

Effects of Diabetic Education on Body Mass Index, Fasting Blood Sugar and Knowledge Gained by Diabetic Patients in Central Hospital Nampula

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Abstract Mozambique, has 274,700 diabetic patients and 9716 deaths due to diabetes, according to a report of 2015 (IDF 2015). There is a poor knowledge of non-pharmacological treatment of diabetes mellitus among the diabetic population. This is Interventional study, 648 of the participants of diabetes mellitus in out-patient diabetic clinic in hospital central Nampula, the participants taken according to inclusion and exclusion criteria, completed 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. The present study found that educational intervention of diabetes was highly effective to gain knowledge of diabetes compare 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 was significantly correlated ($P < .01$). A post hoc Turkey test of 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 ($P = .005$). 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

1. Introduction

1.1. Background

Worldwide

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 could be diabetes, which is type 1 complete deficiency of insulin and diabetes type 2, partial deficiency of insulin with receptor of insulin not functioning 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 European countries, where there is 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 healer for treatment of diabetes. There are unhealthy food 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. There are no professional health, diabetes educators and patients have little or no knowledge of self-management, adherence of treatment, awareness of complication. Among the group of patients who seek care in public hospitals, many are poor and cannot afford the cost of medication or healthy

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foods. There is an 80 dollar expenditure allotted to each patient of diabetes from the country's Ministry of Health and supported by the government. 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 for patients and its outcome. Accordingly, there is an extreme need to educate patients of diabetes to improve diabetic control and reduce its complication.

1.2. Objective and Hypothesis

Problem:

The population for 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 diabetes. There are no professional diabetic health educators and patients receive advice from doctors and dieticians regarding their diets and directions on how to use their prescriptions of medicine so as to continue treatment at home. Due to the large size of patient loads in outpatient consultations of 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 seek 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 [3].

Objective:

1. There is a need for lifestyle modification, knowledge of diabetes and its complication, as chronic disease, so that patients can ability to detect small symptoms of complication and present physician, adherence of treatment and its important.
2. There are different types, categories, and levels of controlled diabetic patients and the each type requires different types of education, depending on complications and diseases associated with diabetes.

There following are the clinical categories patients:

1. Good control 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.

Positive hypothesis, the positive correlation of control of fasting blood sugar change of lifestyle modification includes diet and exercise. The positive correlation with control of fasting blood sugar 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 diabetes more common with age of 45-60 but not uncontrolled by increase of age. The various reasons which can responsible for uncontrolled fasting blood sugar, in case not implemented knowledge of diabetes in life style.

Assumption and limitation

There is a need to implement before each consultation of control of diabetes for writing the prescription of medicine and controlling complication. There should be a 15 minute session of education to reemphasized, remember to patients to continue habits which helping to control diabetes. It is seen continues education help to keep continue positive habits to control diabetes. As increase period after education, some of patients come back to the same stage as they were started.

There were limitations as Mozambique is developing country as limited resources in hospital. To minimized expenditure, there are available only fasting blood sugar. There is no concept of doing the regular postprandial blood sugar. There was some time, none availability of reagent in the laboratory to evaluate blood sugar during the period of study. That makes statically results different from which was accepted. To choose topic also forced to see the available facility in a public hospital.

2. Method

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 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 who come for outpatient consultations	Participation in previous diabetes education programs for more than 3 sessions
Mozambican citizen	Not willing to participate
Any age	Live in a location that makes them unable to return every month for control

Conceptual framework

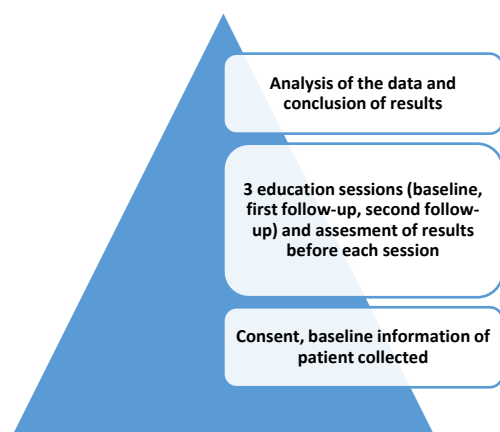


Figure 1. Conceptual framework

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 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 within one month to the next education session.

Organization of education sessions

Amongst the group instructors were a diabetologist, dietician, psychologist, physiotherapist, and diabetic nurse. The following 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.

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. The physicians and other specialists also noted the relevant patient information.

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 physicians and other specialists also noted the relevant patient information.

Method of education

The education sessions were in the form of a conference with all specialists leading a class in various verbal forms, demonstrating real situations, operating the relevant apparatus and discussing any difficulties 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.

Description of Health Education Intervention

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 for 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 for 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 in 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
- Blood pressure, 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
- Specific findings, if noted by each specialists

Variables used and their ranges:

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

A Data was analyzed SPSS 17 version, and graphs made in Excel software.

Outline of presentation of statically analysis as follows:

A. Descriptive Analysis

1. Frequency and percentage tables of various variables with graphic presentations.
2. Central tendency (Mean), standard deviation (stander scores).

B. Correlation Analysis

1. Person Correlation with simple correlation among variables
2. Regression-predictive-ability independent and dependent variable

C. Analyzing difference between groups

1. T-test
2. ANOVA
3. Post hoc Turkey test
4. P - Value of less than 0.05 were considered to be significant.

D. Tables and graphs use for results**3. 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 within 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 age groups, body mass index, blood pressure, and fasting blood sugar in patients with diabetes mellitus.

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 of 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 2, below. Briefly, the percentage of patients with a fair level of knowledge (65.3%) increased from beginning of baseline to very good level of knowledge of diabetes by 52.5% at the end of the second follow up.

Descriptive analysis of body mass index of baseline, first follow up, 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 body mass index levels in diabetes. The measurement of body mass index was performed at baseline, at the first follow up and in the second follow up. The results are shown in Table 3, below. Briefly, percentage of patients with Underweight < 18.5 kg/m² decreased from baseline (4.5%) to the first follow up (3.4%), and to the second follow up (2.5%). The percentage of patients with pre obese 25-29.9 kg/m² were observed to decrease from baseline (35.2%) to the first follow up (27.9%), to the second follow up 920.4%). The percentage of patients with obesity class 1 -30-34.9 kg/m² decreased at each follow up from the baseline (15.6%) to the first follow up (13.1%), to second follow up (8.2%). The percentage of patients with obesity class 2- 30-34.9 kg/m² decreased at each follow up from the baseline (5.7%) to the first follow up (4.5%), to the second follow up (2.8%) respectively.

