Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Nutritional status, Knowledge and Adherence to Dietary advice in Type-2 Diabetes Mellitus (T2DM) patients at a Tertiary care hospital, Peshawar-A case control study (N-KAD study)

Shumaila Gul
Department of Diabetes & Endocrinology, MTI Hayatabad Medical Complex Peshawar, KP, Pakistan. Email; shumyla.arsh@gmail.com,

Kiran Habib
Department of Diabetes & Endocrinology, MTI Hayatabad Medical Complex Peshawar, KP, Pakistan. Email;, hbkiran890@gmail.com

Kehkashan Akbar
Department of Biochemistry, Abbottabad International Medical College Abbottabad, KP, Pakistan kehkashanakbar@gmail.com

Neelam Zeb
Department of Biotechnology, Women University Mardan, KP, Pakistan. neelamzeb@wumardan.edu.pk

Muhammad Ali
Institute of Biotechnology and Microbiology, Bacha Khan University Charsadda, KP, Pakistan Email: drali@bkuc.edu.pk

Shakoor Wisal (Corresponding Author)
Department of Human Nutrition and Dietetics, Bacha Khan University Charsadda, KP, Pakistan Email; swisal@bkuc.edu.pk

Author Details

Keywords: Nutritional status, BMI, adherence, dietary advice, CHO intake, T2DM

Received on 21 Apr 2026
Accepted on 23 May 2026
Published on 31 May 2026

Corresponding E-mail & Author*:

Shakoor Wisal
Department of Human Nutrition and Dietetics, Bacha Khan University Charsadda, KP, Pakistan Email; swisal@bkuc.edu.pk

Abstract

To develop the association between nutritional status, dietary intakes, knowledge and non-adherence to diet in patients with T2DM and their comparison with age-sex-BMI matched healthy non-diabetic individuals. This was a cross-sectional study with a case-control design. A total of 400 diabetic cases (200 males, 200 females) and 60 controls were selected and interviewed from OPD. Enrollment of cases was consisting of all those having confirmed T2DM either newly diagnosed or old diabetics that was confirmed by fasting blood sugar (FBS) and glycated haemoglobin level (HbA1c). The exclusion criteria for cases were un-well patient, patient with dementia, Alzymers disease, patient with type I diabetes (T1DM), diabetic ketoacidosis (DKA), gestational diabetes mellitus (GDM), myocardial infarction (MI) and carcinoma. The purpose of the study explained and informed consent were obtained. Subjects were selected with age as 55 ± 9 for the cases and 53.2 ± 7 for controls that was statistically non-significant. The most of subjects were from rural areas, illiterate; with large family size. Weight, BMI and WC of

subjects were found to be significantly associated with the diabetic status of individuals. Physical activity was neglected by majority of diabetics. Most of subjects reported to have knowledge about high carb foods. Subjects from both group's preferred refined wheat with increased portions than recommendations and total CHO intake was significantly different among the groups. It was concluded that using brown sugar, refined wheat, saturated type of fat and a total of increased carbohydrate intake with poor knowledge of low to moderate glycemic indexed foods were found to be associated with increased BMI and risk of cardiovascular diseases (CVD), and majority of controls exhibited a tendency towards obesity due to poor dietary adherence.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterized by hyperglycemia resulting from a complete or partial deficiency in insulin secretion and/or insulin action, and its prevalence is increasing at an alarming rate worldwide (Singh, Shadangi, Gupta, & Rana, 2025). If left uncontrolled for a prolonged period, T2DM may lead to severe complications, thereby imposing a substantial social and economic burden on both developed and developing countries(Młynarska et al., 2025). Among developing nations, Pakistan has a considerable burden of diabetes, with a prevalence of 16.98%; among these, females account for 17.85%, which is higher than males, and the disease is more prevalent in rural areas (19%) (Ali, Khalid, Haneef, Iqbal, & Ashraf, 2025). Evidence suggests that diabetes can be prevented and controlled through dietary modifications and lifestyle changes (Espinola, Tobias, & Manson, 2026). Dietary therapy has remained a cornerstone in the management of diabetes since before the discovery of insulin, as it plays a vital role in maintaining optimal blood glucose levels and preventing diabetes-related complications (Arshad et al., 2025).

