




Level of Adherence to the Dietary Recommendation and Glycemic Control Among Patients with Type 2 Diabetes Mellitus in Eastern Ethiopia: A Cross-Sectional Study

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Background: Dietary modification is the cornerstone and initial recommendation in the management of diabetes mellitus. Adhering to the recommended dietary practice has a significant role in diabetic control, but not uniformly practised.

Objective: To assess dietary adherence and glycemic control among type 2 diabetic patients on follow-up at Dilchora Referral Hospital (DRH), Dire Dawa, Eastern Ethiopia.

Methods: A hospital-based cross-sectional study was conducted from 22 August to 23 October 2019, at DRH. Data were collected through an interviewer-administered questionnaire. The Perceived Dietary Adherence Questionnaire (PDAQ) was used to estimate the level of dietary adherence. Glycemic control was measured using fasting blood glucose. Multivariate logistic regression analyses were employed to identify factors associated with dietary adherence.

Results: Of the 307 included patients, 62.5% were poorly adherent to the recommended diet. Lack of dietary education (83.38%) and inability to afford a healthy diet (71.33%) were the perceived barriers to practice dietary recommendation. More than half (54.7%) failed to achieve the recommended fasting blood glucose target. In multivariate logistic regression, patients who were adherent to dietary recommendations were 3.56 times more likely to have good glycemic control. Those patients living in urban areas, having monthly income greater than 1000 Ethiopia Birr, family history of the disease, duration of treatment greater than 10 years and who received counseling were more likely to have good dietary adherence.

Conclusion: The level of adherence to the dietary recommendation and glycemic control was low. Healthcare providers should be proactive in tackling the barrier for non-adherence and should promote adherence to dietary recommendations in T2DM patients.

Keywords: type 2 diabetes, dietary adherence, glycemic control, Eastern Ethiopia

Background

Diabetes mellitus (DM) is among the promptly increasing non-communicable diseases and a significant public health problem globally. Type 2 DM (T2DM) accounts for the vast majority of people living with diabetes globally and is mainly the result of excess body weight and physical inactivity.¹ World Health Organization (WHO) has announced on its recent global diabetes report that an estimated 422 million adults were living with DM worldwide.²

According to the International Diabetes Federation (IDF), the number of DM patients has increased from 108 million (4.7% of the population) to 422 million adults

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(8.5% of the population). DM was a common health problem in developed countries, but nowadays, it is also an increasing problem in developing countries. In Africa, an estimated 14.2 million people are living with diabetes.³ Factors driving this dramatic rise in developing countries are flaring of urbanization and lifestyle changes.^{2,3}

Good diabetes management is a balance between healthy medication, exercise, and dietary modification.^{4,5} The American Diabetes Association (ADA) recommends eating food low in sucrose and high in fiber, fruits, vegetables, whole grains, legumes for secondary prevention of T2DM.⁶ Low-carbohydrate diets might seem to be a logical approach in lowering postprandial glucose. However, these diets are also important sources of energy, fiber, vitamins, and minerals for individuals with diabetes.^{5,6}

Poor glycemic control is more common among patients who did not follow dietary regimens and did not practice any physical activity. This could lead to the intensification of pharmacologic treatments.⁷ Governments have to ensure that people can make healthy choices and that health systems can diagnose and treat people with diabetes, even in the most impoverished settings.² Dietary modification is the cornerstone and initial recommendation in T2DM management despite enormous setbacks in its implementation. Non-adherence to lifestyle regimens has been identified as high both in developed and developing countries and is associated with increased hospitalizations and mortality.⁷⁻⁹ This problem could be curbed by collaboration between the patient and the healthcare provider.

