ORIGINAL ARTICLE

A Study on Ketogenic Diets Versus Reduction in Cardiological Events

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ABSTRACT

Objective: To study the effect of ketogenic diet in reducing the cardiovascular events.
Study Design: Randomized control trial
Place and Duration of Study: Medical Unit, Mayo Hospital, Lahore. 1st Oct 2017 to 30th March 2018.
Methodology: Sixty patients of overweight and obese were recruited. The participants already suffering from type 2 diabetes, were also included in the study. Patients within the age group of 18 to 50 years with a body mass index ≥25 kg/m2, and or newly diagnosed as T2 diabetes mellitus having no hypoglycemic agent, and HbA1c < 10% were also included in the study. All patients who gave consent for undergoing ketogenic diet were included in the keto diet group while rest of the participants were enrolled as control group with normal diet plan. This way two groups were formed, one on ketogenic diet and termed as group ketogenic diet (KD) while the other as controls and termed as group normal diet (ND). A ketogenic diet comprising of 75%fats, 25% proteins and 5% carbohydrates with a specified portion of meat, seafood, eggs, vegetables, nuts and beverages were administered to each patient for a period of three months. The baseline tests including biochemical analysis of fasting blood sugar, lipid profile, insulin levels, uric acid, anthropometric measurements including body weight, were recorded and were reanalyzed after every month. The post interventional data was than compared with the pre interventional data among both groups.
Result: The mean age of KD group was 36.51±13.86 years while of ND group was 37.12±14.12 years. There was no significant difference in the waist circumference, weight, and BMI of both group participants. After post intervention there was a significant decrease in the weight, BMI and waist circumference of the KD group. The blood sugar levels were much better reported in the KD group in comparison with ND group post intervention with a significant reduction observed in KD group. The lipid profile also showed promising results with a significant reduction in triglycerides (TG), low density lipoproteins (LDL) as well as total cholesterol (TC) levels while the high-density lipoproteins (HDL) showed an increase in the values in KD group post intervention.There were significant number of the cases (77.42%) in the ND group who wanted to continue the dietary planned they were following in the long term, however only 17.24% of the participants in the KD group wanted to continue the dietary plan in long term.
Conclusion: The ketogenic diet seems to have good potential outcomes in preventing cardiovascular events. However, long-term persistence is difficult among the population of this region.
Keywords: Ketogenic diet, Normal diet, Cardiovascular disease, Effects

INTRODUCTION

The incidence of cardiovascular diseases is increasing globally with 18 million people affected by it. The incidence has increased with a rate of 18.7 % from 2010 to 2020 with an ascent in cases up to 19 million per year. Researchers apprehend the fact that the rate of cardiovascular diseases is not controlled and may lead to an increase in number of deaths as 23.3 million per year by the year 2020. It is pertinent to note that even by disease like cancer the death rate od half of that of those with cardiovascular disease, raising serious concerns [1-3].

Cardiovascular ailments comprise of coronary heart disease, heart failure, congenital heart defects, pericardial disease, cerebrovascular disease, cardiac arrhythmia, hypertension, cardiomyopathy (heart muscle disease), valvular heart disease rheumatic heart disease, cardiac arrest, atherosclerosis, strokes, and dyslipidemia [2]. There are various causes identified as the risks factors for cardiovascular events. These include poor dietary habits, deficiency of vitamins, especially vitamin D, smoking, inactive lifestyle, obesity, hypertensions, excessive intake of sodium, dyslipidemia, and stressful lifestyle [4-5].

For achieving optimal health and preventing cardiovascular events it is very significant to avoid risks factors and attained a healthy lifestyle. A healthy lifestyle specifically focuses on eating healthy with a choice of more natural resources of diet than trans fats and artificial foods. The standard advised dietary administration for the avoidance and treatment of cardiovascular diseases includes elevated vegetables intake as well as high consumption of fruits, fish, legumes, in addition to the whole grain products[6]. The diet specifications are according with the recommended Mediterranean and DASH diets [7-9].

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Recent years have highlighted another dietary resource for the reduction of cardiovascular risks. This involves a ketogenic dietary plan which focuses on body ketosis wherein the energy is taken through ketone bodies produced from fats of the body. This is a variant diet plan than other available diet plans as its major source is ketone bodies instead of glucose.To attain a nutritional state of ketosis, the energy proportion delivered from fat in such a diet is usually 70–80%. Despite the beneficial facts about the ketogenic diet there is a mega controversy about its implications as fats have a poor reputation in context of development of cardiovascular diseases [10].

