Exploring treatment awareness and adherence among type 2 diabetes patients in Lahore, Pakistan

A Akhtar,[1] A Azhar,[2] OU Shirazi,[2] I Aslam,[3] K Fatima,[2] H Fatima,[2] A Masood,[4] H Maryam,[2] M Nawaz,[2] G Razaque,[5] A Sajjad,[2] F Musfeera[2]

[1] Faculty of Pharmaceutical Sciences, University of Central Punjab (UCP), Pakistan

[2] Riphah Institute of Pharmaceutical Sciences, Riphah International University, Lahore, Pakistan

[3] Alliant College of Professional Studies, Lahore, Pakistan

[4] Forman Christian College, Lahore, Pakistan

[5] Department of Pharmacy, University of Balochistan, Pakistan

Corresponding author, email: aliakhtar5657@gmail.com

Aim: In this study, patients with type 2 diabetes in Lahore, Pakistan had their medication knowledge and adherence assessed. Knowledge of diabetes and demographic information were also assessed.

Methods: A face-to-face interview provided a structured questionnaire with four sections as part of a cross-sectional study.

Results: Four hundred and two (402) patients in total, participated in the survey/questionnaire. Most participants (259, 64.4%) were between 40–60 years old. Results indicated that study participants were taking an average of 1.91 ± 1.00 drugs overall, and 1.72 ± 0.58 medications specifically for diabetes. Most individuals (171, 42.5%) were on oral antidiabetic drugs only. A strong correlation was found between diabetes awareness, education level, and the total number of drugs taken. On the other hand, the mean score (2.20 ± 1.17) for pharmaceutical knowledge on the questionnaire was less than the desired level of knowledge. Gender, family history, and the total number of medications used have all been strongly correlated with medication knowledge. Current findings didn't show any connection between medication knowledge, adherence, and diabetes understanding.

Conclusions: Regarding Lahore, Pakistan's type 2 diabetes patients, this study sheds light on their understanding of the condition and the drugs they take. While the factors show no significant differences, the rate of non-adherence remains concerning. It will take further research to fully comprehend the reasons behind these patients' non-adherence.

Keywords: T2D, IDF, IGT, diabetes prevalence, Pakistan, medication adherence, medication knowledge, glycaemic control, HbA1c

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Introduction

Insulin resistance in tissues, coupled with inadequate insulin production, leads to elevated blood glucose levels in people with type 2 diabetes mellitus (T2DM), a common metabolic disease.[1] According to the World Health Organization's (WHO) Global Report on Diabetes, the number of diabetics has tripled since 1980 to 422 million and is expected to increase to 693 million by 2045.[2,3] Inadequate management of diabetes may lead to several complications including renal disease (nephropathy), neuropathy, retinopathy, lower-extremity amputation and cardiovascular disease (including myocardial infarction and stroke), leading to a significantly increased risk of morbidity and mortality amongst diabetics. Although there is no known treatment for type 2 diabetes, lifestyle changes, medicine, and insulin therapy can help control blood glucose levels and avert related health problems. This distinguishes T2DM from type 1 diabetes mellitus (T1DM) and gestational diabetes by a progressive reduction in β-cell insulin production in conjunction with insulin resistance, unlike T1DM and gestational diabetes.[2] High-calorie meals, sedentary lifestyles, obesity rates, and an aging population are some of the factors that are contributing to the rising prevalence of type 2 diabetes.[4,5] The emergence of type 2 diabetes (T2DM) is influenced by a combination of environmental and genetic factors, including childhood growth patterns, gut flora, age, obesity, physical inactivity, and lifestyle choices.[1,2,6,7]

