Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts Glucose Management in Patients with Type 2 Diabetes Mellitus

Ibrar Ahmad[1], Hoor Maab Kaifi [2], Tahir Ghaffar[3],Adan Javed[4],Hira Tahir[5] , Muhammad Hussain Afridi [6].

[1] Assistant Professor, Department of Endocrinology and Diabetes, LRH, MTI , Peshawar, Pakistan
[2]. senior dietcian, Department of Endocrinology and Diabetes, LRH, MTI , Peshawar, Pakistan
[3].Assistant Professor Department of Diabetes and Endocrinology, Hayatabad medical complex, Peshawar
[4].Diabetes Educator, Department of Endocrinology and Diabetes, LRH, MTI, Peshawar, Pakistan
[5].Diabetes Educator, Nutritional Department of Endocrinology and Diabetes LRH, MTI, Peshawar, Pakistan.
[6.]Assistant Professor Diabetes And Endocrinology Unit Hayatabad Medical Complex Peshawar, Pakistan
Corresponding Authors: **Muhammad Hussain Afridi ,Tahir Ghaffar**
Email:Mhussainafd@gmail.com,dr.tg.ktk@gmail.com

Abstract
Background: Previous studies have shown a low adherence to dietary recommendations. The purpose of the study was to determine whether the patients with Type 2 Diabetes Mellitus (T2DM) follow local (Pakistan) nutritional guidelines. We hypothesized that lack of adherence to the nutritional guidelines would be associated with high HbA1c.
Methods: A prospective, cross-sectional study was conducted at the Endocrine and Medicine Department of Lady Reading Hospital, Peshawar, Pakistan, from September 2019 to March 2020. Hospitalized type I & II diabetic patients were assessed using the Perceived Dietary Adherence Questionnaire (PDAQ), and anthropometric measurements were observed. The patients' medical history and demographic details were obtained on a pre-designed questionnaire.
Result: It was found that the majority of the enrolled patients had poor dietary adherence (88.6%). About 78.2% of the participants were physically inactive, and only 16.8% were engaged in routine exercise. The majority of the study participants, 80.6% of them, we're living in an urban area. 89.1% of the population was exposed to Diabetes Mellitus (DM)-related diet education and 88.6% of patients had poor adherence. 63.2% of patients followed recommended dietary practices, 79.3% encountered problems remembering eating foods as per the advice of a healthcare provider, and 57.5% lacked information that might have influenced compliance with dietary recommendations.
Conclusion: We conclude that a high percentage of non-adherence to the dietary recommendation was found among Pakistani patients with DM.
Keywords
Diabetic Mellitus, HbA1c, Dietary recommendations, Adherence, Dietary recommendations

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

Introduction

Globally, among non-communicable diseases, Diabetes mellitus (DM) is a serious public health problem. Mainly people are affected with Type II DM due to physical inactivity and increased body weight[1]. In previous decades it has been observed that DM affects underdeveloped countries more than developed countries[2,3]. It might be due to changes like the inactive way of living, poor nutrition intake, and increasing suburbanization. It has been recommended by the world health organization and the International diabetic federation to perform regular physical exercise and a healthy nutrition-based diet to prevent type 2 diabetes. Previous studies have shown that lifestyle modifications are essential to avoid difficulties and manage DM[4].

Moreover, a high fiber, green vegetables, seasoned fruits, and low sucrose diet is recommended by the American Diabetes Association (ADA). Carbohydrate-based diets are essential sources of energy[5,6]. However, better management of Diabetes requires meals with low-carbohydrate for lowering postprandial glucose. Many studies have shown that patients with poor glycemic control do not follow recommended physical activity, diet, and medication. A key foundation for DM (especially in type II DM) management requires dietary modification. However, it has been seen that non-adherence in developing nations like Pakistan leads to increased disease morbidity and mortality. Many factors are the key reasons behind this increase in DM morbidity like disease duration, healthy diet cost, doctor-patient relationship, and lack of awareness[7-11].

