



An analysis of the association between HbA1c levels of patients with type 2 diabetes and nutritional habits

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General Note

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ABSTRACT

Objective: This study aims to identify the association between the nutritional habits of patients with type 2 diabetes and their HbA1c levels, and to determine the influences of nutritional habits on HbA1c levels.

Methods: This descriptive, correlational, cross-sectional study was based on Type 2 diabetes and nutritional habits. A total of 110 individuals with type 1 diabetes were randomly selected from Uludag University Hospital, Bursa, Turkey. The sample power was found to be 92%. The data collection tools were an Information Form for Diabetes Patients and a Nutritional Habits Form. The study data were analyzed with descriptive, Pearson correlation and multiple regression statistics.

Results: The study results illustrated a statistically significant relation between the HbA1c levels and nutritional habits of diabetes patients ($r = -.88$) and further suggested that 72% of changes in HbA1c levels may result from patients' nutritional habits ($R^2: .72, p = .000$).

Conclusion: Diabetes patients can better manage a nutritional therapy and control HbA1c levels when their nutritional habits have been identified in detail. Nutritional habits are proven to be influential in maintaining glycemic control, which consequently emphasizes the significance of the nutritional habits of patients with diabetes. In summary, this small-scale cross-sectional study indicates the potential role of nutritional habits in glycemic control.

Keywords: Diabetes Mellitus, Type 2 Diabetes Mellitus, Nutritional Management, Hemoglobin A1c protein

1. INTRODUCTION

Diabetes is a public health problem with an increasing prevalence that causes predicaments for individuals and society due to its severe complications and costs (Bennett & Knowler 2005; Türkiye Diyabet Vakfı, 2012; World Health Organization [WHO], 2012). With fundamental changes in life styles and developing technology, the number of diabetes patients in Turkey has increased. Diabetes is undoubtedly one of the most challenging health problems in the 21st century.

In Turkey, diabetes is a growing concern. There have been a number of population-based studies of diabetes prevalence in the country, and screening programs started in the 1940s. In a population-based study published in 2010, it was established that the prevalence of diabetes is about 13.7% for the population over 20 years old with type 1 and type 2 diabetes (Satman et al., 2010). Turkey has an important economic burden of diabetes management cost, which has been estimated at 5.144 billion Euros, as announced at the World Diabetes Congress held by the International Diabetes Federation. Today, it is clear that diabetes is increasing tremendously despite great efforts in Turkey. The results underline the need to increase public awareness and to emphasize the value of lifestyle modification towards traditional Mediterranean nutrition, increased physical activity, and weight reduction (WHO, 2012).

The primary purpose of diabetes management is to ensure glycemic control and prevent complications (American Association of Clinical Endocrinologists [AACE], 2012; American Diabetes Association [ADA] 2012). HbA1c is a measure of glycemic control, as it reflects the average blood glucose level. The target is to sustain HbA1c levels below 6.5% according to ADA 2012 (ADA, 2012).

Type 2 diabetes is primarily insulin resistance initially, and the problem is elevated post-prandial hyperglycemia because hepatic glucose production is not suppressed. It is also a slow progressive disease whereby the beta cells are unable to produce enough insulin and insulin therapy is required (Jacobson, Hauser, Anderson et al., 2005). Nutritional habits play a significant role in the pathogenesis of diabetes, particularly with energy-dense (high fat and carbohydrate) diets and high intake of sugar-laden drinks (AACE, 2012; ADA, 2012; International Diabetes Federation [IDF] 2012). It is of the utmost importance for diabetes patients to maintain a nutritional therapy program, sometimes guided by an expert if needed, like other therapy programs they need to follow. Nutritional therapy is a dynamic process that may exhibit certain individual differences and require individual approaches (Durmaz, 2002; Erdoğan, 2002; IDF 2012; Türkiye Diyabet Vakfı, 2012).

The underlying cause of diabetes complication is multifactorial. Persistently elevated blood glucose reflected in high HbA1c is a significant risk factor for complications. Nutritional habits can help normalize blood glucose (AACE, 2012; ADA, 2012; IDF 2012). Relevant studies in recent literature have revealed that increasing HbA1c levels are directly related to nutritional habits (Cengiz & Cengiz, 2000; Woo, Ho, Sham et al., 2003). A nutritional therapy alone can assure stabilization of blood glucose levels in diabetes type 2 patients. Nutritional therapies are recommended to be unique to the needs of individuals: a successful nutritional therapy should take into account the nutritional habits and socioeconomic conditions of patients (Pek, 2002; Fadiloğlu, 2002; Özer, 2003; Çorakçı, 2005; ADA, 2012).

