JMSCR Vol.||03||Issue||08||Page 7217-7224||August 2015

www.jmscr.igmpublication.org
Impact Factor 3.79
ISSN (e)-2347-176x
crossref DOI: http://dx.doi.org/10.18535/jmscr/v3i8.51

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Nutritional Status-Related Factors Contribute to Poor Glycemic Status in a Sample of Iraqi Patients with Type 2 Diabetes

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Abstract

Background: *Type 2 diabetes mellitus (DM) is now posing the largest disease threat to Iraq's health care services with majority of our patients were reported to have poor glycemic status. Role of nutrition therapy is important, however their nutritional status is not fully being addressed. Therefore, this study aimed to determine nutritional status-related factors and its contribution to glycemic status in a sample of Iraqi patients with Type 2 DM.*

Methodology: *A total of 170 diabetics (91 males, 79 females) aged 20 years and above (Mean + SD = 51.2 ± 10.2 years) from a selected Diabetic Centre in Teaching hospital in Iraq were recruited. Nutritional status characteristics which include anthropometric, biochemical, clinical and dietary intake data including dietary glycemic index (GI) and glycemic load (GL) were collected. Glycemic status was assessed using HbA1c level. Medical characteristic and other lifestyle behaviours including smoking status and physical activity level were also obtained.*

Results: *Subjects participated in the study were diagnosed with Type 2 DM between 5 and 10 years. Their mean HbA1c was 10.4 ± 1.6% with only 0.6% achieved the target treatment goal of HbA1c < 7%. Their mean BMI was 29.6 ± 4.0 kg/m^2 with 89% of the subjects were either overweight or obese. Average energy intake of the subjects was 2032.7 ± 274.6 kcal/day with the proportion of macronutrients were in line with the professional bodies' recommendation. Dietary GI and GL of the subjects were 59.7 ± 3.8 and 21.8 ± 3.8 respectively which generally higher as compared to the other Middle East studies. There were seven factors namely; Subjects who were on diet alone (Beta=0.25, t = 3.949, p=0.0001); LDL level (Beta=-0.331, t = 5.388, p = 0.0001); Dietary GL (Beta = 0.162 , t = 2.714, p = 0.007); physical activity level (Beta = -0.241 , t = -3.580, p = 0.0001); BMI (Beta = 0.214 , t= 3.395, p = 0.001); Subjects who were on Sulfonylurea (Beta=-0.167, t = -2.615, p=0.01); total fiber (Beta = 0.133, t = -2.169, p = 0.032); were found to be the predictors which explained 45% of the variation (R^2 = 0.45) in glycemic status.*

Conclusions: *Poor glycemic status, overweight and obesity were highly prevalent in a sample of Iraqi patients with type 2 DM. Subjects who were on diet alone, high LDL level, high dietary GL intake, lack of physical activity, high BMI, subjects who were not on Sulfonylurea drug and had high total fibre were the factors contributed to poor glycemic status. Future studies should consider incorporating these components into the framework of nutrition-related intervention to Iraqi type 2 DM.*

Key words: *Nutritional status, Glycemic Index, Glycemic Load, Iraqi Type 2 Diabetes Mellitus.*

INTRODUCTION

Iraq has been suffering from constant war and conflict, which has had a consequential effect on the health of the Iraqi people. While the out-break in communicable disease continues, non-communicable chronic diseases, in particular, type 2 diabetes mellitus, now pose the largest disease threat to Iraq's health care services. While the prevalence of diabetes is catching-up, those suffered with diabetes had inadequately controlled with the average HbA1c of 8.4% [14] and only 24% of Iraqi diabetics achieved the target goal (HbA1c > 7%) [21]. This is a cause for concern because poor glycemic control is associated with diabetes-related complications which put substantial financial burden on the health care system.

It is well understood that nutrition therapy is the mainstay of diabetes management but seldom considered a top priority. Nutrition is not as much of a study significance as other medical-related issues that commonly the main focus of the factors associated with glycemic status in various studies among diabetics in Iraq. None of the studies reported on the role of nutritional status-related parameters to glycemic status of Iraqi diabetics. Indeed, dietary glycemic index (GI) and glycemic load (GL) have never been explored which is believed to influence glycemic status [22].