The American Heart Association states that the ketogenic diet highlights some controversies as it is not in line with the dietary guideline suggested by their association [10]. However, many other studies are focused on the benefits of this dietary pattern in reduction of cardiovascular disease. The present study was designed to elaborate and study in detail the effect of ketogenic diet in terms of reduction of cardiovascular events. The results of this research provide evident data in understanding the pros and cons of the ketogenic diet in terms of reducing cardiovascular events and its impacts on patients' health.

MATERIALS AND MEHTODS

This randomized control trial was conducted at Medical Unit, Mayo Hospital, Lahore from 1st Oct 2017 to 30th March 2018. Sixty patients of overweight and obese patients after getting an informed written consent signed by them were recruited. A total of 29 patients out of random selection consented for keto diet while rest 31 patients were placed in the ND group. The overweight and obesity was determined through the BMI (weight in kg and height in m^2) and waist circumference (measured by inch-tape around waist) of each patient. The sample size was calculated as 60 patients after using a calculation based on WHO available sample size calculator website applying 80% power of test and 95% CI. The study was ethically approved by the institutional review boards before its initiation and patient enrollment. The participants already suffering from type 2 diabetes, were also included in the study.

Patients within the age group of 18 to 50 years with a BMI ≥25 kg/m2, and or newly diagnosed as T2DM having no hypoglycemic agent, and HbA1c < 10% were also included in the study. Those patient's serious complications of heart, liver, lung, kidney, or brain disease, or having a history of serious acute or chronic diabetic complications and those who underwent infection, pregnancy, trauma, or surgery, as well as pregnant lactating women, using any kind of drugs which could interfere with glucose metabolism disorders were excluded from the study. All patients who gave consent for undergoing ketogenic diet were included in the keto diet group while rest of the participants were enrolled as control group with normal diet plan. This way two groups were formed, one on ketogenic diet and termed as Group KD while the other as controls and termed as Group ND. A ketogenic diet comprising of 75%fats, 25% proteins and 5% carbohydrates with a specified portion of meat, seafood, eggs, vegetables, nuts and beverages were administered to each patient for a period of three months. In the diet plan each patientconsumed under 50 grams (g) of carbs and approximately 1.5 g of protein per kilogram of body weight per day. For the KD group the daily limits for ingredients were with 30-50 g carbohydrate, 60 g protein, 130 g fat, with a total consumption of calories as 1500±50 Kcal. For the ND group, no limitation was placed on food types with a daily limit as carbohydrate 250-280 g, protein 60 g, fat 20 g, total calories (1500 ±50) Kcal. In both groups a daily consumption of 2000ml of water was mandatory. Below is a sample week keto meal plan.

Table:

	Breakfast	Lunch	Dinner	Snacks with tea (no sugar)
Monday	Egg muffins with Cheddar cheese, spinach, and sun-dried tomatoes	Spiced cauliflower soup with meat	Garlic and herb buttered white chicken with boiled pasat	Roast turkey, cucumber, and cheese roll-ups
Tuesday (Low fiber day)	Scrambled eggs on a bed of sautéed greens with pumpkin seeds	Chicken mayonnaise salad with cucumber, tomato, almonds, and onion	Beef and mushrooms, onions, celery, herbs, and beef broth	Almond smoothie and spinach
Wednesday	Omelet with mushrooms, broccoli, and peppers	egg salad with onion and spices, served in lettuce	chicken breast with cauliflower rice and salad	Nuts
Thursday	Smoothie containing almond milk, nut butter, spinach, and protein powder	Chiken breast, herbs, lemon juice, and olive oil	Garlic butter steak with mushrooms	A boiled egg Flax crackers with cheese
Friday	2 eggs, fried in butter, with avocado and blackberries	Grilled fish with a salad of mixed leafy greens and tomato	Chicken breast with cauliflower mash and green beans	Slices of cheese and bell peppers
Saturday	Scrambled eggs with jalapeños, green onions, and tomatoes sprinkled with sunflower seeds	Fish salad with tomatoes and avocado and nuts	Chicken breast with cauliflower mash and green beans	Celery sticks with almond butter dip and berries
Sunday	Yogurt and eggs	Chicken mayonnaise salad with cucumber, tomato, almonds, and onion	Stir-fried chicken, broccoli, mushrooms, and peppers	Chicken, egg and vegetable

