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Association Between Nutritional Habits and Glycosylated Hemoglobin Level in Type 2 Diabetes Mellitus

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ABSTRACT

Type 2 Diabetes (T2D) is one of the top 10 causes of mortality worldwide, and poor eating habits may lead to an uncontrolled level of HbA1c. A cross-sectional descriptive correlational design was utilized. A convenient sample of 143 adult patients was utilized. The tools used were (a) structured interview questionnaire, (b) Health assessment and lifestyle questionnaire, and (c) Nutritional habits questionnaire. The mean age of the study sample was (47.39±11.53 years) with the mean level of HbA1c (8.05 ±1.45). HbA1c level was positively correlated with the nutritional habits score (r=0.343**; P= 0.000). A significant relationship was found between levels of HbA1c and eating fruits and vegetables. Monthly income is significantly associated with nutritional habits. To promote and improve nutritional habits, regular meetings in clinical settings should be held by an interdisciplinary care team including nurses and dieticians to provide assessment, follow-up, and nutritional advice for T2D patients. Replication of the study in different geographical areas is recommended.

Keywords: Nutritional Habits; Type 2 Diabetes; HbA1c; Nutritional Pattern

INTRODUCTION

Type 2 diabetes (T2D) is one of the most commonly encountered health problems worldwide, and its prevalence among adults has more than tripled over the past two decades. By 2045, this figure will have risen to 700 million. Moreover, in Egypt there were 8.9 million cases of diabetes among adults, and this will rise to 11.9 million cases by 2030, and it may reach 16.9 million cases by 2045. Patients with T2DM are at high risk for many complications due to elevated blood glucose and persistent elevation reflected in high HbA1c. It has been stated in the literature that elevation of HbA1c is due to inappropriate nutritional habits (Elif *et al.*, 2018). Many studies have stated a significant association between HbA1c and several nutrients, such as carbohydrates, fats, meat, vegetables, and fruits (Tayyem *et al.*, 2022). However, little research has been conducted to investigate the relationship between nutritional habits and glycosylated haemoglobin level control. The nutritional habits and dietary patterns of patients with T2D are affected by their age, gender, monthly income, and duration of disease (Ji *et al.*, 2019).

In relation to T2D, dietary patterns and nutrition habits are considered modifiable factors (Hawkes *et al.*, 2015). So, the effect of inappropriate nutrition on T2D can be minimised through modification and follow-up of nutritional habits (England *et al.*, 2014). Therefore, careful attention to diet is a cornerstone for T2D management. A consultation with a diabetic nurse or dietician is obligatory when patients are newly diagnosed and is important in reducing the complications that occur from elevation of HbA1c (Delahanty, 2020). To confirm what the researchers of the current study discussed, previous studies highlighted that the type and components of food are vital and significant in the improvement and management of T2D (Basiak-Rasala, Rozanska & Zatonska, 2019; Ojo, 2019). Furthermore, nutrient profiles of 23596 individuals in New Zealand showed that more than half of them mentioned that their food package is considered to be unhealthy in relation to systems of nutrition (Jiang *et al.*, 2012). In Egypt, searching the literature found few studies in the field of nursing investigating the relationship between HbA1c levels and nutrition habits. This needs strong attention

by health care providers.

Healthcare providers, including certified diabetic nurses and certified diabetes educators, can play a significant role in controlling HbA1c and avoiding complications that may arise from inappropriate nutritional habits. This can be accomplished through establishing evidence-based guidelines in Egypt for patients with T2D including mandatory follow up appointments for HbA1c monitoring and diet consultation based on patient`s needs. Moreover, nurses can help patients with T2D create a personal dietary plan based on the improvement of nutritional habits that help in controlling HbA1c. So, the aim of the current study is to determine the association between nutritional habits and glycosylated haemoglobin levels in type 2 diabetes mellitus.

Hypothesis

There will be a correlation between nutritional habits and HbA1c among patients with T2D.