Among possible influencing factors; socioeconomic status, duration of disease, lack of knowledge about DM, cost of a healthy diet, and poor communication with healthcare providers are the most cited barriers that lead to poor adherence to dietary recommendations.¹⁰⁻¹⁴ Based on the previous studies in Africa, including Ethiopia, the level of adherence to the dietary recommendation was generally low.¹⁴⁻¹⁸ However, such a study was lacking in Dire Dawa, the Eastern part of Ethiopia. Such awareness would be alarming for all stakeholders for providing service in line with WHO nutrition guideline recommendations and help to plan and implement interventions to achieve better glycemic control. Thus, this study was aimed at assessing the level of dietary adherence, factors affecting adherence, and glycemic control among T2DM patients in Dilchora Referral Hospitals (DRH), Dire Dawa, Eastern Ethiopia.

Methods

Study Design and Setting

A hospital-based cross-sectional study was conducted from 22 August to 23 October 2019 at DRH, Eastern Ethiopia. The hospital is located in Dire Dawa, which is the only federal city apart from Addis Ababa, the capital city of Ethiopia. It delivers diversified health services and clinics like antenatal care (ANC) clinics, dental clinics, tuberculosis (TB) clinics, anti-retroviral therapy (ART) clinics, and ophthalmologic clinics. The hospital has 18,888 diabetic patients registered for follow-up care.

Study Population

All adult T2DM patients who were attending follow up in DRH from 22 August to 23 October 2019 were included in the study. However, those who were critically ill and unable to participate in the interview, and also those who had a diabetic period of fewer than six months were excluded.

Sample Size Determination and Procedure

The sample size was determined by using a single population proportion formula. Expecting an overall adherence rate of 25.7%¹⁴ at a 95% confidence interval, and after adding 5% of the calculated sample size for possible non-response, 307 patients were interviewed. Simple random sampling was used to select patients.

Data Collection Method and Survey Instrument

The data collection was done by using an interviewer-administered questionnaire. The tool was adopted and modified from previous studies on a similar topic.^{16,19} A pilot test was done on 20 voluntary T2DM patients who were not included in the final survey. For validation of the survey instrument, all the necessary modification was instituted depending on the feedback from pre-test before implementing in the main study. The questionnaire was evaluated for reliability with a Cronbach alpha value of 0.821 and translated to the local language (Amharic) to avoid biased response. The survey instrument was designed to have two major parts. The first part was used to assess sociodemographic characteristics of study participants. The second part was used to evaluate the level of dietary adherence, the magnitude of glycemic control, and perceived barriers for dietary adherence among T2DM

patients. The Perceived Dietary Adherence Questionnaire (PDAQ) was used for dietary adherence measurement. PDAQ is a nine-item questioner that is developed in 2015 by Ghada Asaad et al to measure patient perceptions of their dietary adherence.²⁰ The response is based on a seven-point Likert scale to answer the question phrased as “On how many of the last 7 days did you?” (Table 2). Higher scores reflect higher adherence except for items 4 and 9, which reflect unhealthy choices (foods high in sugar or fat). For computing a total PDAQ score, the scores for these items were inverted. Although the glycosylated hemoglobin (HbA1c) test is the gold standard to determine the glycemic control of the patient, it was not feasible in our setting. Thus, fasting blood glucose (FBG) was used as a proxy indicator of glycemic control. The average of the last three FBG results was used to categorize patients as having poor or good glycemic control.

Data Processing and Analysis

The responses from each study participants were analyzed using Statistical Package for the Social Sciences (SPSS) software version 21.0 for Windows (SPSS Inc., Chicago, IL) and were double-checked for accuracy. Descriptive aspects of analyses were done through calculating mean, standard deviation, frequencies, and percentages. Multivariate logistic regression was conducted to determine an association between dietary adherence and glycemic control and predictors of dietary adherence. The 95% CI and p-value <0.05 were used to assess the significance of the association.

Operational Definition

Good Dietary Adherence

Patients will be classified as having good dietary adherence if they eat a healthy diet for at least four days in the week.

Good Glycemic Control

If the average of the last three FBG results is between 70mg/dL and 130mg/dL.

Ethics Approval

The study protocol and verbal consent were approved by the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University. This study was conducted following the Declaration of Helsinki. An official letter was obtained from the School of Pharmacy (Ref. No. C/Ac/R/D//01/

2017/19) and given to the DRH administration to secure permission.