Millions of people worldwide suffer from T2DM, making it an alarmingly common condition. In the upcoming years it is anticipated that the disease burden will increase significantly.[2] A multifunctional strategy involving medicine, lifestyle changes, and blood glucose monitoring is necessary for the effective management of type 2 diabetes. A balanced diet and regular exercise are two examples of lifestyle changes that are essential for treating type 2 diabetes and lowering the risk of complications.[8] Furthermore, addressing modifiable risk factors can aid in lowering the incidence and progression of type 2 diabetes, including obesity, physical inactivity, and poor dietary habits. To manage type 2 diabetes and avoid complications, early diagnosis and intervention are crucial. Screening for obesity, sedentary lifestyle, and family history are among the risk factors for type 2 diabetes that can help with early diagnosis and timely treatment initiation. The oral glucose tolerance test (OGTT) and fasting plasma glucose (FPG) are easily accessible tests for the detection and diagnosis of diabetes. Two high readings of FPG > 7.0 mmol/L (126 mg/dL) or OGTT plasma glucose ≥ 11.1 mmol/L (200 mg/dL) after two hours are required, according to WHO and ADA criteria. Levels of glycated haemoglobin (HbA1c) are another tool for monitoring. The International Expert Committee (IEC) suggested eliminating "pre-diabetes" and replacing it with HbA1c ≥ 6.5% in the diagnostic criteria.[8] Prioritising specificity above the normality range of

HbA1c in the diagnosis of diabetes allows for a balance between potential misdiagnosis and clinical impact. Maintaining a body mass index (BMI) of 25 kg/m^2, eating a high-fibre, low-saturated-fat diet with a low glycaemic index, exercising frequently, giving up smoking, and consuming modest amounts of alcohol are all part of managing type 2 diabetes. Personalised lifestyle advice that takes into account each person's modification in lifestyle is essential since it can avert the majority of type 2 diabetes cases.[8] Non-insulin antidiabetics include, amongst others, the following: metformin (biguanide), gliclazide (sulfonylurea), pioglitazone (thiazolidinedione), sitagliptin (DPP-4 inhibitor), liraglutide (GLP1-agonist) and empagliflozin (SGLT2-inhibitor). Distinct processes are employed by each class to regulate their blood glucose levels.[8-10] Even though combination therapy can cause problems such as side effects, toxicity, and decreased compliance, it is frequently required for effective management. Better efficacy and safety profiles for the management of type 2 diabetes may come from the development of new drugs with multiple targets or from the co-formulation of current ones.[7,8]

It has been shown that having a solid understanding of medications positively correlates with improving treatment adherence, quality of life, and pharmacotherapy outcomes. For this reason, it is essential to treat diseases and reduce the incidence of adverse medication responses.[11] Appropriate patient education is one of the requirements for a patient's participation in decreasing medication errors. Despite this, more research is needed to evaluate hospital patients' awareness of their medications.[12] Polypharmacy affects a lot of outpatients, which raises the risk of additional health problems like drug interactions and potential toxicity.[13]

The information that patients need to know to use their drugs correctly is referred to as their knowledge of their medications. This also includes the therapeutic goal, dosage, timing of administration, safety considerations, storage methods, as well as potential interactions and side effects.[14] Inadequate patient medication knowledge can lead to unpleasant drug reactions, the development of new health problems, medication abuse, and a decline in the effectiveness of prescribed drugs.[15] Because adverse medication reactions are so common, they are regarded as a major public health concern. To investigate the previously highlighted concerns in more detail, the goals of this study were to assess T2DM patients' medication understanding and adherence. The association between drug awareness and adherence was another goal of this investigation.

Methods

Study design and settings

Using a cross-sectional study design, the project was carried out from October 10, 2023 to December 1, 2023. In-person questions using a researcher-administered questionnaire were used to collect data. Individuals who met the requirements for inclusion were interviewed. Jinnah Hospital in Lahore served as the site of the data collection. For this research, 404 participants were interviewed. However, inadequate details led to the discarding of data from two subjects. Thus, this study comprised the data from 402 participants.

Sample size

Those patients who fulfilled the inclusion criteria were asked to participate in this investigation. The patients were those collecting their prescriptions from the outpatient pharmacy and those going to their appointments at the diabetic clinic while waiting for their appointments with the doctor at the diabetic care centres. The sample size was determined using Daniel, 1999.[16]

Ethical approval

The medical superintendent of each institute approved the study to be carried out. Before any data was collected, a variety of approaches were used to increase the validity of the findings and decrease misrepresentation and misunderstanding.

Personal information was never requested from patients, including residential addresses, national codes, first and second names, or any other information that could compromise their privacy. The study's research aims, response confidentiality, and the patients' opportunity to withdraw from the trial without consequence or impact on their care were all explained to the patients.

