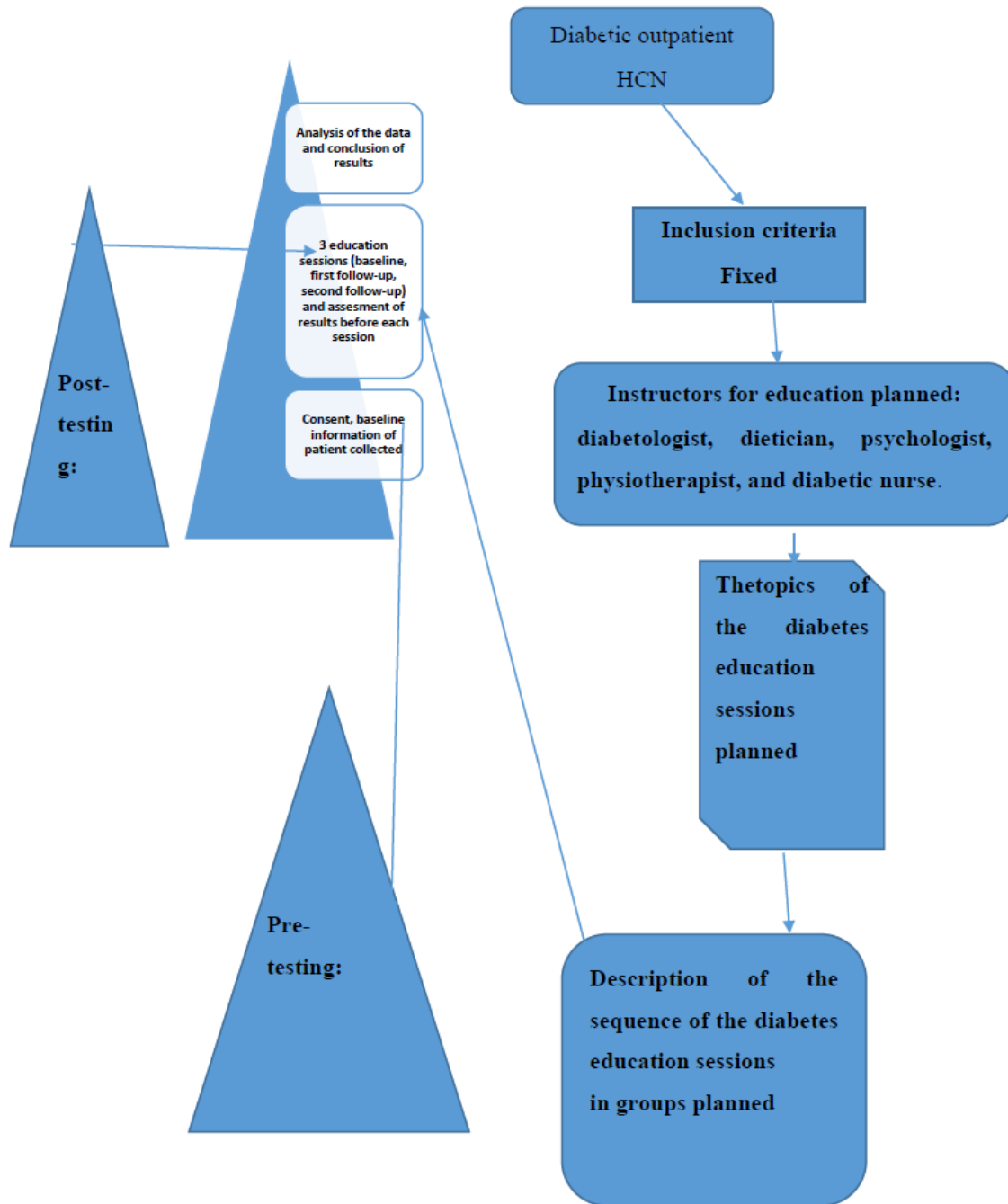


Figure 1. Conceptual framework

### Sample number and characteristics

A sample of 648 participants was taken for this study. The inclusion criteria for participating in the diabetes education program dictated that patients should be of the OPD of diabetes, willing to participate in the education sessions and willing to give consent to be included in the study.

Participants were excluded if they had already completed three sessions of education or if they lived in a district that made it impossible for them to return to one month for the next education session.

### **Organization of education sessions**

**Instructors:** Amongst the group instructors were a **diabetologist, dietician, psychologist, physiotherapist, and diabetic nurse.**

### **Tasks had to be performed before each of the sessions**

#### **The baseline session**

The diabetic nurse took consent and accessed the patient's clinical history before conducting a physical examination that included checking vital signs and body mass index. The physical examination was to be done by a physician. They also noted the results of a blood analysis that tested for sugar, which had been conducted 2-3 days prior to the education session. The participants answered questions based on knowledge of diabetes in pre-test questioner before start of baseline session of education of diabetes to see how much knowledge they have of diabetes.

#### **First follow up**

At the beginning of the session, the diabetic nurse measured the body mass index and noted the results of the blood analysis that tested for sugar, which had been conducted 2-3 days prior to the education session.

