

Impact of Keto diet in type 2 diabetic patients

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Abstract

Type 2 diabetes is a chronic disorder. Its prevalence has been increasing steadily everywhere on the planet. As a result of this increasing trend, it is believed that the number of individuals affected will be doubled within the next decade. Low-carb and ketogenic diets are becoming popular among clinicians and patients, but the appropriateness of reducing carbohydrates intake in obese patients and in patients with diabetes remains debated. Therefore present project was undertaken with specific objective of analyzing effect of keto diet in diabetic patients. A reasonable reduction in weight of patients was seen who were kept on Ketogenic diet. However, it was noticed that Indian dietary habits include significant proportion of carbohydrates and proteins. Thus, a lot of people could not follow it religiously. Also, because of original dietary habits, such diet recommendation is not sustainable for a longer period of time.

Keywords

Keto diet, diabetes, weight loss, low carbohydrate diet

Introduction

Diabetes is an unremitting disease that occurs in case the pancreas does not prepare enough insulin or when the body does not use the insulin produced. Insulin is a hormone produced by the beta cells of islets of langerhans in pancreas that works like a key to process glucose from the diet we eat and transform the same from the dissemination frame work into the cells to produce energy. All types of carbohydrates in body are converted into glucose and insulin aids in absorption of glucose from blood into the cells (Krause, 2016).

Not having the alternative to produce insulin or use it sufficiently causes glucose to collect and deposit in the blood. Uncontrolled high blood glucose levels cause damage to the organs. Basically there are three types of diabetes i.e. gestational diabetes (GDM), Type 1 diabetes and Type 2 diabetes.

Gestational diabetes (GDM) is a kind of diabetes that causes high glucose level in the blood during pregnancy and is connected with the complexities to both mother and fetus.

Generally, women recover from gestational diabetes after pregnancy, yet they are prone to the risk of developing Type 2 diabetes. Children that were affected with diabetes during the gestation period are also prone to a high risk of developing Type 2 diabetes at some point of time in future life.

Type 1 diabetes can be caused in people of any age group. It generally occurs in children up to adolescent age. When type1 diabetes occurs, the body produces very less or no insulin. In this case, insulin doses are inevitable to balance glucose levels in the blood.

Type 2 diabetes is progressively fundamental in adults and contributes to around 90

percent of all diabetes cases. It's a condition that affects glucose control of body. The body is not able to use the insulin produced in the body. Healthy lifestyle including extended physical activity and balanced diet can help in delaying complications of type 2 diabetes. Still after some time most of the individuals with type 2 diabetes require oral hypoglycemic drugs or possibly insulin to balance their blood glucose levels. As insulin is not utilised properly in T2 diabetes, blood glucose levels keep increasing in the body which causes release of more insulin.

Ketogenic diet is becoming very popular now a day for weight loss & decreased weight is also associated with controlled blood glucose level (Sjostrom, 2000). A keto diet is high-fat, moderate protein, low-carbohydrate diet (Carracher *et al.*, 2018). There are various types of keto diet and some of these are as follows-

1. **Standard keto diet:** It has very low sugar content but adequate protein and excess fat diet. It embraces 70% fat, 20% protein and just 10% carbohydrates.
2. **Cyclical keto diets:** This eating regimen includes more of higher-carbs in the middle of the ketogenic diet plan, for e.g. five ketogenic days followed by two high-carb days as a cycle.
3. **Targeted ketogenic diet:** This diet includes extra carbohydrate encompassing the times of the concentrated physical activity.
4. **High-protein ketogenic diet:** It has more protein and the proportion is around 60 % fat, 35% protein and 5% starches however as can be seen, it is as yet an extremely high fat eating diet (Masood *et al.*, 2020). Some research work has been done on effect of keto diet on kidneys (Garneata & Mircescu, 2013) or pre dialytic patients (Prakash *et al.*, 2004) or its impact on Gut (Tuck & Staudacher, 2019). Yet a lot of work needs to be done in the direction of impact of ketogenic diet on diabetes.