Inclusion and exclusion criteria

To make it possible for patients with type 2 diabetes to become familiar with the challenges and opportunities related to managing their diabetes on their own, the following requirements had to be adhered to: 1. the patient had to be a Pakistani national aged < 40 or older; 2. they had to be willing to participate in an interview in Urdu within the hospital premises; and 3. they had to have had a T2DM diagnosis for at least half a year. Patients with type 1 diabetes mellitus and those using anti-diabetic medications for purposes other than diabetes, patients with cognitive impairments like dementia, or were pregnant, and had other types of diabetes were excluded from consideration.

Statistical analysis

IBM SPSS 20 version was used to analyse the gathered data. Descriptive statistics were used to describe the clinical and demographic characteristics. The responses to categorical variables were shown using frequency counts and percentages. The relationship between the demographic factors and medication knowledge as well as the relationship between medication knowledge and medication adherence were examined using a Pearson correlation test. A significant threshold of $p < 0.05$ was established.

Questionnaire and score measurement

An expert in language translation translated the English questionnaire into Urdu, and then the questionnaire was translated back into English for precision and clarity. The survey was divided into four parts. Questions analysing the sociodemographic

characteristics and clinical status of patients were included in the first segment. By employing the Diabetes Knowledge Questionnaire (DKQ) created by Garcia et al., the second portion evaluated the patients' knowledge of diabetes.[17] There were 24 situations in the tool, and there were three possible answers: "yes," "no," and "I don't know." One point was given for a correct response, while zero points were given for an erroneous response ("I don't know" is regarded as incorrect). The total points granted to each patient were averaged to determine their overall score, with 0 and 24 serving as the minimum and maximum scores, respectively. A higher score denoted a greater understanding of diabetes. The questionnaire developed by McPherson et al. and Okuyan et al. was adopted in the study by G Mekonnen and D Gelayee, and was used in the third section to gauge the patient's understanding of their anti-diabetic drugs.[17,18] There were seven verified yes/no questions in this area. The number of right answers determined the overall drug knowledge score; one point was awarded for each right answer, and zero for any erroneous or omitted responses. Each participant received an extra point for accurately answering question 2 in the section by stating the precise mechanism of their drug. Thus, an 8 was the maximum score for this segment, and a 0 was the lowest. A score of ≥ 5 indicated a high level of expertise. Using a technique developed by specialists for a study conducted by Arifulla M et al., the fourth component assessed a patient's adherence to their pharmaceutical regimen.[19] Questions about adherence and related issues were included in this section. A yes-or-no question was used to report medication adherence.

Results

Demographic data

Table I presents the demographic features of all 402 participants who contributed data to the study. At that time, the individuals' average total number of drugs taken was 1.91 ± 1.00 (95% CI: 0.81, 1.01). The average amount of anti-diabetic drugs used by the subjects was 2.19 ± 0.790 (95% CI: 0.11, 0.27). For their antidiabetic regimen, the majority of patients (171, 41.5%) were exclusively using oral anti-diabetic drugs.

Diabetes knowledge questionnaire

Table II lists the scores that each participant received for their answers. The majority of participants answered questions 1, 2, 3, 4, 7, 10, 11, 12, 13, 14, 21 and 21 incorrectly. Regarding question 1, 104 (25.9%) participants believed that overeating sugar and sweet food could cause diabetes. Similarly (180, 44.8%) did not know that diabetes is usually caused by the body failing to produce enough insulin. Many participants (53, 13.2%) believed that the kidneys' inability to filter sugar out of the urine was the cause of diabetes; 152 (37.8%) participants did not know that the kidneys are the main organs for insulin production. Nearly equal numbers of participants (139, 34.6%) thought that diabetes could be cured provided they followed their medication regimen and led a healthy lifestyle. A small number of candidates (91, 22.6%) thought that with frequent physical activity, the need for insulin and other diabetic drugs would increase.

