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Health implications of ketogenic diet in the Kurdistan region

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Abstract--The ketogenic diet has been popularized internationally in recent years, used widely for weight loss by overweight and obese people in a fast way. The purpose of the cross-sectional study was to evaluate the health implication of short and long ketogenic diets among the Kurdish population. a cross-sectional study has been carried from 22nd to 29th April 2021, a web-based questionnaire was consisting of two sections. Section one (3) sociodemographic questions (sex, age, and education level), section two was consisting of the (5) questions about the ketogenic diet information. The results show that the number of participants was 375 people. regarding the question of they have tried the ketogenic diet, 340 responses were yes. more than one complication has been observed such as headache, constipation, keto rash, keto breathes, kidney diseases as well as cholesterol and liver diseases, and about 45.9% (156) have not any complications during the implementation of the ketogenic diet. about 53.23% (181) respondents have stayed in the ketogenic diet for a short-term. In conclusion, the study has been observed that some symptoms of keto flu may appear during the first two weeks and may be followed by other complications during short-term, while the long-term of the ketogenic diet has not been recommended regarding some studies that have been determined some certain risk of some diseases and other chronic diseases such as cardiovascular diseases.

Keywords--ketogenic diet, short-term, long-term, health complication, weight loss.

Introduction

The Ketogenic Diet is a type of diet that is used by individuals in the world and since past decades the use of the ketogenic diet has been increased dramatically. A ketogenic diet is identified as a high-fat intake and adequate protein intake with a low carbohydrate intake, in medication was used to heal epilepsy in children which is hard to control. The mechanism of the Ketogenic

Diet is to force the body to focus on burning fats instead of carbohydrates (freeman et al.,1998). Epilepsy has been treated with fasting and other dietary regimes from at least 500 BC. To imitate the fasting metabolic rate, modern healthcare professionals introduced a ketogenic diet as the treatment for epilepsy in the 1920s. For 2 decades, such therapy was broadly used and its use has fallen significantly with the modern world of antiepileptic pharmacotherapy. By the end of the 20th century, just a small number of treatment centers had this therapy obtainable. There was a boom in its use of practical importance in the ketogenic diet in the last fifteen years (Wheless,2008).

several types of the ketogenic diet have been observed, but the classical ketogenic diet was first determined by scientist Wilder in 1921 that has been used as a therapeutic diet for drug-resistant epilepsy healing. The long-chain triglycerides have been taken from natural foods which is the major part of the fat with commonly in a ratio of four to one of fat to carbohydrates plus an adequate amount of protein, this ratio can be altered to 3.5 to 1 or 2 to 1 for children because of the higher protein requirement for the growth, 80 to 90 % of the total calories should be derived from fat (Hartman et al.,2017). The ketogenic type of low glycemic index treatment has been observed in 2005, also used for the management of drug-resistant epilepsy but also used for weight loss and other health issues. The purpose of the low glycemic index was to lower the glucose level in the blood by restricting the high glycemic index foods such as bread, rice, watermelon, potato including several foods with the high glycemic index, by restricting such foods the elevation of glucose will be controlled in serum (Barzegar et al.,2021).

Obesity is one of the epidemic diseases in the world and it's a common risk factor for various chronic diseases and long-term diseases as well as particular types of cancer. Genetic factors in combination with a sedentary lifestyle and high-calorie consumption lead to overweight and obesity (WHO, 2013). The studies of the nutritional intervention were about reducing dietary fat intake and numerous types of diet while in recent years most studies are focusing on the ketogenic diet as a strategy for losing weight but still, the best and ideal diet is still under debate. The studies are focusing on the complications and strengths of the ketogenic diet and its relation to weight loss (Paoli,2014). Studies have been shown the advantages of the ketogenic diet in increasing insulin sensitivity in obese and obese diabetic patients. The ketogenic diet has been used as a therapeutic diet to manage and treat obesity as well as obese diabetics and it has been determined to be safe for applying for a long-term period of time and found as an effective way to the management of weight and change in nutritional habits (Dashti et al.,2007).

The ketogenic diet has been used internationally and became popular due to the short term effect and success on the loss of weight, also in the united states and other developed and undeveloped countries, it has been used by the population for weight management, the studies have been discussed the long and short term use of ketogenic diet and its relation to the benefits and risk factors including cardiovascular diseases, endocrinological as well as metabolic effect with other complications (Batch et al., 2020). The ketogenic diet besides the weight loss effect also has been observed to reduce the medication intake of diabetes mellitus

DM patients including improvement in the HbA1c hemoglobin that is the last point of the management and control of DM. but the professor and researchers have determined that this effect may change regarding the tolerance of the long and short term from 6 months to a year, the researchers are working to find the tolerance of long term of ketogenic diet and determination of its complications (Abbasi, 2018). The purpose of this study was to determine and evaluate the complication of the ketogenic diet regarding long and short term among the Kurdistan population by conducting a study of a web-based questionnaire, to evaluate the side effects of the ketogenic diet that have been obtained and determine the type of platform that the individuals are being familiar with the ketogenic diet and being used by the Kurdish population.