A few people have proposed that this sort of diet may assist an individual with diabetes, yet the American Diabetes Association (ADA) does not suggest any single eating diet over another.

Each individual has distinctive dietary needs. Specialists customize diet plans based on current dietary patterns, an objective weight or glucose level for the individual.

Notwithstanding, in an individual with diabetes, insulin is either produced less or is not utilised appropriately. This impacts the body's capacity to utilize starches successfully and, thus, increases sugar levels in the blood. In the event that an individual eats a high-carb feast, this can prompt a spike in blood glucose, particularly in an individual with diabetes. Therefore diet is significant for both types of diabetes. Restricting the intake of sugars is the focal idea of the keto diet. People lose weight due to diabetes & weight loss is associated in diabetes control also. Although there are many studies on effect of keto diet on weight reduction but there is paucity of data on effect of keto diet on diabetes. Therefore present study was planned with following aim & objectives.

Aim

- To study effect of keto diet on type 2 diabetes mellitus

Objectives

- To take patients general information
- To assess nutritional status by checking height; weight; hip circumference; waist circumference; BMR, Fat % at the time of initial counselling & at the time of each follow up
- To record medical history – personal & family history for any disease & medication, allergies
- To check blood pressure; lipid profile, blood sugar, blood cholesterol & medications at the time of initial counselling & at the time of each follow-ups
- To give standardized diabetic diet chart to control group and ketogenic diet chart to experimental group of Type 2 diabetes patients
- To compare result of control and experimental group using statistical test after completion of data

Rationale

There is limited number of studies regarding the role of keto diet in Type2 diabetes in Indian patients. So, present study will add to the available data on role of keto diet specially on Rajasthani population. Knowledge gained may be beneficial to society and Improvement in treatment strategy as this study will correlate benefits of ketogenic diet in type 2 Diabetes patients.

Research Methodology

Study design

A single centre, prospective study conducted by Department of Medicine and Department of Food & Nutrition, Mahatma Gandhi University of Medical Sciences & Technology, Jaipur, over a period of three months.

Study area

Patient's data collection was done at Mahatma Gandhi Medical College & Hospital, Jaipur

Study population

Patients of either sex having type 2 diabetes, fulfilling the inclusion criteria were prospectively interviewed.

Inclusion Criteria

- Age 35 – 65 years with type 2 diabetes
- Participants may be male or female
- Cooperative patients
- Having no other associated health ailment than type 2 diabetes

Exclusion Criteria

- Age < 35 years or > 65 years
- Non cooperative patients
- Intolerant to ketogenic diet
- Patients with severe dyslipidaemia (Cholesterol > 350 mg %)
- Patients with serious medical conditions like coronary artery disease / chronic kidney disease with creatinine >2.0 mg / severe bronchial asthma / patients with

- cerebro vascular accident (onset within 6 months)
- Patients having chewing difficulty.

Sample size

100 patients were taken: 50 for control group & 50 for experimental group

Study duration: 3 months

Route of administration: Oral diet

Statistical analysis

Mean values, standard deviations were calculated for each types of values & averages were calculated. Appropriate statistical tests were applied as per statistician software to compare with control group.

Data collection: Consent was taken from patients selected for study from both the groups – control & experimental group.

The general information of patients was recorded on a set performa. In this performa information on patient's name, age, sex, OPD No., family history, social economic status, literacy status, occupation, food preferences, food allergies was recorded.

Nutritional status was assessed at the time of initial counselling & at the time of follow up visits after each month till 3 months. In this, patient's height (cm) & weight (kg) were recorded using heightometer & digital weighing scale respectively. BMI was calculated using following formula: $(Wt. (kg)/Ht.(M)^2)$. Hip circumference & waist circumference was measured by measuring tape. BMR & fat% were determined using body fat analyzer based on bio impedance technique.

Blood pressure was recorded using digital sphignomanometer. Lipid profile & blood sugar was recorded by lab reports at the time of initial counselling & at follow ups. At each month, till 3 months. HbA1c value was also collected at the time of initial counselling & after 3 months at the time of completion of study.