Table I: Sociodemographic details of participants (n = 402)

Details	*n* (%)
Age (year)	
< 40	60 (14.9)
40–60	259 (64.4)
> 60	83 (20.6)
Gender	
Male	174 (43.3)
Female	228 (56.7)
Education level	
No formal education	131 (32.6)
Primary school	93 (23.1)
Secondary school	69 (17.2)
Higher education	109 (27.1)
Occupation	
Retired	31 (7.7)
Unemployed	155 (38.6)
Private sector	52 (12.9)
Government sector	75 (18.7)
Self-employed	72 (17.9)
Student	17 (4.2)
Family history	
Yes	296 (73.6)
No	93 (23.1)
Not sure	13 (3.2)
Duration since diagnosed with T2DM	
6–11 months	48 (11.9)
1–4 years	131 (32.6)
5–9 years	110 (27.4)
> 10 years	113 (28.1)
Participants' anti-diabetic therapy	
Insulin only	94 (23.4)
Insulin combined with oral medication	137 (34.1)
Oral medication only	171 (42.5)

A notable percentage (155, 38.6%) did not know the two subtypes of insulin. Many participants (89, 22.1%) did not know that overindulgence in meals could set off an insulin reaction that leads to dangerously low blood sugar levels. About 135 (33.6%) candidates believed that for the management of diabetes, medication is more important than diet and exercise. Remarkably 75 (18.7%) participants were unaware that diabetes is associated with poor circulation. Most respondents (85, 21.1%) incorrectly associated sweating and shaking with signs of hypoglycaemia, while 123 (30.6%) were unsure or uninformed that frequent urination and thirst were indicators of hyperglycaemia. The average score on the DKQ is 11.10, with a standard deviation of 2.952. The DKQ has a maximum score of 24, with 0 being the minimum. A higher DKQ score is indicative of a better understanding of the disease. Figure 1 reveals a middle skew in the distribution, indicating that a larger proportion of participants scored below

Table II: Number of participants with correct answers to the questions in the diabetes knowledge questionnaire

Questions	*n* (%)
1. Diabetes is a result of excessive sugar and sweet food consumption.	104 (25.2)
2. Ineffective insulin in the body is typically the root cause of diabetes.	180 (44.8)
3. The inability of the kidneys to filter sugar from the urine is the root cause of diabetes.	53 (13.2)
4. Kidneys make insulin.	152 (37.8)
5. Blood sugar levels typically rise in diabetes if left untreated.	315 (78.4)
6. There is a greater probability that my children will develop diabetes if I do.	299 (74.4)
7. Curing diabetes is possible.	139 (34.6)
8. A blood sugar level of 11.7 mmol/L at fasting is excessive (11.7 mmol/L is equal to 210.6 mg/dL.)	240 (59.7)
9. Testing my urine is the best way to determine whether I have diabetes.	84 (20.9)
10. The demand for insulin or other diabetic medications will rise with regular activity.	91 (22.6)
11. Insulin-dependent type 1 and non-insulin-dependent type 2 diabetes are the two primary subtypes	155 (38.6)
12. Too much food can trigger an insulin response, which results in severe hypoglycaemia.	89 (22.1)
13. Medication is more crucial for managing diabetes than food and exercise.	135 (33.6)
14. Poor circulation is frequently a symptom of diabetes.	75 (18.7)
15. Diabetics have a slower rate of wound healing.	354 (88.1)
16. Diabetics should exercise special caution when trimming their toenails.	357 (89.0)
17. A cut should be cleaned with iodine and alcohol if you have diabetes.	334 (83.1)
18. The foods I eat and how I prepare them are crucial.	282 (70.1)
19. My kidneys may suffer from diabetes.	346 (86.1)
20. Diabetics may lack sensation in their hands, fingers, and feet.	350 (87.1)
21. High blood sugar levels might cause trembling and perspiration.	85 (21.1)
22. Low blood sugar is indicated by frequent urination and extreme thirst.	123 (30.6)
23. Diabetics can wear tight elastic hoses or stockings without harm.	254 (63.2)
24. Special foods are a large part of a diabetic diet.	369 (91.8)

the mean. This suggests a notable number of participants with an average level of knowledge regarding diabetes.