The GI is a measure of carbohydrate quality, which classifies carbohydrate foods, based on their response to postprandial glycaemia (Wolever, 2006). The higher the GI of the diets, the higher the glycemic and insulin responses that they produced [6]. Dietary GI however does not consider the effect of a typical amount of carbohydrate in a food portion on the blood glucose level and therefore, the GL is used to consider both the amount and type of carbohydrate in the diet. The assessment of GI/GL intake in the diet of Iraqi diabetics is pertinent because our traditional diet is largely based on polished white rice and refined wheat, which usually high in GI and GL (Al-Razzouqi et al, 2009).

The lack of the data pertaining to nutritional status-related factors including dietary GI/GL intake and its contribution to glycemic status among Iraqi patients with Type 2 diabetes warrants further research. Hence, to fill this gap, this study aimed to determine the nutritional status-related factors and its contribution to glycemic status in a sample of Iraqi patients with type 2 diabetes.

METHODOLOGY

Study design and Subjects Sampling

This was a cross-sectional study and conducted among a total of 170 diabetics who had attended the Medical Diabetic Centre, Merjan Hospital in Babylon. The sample size was sufficient for testing the individual predictors to glycemic status (Green 1991). Eligible subjects include both genders aged 20 years and above with confirmed diagnosis of type 2 diabetes for at least one year prior the study period were conveniently sampled. This study was approved by the internal board of ethical committee and gained approval from the Iraqi Ministry of Health. All subjects provided their written consent prior to entry into the study.

Nutritional Status Assessments and Data Collection

Nutritional status characteristics namely anthropometric, biochemical, clinical and dietary intake data including dietary glycemic index (GI) and glycemic load (GL) were assessed. Glycemic status indicated using HbA1c level was also obtained.

All measurements were taken in the morning after 10 hours fasting. For anthropometric assessments, subjects were weighed using a SECA weighing scale (THD-360, Tanita Health Equipment Ltd., Tokyo, Japan) to the nearest 0.1 kg in a light clothing without shoes. Height was measured to the nearest 0.5 cm without shoes using a wall-mounted SECA microtoise tape (Model 206, Vogel and Halke GmbH & Co., Hamburg, Germany) which was suspended upright against a smooth wall. Weight and height measurements were used to calculate the body mass index (BMI). The WHO classification of BMI was used to classify the subjects as underweight (BMI < 18.5 kg/m^2); normal (BMI 18.5 - 24.9 kg/m^2); overweight (BMI

25.0 - 29.9 kg/m^2); and obese (BMI > 30 kg/m^2) [4]. Waist circumference was measured to the nearest 0.1 cm using a non-elastic tape while subjects stand in a relaxed position with both feet together on a flat surface. Waist girth was measured between the top of right iliac crest and the bottom of the ribs at minimal respiration. Measurements were taken in duplicate and averaged.

For biochemical and clinical assessments, latest blood results for lipid profiles (Total cholesterol, triglycerides, LDL-cholesterol and HDL-cholesterol) and glycemic status (HbA1c) were retrieved from medical records. Blood pressure was measured using a fully automatic blood pressure monitor (Omron M4-1; Omron Healthcare Europe BV, Hoofdorp, The Netherlands)

Subjects were interviewed to collect data on socio-demographic characteristics including duration of diabetes, ethnicity, marital status, educational level, monthly income and employment status. Medical characteristic and other lifestyle behaviours including smoking status. International Physical Activity short Questionnaire (IPAQ-short) was used to assess physical activity levels of the subjects.

Subjects were also required to record all foods and beverages consumed in the 24-h period for three consecutive days that included 2 weekdays and 1 weekend day. Nutrient analysis was performed using a computerized dietary analysis program (Nutritionist Pro Version 2.0; First Data Bank, The Hearst Corp., New York).

