



Impact of Dietary Pattern on Glycemic Level Among Type 2 Diabetic Patients

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Abstract

Diabetes is a lifelong progressive disease. Compliance to a healthy eating pattern is the corner-stone to maintain or reduce body weight and achieve good glycemic control (HbA1c < 7%) which can delay and prevent diabetes related complications. The purpose of the present study is to find the relation between dietary pattern and glycemic level among type 2 diabetic patients. The information was gathered through 9 items dietary compliance questionnaire and 24-hour dietary recall method, and the glycemic level was measured by glycosylated hemoglobin (HbA1c). Type 2 diabetic patients aged 30-60 years, with no comorbidity and minimum of six months duration of diabetes from Jawaharlal Nehru Medical College were selected. The hierarchical regression analysis showed that dietary compliance 12.6% significantly predicted HbA1c ($\Delta R^2 = .126$, F Change = 28.48, $\beta = -.400$, $p < .001$). Only 43.5% of patients always followed the dietary regimen and 48.5% of patients usually followed it with HbA1c level of 7% to 7.3% respectively. It was concluded from the results that compliance to a dietary regimen was inversely related to the glycemic level of the patients.



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Keywords

Diabetes,
Compliance,
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Introduction

Diet is the corner-stone in the management of diabetes mellitus to achieve good metabolic control¹⁰. According to American Diabetes Association dietary intervention promotes healthy eating emphasizing the variety of nutrient dense foods in appropriate proportion and sizes to attain better glycemic control (HbA1c < 7%)³, to achieve and maintain body weight and, to delay and prevent diabetes

related complications². However, the diet of a diabetic need not be a complete deviation from the normal diet. The nutrient of concern in the diabetes management is carbohydrate which has direct effect on postprandial glucose levels in diabetic people¹. A holistic approach of nutrition intervention with individualized food preferences along with support for behavior changes can facilitate the patient to achieve health goals and delayed complications¹.

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Making dietary changes is one of the most effective ways to prevent diabetes and a healthy diet along with exercise cannot only maintain sugar level but also maintain weight². The therapeutic modification of diet in terms of carbohydrates, proteins and fats should be such that it maintains blood glucose and reduces the risk of long term complications¹⁰. The result of recent research showed positive relationship of dietary compliance and better health outcomes in terms of improved glycemic control and lower HbA1c level among diabetes patients. Research also suggested that along with healthy eating habits, about thirty minutes of exercise helps in preventing and managing diabetes and diabetes-related outcomes^{4,13,17}. Research documented the relationship between disturbed eating habits and attitudes, poor glycemic control, and development of micro-vascular complications¹⁴. Non-compliance to recommended diets was related to diabetic ketoacidosis hospitalizations and emergent visits, increased weight and increased glycosylated hemoglobin⁶.

Objective

To find the relationship between dietary pattern compliance and glycemic level measured by glycosylated Hemoglobin (HbA1c) among type 2 diabetic patients.

Methodology

Locale

Rajiv Gandhi Centre for Diabetes and Endocrinology, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh.

Sample and Sampling Method

A subset of 200 type 2 diabetic patients aged 30- 60 years with minimum six months disease duration history and no- comorbidity and were ready to participate in the study were selected through purposive sampling method.

Interview Cum Schedule

Schedule consists of general information and dietary compliance questionnaire. The 9 items five point diet questionnaire was employed to evaluate the dietary pattern and was developed by the investigator with the help of experts. It was based on the dietary regimen given to the patients by the health professionals. Scoring of the diet questionnaire ranges from 9 to

45 and negative items were reversely coded. Higher scores indicate high dietary compliance and lower scores showed non-compliance to the recommended regimen. Glycosylated Hemoglobin was used as an index for glycemic level. HbA1c data were obtained from the patient record file. The most recent value of HbA1c was recorded for analysis. It was graded high, optimal and low according to the range provided by International Diabetes Federation⁹.

Statistical Analysis

Data were expressed as percentage and frequencies or mean and standard deviation. ANOVA was used to find the difference between different groups followed by Scheffe post hoc test. Hierarchical regression model was used to find the predictive relationship of dietary compliance with glycemic level. Throughout all analyses performed, a confidence interval of 95% and a p-value of 0.05 were used to determine statistical significance. SPSS version 20 was used for the analysis.

Results

Demographic Information

The sample comprised of 200 patients, out of which 101 (50.5%) patients were males and 99 (49.5%) were females. The mean age of the patients was 48.6 + 7.7 years. Among age groups, 44 (22%) patients were in early (30-40 years), 72 (36%) in middle (40-50 years) and 84 patients (42%) were in late (50-60 years) age years. With regard to socio-economic status of the sample, the data obtained showed that most of the subjects were from upper middle class (101), 49 (24.5%) were from lower middle, only 21 (10.5%) were from upper class and 6 (3%) belonged to lower SES. The grouping was based on Kuppaswamy socioeconomic classification (2014). Analysis regarding dietary habits revealed that 130 (65%) patients were non- vegetarian and only 70 (35%) sample reported vegetarian dietary habit.