Medication knowledge

Most of the subjects could not identify the anti-diabetic drugs they were taking (291, 72.4%). A somewhat moderate proportion of the subjects (254, 63.2%) were unaware of the purpose of their anti-diabetic drugs. Most individuals demonstrated correct administration of anti-diabetic drugs (369, 91.8%), including dosage, frequency, and mode of administration. Nearly every participant knew when to take their anti-diabetic drugs (301,

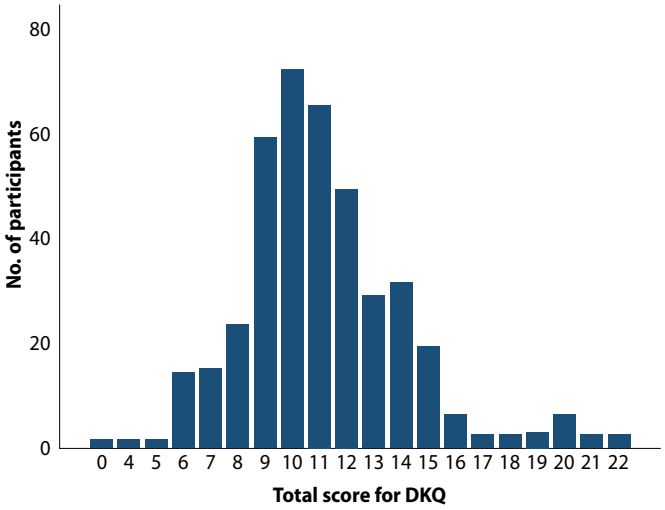

Figure 1: Distribution of participants and overall diabetes knowledge questionnaire scores

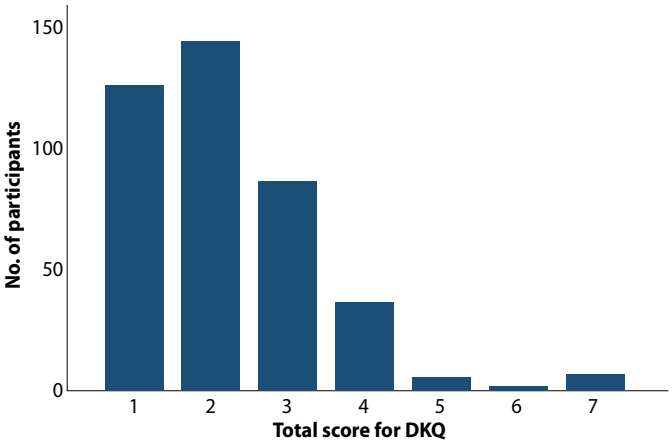

Figure 2: Distribution of participants and overall medication knowledge questionnaire scores

74.9%). However, the research revealed that the subjects were unaware of any potentially negative effects from the anti-diabetic drugs they were taking (305, 75.9%).

Unfortunately, more than 50% of the individuals were unaware of what to do if they had any adverse consequences (308, 76.6%). Although the question "Do you know what to do if you miss a dose of your medication(s)?" was not part of the scoring system for medication knowledge, it was found that 295 people (73.4%) were unaware of what to do in such a situation. On the medication knowledge questionnaire, a maximum score of seven and a minimum score of zero were possible. This questionnaire had a mean score of 2.20 (SD = 1.169) and Figure 2 displays the distribution of pharmaceutical knowledge.

Medication adherence

Few participants (107, 26.0%) admitted to having skipped their anti-diabetic medication dosages for various reasons. Lack of knowledge was cited by non-adherent individuals (57, 14.2%). A small number of them (9, 2.2%) said that their non-adherence was due to side effects. In addition, several gave reasons other than those stated in the questionnaire, such as having no medication

on hand at home, not taking medication or cutting back on dosage when feeling better, having a hectic schedule, not wanting to rely on medication, and bitter taste. The majority of individuals (372, 92.5%) did not routinely check their blood glucose levels. Some suggested that the single-use needles' high cost was the cause of this. Several participants (207, 51.5%) stated that they understood the significance of taking their anti-diabetic drugs. Some of the participants said that their doctor did not offer them information about diabetes; instead, they received it from their nutritionist and/or nurses. But over half said their doctor had not provided them with information about their anti-diabetic drugs (197, 49%).