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

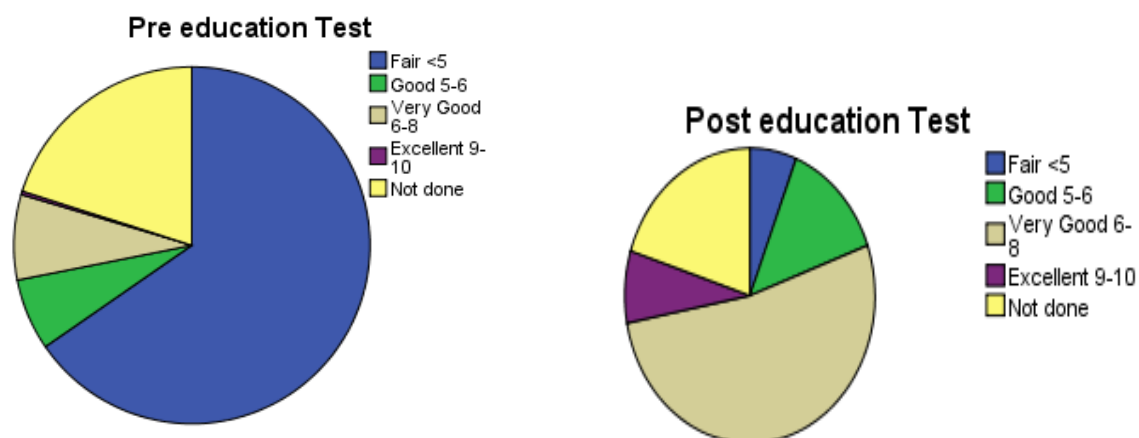


Figure 2.1. Pie chart: In the above charts we see that the distribution of the compared pre-test and post-test scores at baseline and after the second follow up after diabetes education among participants

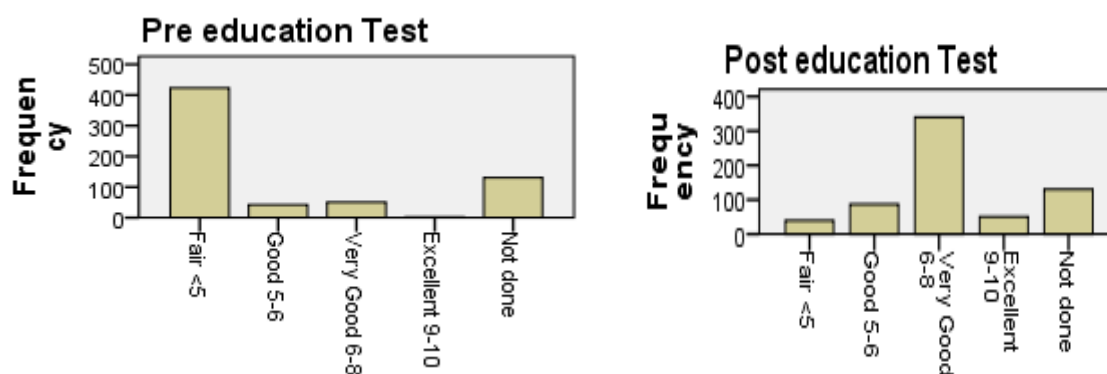


Figure 2.2. Bar chart: In the above charts we see that the distribution of the compared pre-test and post-test scores at baseline and after the second follow up after diabetes education among participants

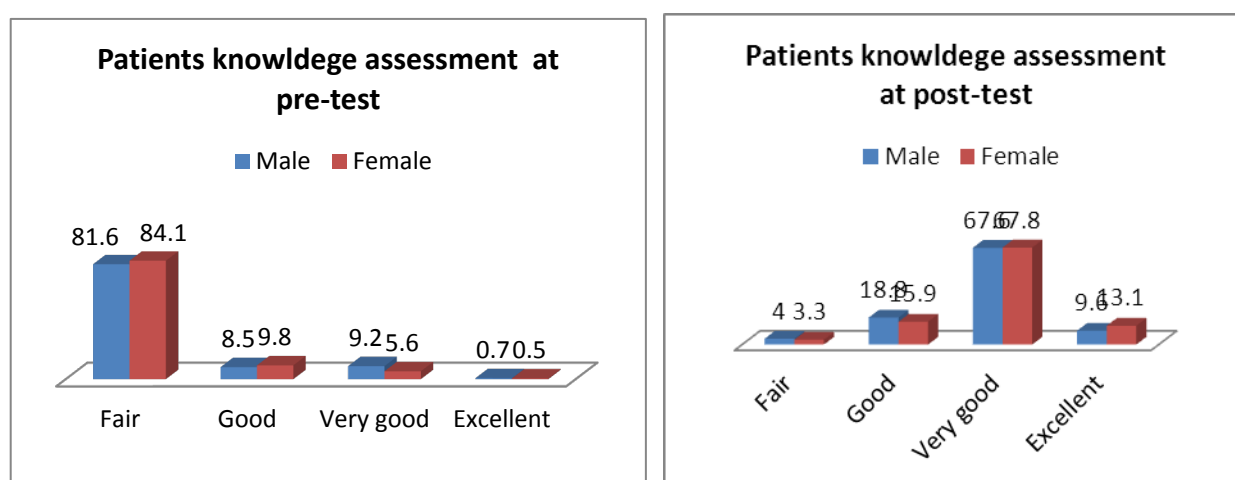


Figure 2.3. Bar chart: In the above charts we see that the distribution of the compared pre-test and post-test scores at baseline and after the second follow up after diabetes education among male and female participants

