

Dietary Pattern Assessment and Body Composition Analysis of Adult Patients with Type 2 Diabetes Mellitus attending Diabetes and Endocrine Center in Mirjan Teaching Hospital, Babil / 2021

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Abstract

Background: Type 2 diabetes mellitus is an array of dysfunctions characterized by hyperglycemia resulting from a combination of resistance to insulin action, inadequate insulin secretion, and excessive or inappropriate glucagon secretion; it accounts for 90–95% of all adults. Poor glycemic control is associated with complications of diabetes, and it could be avoided by good diabetic control, where different factors such as age, gender, obesity, exercise, and education have been reported to be associated with poor control in different settings. **Objectives:** This study showed the relation of some body compositions and intake of certain food items as assessed by a 24-h dietary recall and glycemic control among the study groups. **Materials and Methods:** A cross-sectional study has been conducted on 60 type 2 diabetes patients attending Diabetes and Endocrine Diseases Center in Mirjan Teaching Hospital in Babil, sociodemographic characteristics being studied, glycemic control of patients was studied according to their HbA1c. Glycemic control was studied among patients concerning some anthropometric measures; all these were measured with the aid of an InBody device, which was used in this study. Diet was investigated among the study group by using the 24-h dietary recall method to investigate the relationship between certain food being eaten and glycemic control. Glycemic control was studied among patients in relation to the glycemic index (GI) of foods eaten. **Results:** Sociodemographic characteristics showed that type 2 diabetes was higher among people in age group between 40 and 60 years with mean age 54.75 ± 10.2 years, male gender, urban residents, married people, housewives, and people with secondary and higher education. Regarding glycemic control rate, 75% patients had poor control and 25% had good control. Poor glycemic control was statistically significant with waist circumference ($P = .010$ for males and $P = .003$ for females), waist-to-hip ratio ($P = .031$ for males and $P = .008$ for females), and percentage of body fat ($P = .002$ for males only). There was a statistically significant association between starch and refined grain intake ($P = .000$) and added sugar and other sweetened beverages ($P = .003$), and glycemic control but no statistical association with vegetables, fruits, and milk and its products. Glycemic control was highly statistically significant with the intake of foods with a high GI ($P = .000$).

Keywords: Glycemic index, type 2 diabetes, body composition analysis

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is an array of dysfunctions characterized by hyperglycemia resulting from a combination of resistance to insulin action, inadequate insulin secretion, and inappropriate glucagon secretion; it was previously referred to as “non-insulin-dependent diabetes” or “adult-onset diabetes.” It accounts for 90–95% of all adults.^[1]

T2DM is recognized as a serious public health concern with a considerable impact on human life and health

expenditure. Rapid economic development and urbanization have led to a rising burden of diabetes in many parts of the world.^[2] Globally, about one in 11 adults have diabetes mellitus (DM; 90% have T2DM where the major driving factors of the globe of T2DM include

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overweight and obesity, sedentary lifestyle, and increased consumption of unhealthy diets like refined grains and sugar-sweetened beverage.^[3] Well-defined diabetes risk factors include obesity, dyslipidemia, hypertension, and family history of DM.^[4] Poor glycemic control is associated with complications of diabetes. Factors such as age, gender, obesity, exercise, and education were reported to be associated with poor control in different settings.^[5]

It has been shown that bad dietary habits, obesity, sedentary lifestyle, excessive eating, and abdominal obesity with an imbalance of endocrine factors result in the development of insulin resistance and T2DM, and body compositions such as body fat rate and waist-to-hip ratio (WHR), which are measured by bioelectrical impedance analysis for assessing abdominal obesity and fat distribution are more reliable indicators affecting glycemic control among type 2 diabetic patients.^[6]

The American Diabetes Association has recommended the need for individualized nutritional therapy, because of consumption of western diet with more sugar sweetened-beverage, highly processed food of simple carbohydrates, animal-based foods and fewer vegetables and fruits in addition to eating of diets high in starch with low fiber had high glycemic index which was positively associated with poor glycemic control in T2DM, whereas using of low glycemic index diet is more effective in controlling glycated hemoglobin and fasting blood glucose.^[7-9] In Arabian countries, also some studies have highlighted the effect of dietary patterns on glycemic control in T2DM; a study conducted in UAE in 2018 stated that the intake of soft drinks and fast foods for more than 1 per week could serve as an independent predictor of poor glycemic control, whereas eating of fresh fruits and vegetables could be a protective effect on glycemic control among T2DM patients.^[10] Rahmanian and his colleagues studied some sociodemographic characteristics of T2DM and stated that it occurred between the age of 30–50 years, male to female ratio of the study population was 60:40, and most of the patients were obese, urban residents, educated, and physically inactive.^[11] In Iraq, a study conducted in Basrah revealed that T2DM was 8.7% among the study group, both sexes were affected with female predominance, age was 46–60 years, and 70.3% of them were with BMI ≥ 25 kg/m².^[12]