This is because the doctor did not provide them with any additional information on their drugs, instead informing them that the pharmacists and/or dispensers would advise them regarding their medications. The majority of participants (239, 59.5%) did not participate in choosing their course of treatment. For individuals who participated in the decision-making process, the primary focus was on starting insulin therapy. It was up to the participants to decide whether or not they were willing to begin taking insulin. Regarding their medical issues and/or prescription drugs, nearly all participants (357, 88.8%) said they felt at ease asking their doctors questions. This study set out to assess the associations between medication adherence, medicine knowledge, diabetes knowledge, and demographic characteristics. Table III displays the measurement and tabulation of their correlation.

Table III: The significant relationship between the variables

	p-value and CI	Correlation coefficient
Diabetes knowledge with:		
Education level	< 0.05 (95% CI: 0.021, 0.305)	0.163
Family history	> 0.05 (95% CI: -0.24, 0.584)	0.190
Total medications taken	< 0.05 (95% CI: -0.382, -0.046)	-0.214
Medication knowledge with:		
Gender	< 0.05 (95% CI: 0.080, 0.388)	0.234
Family history	< 0.05 (95% CI: -0.391, -0.014)	-0.211
Total medications taken	< 0.05 (95% CI: -0.207, 0.010)	-0.109

Discussion

The study aimed to determine the Lahore, Pakistan T2DM patients' medication knowledge and adherence to their anti-diabetic regimens. With a prevalence of 6.9%, diabetes mellitus ranks as the 10th most common cause of death in Lahore, Pakistan. Given the prevalence of diabetes in Lahore, Pakistan, ensuring patients' adherence to anti-diabetic medication is one of the steps performed to reduce their exposure to unintended complications of diabetes.[20] For the diabetes knowledge questionnaire, a majority of the participants thought that excessive sugar intake could result in diabetes (262, 63.6%). Albeit the fact that consuming sweets can raise the blood glucose level, diabetes is a metabolic disorder in which severe hyperglycaemia is one of its markers.[21] This question's ambiguity can be the cause of the misunderstanding. A higher chance of developing type 2 diabetes has been linked to changes in lifestyle. As a result, participants may have misinterpreted the idea that consuming sweets in excess causes diabetes.[22]

Additionally, participants indicated that they believed the kidneys had a significant involvement in the development of diabetes. This misperception may arise from the fact that renal disease is a frequent yet serious complication among type 2 diabetics.[23] Participants could not tell whether urine testing was the most effective method of diagnosing diabetes (84, 20.9%). This might be because some participants said they could not tell how high their blood sugar was by looking at their urine when they went to the bathroom; as foamy urine is a sign of elevated blood sugar.[24] Several participants (30.6% and 21.1%, respectively) felt confused by the indications of hypoglycaemia and hyperglycaemia. Patients with diabetes should be aware of the symptoms of hypo- and hyperglycaemia since this will help them make safe and informed decisions, such as taking their medication or eating more sweets.[25]

Using the Starr County Diabetes Knowledge Questionnaire in Urdu, a cross-sectional study was carried out in one of the health centres in Pakistan. As per the study, there was no significant correlation ($p < 0.05$) between the participants' diabetes awareness and their gender, education level, family history of diabetes, and anti-diabetic therapy.[26] The majority of participants (47.7%) showed moderate levels of diabetes knowledge, according to a self-administered questionnaire-based study conducted in Malaysia by Abbasi et al. in 2018. Utilising the Translated Michigan Diabetes Knowledge Test (MDKT), the participants' diabetes knowledge was assessed. Age, education level, occupation, and the kind of anti-diabetic medication were among the variables in this study that were substantially correlated with diabetes knowledge.[27,28] Table III illustrates no substantial correlation between diabetes awareness and factors such as education level, family history, and total number of drugs taken. The participants' scores on the diabetes knowledge questionnaire showed a significance with educational attainment ($p = 0.001$, $r = 0.163$). However, according to research conducted by Bukhsh et al. (2019) and Abbasi et al. (2018), the participants' scores on the diabetes knowledge questionnaire increased with increasing educational attainment.[26,27] One study revealed that the patients' understanding of diabetes was inadequate. Therefore, it is advised that healthcare professionals focus more on diabetes education, particularly regarding nutritional principles.[29,30] There is no noteworthy relationship between diabetes knowledge history and family history of the disease ($p = 0.053$, $r = 0.190$). For European American and African American people from high-risk coronary artery disease (CAD) families, the relevance of family history to the incidence of type 2 diabetes varies. African Americans have a considerably more saturated positive family history structure than European Americans, which makes it harder to identify at-risk individuals unless numerous family members are impacted.