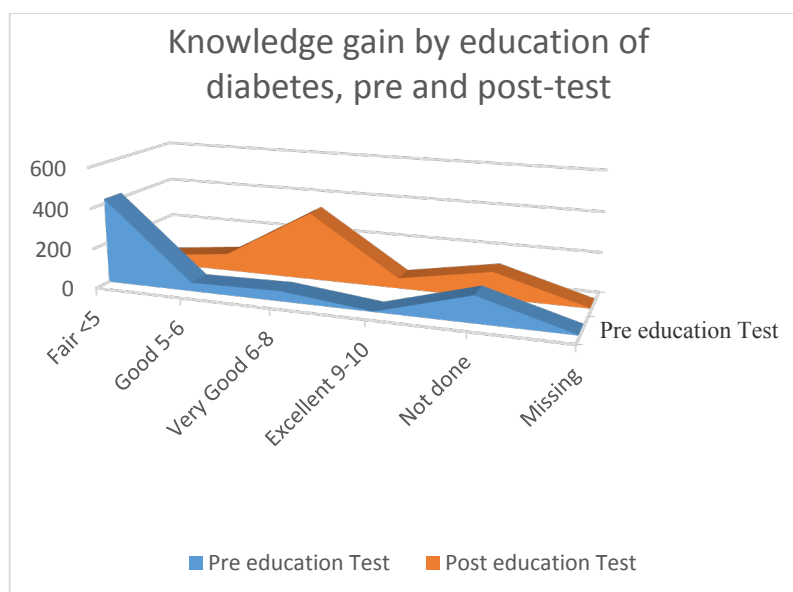


Figure 2.4. Linear chart: In the above charts we see that the distribution of the compared pre-test and post-test scores at baseline and after the second follow up after diabetes education among participants

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

Ranges of BMI	Baseline line		First follow up		Second follow up	
	Frequency	Percentages %	Frequency	Percentages %	Frequency	Percentages %
Underweight <18.5 kg/m ²	29	4.5	22	3.4	16	2.5
Normal 18.5-24.9 kg/m ²	191	29.5	169	26.1	135	20.8
Overweight >25 kg/m ²	9	1.4	9	1.4	11	1.7
Preobese 25-29.9 kg/m ²	228	35.2	181	27.9	132	20.4
Obese >30 kg/m ²	6	.9	7	1.1	10	1.5
Obese class 1 30-34.9 kg/m ²	101	15.6	85	13.1	53	8.2
Obese class 2 35-39.9 kg/m ²	37	5.7	29	4.5	18	2.8
Obese class3 > 40 kg/m ²	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

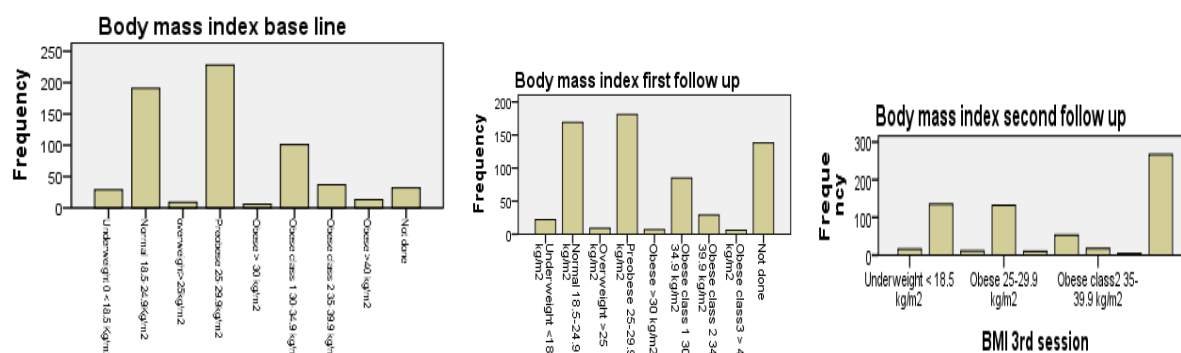


Figure 3.1. Bar chart: In the above charts we see that the distribution of the compared body mass index at baseline, first follow up, and second follow up after education among participants

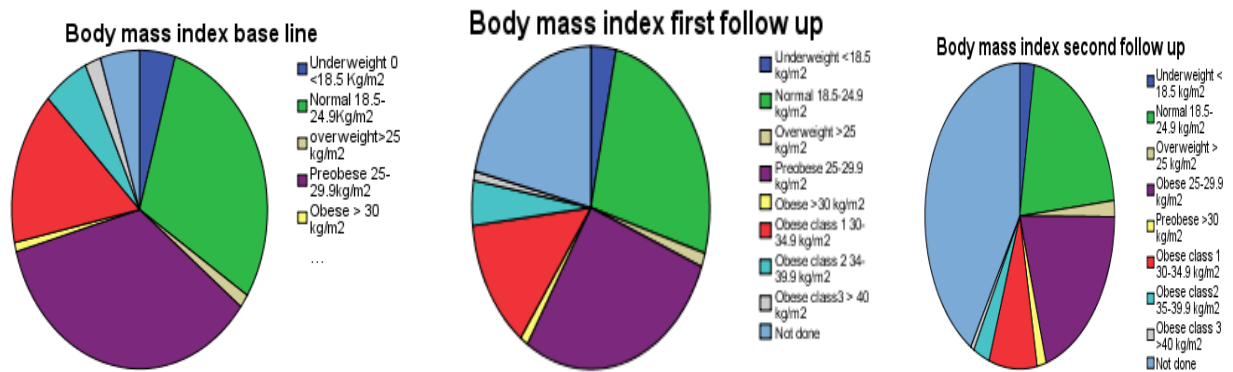


Figure 3.2. Pia chart: In the above charts we see that the distribution of the compared body mass index at baseline, first follow up, and second follow up after education among participants