#### **Second follow up**

At the beginning of the session, the diabetic nurse measured the body mass index and noted the results of the blood analysis that tested for sugar, which had been conducted 2-3 days prior to the education session. The participants answered same questions based on knowledge of diabetes in post-test questioner after complete second follow up session of education of diabetes to see how much knowledge they increased after completion of diabetes education.

### **Methodology of education**

The education sessions were in the form of a conference on all specialties leading a class of various forms verbal, demonstrating real situations, operating the apparatus and discussing difficulties, if any at the end of the session.

#### **Pre- and post-testing**

There was a pre-test questionnaire that aimed to assess the existing knowledge of diabetes before starting the baseline education session. The same questions were asked after the completion of the second follow-up education session.

**The format of the pre- and post-tests given before and after the education sessions:**

**Name of patient-----**

**Answer the questions on**

Questions	Answer before education session	Answer after education session
1 Diabetes mellitus is characterized by hyperglycemia/increased sugar levels, recurrent or persistent in blood.	<b>Yes / No</b>	<b>Yes / No</b>
2. Type 1 Diabetes is more frequent at 5 to 15 years of age.	<b>Yes / No</b>	<b>Yes / No</b>
3. Symptoms of diabetes include the frequent urge to urination, hunger, thirst, weight loss, and weakness.	<b>Yes / No</b>	<b>Yes / No</b>
4. Glibenclamida is an oral antidiabetic medication side effects feeling hungry.	<b>Yes / No</b>	<b>Yes / No</b>
5. A healthy diet of diabetics is poor in greens vegetables, but is rich in sugar and fried foods. It is also healthy to eat food once a day.	<b>Yes / No</b>	<b>Yes / No</b>
6. The benefits of exercise are a decrease in body weight and the use of sugar in cells without insulin.	<b>Yes / No</b>	<b>Yes / No</b>
7. Anxiety and depression increase blood sugar level/uncontrolled diabetes.	<b>Yes / No</b>	<b>Yes / No</b>
9. Insulin should not be frozen.	<b>Yes / No</b>	<b>Yes / No</b>
10. Symptoms of hypoglycaemia/decreased blood sugar are -tremors, palpitations, hungry, and sweating.	<b>Yes / No</b>	<b>Yes / No</b>

**Pre-test mark ----- Post-test mark-----**

**Figure no 2: The format of the pre- and post-tests**

**Description of intervention in health education**

**Description of the specialists that participated in giving the education sessions**

The different types of specialists involved in the health education intervention were:

1. **The psychologist** oriented the patients with basic aspects of psychology to help them live with diabetes.
2. **The diabetologist** provided knowledge about the general concepts of diabetes.
3. **The dietician** provided information about the specific diet needed for diabetic patients.
4. **The physiotherapist** demonstrated important exercises that were specifically for sufferers of diabetes and were applicable to all individuals.

**Group and individual education sessions**

After a three-hour group education session, individual outpatient consultations were conducted in different rooms with different specialists. These patients could consult a diabetologist, dietician, physiotherapist, or psychologist individually according to the specific needs of each patient.

**Organization of health education sessions**

Due to the shortage of separate spaces large enough to accommodate the number of participants in the baseline, first follow-up and second follow-up, sessions were limited to approximately 40-50 participants. To make education sessions more interesting and effective the beginning of each session was realized with baseline participants followed by first follow-up participants, and then second follow-up participants were taken for education of diabetes. There was no restriction on participants if they wanted to attend the same session twice.

Each session built upon the knowledge gained in the previous session. The health outcomes of each patient were assessed in outpatient service to monitor the implementation of the knowledge imparted in the education sessions in daily life.

### **Description of educational materials and information provided**

The topics of the sessions were chosen according to local culture, socioeconomic conditions, beliefs, lifestyle, common complications and associated diseases. The aim was to improve the outcomes of diabetes patients and prevent complications. The information was presented in a manner that the participants could easily understand and would motivate them to implement the new information their daily lives.

### **The topics of the diabetes education sessions**

- Definition of diabetes and types of diabetes
- Symptoms of hypo- and hyperglycemia, both complications of diabetes
- Management of diabetes by diet and physical activity
- Psychological assistance
- Brief knowledge of medicines that are available in the pharmacy of the hospital
- Management of hypoglycemic medication
- Complications of diabetes and early detection
- Dental and foot care
- Diabetic control in special situations such as during Ramadan or when travelling
- Blood sugar monitoring using a glucometer
- How and where to inject insulin and how to prevent complications
- How to prevent primary and secondary stages of diabetes
- Participation of family members if willing and/or required

### **Description of the sequence of the diabetes education sessions**

#### **In groups**

1. Welcome address to participants from a diabetologist
2. First part of the education session: lessons on diabetes by, taught by a diabetologist
3. Second part of the education session: information on diet and nutrition, taught by a dietician
4. Third part of the education session: information on how to cope psychologically with the disease, taught by a psychologist
5. Fourth part of the education session: the benefits of exercise and demonstrations of general exercises that are applicable to all patients, taught by a physiotherapist
6. Fifth part of the education session: how to inject insulin and use a glucometer, taught by a nurse

