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A Comparison Between the Effect of Three Types of Low-Calorie Diets on Controlling Blood Glucose and Lipids in People with Type 2 Diabetes

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Abstract

The blood glucose level of people with diabetes can be normalized through an appropriate diet, physical activity, the use of chemical drugs and medicinal plants. This study aims to investigate the effects of low-calorie diets (1200, 1500, and 1800 kcal) on glucose and serum lipids in poorly controlled type 2 diabetic patients. This clinical trial was conducted among 60 patients with type 2 diabetes mellitus. The criteria for entering the study were fasting blood glucose higher than 130 mg/dl, hemoglobin A_1C higher than 7% and BMI higher than 25. Blood glucose, fasting blood glucose and lipid levels were measured before and after intervention two hours after each meal. Patients were trained by an expert. Then, the questionnaires were completed and analyzed. In this study, the mean fasting blood glucose level in patients who used 1500 and 1200 kcal diet decreased significantly after intervention ($p<0.05$). Glucose decreased significantly after two hours using a 1500 kcal diet ($p<0.009$). In addition, triglyceride and cholesterol levels were significantly reduced in patients who used the 1500 kcal diet ($p<0.05$). Although, there was no significant difference in blood glucose levels between 1200, 1500 and 1800 kcal diets based on gender, residencency and BMI. Regarding the fact that there was no significant difference in reducing blood glucose and serum lipids between 1200 and 1500 kcal diets. It is recommended to use a 1500 kcal diet instead of 1200 kcal diet, which imposes fewer limitations and is easier to tolerate.

Keywords: Low-calorie diets, Poorly controlled diabetes mellitus, Blood glucose, Serum lipid

1. Introduction

Diabetes mellitus is one of the most common endocrine abnormalities and one of the biggest health problems in urban communities(Gyawali, Ferrario, Van Teijlingen, & Kallestrup, 2016; Joshi, Malla, Bhattarai, & Shrestha, 2017; Veghari et al., 2010) . Its prevalence was high in some provinces of Iran and was reported to be about 12%(Noshad, Afarideh, Heidari, Mechanick, & Esteghamati, 2015). The International Diabetes Federation estimates the number of people involved with this disease to be more than 400 million people, i.e. about 6% of the adult population(Organization, 2017). For controlling this disease, nutritional care is primarily important and other treatment efforts alone will not be enough without considering advice and nutritional care. Given that most type 2 diabetic patients do not have enough knowledge about their diet, appropriate nutritional education will play an important role in controlling their disease(Shah, Kamdar, & Shah, 2009). It is often controlled by dietary and lifestyle changes, but oral hypoglycemic or insulin drugs may also be necessary(Asif, 2014). Therefore, by regulating the time for meal and snack, and if the diet is properly adjusted, one can provide the nutritional needs of these patients in terms of energy and nutrients. In the early stages, you can treat the disease with weight loss and physical activity. Hyperglycemia can be reduced in obese people by reducing about 5-10 kg of body weight (Wilding, 2014).

Franz (2016) found that 14% of diabetic patients can control their blood glucose only by diet (Marion J. Franz, 2007). Several studies have shown that nutritional education and proper diets have a profound effect on diabetes-related outcomes such as proteinuria, HbA1c, and body weight(Evert et al., 2013; M. J. Franz, 2016; Lim, Park, Choi, Huh, & Kim, 2009).

Moreover, other sudies found that reducing the weight of diabetics with low-calorie diets (1500 kcal) can reduce the level of fasting blood glucose and triglycerides in these patients (Asif, 2014). Therefore, the aim of this study was to compare three types of low-calorie diets in controlling blood glucose and lipids in poorly controlled diabetic patients.

2. Materials and Methods

The study was a randomized clinical trial among 60 patients with type 2 diabetes who were referred to diabetes clinics affiliated to Babol University of Medical Sciences. Ten patients were excluded from the study due to diet noncompliance, and the study was conducted among 50 patients. Informed witten consent was obtained from all patients.

First, the fasting blood glucose, blood glucose taken two hours after meals and serum lipids (cholesterol, triglyceride, LDL cholesterol and HDL cholesterol) were recorded before dietary intervention and then, were designed by a dietitian and focused on individuals with overweight and obesity according to their height, weight, BMI and type of diet (1200 kcal,1500 kcal, and 1800 kcal). Then, a trained instructor gave nutritional education regarding low-calorie diets. After one month, patients were re-evaluated for weight, fasting blood glucose, blood glucose taken two hours after meals, and serum lipids, and were compared with the levels before the intervention.