The analysis according to distribution of patients on dietary regimen is shown in table 1. Most of the patients 117 (58.5%) reported that 75% of their meals consisted of whole grains, whole grain flour and its products and their mean HbA1c level was 7.3% which was near to acceptable level (less than 7%) range according to ADA criteria (2015)³. According to International Diabetes Federation⁹,

HbA1c values from 7.2% -8% is acceptable range but not ideal. Among total sample, 123 (61.5 %) patients always included pulses and legumes in their daily diet, while 71 (35.5%) usually (more than three times in a week) included in their diet and their mean HbA1c level was 7.6% and 8.5% respectively. About 139 (69.5%) patients daily eats vegetables in either forms (raw or cooked) while 58 (29%) patients (most of them were non-vegetarian) eats vegetables more than three times in a week. Daily vegetable eaters had lower HbA1c (7.5%) than non-vegetarians who ate vegetables usually (HbA1c=8.4%). Analysis regarding fruits intake was revealed that only 80 (40%) diabetic patients took fruits daily, 68 (34%) more than 3 times a week and 26 (13%) once a week and had mean HbA1c level

of 8%, 7.7% and 7.6%, respectively. Among total sample, 169 (84.5%) patients consumed only 25% fats in their meals especially with the gravy or in the form of fried foods like french fries, fried meat etc. and had a mean glycosylated hemoglobin of 7.8%. Only 23 (11.5%) patients reported that they consumed 0% of visible fat had HbA1c of 7.6%. Nearly 51 percent patients reported that they never consumed sugar in any form and had HbA1c of 7% while 78 (39%) informed that they rarely took sugar in tea, sweet and dessert and had 8% as their mean HbA1c level. Although in small amount, sugar increases glycosylated hemoglobin beyond optimal level of 7%^{3,9}. Almost 182 (91%) people never and 15 (7.5%) patients rarely ate junk foods and had HbA1c of 7.3% and 8% respectively.

Table 1: Distribution of patients on food groups consumption/day and their mean HbA1c level

Meals included	Never/ 0%	Rarely/ Once a week /25%	Sometimes/ Twice a week /50%	Usually/ More than three times a week/ 75%	Always / Daily /100%
Whole grain flour and whole grain products	-	1.5% (7.2)	31.5% (8.3)	58.5% (7.3)	8.5% (7)
Pulses and Legumes	0.5% (9.6)	1% (7.1)	1.5% (9.1)	35.5% (8.5)	61.5% (7.6)
Vegetables	-	0.5%(13)	1%(9)	29% (8.4)	69.5% (7.5)
Fruits	5%(9.1)	13%(8.8)	8%(7.6)	34%(7.7)	40%(8)
Sweets, jams, jelly etc.	51%(7)	39%(8)	0.5%(8)	9.5%(8.2)	-
Fats, fried foods mayonnaise etc.	11.5%(7.4)	84.5%(7.8)	4%(9)	-	-
Junk foods	91%(7.3)	7.5%(8)	1.5%(9)	-	-

The results of the tables 2 revealed that females were more complied with the intake of whole grains, pulses & legumes, vegetables and fruits as compared to males. Males were more complied with the restriction of sweets, fried foods and junk foods than females. The Analysis of variance (ANOVA) for gender groups also revealed significant differences between males and females on dietary compliance (F= 3.906, p < .05). A perusal of the mean scores in the table 2 showed that female scored higher on diet (Mean= 39.41) as compare to males (Mean= 38.59).

The values in the tables 3 revealed that patients in their late age group (51-60 years) were more complied with the intake of whole grains, pulses & legumes, vegetables and fruits as compared to middle age (41-50 years) patients followed by early age group (31-40) patients. They were also more complied with the restriction of sweets, fried foods and junk foods than lower age groups. The result of ANOVA revealed significant differences between various age groups on dietary (F=4.414, P < .05) compliance.

Table 2: Distribution of females and males on dietary pattern compliance

Gender wise dietary compliance	Females Percentage (HbA1c in %)	Males Percentage (HbA1c in %)
Whole grain flour and whole grain products	72.6 (8.1)	63.4 (7.6)
Pulses and Legumes	97.7 (8.1)	96 (8.2)
Vegetables	100 (8)	96.2 (8.1)
Fruits	78.6 (7.9)	66.7 (7.8)
Sweets, jams, jelly etc.	87.4 (7.8)	92.2 (7.8)
Fats, fried foods mayonnaise etc.	94.5 (8.2)	96.4 (7.9)
Junk foods	98 (8.1)	99 (8)
Mean (SD)	39.41(2.60)	38.59 (1.74)
F value	3.906	
Significance	.050*	