#### **On an individual basis:**

7. Sixth part of education session: individual consultations with each patient with a diabetologist, dietician, psychotherapist, or physiotherapist to help participants with particular recommendations based on associated diseases and complications, if needed

### **Patient interviews**

The patients were interviewed in order to gather the following information:

- Identification details
- Medical history/past clinical history
- Body mass index
- Drug history (type of oral hypoglycemic agents, injectable form antidiabetic agents, drugs to maintain blood pressure and lipids)
- Analysis of fasting blood sugar before each session

<b>The format of the questionnaire that was used to collect the data</b>
<b>Participant consent signature after explanation of the study and its motivations</b> _____
<b>Questionnaire</b>
<b>Identification:</b>
Name of patient _____ Sex _____ Age _____
Racial status _____ marital status _____
Address _____ City of Birth _____
Nationality _____
1-month evaluations:
Pre-course test and course date _____
1 <sup>st</sup> evaluation date _____
2 <sup>nd</sup> evaluation date _____
3 <sup>rd</sup> evaluation date _____
<b>Course details:</b>
Name of previous diabetes education course and type of program _____
<b>History:</b>
Type of diabetes and duration _____
Past history _____
Social and family history _____
Habits _____
<b>Examination information and complications (if any):</b>
<b>BMI</b>
Pre course test ____ 1 <sup>st</sup> evaluation ____ 2 <sup>nd</sup> evaluation _____ 3 <sup>rd</sup> evaluation _____
<b>Investigation</b>
<b>Fasting Blood sugar</b>
Pre-course test ____ 1 <sup>st</sup> evaluation V ____ 2 <sup>nd</sup> evaluation _____ 3 <sup>rd</sup> evaluation _____
<b>Others (if given)</b> _____
<b>Conclusion</b> _____
<b>Figure no 3: The format of the questionnaire that was used to collect the data</b>

**Variables used and their ranges**

**Age**

21-40 years

41-60 years

61-80 years



81-100 years  
Information not given

**Pre-education test score**

Fair: <5  
Good: 5-6  
Very good: 7-8  
Excellent: 9-10  
Information not given

**Post-education test score**

Fair: <5  
Good: 5-6  
Very good: 6-8  
Excellent: 9-10  
Information not given

**Body mass index (repeated for the baseline, first follow-up, and second follow-up)**

Underweight:  $0 < 18.5 \text{ Kg/m}^2$   
Normal:  $18.5\text{-}24.9\text{Kg/m}^2$   
Overweight:  $>25\text{kg/m}^2$   
Pre obese:  $25\text{-}29.9\text{kg/m}^2$   
Obese:  $> 30 \text{ kg/m}^2$   
Obese class 1:  $30\text{-}34.9 \text{ kg/m}^2$   
Obese class 2:  $35\text{-}39.9 \text{ kg/m}^2$   
Obese:  $>40 \text{ kg/m}^2$   
Information not given

**Fasting blood sugar (repeated for the baseline, first follow-up, and second follow-up)**

Hypoglycemic range:  $<3.9 \text{ mmol/dl}$   
Normal:  $4\text{-}5.8 \text{ mmol/dl}$   
Mild hyperglycemic range:  $5.9\text{-}11 \text{ mmol/dl}$   
Moderate hyperglycemic range:  $12\text{-}19 \text{ mmol/dl}$   
Sever hyperglycemic range:  $> 20 \text{ mmol/dl}$   
Problem with laboratory  
Information not given

**Data analysis**

Statistical analysis was conducted with the Statistical Program for the Social Sciences (SPSS) version 22.0 software. Excel software was used for the formation of graphs using the SPSS results. The results were analyzed using descriptive analysis, such as percentages, means, and standard deviations of variables. The chi-square, Pearson correlations, degree of freedom, T-test, ANOVA, and post-hoc Turkey test were conducted to determine the relationship between the variables. A t-test, ANOVA, and p-value of less than 0.05 were considered to be significant. The tables and graphs below displaying the results.

**Results**

A sample of 648 participants was taken for this study. This study was conducted on regular patients of the diabetic outpatient department of the Central Hospital of Nampula. The study investigated the effects of three sessions of the diabetes education program (baseline, first follow-up and second follow-up) on each patient at one-month intervals. The inclusion criteria for participating in the