There is a growing need for large-scale awareness programs to educate diabetic patients regarding dietary modifications and the consequences of long-term non-compliance(Nurkolis et al., 2025). However, due to inadequate consultation with Dietitians and Nutritionists, misconceptions and controversies regarding diabetic diets are common among patients.(Awuchi, Echeta, & Igwe, 2020) Such misunderstandings not only contribute to poor glycemic control but may also lead to unintentional weight loss due to deficiencies in essential macro- and micronutrients (Williamson, Hunt, Pope, & Tolman, 2000). Although low-carbohydrate diets are increasingly recommended, these diets should not be interpreted as no-carbohydrate diets; rather, they may be more appropriately described as no bad carbohydrate diets. Such dietary approaches emphasize the avoidance of refined carbohydrates that adversely affect blood glucose levels. Unfortunately, poor awareness regarding modified diets and inadequate nutritional education among diabetic patients remain major concerns (Petroni et al., 2021).

Adherence or compliance refers to the extent to which an individual's behavior corresponds with medical advice (Mir, 2023). Effective compliance depends on mutual commitment between the patient and the healthcare provider toward shared therapeutic goals. Nevertheless, poor dietary compliance is common among diabetic individuals and is considered a major factor contributing to increased healthcare expenditures (DiMatteo, Martin, & Haskard-Zolnierek, 2025). Several factors influence dietary non-compliance among diabetics, including rapid lifestyle transitions, increased consumption of fast foods, reduced intake of home-cooked meals, and sedentary lifestyles. These factors contribute to obesity at younger ages, which subsequently increases the risk of chronic diseases. Dietary management of T2DM may be improved through the use of low-carbohydrate diets (LCDs), which have recently been supported by various clinical trials due to their beneficial effects on hyperglycemia, lipid profiles, obesity, dyslipidemia, and cardiovascular diseases. Furthermore, LCDs may help reduce the dependence of diabetic patients on oral anti-diabetic medications and insulin therapy. (H. M. Dashti, 2021).

Therefore, the present study focused on identifying carbohydrate-rich foods that should be avoided by diabetic patients. The findings generated through this research will assist healthcare professionals in guiding patients regarding the glycemic index of different foods and will further highlight the importance of effective dietary counseling among patients with T2DM in Khyber Pakhtunkhwa (KPK), Pakistan. This study was designed to evaluate the proportion of dietary non-compliance among individuals with T2DM, identify the factors associated with non-compliance, and compare these findings with age, gender and BMI-matched healthy non-diabetic individuals

MATERIALS AND METHODS

This study was conducted in the Department of Diabetes & Endocrinology, MTI/HMC, Peshawar which consisted of identification, selection, interviewing, anthropometric measurements and dietary intakes from subjects. This was cross-sectional with a case-control design that was carried in out-patients department (OPD) MTI, Hayatabad Medical Complex, Peshawar. A total of 400 type II diabetes patients (200 males, 200 females) was studied along with a feasible appropriate sample (n=60) of age-sex-BMI matched healthy non-diabetic individuals as control. The age range was from 40 to 70 years.

Inclusion and Exclusion Criteria: Enrollment of cases was consisting of all those having confirmed T2DM either newly diagnosed or old diabetics that were confirmed by clinical and laboratory tests including FBS and HbA1c as advised by the Endocrinologist. The exclusion criteria for cases were any diseased patient who has any disease like dementia, Alzheimer's disease, T1DM, DKA, GDM, current MI and carcinoma.

Informed Consent: The purpose of the study explained to all subjects and informed consent were obtained from the subjects to enroll for the study.

Medical History and anthropometry: Medical history with family history, subjects were interviewed and documented in the questionnaire. Medical test results i.e., hemoglobin (g/dl), total cholesterol (mg/dl), triglycerides (mg/dl), high density lipoproteins (HDL) mg/dl, low density lipoproteins-(LDL) mg/dl, and creatinine (mg/dl) levels were recorded in the questionnaire. Anthropometric measurements including waist circumference (WC) and body mass indexes (BMI) of subjects were taken by following the recommended WHO standard procedures, recorded and classified into categories by applying the WHO cut-off values (WHO. Expert Committee, 1995) (WHO. Expert Committee, 1997).

Socio-demographic, Dietary & Nutritional status Assessment: The demographic and socio-economic status of the enrolled subjects was collected by interviewing them and recorded. For dietary assessment a 24-hour dietary recall questionnaire and Food frequency questionnaire (FFQ) were filled from subjects, from which calculated their carbohydrate intake per day in grams and frequency of low carbohydrate foods, moderate carbohydrate foods and high carbohydrate foods. For data entry and error checking, a program was established at the beginning of the study. The analysis of all data were performed by using computer program, Microsoft excel software. The statistical analysis included frequencies, mean, p-value (<0.005) and 95% confidence interval (CI) that were generated by using Chi^2 (α^2) test and student t-test.

