Impact of Different Types of Diets on Controlling Blood Glucose Level and Prevention of Complications Among Patients with Type 2 Diabetes.

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Abstract

Background: Globally, diabetes is a major health problem that can affect people of all ages and all races. However, there is still no cure for diabetes, diet is one of the most important approaches in maintaining controlled glycemic level. Aim: To evaluate the impact of different types of diets on controlling blood glucose level and prevention of complications among patients with type 2 diabetes. Sample: Purposive sample of 90 patients diagnosed with type 2 diabetes, categorized into 3 groups according to their diet preference as low carbohydrate diet, Ketogenic diet, and vegan diet. Research design: Quasi experimental research design was utilized in this study. Study Setting: This study was conducted in diabetes outpatient's clinic at Kafrelsheikh University Hospital. Tools: one tool was developed to collect data and consisted of three parts as following; Part one to collect patients' sociodemographic data, Part two designed to assess participants' medical data and diabetes related complications, and part three used to assess the effect of diets on certain variables. Results: showed that there was a statistical difference between total HA1C mean scores in relation to time of intervention as mean scores decreased from 6.71 in bassline period to 6.62 and 6.30 in 3- and 6months post intervention consequently for group following ketogenic diet as (F=8.921&p=<0.05). Conclusion: following healthy nutritional regimen is a significant factor for restoring health for patients with type 2 diabetes. ketogenic diet is the most relevant for patients with type 2 diabetes followed by vegan and low carb diet. Recommendations: nurses emphasize on continuous teaching of patients with type 2 diabetes about different types of diets and its effect on controlling blood glucose level and prevention of complications.

Keywords: Types of diets, Blood glucose, Complications, Type 2 diabetes.

Introduction

Diabetes is a major metabolic disorder that is caused by a combination of two primary factors: defective insulin secretion by pancreatic β -cells and the inability of insulinsensitive tissues to respond appropriately to insulin (Galicia-Garcia, 2020). In (T2DM) type 2 diabetes, cells don't respond normally to insulin; this is called insulin resistance. The pancreas makes more insulin to try to get cells to respond. Eventually the pancreas can't keep up, then blood glucose rise (Gavin, 2018) & (American Diabetes Organization, 2020).

Globally, prevalence of type 2 diabetes mellitus has reached epidemic magnitudes in the last few years of the 20th century because of the consequential adverse lifestyles resulted in widespread of obesity (WHO, 2020). As of today, almost 34.2 million people of all ages or 10.5% of the United States (U.S) population has diabetes, and about 34.1 million adults

aged 18 years or older or 13.0% of all adults in US had diabetes (Centers for Disease Control, 2020).

The International Diabetes Federation (IDF) in 2021 stated that Egypt is one of the 21 nations and regions of the IDF district. The IDF reported that 537 million people have diabetes worldwide, and 73 million people in the IDF region. It also conveyed that 10,930,700 adults have been affected with diabetes from total population 59,379,900 with prevalence rate of 18,4%. It was also confirmed that, by 2045 this will increase to 135.7 million (International Diabetes Federation, 2021). People can have type 2 diabetes at any age, even during childhood. They also are more likely to develop type 2 diabetes in cases of: overweight or having obesity, are age 35 or older, have a family history of diabetes, are African American, American Indian, Asian American, Hispanic/Latino, or Pacific Islander, are not

physically active, have prediabetes, have a history of gestational diabetes (Cole & Florez, 2020)..

Type 2 diabetes can be diagnosed by many diagnostic tests including; glycated hemoglobin (A1C) test, random blood sugar test, fasting blood sugar test and glucose tolerance test. A1C test indicates average of blood sugar level for the past two to three months and its results are indicted as: below 5.7% is normal, 5.7% to 6.4% is considered prediabetes and 6.5% or higher on two separate tests diagnosed diabetes. In addition, random blood glucose test should not exceed 200mg/dl, fasting blood sugar test should be less than 126 mg/dl and oral glucose tolerance test should be less than 200 mg/dl after two hours of drinking sugary fluid to avoid diagnosis with diabetes (Roglic, 2016).