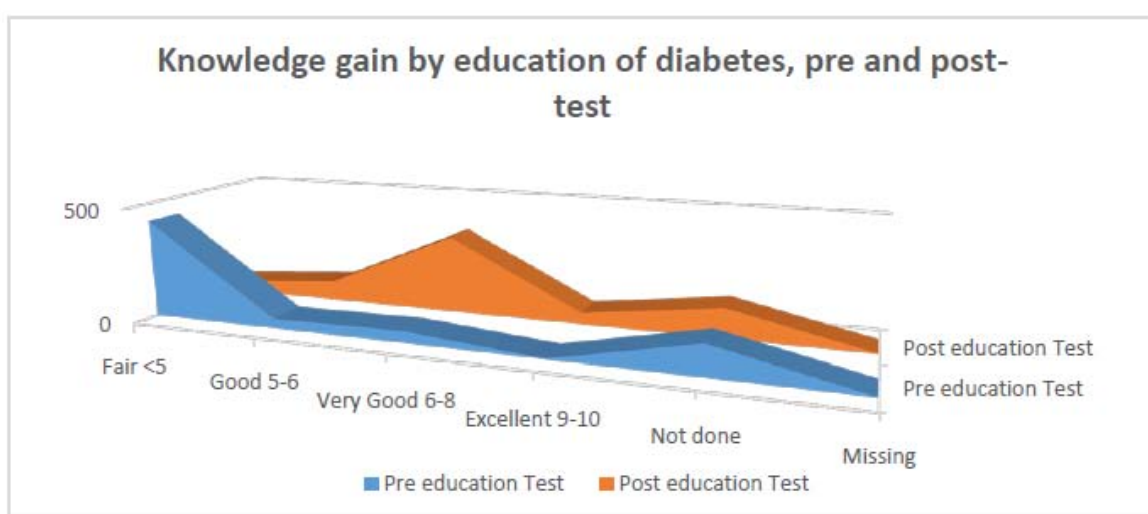
diabetes education program dictated that patients should be in the OPD, willing to participate in the education sessions and willing to give consent to be included in the study. Participants were excluded if they had already completed three sessions of education or if they lived in a district that made it impossible for them to return to one month to the next education session. Amongst the group instructors were a diabetologist, dietician, psychologist, physiotherapist, and diabetic nurse. There was a pre-test questionnaire that aimed to assess the existing knowledge of diabetes before starting the baseline education session. The same questions were asked after the completion of the second follow up education session. There were various variables to assess from baseline to second follow up education session. The variables were assessed body mass index, fasting blood sugar.

**Descriptive analysis of Pre-test and post-test score at before baseline and after second follow up**

A sample of 648 patients with diabetes mellitus, those who had participated in educational sessions concerning diabetes mellitus, was taken for study in order to determine the effect of education on improving knowledge levels in diabetes. The analysis of knowledge increased to diabetes mellitus among participants was performed pre-test at the beginning baseline, and post-test at the end second follow up. The results are shown in Table 12, below. Briefly, the percentage of patients with fair level of knowledge (65.3 %) increased from beginning of baseline to very good level of knowledge of diabetes of 52.5 % at the end of second follow up.

**Table 2.** Descriptive analysis of Pre-test and post-test score

		Pre education Test Post education Test			
		Frequency	Percentages	Frequency	Percentages
Valid	Fair <5	423	65.3	39	6.0
	Good 5-6	42	6.5	87	13.4
	Very Good 6-8	50	7.7	340	52.5
	Excellent 9-10	2	.3	51	7.9
	Not done	130	20.1	130	20.1
	Total	647	99.8	647	99.8
Missing	System	1	.2	1	.2
Total		648	100.0	648	100



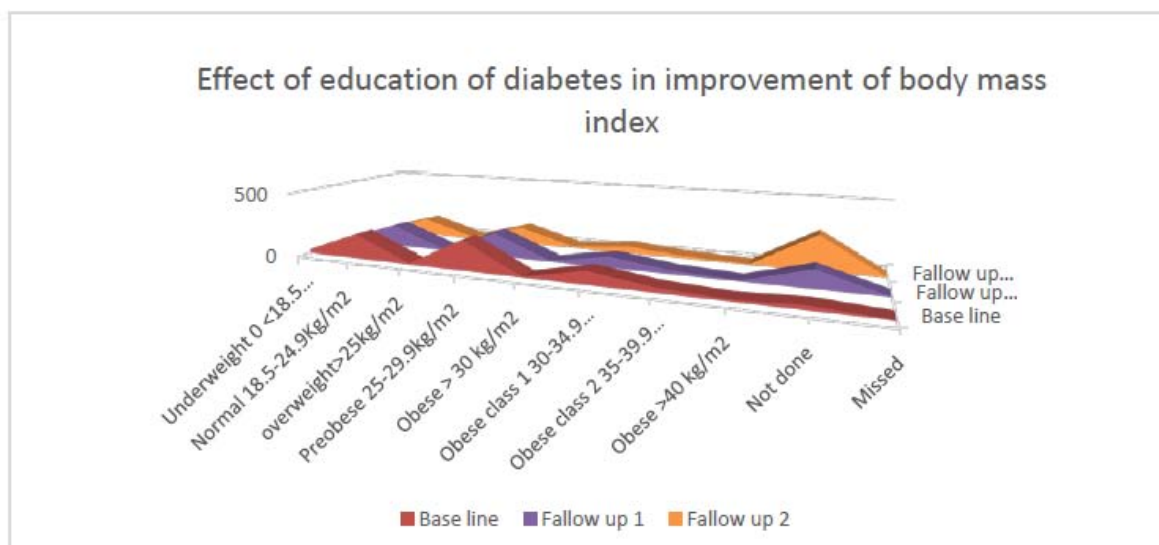
**Figures 3: Linear chart:** In the above charts we see that distribution of the compared pre-test and post-test scores at baseline and after second follow up after diabetes education among participants.