Materials and Methods

Study Design and Respondents

A cross-sectional study has been conducted based on the web study among Kurdish individuals to determine the impact of the long and short-term ketogenic diet by asking some questions to obtain data on the complication that have been caused by the long-term and short-term implementation of the ketogenic diet. the questionnaire was conducted from 22nd to 29th April 2021. The Google form has been used for the questionnaire and was conducted by using different platforms of the web such as Email, Social Media groups, Viber groups, and other web-based platforms that 375 participants have been responded. the non-educated respondents have been helped to fill in the form without any other exclusion.

Instruments and study questionnaire

The web-based questionnaire study has been carried out by using Google form and consists of two sections. The first section consists of the 3 socio-demographic questions (age, gender, and education level) while the second section consists of the 5 questions about the ketogenic diet (have you tried the ketogenic diet? How do you become familiar with the ketogenic diet? , How long did you stay on the ketogenic diet?, Do you have any health issues with the ketogenic diet? if yes which health complications?). the data were obtained in this form.

Statistical Analysis of the questionnaire study

The obtained data coded and analyzed by using SPSS statistical package for analyzing for social sciences version v.22.0 (IBM). To determine the relation and differences between the obtained data with the determination of complications of long-term and short-term of the KD.

Results

The questionnaire has been launched on the 22nd of April 2021, the data were collected and data were analyzed statistically. The overall number of participants was (375) respondents among web-based questionnaires in the Kurdistan region. About the data of the first section, Regarding the gender of participants, 77.3% (290) were female and 22.7% (85) were male. The age group of the participants:

7.2% (27) from the group of 12-21, 49.1% (184) from 22-31 group, 33.3% (125) from 32-41 group, 8.3% (31) from 42-51 group followed by the 2.1% (8) of 52-62 age group. Regarding the education level of the participants: Illiterate 0.5% (2), Primary school 2.9% (11), High school 17.6% (66), 62.1% (233) university and institutions including Higher education which was 16.9% (63) participants [Table 1].

Table 1
Demographic characteristics of Participants in Questionnaire

Variables	NO. (%)
Gender	
Female	290 (77.3)
Male	85 (22.7)
Age Groups (Years)	
12-21	27 (7.2)
22-31	184 (49.1)
32-41	125 (33.3)
42-51	31 (8.3)
52-62	8 (2.1)
Education	
Illiterate	2 (0.5)
Primary	11 (2.9)
High School	66 (17.6)
University or Institution	233 (62.1)
Higher Education	63 (16.9)
Total	375 (100%)

About the second section of the questionnaire regarding the relations and general information of the Ketogenic diet, regarding the question of the, have you tried ketogenic diet? 340 responses were yes I have tried: 78.2% (266) females and 21.76% (74) males. About the option of no: 35 responses was 9 which is 68.6% (24) female and 31.4%(11) male [Table2]

Table 2
relation between trying of ketogenic diet and Gender

Ketogenic Diet	Gender?		Total
	Female	Male	
Have you tried the ketogenic diet?			
Yes	266	74	340
No	24	11	35
Total	290	85	375

Among 340 Participants who have tried the ketogenic diet, the major respondents observed to the one month about 20%(68) respondents followed by the 17.6%(60)

two months, 15.6% (53) less than a month, 15.6%(53) for three months as shown in the [Table 3]. The study observed the complications as 11%(37) people with the only headache complications especially during the short term of ketogenic diet followed by 9.1% (31), also as mentioned in the table others which means more than one complication is followed mostly by the headache, constipation, keto rash, keto breathe, kidney diseases as well as cholesterol and liver diseases, and about 45.9% (156) have not any complications during the implementation of the ketogenic diet. about 53.23% (181) respondents have stayed in the ketogenic diet for a short-term.

Table 3
The duration of having stayed in ketogenic diet regarding complications

Duration /Complication	No. (%) Participants	Complications	No. (%)
less than one Month	53 (15.6)	None	15 (4.4)
		cholesterol	2 (0.6)
		Constipation	4 (1.2)
		Fainting	1(0.3)
		Fatigue	5 (1.5)
		Headache	10 (2.9)
		Keto Breath	2 (0.9)
		Others	14 (4.1)
1 Month	68 (20)	None	35 (10.3)
		Constipation	5 (1.5)
		Fatigue	2 (0.6)
		Headache	8 (2.4)
		kidney Diseases	2 (0.6)
		others	16 (5)
2 Months	60 (17.6)	None	32 (9.4)
		Constipation	6 (1.8)
		Headache	5 (1.5)
		kidney Diseases	3 (0.9)
		others	14 (4.1)
3 Months	53 (15.6)	None	21 (6.2)
		Constipation	10 (2.9)
		Hair Loss	3 (0.9)
		Headache	7 (2.1)
		Others	12 (3.5)
4 Months	20 (5.9)	None	11(3.2)
		Constipation	5 (1.5)
		Hair Loss	1 (0.3)
		Headache	2 (0.6)
		Others	1 (0.3)
5 Months	15 (4.4)	None	6 (1.8)
		Constipation	1 (0.3)
		gallbladder swollen	2 (0.6)
		Headache	3 (0.9)
		kidney Diseases	2 (0.6)