Type 2 diabetes can lead to many complications such as heart disease, stroke, eye and kidney disease, foot problems, nerve damage, hearing problems and mental health. Researches recommended that controlling high blood pressure, taking medicines as prescribed, following healthy diet and practicing exercise are effective approaches in controlling and managing diabetes and its related complications (Faselis et al., 2020)

As of today, there is still no cure for diabetes. The progression of diabetes is influenced by food behaviors, dietary management is one of the most important approaches in preserving blood glucose level and prevention of diabetes related complications (Better Health, 2021). Nevertheless, the majority of patients do not receive dietary teaching that match culturally and traditionally with them. It is well known that it will be more effective when patients with diabetes know what they eat. As treatment of diabetes deeply depend on the patients' knowledge and readiness to follow the proper diet for diabetes control, so, it is recommended to give attention regarding different effective diets, ketogenic, as low carb and vegan diet. (Gray & Threlkeld, 2019) and (Mayo Clinic, 2021).

Ketogenic diet name came from ketosis, in which there is severe restriction for carbohydrates leading body to break down of fats to get energy. Keto diet is a very low - carb diet, making the consumed foods more restrictive than a low – carb diet. ketosis produces a fuel source called ketones. A ketogenic diet may help in controlling levels of HbA1c which is the amount of glucose traveling with hemoglobin in the blood over about 3 months some. It can be helpful for people with type 2 diabetes because it allows the body to preserve glucose levels at a low but healthy level. The ketogenic diet helps in increasing activity, improving sleep, decreasing body weight because it burns and breakdown fats. It is also effective for people with prediabetes and type 2 diabetes resulted from obesity (Craig, Winston J., 2019).

Low carbohydrate or low carb diet is a type of diet in which patients consume fewer calories than the body requires to achieve a negative energy balance. A low carbohydrate diet is a strategy for eating and drinking fewer carbohydrates such present in sugary foods, rice, corn and pasta, and focus on consuming lots of protein, green leavy vegetables, whole bread. The foods included in low carb diet including; broccoli, cauliflower, asparagus, fruits, nuts & seeds such as avocados, lemon, berries, walnuts, pecans, pumpkins (University of Glasco, 2020).

Vegan diet focus on foods that include adequate amount of fiber and protein that work together to keep blood sugars balanced. Vegan diet confirms on no meat, fish, eggs, poultry, milk, cheese, or other dairy products. It is better for patients following vegan diet to eat Beans, Lentils, Nuts and seeds, cauliflower, Berries, Apples, Pears, Avocado, Oatmeal. a healthy vegan diet may help managing type 2 diabetes and reduce the risk for getting heart disease, certain cancers, obesity (**Pollakova et al., 2021**)

Therefore, the healthcare professional team specially the diabetic nurses should develop continuous non pharmacological management and intervention such as life style modification in form of following different types of healthy diet regimens, which could help in controlling blood glucose level and prevent complications among patients with type 2 diabetes mellitus. However, these types of diets should be coincided with people's culture and dietary habits to help in controlling blood glucose level, prevention of type 2 related complication, reducing burden of the disease and improve health related quality of life. This approach is the focus of the current research and its impact on controlling blood glucose level and prevent complications.

Therefore, the aim of the currents study is to evaluate the impact of different types of diets on controlling blood glucose level and prevention of complications among patients with type 2 diabetes.

Significance of the Study:

Now adays, diabetes has identified as one of the most serious and public chronic diseases of the aeras, affecting people biopsychosocial as well as threat life, increase disability level, costly complications, and reducing life anticipation (Zheng et al., 2018). Globally, it has been reported that over half a billion of people are affected with diabetes which means that over 10.5% of the world's adult population now have this disease. In addition, almost 37.3 million people of all ages or 11.3% of the United States (U.S) population has diabetes and about 96 million adults aged 18 years or older had prediabetes (Sun et al., 2021). In addition, the revision of the medical record and statistical data of Kafrelsheikh University Hospital revealed that the number of patients with diabetes who are planned to be treated are 714 patients from (January 2020 to December 2020).

