International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 13, Issue 1, pp: (122-134), Month: April 2025 - September 2025, Available at: www.researchpublish.com

Role of Dietary Patterns among Patients with Type 2 Diabetes in Diabetes Control, A Cross-Sectional Study, Thi-Qar Governorate /Iraq

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DOI: https://doi.org/10.5281/zenodo.15532917

Published Date: 28-May-2025

Abstract: **Background: The incidence of type 2 diabetes mellitus (T2DM) is on the rise and has emerged as a significant global public health concern due to changes in lifestyle and the acceleration of the world's aging population trend. In type 2 diabetes mellitus, numerous studies have shown that the most effective way to enhance glycemic control is by thorough dietary intervention, either alone or in conjunction with medication.**

Aim of Study: This study aimed to knowing role of dietary patterns among patients with type 2 diabetes in diabetes control. Methodology: This cross-sectional study included 250 patients with non-insulin-dependent diabetes who were attending Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC), a tertiary facility in southern Iraq. The data was gathered through in-person interviews with patients through questionnaires distributed on the basis of axes. Results: The results of this study indicate that 82.0% of patients follow unhealthy food patterns. While 18.0% of diabetic patients follow a healthy food pattern. A very high percentage (86.4%) of the patients with T2DM have high levels of HbA1c. Finally, the results found there were negative correlation between HbA1c with Carbohydrate scores, fiber scores, fat scores, and the overall food patterns scores (r=-0.504, r=-0.312, r=-0.680, and r=-0.713) respectively. Conclusion: This cross-sectional study concluded that there was negative correlation between HbA1c with Carbohydrate scores, fiber scores, fat scores, and the overall food patterns scores.

Keywords: **Role, Dietary, Patterns, Patients, Type 2 Diabetes, Diabetes Control, A Cross-Sectional Study.**

1. INTRODUCTION

The second form of diabetes, known as non-dependent insulin diabetes, makes up about 90% of all cases of the disease. It is defined by the dysregulation of the metabolism of macronutrients (fat, protein, and carbohydrates) due to decreased insulin secretion with or without insulin resistance **(1).**

Diabetes is a significant public health concern in Iraq due to high prevalence of Type 2 diabetes, which is among the highest in the Middle East.Due to the influence of culture on diet, a large number of Iraqis consume excessive amounts of calories, especially from meals high in unhealthy fats , sugar and carbohydrates, which has raised their risk of type 2 diabetes **(2) .** Approximately 1.4 million Iraqis suffer from diabetes. In Iraq, the reported prevalence of type 2 diabetes varies from 8.5%

(IDF—age-adjusted) to 13.9%. According to a local study that involved around 5400 residents of Basrah, Southern Iraq, the age-adjusted prevalence of diabetes among participants ages 19 to 94 was 19.7% **(3).** Regarding the percentage of diabetic mortality in Iraq increased from 3.5% in 2000 to 5.9% in 2012. Additionally, diabetes is considered Iraq's sixth leading cause of death ,This indicates the diabetes epidemic in Iraq, which is experiencing a similar pandemic to that of the Middle East **(4).**

Fats, commonly referred to as Lipids, are the main structural elements of cellular membranes and provide energy for the cells. Monounsaturated fats (MUFAs), polyunsaturated fats (PUFAs), saturated fats, and trans fats are the four types of dietary fats. Typically, food's fat content is a combination of these several forms. While a greater percentage of saturated fats come from animal products (and some plant-derived oils), unsaturated fats can be found in a wide range of foods, such as fish, nuts, seeds, and many plant-derived oils. Although trans fats in food are mostly produced by processing vegetable oils, they can also be found in small proportions in animal products like (trans fats in ruminant animal products such as sheep, goats, and cows) **(5).**

Specifically, some studies it's found that the type of dietary fat plays a significant role in the treatment of type 2 diabetes and medical nutrition therapy. It has been discovered that monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) can effectively prevent and treat type 2 diabetes and its associated complications when they are substituted for saturated fat in the diet **(6)** .

Regarding the carbohydrate in food, Higher consumption, primarily from sugar and starchy carbohydrates, was linked to an increased risk of CVD and death. On the other hand, cutting back on carbohydrates, especially refined ones, may be more important today to lower mortality risk in certain people (such as those with type 2 diabetes and insulin resistance) **(7) .**

Fibers are polymers of carbohydrates that are not absorbed or broken down in the human small intestine. Based on their use in food items and physiological impacts dietary fibers are traditionally divided into two categories: water-soluble and insoluble modes **[(8) (9)] .**

Dietary fiber has drawn a lot of interest from researchers studying glycemic management in patients with type 2 diabetes. Numerous epidemiological studies have found a connection between dietary fiber intake and the incidence of type 2 diabetes thus far, however these results are debatable. Although some research has demonstrated a protective relationship between dietary fiber consumption and the incidence of type 2 diabetes, other studies have found no significant correlations **(10) .**