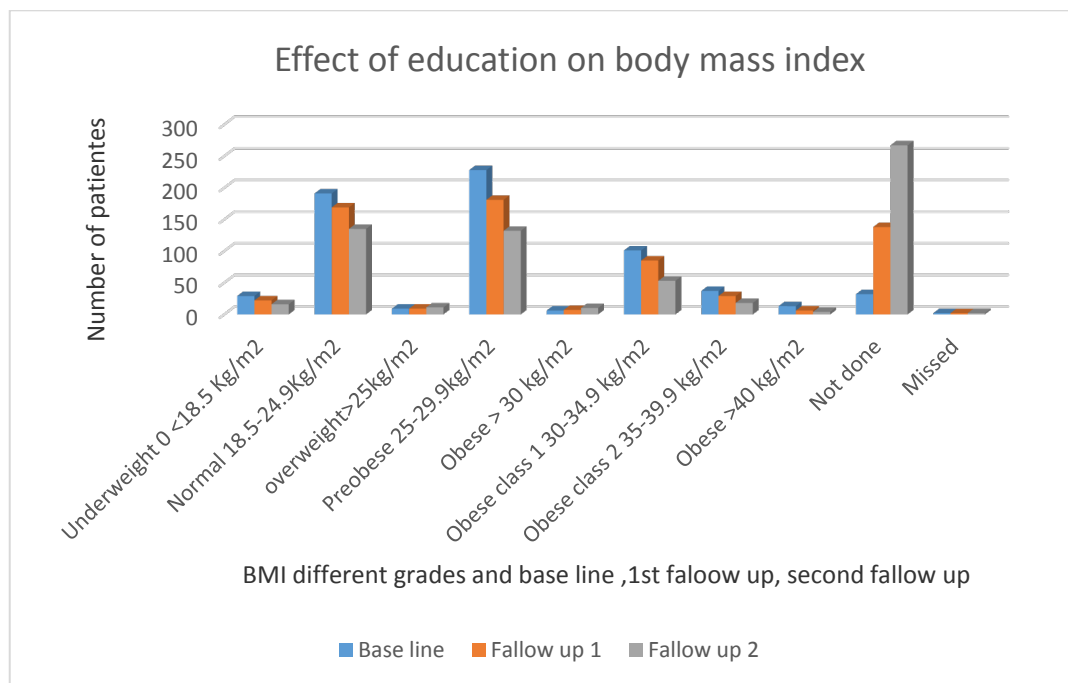


Figure 3.3. Bar chart: In the above charts we see that the distribution of the compared body mass index with grades of obesity at baseline, first follow up, and second follow up after education among participants

Descriptive analysis of fasting blood sugar at baseline, first follow up and second follow 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 the effect of education on improving fasting blood sugar concentration in diabetes. The analysis of fasting blood sugar levels was performed at baseline, at the first follow up and in the second follow up. The results are described in Table 4, below. Briefly, the percentage of patients with hypoglycemic concentrations <3.9 mmol/dl improved from baseline (4.8%), to the first follow up (4.2%), to the second follow 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 follow up (19.0%), to the second follow up (15.0%). The percentage of patients with mild hyperglycemic concentrations of 5.9-11.0 mmol/dl decreased at each follow up from the baseline (41.4%), to the first follow up (37.0%), to the second follow up (28.2%). The percentage of patients with moderate hyperglycemic levels of 12.0-19.0 mmol/dl was observed to decrease at each follow up from the baseline (22.2%), to first follow up (17.9%), to second follow up (12.5%). The percentage of patients with severe hyperglycemic levels of >20.0 mmol/dl decreased from baseline (7.9%), to the first follow up (4.5%), to the second follow up (3.2%).

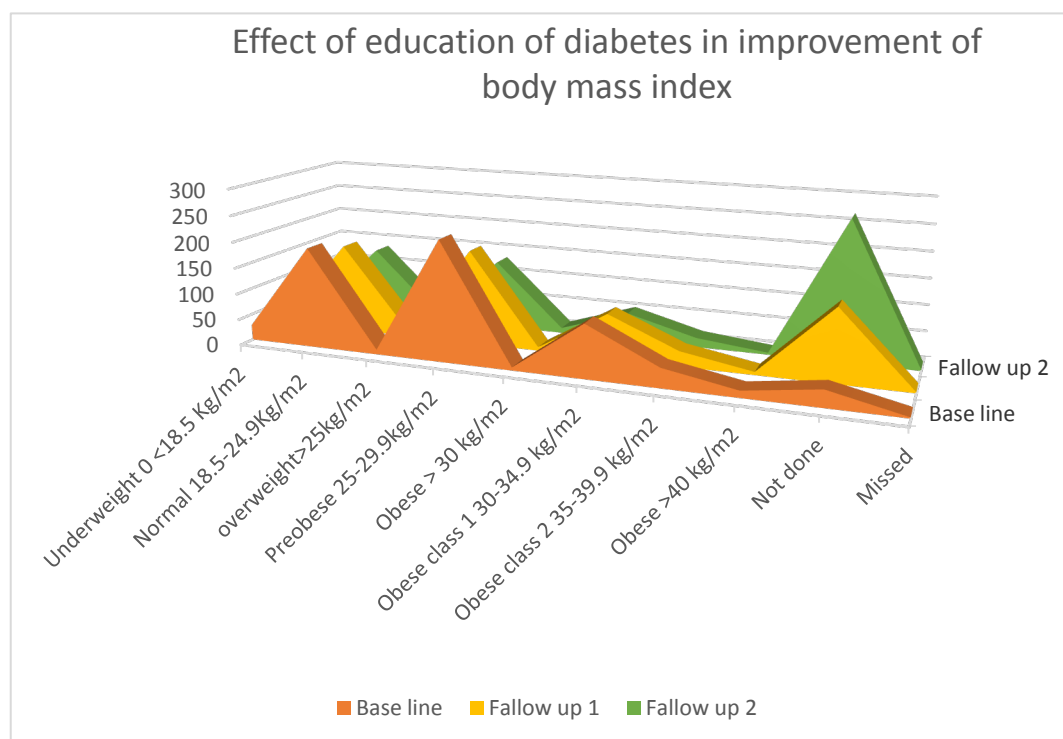


Figure 3.4. Linear chart: In the above charts we see that the distribution of the compared body mass index at baseline, first follow up, and second follow up after education among participants

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

Ranges of Blood Sugar	Baseline line		First follow up		Second follow up	
	Frequency	Percentages %	Frequency	Percentages %	Frequency	Percentages %
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

Bar Chart

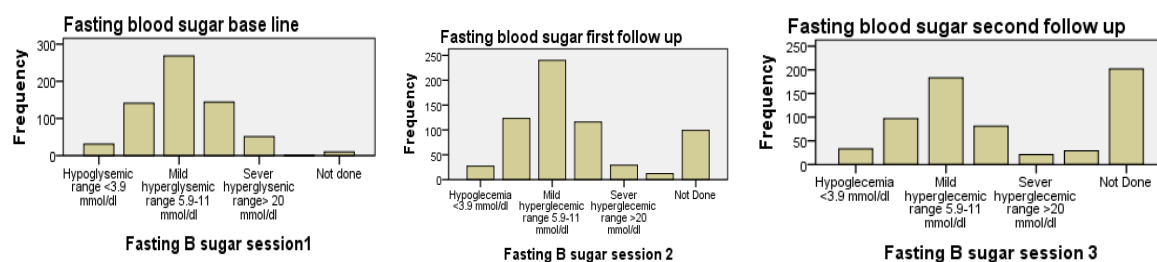


Figure 4.1. Bar chart: In the above charts we see the distribution of comparing fasting blood sugar scores at baseline, first follow up, and second follow up after diabetes education among participants