With diabetes, insulin cannot properly regulate the glucose levels in the body, leading to raised blood sugar which is called hyperglycemia. Over time, uncontrolled blood diabetes will lead to serious damages to different body systems. This is why early detecting and managing diabetes with pharmacological and nonpharmacological (dietary approaches) is important to reduce the risk of further diseases and maintain a normal blood glucose level (Farmaki et al., 2020). Although, there is still no absolute cure for diabetes, some researches proved that following non-pharmacological approach as healthy diets could control blood glucose level and prevent complications among patients with type 2 diabetes, as well as diet is a major part of maintaining low levels of glucose index and decreasing the risk of diabetic complications, which is why it is crucial to explore not only the recommended diet but also how specific diets affect the glucose levels of the body (Raveendran, 2018).

Untreated and /or neglected diabetes could cause serious complications such as heart disease

and stroke; cardiovascular disease affects up to 65% of all deaths in people with diabetes. peripheral arterial disease. retinopathy (blindness), nephropathy (renal disease). peripheral neuropathy, and lower-extremity amputations (Wamil et al., 2020). It is also mentioned by (Forouhi et al., 2018) in their study that diabetes is one of the biggest global public health problems and its incidence is estimated to increase from 425 million people in 2017 to 629 million by 2045, with linked health. social problems and economic costs

Diabetes has a significant link with diminished quality of life and high morbidity. Effective management of diabetes a associated had been with momentous enhancement in quality of life (Trikkalinou et al., 2017). Statistics about the epidemiology of DM in Egypt are sparse. Nevertheless, according to the IDF, Egypt ranks ninth in the prevalence of DM worldwide, and the number of adult diabetic patients was 8,850,400 in early 2020, with a prevalence of 15.2%. (International Diabetes Federation, 2021).

In addition, the finding of this study may identify the impact of different types of diets which include low fat diet, vegetarian diet and low carbohydrate die, and also this study results may identify the most effective type of diet that could help patients with type 2 diabetes to control their blood glucose level and prevent its related complications. There were no nursing researches that studied the effect of the three specific types of diet that included in this study. Furthermore, data derived from this study may afford a base for other studies in such field.

Aim of the Study:

The aim of this study was to evaluate the impact of different types of diets on controlling blood glucose level and prevention of complications among patients with type 2 diabetes.

Research Hypotheses:

In order to fulfill the purpose of this research, the subsequent hypotheses were proposed to be examined:

H1: There will be significant differences in blood glucose level and diabetes related complications after adhering to low carb diet among patients with type 2 diabetes.

- **H2**: There will be a significant difference in blood glucose level and diabetes related complications after adhering to ketogenic diet among patients with type 2 diabetes.
- **H3**: There will be a significant difference in blood glucose level and diabetes related complications after adhering to vegan diet among patients with type 2 diabetes.

Operational definition

Different types of diets

In the current study different **types of diets** include the following

- 1- Low carb diet: type of diet that contains 50– 100-gram carbohydrate with carb ratio 10 -20 % from required carb/ day (1 cup of skimmed milk that contain 12 g carb, 20 g chocolate gives 8 g carb, 2 tamers contain 30 g carb). no rice, white bread, black or chocolate, juice, macaroni donut as it contains high glycemic index sugar that. if patient practice exercise such as walking or cycling then he can take apple, watermelon at night because exercise with low carb diet act as ketogenic diet.
- 2- Ketogenic diet: diet that keep the patient in ketosis state, it contains 20-50 gram from carb /day with carb ratio 5-10% calory (the best for decreased weight and control blood glucose level) from required carb/ day. Patient can transfer to low carb diet if blood glucose controlled.
- 3- A vegan: only plant-based foods such as fruits, vegetables, grains, beans, nuts, and seeds are allowed in a vegan diet. A vegan diet excludes any animal products, such as dairy, eggs, and honey.