RESULTS

In the sample of n= 400 male and female were 50/50% and the mean age was 55 ± 9 for the cases and 53.2 ± 7 for controls; most of subjects were from rural areas. Family size for most of subjects were above 6 family members that is 44% cases and 41.6% controls ($p<0.05$). Illiteracy was seemed to be present among 71.75% of cases and 68.33% of controls. The difference between occupation and income of the respondents was statistically non-significant among cases and controls ($p>0.05$) as shown in Table 1. Data on anthropometrics was analyzed using descriptive statistics and independent sample t-test. Weight (kg) of the respondents was found to be significantly associated with the diabetic status of individuals revealing a lower weight

among controls as compared to cases. BMI was found to be significantly associated with disease status. In addition, waist circumference (cm) also showed a statistically significant association with disease status of the respondents. Fasting blood sugar was found to be quite high among the cases while it showed an understandably ideal value for controls. In addition, HbA1c scores were also high among diabetic subjects (10.85 ± 2.38) as compared to controls (4.7 ± 0.42).

Table 1: Socio-demographic characteristics of respondents

Variable	Category	Group		P Value
		Case	Contr	
Gender	Female	200	30	-
	Male	200	30	
Age	-	55 ±	53.2 ±	0.
Locality	Rural	282	47	0.
	Urban	118	13	38
Marital status	Married	362	52	0.
	Single	6	8	65
	Widowed	32	0	
Family size	<3	95	17(28.	0.
	4 to 6	129	18	17
	>6	176	25	
Education	Illiterate	287	41	0.
	Secondary	82	12	24
	FA/FSC	14	2	
	Bachelor	8	3	
	Masters	4	2	
	M. Phil.	3	0	
	Ph. D.	2	0	
Occupation	Unemploye	99	5	0.
	Labor/Drive	59	15	51
	Office work	14	11	
	Professional	6	2	
	Retired	20	0	
	House wife	185	26	
	Business	15	1	
	Teacher	2	0	
Income (PKR/Month)	<10000	37	6	0.
	10000-	225	27	22
	>20000	138	27	

Both the parameters of blood sugar including FBS and HbA1c were significantly associated with the diabetic status of study respondents ($p>0.01$). Among the lipid profile, cholesterol and LDL were found to be non-significantly different among cases and controls. Serum TGL and HDL were found to be significantly different among both study groups and were found to be associated with the diabetic status of individuals ($p<0.01$). Mean scores recorded for TGL were raised for cases than for controls (Table 2). Serum Hb levels were also found to be significantly different among the two groups with controls having a greater mean score as compared to Hb levels of cases. Serum creatinine values were 1.39 ± 1.00 mg/dl and 0.84 ± 0.18 mg/dl for cases and controls, respectively and were found to be significantly associated with the diabetic status of individuals.

Knowledge of subjects regarding different glycemic effects of food items was assessed with a total of 98% cases and 95% controls reporting to have knowledge about high carb foods. This proportion of knowledge about glycemic index declined when

asked about medium and low carbs food (Figure 1). Most of the cases (58.25%) used brown sugar followed by 30% cases who had given up on the use of any form of sugar. Control respondents had a major (88%) use of table sugar instead of brown sugar. The type of sugar used was significantly different with the diabetic status of individuals (Table 3). 59.25% cases reported to be taking sugar foods once per week while 36.67% controls reported the same frequency of sugar foods. The intake of sugar drinks was also found to be significantly associated with diabetic status of study respondents with 62.5% cases and 55% reported to had given up on sugar containing drinks ($p<0.05$).

Table 2: Anthropometric and biochemical assessment

Variable	Case	Contro	P
Weight (kg)	75.75 ±	72.72 ±	0.01
Height (cm)	163.52 ±	166.26	0.00
BMI	28.41 ±	26.36 ±	0.00
Waist	102.5 ±	97.49 ±	0.00
FBS (mg/dl)	229.13 ±	92.58 ±	0.00
HbA1c (%)	10.85 ±	4.7 ±	0.00
Cholesterol (mg/dl)	160.19 ±	146.72	0.05
Triglycerides	230.61 ±	117.82	0.00
HDL (mg/dl)	33.1 ±	54.05 ±	0.00
LDL (mg/dl)	83.84 ±	90.4 ±	0.24
Hemoglobin (g/dl)	11.46 ±	12.39 ±	0.01
Creatinine (mg/dl)	1.39 ± 1.00	0.84 ±	0.00

Type of fats and wheat intake as well as the portion of wheat and total carbohydrates intake per day revealed fat intake to be non-significantly associated with the diabetic status of study respondents with 94% cases and 100% controls taking fat once or twice a day ($p>0.05$). Fat type consumption was statistically different between the groups with most of the cases (88.75%) as well as controls (63.33%) reported to be taking saturated fats (ghee).