The effect model was preferredcorresponding to heterogeneity. The baseline tests including biochemical analysis of fasting blood sugar, lipid profile, insulin levels, uric acid, anthropometric measurements including body weight, were recorded and were reanalyzed after every month. The data was entered in a well-structured questionnaire. The data variables included demographic, clinical details, comorbidity related information as well as BMI, lipid profile value, (TG (triglyceride), TC (cholesterol), LDL (low-density lipoprotein cholesterol), HDL (high-density lipoprotein cholesterol), FBG (fasting glucose), FINS (fasting insulin), HbA1c (glycosylated hemoglobin)) at the start of the study and follow up. The data was analyzed using SPSS version 26.0 through applying chi square test for analysis wherein p value as 0.005 was considered as significant.

RESULTS

The mean age of KD group was 36.51±13.86 years while of ND group was 37.12±14.12 years. There was no significant difference in the waist circumference, weight,and BMI of both group participants. Table 1

Table1: Demographic data comparison between both groups and initiation of the study

Variables	KD group (n=29)	ND group (n=31)	P value
Age (years)	36.51±13.86	37.12±14.12	0.659
Waist(cm)	108.51±12.14	107.34±12.27	0.713
Weight (kg)	78.33±15.28	77.96±14.77	0.857
BMI (kg/m^2)	29.14±5.82	29.76±6.08	0.935

The biochemical analytes at the initiation of the study showed a slightly higher value of uric acid in ND group while the mean HbA1c of the KD group and FINS, FBG was higher in the KD group in comparison with the ND group. However, the variance was insignificant between both groups. Table 2.

Table 2: Comparison of biochemical analytes at imitation (Pre intervention) of the study

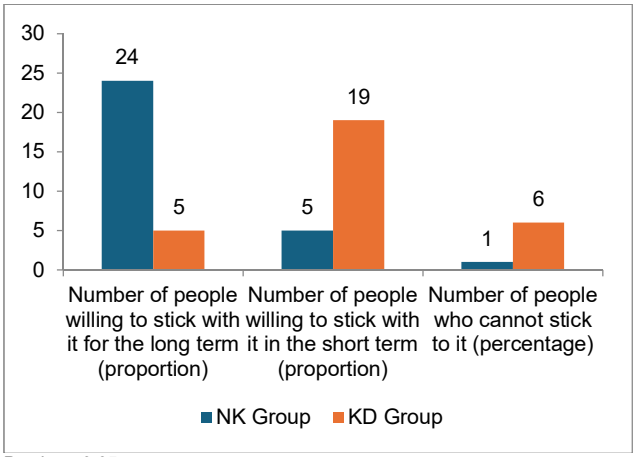
Variables	Ketogenic diet group	Diabetic diet group	P value
UA(µmol/L)	378.24±24.36	382.42±26.63	0.669
HbA1C (%)	8.74±1.64	8.70±1.60	0.673
FBG (mmol/L)	9.01±2.78	8.98±2.49	0.940
FINS (pmol/L)	48.62±17.84	45.9±14.39	0.687
LDL (mmol/L)	2.76±0.66	2.78±0.70	0.864
HDL (mmol/L)	1.09±0.11	1.11±0.20	0.469
TG (mmol/L)	1.77±0.59	1.82±0.78	0.717
TC (mmol/L)	4.55±0.69	4.57±0.67	0.830

The results of the research presented a significant variance among groups post intervention of dietary modification within groups.There was a significant decrease in the weight, BMI and waist circumference of the KD group then the ND group. However the uric acid increased in the KD group from 378.24±24.36 to 467.44±35.68 µmol/L while it decreased in the ND group from 382.42±26.63 to 379.54±25.79 µmol/L respectively. The blood sugar levels were much better reported in the KD group in comparison with ND group post intervention with a significant reduction observed in KD group. The lipid profile also showed promising results with a significant reduction in triglycerides (TG), low density lipoproteins (LDL) as well as total cholesterol (TC) levels while the high-density lipoproteins (HDL) showed an increase in the values in KD group post intervention. Table 2.

When the enrolled participants were interviewed about theirview to persist to the dietary planned offered in both groups, there were significant number of the cases (77.42%)in the ND group who wanted to continue the dietary planned they were following in the long term, however only 17.24% of the participants in the KD group wanted to continue the dietary plan in long term. A significant number of the participants in the KD group were willing to stick to the dietary planned offered in a short-term course (65.51%) [Fig. 1].

