

Dietary Intake Adequacy and Evaluation of Nutritional Value in Diabetic Patients

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Authors' contributions

This work was carried out in collaboration between all authors. Authors BEK and MRN designed the study, wrote the protocol and supervised the work. Author SB managed the literature searches. Authors MRN and BEK carried out all laboratory work, analysis of data managed by authors BEK and MR. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Diabetes as a health problem, leads to many pathological effects. Many studies showed that micronutrients found in these patients are not in accordance with the recommendations of RDA*. The aim of this study was to assess the adequacy of nutrient intake in diabetic patients attending diabetes clinics in Markazi Province of Iran, there by basic information on the nutritional status of this group of patients was obtained and early survey started.

Study Design: Cross - sectional study.

Place and Duration of Study: Clinical Research Unit, Markazi Province, Arak, Iran, between April 2012 and July 2013.

Methodology: In a random sample procedure 250 diabetic patients referring to diabetic clinics in Markazi Province was assessed. A questionnaire was completed for each patient. This form

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included some demographic data and laboratory food frequency questionnaire (FFQ -168) and a 24-hour dietary recall. After completing the questionnaire the amount of energy and nutrients in each food and beverage ingredients were calculated by using food composition table USDA designed in a food processing software. The standard amounts of Recommended Daily Allowances (RDA 1989) were used to evaluate the adequacy of the diet. Data was analyzed using Pearson correlation coefficient, chi-square and Independent Samples T-test, Paired Samples T-test the SPSS16 statistical software were used.

Results: In this study, about 32% of patients had normal weight and 68% of them were overweight or obese. The mean of fasting blood glucose was 212.5 mg /dl. Percentage of energy derived from carbohydrate, protein and fat, was 58.8 and 13.6 and 27.6% respectively. Percentage of energy from saturated fat was around 17%. Among male patients, energy intake, fiber, unsaturated saturated fat energy percentage, calcium, phosphorus, iron, potassium, zinc, vitamin A, selenium, vitamin K, vitamin C and vitamin E intake values are significantly different from RDA values, the amounts of iron, percent of energy from saturated fatty acids, and vitamin E intakes were significantly higher than RDA values and other nutrient intakes were lesser than the RDA. Among female patients, fiber intake, percentage of energy from unsaturated and saturated fat, calcium, phosphorus, potassium, zinc, vitamin B1, folic acid and vitamin E values are significantly different from RDA values, among these amounts, energy from saturated fat, zinc, vitamin B1 and vitamin E were significantly higher than RDA values and other nutrient intakes were lesser than the RDA.

Conclusion: Our findings indicate that the nutritional adequacy of food intake in diabetic patients, is not desirable. The amount of energy from carbohydrate was higher than RDA recommendations. Percent of energy from saturated fatty acids was higher than standard. Despite the apparent over-weight and obesity of patients, there was nutrient deficiency in them. In overall, in this area choice of balance diet and training are necessary.

Keywords: Diabetes mellitus; macronutrient; micronutrient.

ABBREVIATIONS

RDA: Recommended Dietary Allowances; FFQ: Food Frequency Questionnaire; USDA: United States Department of Agriculture; ADA: American Diabetes Association; T2DM: Type 2 Diabetes Mellitus; USFAs: Un Saturated Fatty Acids; MUFAs: Mono Un Saturated Fatty Acids; PUFA: Poly Un Saturated Fatty Acids; ULSAM: The Uppsala Longitudinal Study of Adult Men; SFAs: Saturated Fatty Acids; EPIC-InterAct Study: European Prospective Investigation into Cancer and Nutrition; CVD: Cardio Vascular Disease; PMBG: Postmeal Blood Glucose; ARIC: Atherosclerosis Risk in Communities.

1. INTRODUCTION

Medical nutrition therapy is an integral part of diabetes management [1], especially the management of metabolic control for achieving optimal weight [2,3]. Dietary pattern has synergistic effects of whole foods and may prove more beneficial in terms of assessing the quality of dietary intake [4]. Dietary intake has essential role in ethiology and management of type 2 diabetes mellitus [1]. Dietary intake with high energy especially with fat and simple sugars and low fiber diet has been shown to increase of T2DM [5]. The newest lists focus on control of daily energy intake [6]. Several studies have examined the effects of dietary carbohydrate, fat and proteins on postprandial glucose [7-11]. The

main principles of diabetes management are healthful eating pattern, regular physical activity, and often pharmacotherapy. For many individuals with diabetes, the most important challenging part of the treatment plan is determining what to eat. It is the position of the American Diabetes Association (ADA) that there is not a "one-size-fits-all" eating pattern for individuals with diabetes. The ADA also recognizes the basic and integral role of nutrition therapy in overall diabetes management and has historically recommended that each person with diabetes be actively engaged in self-management, education, and treatment planning with his or her health care provider, which includes the collaborative development of an individualized eating plan [12,13].