Moreover, increased disease morbidity and mortality have disturbed developing countries' quality of life and overall health care structure[12-14]. It has been observed that patients' poor understanding of dietary intakes leads to non-adherence. In Pakistan, health care providers, with the help of government and non-government actors, are trying their best to make patients aware. Previous studies conducted in low-income countries have shown a low adherence to dietary recommendations[2,3,11]. The purpose of the study was to determine whether the patients with T2DM follow local (Pakistan) nutritional guidelines. We hypothesized that lack of adherence to the nutritional guidelines would be associated with high HbA1c levels.

Methodology

A prospective, cross-sectional study was conducted at the Endocrine and Medicine Department of Lady Reading Hospital, Peshawar, Pakistan, from September 2019 to March 2020. Hospitalized type I & II diabetic patients were assessed using the PDAQ, and anthropometric measurements were observed. The patients' medical history and demographic details were obtained on a pre-designed questionnaire. Patients with a history of long-term intake of drugs that can cause anorexia or patients with a history of long-term/medical/surgical conditions that may affect dietary intake such as acromegaly, Cushing's syndrome, and post pancreatectomy were excluded from the study. Prior ethical approval was obtained from The Institutional Review, and Ethical Board committee of LRH (IRB#...............; Dated...........), and the study was conducted in accordance with the declaration of Helsinki. Research objectives were explained to study participants, and written informed consent was obtained from all participants.

The purposive sampling technique was used, and the total sample size n=180 was calculated using statistical software "Sample Size Determination in Health Studies by WHO" with 80% power of the test and 95% confidence interval with a 5% level of significance. The standard deviation values of HbA1c levels are 0.62 and 0.70 in SIM and GIM groups, respectively. Each group will be equally distributed, with n=90 patients in the SIM group and n=90 in the GIM group.

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

The data was analyzed using SPSS version 20.0. The Spearman correlation analysis was performed (using Graph Pad Prism, La Jolla, California, United States) to examine the relationships among socio-demographic data, anthropometry variables, and HbA1c levels versus dietary adherence, as well as to compare perceived and actual adherence data are expressed as means, standard deviation. When comparing completers to non-completers of the 3-day diet record, the Student t-test or the chi-square test was used to evaluate differences in absolute or proportional values, respectively, with $p < 0.05$ considered significant. Multiple linear regression models were applied to assess the association between dietary adherence and HbA1c levels, assigned as the continuous dependent variable.

Results

A total of 180 patients participated in this study. About 78.2% of the participants were physically inactive, and only 16.8% were engaged in routine exercise. The majority of the study participants, 80.6% of them, we're living in an urban area. 89.1% of the population was exposed to DM-related diet education, and 88.6% of patients had poor adherence (Table 1).

Table 1: Baseline characteristics of the study population.

Variables		Mean	SD
Age; years		53.06	11.672
Weight; kg		67.13	11.237
Height; cm		161.44	7.988
BMI; kg/m^2		25.789	4.6438
HbA1c; %		11.038	2.6744
PDAQ Score		17.12	11.709
		Frequency	Percentage
Adherence	Poor	342	88.6
	Good	38	9.8
Gender	Male	151	39.1
	Female	229	59.3
Socioeconomic Status	Poor	191	49.5
	Average	94	24.4
	Good	95	24.6
Life Style	Joint	270	69.9
	Nuclear	110	28.5
Residence	Urban	311	80.6
	Rural	69	17.9
Occupational Status	Employed	64	16.6
	Self-Employed	1	0.3
	Unemployed	315	81.6
Monthly Income; PKR	Not Reported	318	82.4
	< 5 K	25	6.5
	5-15 K	16	4.1
	> 15 K	6	1.6
Duration of DM; years	0-5	112	29