		Memory loss and Constipation	1 (0.3)
6 Months	18 (5.3)	None Hair Loss Headache kidney Diseases Liver Diseases	11 (3.2) 2 (0.6) 2 (0.6) 2 (0.6) 1 (0.3)
7 Months	6 (1.8)	None Fatigue and cholesterol Liver Diseases	4 (1.2) 1 (0.3) 1 (0.3)
8 Months	10 (2.9)	None Cholesterol Others	6 (1.8) 1 (0.3) 3 (0.9)
9 Months	11 (3.2)	None Others	9 (2.6) 2 (0.6)
One year	6 (1.8)	None Headache, Constipation	5 (1.5) 1 (0.3)
more than a year	2 (0.6)	Headache, Keto Rash Headache, Constipation	1 (0.3) 1 (0.3)
more than a year and still continue	3 (0.9)	None Cholesterol, Constipation Keto Rash Spots	1 (0.3) 1 (0.3) 1 (0.3)
Total	340 (%100)		340 (%100)

Regarding the platform that participants became familiar with the ketogenic diet, the major platform was 49.9% (187) social media followed by 23.1% (83) internet, 17.1% (64) friends, 6.1 % (23) doctors, 5% (18) public media. the results have been represented in [Table 4].

Table 4
Platform where the participants became familiar with the ketogenic diet

Variables	NO. (%)
Doctor	23 (6.1)
Friends	64 (17.1)
Internet	83 (23.1)
Public Media	18 (5)
social media	187 (49.9)
Total	375 (100%)

Discussion

The cross-sectional study has been showing that the females have been more interested in diet and the participants were 77.3% (290) females, in the epidemiological studies have been shown the significant difference in the obesity prevalence among gender and females are more susceptible to be obese, also have been observed the higher ratio of obese female rather than obese males (Arroyo

and Mincey, 2016). The obesity ratio among adults is over increasing and many diet programs and guidelines have been established to manage this epidemic disease which is a factor of causing and improvement of other chronic and long term diseases such as diabetes mellitus, Cardiovascular diseases including other diseases. Many types of diets and lifestyle modifications have been recommended (Wharton et al.,2020).

Most of the respondents regarding education level were from universities and institutions, studies have been observed that the education level is an important indicator related to the increase and awareness of the nutritional knowledge of the individuals including translation of the nutritional knowledge and strategies into a better implementation of programs (Hiza et al.,2013). The ketogenic diet has been determined that will not reduce the metabolic rate of the individuals as the low-fat diet has been observed that will decrease by 400kcal/day while during very low-carb diets such as ketogenic diet there is no significant difference in the decrease of the metabolism rate which is a factor that helps in weight loss and that's why it has been preferred by the individuals and about 90.7%(340) of the respondents have been tried the ketogenic diet for weight loss (Abbasi, 2018).

Carbohydrates are known as the primary source of producing energy in the tissues in the body during restricting or deprive of carbohydrates consumption into 50g in a day will lead to reduced insulin secretion and the body will go under a catabolic state. The depletion of the glycogen stores will start and two metabolisms will take place which are ketogenesis and gluconeogenesis during the low availability of carbohydrates (Mohorko et al.,2019). Many studies have been done about the treatment of diabetes 2 by low carb ketogenic diet by controlling of glycemic index in the patients results in the lowering medications and discontinued in the most patients, low carb ketogenic diet has been very effective in controlling and lowering the glycemic index among patients but patients with diabetes that use ketogenic diet should be under the supervision of physicians and able of altering their medication intake (Yancy et al., 2005)

Regarding the major communal complications of the short-term ketogenic diet has been observed as headache, vomiting, fatigue, constipation, keto rash, keto breathe, these complications may be resolved during some days to few weeks but by taking adequate water and fluids including controlling electrolyte intake will help the individuals to not have these symptoms (Patel and Makaryus, 2020). According to the complications that have been obtained in the questionnaire, most of the complication in the short-term ketogenic diet was a headache, constipation including more than one symptoms such as headache and constipation within memory loss, kidney disease, keto rash, and other complications that have been determined. Most of the respondents have stayed on a ketogenic diet for one month.