Note: The extended-release oral tablet of Metformin or any form of its brand names that include (Glucophage, Riomet, Fortamet, and Glumetza) was used in combination with one of the three mentioned diets as the drug of choice and the first line of treatment of type2 diabetes. Its dose depended mainly on the patient weight. Every patient received colored brochure containing information about the disease and examples of the mentioned diets with its amount (breakfast, lunch and dinner).

Scoring system will be matched with the interpreted results of glycated hemoglobin (A1C) test according to American Diabetic Association as follows:

- Normal when the percent is less than 5.7%.
- prediabetes is detected from 5.7% to 6.4%
- A two-test mean of 6.5% or above suggests diabetes.

Research design

The research design utilized for this study was quasi-experimental.

Study Setting: This study was carried out at Kafrelsheikh University Hospital's diabetic outpatient clinics.

Sample

G power analysis was used to determine the purposive sample of 90 patients with type 2 diabetes who were included in the current study. Patients were divided into three groups, according to their diet preference, each group contained 30 patients as follow; G1 adhered to low carbohydrate diet, G2 adhered to ketonic diet and G3 adhered to vegan diet. Inclusion criteria included adult male and female patients, age ranged from 20-60 years old, diagnosed with type 2 diabetes, fully conscious, able to converse, and willing to engage in the study. criteria: Patients Exclusion receiving medications for controlling diabetes other than Metformin. patients diagnosed with decompensated liver disease, cancer, advanced heart failure, and heart attacks, and any physical or psychological instability that would impact study participation.

Tools of the Study

Following a review of prior studies and literature, the researcher created a tool that was split into three sections and translated it into Arabic form. Seven questions made up Part I, that used to assess sociodemographic characteristics of study participants as age, gender, place of residence, educational level, marital status, employment and smoking. Part II, included three questions aimed to evaluate medical data as BMI, HA1c level, and questions about diabetes related complications. Part III, involved five questions which evaluated the effect of diets on some variables such as fatigue, sleep disturbance, practicing everyday activities, regular tasks, and continued diet compliance.

Validity and Reliability

Five knowledgeable faculty members from Kafrelsheikh University's faculties of medicine

and nursing who specialize in medical surgical nursing and medicine evaluated the study tool's face and content validity. The tools' clarity, information coverage, length, phrasing, structure, and over all style were evaluated by the experts. Changes were made in accordance with that. The Cronbach alpha test was used to assess the tool's reliability (alpha = 0.7).

Ethical Considerations

Both formal permission from the hospital administrator and ethical approval from Kafrelsheikh University's Scientific Ethical Committee (approved # MKSU 23-3-20) were granted in order to perform the study. Patients were informed about the study's purpose, and individuals who consented to participate in the study gave their informed consent. Participants have been informed that they have the autonomy to leave the study at any moment and without explanation. They were also given assurances on the protection of the data's confidentiality and anonymity through coding data. Respect was shown for ethics, morals, culture, and beliefs.

Pilot study

To verify the study's feasibility and the instrument used to collect data, a pilot study was carried out on nine patients who met the same inclusion criteria. It also looked at concerns regarding the research design and the amount of time needed to complete the form. The research tool didn't need to be changed based on comments from the pilot study. The entire study sample included patients who took part in the pilot study.

Data collection

Data collection started from January 2021 through June 2021.

Procedures

After receiving the formal approval from Research Ethical Committee at Faculty of Medicine, Kafreelsheikh University to conduct this study, an official permission was taken from the gastrointestinal unit at kafreelsheikh University Hospital and hospital administrators to conduct this study. The study was conducted on four phases as the following: assessment, planning, implementation, and evaluation phase. Assessment phase: involved collecting data through reviewing the literature regarding the disease, its treatment and by using the suitable tools, checking the feasibility of the study, also, accessibility of the sample was assessed.

Planning phase; based on the outcome of the assessment phase, final decision about time needed and frequency of patients' interview was developed after final tool development, also, the researcher develop schedule to collect data including day, time and duration.