Diet GI was analysed from the diet records using a Microsoft Excel by using the formula; Diet GI= amount of carbohydrate (g) x GI value of foods. Diet GL was then calculated as the product of GI and carbohydrate intake divided by 100 [5]. Due to lack of availability of local GI values, GI values of numerous Iraqi foods needed to be matched with a data from neighbouring countries i.e. from the United Arab Emirates and Lebanon [3]. Majority of the data were also obtained from similar foods published internationally or in its updated version online database of University of Sydney [2].

To improve the accuracy of this GI matching process, the GI assignment was based on previously published procedures of low – GI diet which was associated with a short-term improvement of glycaemic control in Asian patients with type 2 diabetes. [1].

Data analyses

The results were analyzed using SPSS version 22.0 (SPSS Inc, Chicago, IL, USA). Descriptive statistics was used to generate means and standard deviation of the variables. Pearson-moment product correlation was used to test for the relationship between nutrition-related factors and glycemic status. Multiple linear regression analysis was used to determine the predicted risk factors associated with glycemic status. Statistical significant were set at $p < 0.05$.

RESULTS

A total of 170 patients with confirmed diagnosis of Type 2 DM (91 males, 79 females) aged 20 years and above (Mean ± SD = 51.2 ± 10.2 years) were recruited in this study (Table 1). The majority of the subjects were Arabic, male, married and one-third of them worked as professional. More than half of the patients had been attained an education at tertiary level.

Patients participated in the study have been mostly diagnosed with Type 2 DM for duration between 5 and 10 years. Indeed, the proportion of patients (38%) who had diabetes at the age of 30’s was also high.

Their mean HbA1c was 10.4 ± 1.6% and the proportion of patients who had achieved a target treatment goal of HbA1c < 7% was only 0.6% (Figure 1) On average, subjects were categorized as overweight with their mean BMI was 29.6 ± 4.0 kg/m^2 and only 10% of them were within the normal range of BMI. About 45% and 44.2% of the subjects were overweight and obese respectively (Table 1).

Table 1 Distribution of patients by Socio-demographic characteristic (n=170)

Characteristics	**Mean**	**95% CI**
Age (years)	50.92 ± 10.62	49.31-52.53
	n	**%**
Sex		
Male	91	53.5
Female	79	46.5
Ethnicity		
Arabic	134	78.8
Kurdish	36	21.2
Place of Living		
Urban	97	57.1
Rural	73	42.9
Education Level		
Primary	25	14.7
Secondary	57	33.5
Tertiary	88	51.8
Marital Status		
Single	31	18.2
Married	104	61.2
Widowed / Divorced	35	20.6
Duration of diagnosis (years of Diabetes)		
1 - 5	41	24.1
6 - 10	85	50.0
11 - 15	34	20.0
16 - 20	10	5.9
Onset age of diabetes (years)		
20-29	10	5.9
30-39	64	37.6
40-49	52	30.6
50-59	39	22.9
60-69	5	2.9

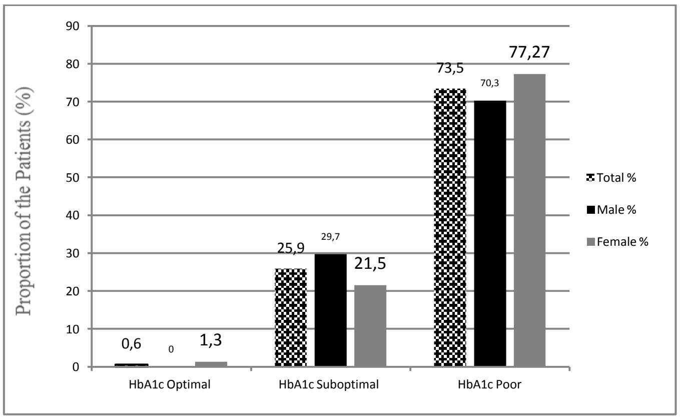

Figure 1 Distribution of patients' HbA1c across a gender (n=170)

Average energy intake of the subjects was 2032.7 ± 274.6 kcal/day with the contribution of energy from carbohydrate (58.7%), protein (17.3%) and fat (24.0%) were in line with the professional bodies recommendations (Table 2). Dietary GI and GL of the subjects were 59.7 ± 3.8 and 21.8 ± 3.8 respectively which were generally higher as compared to the other Middle East studies.