**Descriptive analysis of body mass index of baseline, first follow up, second follow up**

A sample of 648 patients with diabetic mellitus, those who had participated in educational sessions concerning diabetes mellitus, was taken for study in order to determine the effect of education on improving body mass index levels in diabetes. The measurement of body mass index was performed at baseline, at the first follows up and at the second following up. The results are shown in Table 14, below. Briefly, percentage of patients with Underweight <18.5 kg/m<sup>2</sup> decreased from baseline (4.5 %) to the first follows up (3.4%), and to the second following up (2.5%). The percentage of patients with pre obese 25-29.9 kg/m<sup>2</sup> were observed to decrease from baseline (35.2%) to the first follows up (27.9%), to the second following up (20.4%). The percentage of patients with obese class 1 -30-34.9 kg/m<sup>2</sup> decreased from each following up from baseline (15.6%) to the first follows up (13.1%), to second following up (8.2%). The percentage of patients with obese class 2- 30-34.9 kg/m<sup>2</sup> decreased from each following up from baseline (5.7%) to the first follows up (4.5%), to the second following up (2.8%) respectively.

**Table 3.** Descriptive analysis of body mass index at baseline, first follows up and second following up

Ranges of BMI	Baseline line		First fallow up		Second follow up	
	Frequenc y	Percent ages %	Freque ncy	Percentage s %	Freque ncy	Percenta ges %
Underweight <18.5 kg/m <sup>2</sup>	29	4.5	22	3.4	16	2.5
Normal 18.5-24.9 kg/m <sup>2</sup>	191	29.5	169	26.1	135	20.8
Overweight >25 kg/m <sup>2</sup>	9	1.4	9	1.4	11	1.7
Preobese 25-29.9 kg/m <sup>2</sup>	228	35.2	181	27.9	132	20.4
Obese >30 kg/m <sup>2</sup>	6	.9	7	1.1	10	1.5
Obese class 1 30-34.9 kg/m <sup>2</sup>	101	15.6	85	13.1	53	8.2
Obese class 2 35-39.9 kg/m <sup>2</sup>	37	5.7	29	4.5	18	2.8
Obese class3 > 40 kg/m <sup>2</sup>	13	2.0	6	.9	4	.6
Not done	32	4.9	138	21.3	267	41.2
Total	646	99.7	646	99.7	646	99.7
Missing	2	.3	2	.3	2	.3
Total	648	100.0	648	100.0	648	100.0



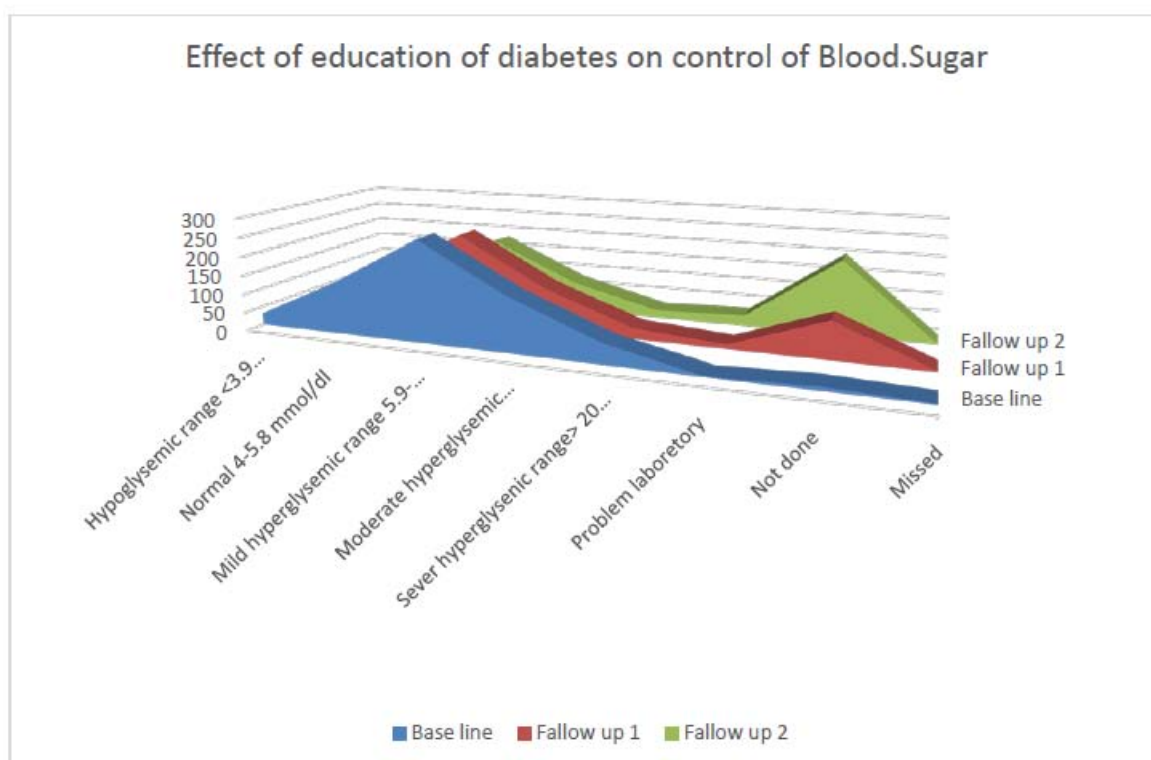
**Figures 4. Linear chart:** In the above charts we see that distribution of the compared body mass index at baseline, first follows up, and second following up after education among participants.