The ADA stated that hemoglobin A1c (HbA1c) is an appropriate diagnosing screening tool for DM and prediabetes; glycemic status for good glycemic control is when HbA1c $< 7\%$, whereas that for poor control is when HbA1c $\geq 7\%$.^[1] Poor glycemic control and BMI ≥ 25 kg/m² are risk factors for type 2 diabetes with a positive association between overweight or obese and having suboptimal glycemic control, whereas other studies conducted in India showed no association between BMI and glycemic control.^[1,13,14] The risk of T2DM increased by

adding abdominal obesity, which was measured by waist circumference (WC); WC was more than 88 cm in females and more than 102 cm in males. A study conducted in 2016 showed that there is a significant statistical association between WC, WHR, and diabetic risk and the risk increased by 23% and 28%, respectively, for every 10 cm increase in WC and 10% increase in WHR.^[15]

Diet and dietary patterns have been consistently associated with T2DM; dietary habits and sedentary lifestyle are the major risk factors for rapidly rising T2DM among developing countries, and elevated HbA1c level can be achieved through dietary management and the patient could be prevented from complications of diabetes.^[16] The amount of carbohydrate (CHO) in grams and the type of CHO in the food influence blood glucose level, which is the strong predictor of glycemic response in agreement with the National Academy of Science-Food and Nutrition Board that recommends range of CHO intake to be 45–60% of total calories.^[17] Intake of vegetables is beneficial for the general health and prevents T2DM with an inverse correlation because vegetables may prevent diabetes as they are rich in nutrients and antioxidants and considered as a protective barrier against the disease.^[18]

Fruit intake is recommended together with vegetables, where seven to 10 servings per day aid in achieving good glycemic control. Randomized controlled trials have shown that supplementation with fresh fruits for 6–8 weeks improves HbA1c in patients with T2DM because fruits also contain antioxidants like vegetables.^[19] Milk and dairy products have an impact on glycemic control in type 2 diabetes; evidences from randomized controlled trials have suggested that milk and dairy may have modest benefits in assisting weight loss in the short term with a beneficial effect of yogurt in lowering T2DM risk as there is a linear inverse association between milk and dairy products in T2DM glycemic control.^[20]

Legumes (beans, peas, and lentils) are considered as low-GI foods, which can reduce HbA1c and systolic pressure among type 2 diabetic patients; they are recommended in nutritional guidelines of type 2 diabetic diet.^[1] Jenkins *et al.*'s randomly assigned 121 patients with T2DM received 1 cup/day of legumes for 3 months; their HbA1c reduced by 0.3–0.5% in comparison to other groups who consumed less than this amount.^[21] Added sugar and other sweetened beverages also have a role in glycemic control, because they contain fructose that can raise triglycerides and HbA1c if taken more than 10% of total calories used.^[22]

Aims of the study

The aims of this study were assessment of sociodemographic characteristics; body composition analysis to detect WHR, percentage of body fat (PBF), and dietary pattern among the study group; and determination of relationship

between dietary patterns and some body compositions, and the glycemic control of the study group.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Diabetes and Endocrine Diseases Center of Mirjan Teaching Hospital in Babil Governorate, Iraq. The study was conducted during the period from March 1, 2021, to April 1, 2021. A convenient sample of 60 type 2 diabetic patients of either sex were included; any adult patients above 20 years with type 2 diabetes (male or female) were included, whereas pregnant, edematous, and type 1 diabetic patients were excluded from the study. The attendance to the Diabetes and Endocrine Diseases Center was twice weekly from 9:00 AM to 12:00 PM for 1 month.