Table 3: Comparison in biochemical analytes pre and post intervention between KD and ND groups

	KD group (n=29)		P	ND group (n=31)		P-value
	Pre-Intervention	Post Intervention		Pre-Intervention	Post Intervention	
Waist(cm)	108.51±12.14	99.25±14.59	0.000	107.34±12.27	106.57±9.77	0.000
Weight (kg)	78.33±15.28	70.25±14.80	0.000	77.96±14.77	77.35±13.29	0.000
BMI (kg/m2)	29.14±5.82	26.22±5.75	0.000	29.7±6.08	29.42±5.98	0.000
UA (umol/L)	378.24±24.36	467.44±35.68	0.000	382.42±26.63	379.54±25.79	0.238
HbA1C(%)	8.74±1.64	7.82±1.44	0.000	8.70±1.60	8.43±1.51	0.000
FBG (mmol/L)	9.01±2.78	7.63±1.70	0.000	8.98±2.49	8.43±2.17	0.000
FINS (pmol/L)	48.62±17.84	40.39±9.54	0.000	45.9±14.39	84.23±10.80	0.000
LDL (mmol/L)	2.76±0.66	2.34±0.46	0.019	2.78±0.70	2.60±0.59	0.140
HDL (mmol/L)	1.09±0.11	1.22±0.24	0.000	1.11±0.20	1.13±0.21	0.000
TG (mmol/L)	1.77±0.59	1.45±0.27	0.000	1.82±0.78	1.65±0.47	0.000
TC (mmol/L)	4.55±0.69	4.03±0.44	0.000	4.57±0.67	4.22±0.45	0.000



P value <0.05

Figure 1: Comparison between the KD and ND group data willing to continue their dietary plan in future.

DISCUSSION

Worldwide there is a raised incident of cardiovascular disease with increased trend in sever morbidities and mortality. Obesity plays an important role in causing cardiovascular events among vulnerable population. The incidence of cardiovascular is far ahead than other lethal disease causing an international concern to control and prevent its formation[11]. Literature reveals that an appropriate dietary patterns and healthy lifestyle including daily exercise causes a positive implication in prevention and control of cardiovascular events among general population. It is also elaborated in the research that patients having type diabetes can also prevent cardiovascular events by following dietary interventions and daily exercise. The current research emphasized similar facts and evidently proved the reduction in blood glucose levels and lipid profile by following a specified dietary plan (KD group).

There have an adequate criticism on the application of ketone diet due to the high fat content and low carbohydrates especially until the mid of last decade. A study published in lancet[12] suggested that a high consumption of carbohydrates was directly associated with mortality. Scientistsstartedreevaluating the ketone diet since the publication of Lancet data. Research has proved it to be a therapeutic diet with a significant benefit in reducing cardiovascular disease and its related risk factors as obesity, high blood sugar and increase cholesterol levels in the body [13].

In the ketosis state the insoluble triglycerides are transformed into water-soluble ketone bodies (acetoacetate, β hydroxybutyric-acid soluble in the water, as well as acetone which are insoluble in water). It is pertinent to mention that the keto bodies suppress the food craving and consequently assist in the reduction of weight and lipid analytes including TG, LDL and TC[14-15]. Similar results have been reported in the current study as well.

The ketone diet application focuses on the consumption of low carbohydrate diet which results in the decomposition rate regulation of the liver glycogen and further reducing blood glucose. This has also been observed in the results of the present study and elsewhere[16]. Goday et al[17] established the security, acceptance, and efficacy of short-term KD among the patients with T2DM. Tay et al[18] also verified the efficacy of ketone diet in reducing blood glucose levels and being highly beneficial not only for healthy patients but also for those suffering from type 2 diabetes.

Saslow et al[19] also proved similar results in their research wherein the beneficial effects of the ketone diet in controlling blood glucose have been emphasized. The control of body weight through ketone diet is also positive outcome of the ketone diet. Partsalaki et al[20] elaborated in their research that ketone diet assists in reduction of waist circumference which is the main factor in obesity, thus supporting in achieving healthier body shape and prevention of any adverse cardiovascular events. The present study results also prove similar facts wherein the KD group presented reduction in waist circumference post intervention in comparison with the ND group.

CONCLUSION

Continuing ketogenic diet can restrain not only weight but also assist in controlling the blood glucose and blood lipid in overweight and obese patients with or without T2 diabetes mellitus. However, long-term persistence is difficult among the population of this region. The ketone diet seems to have good potential outcomes on preventing cardiovascular events.

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