### **Descriptive analysis of fasting blood sugars at baseline, first follows up and second following up**

A sample of 648 patients with diabetes mellitus, those who had participated in educational sessions regarding diabetes mellitus, was taken for study in order to observe effect of education on improving fasting blood sugar concentration of diabetes. The analysis of fasting blood sugar levels was performed at baseline, at the first follows up and at the second following up. The results are described in Table 15, below. Briefly, the percentage of patients with hypoglycemic concentrations <3.9 mmol/dl improved on baseline (4.8%), to the first follows up (4.2%), to the second following up (5.1%). The percentage of patients with a normal fasting blood sugar range of 4.0-5.8 mmol/dl decreased from baseline (21.8%), to the first follows up (19.0%), to the second following up (15.0%). The percentage of patients with mild hyperglycemic concentrations of 5.9-11.0 mmol/dl decreased from each following up from baseline (41.4%), to the first follows up (37.0%), to the second following up (28.2%). The percentage of patients with moderate hyperglycemic levels of 12.0-19.0 mmol/dl were observed to decreased at each following up from baseline (22.2%), to first follows up (17.9%), to second following up (12.5%). The percentage of patients with severe hyperglycemic levels of >20.0 mmol/dl decreased from baseline (7.9%), to the first follows up (4.5%), to the second following up (3.2%).

**Table 4.** Descriptive analysis of fasting blood sugar at baseline, first follows up and second following up

Ranges of Blood Sugar	Baseline line		First follow up		Second follow up	
	Frequen cy	Percentag es %	Frequenc y	Percentag es %	Frequency	Percentag es %
Hypoglycaemic<3.9 mmol/dl	31	4.8	27	4.2	33	5.1
Normal 4-5.8 mmol/dl	141	21.8	123	19.0	97	15.0
Mild hyperglycaemic 5.9-11 mmol/dl	268	41.4	240	37.0	183	28.2
Moderate hyperglycaemic 12-19 mmol/dl	144	22.2	116	17.9	81	12.5
Sever hyperglycaemic> 20 mmol/dl	51	7.9	29	4.5	21	3.2
Problem laboratory	1	.2	12	1.9	29	4.5
Not done	10	1.5	99	15.3	202	31.2
Total	646	99.7	646	99.7	646	99.7
Missing	2	.3	2	.3	2	.3
Total	648	100.0	648	100.0	648	100.0



**Figures 6. Linear chart:** In the above charts we see the distribution of comparing fasting blood sugar scores at baseline, first follows up, and second following up after diabetes education among participants.

### Summary table of descriptive statistics mean and standard deviation

A sample of 648 patients with diabetes mellitus, who had participated in educational sessions regarding diabetes, was taken for study in order to determine the effect of education on improving outcomes of diabetes. The mean and standard deviation was calculated using to plan to code, without grouping into categories. For the evaluation of basic knowledge regarding diabetes mellitus prior to participating in the baseline education sessions, and assessment was performed of the pretest score. The average was 2.33 (SD=2.11). For the evaluation of knowledge gained after completing the second following up session of diabetes education, the assessment revealed an average posttest score of 7.34 (SD=1.43). The average age of participants were 49.79 years (SD=13.06 years). The average body mass index (BMI) of the participants at baseline was 26.89 kg/Miter<sup>2</sup> (SD=5.69 kg/Miter<sup>2</sup>), followed by an average BMI at the first follows up of 26.43 kg/Miter<sup>2</sup> (SD=5.35 kg/Miter<sup>2</sup>), and an average BMI at the second following up of 26.18 kg/Miter<sup>2</sup> (SD=5.03 kg/Miter<sup>2</sup>). This showed that a very small decrease in BMI from baseline to the second follows up occurred. The average fasting blood glucose concentration on baseline was 10.15 mmol/dl (SD=6.00 mmol/dl), at the first follows up 9.32 mmol/dl (SD=5.17 mmol/dl), and at the second following up 8.89 mmol/dl (SD=5.19 mmol/dl). Therefore, a gradual decrease in the fasting blood glucose concentration was observed from baseline to the second following up.