Data were collected by direct interview from patients and filled by the researcher according to the questionnaire, which was written in English and designed after reviewing the literature, which included the sociodemographic characteristics of the patients (name, age, gender, residence, marital status, occupation, and level of education), anthropometric measurements (weight, height, WC, and WHR), InBody device for body composition assessment (weight, BMI, WHR, and PBF), level of physical activity factor (sedentary or no activity 1.2, light activity 1.375, moderate activity 1.55, and very active 1.725), calculation of basal metabolic rate, total energy expenditure, calories consumed, duration of diabetes, type of treatment used, HbA1c result, and associated comorbidities. An HbA1c level of <7% was considered as good controlled DM and ≥7% as poorly controlled T2DM.^[1]

Height was measured in centimeter and weight was measured in kilogram. BMI was calculated in kilogram per square meter by an InBody device (according to the World Health Organization: BMI <18.5 is underweight, 18.5–24.9 is normal, 25–29.9 is overweight, 30–39.9 is obesity, and ≥40 is morbid obesity).^[23] WC was measured when the patient was standing and the tape measure was put midway between the lower subcostal margin and iliac crest, and at the end of expiration, the result was obtained (low risk or normal weight for men <94 cm and women <80 cm, moderate risk or overweight for men 94–<102 cm and for women 80–<88 cm, and high risk or central obesity for men >102 cm and women >88 cm). WHR was set as low risk for females ≤0.80 and men ≤0.95, medium risk for women 0.81–0.85 and males >0.95–1.0, and high risk for men ≥1.0 and women >0.85).^[24] PBF was measured by an InBody device (InBody GS 6.5 multi-frequency bioelectrical impedance analysis); according to it, PBF was set as 10–20% for males and 18–28% for females, where these measures were regarded as normal. The dietary pattern was assessed by using the 24-h dietary recall method, where the type and amount of food and beverages eaten were registered according to the recall

of the patient using household measures (cups, bowls, spoons, etc.) in the past 24 h from midnight to midnight of the previous day; all food groups in the recall were analyzed according to the food groups (starches and grains, vegetables, fruits, milk and dairy, meat, poultry, fish, eggs, cheese, legumes, added fat and added sugar, and other sweetened beverages).^[25]

By using of Diabetes Food Pyramid and Food Exchange Lists for Diabetes, where both divide the diet of type 2 DM into six food groups and each group with the recommended number of servings per day and compare the frequency of these servings with the number of servings of each food group which were obtained by the recall.^[26,27] Then, the servings of foods group being obtained by the recall were grouped according to their glycemic index (GI) into 3 categories; foods with GI ≥ 70 as high GI foods, foods with GI 55–69 as medium GI foods, and foods with GI < 55 as low GI foods according to the international tables of GI and glycemic load values which were compared with the glycemic control of the study group.^[28]

Statistical analysis

Each questionnaire was assigned a serial identification number using the Statistical Package for the Social Sciences, version 26. The categorical data were presented as frequency and percentage tables; pie chart was also used. The continuous variables were represented as mean and standard deviation for normally distributed data. The chi-square test was performed to assess statistical relations between defined dependent and independent variables. A level of *P* value ≤.05 was considered significant.

Ethical considerations

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before the sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 471 on March 23, 2021.

RESULTS

Sixty patients with T2DM were enrolled in this study. Table 1 shows the frequencies and distribution of sociodemographic characteristics: age, gender, residence, marital status, occupation, and educational level. Age group of 40–69 years showed the highest percentage of patients (88.4%) with mean age 54.75 ± 10.139 years. Male patients were higher than female patients, 31 (51.7%). Also, urban residents occupied 42 (70%) in comparison to rural patients. The highest percentage of diabetes was among married patients, 53 (88.3%). Also, job categories

Table 1: Frequency and percentage of sociodemographic features of patients, N = 60

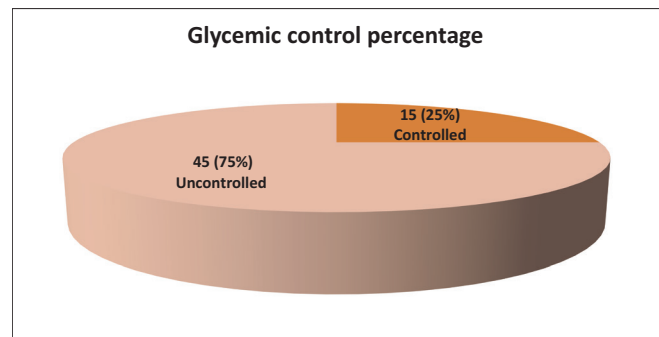
Variable	Frequency	Percentage
Age group (years)		
30–39	3	5.0
40–49	16	26.7
50–59	19	31.7
60–69	18	30.0
70–79	4	6.7
Mean ± SD = 54.75 ± 10.139 years, range = 31–78 years		
Gender		
Male	31	51.7
Female	29	48.3
Residence		
Urban	42	70.0
Rural	18	30.0
Marital status		
Single	1	1.7
Married	53	88.3
Widow	6	10.0
Job categories		
No job	2	3.3
Housewife	24	40.0
Retired	12	20.0
Business	9	15.0
Clerk	13	21.7
Education level		
Illiterate	9	15.0
Primary	15	25.0
Secondary	16	26.7
Higher education	20	33.4
Total	60	100.0