Micha and colleagues discovered that a higher incidence of type 2 diabetes was associated with a lower intake of dietary fiber, and whole grains, as well as a higher intake of processed and unprocessed red meat, foods with a high glycaemic load, and sugar-sweetened beverages **(11)** .According to one research, a person's "carbohydrate tolerance" may play a role in determining the best diet for glycemic and weight control (12) **.**

2. METHODOLOGY

Study design and population

This study is an observational and analytical cross-sectional study included Type 2 diabetes not using insulin for glucose control and they can provide informed consent and complete the required dietary and clinical assessments who were attending Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC), a tertiary facility in Thi-Qar, Southern Iraq, patients came from all districts, sub-districts, and the city center. The data collect started from first September until the end of October 2024. Before collecting the data, official approval was obtained to conduct the study from the Southern Technical University and Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC).

Sampling Size:

Daniel and Cross formula for calculating sample size was used to calculate the sample size **(13)** . As a result, the minimum sample size for Patients with diabetes mellitus type 2 is **243**, while we have taken **250** to strengthen the study, as shown below:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where:

n = sample size (250)

Z = Z-score corresponding to the level of confidence (for a 95% confidence level, Z ≈ 1.96)

P=Expected prevalence or proportion. In Iraq , a study by Abusaib indicated that the overall prevalence of diabetes mellitus type 2 was **19.7% (3)** .

d = Precision (*d*= 0.05) (the maximum allowable difference between the sample proportion and the population proportion)

***Sampling Technique*:**

In this study, 250 patients with type 2 diabetes mellitus were selected from Thi-Qar Specialized Diabetes Endocrine and Metabolism Center (TDEMC), by non-random sampling technique (Convenience sampling method).

Data Collection

The data was collected through questionnaires distributed on the basis of axes following are :-

Sociodemographic and health characteristics of participants:

It consists of (10) items, related to the Socio-demographic characteristics of these patients which include (age, gender, marital status, residential area, education level, occupational status, socioeconomic status , Body mass index(BMI), Duration of disease ,HbA1c**)**.

Assessment of food pattern (common)

Assessment of consumption the types of fats (Unsaturated fats , Saturated fats and trans-fatty acid contain food items)

1-Healthy fats-contain food consumption : includes white meat (Fish and chicken) , olive oil , nuts (cashew, walnut, almonds, pistachios) , and low-fat dairy products **(14).**

2-Unealthy fats-contain food consumption : includes red meat , Fried Foods with saturated fats or trans-fatty acid ,egg with yolk , high-fat dairy products ,and Fast foods **(14).**

Assessment of Carbohydrates-contain food consumption

1- Healthy Carbohydrates-contain food consumption: includes whole grains bread (barley, oat) and legumes (Beans, Lentils, Chickpeas) **(14).**

2- Unhealthy Carbohydrates-contain food consumption : includes processed or refined carbohydrate foods (white bread),includes processed or refined carbohydrate foods (white rice),High and Medium glycaemic fresh fruits (watermelon, pineapple, bananas (ripe),dates) ,Starchy vegetables (potatoes, corn) and Sugar sweetened beverages **(14).**

Assessment of fibers-contain food consumption

Includes fibers-contain food consumption low glycaemic fresh fruits (oranges, apples, peaches, pears, apricots, strawberries, cherries), leafy green vegetables, and non-starchy vegetables (tomatoes, eggplants, onions, peppers, cucumbers).

Scoring Criteria

Fat:

The questions regarding assessment of fat-contain food items" The rating and scoring of items are four points Likert scale applied for rating fat-contain food items.

For healthy foods; the four-point type Likert scales scored as (4) for **4 or more times a week**, (3) for **(2-3) times a week**, (2) for **Once a week**, and (1) for **Never**. **For unhealthy foods;** the four-point type Likert scales scored as (1) for **4 or more times a week**, (2) for **(2-3) times a week**, (3) for **Once a week**, and (4) for **Never**.

The fat-contain food items "With 9 food items, the minimum score was 9, and the maximum score was 36. A score between >65% was deemed healthy consumption (>29 score), while a score of less than 65% was regarded unhealthy consumption (=<29) **(15).**

Carbohydrate:

The questions regarding assessment of Carbohydrates-contain food items" The rating and scoring of items are four points Likert scale applied for rating Carbohydrates-contain food items.

For healthy foods; the four-point type Likert scales scored as (4) for **4 or more times a week**, (3) for **(2-3) times a week**, (2) for **Once a week**, and (1) for **Never**. **For unhealthy foods;** the four-point type Likert scales scored as (1) for **4 or more times a week**, (2) for **(2-3) times a week**, (3) for **Once a week**, and (4) for **Never**.

The Carbohydrates-contain food items "With 7 food items, the minimum score was 7, and the maximum score was 28. A score between >65% was deemed healthy consumption (>23 score), while a score of less than 65% was regarded unhealthy consumption (=<23) **(15).**

Fiber:

The questions regarding assessment of fiber-contain food items" The rating and scoring of items are four points Likert scale applied for rating fiber-contain food items.