METHODOLOGY

Research Design

A cross-sectional, descriptive, and correlational study was conducted to achieve the aim of the study. A correlational design is a way to do quantitative research that looks for links between two or more variables in the same group, like the link between eating habits and HbA1c (Grove, Burns & Gray, 2012).

Sample

A convenient non-probability sample consisting of 143 patients was taken. The inclusion criteria are age above 18 years, both male and female with T2D, and the exclusion criteria include patients with any mental or cognitive impairment. The sample size was calculated using G-power version 3.1.1 for power analysis. A Power of 0.95 (β = 1-.95 =0.05) at alpha 0.05 (one-sided tail) and the significance level at $P \leq 0.05$.

Setting

The study was carried out at the Diabetes and Endocrinology Outpatients' Unit at Kasr El Aini Hospital, affiliated with Cairo University. This unit covers free examinations, treatment, and follow-up services for diabetic patients coming from different governorates in Egypt.

Data Collection

A face-to-face interview was conducted to collect sociodemographic data such as age, gender, level of education, monthly income, marital status, and duration of disease. Also, health assessment questionnaires were developed by the researchers to collect information about laboratory investigations (HbA1c level) and lifestyle habits.

Another questionnaire related to nutritional habits consisted of two parts. The first one collected data about nutritional habits such as eating the main meals during the day, eating snacks between meals, using artificial sweets, visiting nutritionists, etc. (8 items) and the second part included items related to eating patterns such as number of meals per day, number of fruits and vegetables per week, number of meals per week eating meat per week, etc. (5 items), the origin of the tool has been carried out by (Asaad *et al.*, 2015) and necessary modifications have been made by the researchers of the current study to assess the nutritional habits. The scoring system of this tool is classified by the researchers of the current study as follow: (0) is specified for a response of No and (1) is specified for Yes. Three levels were allocated for patients' responses: Poor level considered at (≤ 4) if the response is $\leq 50\%$. The desirable level ranges between (>4 to ≤ 6) if the response is from 50 to $\leq 75\%$. A good level is considered at (>6) if the patient's response to questions is > 75 %. The questionnaires were translated into Arabic and content validity was established. The researchers met the patients for 30–45 minutes in a private room in order to collect data in a quiet environment.

Validity of the Questionnaires

Content validity was established by a panel of five experts (three experts from faculty members in Medical Surgical Nursing and two experts from the Diabetes and Endocrinology Department) for the clarity and appearance of the questionnaires. Necessary modifications were made accordingly, and objectivity was ensured by using a pilot study on 10% of the participants.

Ethical Consideration

Written approval was granted from the Head of Diabetes and Endocrinology outpatients' unit. The purpose and importance of the study were explained to each patient. The researchers ensured that voluntary participation was obtained using written informed consent. Coding the data was also done to ensure anonymity and confidentiality of patients' information.

Data Analysis

Statistical Package for the Social Science (SPSS) programme version 24 (Gogoi, 2020) was used to analyse the data. Descriptive statistics such as frequency, percentage, mean, and standard deviation

were used. Inferential statistics such as the *F*-test and Pearson correlation coefficient were utilised to analyse the data. $P \leq 0.05$ is set as the level of significance.

RESULTS

Table 1: Personal Characteristics and Score of Nutritional Habits among the Study Sample (N=143)

Sociodemographic Characteristics	No	%	F-test	P-value
Age	Mean±SD	(47.39±11.53)	1.051	0.410
Gender				
Male	76	53.1	0.407	0.525
Female	67	46.9		
Level of Education				
Cannot Read and Write	37	25.90	1.082	0.368
Read and Write	23	16.10		
Primary	28	19.60		
Secondary	25	17.50		
University	30	21.00		
Monthly Income				
Adequate	102	66.40	4.742	0.010
Inadequate	48	33.60		
Marital Status				
Single	20	13.99	0.255	0.614
Married	123	86.01		
Duration of Disease (Years)	10.35 ± 6.47		0.873	0.626
HbA1c	8.05 ±1.45		1.783	0.012*

*Significant at *P≤ 0.05; F value of Anova test*

Table 1 illustrates that less than half of the study sample (46.9%) were female, with a mean age of (47.39±11.53). There was a significant relationship between monthly income and total nutritional habits score (P =0.01). Also, the mean level of HbA1c was (8.05±1.45) and significantly associated with nutritional habits (P <0.05).