2. MATERIALS AND METHODS

2.1 Study Design

Diabetic men and women from Diabetic – Centre in hospitals of Markazi province were offered an opportunity to participate in this study.

2.2 Study Subjects

These adult (n=250) diabetic patients (men and women) between 45-79 years in age, that referred to Diabetic –centre selected in five city of Markazi-province.

2.3 Demographic, Anthropometric and Laboratory Measures

Standard demographic information and anthropometric measurements including weight and height for the calculation of body mass index (BMI), were recorded. A fasting blood sugar were analyzed. A questionnaire was completed for each patient. This form included some *demographic data and laboratory food frequency questionnaire (FFQ -168) and a 24-hour dietary recall*. After completing the questionnaire, the amount of energy and nutrients in each food and beverage ingredients were calculated by using food composition table USDA Designed in a food processing software. The standard amounts of Recommended Daily Allowances (RDA 1989) were used to evaluate the adequacy of the diet. Also we record systolic and diastolic blood pressure (mmHg). Injected insulin dose, Metformin and Glibenclamide were determined.

2.4 Statistical Analyses

Data was analyzed using Pearson correlation coefficient, chi-square and Independent Samples T-test, Paired Samples T-test with SPSS16 statistical software. Values are demonstrated as mean±SD. Differences with *p<0.05 were regarded as statistically significant.

3. RESULTS

3.1 Demographic, Anthropometric and Laboratory Measures

The study represented that thirty-two percent of ** patients with normal weight, and sixty-eight percent had over – weight or obese. Table 1 shows anthropometric measurement of patients.

Food groups intake in patients Food groups intake in men and women showed in Table 2. There was no significant difference between two groups, but men received more food groups than women.

If we accepted adequate food groups for meat will be equal 2.5 serving, milk and dairy products, 2.5 serving, fruits and vegetables 2 and 3 serving, and cereals, breads is be equal 9 serving, in the basis of this classification food group distribution in their diets, determined in Table 3.

According to Table 3 the most problem for food groups intake was observed in vegetable groups. The second problem was in milk and dairy groups. Only 32% of patients received adequate

Table 1. Anthropometric characteristics of patients

Variable	Men(Mean±SD)	Women(Mean±SD)	Toal Mean±SD	P-value
Age (year)	62.5±17.14	59.23±7.6	62.5±17.14	N.S
Weight (kg)	79.16±17.12	68.12±6.5	73.4±13.7	P=0.019
Height (Cm)	167.6±8.3	157.2±6.8	162.2±9.11	N.S
BMI (Kg/m ²)	28±4.5	27.7±3.7	27.9±4.02	N.S

Table 2. Food groups intake in men and women

Food groups	Men(Mean±SD)	Women(Mean±SD)	Toal Mean±SD	P-value
Meat & legumes	2.4 ±1.5	2±1.1	2.2±0.3	N.S
dairy	2.2±0.8	1.9±1.1	2.1±0.6	N.S
Bread & cereals	9.4±1.4	9±0.9	9.2±1.4	N.S
fruits	1.8±0.9	2±1.4	1.9±1.2	N.S
vegetables	1.2±0.6	0.7±0.9	0.95±0.6	N.S
Fats & oils	3±0.6	2.4±0.7	2.7±0.6	N.S

servings for these mentioned groups. Macro and micro – nutrients intake of their diets shown in Tables 4,5,6.

On the basis of MAR(Mean Adequacy Ratio) as an index of nutritional status, and adequacy of nutrients (Nutrient Adequacy Ratio=NAR). Which

estimated that the ratio of any nutrient intake divided by the amount of recommended allowances of the same nutrient. Nutritional status of patients divided into three groups (adequate. Moderate and weak). Fig. 1 shows the percentage of different nutritional status in patients.