For fiber foods; the four-point type Likert scales scored as (4) for **4 or more times a week**, (3) for **(2-3) times a week**, (2) for **Once a week**, and (1) for **Never**.

The fiber-contain food items "With 3 food items, the minimum score was 3, the maximum score was 12 and, and the median score was 8. A score between 50 and 74% was deemed neutral consumption (8-10), less than 50% was deemed unhealthy consumption (<8), while a score of more than 75% was regarded healthy consumption (>10) **(16).**

Statistical Analysis

The information for each item on the questionnaire was copied to code sheets, the data was input into a personal computer, and the statistical package from SPSS-27 was used to evaluate the data. Simple statistics like frequency, percents, average, standard deviation, and range displayed the data. A Chi-square test (X^2-test) or Fisher exact test was utilized to identify the significance of qualitative data percentage differences. The P-value was considered statistically significant when it was equal to or less than 0.05 (17).

Ethical Considerations

• Obtain informed consent from all participants.

• Ensure confidentiality of patient data.the participants was ensured that all the data collected were used for research purpose only.

3. RESULTS

Sociodemographic and health characteristics of participants

In Table 3.1, the results of this study indicate that most patients with T2DM belonging to ages 50-58 years (33.2%), followed by those aged 41-49 years (25.6%), 59-67 years (22.4%), 32-40 years (9.6%), while lowest percentage (9.2%) of patients are aged >67 years. The mean of age 53.3±9.8 (with range; 32-75) years. The gender ratio is 65.6% female to 34.4% male. While 84.8% of patients were married, followed by widow (12.0%), single (1.6%), and divorced (1.6%). Most patients live in urban areas (80.4%) compared to rural (19.6%). The highest proportion has Illiterate (40.0%), followed by Primary (18.0%), Intermediate (13.6%), read and write (13.6%), Collage and higher studies (11.2%), and secondary (3.6%). Regarding occupational status, the highest percentage (61.2%) of the participants were housewives, 16.8% of patients have self-employed, 14.4% employed, and 7.6% retired.The highest percentage 48.4% of patients have low socioeconomic status, followed by 34.4% medium socioeconomic status, and 17.2% high socioeconomic status. Also,the present results found that most patients with T2DM were obese (50.8%), followed by those overweight (35.6%), while lowest percentage (13.6%) of patients have normal weight Also,the results of the study reveal that more than half of patients their duration of disease with T2DM was 1-5 years (50.8%) , followed by 6-10 years (26.0%),11-15 years (12.4%), 16-20 years (7.6%), and >20 years (3.2%). Finally 86.4% of the patients with T2DM have high levels of HbA1c. The mean of HbA1c was 8.97±2.237 (with range; 5.7-14.9).

Table (3.1): Socio-demographic and health characteristics of participants

Sociodemographic characteristics of patients with DM		No.	%
Age groups	32-40 years	24	9.6
	41-49 years	64	25.6
	50-58 years	83	33.2
	59-67 years	56	22.4
	>67 years	23	9.2
	Mean± SD (Range)	**53.3±9.8 (32-75)**	
Gender	Male	86	34.4
	Female	164	65.6
Marital status	Single	4	1.6
	Married	212	84.8
	Divorced	4	1.6
	Widow	30	12.0
Residential area	Urban	201	80.4
	Rural	49	19.6
Education level	Illiteracy	100	40.0
	Read & write	34	13.6
	Primary graduate	45	18.0
	Intermediate graduate	34	13.6
	Secondary graduate	9	3.6
	Collage and higher studies	28	11.2
Occupational Status	Government employed	36	14.4
	Self- employed	42	16.8
	Retired	19	7.6
	house wife	153	61.2
Socioeconomic status	Low	121	48.4
	Medium	86	34.4
	High	43	17.2
BMI categories	Underweight (<18.5)	-	-
	Normal weight (18.5-24.9)	34	13.6
	Overweight (25-29.9)	89	35.6
	Obesity (>=30)	127	50.8
Duration of DM	1-5 years	127	50.8
	6-10 years	65	26.0
	11-15 years	31	12.4
	16-20 years	19	7.6
	>20 years	8	3.2
HbA1C categories	controlled (5.7-6.4%)	34	13.6
	uncontrolled (>6.4%)	216	86.4
	Mean± SD (Range)	**8.97±2.237 (5.7-14.9)**	