Pie Chart

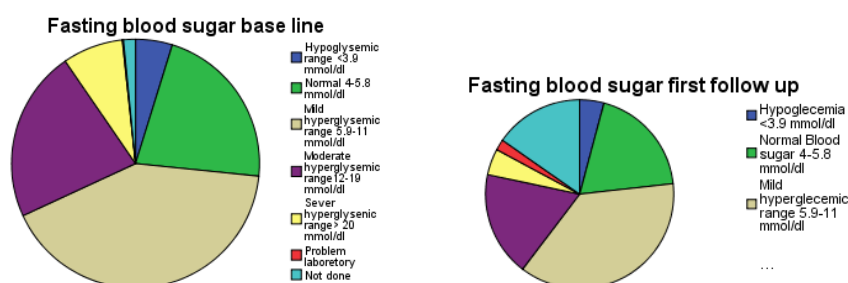


Figure 4.2. Pie chart: In the above charts we see the distribution of comparing fasting blood sugar scores at baseline, first follow up, and second follow up after diabetes education among participants

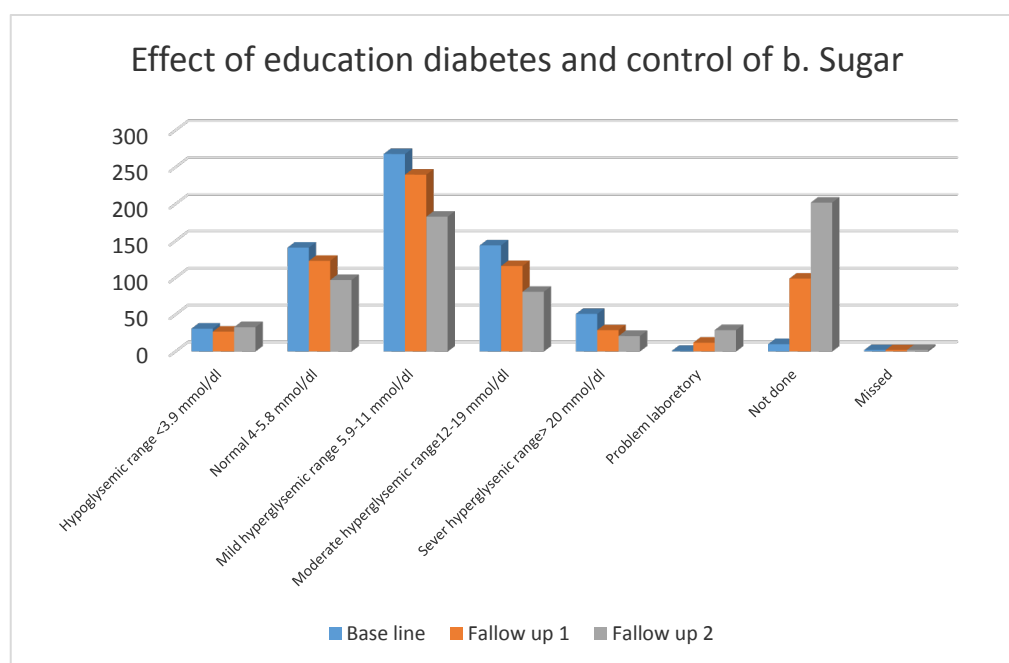


Figure 4.3. Bar chart: In the above charts we see the distribution of comparing fasting blood sugar scores with grades at baseline, first follow up, and second follow up after diabetes education among participants

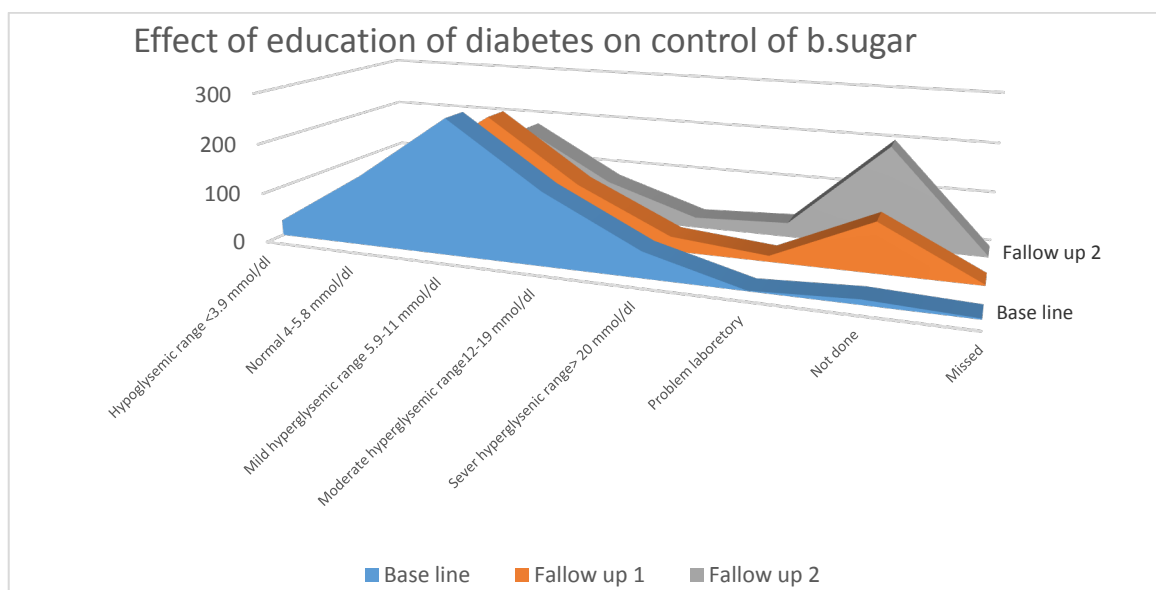


Figure 4.4. Linear chart: In the above charts we see the distribution of comparing fasting blood sugar scores at baseline, first follow up, and second follow up after diabetes education among participants