In contrast, European Americans have a dose-dependent risk connection. Simply because of this conclusion, significant public health initiatives aimed at preventing diabetes in African

Americans should be launched. More investigation into the genetic, biochemical, and environmental factors causing racial variations as well as a deeper comprehension of the connection between incident T2DM and family history in different racial and ethnic groups should result in improved preventive measures.[31] Additionally, there was a significant relationship (p = 0.031, r = -0.214) between the participants' diabetes knowledge level and the number of medications they were taking. A score of at least five indicated a good degree of medication knowledge. The average score for medication knowledge was 2.20 ± 1.17, indicating that most participants' understanding of their anti-diabetic drugs was below average. Out of all participants, only twelve (2.99%) had a score of ≥ 5. The majority of participants (291, 70.6%) were unable to list all of their anti-diabetic drugs, and 305 participants (74.0%) were unaware that their anti-diabetic drugs could have negative effects. It is not unexpected that the majority of participants were unable to list all of their anti-diabetic medications together with their side effects, since polypharmacy is prevalent among them, with a mean of 1.91 ± 1.00 for all prescriptions used.

However, as hypoglycaemia is a common occurrence for people on anti-diabetic drugs, patients must recognise this common side effect so that they can take the necessary action to address it. Good communication between the physician and patient is essential to address the risk of hypoglycaemia resulting from potential therapeutic misunderstanding and to minimise hypoglycaemia episodes.[32] A few of the subjects were unaware of the proper technique for administering their anti-diabetic drugs. Before the modifications, it was noted that most individuals who provided incorrect answers continued to take their medications. Inadequate dosing might lead to harmful pharmacological responses and pharmaceutical abuse.[33] Participants' scores on drug awareness were significantly impacted by factors such as gender, family history of diabetes, and total number of medications used.

Compared to males, women were found to know more about their prescriptions (the mean score was 1 and 2 respectively). A family history of diabetes improved a participant's performance on the pharmaceutical understanding questionnaire compared to those who knew nothing about the illness (p = 0.031, r = -0.211). Medication knowledge and adherence significantly correlated, according to the current study. This may have been the result of several circumstances. Some individuals whose medication knowledge was not up to par demonstrated adherence to their prescribed regimen (347, 83.7%) because their prescription schedule was organised using a pill box or with assistance from family members (334, 81.1%). Furthermore, it's possible that the participants' medication adherence was influenced by the fact that they didn't have to worry about paying for their prescriptions (347, 84.2%).

Another significant social component brought up by the respondents was the interaction between the patient and the physician, wherein a positive relationship was described as a facilitator and vice versa. A patient's confidence and capacity to manage a chronic condition like diabetes were enhanced by effective communication between the patient and the doctor, which enhanced medication adherence.[34] Consequently, healthcare providers who were assisting them in developing rapport and using their abilities to provide patient-centred care must have the proper training. Furthermore, patient medication adherence to diabetes has been enhanced by pharmacist-led interventions, which may be viewed as an addition to the University Diabetes Centre's present support services.[35] It is possible for non-adherence to diabetic treatment to be unintentional (forgetting) or intentional (decision-making).[36] The gap between medication adherence (MMAS-8) and diabetic control (HbA1c) among some interviewees, where some low adherents had good diabetic control, may be explained by intentional non-adherence.