Result

Among 307 study participants, more than half (55%) were females and most of them (68.4%) were married. Government employees accounted for 33.9% of the respondents, and 42.99% of them were aged between 18 and 40 years. The place of residence for the majority (87.6%) was urban. About 31.9% of the respondents had no formal education, and 46.6% of them had 1000–2000 Ethiopian Birr monthly income. Nearly half (49.2%) of the study participants have a comorbid medical condition and about 65% of them had a family history of DM. The respondents had 6.37 ± 4.96 mean years since the diagnosis of DM. The majority (90.9%) of study participants have received counselling regarding a healthy diet while about two-thirds (72%) followed the dietary recommendation. However, only 38.4% have followed the weekly exercise recommendation (Table 1).

Intake of foods high in fibers such as oatmeal, high fiber cereals, and whole-grain bread within the last seven days was high in the current study with a mean score of 5.45. The participants also followed a healthful eating plan for more than four days within a week with a mean score of 4.84. In the present study, eating food rich in carbohydrates was also high with a mean score of 4.23. The intake of food containing canola, walnut, olive, or flax oils and foods rich in omega-3 fatty acids within the last seven days was low with a mean score of 0.32 and 0.72, respectively. The majority (62.5%) of the study participants had poor dietary adherence based on PDAQ (Table 2).

Among possible perceived barriers that hinder the patients' adherence to the dietary recommendation, lack of knowledge/lack of diet education (83.38%), and inability to afford the cost of recommended diet (71.33%) were the two major barriers claimed by the study participants (Table 3).

The average of the last three FBG results was used to determine the patient's glycemic control status. Accordingly, more than half (54.7%) failed to achieve the recommended fasting blood glucose target (Figure 1). The overall mean FBG was 154.2 ± 52.32 mg/dL with 148.13 ± 57.03 mg/dL in patients who had good dietary adherence and 158.60 ± 65.62 mg/dL in those who had poor dietary adherence.

In multivariate logistic regression analyses, patients who were adherent to dietary recommendations were 3.56 times more likely to have good glycemic control [AOR= 3.56, 95% CI: 1.75–8.23] as compared to their

Table 1 Sociodemographic Characteristics of the Study Participants at Dilchora Referral Hospital

Variables	Categories	Frequency (N)	Percent
Age (years)	18–40	132	42.99
	41–60	80	26.06
	≥61	95	30.96
Sex	Male	138	45.0
	Female	169	55.0
Marital status	Married	210	68.4
	Single	21	6.8
	Divorced	22	7.2
	Widowed	54	17.6
Occupation	Government Employee	104	33.9
	Farmer	25	8.1
	Business person	55	17.9
	Others	123	40.1
Residence	Urban	269	87.6
	Rural	38	12.4
Education level	No formal education	98	31.9
	Primary	82	26.7
	Secondary	78	25.4
	College/ university	49	16.0
Monthly income (in ETB)	<500	14	4.6
	500–1000	62	20.2
	1000–2000	143	46.6
	>2000	88	28.7
Mean duration since diagnosis		6.37 ± 4.96	
Mean duration since starting DM treatment		6.33 ± 4.98	
Family history	Yes	109	35.5
	No	198	64.5
Co-morbidity	Yes	151	49.2
	No	156	50.8
Physical exercise	Yes	189	61.6
	No	118	38.4
Previous exposure to any education regarding diet recommendation from healthcare providers	Yes	279	90.9
	No	28	9.1
Follow doctor's recommendation regarding diet	Yes	221	72.0
	No	86	28.0
Encounter problem of remembering eating foods according to doctors' advice	Yes	97	31.6
	No	210	68.4

Abbreviations: ETB, Ethiopian Birr; SD, standard deviation.