Table 2: Association between HbA1c and Items of Eating Pattern Among the Study Sample (N=143)

Variables	Categories	No	%	Mean of HbA1c±SD	95% CIª	F	P -value
Number of meals the patient eats per day	≤ 3	1	7	9.70±1.51	7.81-8.29	0.687	0.51
	4-5	45	31.5	8.08±1.55			
	≥ 6	97	67.8	8.05±1.39			
The meals that patient forget	Breakfast	33	23.1	7.77±1.39	7.81-8.29	3.197	0.044*
	Lunch	43	30.1	8.01±1.29			
	Dinner	49	34.3	8.54±1.57			
Snacks eaten between meals per day	No	41	28.7	7.72±1.25	7.72±1.25	2.732	0.069
	1-2 times	79	55.2	7.72±1.25			
	More than 2 times	23	16.1	7.72±1.25			
Number of eating fruits and vegetables per week	Daily	28	19.6	7.67±1.21	7.81-8.29	3.10	0.048*
	1-2 /week	91	63.6	8.28±1.47			
	3-5 /week	24	16.8	7.65-1.44			
Number of eating meat per week	Daily	4	2.8	7.50±.35	7.81-8.29	0.662	0.662
	1-2 /week	113	79.0	8.02±1.51			
	3-5 /week	26	18.2	8.28±1.21			

*Significant at *P≤ 0.05; F value of Anova test*
at 95% Confidence Interval for the mean of HbA1C of one sample t-test

Table 2 indicates two significant association (P < 0.05) between HbA1c and the meals that patients forget number of eating fruits and vegetables as well per week with 95% CI (7.81-8.29).

Table 3: Correlation between Nutritional Habits Score and HbA1c Level among the Study Sample (N=143)

	Mean ±SD	R	P-Value
HbA1C	8.05 ±1.44		
Nutritional Habits	3.98±1.29	0.343**	0.000

**Correlation is significant at 0.01
*Score (r=0.343**; P= 0.000)*

Table 3 reveales that HbA1c level is strongly correlated with nutritional habits.

Table 4: Association between HbA1c and Lifestyle Habits of the Study Sample (N=143)

	N (%)	Mean± SD	F	P -value
Smoking	Yes 45(31.47)	8.21±1.43	0.752	0.387
	No 98(68.53)	7.98±1.44		
Practicing exercise	Yes 35(24.48)	7.62±1.72	4.29	0.040
	No 108(75.52)	8.05±1.44		
Using saturated fat in diet	Yes 99(69.23)	8.33 ±1.38	12.93	0.000
	No 44 (30.77)	7.43±1.38		

* Level of significant is considered at P≤0.05

Table 4 shows that the majority of the patients (75.52%) did not exercise, which has a significant association with HbA1C (P =0.041). The same table revealed that around two thirds of patients (69.23%) used saturated fat in their diets and this finding indicated a highly significant association with HbA1c (P=0.000).
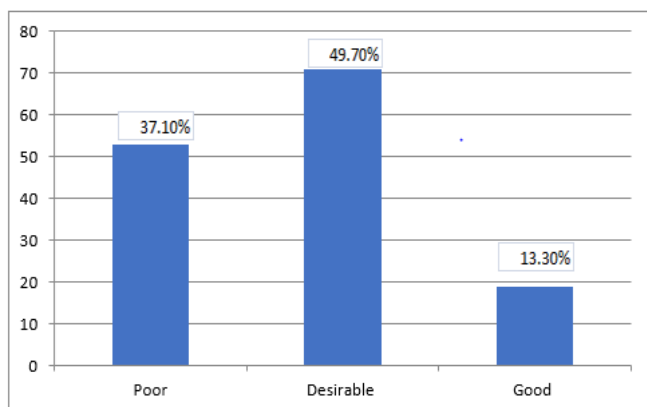
DISCUSSION