Table 3: Distribution of patients on dietary pattern compliance according to age

Age wise dietary compliance	31-40 years Percentage (HbA1c in %)	41-50 years Percentage (HbA1c in %)	51-60 years Percentage (HbA1c in%)
Whole grain flour and whole grain products	58.5 (8)	66.3 (8.2)	73.7 (7.6)
Pulses and Legumes	95 (7.9)	96 (8.3)	98 (7.3)
Vegetables	94.9 (7.8)	97.8 (8)	100 (7.2)
Fruits	71.5 (7.6)	68.4 (8)	77 (7.9)
Sweets, jams, jelly etc.	85.1 (7.8)	85.9 (8.4)	95.8 (7.8)
Fats, fried foods mayonnaise etc.	80 (8)	94 (8.2)	95.7 (7.9)
Junk foods	96 (8)	100 (8.3)	98.9 (7.8)
Mean (SD)	38.70 (3.159)	38.38 (2.976)	39.71 (2.714)
F value		4.414	
Significance		.013*	

Table 3a: Scheffe Post Hoc comparison among different age groups on dietary compliance

Dependent variable	(I) Age	(J) Age code	Mean difference code	Standard (I-J)	Significance Error
Dietary compliance	Early	Middle	.330	.557	.840
		Late	-1.010	.542	.179
	Middle	Late	-1.339*	.467	.018*

Then Scheffe Post Hoc comparison was conducted to find out which age groups differed significantly and the values are shown in table 3a. The p-value of middle and late age group for dietary compliance was shown as .018, this means that average of dietary pattern compliance of late age group and middle age

group is significantly different. The perusal of mean scores of middle and late age group patients in table 3 showed that late age group (mean=39.71) patients complied more with diet as compare to middle aged patients (mean=38.38).

Table 4: Relationship between dietary compliance and glycosylated hemoglobin

Variable	Step 1 β	Step 2 β
Constant	7.90***	16.39***
Gender	.020	-.117
Age	.048	.095
SES	-.059	.090
Dietary compliance		-.400***
	$R^2 = .010$	$R^2 = .136$
	$\Delta R^2 = .010$	$\Delta R^2 = .126$
	F Change= .643	F Change= 28.48***
	F= .643	F= 7.671***

***p < .001

A two-step Hierarchical Regression Analysis was conducted with HbA1c as the criterion variable as shown in table 4. In first step demographic variables were entered, the demographic variables accounts for only 1% of the total variance in predicting HbA1c. Beta values of the result showed no significant relationship. After controlling for demographic variables, dietary compliance was entered at step second. It increased 12.6% of variance in predicting HbA1c ($\Delta R^2 = .126$, F Change= 28.48, $p < .001$). Beta values showed negative predictive relationship of HbA1c to dietary compliance ($\beta = -.400$, $t = -5.337$, $p = .000$).

Discussion

The dietary pattern compliance 12.6% significantly predicted the inverse relationship with glycosylated hemoglobin. Diet which include high content of whole cereals, vegetable and fruits, adequate amount of proteins, and low intake of trans fatty acids improve insulin sensitivity which results in better glycemic control in diabetic patients⁷ than those who never or occasionally complied to this dietary pattern. The beneficial effects of whole grains on health are well known, as it contains dietary fiber, starch, antioxidants, phenolic compounds, lignin which have been linked to reduced risk of obesity, insulin resistance, dyslipidemia, high cholesterol, and heart disease¹². A meta-analysis of studies evidenced that fresh fruits and vegetables, whole grains and moderate amount of animal protein may be protective against diabetes¹¹. In the present study

females and aged patients (more than 51 years of age) were found to be more adherent to the whole grains, pulses & legumes, vegetables and fruits as compared to males and lesser aged (below 51 years) patients. Males and patients above 51 years of age were more complied with the restriction of sweets, fried foods and junk foods with the variation of mean HbA1c values of 7.3% to 8.3%. According to American Diabetes Association³ glycosylated hemoglobin below or around 7% is associated with reduced micro as well as macro-vascular complications³. Research also documented that dietary regimen were followed more by females⁵ and older age patients^{16,19} than males and younger patients. Older patients were more engaged in self-care activities¹⁶ and consequently had low glycosylated hemoglobin, while females were more concern about diabetes related complications as compared to males and hence complied more with dietary recommendations⁵. Despite the fact that compliance to treatment regimen reduces disease related complications and improves glycemic control¹³, it was not found to be satisfactory in the present study. Dietary compliance, as reported by the patients, who always followed the regimen was 43.5%, and 48.5% patients usually complied with the given dietary pattern. Research evidenced the ill effects of non-compliance to healthy diet regimen in the form of chronic diseases including diabetes, hypertension, cardiovascular diseases, obesity¹⁸. On the other side, National Diabetes fact sheet¹³ revealed the beneficial effects of healthy diet on

weight reduction and insulin sensitivity among type 2 diabetes patients. Improved insulin sensitivity will have the favorable effects on glycemic control which delayed and prevents risk factors of long term complications associated with uncontrolled diabetes^{8,15}.

Conclusion

Diabetes is a progressive disease and needs a lifelong dietary modification along with behavioral changes for prevention of risk factors of long term complications associated with uncontrolled diabetes. It was concluded from the results that dietary compliance was inversely related to the blood

glucose level. It plays a crucial role in achieving and maintaining good glycemic control.

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