SD: standard deviation

of the highest percentage of diabetic patients were housewife and clerk, 37 (61.7%). Regarding educational level among the studied group, the highest percentage of patients had secondary and higher education, 16 (26.7%) and 20 (33.4%), respectively.

Figure 1 shows the distribution of glycemic control by HbA1c % among diabetic patients where 45 (75%) patients had uncontrolled HbA1c % ($\geq 7\%$) and 15 (25%) patients had controlled HbA1c % ($< 7\%$).

Table 2 shows the distribution of anthropometric and some body composition characteristics of patients according to their glycemic control: According to BMI category, the highest percentage of uncontrolled T2DM was among overweight and obesity grade 1 patients, 25 (41.6%), with no statistical significant association ($P = .289$). WC in both males and females had an effect on glycemic control, where the highest percentage was among males with WC more than 102cm, 13(41.93%), with statistically significant correlation ($P = .010$); uncontrolled diabetes among females was higher among

**Figure 1:** Frequency and percentage of patients according to glycemic control, N = 60

those with WC of 88cm and higher, 21 (72.4%), with statistically significant association ($P = .003$). Glycemic control has been studied concerning WHR; the highest rate of uncontrolled diabetic male patients was among those with WHR between 0.95 and 1.0 (58.06%) with statistically significant association ($P = .031$), whereas female WHR patients also showed statistical association ($P = .008$) with the highest proportion among those with WHR higher than 0.85 (65.5%) as shown in Table 2. The same table shows the relation of glycemic control with PBF, which revealed that the highest rate of uncontrolled male patients was among those with PBF higher than 20% (70.96%) with statistically significant association ($P = .002$), whereas female PBF showed no statistically significant association ($P = .694$).

Table 3 shows different food servings being eaten in the previous 24h in relation to the glycemic control; the percentage of uncontrolled diabetic patients among those who ate more than 11 servings of starch and grains per day was 96.3% with highly statistically significant association ($P = .000$).

Vegetable intake showed no statistically significant association with glycemic control ($P = .52$), 17.7% of uncontrolled diabetics had vegetables eating more than 5 servings, in comparison the 40% of controlled patients who ate 3-5 servings. Fruit servings also showed no statistically significant association with glycemic control ($P = .307$) where the lowest percentage (11.1%) of uncontrolled patients was among those who ate more than 4 servings/day.

Milk servings showed the highest proportion of no milk intake among uncontrolled patients (57.7%) and the highest rate among controlled (60%) with no statistically significant association ($P = .586$). Patients who consumed legumes at the time of obtaining the dietary recall and the number of servings eaten were studied; only 16 of 60 patients (26.6%) consumed legumes for that day, and 11 of them (68.8%) had uncontrolled diabetics in comparison to those with controlled diabetics with no statistically significant association ($P = .500$).

Table 2: Distribution glycemic control by HbA1c % in relation to BMI categories and some body composition characteristics, n = 60