It has been strongly suggested that an interdisciplinary care team as well as dieticians should be responsible for specifying the correlation between nutritional habits and HbA1c levels as well as ensuring the self-care of diabetes patients in diabetes management, which will certainly contribute to better diagnosis of individuals with diabetes.

This study aims to identify the association between the nutritional habits of patients with type 2 diabetes and their HbA1c levels, and to determine the influences of nutritional habits on HbA1c levels.

2. MATERIALS AND METHODS

Study Design

This study was designed as a descriptive, correlational cross-sectional study to investigate the correlation between the nutritional habits of patients with type 1 diabetes and their HbA1c levels at the Uludağ University Hospital Endocrinology Clinic in Bursa, Turkey.

Setting and sample

The study was conducted in Uludağ University Hospital Endocrinology Clinic in Turkey. In this clinic, there is one certified diabetes nurse (a title given to people who have taken a month-long course in nursing diabetes given by the Diabetes Nursing Association in Turkey). Basic diabetes education is given at the clinic, and individuals with diabetes are informed that they may come to the clinic whenever they need, participate in group training programs organized weekly, and attend health checks every three months. The average Uludağ University Hospital Endocrinology clinic HbA1c level is 8 %. There are 445 registered adults with Type 2 diabetes, who are expected to attend health checks every 3 to 6 months. The HbA1c level of only 225 of the patients was higher than 7%.

The inclusion criteria for the sampling were being over 18 years of age, having been diagnosed with type 2 diabetes at least six months earlier, having completed basic diabetes education, having an HbA1c level higher than 7 %, and volunteering to participate in the study. The exclusion criteria for the sampling were people with advanced retinopathy and neuropathy, and these were not included in the sample.

The sample of the study comprised 110 individuals with type 1 diabetes patients who were randomly selected, were aged 19-65, had been diagnosed with diabetes at least six months previously, had completed basic diabetes education, had an HbA1c level higher than 7 %, and had consented to participate in the study.

110 people were included in the study and the sampling size power was determined as 92%. Participation in the study was voluntary and reached 50 %. The personal characteristics of diabetes patients are given in Table 1 in the Results section.

Ethical Considerations

Permission in writing was granted by the Board of Ethics of Uludağ University Hospital to certify that this study had no potential risk of damaging patients physically or morally. The consenting participants were informed about the purpose and implementation of the study and they were asked to sign a consent form.

Measurements/Instruments

Questionnaire items

Two forms, a demographic data form of the individual diabetes patients and a nutritional habits form, were used to collect data. The demographic data form of the individual diabetes patients included five questions inquiring age, gender, educational status, and diabetes duration. It was completed by the researcher in a face-to-face interview.

HbA1c Measurement

HbA1c levels of patients were recorded by the researcher from patient files. Hemoglobin is the oxygen-carrying pigment that gives blood its red color and is also the predominant protein in red blood cells. About 90% of hemoglobin is hemoglobin A (The "A" stands for adult type). Although one chemical component accounts for 92% of hemoglobin A, approximately 8% of hemoglobin A is

made up of minor components that are chemically slightly different. These minor components include hemoglobin A1c, A1b, A1a1, and A1a2. Hemoglobin A1c (HbA1c) is a minor component of hemoglobin to which glucose is bound. HbA1c is also referred to as glycosylated or glucosylated hemoglobin. A chemical (electrical) charge is present on the molecule of HbA1c, and the amount of the charge differs from the charges on the other components of hemoglobin. The molecule of HbA1c also differs in size from the other components. HbA1c may be separated by charge and size from the other hemoglobin A components in blood by a procedure called high pressure (or performance) liquid chromatography (HPLC). HPLC separates mixtures (e.g. blood) into its various components by adding the mixtures to special liquids and passing them under pressure through columns filled with a material that separates the mixture into its different component molecules. Because HbA1c is not affected by short-term fluctuations in blood glucose concentrations, for example due to meals, blood can be drawn for HbA1c testing without regard to when food was eaten.

All HbA1c tests were undertaken in the Uludag University Hospital laboratory using the same assay method. The high-performance liquid chromatography (HPLC) method was used to assay HbA1c.