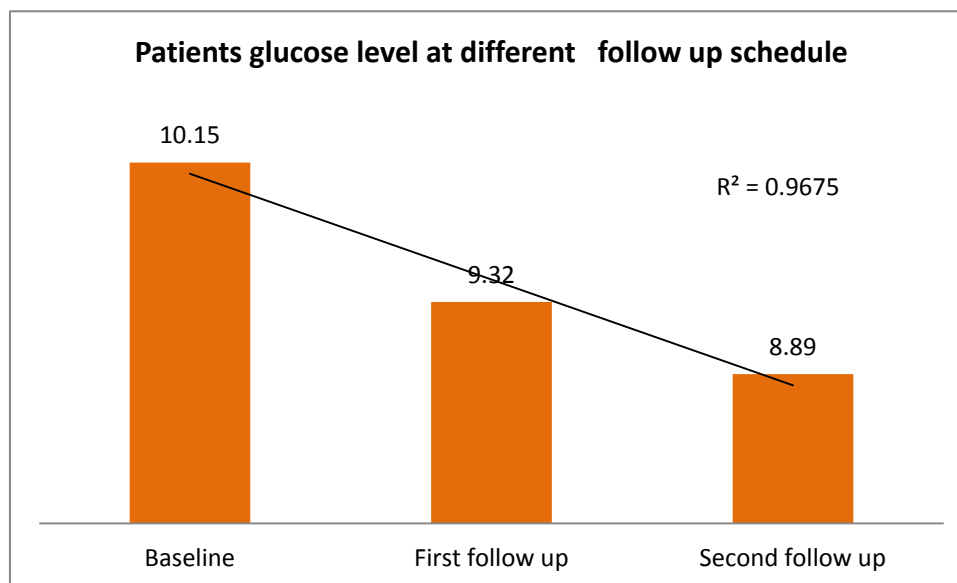


Figure 4. Bar chart: In the above charts we see the distribution of comparing fasting blood sugar scores at baseline, first follow up, and second follow up after diabetes education among participants

Summary table of descriptive Statistics Mean and standard Deviation:

Table 5. Descriptive statistics mean and standard Deviation of variables

Descriptive Statistics Mean and standard Deviation		
	Mean	Std. Deviation
Pretest_Score	2.33	2.11
Posttest_Score	7.34	1.43
Age	49.79 years	13.06 years
Body mass index base line	26.89Kg/Miter2	5.69 Kg/Miter2
Body mass index first follow up	26.43 Kg/Miter2	5.35 Kg/Miter2
Body mass index second follow up	26.18 Kg/Miter2	5.03 Kg/Miter2
Blood glucose base line	10.15 mmol/dl	6.00 mmol/dl
Blood glucose first follow up	9.32 mmol/dl	5.17 mmol/dl
Blood glucose second follow up	8.89 mmol/dl	5.19 mmol/dl

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 in diabetes. The mean and standard deviation were calculated using plain coding, 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 on the pretest score. The average was 2.33 (SD=2.11). For the evaluation of knowledge gained after completing the second follow up session of diabetes education, the assessment revealed an average posttest score of 7.34 (SD=1.43). The average age of participants was 49.79 years (SD=13.06 years). The average body mass index (BMI) of the participants at baseline was 26.89 kg/Miter2 (SD=5.69 kg/Miter2), followed by an average BMI at the

first follow up to 26.43 kg/Miter2 (SD=5.35 kg/Miter2), and an average BMI at the second follow up to 26.18 kg/Miter2 (SD=5.03 kg/Miter2). This showed that a very small decrease in BMI from baseline to the second follow ups occurred. The average fasting blood glucose concentration at baseline was 10.15 mmol/dl (SD=6.00 mmol/dl), at the first follow up 9.32 mmol/dl (SD=5.17 mmol/dl), and in the second follow 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 follow up.

Chi-squared test

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 of age with other variables

2. Correlation of age with BMI. The results of the chi-squared tests were significant, with the following associations observed: age correlated with BMI at baseline (value=172.04^a, df=48, P<.001), at the first follow up (value=136.10^a, df=48, P<.001) and in the second follow up (value 140.52^a, df=48, P<.001).

3. Correlation of age with fasting blood glucose concentration. The results of the chi-squared tests were significant, with the following associations observed: age correlated with fasting blood glucose concentrations at baseline (value=56.69^a, df=36, P<.001), at the first follow up (value=103.52^a, df=36, P<.001) and in the second follow up (value=73.06^a, df=36, P<.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.

Table 6. Descriptive Chi-Square Tests among variables

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Age * Body mass index base line	172.04a	48	.000
Age* Body mass index first follow up	136.10 ^a	48	.000
Age* Body mass index second follow up	140.52a	48	.000
Age* Fasting blood sugar base line	56.69a	36	.015
Age* Fasting blood sugar first follow up	103.52a	36	.000
Age * Fasting blood sugar second follow up	73.06a	36	.000
Age* Pre-test	29.07a	24	.217
Age* Post-test	33.73a	24	.089
Post-test* Age	33.73 ^a	24	.089
Post-test * Body mass index base line	31.62a	32	.485
Post-test* Body mass index first follow up	59.69a	32	.002
Post-test * Body mass index second follow up	74.99a	32	.000
Post-test * Fasting blood sugar base line	35.13a	24	.066
Post-test * Fasting blood sugar first follow up	50.60a	24	.001
Post-test* Fasting blood sugar second follow up	88.02a	24	.000

Table 7. Correlation of age with BMI: The table below shows the results of the Pearson correlation tests performed. Age was significantly positively correlated with BMI at baseline, at the first follow up and in the second follow up ($P < .001$)

Correlations					
		Age	Body mass index base line	Body mass index first follow up	Body mass index second follow up
Age	Pearson Correlation	1	.115**	.074	.070
	Sig. (2-tailed)		.003	.060	.077
	Sum of Squares and Cross-products	3442.523	353.372	291.918	306.477
	Covariance	5.362	.550	.455	.477
	N	643	643	643	643
Body mass index base line	Pearson Correlation	.115**	1	.462**	.265**
	Sig. (2-tailed)	.003		.000	.000
	Sum of Squares and Cross-products	353.372	2780.652	1642.646	1046.204
	Covariance	.550	4.311	2.547	1.622
	N	643	646	646	646
Body mass index first follow up	Pearson Correlation	.074	.462**	1	.581**
	Sig. (2-tailed)	.060	.000		.000
	Sum of Squares and Cross-products	291.918	1642.646	4542.844	2933.461
	Covariance	.455	2.547	7.043	4.548
	N	643	646	646	646
Body mass index second follow up	Pearson Correlation	.070	.265**	.581**	1
	Sig. (2-tailed)	.077	.000	.000	
	Sum of Squares and Cross-products	306.477	1046.204	2933.461	5618.520
	Covariance	.477	1.622	4.548	8.711
	N	643	646	646	646