Variable	Glycemic control (HbA1c %)		Total (N = 60), n (%)	χ^2 (df)	P value
	Controlled (HbA1c < 7%)	Uncontrolled (HbA1c ≥ 7%)			
BMI category (kg/m ²), mean ± SD = 30.45 ± 5.482 kg/m ² , range = 18–42 kg/m ²					
Underweight (BMI < 18.5)	1	0	1 (1.66)	6.15 (5)	.289
Normal weight (BMI = 18.5–24.9)	1	9	10 (16.6)		
Overweight (BMI = 25–29.9)	5	12	17 (28.3)		
Obesity grade 1 and 2 (BMI = 30–39.9)	8	20	28 (46.6)		
Morbid obesity (BMI ≥ 40)	0	4	4 (6.6)		
WC (cm), mean ± SD = 99.78 ± 10.105 cm, range = 76–121 cm					
WC in males (cm)				9.22 (2)	.010*
<94	4	1	5 (16.1)		
94– ≤102	2	9	11 (35.5)		
>102	2	13	15 (48.4)	11.934 (2)	.003*
WC in females (cm)					
<80 cm	1	1	2 (6.9)		
80–<88	3	0	3 (10.34)		
≥88 cm	3	21	24 (82.75)		
WHR, mean ± SD = 0.95 ± 0.054					
WHR in males				6.943 (2)	.031*
<0.95 (low risk)	4	2	6 (19.35)		
0.95–<1.0 (moderate risk)	4	18	22 (70.96)		
≥1.0 (high risk)	0	3	3 (9.67)	9.56 (2)	.008*
WHR in females					
≤0.80 (low risk)	3	1	2 (6.9.0)		
>0.80–≤0.85 (moderate risk)	2	2	5 (17.24)		
>0.85 (high risk)	2	19	22 (75.90)		
PBF %, mean ± SD = 32.20 ± 10.237%, range = 14–41%					
PBF in males				9.144 (1)	.002*
10–20%	4	1	5 (16.12)		
>20%	4	22	26 (83.88)	0.155 (1)	.694
PBF in females					
18–28%	1	2	3 (10.34)		
>28%	6	20	26 (89.66)		

HbA1c: hemoglobin A1c, BMI: body mass index, SD: standard deviation, WC: waist circumference, WHR: waist-to-hip ratio, PBF: percentage of body fat

*Significant at $\alpha \leq 0.05$

Added sugar and other sweetened beverages showed that people who consume beverages and add sugar to their diet usually have a higher percentage of uncontrolled diabetics (82.2%) with statistically significant association ($P = .003$). GI of foods being eaten was also studied, which revealed that 36 (80%) patients with uncontrolled DM ate their foods of predominantly high GI with a highly statistically significant association ($P = .000$).

DISCUSSION

This cross-sectional study included 60 type 2 diabetic patients with age greater than 20 years who attended the Diabetes and Endocrine Diseases Center in Babil. The sociodemographic characteristics of the study groups

revealed that T2DM was higher in the age group between 40 and 60 years (88.4% patients) with mean age of the patients 54.75 ± 10.2 years, this result were in agreement with the study conducted in Iraq in Basrah city, which showed that T2DM was mainly in the age group between 40 and 60 years.^[12] Also our results showed that males had a higher rate of diabetes than females with urban residence; these females were married mostly and were housewives and clerks; these results were in agreement with those of Rahmanian *et al.* who studied some sociodemographic features of T2DM that showed that diabetes occurred between the age of 30 and 50 years with male predominance, and most of their patients were obese, urban residents, and educated.^[11] Glycemic control was

Table 3: Relation of food servings by a 24-h dietary recall of patients to their glycemic control, *N* = 60

Variable	Glycemic control (HbA1c %)		Total	χ^2 (df)	<i>P</i> value
	Controlled (HbA1c < 7%)	Uncontrolled (HbA1c ≥ 7%)			
Starch servings, mean ± SD = 11.49 ± 4.885, range = 4–24					
<6 servings	4	0	4 (6.67)	19.922 (2)	.000*
6–11 servings	10	19	29 (48.33)		
>11 servings	1	26	27 (45)		
Vegetable servings, mean ± SD = 3.29 ± 2.078, range = 1–10					
No intake	5	3	8 (13.3)	7.733 (3)	.052
<3 servings	3	17	20 (33.4)		
3–5 servings	6	18	24 (40.0)		
>5 servings	1	7	8 (13.3)		
Fruit servings, mean ± SD = 2.35 ± 1.491, range = 1–6					
No fruit intake	1	8	9 (15)	3.604 (3)	.307
<2 servings	8	13	21 (35)		
2–4 servings	4	19	23 (38.3)		
>4 servings	2	5	7 (11.66)		
Milk servings, mean ± SD = 1.08 ± 0.493, range = 1–3					
No milk intake	9	26	35 (58.4)	1.070 (2)	.586
<2 servings	6	16	22 (36.6)		
2–3 servings	0	3	3 (5)		
Legume servings, mean ± SD = 2.75 ± 1.844, range = 1–8					
No intake	10	34	44 (73.3)	0.455 (1)	.500
Legumes intake	5	11	16 (26.7)		
Added sugar and other sweetened beverages usually					
Yes for sugar	6	36	42 (70)	8.571 (1)	.003*
No for sugar	9	9	18 (30)		
Predominant GI foods					
High GI	1	36	37 (61.6)	30.589 (3)	.000*
Medium GI	6	6	12 (20)		
Low GI	7	1	8 (13.4)		
No predominant	1	2	3 (5)		