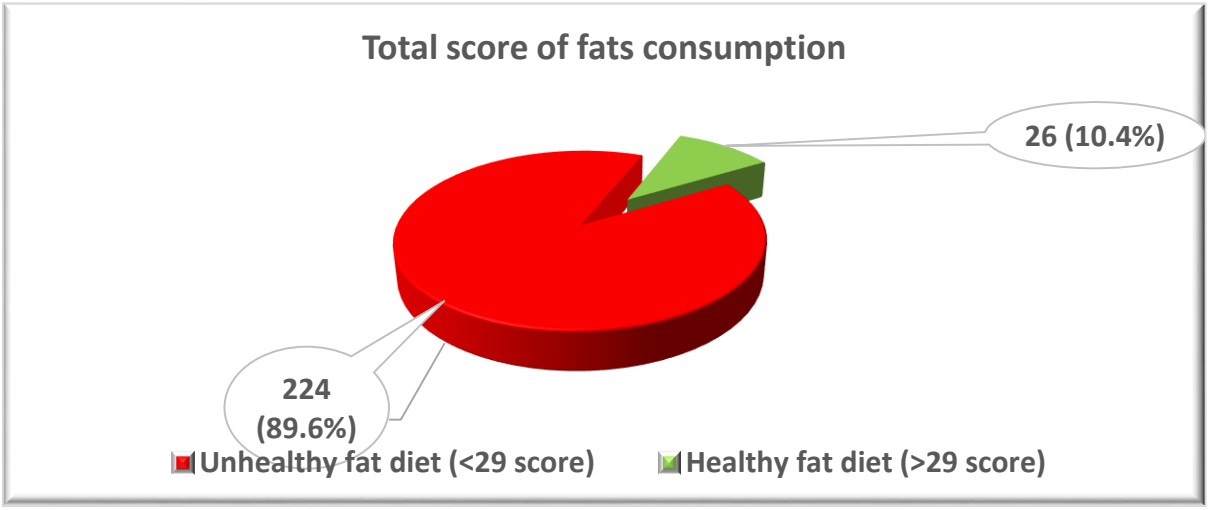

Figure (3.1): Pie chart illustrates the total fat consumption score of the participants

In Figure (3.1) the results of this study indicate that 89.6% of patients follow foods that contain unhealthy fats. While 10.4% of diabetic patients follow a healthy diet towards fats.

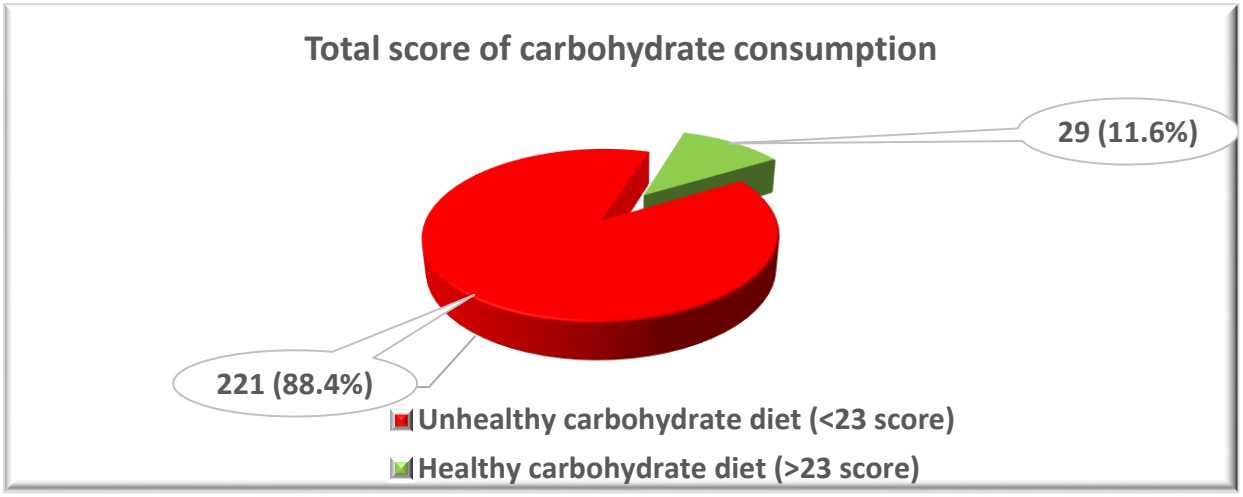

Figure (3.2): Pie chart illustrates the total carbohydrate consumption score of the participants

In Figure 3.2, the results of this study indicate that 88.4% of patients follow foods that contain unhealthy carbohydrates. While 11.6% of diabetic patients follow a healthy diet.