The nutritional habits form was designed by Kavak on the basis of relevant literature to determine the levels of knowledge of participating diabetes patients (Kavak, 2006). The validity and reliability of the form was performed by Kavak (Kavak, 2006). It included 21 closed-ended questions about meals and refreshments and dieting and nutritional habits, which were evaluated as true (1) or false/blank (0). The total score for the patients with type 2 diabetes ranged from 0 to 21 and the scores were evaluated on a scale of 0-100 to facilitate ranking. Higher scores on the Nutritional Habits Form indicated good eating habits for diabetes patients (Kavak, 2006). The Nutritional Habits Form took 15 minutes to complete this form was administered by the researchers.

Data Analysis

Descriptive characteristics of diabetes patients were measured as percentages. The correlation between the mean scores of the nutritional habits of patients and their HbA1c levels was analyzed using Pearson Correlation Analysis. Multiple Regression Analysis was used to assess to what extent the mean scores of nutritional habits affected HbA1c levels (Aksakoğlu, 2006). The nutritional habits total score was analyzed in the multiple regression. All the analyses were carried out with Minitab 15 statistical package.

Power analysis was made in two groups with the Minitab 14 program using Power and Sample Size menus. The significance level was less than 0.05 with 95% confidence intervals (CI).

3. RESULTS

The personal characteristics of the diabetes patients are given in Table 1.

Table 1 The Personal Characteristics of Patients with Type 2 Diabetes (n:110)

Descriptive Characteristics	n	%	
Gender	Female	85	56,66
	Male	65	43,34
Educational Status	Illiterate	5	3,33
	Literate	15	10
	Primary School	35	23,33
	Secondary School	19	12,66
	High School	50	33,33
	College	16	10,66
Diabetes Duration	1-5 years	43	28,66
	6-10 years	30	20
	11-15 years	35	23,33
	16-20 years	19	12,66
	21 and ↑	13	8,6
A1c*	M±SD		
	7.5% ± 1.5		
Age *	42,42 ± 7.89		

*Age is provided as average

It was seen from the descriptive characteristics of the patients who took part in the study that 59.9% were female, 27.7% were educated to primary school level, 24.54% had had diabetes for 11-15 years, and 70% did not use any medication; their mean age was 52.42 ± 7.89 years, and their mean HbA1c level was $7.4\% \pm 1.5$.

Table 2 Correlation between the Nutritional Habits of Patients with Type 2 Diabetes and their HbA1c Levels (n:110)

	M±SD	r	p
%A1c	7.5 ± 1.5	-.89	.000
Nutritional Habits	71.2 ± 11.4		

The correlation analysis between the mean scores of the nutritional habits of patients with type 2 diabetes and their HbA1c levels showed a statistically significant strong negative correlation ($r = -.88$, $p = .000$) (Table 2).

Table 3 Multiple Regression Analysis of the Effects on HbA1c Levels of the Nutritional Habits of Patients with Type 2 Diabetes (n:110)

Independent Variable	B	β	p	R	R Square
Nutritional Habits	-16.78	-.75	.000	.80	.75

Multiple Regression Analysis showed that the mean scores of nutritional habits statistically influenced the A1c levels of patients ($p = .000$), which suggested that 72% of the changes in HbA1c levels resulted from the nutritional habits of individuals with diabetes type 1 (Table 3).

4. DISCUSSION

Our findings have several implications for improving glycemic control and nutritional habits among Turkish diabetic patients. The average HbA1c value of patients with type 2 diabetes was $7.4\% \pm 1.5$ (Table 2). The HbA1c value was found to be 7 or above in 100% of patients with type 2 diabetes. Çağın et al. (2003) conducted a study with patients with type 2 diabetes and stated that the average HbA1c value was 8.38%, which agrees with the findings of our study. An average HbA1c value of 7% or above requires a restructuring of the nutritional therapy of diabetes patients (ADA, 2012).

Diabetes care is considered to be team care between several health disciplines. In the health care system of Turkey, each diabetes patient has to make an appointment to reach a doctor or nurse; they have to come to the institution to make the appointment, and come to the institution once more for examination. Also, due to time constraints, the patient may not express himself/herself adequately, or the comprehension of the problem by the doctor or dietician may be insufficient. For this reason people with diabetes need to be monitored by diabetes nurses.

The role of the diabetes nurse has been recognized as special in the health policies of this country. He or she is responsible for all education including nutrition education, and for monitoring glycemic checks. The greatest problem for a diabetes nurse is that nutritional habits vary by region. In the west and south of the country olive oil is consumed, while in the north and east food contains more butter and meat, and this can affect the glycemic control of a diabetic. It was stated in a 2012 report by the American Diabetics Association (ADA, 2012) that the HbA1c levels of diabetics can vary according to their nutritional habits. A relationship was also found between the nutritional habits and HbA1c levels of Type 2 diabetics in this cross-sectional study, which was carried out based on this information.