Implementation phase: The researcher determined that face- to- face interviews with the subjects would be the best approach for collecting accurate and complete data. In order to identify the subjects for the study, the researcher inter the out patients' clinics and introduce herself. After brief introduction the researcher announced the name and the aim of the research study and then requested individuals who might be interested in participating to please identify themselves. After the identify, they were directed to specific area where they were given additional information about the study. the interview took place in the waiting rooms at the outpatient's clinics. The researcher was careful to provide a private space in the in the waiting areas where the subjects could be comfortable and have privacy during the interview. The researcher emphasized that anonymity and confidentiality will be assured through coding the data. The researcher conducted a prospective comparative study of 90 patients with type 2 diabetes with selected inclusion criteria were divided into three equal groups according to their chosen / preferred diet as follows; group (1) followed low carbohydrate diet, group (2) followed ketogenic diet, and group (3) followed vegan diet. hemoglobin A1C and BMI, and complications of diabetes were assessed at baseline for each group. After the assessment was obtained the researcher designed nursing educational protocol in form of printout and flyers based on literatures that might help all groups to adhere to their preferred diet.

the researcher designed two theoretical sessions/ day for each group according

to their classifications. this arrangement done in coordination with specialized physician in diabetic the clinic, each session was taken in 30-40 minutes. Patients were divided into three groups. The researcher gave two sessions/ day for one group of participants. This process continued for one month. Various teaching methods were used such as lectures, group discussion, Various teaching media were used, such as colored pictures, and hand out. Comparison between findings of total hemoglobin A1C mean scores was done to evaluate the effect of different diets on controlling blood glucose among patients with type 2 diabetes.

Evaluation phase: by coordination with specialized physician follow up done by meeting the patients in their scheduled day in the clinic and assessing hemoglobin A1C results that was requested to be done in the hospital Labe in addition, BMI, and complications of diabetes were assessed at baseline, three and six months later after adhering to the selected/ preferred diet using part two and three of the same tool. **Data analysis**:

SPSS, version 23, was used to tabulate, compute, and analyze the collected data. Frequency distribution, percentage, means, and standard deviations are examples of descriptive statistics. The study variables were analyzed and described using Fisher's accurate, chi-square and repeated measures ANOVA testing.

Level of significance:

For the above-mentioned statistical test done, the threshold of significance is fixed at 5% level (p-value). The results were considered:

-Non-significant when the probability of error is more than 5% (p > 0.05).

-Significant when the probability of error is less than 5% (p < 0.05).

-Highly significant when the probability of error is less than 0.1% (p < 0.001).

-The smaller the p-value obtained, the more significant are the results.

Results

Table 1 presented the demographic characteristics of the three groups and showed that more than (66%) of the study subjects were married, females and more than (50%) of them resided in rural areas, and can read and write. Regarding age, about 50% of the subjects ranged from (41-50 years old). Regarding occupation, there was mix between all occupational categories among the three groups and about (33%) of the subjects were housewife. In relation to smoking, the majority of all study groups were nonsmokers. There was no statistically significant between the demographic data among the groups so they are homogenies groups.

Table 2 denoted comparison of the medical data among the three groups of study during the baseline, 3- and 6-months post intervention. Among the 3 groups, there were statistically significant differences in relation to complication of diabetes such as heart failure, hypertension, neuropathy and nephropathy as x2=7.683& p=0.021, x2=10.588& p=0.005 and x2=10.949& p=0.004, x2=6.207& p=0.045consequently. otherwise, there were no statistically significant differences among the study groups.

Table 3 denoted the comparison between effect of different diets on some variables among the three groups of study after 3 and 6 months of intervention. Table 3 showed statistically significance difference between the three diets and presence of positive effective on health, reducing sleep disturbance after 3 x2=16.705& months as p=0.001 and x2=41.918& p=0.001 respectively. the table also showed statistically significance difference between the three diets and presence of positive effective on health, reducing sleep disturbance, decreasing fatigue and practicing daily living activity after 6 months as x2=24.375& p=0.001. x2=25.968& p=0.001 and x2=23.068& p=0.001, x2=19.327& p=0.001 consequently.