**Table 5.** Descriptive statistics mean and standard deviation

	Mean	Std. Deviation	t	Asymp. Sig P
Pretest_Score	<b>2.33</b>	<b>2.11</b>	<b>t (24.33)</b>	<b>P &lt;=.001</b>
Posttest_Score	<b>7.34</b>	<b>1.43</b>	<b>t (113.36)</b>	<b>P &lt;=.001</b>
Body mass index base line	26.89	5.69		
Body mass index first follow up	26.43	5.35		
Body mass index second follow up	26.18	5.03		
Blood glucose base line	<b>10.15</b>	<b>6.00</b>	<b>t (42.59)</b>	<b>P &lt;=.001</b>
Blood glucose first follow up	<b>9.3294</b>	<b>5.17</b>	<b>t (41.92)</b>	<b>P &lt;=.001</b>
Blood glucose second follow up	<b>8.89</b>	<b>5.19</b>	<b>t (35.11)</b>	<b>P &lt;=.001</b>

### Chi-squared tests

Chi-squared tests were performed in order to determine the effect of education on patients with diabetes mellitus regarding controlling various parameters of health and diabetic complications, the knowledge gained concerning diabetes and factors involved in diabetes control, and the relationship between these effects.

### Chi-squared correlation between ages with other variables

**1. Correlation between ages with BMI.** The results of the chi-squared test were significant, with the following associations observed: age correlated with BMI at baseline (value=172.04<sup>a</sup>, df=48, P<.001), at the first follows up (value=136.10<sup>a</sup>, df=48, P<.001) and at the second following up (value 140.52<sup>a</sup>, df =48, P<.001).

**2. Correlation between ages with fasting blood glucose concentration.** The results of the chi-squared test were significant, with the following associations observed: age correlated with fasting blood glucose concentrations on baseline (value=56.69<sup>a</sup>, df=36, P<.001), at the first follows up (value=103.52<sup>a</sup>, df=36, P<.001) and at the second following up (value=73.06<sup>a</sup>, df =36, P<.001).

**Table 6.** Descriptive Chi-Square Tests among variables

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Age * Body mass index on base line	172.04a	48	.001
Age* Body mass index on first following up	136.10 <sup>a</sup>	48	.001
Age* Body mass index on seconds following up	140.52a	48	.001
Age* Fasting blood sugar on base line	56.69a	36	.015
Age* Fasting blood sugar on first following up	103.52a	36	.001
Age * Fasting blood sugar on seconds following up	73.06a	36	.001
Age* Pre-test	29.07a	24	.217
Age* Post-test	33.73a	24	.089
Post-test* Age	33.73 <sup>a</sup>	24	.089
Post-test * Body mass index on base line	31.62a	32	.485
Post-test* Body mass index on first following up	59.69a	32	.002
Post-test * Body mass index on seconds following up	74.99a	32	.001
Post-test * Fasting blood sugar on base line	35.13a	24	.066
Post-test * Fasting blood sugar on first following up	50.60a	24	.001
Post-test* Fasting blood sugar on seconds following up	88.02a	24	.001

### Pearson correlation

In order to examine the effect of education regarding diabetes mellitus on controlling various variables of health and the control of diabetic complications, and to determine the amount of knowledge gained after diabetes education, a Pearson correlation matrix was created using all variables in order to determine the relationship between them.

Age with body mass index of baseline, first follow up and second follow up	(P<.001)
Age with blood sugar of baseline, first follow up and second follow up	(P<.001)
Posttest with body mass index of baseline, first follow up and second follow up	(P<.01)
Posttest scores with fasting blood sugar of baseline, first follow up and second follow up	(P<.01)
Age was significantly positively correlated with pretest and posttest scores	(P=.01)

### ANOVA and regression analysis

In order to examine the effect of diabetes education on the control of diabetes and on the incidence of complications, a multiple linear regression was conducted. This allowed an assessment of the control of fasting blood sugar concentrations on baseline as a dependent variable, with the independent variables of baseline, BMI, and post-test score.

**Table 8.** Regression, ANOVA analysis and post hoc Turkey test:

Base line linear regression The individual predictor Post hoc Turkey tests	Significant F(7,637)= 2.44 , P<= .018 , R2= .026 B=1.94 P< .001 suggest that for every one unit increase in baseline fasting blood sugar, the other variables baseline body mass index,
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	increase 1.94 Unit, Baseline body mass index, compared with dependent variable baseline follow up fasting blood sugar significant $P < .05$ .
First follow up linear regression The individual predictor Post hoc Turkey tests	significant, $F(7,673)= 52.34, P<= .001, R2= .365$ $R2= .365$ $B=0.42 P< .001$ suggests that for every one unit increase in first following up fasting blood sugar, the other variables in first following up body mass index, increase 0.42 Unit, Body mass index, compared with dependent variable in first follows up blood sugar are significant $P < .005$ .
First follow up linear regression The individual predictor Post hoc Turkey tests	significant, $F(7,673)= 52.34, P<= .001, R2= .365$ $R2= .365$ $B=-.165P< .001$ suggests that for every one unit decrease in seconds following up fasting blood sugar, the other variables second follow up body mass index, decrease -.165 Unit Body mass index, compared with dependent variable in first following up blood sugar are significant $P < .005$ .
Second follow up linear regression The individual predictor Post hoc Turkey tests	significant, $F(8,632)= 66.37, P<= .001, R2= .450$ $R2= .450$ $B=0.42 P<.001$ suggests that for every one unit increase in first following up fasting blood sugar, the other variables first follow up body mass index, increase from 0.42 Unit, Second following up body mass index, compared with dependent variable seconds following up fasting blood sugar are significant $P < .005$ .