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

	5-10	144	37.3
	> 10	124	32.1
Family History of DM	Yes	342	88.6
	No	38	9.8
Diabetes Treatment	Oha	67	17.4
	Insulin	129	33.4
	Both	184	47.7
Comorbidity	Yes	341	88.3
	No	39	10.1
Complications	Yes	348	90.2
	No	32	8.3
Retinopathy	Not Reported	13	3.4
	Yes	164	42.5
	No	203	52.6
Nephropathy	Not Reported	22	5.7
	Yes	24	6.2
	No	334	86.5
Hypertension	Not Reported	16	4.1
	Yes	256	66.3
	No	108	28
Neuropathy	Not Reported	14	3.6
	Yes	273	70.7
	No	93	24.1
PVD	Not Reported	250	64.8
	Yes	27	7
	No	103	26.7
Exercise	Yes	65	16.8
	No	302	78.2
Exposure to diet education	Not Reported	1	0.3
	Yes	344	89.1
	No	35	9.1

DM-Diabetes Mellitus; BMI- Body Mass Index; HbA1c-Hemoglobin A1c; PDAQ-Perceived Dietary Adherence Questionnaire; PVD-Peripheral Vascular Disease.

Concerning patient compliance to dietary recommendations, 63.2% of patients followed recommended dietary practices, 79.3% encountered problems remembering eating foods as per the advice of doctors/dietitians/healthcare provider, and 57.5% had information lack that influenced compliance to dietary recommendations (Table 2).

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

Table 2: Patient compliance to dietary recommendations.

Variables		Frequency	Percentage
Follow recommended dietary practices	Yes, I follow all the time	244	63.2
	I follow at times	60	15.5
	Not often	40	10.4
	Rare	27	7
	No, I don't follow	9	2.3
	Not Reported	6	1.6
Times, when recommended dietary practices are not followed	Everyday	74	19.2
	Every 2-3 days	32	8.3
	Once a week	21	5.4
	Every two weeks	12	3.1
	Once a month	22	5.7
	For more than a month	2	0.5
Dietary recommendations hard to follow	Not Reported	218	56.5
	Food choices, e.g., complex carbohydrates	100	25.9
	Meal compositions, e.g., amount of fruits, vegetables, proteins, carbohydrates, fats	37	9.6
	Meal frequency	16	4.1
	Meal timings	7	1.8
	Others	2	0.5
Encounter problems remembering eating foods as per the advice of doctors/dietitians/healthcare provider	Yes	306	79.3
	No	74	19.2
Factors influencing compliance with dietary recommendations	Not Reported	13	3.4
	Lack of information	222	57.5
	Financial constraints	72	18.7
	Lack of quality food in our area	28	7.3
	Taste and preferences	4	1
	Poor self-control	13	3.4
	Lack of adequate food in the household	26	6.7
Preferences making it easy to follow the dietary recommendations	Not Reported	1	0.3
	Perceived expected benefits e.g. I will live long, get sick less often	188	48.7
	Enough money to procure food	90	23.3
	Food availability in my area	40	10.4
	Family support	28	7.3
	Others, specify	33	8.5

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

The mean HbA1c levels were significantly higher among patients with poor adherence compared to those with good adherence to dietary recommendations (p=0.002).

Table 3: Mean HbA1c levels with respect to Dietary Adherence.

Variables	Adherence		t	p-value
	Poor	Good		
HbA1c	11.18±2.66	9.75±2.45	3.150	0.002*

HbA1c-Hemoglobin A1c
*p<0.05 is considered statistically significant.

As per the multiple linear regression analysis (Table 4), respondents who had good glycemic control were 3.8 times more likely to have good adherence to dietary recommendations with poor control (OR=3.82; 95%CI=0.96-15.18).

Table 4: Predictors of Adherence to Dietary Recommendations among Type 2 Diabetic Patients.