Figure 1 showed that there was a statistical difference between total HA1C mean scores in relation to time of intervention as mean scores

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decreased from 6.71 in bassline period to 6.62 in 3 months post intervention to 6.30 in 6 months post intervention for group following ketogenic diet (F=8.921&p=<0.05). There was no significance among the other two groups in

relation to time of intervention. Repeated measures ANOVA test was used to answer the three-research hypothesis through testing the change in means over the time of intervention between the three groups

Table 1. Distribution and	percentages of de	emographic chara	cteristics of the	studied subjects (N=90).
abit 1. Distribution and	percentages of a	smographic chara		studied subjects (11 200

	carbo	Low ohydrate diet	Ketoge	nic diet	Vega	n diet	Chi – Square / Fisher's exact test			
	n	%	n	%	n	%	X ²	Р		
Age (Years)										
20 - 30	2	6.7	3	10.0	2	6.7				
31 - 40	6	20.0	10	33.3	9	30.0				
41 - 50	18	60.0	13	43.3	14	46.7				
51 - 60	4	13.3	4	13.3	5	16.7	2.413	0.878		
Mean ±SD	42.	.8 ±4.3	43.6	±5.1	43.9	±3.9	0.763	0.469		
Gender										
Male	9	30.0	12	40.0	10	33.3				
Female	21	70.0	18	60.0	20	66.7	0.689	0.709		
Residence										
Urban	15	50.0	10	33.3	10	33.3				
Rural	15	50.0	20	66.7	20	66.7	2.338	0.311		
Marital Status										
Married	28	93.3	26	86.7	25	83.3				
Not married	2	6.7	4	13.3	5	16.7	1.450	0.484		
Employment										
Governmental work	9	30.0	6	20.0	12	40.0				
Non-governmental work	8	26.7	9	30.0	2	6.7				
Unemployed	3	10.0	7	23.3	5	16.7				
Housewife	10	33.3	8	26.7	11	36.7	8.609	0.197		
Educational level										
Can read and write	20	66.7	15	50.0	18	60.0				
Can not read and write	10	33.3	15	50.0	12	40.0	1.744	0.418		
Smoking Status										
Yes	4	13.3	5	16.7	7	23.3				
No	26	86.7	25	83.3	23	76.7	1.064	0.587		