The current study was conducted to determine the relationship between nutritional habits and HbA1C levels in T2D patients. A strong positive correlation was found between nutritional habits and HbA1c levels in patients with T2D. This is congruent with a study done in Turkey by Elif *et al.*, (2018). International and Middle Eastern studies have also reported in the literature that improving dietary habits can help control HbA1c levels (Geistanger *et al.*, 2008). In the same line, Badedi *et al.*, (2016) highlighted that patients who were not following the recommended diabetes diet had poor glycemic control. Another study conducted in Qatar by Tayyem *et al.*, 2022, aimed to find out the relation between eating different types of diet and glycemic control among T2D patients, and stated that if patients regulated their dietary habits, they may have better glycemic control.

The lower percentage of patients under the study were found to have a good level of nutritional habits and more than one third reported a poor level. And the mean level of HbA1c was 8.05 ±1.45 (>7%) which means that patients have poorly controlled diabetes. This finding is congruent with a study conducted in Bahrain by Shamsi *et al.*, (2013). Another study conducted in the Kingdom of Saudi Arabia by Badedi *et al.*, (2016) highlighted that the majority of T2D had poorly controlled HbA1c. Moreover, Elif *et al.*, (2018) reported the same findings. So, the study will contribute to the nursing implications for controlling HbA1c levels and nutritional habits among Egyptian patients. In this respect, ADA (2021) established guidelines for diabetic patients at the time of diagnosis and highlighted the importance of providing advice through follow-up sessions. So, patients can obtain care and have continuous consultation with nutritionists or health care providers such as nurses. In this way, nursing education makes it easier for nurses and patients to talk to each other in different settings and gives people easier access to dietary advice and HbA1C monitoring.

In this study, the patients' mean age was 47.39±11.53 and was not significantly associated with nutritional habits. This finding is incongruent with Shamsi *et al.*, (2013), who stated a highly significant association. Another study found that a higher percentage of diabetic patients aged 51 to 70 years had poor glycemic control due to dietary habits (Ma *et al.*, 2016).

Regarding marital status, it was found that there were no differences between single and married patients in relation to nutritional habits. This is inconsistent with Shamsi *et al.*, (2013), who stated that singles had the lowest score for dietary practice. The present study found no significant association between educational level and dietary habits. A study conducted in Mexico, on the other hand, found a positive relationship between educational level and dietary habits. The same finding was reported by Shamsi *et al.*, (2013), as well as findings from other studies highlighting the link between low educational level and nutritional habits (Casey & Wintergerste, 2000). Gender is not significantly associated with nutritional habits, which is consistent with a study conducted by Shamsi *et al.*, (2013). In contrast, Ji *et al.*, (2019) mentioned that gender is associated with dietary habits.

In relation to monthly income, the present study found a significant association with nutritional habits. In the same line, studies conducted by Bijlsma-Rutte *et al.* (2018); Tao *et al.*, (2016) reported that diabetic patients who are not financially led suffer from poor glycemic control due to an increased level of HbA1c. While patients with a higher income are able to get different types of healthy food and reach medical services easily, they also have a lower chance of developing complications. This could be due to the ability of patients with higher incomes to purchase high-quality and healthy foods such as fresh fruits and vegetables that help them enhance their nutritional habits. In relation to the duration of diabetes, the researchers of the current study found no significant association with nutritional habits. However, the mean age of disease duration is more than ten years. One reason could be that the longer a person has had diabetes, the more likely they are to have good eating habits, so they tend to stick to their diet plan more.