HbA1c: hemoglobin A1c, SD: standard deviation, GI: glycemic index

*Significant at $\alpha \leq 0.05$

tested in this study where poor control comprised 75% of patients in comparison to good control in 25% of patients; this result was in agreement with that of a study conducted in Kuala Selangor in Malaysia in 2019 that showed that the rate of good control was 34%, whereas that of poor control was 66%.^[29] The relation of anthropometric measures to the glycemic control was studied, which showed that poor glycemic control was higher among overweight and obese type 2 diabetic patients and there was no statistically significant association; this result was in agreement with that of a cross-sectional study conducted in 2016 in India, which showed that glycemic control was not significantly associated with BMI and WHR.^[30] It was in contrast to other studies that showed a statistically significant association between BMI and glycemic control, where BMI increased the relative risk of disease.^[31] WC showed a statistically significant relation with glycemic control among the study group, which was in agreement with many studies that showed a statistically significant association between glycemic control and WC. A study held in Nigeria

revealed that the risk of type 2 diabetes increased by adding abdominal obesity measured by WC and insulin-resistance syndrome, especially when WC was higher than 88 cm in females and higher than 102 cm in males.^[15] Also, the same study had a significant statistical association between glycemic control and WHR, which is in agreement with the study that showed that the diabetes risk increased by 23% and 28%, respectively, for every 10 cm increase in WC and 10% increase in WHR.^[15] The study showed a significant statistical association between PBF and glycemic control in males but not in females; it was in agreement with a case-control study conducted in Iraq that showed a significant association between PBF and T2DM patients even in the presence of normal BMI.^[32]

The effect of diet and servings eaten also has been investigated in this study, which were obtained from the participants by 24-h dietary recall. The study showed a highly statistically significant association between intake of grains and starch food and glycemic control ($P = .000$);

it coincided with a study conducted in Qatar that showed that poor glycemic control in age greater than 18 years was correlated with intake of fast foods, croissants, and white bread.^[33] Vegetables and fruits showed a good effect on glycemic control with a non-statistical association between their intake and poor glycemic control, and this result was in agreement with that of randomized controlled trials that showed that intake of fruits and vegetables 7–10 servings per day was associated with good glycemic control because fruit and vegetables contain antioxidants with protective effect, especially when taken for 6–8-week period.^[19]

Milk and other dairy products also revealed a protective effect for glycemic control in our study with no statistical association; this result was in agreement with that of a randomized controlled trial that suggested that milk and dairy products may have a modest benefit in assisting weight loss in the short term with the beneficial effect in lowering GI, which is important for the metabolic health of type 2 diabetic patients.^[20] Legumes such as beans, peas, and lentils also showed no statistically significant association with glycemic control in our study, which is in agreement with Jenkin *et al.*'s study that showed that after intake of 1 cup per day of legumes for 3 months, the HbA1c of the patients included in his study reduced by 0.3% to 0.5% in comparison to other people who consumed less than this amount.^[21]

Added sugar and other sweetened beverages also were statistically associated with poor glycemic control in our study group which was agreed with a study revealed that consumption of table sugar more than 10% of total calories consumed and soft drinks were associated with increased obesity and T2DM risk because of high fructose corn syrup content in its manufacturing.^[16] Glycemic index of foods intake with predominantly of high glycemic index was highly statistically associated with poor glycemic control, this result was in agreement with a meta-analysis prospective cohort study of 4-26 years. follow up which showed the causal relation of the role of GI and glycemic load in the incidence of T2DM and its control,^[34] and also agreed with the international expert on carbohydrate research held a scientific summit revealed that diets with low GI and low glycemic load are considered as preventive and management tools of the disease, obesity and insulin resistance.^[35]

CONCLUSIONS

Type 2 diabetes is more among the age group between 40 and 60 years with male gender, urban residence, married patients, housewives, and secondary and higher education being the predominant factors. Poor glycemic control was higher with 75% of patients than good glycemic control in 25% of patients.

Poor glycemic control was higher among overweight and obese patients with T2DM, and was statistically significant

with WC, WHR in both sexes, and PBF in males. Also, there was a statistically significant association between eating of starch and refined grains, and added sugar and other sweetened beverage intakes with glycemic control, but no relation between intake of vegetables, fruits, milk, milk products, and legumes and glycemic control. Foods of high GI were only statistically associated with poor glycemic control in this study.

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Conflicts of interest

There are no conflicts of interest.

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