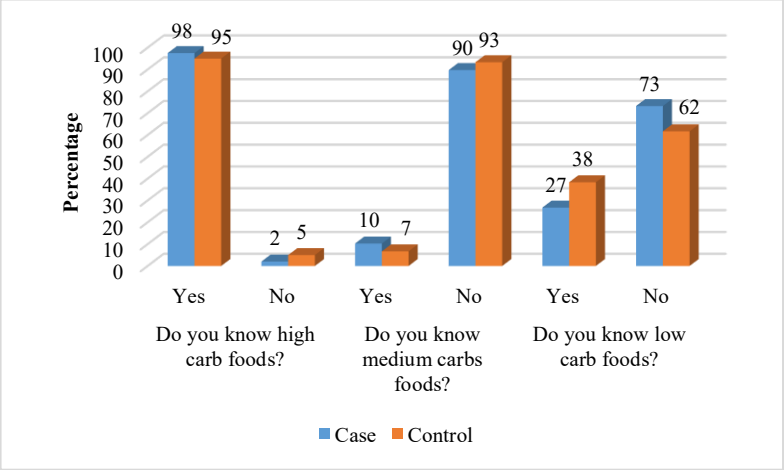

Figure 1: Knowledge about glycemic index

Although the consumption of unsaturated fats (oil) was little among cases (11.25%) controls showed a greater consumption (36.67%) of oil. Most of the respondents from both groups preferred refined wheat as compared to whole wheat flour (Table 4). Portions of wheat and total CHO intake was significantly different among the groups with mean scores of 185.15 ± 78.96 (g/meal) and 378.06 ± 75.99 (g/day) for cases while 176.5 ± 62.43 (g/meal) and 373.53 ± 34.72 (g/day) for controls; for wheat portions and total CHO, respectively. Cases showed an overall greater

consumption of wheat portions as well as total CHO as compared to controls (Table 4). All of this available data revealed a complete non-adherence among study participants especially cases. The possible reasons for this can be the lack of sufficient education among them as most of the cases as well as controls were illiterate. In addition, trend of dietary consultation was close to none among the respondents due to the unawareness of the nutrition sciences and the presence of dietitians. As per our objectives, the dietary non-adherence was to be compared with dietary adherence but due to the lack of dietary adherence among the study respondents, a generalized comparison was made between the cases and controls.

DISCUSSION

Low socioeconomic status (SES), primarily measured through income, occupation, and educational level, has been identified as an independent risk factor for T2DM (Tatulashvili, Fagherazzi, Dow, Cohen, Fosse, & Bihan, 2020). However, in the current study, no significant association was observed between socio-demographic characteristics and diabetic status among the participants. In contrast, anthropometric indicators showed a significant association with

Table 3: Sugar type, frequency and sugary foods consumption

Variable	Category	Group		P Value
		Case	Contr	
Use of sugar in tea	Table	48	53	0.00
	Brown	233	7	
	None	119	0	
Frequency of sugar	Never	123	0	0.00
	1	123	5	
	2-4	68	16	
	5-6	36	21	
	1-2	48	17	
	>3	2	1	
Sugar food intake	Never	146	29	0.49
	1	237	22	
	2-4	13	9	
	5-6	0 (0%)	0	
	1-2	4 (1%)	0	
	>3	0 (0%)	0	
Sugar drinks	Never	250	33	0.04
	1	141	17	
	2-4	6	8	
	5-6	1	1	
	1-2	1	1	
	>3	1	0	

Table 4: Intake of different food types, wheat portion and total CHO

Variable	Category			P Value
		Case	Con	
Fat	Nev	0	0	0.42
	1	1	0	
	2-4	2	0	
	5-6	4	0	
	1-2	376	60	
	>3	17	0	
Fat type	Oil	45	22	0.00
	Ghe	355	38	

Wheat	Refi	316	38	
	Who	84	22	0.27
Portion of wheat	-	185.	176.	
Total	-	378.	373.	