In this study, patients with poorly controlled type 2 diabetes, fasting blood glucose levels higher than 30 mg/dL, lower than 200 mg/dL, HbA1C more than 7%, overweight and obesity according to BMI, and low activity were included.

The exclusion criteria included people with cardiovascular disease, liver disease, kidney disease, lactating and pregnant women, diabetic children and people under the age of 20 years.

Cholesterol was measured by enzymatic method (End-point) using Man's kit, triglyceride was measured by enzymatic method using reagents from Beckman (Beckman Diagnostics, Fullerton, CA, USA) and blood glucose was measured by enzymatic method using Man's kit. The tool for gathering data was a questionnaire containing demographic information and patient tests. Data were analyzed by SPSS16 software using Chi-square, T-test and ANOVA. $P<0.05$ was considered significant.

3. Results

This study was conducted among 50 patients with poorly control type 2 diabetes; 21 patients (42%) had 1200 kcal diet, 15 patients (30%) had 1500 kcal diet and 14 patients (28%) had 1800 kcal diet. Of all studied subjects, 13 (26%) were male and 37 (74%) were female. 36 (72%) were housewives and 9 (18%) were self-employed. In terms of residence, 36 (72%) were urban and 14 (28%) were rural. In terms of education, 15 (30%) were illiterate, 24 (48%) had primary education, 9 (18%) had diplomas and 2 (4%) had higher education than diplomas. 17 (34%) were overweight, 16 (32%) were obese and 10 (20%) were extremely obese. 44 cases (89.8%) were heavy and 35 (72.3%) used glucose control medication.

The of 1500 kcal diet resulted in a significant decrease in fasting blood glucose and blood glucose taken two hours after meals in the subjects. The 1200 kcal diet also significantly decreased fasting blood glucose ($p<0.05$), but the changes in blood glucose taken two hours after meals was not statistically significant. The 1500 kcal diet also significantly decreased triglyceride and cholesterol ($p<0.05$). The mean of the differences between the three treatment diets was not significant before and after the intervention (Table 1).

Comparing two different diets using Tukey tests showed that none of the diets had a significant difference. The difference between BMI before and after dietary intervention was not significant.

Table 1. The mean glucose and lipid parameters, before and after the diet in the study subjects

Parameter mg/dl	Diet kcal	Before intervention Mean±SD	After intervention Mean±SD	p-value	The difference, before and after intervention Mean±SE	p-value
Fasting blood sugar	1200	188.8 ± 48.6	161.9 ± 43.2	0.013	26.9 ± 9.8	0.283
	1500	171.4 ± 33	140.5 ± 31.3	0.002	30.9 ± 8.2	
	1800	176.8 ± 61.4	171.3 ± 61.5	0.732	5.5 ± 15.6	
Blood glucose taken two hours after meals	1200	233.3 ± 76	225.2 ± 62	0.064	6.8 ± 14.5	0.23
	1500	230.2 ± 59.7	182 ± 52.4	0.009	44.5 ± 14.4	
	1800	241.6 ± 92.1	225.1 ± 86.7	0.193	25.3 ± 18.2	
Triglyceride	1200	218.8 ± 118.7	196.7 ± 89.5	0.375	22.1±24.4	0.795
	1500	206.3 ± 77.5	169.5 ± 72.5	0.033	39.7±16.7	
	1800	163 ± 84.7	143.8 ± 64.6	0.283	19.2±17.1	
Cholesterol	1200	221.3 ± 53.2	211.9 ± 43.8	0.235	9.4 ± 7.7	0.41
	1500	207.1 ± 43.8	194 ± 49.4	0.031	20.9 ± 8.4	
	1800	200.2 ± 37.8	175.9 ± 46.3	0.024	24.2 ± 9.5	
LDL cholesterol	1200	127 ± 40.3	120.6 ± 40.1	0.287	3.3 ± 2.9	0.836
	1500	127.7 ± 32.1	135.7 ± 35	0.94	0.5 ± 7.1	
	1800	115.1 ± 44	109.6 ± 40	0.326	5.6 ± 5	
HDL cholesterol	1200	45.1 ± 9.7	41.1 ± 11.3	0.125	4 ± 2.5	0.918
	1500	42.9 ± 12.4	39.5 ± 8.2	0.181	2.8 ± 2	
	1800	55.6 ± 32.1	53.4 ± 27.9	0.164	4.3 ± 2.8	

In this study, there was no significant difference between the three low-calorie diets in reducing serum glucose and lipids in terms of gender, residency and BMI.