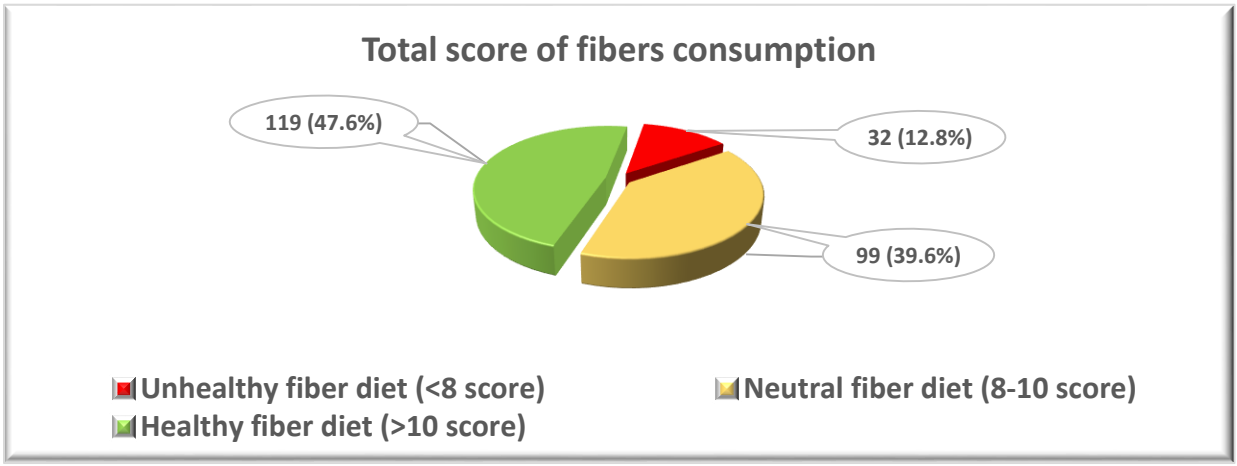

Figure (3.3): Pie chart illustrates the total fibre consumption score of the participants

In Figure 3.3, the results of this study indicate that 47.6% of patients follow healthy foods that contain fibres, 39.6% of patients with T2DM follow neutral fibres diet. While 12.8% of diabetic patients follow a unhealthy fibres diet.

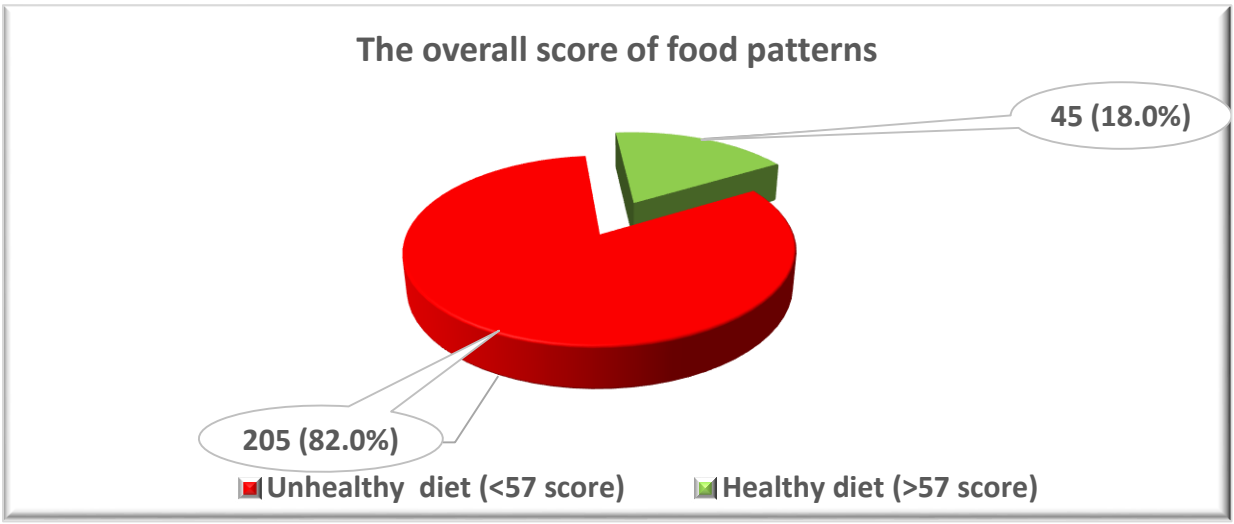

Figure (3.4): Pie chart illustrates the overall score of food patterns

In Figure 3.4, the results of this study indicate that 82.0% of patients follow unhealthy food patterns. While 18.0% of diabetic patients follow a healthy food pattern.

Level of HbA1c according to food pattern

The results in table (3.2) showed that 90% of individuals with an unhealthy carbohydrate diet had uncontrolled HbA1C (>6.4%), compared to only 10.0 % of those with a controlled HbA1C (5.7-6.4%). Additionally, 91.1% of individuals with an unhealthy fat diet had uncontrolled HbA1C (>6.4%), compared to only 8.9 % of those with a controlled HbA1C (5.7-6.4%). Regarding to fibers , 96.9% of individuals with an unhealthy fiber diet had uncontrolled HbA1C (>6.4%) , compared to 3.1 % of those with a controlled HbA1C (5.7-6.4%)

Finally, 91.2% of individuals with an unhealthy diet had uncontrolled HbA1C (>6.4%), while this percentage decreased to 8.8 % among those with a controlled HbA1C (5.7-6.4%).