	Baseline						3 Months									6 Months								
	Lo carboh di	ow Iydrate iet	Kete	etogenic Vegan diet diet		Chi – Square / Fisher's exact test		Low carbohydrate diet		Ketogenic diet		Vegan diet		Chi – Square / Fisher's exact test		Low carbohydrate diet		Ketogenic diet		Vegan diet		Chi – Square / Fisher's exact test		
	n	%	n	%	n	%	X ²	Р	n	%	n	%	n	%	X ²	Р	N	%	Ν	%	n	%	X ²	Р
BMI																								
Underweight	0	0.0	0	0.0	0	0.0			0	0.0	2	6.7	1	3.3			2	6.7	2	6.7	6	20.0		
Normal	2	6.7	4	13.3	7	23.3			3	10.0	7	23.3	9	30.0			11	36.7	12	40.0	11	36.7		
Overweight	8	26.7	10	33.3	11	36.7			15	50.0	10	33.3	11	36.7			9	30.0	8	26.7	6	20.0		
Grade I obesity	12	40.0	9	30.0	5	16.7			6	20.0	8	26.7	5	16.7			8	26.7	5	16.7	3	10.0		
Grade II obesity	5	16.7	5	16.7	5	16.7			4	13.3	1	3.3	3	10.0			0	0.0	3	10.0	3	10.0		
Grade III obesity	3	10.0	2	6.7	2	6.7	6.538	0.587	2	6.7	2	6.7	1	3.3	9.001	0.532	0	0.0	0	0.0	1	3.3	11.243	0.339
Complications																								
Heart disease	8	26.7	12	40.0	13	43.3	2.010	0.366	2	6.7	6	20.0	0	0.0	7.683	0.021^{*}	1	3.3	0	0.0	0	0.0	2.022	0.364
Hypertension	7	23.3	11	36.7	13	43.3	2.756	0.252	0	0.0	0	0.0	5	16.7	10.588	0.005^{*}	0	0.0	0	0.0	1	3.3	2.022	0.364
Peripheral																								
vascular disease	10	33.3	14	46.7	13	43.3	1.193	0.551	7	23.3	6	20.0	5	16.7	0.417	0.812	2	6.7	0	0.0	1	3.3	2.069	0.355
Neuropathy	13	43.3	17	56.7	15	50.0	1.067	0.587	7	23.3	2	6.7	13	43.3	10.949	0.004^{*}	1	3.3	0	0.0	0	0.0	2.022	0.364
Nephropathy	7	23.3	9	30.0	10	33.3	0.757	0.685	3	10.0	0	0.0	0	0.0	6.207	0.045^{*}	1	3.3	0	0.0	1	3.3	1.023	0.600
Retinopathy	7	23.3	9	30.0	10	33.3	0.757	0.685	1	3.3	0	0.0	0	0.0	2.022	0.364	0	0.0	0	0.0	1	3.3	2.022	0.364
Stroke	7	23.3	9	30.0	10	33.3	0.757	0.685	0	0.0	0	0.0	0	0.0	0.000	1.000	0	0.0	0	0.0	0	0.0	0.000	1.000
Liver disease	7	23.3	9	30.0	10	33.3	0.757	0.685	1	3.3	0	0.0	0	0.0	2.022	0.364	0	0.0	0	0.0	0	0.0	0.000	1.000
Respiratory disease	7	23.3	9	30.0	10	33.3	0.757	0.685	0	0.0	0	0.0	0	0.0	0.000	1.000	0	0.0	1	3.3	2	6.7	2.069	0.355

Table 2. Comparison of the medical data and diabetes related complications among the studied subjects (N=90).

*significant<0.05

				3 1	Months			6 Months											
	Low carbohydrate diet		te Ketogenic diet		Vegan diet		Chi – Square / Fisher's exact test		Low carbohydrate diet		Ketogenic diet		Vegan diet		Chi – Square / Fisher's exact test				
	Ν	%	n	%	n	%	X ²	Р	n	%	Ν	%	n	%	X ²	Р			
-If patient following the recommended diet	28	93.3	30	100.0	30	100.0	4.091	0.129	26	86.7	27	90.0	26	86.7	0.207	0.902			
-Practicing daily work tasks as usual	30	100.0	17	56.7	19	63.3	16.705	<0.001**	21	70.0	5	16.7	22	73.3	24.375	<0.001**			
-Sleep disturbances	17	56.7	0	0.0	0	0.0	41.918	< 0.001**	20	66.7	4	13.3	22	73.3	25.968	<0.001**			
-Fatigue	13	43.3	7	23.3	7	23.3	3.810	0.149	20	66.7	5	16.7	22	73.3	23.068	<0.001**			
- Practicing daily activity as usual	6	20.0	5	16.7	7	23.3	0.417	0.812	19	63.3	6	20.0	22	73.3	19.327	<0.001**			

Table 3: Comparison of the effect of diets on some variables among studied groups (N=90)

*significant<0.05

Figure (1) Comparison between total HbA1C mean scores during three time points (bassline, 3- and 6-months post intervention) among the studied groups (N=90).





Discussion

A sample of 90 patients with T2DM divided into three groups was utilized in the current study. Regarding the demographic characteristics, this study results indicated that; that more than two thirds of the study subjects were married females and more than half of them resided in rural areas, and can read and write. Regarding age, about half of the subjects ranged from (41-50 years old). This result is in the same line with the results of study done by (Birarra & Gelavee, 2018) who "Metabolic syndrome among type 2 diabetic patients in Ethiopia" and reported that the proportion of patients with T2DM increased in all age groups and most among females who can read and write. From the researcher point of view. obesity type 2 diabetes is common among female because of insulin resistance that result from obesity.