The study conducted by Sweileh et al. (2014) revealed that a client's attitude towards medication adherence is contingent upon their perceptions regarding the significance of taking prescribed medications for the treatment of their health condition and the associated repercussions.[37] The hypothesis was that patients with diabetes who believed that taking their anti-diabetic drugs was important and who had a positive attitude toward medicine would be more likely to take them as directed. However, patients with diabetes who felt that their diabetes treatment was bad for them and who thought their regimen was bad were more likely not to take their prescriptions as prescribed.[37] Consequently, one may conclude that medical belief and adherence are related. The Morisky Medication Adherence Scale (MMAS-8) was used in an Iranian study to measure medication adherence in patients with type 2 diabetes. The results showed that most participants (59.12%) had moderate adherence, while 27.2% had low adherence to their prescribed regimen. One of the study's important variables for medication adherence was age.[38] The results of this investigation showed no significant relationship between drug knowledge, adherence to a prescribed regimen, and diabetes understanding. The same theory was supported by a 2018 study which found no evidence of a significant relationship between medication adherence and diabetes knowledge.[39] Nonetheless, research has been done to support the idea that there is a strong correlation between medication adherence and diabetes knowledge. Accordingly, one study from 2020 found that among patients with type 2 diabetes, there was a small but favourable connection (p < 0.01) between medication adherence and diabetes awareness.[40] A 2011 study also found that a lower incidence of medication adherence was linked to inadequate diabetes awareness.[41]

Moreover, it has been observed in two research projects that medicine awareness significantly predicts medication adherence (p < 0.001).[18,42] While the rate is higher in underdeveloped nations, the reported mean rate of non-adherence in industrialised nations is only 50%. The study's non-adherence rate of 14.2% does not support the premise, given that Lahore, Pakistan is a developing nation.[43] It is necessary to take action to increase these patients' adherence to further improve their health. Setting a reminder for patients to take their medications was one of the

incentives, particularly since in the current study, the inability to check glucose regularly was the primary cause of non-adherence. Personalised patient education, such as educating patients about the unique dangers if they stop taking their medication, is another intervention that has been shown to increase adherence.[44] It has been demonstrated that comprehensive and individualised pharmacist interventions, like streamlining treatment regimens, are beneficial in helping patients remember to take their prescriptions.[45] Health professionals, especially pharmacists (who are the least used group in Pakistan), should therefore be involved in the dissemination of disease-related education and counselling to increase patients' functional health literacy about self-monitoring and care practices for chronic diseases in hospitals as well as community settings.[46]

We interviewed every member of the sample, ensuring that the data-gathering process remained consistent. Additionally, because just one researcher assisted with the interview, participants were able to get clarification on any questions they had.

Similar to previous research, this study has certain intrinsic limitations. Because the medication adherence questionnaire in this study involves self-reporting, there is a chance that recollection bias and a lack of transparency will alter the true rate of medication adherence.

Conclusion

This study looked at the medication adherence and knowledge of T2DM patients in Lahore, Pakistan. It was found that most of the patients did not know enough about the medications they were taking to control their diabetes. Furthermore, it was shown that nearly 14% of the patients did not take their T2DM medication as prescribed. It was found that knowledge of diabetes was highly correlated with education level and total number of drugs consumed. Gender, family history, and the total number of medications used were all strongly correlated with medication knowledge. Nevertheless, no apparent connection was found between medication knowledge, adherence to treatment, and diabetes knowledge. The degree of medication awareness and the non-adherence rate were markedly low, even in the absence of any link. Strategies including the usage of mobile phone applications for reminders and individualised patient education have been put into place to lessen these problems. However, to optimise their effectiveness and efficiency, these techniques need to be reviewed and improved. Future research on other pertinent factors, including diet, blood glucose level, and body mass index, may provide more light on the relationship between adherence to medicine and medication knowledge. Better diabetes preventive and management strategies still require the planning of both individualised and group education programmes. Prioritising behavioural therapy and counselling is important for subjects with little experience.

Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

Prior to commencement of the study ethical approval was obtained from the following ethical review board: Riphah Institute of Pharmaceutical Sciences Human & Animal Ethics Committee (007184)

ORCID

A Azhar https://orcid.org/0009-0009-1894-5049

A Akhtar https://orcid.org/0000-0002-6602-6938

K Fatima https://orcid.org/0009-0001-6406-480X

H Fatima https://orcid.org/0009-0000-7043-4988

H Maryam https://orcid.org/0009-0007-3043-8985

M Nawaz https://orcid.org/0009-0005-3740-2526

A Sajjad https://orcid.org/0009-0002-6784-1632

F Musfeera https://orcid.org/0009-0009-3186-3582

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