Concerning the association between HbA1c level and items of eating pattern, the present data revealed that the mean level of HbA1c is minimally decreased in patients eating six meals or more per day. However, no significant relationship was found in this study. This

finding is incongruent with Tayyem *et al.*, (2022), who reported that diabetic patients following a variety of diets had better glycemic control than those following one type. Regarding the meal that patients forget, the higher the percentage of patients in the study who forget to take their dinner, the lower the HbA1c level. This could be due to the fact that dinner meals are usually eaten late and not all family members are available, and Egyptian people do not like to eat on their own; they believe that eating in a group will enhance their appetite.

It was shown in the present study that the number of snacks eaten between meals per day is not significantly associated with HbA1c level. This finding is contradicted by Bellisle (2014), who evaluated the relationship between snacking and energy consumption and reported a strong association between energy compensation and the number of snacks. The findings of the current study indicated a significant association with HbA1c as regards the frequency of eating fruits and vegetables per week. This is supported by a study conducted by Jiang *et al.* (2012) who highlighted that consumption of dietary fibre improves HbA1c control among Chinese diabetic patients. Similarly, other researchers found that eating vegetables and fruits helps prevent T2D development by controlling HbA1c (Sami *et al.*, 2017). Regarding the number of meals per week, the present study showed no statistically significant association with HbA1c level. This finding is in line with a study done by Sanders, Wilcox & Maki (2022), despite other studies carried out by Sucher *et al.*, (2017) highlighting positive relations. Other observational data also contradicted the study findings, suggesting a positive association (Johnson *et al.*, 2019). Although no significant association was found between eating meat and the level of HbA1c, the researchers of the current study recommend that diabetic patients use fish and plant-based protein foods as alternatives to meat and should be included in dairy products. Also, this group of patients needs to be aware of how to choose healthier foods based on evidence in order to improve their eating habits.

In reference to the association between HbA1c and lifestyle habits among patients with T2D, concerning smoking, no statistically significant association was found. This finding is supported by Tayyem *et al.*, (2022). On the contrary, other data reported by Ji *et al.,* (2019) stated that smoking is considered one of the uncontrollable factors that affect the level of HbA1c and the development of diabetes. As regards practising exercise and its relation to HbA1c, the present study indicated a significant association, and this finding is

supported by Ji *et al.,* (2019). These findings are similar to a study conducted in Korea by Yun *et al.,* (2022), who found that regular exercise was associated with a controlled HbA1c level and was beneficial for patients with diabetes. When Tayyem *et al.*, (2022) looked at the relationship between glycemic control and different diets in people with T2D, they found that the level of HbA1c was not linked to exercise in any way that was important.

Regarding using saturated fat in diet, the higher percentage of patients under the study mentioned that they are using saturated fat with a highly significant association with HbA1c. These findings are supported by several studies conducted by Tay *et al.*, (2014); SACN, 2019, Tayyem *et al.*, (2022), all of which concluded that a low-fat diet contributes to glycemic control in adults with T2D. In this respect, Dyson *et al.* (2019) mentioned that replacing saturated with unsaturated fats will benefit insulin sensitivity and control HbA1c levels.

CONCLUSION

In summary, the study findings indicated a positive association between nutritional habits and HbA1c levels in patients with T2D. Although the higher percentage of patients under the study have desirable levels of nutritional habits, the mean level of HbA1c was above eight, which means that they have poorly controlled diabetes. Dietary consultation among patients with T2D in Egypt needs more effort from health care providers, including nursing staff. Also, an interdisciplinary care team with effective collaboration between nurses and dieticians for providing appropriate assessment, follow-up, and advice to T2D patients. The role of diabetic nurses should be emphasised through establishing effective guidelines, including continuous monitoring of HbA1c and dietary advice to enhance good nutritional habits that will be reflected in controlling diabetes and preventing complications. The nursing curriculum should integrate the role of advanced technology, such as using continuous mobile phone consultation and follow-up sessions for this group of patients.

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