Over all, there were no nursing researches that studied the effect of the three specific types of diet on blood glucose level and prevention of type 2 diabetes related complications in the same study, but there were researches studied the effect of each diet separately or other types of diets .Regarding blood glucose level and type 2 diabetes related complications among studied subjects, the results of the current study showed significant decrease in in blood glucose and type 2 related complications among the studied subjects after adhering to ketogenic diet followed by vegan and low carbohydrate diet .

On investigating the effect of different diets on blood glucose level, the results of the current study revealed that ketogenic diet was most effective on controlling blood glucose level followed by vegan and low carb diet. These findings were supported by the finding of study done by (Yuan et al., 2020) who studied "Effect of the ketogenic diet on glycemic control, insulin resistance, and lipid metabolism in patients with T2DM: a systematic review and meta-analysis" and (Kumar et al., 2020) who studied " implicating the effect of ketogenic diet as preventive measure to obesity and diabetes mellitus" and both of them stated that: ketogenic diet is not only effective on controlling blood glucose level, but also has a great benefits on reducing body weight and controlling lipid profile and prevent diabetes associated disease such as hypertension and heart disease. From the researcher point of view, the component of ketogenic diet is effective in decreasing body weight that decrease blood sugar.

The results of this study also supported by the results of study done by (Kumar et al., 2020) who studied" Implicating the effect of ketogenic diet as a preventive measure to obesity and diabetes mellitus" and suggested that; diet is the significant issue responsible for triggering some kind of health problems that accompany the lifestyle, in addition they reported that ketogenic diet is very effective in managing and preventing such problems as obesity and type 2 diabetes.

Regarding blood glucose level and T2DM related complications after adhering to low carbohydrate diet, this study results is in agree with the study of (Dashti et al., 2020) who Efficacy of low carbohydrate studied" ketogenic diet in the treatment of Type 2 Diabetes" and reported that Low carbohydrate shifts the body to an alternate metabolic pathway that stabilizes insulin resistance. normalizes blood glucose, glycosylated hemoglobin and hepatic, renal and plasma lipid profile in type 2 diabetic patients.

Regarding blood glucose level and T2DM related complications after adhering to vegan diet, this study results is in agree with the study (Pollakova et al., 2021) who studied "The Impact of Vegan Diet in the Prevention and Treatment of Type 2 Diabetes: A Systematic Review" and reported that; many data-based studies have confirmed that the vegan diet is linked with lower T2D prevalence or incidence, although in some cohorts, it is not possible to distinguish if the beneficial effects derive from the vegan diet alone or from the overall healthy lifestyle. Furthermore, the results of randomized controlled studies performed in T2D patients have indicated its antihyperglycemic effect, even in the longterm.

Conclusion

In conclusion, this research revealed that different types of diets such as low carbohydrate,

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ketogenic and vegan diet could statistica control blood glucose level and diabetes related t complications among patients aged 20- 60 yea diagnosed with type 2 diabetes. In addition, t study showed that ketogenic diet is the most releva for patients with type 2 diabetes followed by veg and low carbohydrate diet.

Limitation of the study:

The main limitation for the study is that the sample sizes are relatively small. A larger sample size is needed to understand the durability of the diets in a larger and more varied population.

Based on the current study findings, the following recommendations are formulated:

- Nursing role as an educator should be continuing to teach patients with T2DM about following low carbohydrate, ketogenic and vegan diets and its role on controlling blood glucose level and its related complications
- Comparing the current study results with other study findings following the same diets without using oral hypoglycemic medication to get more identified results for generalization.
- Replication of the study on a larger probability sample selected from different geographical areas is recommended to obtain more generalizable data.
- Further researches should need to be applied on different types of diets and other nonpharmacological approaches combined or not combined with pharmacological regimens to investigate their effect on blood glucose level and diabetes related complications.

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