Difficulty in chewing and swallowing the food was noted (if any). Information on appetite/ food intake was recorded to assess nutritional status. Weight loss and weight gain was noted of patients at each visit.

Medical history was recorded by patients or attendant's interview to rule out any comorbid condition & history of medication was also noted.

Control group was advised & counselled for standard diabetic diet while the experimental group was given standard keto diet charts. All patients were given diet plans according to their reports. Ketogenic diet was given to patients who fulfilled inclusion criteria & were enrolled for study.

Sample format of diet chart for standard diabetic diet

8 am: Milk (toned sugar free ½ glass) + 1 bowl Dalia/ upma/ oats/ rabadi/ 1.5 idli/ brown bread + 1 bowl sprouts/ 2 eggs white.

11 am: Fruits (g) – Apple/ orange/ mausambi/ pomegranate/ papaya/ guava/ jamun/

pears (No juice)

1 pm: Salad 200 g + Multigrain chapatti (without ghee) + dal + veg + chaach

5pm: Milk (toned sugar free ½ glass) + g roasted chana

7pm: Salad 200 g + Multigrain chapatti(without ghee) + dal + veg

Avoid - Sugars & starchy foods like cereals (rice/ wheat/ pasta/ Maida), roots & tubers (potato/ arbi/ sweet potato/ yam), fruits (mango/ banana/ cheeku/ grapes/ lithi/ dates), unhealthy fats (dalda/ Trans fats etc.)/ fruit juices & sweets (sugar/ honey/ jaggery/ chocolates/ cakes/ ice creams)

Exercise: ½ an hour walk morning & evening

Sample format for diet chart for ketogenic diet

8 – 9 am Breakfast: Milk 1 glass sugar free (Gold/ buffalo's) + sprouts 60g + 4 tsp. oil

12 pm Lunch: 200 g raw vegetables + Curd from gold milk + Dal + jow/ bajra/ multigrain chapatti + 4 tsp. ghee

4 pm Evening Snack: 2 eggs (Whole) / Paneer (from gold milk) 50 g

7 pm Dinner: 200 g raw vegetables + Baked beans + 30 g cheese + 4 tsp. ghee

Avoid - Sugars & starchy foods like cereals (rice/ wheat/ pasta/ Maida), roots & tubers (potato/ arbi/ sweet potato/ yam), fruits (mango/ banana/ cheeku/ grapes/ litchi/ dates), unhealthy fats (dalda/ Trans fats etc.)/ fruit juices & sweets (sugar/ honey/ jaggery / chocolates/ cakes/ ice creams)

Exercise: ½ an hour walk morning & evening.

Participant's confidentiality: Any data, forms, reports or other records were identified only by a participant identification number (patient ID) to maintain confidentiality.

Results and Discussion

A total of 100 diabetic patient's data (50 control patients receiving standard diabetic diet and 50 experimental group patients receiving ketogenic diet) was collected in this study and their data was analysed statistically and described below:

Table 1 - Number of male & female patients in control & experimental group

Parameters	Control Group		Experimental Group	
Gender	Frequency	Percentage	Frequency	Percentage
Male	32	64.00	22	44.00
Female	18	36.00	28	56.00
Total	50	100	50	100.00

Table 1 represents the number of males and females registered in control group & in experimental group. In control group 64% males & 36% females were registered while in keto diet group, 44% males & 56% females were registered.

Table 2 - BMI of control group & experimental group at the time of initial assessment

Parameters	Control Group		Experimental Group	
BMI	Frequency	Percentage	Frequency	Percentage
Underweight	6	12.00	0	0
Normal	16	32.00	0	0

Overweight	19	38.00	23	46.00
Obese	9	18.00	27	54.00
Total	50	100.00	50	100.00

Table 2 represents the Body Mass Index (BMI) of both control & experimental group patients. In control group, 6 patients were underweight & 16 patients were normal out of 50, while no patients were found in this BMI classification category in experimental group. In control group, 38% patients were overweight while in experimental group, 46% patients were found overweight. In control & experimental groups, 18% & 54% patients were marked as obese patients respectively. Joshi & Vishwanathan (2018) also recommended that keto diet is beneficial in reducing weight & menace obesity but it should be prescribed in moderation.