Table 2 Distribution of patients by Nutritional intake and Recommended Goal (n=170)

	Male(91)	Female(79)	Total(170)	Recommendation Goal	t**	P-value*
Energy(Kcal/day)	2035.83±272.8	2029.07±278	2032.69±69		-0.159	0.874
Carbohydrate (g/day)	299.49±47.94	279.22±47,66	298.44±47.68	50-60%	-0.308	0.759
% energy	58.84	55.03	58.74			
Protein (g/day)	88.0±13.2	90.0±17.0	80.41±15.11	15-20%	0.473	0.637
% energy	17.29	17.74	15.82			
Fat (g/day)	56.82±12.7	55.15±12.56	56.04±12.67	25-30%	-0.857	0.392
% energy	25.11	24.46	24.92			
Cholesterol(mg/d)	263.49± ±94.8	289.29,,111.1	275.48±103.2	<200mg/d	1.633	0.104
Sugar total(g/d)	56.45±14.89	57.66,,15.82	57.02±15.29	<200g/d	0.511	0.610
Sodium(mg/d)	2810.12±500.3	2715.51±445.7	2766.1±476.7	<2400mg/day	-1.293	0.198
Crude fiber(g/d)	13.36±10.7	15.69±11.9	14.44±11.34	20-30	1.336	0.183

In bivariate correlation, variables which were found to have significant relationship with glycemic status were age ($p< 0.01$; $r= 0.2$); BMI ($p< 0.05$; $r= 0.216$), total cholesterol ($p< 0.001$; $r= 0.4$) Triglyceride ($p< 0.001$; $r= 0.36$); LDL-cholesterol ($p< 0.001$; $r= 0.41$); diastolic blood pressure ($p< 0.01$; $r= 0.21$), physical activity level ($p< 0.001$; $r= -0.25$); dietary GL ($p< 0.05$; $r = 0.22$); and dietary protein ($p< 0.05$; $r= 0.16$) were correlated with glycemic status. Medical background were also found significantly different when stratified according to glycemic status in which those who were on diet alone had highest HbA1c (13.4 $\pm$ 2.4%) than those who were receiving drugs therapies which were Biguanide (10.6 $\pm$ 1.7%) and Sulfonylurea (9.9 $\pm$ 1.8%) ($p< 0.001$; $F = (2, 167) = 22.3$).

Multivariate regression analysis showed seven factors namely (Table 3); Diet alone (Beta=0.25, t = 3.949, p=0.0001); LDL level (Beta=-0.331, t = 5.388, p = 0.0001); Dietary GL (Beta = 0.162 , t = 2.714, p = 0.007); physical activity (Beta = -0.241 , t = -3.580, p = 0.0001); BMI (Beta = 0.214 , t= 3.395,p= 0.001); Sulfonylurea (Beta=-0.167, t = -2.615, p=0.01); total dietary fiber (Beta = 0.133, t = -2.169, p = 0.032); were found to be the predictors for glycemic status. These predictors explained 45% of the variation in HbA1c according to the multiple linear regression model ($R^2 = 0.45$)

Table 3 Contributions of predictors

Variables	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.	R square	Adjusted R square
Diet alone	1.822	0.247	3.949	.0001	.175	.170
LDL	1.415	0.331	5.388	.0001	.276	.268
Dietary GL	0.080	0.162	2.714	.007	.358	.342
Physical activity	0.00	-0.241	-3.580	.0001	.377	.358
BMI	0.036	0.214	3.395	.001	.403	.381
Sulfonylurea	-0.641	-0.167	-2.615	.010	.434	.410
Fiber	-0.072	0.133	-2.169	.032	.450	.423

DISCUSSION

This study determine nutritional status-related factors and its contribution to poor glycemic status in a sample of Iraqi patients with type 2 diabetes. In this study, those who were only receiving dietary advice, high LDL-c, high dietary GL, low physical activity, high BMI, those who were not on Sulfonylurea and high dietary fibre contributed to glycemic status. The overall mean age of the patients was 50.92 years and majority of them was diagnosed with type 2 DM at 30's of their ages. This was in agreement with many studies in Middle East which on average age of 51 years [17,14]. This is due to the consequence of urbanization together with lifestyle changes, and, perhaps, most prominently, a Western-style diet (Badran & Laher, 2012).