4. Discussion

A balanced diet is the basis for controlling diabetes, and failure to cure this disease is often due to a lack of an appropriate diet. The results of this study showed that the 1500 kcal diet could significantly reduce fasting blood glucose and blood glucose taken two hours after meals. In addition, although fasting blood glucose decreased after intervention in the 1200 kcal diet, blood glucose taken two hours after meals did not decrease significantly.

Nevertheless, the 1800 kcal diet could not change the fasting blood glucose and blood glucose taken two hours after meals significantly. The 1200, 1500 and 1800 kcal low-calorie diets were based on 55% carbohydrates, 20% protein and 25% fat. These diets are mainly different in terms of bread and cereal unit, meat unit and fat unit; bread and cereal units were 10.5, 7.5 and 5.5 units, respectively, the meat and related products were 5.5, 4.5 and 3 units, respectively, and fat units were 6.5, 3.5 and 3 units, respectively, in 1800, 1500 and 1200 kcal diets. Although the difference between the bread and cereal, meat and fat is not significant in 1800 and 1500 kcal diets, this difference is relatively significant in 1200 kcal diet. Since the limitation of food group units in 1500 kcal diet is more balanced than 1200 and 1800 kcal diets, and is more acceptable for the patient, it can be used to control fasting blood sugar and blood glucose taken two hours after meals(Association, 2010; Jazet, de Craen, van Schie, & Meinders, 2007; Rabinovitz et al., 2004). Perhaps, one of the reasons why the 1200 kcal diet failed to reduce blood glucose after a meal would be its higher dietary restriction compared to 1500 and 1800 kcal diets, which would result in a patient's noncompliance. Although several studies have been done regarding the role of diets in treating diabetes, there has not been much research in this regard. After reviewing the treatment outcomes in diabetes mellitus, Sunsaneevithayakul et al. proved that by implementing a dietary treatment, blood glucose was well controlled in the vast majority of patients and in some cases, led to the discontinuation of insulin(Sunsaneevithayakul et al., 2006). Katsilambros et al. also found that the energy limit of around 500 kcal per day was most helpful in overweight diabetics(Katsilambros, 2001).

Sargrad et al. also showed that low-calorie diet significantly reduces plasma fasting glucose levels(Sargrad, Homko, Mozzoli, & Boden, 2005) . After examining the role of diet in 10 diabetic patients, Boden showed that fasting glucose levels returned to normal levels using low-calorie diet, and the mean hemoglobin A1C decreased and insulin sensitivity increased . In the present study, the 1500 kcal diet could significantly reduce the level of cholesterol and triglyceride, but this result was not observed in the 1800 and 1200 kcal diets. In a study on subjects with a BMI higher than 30 for a period of 14 weeks who underwent a 425 kcal diet, showed that the levels of cholesterol and triglyceride decreased significantly and glucose returned to normal level at the end of the

diet(Capstick et al., 1997). The results of our study showed that there was no significant difference between the diets (1200, 1500 and 1800 kcal) before and after the intervention in fasting blood glucose and blood glucose taken two hours after meals based on gender, and gender played a significant role in improving the results after using the diet. However, considering the small number of men in this method, judgment may be difficult in this case.

The results of this study showed that in subjects with overweight and obesity according to BMI, there was no significant difference between parameters of fasting blood glucose, blood glucose taken two hours after meals, triglyceride, cholesterol, LDL and HDL in using the diets (1200, 1500 and 1800 kcal). In two separate studies, Tenhove and katsuki et al. stated that the use of low-calorie diets in obese diabetic women with infertility not only reduced and regulated blood glucose levels, but also led to the return of fertility in these women(KATSUKI et al., 2000; ten Hove, de Meijer, & Meinders, 2000).

This suggests that an appropriate diet will be beneficial to people in any range of BMI, and the idea that only obese people with higher BMIs get better results is not correct.

5. Conclusion

Considering the significant effect of the 1500 Kcal diet on reducing diabetes mellitus and the level of blood glucose and lipids in diabetic patients and better tolerance of this diet by patients, this diet can be used to control diabetes and lipids in diabetic patients rather than using more difficult diets.

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Conflicts of Interests

The authors declare that these is no conflict of interests.

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