Variables		Adherence		OR	95% CI		P-Value
		Poor	Good		Lower Bound	Upper Bound	
Age Group	28-48 years	119(35.4)	16(43.2)	1.120	0.303	4.137	0.865
	49-69 years	192(57.1)	18(48.6)	0.781	0.215	2.842	0.708
	70-90 years	25(7.4)	3(8.1)	1			
Glycemic Control**	Good Control	8(2.3)	3(7.9)	3.825	0.963	15.187	0.057*
	Fair Control	28(8.2)	5(13.2)	1.821	0.655	5.065	0.251
	Poor Control	306(89.5)	30(78.9)	1			
BMI Category	Underweight	1(0.3)	-	-	-	-	-
	Normal weight	111(33.7)	6(16.2)	0.279	0.107	0.726	0.009*
	Overweight	119(36.2)	12(32.4)	0.520	0.241	1.124	0.096
	Obese	98(29.8)	19(51.4)	1	.	.	.
Gender	Male	140(40.9)	11(28.9)	0.588	0.282	1.224	0.156
	Female	202(59.1)	27(71.1)	1			
Socioeconomic Status	Poor	175(51.2)	16(42.1)	.698	0.310	1.570	0.385
	Average	83(24.3)	11(28.9)	1.012	0.416	2.462	0.979
	Good	84(24.6)	11(28.9)	1			
Lifestyle	Joint	246(71.9)	24(63.2)	0.669	0.332	1.347	0.260
	Nuclear	96(28.1)	14(36.8)	1			
Residence	Urban	280(81.9)	31(81.6)	0.981	0.413	2.329	0.965
	Rural	62(18.1)	7(18.4)	1			
Occupational Status	Employed	59(17.3)	5(13.2)	0.724	0.271	1.933	0.519
	Self-Employed	1(0.3)	-	3.323	0.323	3.323	-

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

	Unemployed	282(82.5)	33(86.8)	1			
Monthly Income	< 5k	23(7.0)	2(5.4)	0.435	0.033	5.784	0.528
	5-15 K	15(4.6)	1(2.7)	0.333	0.017	6.374	0.466
	> 15 K	5(1.5)	1(2.7)	1			
Diabetes Duration	0-5	96(28.1)	16(42.1)	2.130	0.901	5.035	0.085
	5-10	131(38.3)	13(34.2)	1.268	0.523	3.076	0.599
	> 10	115(33.6)	9(23.7)	1			
Family History of DM	Yes	310(90.6)	32(84.2)	0.551	0.214	1.416	0.216
	No	32(9.4)	6(15.8)	1	.	.	.
Treatment	Oha	58(17.0)	9(23.7)	2.440	0.963	6.184	0.060
	Insulin	111(32.5)	18(47.4)	2.550	1.161	5.603	0.020*
	Both	173(50.6)	11(28.9)	1	.	.	.
Comorbidity	Yes	311(90.9)	30(78.9)	0.374	0.158	.886	0.025*
	No	31(9.1)	8(21.1)	1	.	.	.
Complications	Yes	316(92.4)	32(84.2)	0.439	0.168	1.145	0.092
	No	26(7.6)	6(15.8)	1			
Retinopathy	Yes	151(44.2)	13(34.2)	0.613	0.303	1.240	0.173
	No	178(52.0)	25(65.8)	1			
Nephropathy	Yes	16(4.7)	8(21.1)	5.067	2.003	12.814	0.001*
	No	304(88.9)	30(78.9)	1	.	.	.
Hypertension	Yes	235(68.7)	21(55.3)	0.478	0.241	0.948	0.035*
	No	91(26.6)	17(44.7)	1	.	.	.
Neuropathy	Yes	253(74.0)	20(52.6)	0.329	0.166	0.655	0.002*
	No	75(21.9)	18(47.4)	1	.	.	.
PVD	Yes	22(6.4)	5(13.2)	0.748	0.256	2.188	0.596
	No	79(23.1)	24(63.2)	1	.	.	.
Exercise	Yes	58(17.6)	7(18.4)	1.055	0.443	2.513	0.904
	No	271(82.4)	31(81.6)	1			

*significant at p<0.05. **Based on HbA1c

DM-Diabetes Mellitus; HbA1c-Hemoglobin A1c; PVD-Peripheral Vascular Disease.

Discussion

It was observed dietary recommendations for diabetes mellitus were low in the Pakistani population. A very less number of study patients were following the health care provider's recommendations for all prescriptions. Although it was observed in several other global studies that patients are not following doctors' or Healthcare Provider's recommendations accordingly[11,15-17]. On the contrary, very few studies have been conducted on the Pakistani population to address this issue. Most third-world countries' studies have also shown poor diet adherence[18]. Studies have shown that a low carbohydrate diet positively affects body mass index, overall blood pressure, lipid profile glucose level, and reduces overall cardiovascular risk[19-21].