Table 2 Perceived Dietary Adherence Questionnaire Score for Type 2 Diabetes Mellitus Patients at Dilchora Referral Hospital

Items	Mean ± SD
On how many of the last seven days have you followed a healthful eating plan?	4.84 ± 1.06
On how many of the last seven days did you eat the number of fruit and vegetables?	4.40 ± 1.41
On how many of the last seven days did you eat carbohydrate-containing foods with a low Glycemic Index? (e.g., dried beans, lentils, barley, pasta, low-fat dairy products)	4.23 ± 1.50
On how many of the last seven days did you eat foods high in sugar, such as rice, potatoes, etc.?	1.50 ± 1.25
On how many of the last seven days did you eat foods high in fiber such as oatmeal, high fiber cereals, and whole-grain bread?	5.45 ± 1.54
On how many of the last seven days did you space carbohydrates evenly throughout the day?	2.11 ± 1.20
On how many of the last seven days did you eat fish or other foods high in omega-3 fats?	0.72 ± 1.09
On how many of the last seven days did you eat foods that contained or were prepared with canola, walnut, olive, or flax oils?	0.32 ± 0.77
On how many of the last seven days did you eat foods high in fat (such as high-fat dairy products, fatty meat, fried foods, or deep-fried foods)?	1.34 ± 1.12
Overall adherence	N (%)
Good	115 (37.5)
Poor	192 (62.5)

Abbreviation: SD, standard deviation.

counterparts. Study participants who were living in an urban area were 2.16 times more likely to have good dietary adherence [AOR=2.16, 95% CI: 1.98–4.72] than those who live in rural areas. Besides, study participants who had a monthly income of greater than 1000 Ethiopian Birr were 2.33 times more likely to have good dietary adherence [AOR= 2.33,95% CI: 1.19–4.53] compared to their counterparts. Regarding dietary education, study participants who have received counseling on a healthy diet were 2.56 times more likely to have good adherence to a dietary recommendation [AOR=2.56, 95% CI: 1.03–6.36]. Moreover, diabetic patients who had a positive family history of diabetes were 2.23 more likely to be adherent to the recommended diet as compared to those who had no family history of diabetes [(AOR=2.23, 95% CI: 1.32–3.76) (Table 4).

Discussion

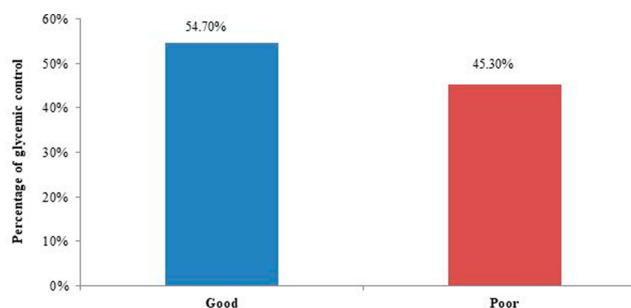
This study tried to assess the level of adherence to the dietary recommendation, factors affecting adherence, and

Table 3 Perceived Barriers Influencing Adherence to the Recommended Diet at Dilchora Referral Hospital

Barriers	Frequency (N)	Percent
Lack of knowledge/lack of diet education	256	83.38
Unable to afford the cost of the recommended diet	219	71.33
Do not believe diet can control blood glucose	89	28.99
Lack of appetite for a recommended diet	145	47.23
Unable to remember the recommended diet	119	38.76
It takes too long to cook recommended diet	97	31.59
The difficulty of adhering to the recommended diet during social or work events	28	9.12
Stress	162	52.76
Other	27	8.79

glycemic control among T2DM patients in DRH since limited data are available regarding this in Dire Dawa, Ethiopia. The study revealed that only 37.5% of the study participants had depicted good adherence to a dietary recommendation. This finding was comparable with the adherence level reported by previous study in Hungary (33.2%).²¹ However, it was slightly higher than the previous study conducted in northern Ethiopia (25.7%)¹⁴ but greater than the overall dietary recommendation in Italy (3%).²² In contrast, it was lower than another study that was done on dietary practice and associated factors in Addis Ababa, Ethiopia (48.6%),¹⁵ and Washington (48%).²³ This could be explained by the difference in the setting and associated sociodemographic characteristics of the study participants among studies and the availability of a healthy diet in the area.