The mean score of the nutritional habits of the 110 participants was 70.2 ± 11.4 . The study data revealed that diabetes patients did not have sufficient knowledge about nutritional and lifestyle habits. Therefore, once diagnosed with type 2 diabetes, patients should be monitored by diabetes nurses (Hu, Manson & Stampfer, 2001; ADA, 2012). After the diagnosis stage, type 2 diabetics should be checked by diabetes nurses as specified in the ADA 2012 report. This is because diabetes nurses are seen by patients as more accessible. The study findings suggested a statistically significant strong negative correlation between the nutritional habits of patients with diabetes 2 and their HbA1c levels ($r = -.88$, $p = .000$) (Table 3). No similar study comparing the nutritional habits of diabetes patients and HbA1c levels was found in a review of relevant literature. However, HbA1c levels have been considered to be an implication of the efficiency of diabetes education programs, particularly including nutritional therapy, in the management of

diabetes for diabetes patients, and HbA1c levels have been measured before and after diabetes education. Bloomgarden et al. (1987) conducted a study that evaluated HbA1c levels before and after diabetes education including nutritional therapy, and found that HbA1c levels decreased from 6.8% to 6.1%. Keers et al. (2003) similarly reported a reduction from 8.14% to 7.75% and Goudswaard et al. (2004) asserted that HbA1c levels declined from 8.2% to 7.2%. In these three studies too, the effect of nutrition habits on glycemic control was emphasized. Goudswaard et al. (2004) stated that diabetics should be given nutrition education before drug treatment and that in this way glycemic control parameters could be better kept under control. Keers et al. (2003) laid emphasis on nutritional habits, and emphasized the need for a detailed examination of the nutritional habits of diabetics in each culture.

Jiang, et al. (2013) reported that increasing fiber intake may be an effective approach to improve glycemic control. It was stated in a study by Jiang et al. (2013) that nutritional habits have a great effect on an individual's glycemic control, and it was emphasized that this kind of study should be carried out separately in all countries because of cultural differences. The present study supports this work.

In most studies of HbA1c level reduction and nutrition a habit, the relationship between them has been examined (ADA, 2012). No study was found in the literature of Turkey or the rest of the world of what most concerns the diabetes nurse, namely the extent to which changes in HbA1c levels are connected to nutrition habits. The present study was concerned with this result in particular.

The findings of our study found that 72% of the changes in HbA1c levels of individuals with diabetes type 2 resulted from their nutritional habits (Table 4). The review of relevant literature yielded no similar study, which reiterated the unique character of our study. Therefore, a thorough investigation of nutritional habits should be carried out by health professionals in order to stabilize HbA1c levels. Diabetes patients can manage a nutritional therapy and control HbA1c levels better when their nutritional habits have been identified in detail (Riccardi, Giacco & Parillo, 2003; ADA, 2012; IDF, 2012).

A change of 72% in HbA1c levels is information which it is important to emphasize when discussing nutrition habits in the education of diabetes nurses. It is expected that this information, passed on to diabetics in the course of diabetic education, will cause a positive change in the nutritional habits of Turkish diabetics.

Finally, we observed that HbA1c level was consistently associated with nutritional habits regardless of the duration of the disease, suggesting that nutritional habits may make a difference at any time during the progression of the disease.

5. CONCLUSION

Diabetes patients can manage a nutritional therapy and control HbA1c levels better when their nutritional habits have been identified in detail. A change of 72% in HbA1c levels is information which it is important to emphasize when discussing nutrition habits in the education of diabetes nurses. It is expected that a change of this information, passed on to diabetics in the course of diabetic education, will cause a positive change in the nutritional habits of Turkish diabetics. The results of our study have been shared with the Turkish Association of Diabetes Nurses, and education is planned by the association on the nutrition habits of diabetics for all diabetes nurses in the framework of the national health policies on diabetes in this country.

It was concluded that the nutritional habits of diabetes patients were related to HbA1c levels and that nutritional habits were significant in the control of HbA1c levels. In summary, this small-scale cross-sectional study indicates the potential role of nutritional habits in glycemic control. Our results, if confirmed, may have clinical and public health implications in diabetic control among Turkish adults.

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