We found a significant association between poor dietary adherence and high HbA1c; it was seen that good glycemic control and normal weight (w.r.t. BMI) were significant predictors of good dietary adherence. Davison et al. also reported that individuals with lower BMI, HbA1c, and triglycerides reported being more adherent to dietary recommendations[22]. Glycemic control and

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

triglyceride levels are controlled with a low carbohydrate diet[18]. It has been found that most of the study participants were obtaining a high rich carbohydrate diet compared to other food sources. The majority of the Pakistani population consumes a high carbohydrate-rich diet daily. The Pakistani population utilizes a moderate level of fruits, vegetables, and omega-3 fats and consumes a high amount of rice, which is a rich source of carbohydrates[23]. Moreover, government and non-government actors are also interested in awareness campaigns for dietary adherence for the local population.

Among the potential barriers that might influence compliance with dietary recommendations, 79.3% of patients encountered problems remembering eating foods as per the advice of doctors/dietitians/healthcare providers, 57.5% reported a lack of information, and 18.7% had financial constraints. This is also supported by another similar study conducted in Ethiopia; lack of nutritional education, unavailability of food, and high cost were the prime factors influencing non-adherence to recommended dietary recommendations[24].

It was observed that around 78.2% of the participants were physically inactive and were not following any routine exercise protocol. Almost half of the study population, 49.5% of the patients, belonged to a poor socioeconomic class and were not having enough money to meet adherence compliance. It has been reported multiple times that the cost of the recommended dietary approach is among the major reasons behind non-adherence among patients with comorbid conditions[2,11]. Around 88.3% of the patients with comorbidity mostly deal with multifaceted medications and dietary recommendations. The rapid inflation growth in Pakistan has severely affected the healthy food cost. The health care provider should prepare a list of low-cost healthy food that could help patients follow dietary recommendations.

The study limitations must be considered while interpreting the current results. Firstly, as the data was self-reported, subjecting to biases, limiting accurate assessment as the individuals might have selected suitable answers beyond their personal opinions. Moreover, the study data does not represent the entire Pakistani population; hence it cannot be generalized.

Conclusion

Our study revealed a high percentage of non-adherence to dietary recommendations among Pakistani patients with DM. Significant reasons for non-adherence in our population are lack of awareness, patients encountering problems remembering eating foods as per the advice of healthcare providers, and poor understanding of dietary intake leads to non-adherence.

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts
Glucose Management in Patients with Type 2 Diabetes Mellitus

References

1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of Diabetes: estimates for the year 2000 and projections for 2030. Diab Care. 2004;27(5):1047–1053. doi:10.2337/diacare.27.5.1047

2. Mohammed AS, Adem F, Tadiwos Y, Woldekidan NA, Degu A. Level of adherence to the dietary recommendation and glycemic control among patients with type 2 diabetes mellitus in eastern ethiopia: a cross-sectional study. Diabetes, metabolic syndrome and obesity: targets and therapy. 2020;13:2605.

3. Malik, S., Basit, R., Naz, S., Mawani, M., Masood, M.Q. and Akhter, J. (2016) Adherence to Lifestyle Advice and Treatments in Pakistani Patients with Type 2 Diabetes Mellitus. Journal of Diabetes Mellitus, 6, 49-57.

4. Shrivastava S, Shrivastava PS, Ramasamy J. Role of self-care in management of Diabetes mellitus. J Diabetes Metab Disord 2013;12:14.

5. Association AD. Standards of Med Care in Diabetes; 2017.

6. Association AD. Nutrition recommendations and interventions for Diabetes:a position statement of the American Diabetes Association. Diab Care. 2008;31(Supplement 1):S61–78. doi:10.2337/dc08-S061

7. Vijan S, Stuart NS, Fitzgerald JT, et al. Barriers to following dietary recommendations in type 2 diabetes. Diabet Med. 2005;22:32–38.