** . Correlation is significant at the 0.01 level (2-tailed).

Table 8. Correlation of age with fasting blood sugar concentrations: The table below shows the results of the Pearson correlation tests performed. Age was significantly positively correlated with fasting blood sugar concentrations at baseline, at the first follow up and at the second follow up ($P = .001$)

		Age	Fasting blood glucose base line	Fasting blood glucose first follow up	Fasting blood glucose second follow up
Age	Pearson Correlation	1	-.001	-.009	-.013
	Sig. (2-tailed)		.976	.818	.743
	Sum of Squares and Cross-products	3442.523	-1.900	-23.045	-39.751
	Covariance	5.362	-.003	-.036	-.062
	N	643	643	643	643
Fasting blood glucose base line	Pearson Correlation	-.001	1	.260**	.169**
	Sig. (2-tailed)	.976		.000	.000
	Sum of Squares and Cross-products	-1.900	770.551	311.889	246.176
	Covariance	-.003	1.195	.484	.382
	N	643	646	646	646
Fasting blood glucose first follow up	Pearson Correlation	-.009	.260**	1	.541**
	Sig. (2-tailed)	.818	.000		.000
	Sum of Squares and Cross-products	-23.045	311.889	1870.107	1227.206
	Covariance	-.036	.484	2.899	1.903
	N	643	646	646	646
Fasting blood glucose second follow up	Pearson Correlation	-.013	.169**	.541**	1
	Sig. (2-tailed)	.743	.000	.000	
	Sum of Squares and Cross-products	-39.751	246.176	1227.206	2755.382
	Covariance	-.062	.382	1.903	4.272
	N	643	646	646	646

** . Correlation is significant at the 0.01 level (2-tailed).

Table 9. Correlation of age with pretest and posttest scores: The table below shows the results of the Pearson correlation tests performed. Age was significantly positively correlated with pretest and posttest scores ($P = .01$)

Correlations		Age	Pre education Test	Post education Test
Age	Pearson Correlation	1	.013	.038
	Sig. (2-tailed)		.748	.334
	Sum of Squares and Cross-products	3442.523	29.963	62.231
	Covariance	5.362	.047	.097
	N	643	642	642
Pre education Test	Pearson Correlation	.013	1	.725**
	Sig. (2-tailed)	.748		.000
	Sum of Squares and Cross-products	29.963	1650.318	823.261
	Covariance	.047	2.555	1.274
	N	642	647	647
Post education Test	Pearson Correlation	.038	.725**	1
	Sig. (2-tailed)	.334	.000	
	Sum of Squares and Cross-products	62.231	823.261	781.054
	Covariance	.097	1.274	1.209
	N	642	647	647

** . Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlation of the post-test score with BMI: The table below shows the results of the Pearson correlation tests performed. The posttest scores were significantly positively correlated with BMI at baseline, at the first follow up and at the second follow up (P=. .01)

Correlations		Post education Test score	Body mass index base line	Body mass index first follow up	Body mass index second follow up
Post education Test score	Pearson Correlation	1	.000	.185**	.179**
	Sig. (2-tailed)		.994	.000	.000
	Sum of Squares and Cross-products	781.054	.433	347.053	373.575
	Covariance	1.209	.001	.539	.580
	N	647	645	645	645
Body mass index base line	Pearson Correlation	.000	1	.462**	.265**
	Sig. (2-tailed)	.994		.000	.000
	Sum of Squares and Cross-products	.433	2780.652	1642.646	1046.204
	Covariance	.001	4.311	2.547	1.622
	N	645	646	646	646
Body mass index first follow up	Pearson Correlation	.185**	.462**	1	.581**
	Sig. (2-tailed)	.000	.000		.000
	Sum of Squares and Cross-products	347.053	1642.646	4542.844	2933.461
	Covariance	.539	2.547	7.043	4.548
	N	645	646	646	646
Body mass index second follow up	Pearson Correlation	.179**	.265**	.581**	1
	Sig. (2-tailed)	.000	.000	.000	
	Sum of Squares and Cross-products	373.575	1046.204	2933.461	5618.520
	Covariance	.580	1.622	4.548	8.711
	N	645	646	646	646

** . Correlation is significant at the 0.01 level (2-tailed).

Table 11. Correlation of the post-test score with fasting blood sugar concentration: The table below shows the results of the Pearson correlation tests performed. The posttest scores were significantly positively correlated with fasting blood sugar concentrations at baseline, at the first follow up and at the second follow up (P=. .01)

Correlations		Post education Test score	Fasting blood sugar of baseline	Fasting blood sugar first follow up	Fasting blood sugar second follow up
Post education Test score	Pearson Correlation	1	.017	.148**	.219**
	Sig. (2-tailed)		.668	.000	.000
	Sum of Squares and Cross-products	781.054	13.067	178.553	319.767
	Covariance	1.209	.020	.277	.497
	N	647	645	645	645
Fasting blood sugar of baseline	Pearson Correlation	.017	1	.260**	.169**
	Sig. (2-tailed)	.668		.000	.000
	Sum of Squares and Cross-products	13.067	770.551	311.889	246.176
	Covariance	.020	1.195	.484	.382
	N	645	646	646	646
Fasting blood sugar first follow up	Pearson Correlation	.148**	.260**	1	.541**
	Sig. (2-tailed)	.000	.000		.000
	Sum of Squares and Cross-products	178.553	311.889	1870.107	1227.206
	Covariance	.277	.484	2.899	1.903
	N	645	646	646	646
Fasting blood sugar second follow up	Pearson Correlation	.219**	.169**	.541**	1
	Sig. (2-tailed)	.000	.000	.000	
	Sum of Squares and Cross-products	319.767	246.176	1227.206	2755.382
	Covariance	.497	.382	1.903	4.272
	N	645	646	646	646

** . Correlation is significant at the 0.01 level (2-tailed).

Table 13. ANOVA and Regression Analysis

First follow up

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.604 ^a	.365	.358	1.36503	.365	52.345	7	637	.000
a. Predictors: (Constant), Post education Test, Body mass index first follow up.									

ANOVA ^a						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	682.740	7	97.534	52.345	.000 ^b
	Residual	1186.925	637	1.863		
	Total	1869.665	644			
a. Dependent Variable: Fasting blood sugar first follow up						
b. Predictors: (Constant Post education Test, Body mass index first follow up,						

Table 14. ANOVA and Regression Analysis

Second follow up

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.676 ^a	.457	.450	1.53319	.457	66.373	8	632	.000

a. Predictors: (Constant), Post education Test, Age, Body mass index second follow up.