With BMI of the patients was found to be slightly higher when comparing to other local studies. Ahmed et al (2012) found the BMI of the patients was 28.2 kg/m^2 in Baghdad, so majority of studied patients either overweight or obese. In this study, all most all the patients 99% have poor glycemic status indicate by HbA1c > 7%. This revealed that the whole picture of glycemic status among Iraqi type 2 diabetic patients was poor. This result is not so surprising, due to that results of study which has been conducted by Mansour (2009), showed about 94% of patients were not achieved target treatment goal of glycemic control.

In this study there were 10.6%, 95.3%, and 86.5% of the patients did not met the recommended target set by the American Diabetes Association (2015) [12], and by Ministry of Health Malaysia (2009) for cholesterol, LDL-C and HDL-C respectively [7]. Ismail et al. (2001) had found that there were 90.9% of patients with T2DM unable to met recommended level of LDL-C[8]. This proportion was smaller than the findings in present study 95.3%. The prevalence of raised total cholesterol noticeably increases according to the income level of the country. In low-income countries, around 25 % of adults had high total cholesterol, while in high-income countries, over 50 % of adults had high total cholesterol [9]. Although, the difference was not statically significant, there was greater percent of male patients met the recommended goal of cholesterol than the female patients.

Reporting of studied patients was not considering them to be in low GI food. In this study, the mean GI intake of the male patients was 59.85 ±3.63 and GI intake of the female patients was 58.77±3.84 respectively. This is in accordance with the study by Schulz et al., (2005) which was also reported that dietary GI was significantly higher in men than women [20]. One study has been conducted to show the prevalence of physically active among people of Eastern Mediterranean countries. It revealed that Oman had the highest (26%) and Egypt had the lowest (9%) prevalence of active person.

Moreover, the positive association between BMI and HbA1c means that those patients with higher BMI greater than recommended ranges, they were likely to have poor glycemic status. This was supported by Kattab et al (2010) that found diabetes was more likely to be poorly controlled among those with higher BMI [13]. In addition to that several studies have shown that there was a positive correlation between total cholesterol and poor glycemic status. An Indian study showed that there was a significant correlation between hypertriglyceridemia and poor glycemic status.

A seven-predictor multiple linear regression model was proposed to explain the variation of glycemic status. The seven predictor variables proposed were Diet alone, LDL-cholesterol, dietary GL, Physical activity, BMI, on OAD Sulfonylurea drug and total dietary fiber.

This study suggests that the overall HbA1c will increase by 1.8 when those patients who were remaining on their diet alone for each one unit, and this variable made the strongest unique contribution in explanations HbA1c.The next variable was LDL-cholesterol and those patients who had increased by one unit of LDL-cholesterol were followed with 1.4 units increased in HbA1c. Another variable was age, which means that by increasing age of patients one unit will be followed with 0.02 increasing in HbA1c, but in this study it was though not statistically significant. The findings from general linear regressions revealed that the coefficient of determination of model was 45%which means that 45% of HbA1c was explained by the independent variables.

CONCLUSION

In conclusion, the present study showed the significant contribution of nutritional status-related factors namely diet alone, LDL level, Dietary GL, Physical activity, BMI, on Sulfonylurea and total dietary fibre to glycemic status. Future studies should consider incorporating these components into the model to increase the effectiveness of any intervention to Iraqi type 2 DM.

ACKNOWLEDGEMENTS

I would like to thank my supervisor as well as my co- supervisor, for their endless support in making this study success. My gratitude also to my family & my colleagues for their assistance.

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