Table 3. Distribution of food groups in patients

Food groups	Men(%)	Women(%)	Toal (%)	P-value
Meat & legumes	66	69	40	N.S
dairy	75	46	32	N.S
Bread & cereals	100	100	72	N.S
fruits	66	61	28	N.S
vegetables	0	0	0	N.S
Fats & oils	62	58	60	N.S

Table 4. Analysis of macronutrients in patients

Variable	Men	RDA _m	Women	RDA _f	P-value
Energy(Kc/d)	1934.5	2300	1855.7	1900	N.S
% energy from CHO	58.2	55	59.3	55	N.S
% energy from fats	27.7	30	27.6	30	N.S
% energy from proteins	14.2	15	13.2	15	N.S
% energy from SFA _s	17.5*	≤10	15.9*	≤10	N.S
% energy from USFA _s	10.1*	>15	11.7*	>15	N.S
Cholesterol(mg/d)	239.1	≤300	139.7*	≤300	P=0.003
Fiber(gr/d)	19.4*	30	20.4*	28	N.S

Table 5. Minerals intake in patients

Variable	Men	RDA _m	Women	RDA _f	P-value
Ca (mg/d)	813.3*	1200	801.4*	1200	N.S
P (mg/d)	864.9*	700	853.7*	700	N.S
Fe(mg/d)	11.9*	10	10.8	10	N.S
K(mg/d)	1322.5*	1900	1405.5*	1900	N.S
Na(mg/d)	2532	2400	2755.7	2400	N.S
Zn(mg/d)	8.5*	15	20.4*	15	N.S
Se(µg/d)	49.6*	70	50	55	N.S

Table 6. Vitamins intake in patients

Variable	Men	RDA _m	Women	RDA _f	P-value
V.A(µg/d)	704*	1000	593	800	N.S
V.D(µg/d)	11.07	10	10.1	10	N.S
V.E(mg/d)	12.1*	10	11.2*	8	N.S
V.K(µg/d)	61.2*	80	55.9	65	N.S
V.B ₁ (mg/d)	1.27	1.2	1.42*	1.1	N.S
V.B ₂ (mg/d)	1.5	1.3	1.5	1.1	N.S
V.B ₃ (mg/d)	14.9	16	18.6	14	N.S
V.B ₉ (folic Acid)(µg/d)	185.9*	400	222.8*	400	N.S
V.C(mg/d)	64.7*	90	74.8	75	N.S

*P<0.05

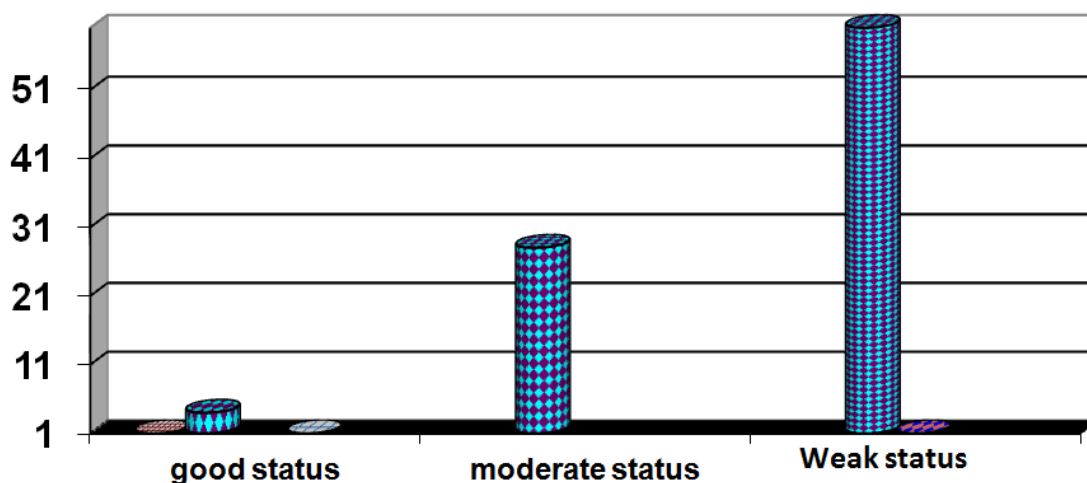


Fig. 1. The percent of nutritional status in patients

4. DISCUSSION

This study showed that overall quality of dietary intake consumed by patients with T2DM was less than that of healthy populations like Mediterranean regions. In this cross sectional study a cause and effect relationship between dietary quality and incidence of T2DM cannot be determined. Individuals with T2DM. When micronutrients intake was assessed using adequacy score, results showed that micronutrient adequacy was suboptimal in both groups (men & women). When the intake of sixteen micronutrients was assessed, the patients with T2DM consumed significantly less calcium, potassium, zinc, selenium, vitamin A, vitamin K, folic acid and vitamin C.