In the present study, the average level of carbohydrate intake of the study participants was more than four times a week which is consistent with the previous study in South Gondar, Ethiopia (5 times a week).¹⁴ This could be due to the cheapness and readily availability of carbohydrate-

**Figure 1** Level of glycemic control among type 2 diabetes mellitus patients at Dilchora Referral Hospital.

containing food in Ethiopia. Similarly, study participants had a high consumption of fruits and vegetables of 4 days a week. This was in contrast with the previous study by Ayele et al (1.84 times a week).¹⁴ This disparity might be due to the accessibility and relative cheapness of vegetables and fruit in the study setting, which is well known for its vegetables and fruits.

Carbohydrate intake was high in the study participants compared to other sources of food, which can significantly affect their glycemic control. Limiting carbohydrate intake had favorable effects on body weight, body mass index (BMI), abdominal circumference, systolic blood pressure, diastolic blood pressure, triglyceride level, FBG level, insulin level, HDL cholesterol level, and C-reactive protein level.²⁴ Low-carbohydrate diets in T2DM results in the improvements of glycemic control and triglyceride levels according to a meta-analysis of 13 randomized clinical trials.²⁵

In the current study, more than half of the respondents have poor glycemic control as shown by the high fasting blood glucose. This is comparable to the previous study on medication regimen complexity and its impact on glycemic control in Debretabor University Hospital (57.1%),¹⁹ another study in northwest Ethiopia (57.5%),²⁶ and a systemic review in Ethiopia (51%).²⁷ The small discrepancy between the findings of this study and other studies could be clarified by the fact that the study done in Northwest Ethiopia used the recommended test for glycemic control (HbA1c test), while in our study setting, the FBG test was used for the assessment of glycemic control. Besides, a difference in the study participants and study design could play a role in such differences.

Concerning barriers to dietary adherence, lack of knowledge/lack of diet education was the major setback claimed by 83.4% of the study participants even though the majority have received counseling about a healthy diet. This is comparable with previous studies in Ethiopia, in which many of the study participants have cited lack of knowledge/lack of diet education as the main barriers that hinder adherence to the recommended diet in Northwest Ethiopia (87%)¹⁴ and Harar town (93.7%).¹⁵ Even though they have taken adequate counseling about diet, the majority of the study participants did not implement in their life, as evidenced by the high intake of carbohydrates in their meal. The diet education and follow up also might not be sufficient as evidenced by a low level of dietary adherence. Another obstacle that was reported by 71.3% of the respondent was the inability to afford the cost of the

Table 4 Predictors of the Level of Dietary Adherence Among Type 2 Diabetic Patients at Dilchora Referral Hospital

Variable	Dietary Adherence		Odds Ratio(95% CI)		P-value
	Good	Poor	COR	AOR	
Glycemic control					
Good	78	61	4.53(2.76–7.43)	3.56(1.75–8.23)	0.00
Poor	37	131			
Sex					
Male	60	78			0.84
Female	55	114	0.63(0.39–0.99)	0.59(0.34–1.05)	
Residence					
Urban	105	156	2.42(1.15–5.09)	2.16(1.98–4.73)	0.041
Rural	10	36			
Monthly income (in ETB)					
≤1000	17	58			0.00
>1000	98	134	2.49(1.37–4.547)	2.33(1.19–4.53)	
Family history of DM					
Yes	56	51	2.62(1.61–4.27)	2.23(1.32–3.76)	0.03
No	59	141			
Duration since diagnosis of DM					
≤10 years	97	174			0.349
>10 years	18	18	1.794(0.89–3.608)	1.43(0.68–2.99)	
Duration since starting DM treatment					
≤10 years	88	177			0.01
>10 years	27	15	3.62(1.83–7.153)	3.82(1.87–7.80)	
Previous exposure to dietary education					
Yes	107	160	2.68(1.19–6.03)	2.56(1.03–6.36)	0.042
No	8	32			

Abbreviations: ETB, Ethiopian birr; DM, diabetes mellitus.

recommended diet since the majority of the study participants earn a monthly income of less than 2000 Ethiopia Birr. This finding was also corroborated by previous studies conducted in Ethiopia and globally.^{28,29}

The American Diabetic Association standards added an increased emphasis on dietary adherence to be addressed as the priority when treatment goals are not met.³⁰ This is corroborated by our study finding in which patients who were adherent to dietary recommendations were 3.56 more likely to have good glycemic control. This study showed us more emphasis should be placed on increasing adherence to the diet and educating the patient more about a healthy diet.