Table (3.2) Level of HbA1c according to food pattern

		HbA1C categories				**P-value**
		controlled **(5.7-6.4%)**		uncontrolled **(>6.4%)**		
		No.	**%**	**No.**	**%**	
Total Score of carbohydrate food assessment	Unhealthy carbohydrate diet	22	10.0	199	**90.0**	<0.001
	Healthy carbohydrate	12	41.4	17	58.6	
Total score of fat foods assessment	Unhealthy fat diet	20	8.9	204	**91.1**	<0.001
	Healthy fat diet	14	53.8	12	46.2	
Total score of fiber foods assessment	Unhealthy fiber diet	1	3.1	31	**96.9**	0.001
	Neutral fiber diet	7	7.1	92	92.9	
	Healthy fiber diet	26	21.8	93	78.2	
The Overall Score of Food Patterns	Unhealthy diet	18	8.8	187	**91.2**	<0.001
	Healthy diet	16	35.6	29	64.4	

Correlation between HbA1c and food patterns

In Table 3.3, the results found there were negative correlation between HbA1c with Carbohydrate scores, fiber scores, fat scores, and the overall food patterns scores (r=-0.504, r=-0.312, r=-0.680, and r=-0.713) respectively. While there was positive correlation between Carbohydrate scores with fat scores, and the overall food patterns (r=0.480, and r=0.799)

respectively. In addition, there was moderate positive correlation between fiber scores with fat scores, and the overall food patterns (r=0.317, and r=0.404) respectively. Finally, there was strong positive correlation between fat scores and the overall food patterns (P<0.001; r=0.884).

Table (3.3): Correlation between HbA1c and food patterns

Correlations					
		Carbohydrate scores	**Fiber scores**	**Fat scores**	**Overall scores**
HbA1c	R	**-0.504****	**-0.312****	**-0.680****	**-0.713****
	P-value	**<0.001**	**<0.001**	**<0.001**	**<0.001**
	N	250	250	250	250
**. Correlation is significant at the 0.01 level (2-tailed).					

4. DISCUSSION

The results of this study indicate that most patients with T2DM were older age. These results agreed with the study findings conducted in Jazan, Saudi Arabia by **Elfaki *et al.*, (18)** which found that most of the T2DM belonging to age groups of (51-60 years) with (30.5%), followed by those aged 41-49 years (28.6%). Also, another study in Baghdad , Iraq by **Al-Majidi *et al.*, (19)** that showed the role of ageing in the development of diabetes type 2 which reported that 92 % of patients fall within age groups (50 – 60 years), followed by 8 % of patients fall within age groups <50 years. The increase in the older age groups among the samples of this study may be because type 2 diabetes is mostly associated with the elderly, which increases the frequency of these advanced age groups. This explanation is supported by **Al Mansour (20)** which reported that diabetes type 2 was more prevalent among the older respondents compared with the younger age groups. In this study, the majority of the study sample comprises females, representing 164 (65.6%) of the total sample size. This result agreed with study findings conducted by **Baral *et al.*, (21)** which reveals that most of participants were females (56.9%) **.** Other study conducted by **Elfaki *et al.*, (18)** which reveals that half of participants were females (55.6%).

A possible reason for this result could be that women are less active than men and follow a sedentary lifestyle, and therefore may be overweight or obese. Women are also less aware than men of the risks of physical inactivity and the damage caused by obesity and its complications, so they are more likely to develop diabetes. This explanation is supported by **Kautzky-Willer *et al.*, (23)** which revealed that the most prominent risk factor to T2DM , which is obesity, is more common in women .

Regarding to marital status, A high proportion of the patients with DM were married.These results are similar to findings of study done by **Aladhab & Alabbood (24)** which indicated that the majority (85.7%) of the study sample were married. Also, other recent study conducted by **Hamoodah *et al* ., (25)** which indicated that the majority (72%) of the study sample were married. A possible explanation for this increase in married people in this study may be logical because most of the sick participants are from the older age groups.

In this study, the results reported that most patients with T2DM living in urban areas. This findings supported by study conducted by **Nasir *et al.*, (26)** which found the most of the patients living in urban . Also, other recent study conducted by **Elenga-Bongo *et al.*, (27)** which found the same results. The possible explanation for this increase in the number of residents in urban areas may be due to many factors, including the availability of health institutions equipped with the best technology and the most skilled doctors and easy access to them by residents of urban areas, which facilitates early diagnosis of many cases of diabetes and their increase in urban areas compared to rural areas that lack early detection programs and difficulty in access to health facilities. Additionally, this high prevalence of diabetes in urban can also due to reflects the consequences of urbanization, the change in eating habits linked to it and sedentary lifestyle.

Concerning to the level of education of type 2 diabetic patients, it is demonstrated that the highest percentage of them illiterate, they accounted (40.0%) for the study sample. This result agreed with results obtain from study carried out by **Baral *et al.*, (21)** who found that the educational level to most patients with type 2 diabetes were illiterate. Also, these results were agreed with recent study done by **Al-Majidi *et al.*, (19)** which found the same results. A possible explanation for this increase in the number of illiterate people visiting the hospital may be due to lack of knowledge, and poor blood sugar control, those lead to more frequent visits to the hospital compared to higher educational levels. This explanation supported by **Sharma *et al.*, (28)** which found that there was high prevalence of poor-quality diet and sub-optimal diabetes control among illiterate diabetes patients.