A study based on the ARIC cohort in relationship between dietary potassium, as measured by food frequency questionnaire, and diabetes risk, with average dietary potassium intake levels of less than 2700 mg/d, found no significant association. [14]. In our study potassium intake was 1322 and 1405 mg/d in men and women respectively. That was less than, in comparison with RDA. Systematic review and meta-analysis in patients with diabetes demonstrates that Zinc supplementation has beneficial effects on glycaemic control and promotes healthy lipid parameters [15]. Vitamin A, C and E are antioxidants, They worked along with other minerals, like selenium and other compounds. Antioxidants are not usually implicated in the aetiology of type 2 diabetes directly, but may help to prevent effect of vitamins C, E and A can reduce this damage [16]. Studies have

suggested that vitamin K may improve glycemic status and insulin sensitivity. In healthy young male volunteers, showed that men with lower phylloquinone intakes had lower insulin and higher glucose concentrations after oral glucose loading than did men with higher phylloquinone intakes [17]. Oral supplementation of vitamin C with metformin, reduced FBS, PMBG, and improved HbA1c [18].

Researchers, looked at plasma vitamin C and consumption of fruit and vegetable in relationship with the prevention of type 2 diabetes. They showed that higher plasma vitamin C levels and, to a lesser degree, fruit and vegetable intake were associated with a substantially decreased risk of developing diabetes. Their findings showed an important public health message for the benefits of a diet rich in fruit and vegetables in diabetes prevention [19].

Evaluation of macronutrients showed that energy in two groups was less than RDA. Distribution of total energy intake also was normal, but percentage of energy from SFA (Saturated Fatty Acids) was abnormal (17.5 versus <10). Inversely percentage of energy from USFAs (MUFA+PUFA) was lower than normal (10.5 versus 25). The potential role of SFAs intake in the development of diabetes mellitus, investigated in ULSAM cohort. These suggest that SFAs intake among 50 year – old men independently predicts insulin resistance 20-years later [20]. In recent prospective study (Melbourne Collaborative Cohort Study) investigation showed that total SFAs in phospholipids and reported dietary intake were

positively related with diabetes incidence ([21]. The investigation of Jiang R, et al. [22] on food groups (Nuts), as an important source of MUFAs and s) showed the Nuts have been associated with lower risk of diabetes in women even after adjusting for fiber intake. In the Iowa Women's Health Study, incidence of T2DM was independently and inversely associated with vegetable fat (low in SFAs) intake reported by FFQ [23]. There was also an inverse relation between incidence of diabetes and substitution of PUFA for SFA. The incidence of type 2 diabetes observed in The EPIC-Inter-Act Study in population with a high intake of total fiber compared with a low intake was associated with an 18% lower risk, when adjusted for lifestyle and dietary factors. This finding was mainly driven by the intake of cereal fiber and vegetable fiber, intake of fruit fiber did not have any effect on lowering incidence of T2DM. A stronger inverse association observed between cereal fiber intake and type 2 diabetes than for fruit or vegetable fiber is consistent with previous meta-analyses of fiber intake and type 2 diabetes [24], [25], recently meta analyses research that has shown stronger associations for whole grain intake [26] than for fruit and vegetable intake in relation to risk of type 2 diabetes [27]. The American Diabetes Association recommends fiber consumption of at least 14 g/1,000 kcal/d or a range of 25 to 30 g/d, the values recommended by the United States Department of Agriculture [3]. Where as the American Dietetic Association's position statement recommends 30 to 50 g of dietary fiber per day for patients with type 2 diabetes mellitus [28]. Our study showed that a significantly difference between RDA fiber intake between men (30 gr/day) and women (28 gr/day) compare with dietary intake .In addition, there is a limited research regarding optimal dietary cholesterol and trans fat intake in people with diabetes. One large prospective cohort study [29] in women with type 2 diabetes found a 37% increase in CVD risk for every 200 mg cholesterol/1,000 kcal. Due to the lack of research in this area, people with diabetes should follow the guidelines for the general population. The Dietary Guidelines for Americans, 2010 [30]. The cholesterol intake of our study in men and women was 239 gr/day 139.7 gr/day respectively. That was adequate or (less than 300 mg/day). Intake of cholesterol in women was less than men ($P \leq 0.003$). It seems a relationship between low intake of saturated fatty acids (SFAs) and low cholesterol intake, because the source of dietary cholesterol and SFAs is similar.

5. CONCLUSION

Our findings showed that the nutritional quality for dietary intake of diabetic patients was not Suitable. Distribution of energy from carbohydrates and SFAs is greater than RDA, In spite of over – weight and obesity among patients, the intake of several micronutrients in diets was inadequate. The patients must be intake a healthy food pyramid and diabetic – center must be educate all of the patients that referred to these clinical – center.

CONSENT

It is not applicable.

ETHICAL APPROVAL

All authors hereby that all human studies have been examined and approved by the appropriate ethics committee with code 91-139-9 by the Ministry of Health & Educational Medicine, Arak Medical University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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