T2DM, as cases had a greater prevalence of increased BMI compared to controls. These findings highlight the important role of nutritional status and obesity in the progression and management of T2DM. Diabetes-related complications were also prevalent among the study population and may negatively affect quality of life and dietary adherence. Previous studies reported diabetic retinopathy among 57 out of 302 respondents (Tatulashvili, Fagherazzi, Dow, Cohen, Fosse, & Bihan, 2020) and diabetic foot syndrome among 32 out of 230 individuals (Ferm, DeSalvo, Prichett, Sickler, Wolf, & Channa, 2021). Similar observations in the present study indicate that prolonged and uncontrolled diabetes contributes to multiple health complications, further complicating disease management.

Dietary knowledge, particularly regarding glycemic index (GI), plays a crucial role in diabetes control. Diets composed of carbohydrates (CHO) with a low GI are considered beneficial in glycemic management; however, awareness regarding GI among the general population remains limited (Hodge, English, O'Dea, & Giles, 2004). In the present study, inadequate dietary knowledge among diabetic patients may have contributed to poor dietary practices and suboptimal glycemic control. Although most participants had been diagnosed with diabetes for more than one year, the intake of white sugar was comparatively low, reflecting some level of dietary modification and adherence to medical advice.

Despite reduced white sugar consumption, the use of brown sugar was common among study participants. Brown sugar, which is unprocessed or partially refined and contains minimal nutritional value and low mineral content, is often perceived as a healthier alternative to table sugar, even among diabetic individuals (Rab, 2018). This misconception may negatively influence dietary adherence and glycemic management. Furthermore, the frequent consumption of sugary foods and beverages observed among the participants may also contribute to uncontrolled diabetes. Supporting this finding, (Datta & Husain, 2020) reported that a substantial proportion of household expenditure in Pakistan is spent on sugar-sweetened beverages. These findings collectively indicate poor adherence to dietary recommendations among T2DM patients.

The consumption of edible ghee and oil, which are major components of traditional Pakistani cuisine, was also high among the cases in the present study (Pervaiz et al., 2022). Epidemiological evidence suggests that saturated fat intake is associated with insulin resistance and hyperinsulinemia (Maeng, 2025). Therefore, the higher intake of saturated fat-rich foods, particularly ghee, among diabetic cases may be associated with poor glycemic control and adverse nutritional status.

Wheat consumption was another important dietary pattern identified in this study. The high expenditure on wheat products and the daily intake of wheat portions among participants support previous findings that wheat is a staple food across all socioeconomic classes in Pakistan (Haider & Zaidi, 2017). Moreover, the predominant use of refined flour among the study population may contribute to weight gain and obesity. Previous literature has shown that higher whole grain intake is associated with better weight management, whereas refined grain consumption is linked with increased weight gain. These findings suggest that poor dietary choices, inadequate nutritional knowledge, and low adherence to dietary advice collectively contribute to unfavorable nutritional status and poor diabetes management among T2DM patients.

Conclusion

The findings of the study demonstrated that poor dietary practices, excessive

carbohydrate consumption, preference for refined wheat products, intake of saturated fats, and inadequate knowledge regarding low- to moderate-glycemic index foods were significantly associated with poor nutritional status and increased risk of obesity and cardiovascular diseases among patients with type 2 diabetes mellitus (T2DM). Anthropometric indicators such as BMI and waist circumference were strongly linked with diabetic status, while lack of physical activity further contributed to poor disease management. Although many participants possessed basic knowledge about high-carbohydrate foods, adherence to recommended dietary practices remained inadequate. The study also highlighted that even healthy controls showed a tendency toward overweight and obesity due to unhealthy dietary behaviors, emphasizing the growing burden of poor lifestyle practices in the general population.

RECOMMENDATIONS

It is recommended that comprehensive nutrition education and counseling programs should be implemented for patients with T2DM to improve dietary adherence and awareness regarding balanced meal planning, portion control, glycemic index foods, and healthy fat choices. Healthcare professionals should encourage the replacement of refined wheat products and saturated fats with whole grains, fiber-rich foods, and healthier unsaturated fats to improve glycemic control and reduce cardiovascular risk. Regular physical activity and lifestyle modification interventions should also be promoted as essential components of diabetes management. In addition, community-based awareness campaigns targeting both diabetic and non-diabetic populations are needed to prevent obesity and related metabolic disorders through healthier dietary and lifestyle practices.

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