## Discussion

The present study found that educational intervention were highly effective against controlling anthropometric parameters (BMI), as these had significantly decreased in baseline at the second patient follows up sessions. Metabolic control (blood sugar) also showed a significant positive improvement in baseline at the second follows up visit. Finally, participants also showed an improvement in knowledge through diabetes education. This was assessed by a pre-test prior to the commencement of education and a post-test after the completion of second following up educational sessions at the central hospital in Nampula. The knowledge provided by the education helped the participants to improve and change their lifestyle, especially their dietary and exercise habits, their psychological adjustment and their attitude to living with diabetes.

Similar studies have previously been performed, with some comparable findings being reported. Newly diagnosed diabetic patients need self-management education, as this helps to increase their level of knowledge of diabetes and to provide them with skills to manage their diabetes life long, as it is a chronic condition (*American Diabetes Association, 2014*). A Cochrane review (*Deakin, 2009*) concluded that a reduction in blood sugars concentrations, reduced HbA1c, reduced BMI, reduced systolic and increased knowledge of diabetes. A Cochrane review (*Deakin, 2009*) concluded that from



group education of diabetes patients get motivated, start adherence to treatment and understand diabetes. The study performed by Balagopal et al. (2008) showed reduced levels of obesity and improved dietary habits of diabetic and pre-diabetic patients after education regarding diabetes. The lifestyle modifications were effective against reducing a number of the risk factors of type 2 diabetes mellitus and in improving self-management of the disease. Meta analyses and the outcome of various studies has shown positive impacts after receiving diabetes education, and enhanced knowledge of diabetes have been presented by Ricci-Cabello et al. (2014). In order to promote diabetes awareness, self-care behaviors can be useful. Choi et al. (2016) described innovative strategies for the improvement on diabetic control and glycemic improvement in Chinese patients through the continuing education of diabetes mellitus during patient examination and by increasing family involvement via diabetic knowledge. Mollaoğlu et al. (2009) emphasized repeated diabetic education sessions to control and improve metabolic parameters. Salinero-Fort et al. (2011), using experimental and control groups regarding diabetes education.

The present study found that participants had age group of diabetes mellitus were 41-60 years, of which 56% were male. A further study found that, regarding type of diabetes, diabetes mellitus type 2 was detected at the highest prevalence of 87.5%, however the prevalence of diabetes mellitus type 1 was 5.1%.

## Conclusion

The Mozambique, which shows a progressive increase in the number of patients with diabetes mellitus due to the lack of a healthy diet, a sedentary life style and urbanization. Regarding patients with diabetes mellitus in a central hospital in Nampula, it was recognized that there was a need to organized education concerning diabetes, such as regarding the diabetic diet, increasing patient knowledge of diabetes to avoid the risks of complications, physical activity and its importance, and the psychological motivation to live with diabetes.

The study also showed that the majority of the participants had diabetes mellitus types 2, were in the majority of the patients controlled their fasting blood glucose, body mass index and increased knowledge of diabetes from education of diabetes.

## Motivational quotes

**“Exercise and diet can help prevent or even totally reverse metabolic conditions like diabetes and cardiovascular disease – only thing is, you’ve got to catch them young... You know, while these conditions are still of ‘impressionable minds’!”**

– Deepak ‘The Fitness Doc’ Hiwale

There is currently a need to design a national policy and program for diabetes education. Clinicians and health educators should continue to reemphasize that patients with diabetes mellitus make healthy behavioral changes in order to control their diabetes and reduce the occurrence of complications.

The limitations of this study include that some of the diabetic patients used traditional medications, some did not adhere to treatment, and some were lost to follow up, all of which can cause uncontrollable diabetes and increase the incidence of complications. Patients were very interested in taking medicine free of charge in a government hospital. Limitations were also found here, such as the intermittent non-availability of the results of blood sugar results and other biochemical results due to a lack of laboratory reagents. Patients who lived district, distance from the hospital, were not able to regularly attend three education sessions. Patients were more interested in obtaining medication than on lifestyle modification. Patients were generally from a poor or lower income group, and were unable to buy the recommended food. It was also noted that some patients had an insufficient economic condition to take small and frequent meals. Some of the patients presented with a delayed diagnosis, with irreversible complications.

One of the strengths of this study is that patients, at the commencement of educational sessions, were encouraged to participate and to bring laboratory results and other activities to the follow up sessions by reminding them that they would receive prescription medicine at the end of the successful

completion of all of the essential activities involved in the education sessions. This encouraged patients to take a further interest in the study, and the majority of these patients then implemented the required changes in their lives and achieved positive significant outcomes of controlling their diabetes.

### Contribution to knowledge

This study adds to the current body of knowledge regarding lifestyle modification and patient knowledge of diabetes. The education provided with this study allowed patients to understand diabetes and to control and minimize related complications.

### Suggestion for future research

However, a need remains to involve other departments in future study, for example emergency and intensive care medicine, district hospitals and effect of education of diabetes of family members to control the diabetic of patient, in order to see effect of education of diabetes to improve the knowledge of diabetes in public for primary prevention of diabetes in society.

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