In multivariate logistic regression, residence, monthly income, family history of DM, duration since diagnosis of DM, duration since the treatment of DM, and previous exposure to dietary education were the significant predictors of

adherence to a dietary recommendation. Accordingly, study participants who had taken counseling on a healthy diet were 2.56 times more likely to have good adherence to dietary recommendations. This disparities could probably be due to the better knowledge, understanding and implementation of proper nutritional life among the recipients dietary counseling patients as compared to their counterparts. However, the result is lower than the previous study done in Addis Ababa (3.3 times)¹⁵ and Malaysia (2.78).³¹ The lower value obtained in the present study might be due to a problem in the follow-up counseling regarding dietary adherence as evidenced by the high intake of carbohydrates in the patients and low level of dietary adherence even though they claimed to adhere food intake in line with doctors' advice. Such a response by the participants is also liable to recall and social desirability biases. It could also be due to the low socio-economic status of the study participants, as reported in the

Zimbabwe study, which showed that the strained economic situation was adversely affecting the management of DM.³²

Study participants who had a monthly income of greater than 1000 Ethiopian Birr were 2.33 times more likely to have good adherence. This is in agreement with the previous study, which showed that study participants with monthly incomes below \$150 were poorly adherent to dietary recommendations (AOR = 6.781, 95% CI: 2.001–9.902).¹⁴ The annual increase in the cost of healthy foods might have a negative impact on patients who were from low socioeconomic levels like Ethiopia. Therefore, providing reliable information regarding lists of low-cost healthy foods and foods that can be cheaply cooked at home may also be beneficial for patients to overcome the cost barrier for dietary adherence especially in low-income patients.

In multivariate regression, respondents who had >10 years of diabetic disease were 3.82 times more likely to have good dietary adherence in comparison with their counterparts who had ≤10 years of duration of DM treatment. This might be due to prolonged exposure to a health professional and dietary counseling. Study participants who were living in an urban area were 2.16 times more likely to have good dietary adherence. Likewise, having a positive family history of diabetes was positively (2.231) associated with good dietary adherence.

Limitations and Strength of the Study

The present study assessed the level of adherence to dietary recommendations and glycemic control among T2DM in Dire Dawa where studies are limited. Therefore, the result of this study could be used as a baseline data for further studies. As a limitation, this study is a self-reported survey, which may be subjected to recall and social desirability biases. Besides, the current study did not assess medication and exercise adherence, and we cannot infer causal relationship between the predictors and outcomes since it is a cross-sectional study. There was also a lack of measurements of HbA1C which is the standard way of assessing glycemic control.

Conclusion and Recommendations

In the present study, the level of adherence to the dietary recommendation was generally low. Participants who had good dietary adherence were more likely to have adequate glycemic control. Lack of knowledge, inability to afford the recommended diet and lack of previous exposure to

dietary education were the most significant barriers responsible for non-adherence. Therefore, health professionals must become proactive addressing these barriers and healthcare decisions and policymakers should design effective dietary practice guidelines for people with T2DM in areas where these are not available to achieve desired level glycemic control.

Abbreviations

ADA, American Diabetes Association; DM, diabetes mellitus; DRH, Dilchora Referral Hospital; FBG, fasting blood glucose; PDAQ, Perceived Dietary Adherence Questionnaire; T2DM, type 2 diabetes mellitus; WHO, World Health Organization; AOR, adjusted odds ratio; COR, crude odds ratio; SD, standard deviation.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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