Table 3 - Average Measurements of weight in control & experimental group patients

Parameters	Control Group	Experimental Group
Duration	Weight (Kg)	Weight (Kg)
Month 0	79.9	114.6
Month 1	78.96	112
Month 2	78.64	109.3
Month 3	78.3	106.5

Table 3 is depicting average weight of 50 patients in Kg for both control & experimental groups. It was observed 79.9 Kg for control group & 114.6 Kg for experimental group at the time of registration, which showed 2% reduction (not significant) in control group, while 7% decrease (significant) was seen in experimental group at the time of completion of study. The present findings are in consonance of the results Dashti *et al.* (2004) who supported significant reduction in weight & BMI in patients on ketogenic diet.

Table 4 - Average measurements of waist circumference in control & experimental group

Parameters	Control Group	Experimental Group
Duration	Waist (cm)	Waist (cm)
Month 0	87.05	112.6
Month 1	84.55	110.1
Month 2	84.9	106.9
Month 3	83.72	103.7

Table 4 is presenting average waist circumference of patients in control & experimental group at the time of starting & completion of study. A non significant reduction of 3.83% in waist circumference was seen in control group, while in experimental group it was found to be declined to 7.9% after 3 months ($p < 0.01$). A decrease in waist circumference may be attributed to weight reduction that was found more in ketogenic diet patients as compared to standard diabetic diet.

Table 5 - Occurrence of blood pressure in control & experimental group at the time of initial counselling & at completion of study (3 months)

Parameters	Control Group	Experimental Group
Duration	BP (mm Hg)	BP (mm Hg)
Month 0	140/95	150/95
Month 3	130/90	130/80

Table 5 is showing initial & final blood pressure values in both groups of patients. A reduction of 7% in systolic & of 5.27% in diastolic pressure was seen in control group, while in experimental group, a decline of 13.34% & 15.79% was observed in systolic & diastolic pressure. Warner (2010) also described a reduction in blood pressure on low carbohydrate diet. They found nearly half of those who followed the low-carbohydrate group had their blood pressure medication decreased or discontinued during the study, compared to only 21% of those in the orlistat group.

Table 6 - Comparison of cholesterol in control & experimental group patients

Parameters	Control Group	Experimental Group
	Cholesterol (mg)	Cholesterol (mg)
Month 0	270	300
Month 3	200	180

Table 6 is depicting cholesterol content of control & experimental group at the time of initiation & completion of study. A decline of 25.93% & of 40% was observed in control & experimental groups respectively. It is in consonance with the research of Rosa *et al.*, 2020 who described decrease in weight, BMI & lipid profile after giving very low calorie ketogenic diet to patients. It was also reported by Warner (2010) also.

Table 7- Average blood sugar levels of control & experimental group patients

Duration	Control	Experimental
Month 0	148.1	155.6
Month 3	135.4	141.5

Above table 7 is presenting random blood sugar profile of diabetic patients on standard & keto diet. After 3 months, a decline of 8.58% was seen in control group while 9.07% decrease was observed in random blood sugar level of experimental group. It is in agreement with the findings of Hussain *et al.*, (2012). Decrease in blood sugar level may be attributed to more weight loss with ketogenic diet.

Conclusion

After analysing results & discussion of the present study, it can be concluded that ketogenic diet is beneficial in reduction of weight, waist circumference, cholesterol, blood pressure & blood sugar level. But most of the patients were not willing to follow it for long time as it contained high fat & very low carbohydrate levels. From other studies also it was found that long usage of ketogenic diet contributed to some negative health impact like elevated lipids, altered body metabolism, insulin resistance etc. (Seidemann *et al.*, 2018). Therefore it should be advised in moderation for shorter time duration only with careful monitoring of diagnostics & patient's adherence to avail best results for weight loss as well as control of metabolic problems including diabetes.

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