In regard to the participants' occupational status, it was found that the largest proportion of the study sample consisted of individuals who identified as housewives (61.2%).This results is similar to the result obtained from study carried out by **Mohamed *et al.* (29)** which indicated that the majority of the study sample were housewives . Also, these results were compatible with study done by **Nasir *et al.*, (26)** which found the same results. A possible explanation for this result , may be due to most housewives may have sedentary routines due to household responsibilities that do not require much physical effort, which increases the risk of obesity and insulin resistance **(30) .**

About socioeconomic status, a majority of patients have low socioeconomic status, this result agreed with study findings conducted by **Nasir *et al.*, (26)** which reveals that most of patients have low socioeconomic status **.**Also, other study conducted by **Adil & Ismail (31)** these study reported that majority of patients have insufficient income with low socioeconomic status. A possible explanation for this increase in the number of low socio-economic status people visiting the hospital may be due lack of knowledge in blood sugar control, and a lack of healthy diet quality due to high cost, all of which are associated with a uncontrolled levels to blood sugar that make people attending frequent to hospitals. This explanation supported by **Sharma *et al.*, (28)** , which found that there was a greater prevalence of uncontrolled levels to blood sugar in low socio-economic status diabetes patients.

The present results found that more than half of patients with T2DM were obese. This results were similar to the result obtained from study carried out by **Shiriyedeve *et al.*, (32)** which reveals that most of participants were obese **.** Another study conducted by **Sabea *et al.* (33)** also supported these results. This may be due to the direct correlation between obesity and DM. According to a study by **Parmar (34)** reported that the relationship between obesity and diabetes is of such interdependence that term 'diabesity' has been coined. Major factors causative towards ‘diabesity’ include chronic overconsumption of energy-dense food, lifestyle, genetic makeup and environment play important roles in adipose tissue function or dysfunction. T2DM is characterized by impaired fat metabolism in adding up to glucotoxicity. Overconsumption of energy-dense foods results in excessive fat deposition and enhanced insulin resistance.

The results of the study reveal that more than half of patients their duration of disease with T2DM was 1-5 years. These results aligned with the study done in Basra, Southern Iraq by **Aladhab & Alabbood (24)** which reveal that most of patients their duration of disease was less than 5 years. Also, these results were compatible with study done by **Lee & Li (35)** that found the same results. The samples in this study predominantly included diabetic patients in the early stages of the disease, this may be attributed to increasing health awareness about the need for early detection of chronic diseases, especially among the elderly.

In this study, the majority of the patients (86.4 %) with T2DM have high levels of HbA1c .These results are compatible with the study conducted by **Elfaki *et al.*, (18)** reported that the most of patients (90.8%) suffer from high levels and uncontrolled of HbA1c .Also, study carried out by **Al-Majidi *et al.*, (19)** supported this result . There are many reasons for increased HbA1c levels, which may result from bad behaviors such as light physical activity, as shown in this study, or lack of awareness of following nutritional programs and a healthy lifestyle. Some behaviors increase the risk of HbA1c changes, including poor eating habits, being overweight, and physical inactivity **(36).**

In Figure (3.1) the results of this study indicate that 89.6% of patients follow foods that contain unhealthy fats. Although there is a healthy diet for some food items that contain fats, most of patients with T2DM follow unhealthy diet regarding all foods that contain fats. These results aligned with study carried out by **Al-Mssallem *et al.*, (37)** which found that the dietary intake of saturated fats was higher than the daily recommended allowance for both males and females. Consequently, the unsaturated fats intakes were below the daily recommended allowance for both groups .But, these results incompatible with study conducted by **Iatcu *et al.*, (38)** which reported that there was a lower consumption of unhealthy fats and oils. A possible explanation for the increased incidence of unhealthy diets concerning food items containing fat may be due to insufficient knowledge of the effect of fats on insulin resistance and blood sugar control.

In figure (3.2), most patients with T2DM follow foods that contain unhealthy carbohydrates. These results aligned with study carried out by **Al-Mssallem *et al.*, (39)** which showed that foods that contain unhealthy carbohydrates intake was high among Saudi patients with type 2 diabetes . Also, these results were compatible with recent study done by **Sharifi (40)** which reported that the diabetic group consumed more unhealthy carbohydrates than the healthy group. This may be due to a lack of nutritional knowledge, dietary habits, economic constraints, and limited availability of better options. In addition, many traditional diets are based on unhealthy carbohydrate-rich meals, which makes them difficult to change.