Concerning the long-term complications, the researchers have been observed that during a long-term ketogenic diet some serious diseases may develop that affect the health negatively such as hepatic steatosis, kidney stones, cardiovascular diseases, cholesterol including deficiency of vitamins and minerals (Patel and Makaryus, 2020). The certainly appealing diets of the low-carbohydrate diet and the ketogenic diet have been known as a temptation for attaining easier weight

loss and reducing the ratio and risk of obesity in developed countries as well as undeveloped countries. The health professionals and nutritionists have little researches and discussion about the potential of negative health issues regarding the ketogenic diet but they have been mentioned the health issues such as kidney problems, bad breath, and lack of concentration with the uncertainties of low carbohydrate diets that can be dangerous to health (Bilsborough,2003).

Obese people are appealing and looking for the fast way to lose their weight and they don't care about the health as much as to the loss of weight, while serious health issues have been addressed related to the ketogenic diet such as Cardiac diseases, loss of muscle, osteoporosis and other health issues and people should follow the dietary recommendations and scientific evidence related to practices of the popular dietary programs (Bilsborough,2003). after starting the ketogenic diet some people suffer from keto flu which may appear for about one week that consists of a group of symptoms such as fatigue, irritability, foggy brain, Headache, nausea, constipation including difficulties in sleeping. Studies have been shown that ketogenic flu is a condition that appears due to the changes in adaption-associated syndrome. The condition is not understood by nutritional and possibly immune imbalance including fighting off the body to the process of adaptive bodily promoted by the ketogenic diet (Bostock et al., 2020).

The condition of keto flu is not recognized in medicine (Bostock et al., 2020) but the symptoms have been also observed by the short-term use of ketogenic diet especially less than one month and one month for individuals that stayed on the ketogenic diet. Regarding the responses of the questionnaire, 49.9% of the respondents have been familiar with the ketogenic diet from the social media platform, and many groups in the social media have been recognized to recommend the people implement this diet among the Kurdish people and many restaurants opened in Kurdistan that related to the keto diet and provide keto meals for people who are in the ketogenic diet and providing a keto diet environment for them.

Plant-based diets with a daily recommendation of non-saturated fats with very small amounts of saturated fats and meats have been observed as the best epidemiological studies and evidence of the randomized clinical trial as the safest diet and connected with reducing in several chronic diseases such as atherosclerosis cardiovascular diseases. The randomized clinical studies about the ketogenic diet have been addressed many unanswered questions and didn't provide much required evidence and many unknown details have not been proved (O'Neill,2020).

Conclusion and Recommendations

The purpose of the questionnaire web-based study was to evaluate the effect of the ketogenic diet and its complications during long- and short-term period of ketogenic diet among the Kurdish population, the social media platform has been determined as the most used platform for following ketogenic diet instructions and application with the recommendations by the Kurdish individuals that are interested in losing weight. An overview of the ketogenic diet and the history of it has been represented, with the mechanism and idea of working of the ketogenic

diet for losing weight and has been used internationally in developed and undeveloped countries.

The researches and evidence have been observed that the ketogenic diet can be used for reversing and managing type2 diabetes Mellitus but it should be applied under the supervision of health professionals to control the medication intake of patients, the patients with Diabetes Mellitus should apply a ketogenic diet by following and under supervision of their doctors. The long-term implication of the ketogenic diet was associated with the increased risk of some chronic diseases and other health conditions according to some studies such as cardiovascular diseases, kidney diseases, cholesterol including liver diseases, and cholesterol. That's why the long term of using a ketogenic diet is not recommended and still, there are some unanswered questions and complications that have not been observed.

The short-term period of using ketogenic diet has been observed to help in loose of weight in a fast way and some complications may appear during the first weeks which is called keto flu that some symptoms of headache, nausea, vomiting, and other symptoms have been observed among some people and it will disappear over time until the body adapts with the ketogenic diet and after one to two months some people start to have some symptoms of headache, constipation, fatigue as well as kidney diseases due to the metabolism of ketosis and liver diseases due to the high-fat consumption as well as cholesterol development. Some complications are related to the wrong application and use of ketogenic diet, for example, adding more protein and unhealthy fats in the diet leads to more ketosis and it will be a risk factor of kidney diseases including kidney stones, cardiovascular diseases, liver diseases, and high cholesterol, the ketogenic diet should be applied in a correct way by following the health professionals and health recommendations with the suitable intake of each food and nutrients to apply a correct. The quality of the fat intake and general recommendations of food intake during the ketogenic diet is important, health professionals and nutritionists are not recommending ketogenic diet for the long-term duration, the complications and health issues of the ketogenic diet for the long and short term has not been addressed all of the points and studies are continuing about the ketogenic diet and in some studies has been considered as an unhealthy diet.

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