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	1248.175	8	156.022	66.373	.000 ^b
	Residual	1485.622	632	2.351		
	Total	2733.797	640			

a. Dependent Variable: Fasting blood sugar second follow up

b. Predictors: (Constant), Post education Test, Age, Body mass index second follow up.

Table 15. Descriptive statistics mean and standard deviation

	Mean	Std. Deviation	t	Asymp. Sig P
Pretest_Score	2.33	2.11	t (24.33)	P <=. 001
Posttest_Score	7.34	1.43	t (113.36)	P <=. 001
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	10.15	6.00	t (42.59)	P <=. 001
Blood glucose first follow up	9.3294	5.17	t (41.92)	P <=. 001
Blood glucose second follow up	8.89	5.19	t (35.11)	P <=. 001

Table 16. Chi-square tests

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Age * Body mass index base line	172.04a	48	.000
Age* Body mass index first follow up	136.10 ^a	48	.000
Age* Body mass index second follow up	140.52a	48	.000
Age* Blood glucose base line	56.69a	36	.015
Age* Blood glucose first follow up	103.52a	36	.000
Post-test* Body mass index first follow up	59.69a	32	.002
Post-test * Body mass index second follow up	74.99a	32	.000
Post-test * Blood glucose base line	35.13a	24	.066
Post-test * Blood glucose first follow up	50.60a	24	.001
Post-test* Blood glucose second follow up	88.02a	24	.000

Table 17. Pearson correlation

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 score with fasting blood sugar of baseline, first follow up and second follow up	(P<. 01)

Table 18. Regression, ANOVA analysis and post hoc Turkey test

Baseline Linear regression The individual predictor Post hoc Turkey test	Significant F(7,637)= 2.44 , P<= .018, R2= .026 B=1.94 P< .000 suggest that for every one unit increase of baseline fasting blood sugar, the other variables baseline body mass index, 1.94 Unit, Baseline body mass index, with dependent variable baseline follow up fasting blood sugar significant P < .05.
First follow up linear regression The individual predictor Post hoc Turkey test	Significant, F (7,673) = 52.34, P<= .000, R2 = .365 R2 = .365 B=0.42 P< .001 suggest that for every one unit increase of the first follow up fasting blood sugar, the other variables first follow up body mass index, increase 0.42 Units, Body mass index, compared with dependent variable first follow up blood sugar are significant P < .005.
First follow up Linear regression The individual predictor Post hoc Turkey test	significant, F(7,673)= 52.34, P<= .000, R2= .365 R2= .365 B=-.165P< .001 every one unit decrease of second follow up fasting blood sugar, the other variables second follow up body mass index, decrease -.165 Unit Body mass index, compared with dependent variable first follow up blood sugar are significant P < .005.
Second follow up linear regression The individual predictor Post hoc Turkey test	Significant, F (8,632) = 66.37, P<= .000, R2= .450 B=0.42 P< .001 suggest that for every one unit increase of the first follow up fasting blood sugar, the other variables first follow up body mass index, increase 0.42 Units, Second follow up body mass index, compared with a dependent variable second follow up fasting blood sugar are significant P < .005.

4. Summary of Main Findings

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 within 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 age groups, body mass index, and fasting blood sugar.

5. Discussion

The present study found that educational intervention was highly effective in controlling anthropometric parameters (BMI), as these had significantly decreased from baseline at the second patient follow up visit. Metabolic control (blood sugar) also showed a significant positive improvement from baseline in the second follow up visit. Finally, participants also showed an improvement in knowledge through diabetes education. This was assessed by a pretest prior to the commencement of education and a posttest after the completion of the second follow 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 [3]. A Cochrane review [25] concluded that a reduction in blood sugar concentrations, and increased knowledge of diabetes. A Cochrane review [25] concluded that through group education of diabetes patients get motivated, start adherence to treatment and understand diabetes. Meta analyses and the outcome of various studies have shown positive impacts after receiving diabetes education, and enhanced knowledge of diabetes has been presented by Ricci-Cabello et al. [17]. In order to promote diabetes awareness, self-care behaviors can be useful. [23] described innovative strategies for the improvement of 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 [6], emphasized repeated diabetic education sessions to control and improve metabolic parameters. [8], using experimental and control groups regarding diabetes education.

The effect of pre- and posttests, showed a reduction in HbA1c, but no effect on BMI.

The present study found that participants had age group with diabetes mellitus was 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%.

6. Conclusions

Diabetes mellitus is a chronic and progressive disease, the prevalence of which is rapidly increasing. Uncontrolled diabetes mellitus may cause severe and irreversible untreatable complications, such as cardiovascular disease, retinopathy, nephropathy and cataract development. There is therefore a need to control anthropometric and metabolic parameters within an acceptable range in order to avoid the development of complications.

Currently, it is not only wealthy countries that have a high prevalence of diabetes mellitus; low and mid-level economic countries are also progressively showing an increase in the prevalence of diabetes mellitus. This includes Mozambique, which shows a progressive increase in the number of patients with diabetes mellitus due to the lack of a healthy diet, a sedentary lifestyle and urbanization. Regarding patients with diabetes mellitus in a central hospital in Nampula, it was recognized that there was a need for organizing, 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.

Diabetes education was performed with general and specific groups of patients, according to the needs of the patients, the complications of the diabetes mellitus and other diseases associated with them. Three education sessions were organized, at an interval of one month (baseline, first follow up and second follow up). Each participant was evaluated in each session regarding their BMI, blood sugar. The statistical analysis showed strong significantly positive effects on controlling each of these parameters. Prior to the commencement of the baseline education session, an evaluation of the evolution of patient knowledge regarding diabetes mellitus (the pre-test) was performed. At the end of the second follow up, a post-test was performed, which showed strong significant increases in the knowledge of diabetes.

The study also showed that the majority of the participants had diabetes mellitus type 2, were in the 41-60-year age group.

Motivational quote

“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 in the results of blood sugar results due to a lack of laboratory reagents. Patients who lived district, distance from the hospital, 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 significant positive outcomes in controlling their diabetes.

7. Contribution to Knowledge

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

8. Suggestion for Future Research

However, a need remains to involve other departments in future studies, for example, emergency and intensive care medicine, district hospitals and the effect of education of diabetes of family members to control the diabetic of the 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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