8. Nagelkerk J, Reick K, Meengs L. Perceived barriers and effective strategies to Diabetes self-management. J Adv Nurs. 2006;54:151–158.

9. Glasgow RE. A practical model of diabetes management and education. Diab Care. 1995;18:117–126.

10. Cox DJ, Gonder-Frederick L. Major developments in behavioral diabetes research. J Consult Clin Psychol. 1992;60:628. doi:10.1037/0022-006X.60.4.628

11. Ayele AA, Emiru YK, Truneh SA, Ayele BA, Gebremarium AD, Tegegn H. Clinical Diabetes and Endocrinology, adherence to the dietary recommendation and barriers among type 2 DM patients: A cross-sectional study in an Ethiopian Hospital. BMC. 2018;4(21):Page 3 of 7.

12. Broadbent E, Donkin L, Stroh JC. Illness and treatment perceptions are associated with adherence to medications, diet, and exercise in diabetic patients. Diabetes Care. 2011;34(2):338–340.

13. Resnick HE, Foster GL, Bardsley J, Ratner RE. Achievement of American Diabetes Association clinical practice recommendations among US adults with Diabetes, 1999–2002 the National Health and nutrition examination survey. Diabetes Care. 2006;29(3):531–537.

14. Khattab M, Khader Y, Khawaldeh A, Ajlouni K. Factors associated with poor glycemic control among patients with type 2 diabetes. J Diabetes Complicat. 2010;24(2):84–89.

15. Worku A, Mekonnen Abebe S, Wassie MM. Dietary practice and associated factors among type 2 diabetic patients: a cross sectional hospital based study, Addis Ababa, Ethiopia. SpringerPlus. 2015 Dec;4(1):1-8.

16. Bai RR, Kumari R. Perceived Dietary Adherence and its Barriers to Dietary Recommendations among Type 2 Diabetes Mellitus Patients. Innov J Nurs Healthc. 2020;6(3):1-5.

17. Raj GD, Hashemi Z, Contreras DC, Babwik S, Maxwell D, Bell RC, Chan CB. Adherence to diabetes dietary guidelines assessed using a validated questionnaire predicts glucose control in adults with type 2 diabetes. Canadian Journal of Diabetes. 2018 Feb 1;42(1):78-87.

Ibrar Ahmad et. al
Adherence to Local Diabetic Dietary Guidelines, as Measured by a Validated Questionnaire, Predicts Glucose Management in Patients with Type 2 Diabetes Mellitus

18. Santos FL, Esteves SS, da Costa Pereira A, Yancy WS Jr, Nunes JP. Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors. Obes Rev. 2012;13:1048–1066

19. D- e- shahwar, Altaf KF, Noushad S, Ahmed S. Nutritional Stress as an adverse effect of anti-diabetic medications. IJEHSR. 2016;4(3):48-52.

20. Sami W, Ansari T, Butt NS, Ab Hamid MR. Effect of diet on type 2 diabetes mellitus: A review. International journal of health sciences. 2017 Apr;11(2):65.

21. Imran M, Begum S, Kandhro AH, Ahmed N, Qasim R. The management of glycemic control in associated disorders. IJEHSR.2017;5(2):37-42.

22. Davison KA, Negrato CA, Cobas R, Matheus A, Tannus L, Palma CS, Japiassu L, Carneiro JR, Rodacki M, Zajdenverg L, Araújo NB. Relationship between adherence to diet, glycemic control and cardiovascular risk factors in patients with type 1 diabetes: a nationwide survey in Brazil. Nutrition journal. 2014 Dec;13(1):1-1.

23. Rafique I, Muhammad AN, Murad N, Munir MK, Khan A, Irshad R, Rahat T, Naz S. Adherence to Pakistan dietary guidelines–Findings from major cities of Pakistan. medRxiv. 2020 Jan 1.

24. Demilew YM, Alem AT, Emiru AA. Dietary practice and associated factors among type 2 diabetic patients in Felege Hiwot Regional Referral Hospital, Bahir Dar, Ethiopia. BMC research notes. 2018 Dec;11(1):1-7.