In figure (3.3), The current results found that the highest percentage of patients eat healthy foods that contain fibers. These results aligned with study carried out by **Elfaki *et al.*, (18)** which revealed that vegetables and fruits was consumption 5 times per week among patients . Also, these results compatible with study conducted by **Saaty & Aljadani (41)** which

found the same results. Perhaps the reason is due to the availability of these foods and their low prices compared to other foods, such as foods rich in protein and fats. **In figure (3.4)** the most patients have inadequate assessment score regarding consumption of healthy food patterns.The results are line with a study in Shiraz, Iran by **Mirahmadizadeh *et al.* (42)** which found the Levels of adherence diet amongst patients with T2DM are not within the not good range. Another study conducted in Riyadh by **Aljahdali & Bawazeer (43)** , this finding confirms the low compliance with the dietary recommendations among T2DM . explanation for this result may be due to the high consumption of unhealthy carbohydrates especially processed or refined carbohydrate foods (white bread and white rice) The results found there were negative correlation between HbA1c with Carbohydrate scores . A significant negative correlation between HbA1c and carbohydrate scores suggests that higher carbohydrate intake, particularly of better quality with low glycemic index , is associated with lower HbA1c levels, highlighting the potential role of carbohydrate quality in glycemic control.These result agreed with study carried out in Babil ,Iraq by **Al-Bayati & Al-Diwan (44)** ,who showed a highly statistically significant association between intake of grains and starch food and glycemic control, that also agreed with the international expert on carbohydrate research held a scientific summit revealed that diets with low glycemic index and low glycemic load are considered as preventive and management tools of the diseases, obesity and insulin resistance . Another study conducted by **Gan *et al.*, (45)** reported that a greater intake of carbohydrates from whole grains, and carbohydrates from non-starchy vegetables was significantly associated with a lower risk of T2DM. This relationship may be explained that foods such as whole grains with a low glycemic index (GI) may help patients lower or manage their blood sugar levels.

The results found there were negative correlation between HbA1c with fiber scores, this indicate that higher fibers intake, is associated with lower HbA1c levels, highlighting the potential role of fibers quality in glycemic control. This result agreed with study carried out by **Reynolds *et al.*, (46)** concluded that higher-fibre diets are an important component of diabetes management, resulting in improvements in measures of glycaemic control, blood lipids, and body weight reduction. Another study conducted by **Elfaki *et al.*, (18)** reported that the pattern of consumption of fruits and vegetables among T2DM patients conformed to the recommended levels and showed statistical significance in achieving the target HbA1c <7. This relationship may be explained that foods such as fruits and vegetables may help T2DM patients lower or manage their blood sugar levels. This explanation is supported by **Giuntini *et al.*, (47)** which reported that dietary fiber can contribute to a reduction in the glycemic response resulting from the consumption of carbohydrate-rich foods.

The results found there were negative correlation between HbA1c with fat scores , A statistically significant association between HbA1c and fats scores suggests that higher fats intake, particularly of healthy fat high quality , is associated with lower HbA1c levels, highlighting the potential role of fats quality in glycemic control.These result agreed with study carried out by **Al-Adwi *et al.*, (48)** who reported that following a low-fat diet improves glycemic control and decreases HbA1c levels. Also ,another recent study conducted by **Al-Mssallem *et al.*, (37)** supported this result. This relationship may be explained that eat healthy fat may help T2DM patients lower or manage their blood sugar levels due to improved insulin sensitivity and better glycemic control. Another explanation is supported by **Zimmer (49)** which revealed that healthy fats may be help slow digestion and reduce postprandial glucose spikes, preventing blood sugar fluctuations.

The results found there were negative correlation between HbA1c with the overall food patterns scores , A highly statistically significant association between HbA1c and overall food patterns scores suggests that higher healthy food intake is associated with lower HbA1c levels, highlighting the potential role of diet quality in glycemic control .This findings are supported by **Micha *et al.*, (11)** who found that a higher incidence of type 2 diabetes was associated with a lower intake of dietary fiber, nuts or seeds, yogurt, and whole grains, as well as a higher intake of processed and unprocessed red meat, foods with a high glycaemic load, and sugar-sweetened beverages .Moreover , these result are in line with a study conducted by **Becerra-Tomás *et al.*, (50)** on Mediterranean diet, which showed that the idea behind the Mediterranean diet is to eat more seafood, wholegrain foods, nuts, fruits, vegetables, and legumes. In people with type 2 diabetes, a Mediterranean diet plays a significant impact in glycemic management and preventing cardiovascular disease by decreasing triglycerides, lowering HbA1c. This explanation is supported by **Al-Mssallem, M., & Al-Arifi (51)** which reported that following healthy dietary pattern is associated with hemoglobin A1c <7% .

5. CONCLUSION

1. The study results show a statistically significant relationship between socio demographic variables and the incidence of type 2 diabetes.
2. In this study, most diabetic patients were obese and overweight
3. The study revealed that many diabetic patients followed unhealthy dietary patterns, such as excessive carbohydrate and fat consumption.

4. Overall, the study concluded that the general assessment of dietary patterns was unhealthy among many diabetic patients.In this study, higher glycated hemoglobin (HbA1c) levels were associated with unhealthy carbohydrate, fiber, and fat intake. However, a significant nagative correlation was found between fat scores, carbohydrate and fiber scores, and overall dietary patterns.

Funding

None

Conflict of interest statement

No conflict of interest is declared.

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