



Assessment of medication adherence and knowledge regarding the disease among ambulatory patients with diabetes mellitus in Karachi, Pakistan

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ABSTRACT

Objective: To report medication adherence among ambulatory patients with diabetes mellitus (DM) using Morisky 8-item medication adherence MMAS-8 scale and assess current standard of knowledge regarding their disease using a especially developed Patient 10-item Knowledge Assessment (PKA-X) scale. **Methods:** A quantitative cross sectional study was conducted for 3 months in Karachi, Pakistan using Morisky 8-item medication adherence scale[®] documenting the medication adherence of ambulatory patients with DM and to find out their knowledge regarding the disease using a newly developed Patient 10-item knowledge assessment PKA-X scale. **Results:** The mean MMAS-8 score of the total sample was 4.69 (1.9 SD) which was interpreted as 'Low medication adherence' (P value<0.01). Majority of patients (N=204, 79.4%) had low adherence (P value<0.01). The mean score reported by PKA-X scale was 9.0 (SD 1.4) which was interpreted as 'Excellent knowledge'. Bulk of patients (N=202, 78.6%) had excellent knowledge (P value<0.01). No significant association existed between patient knowledge and their medication adherence (P value>0.05). **Conclusion:** The medication adherence of the patients is very low and adequate measures are the need of the hour to address this issue though the standard of knowledge has greatly improved. However, having good knowledge about the disease does not guarantee adherence to medication regimen.

Key words: Diabetes mellitus, Karachi, Knowledge, Medication adherence, Patients, Pakistan.

INTRODUCTION

Medication adherence is simply defined as taking medication as prescribed for the proposed duration. This issue is of paramount importance as non adherence to medication regimen has reported adverse outcomes in the

management of disease either aggravating it and associated comorbidities or increasing the health care costs or at times both. This is quiet prevalent in chronic diseases such as diabetes mellitus (DM) which can only be managed by adherence to treatment and medication.¹⁻³

DM is a chronic disease which can only be managed by adequate pharmacotherapy.⁴ Adherence to medication regimen in case of DM is of clinical significance as the disease requires medications at regular intervals or as prescribed by a prescriber to keep a check on the level of glucose in the blood. Any lapse in the therapy may risk a

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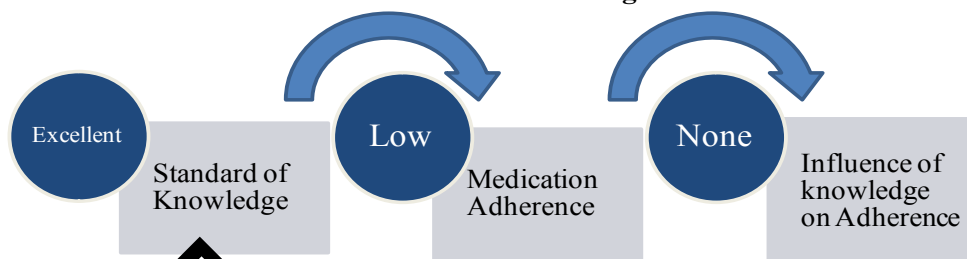
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The medication adherence of DM patients of Pakistan calculated by Morisky 8 item medication adherence scale is **4.69**

Low Adherence

The standard of knowledge of DM patients of Pakistan calculated by Patient 10 item Knowledge assessment scale is **9.0**

Excellent Knowledge



The improved knowledge regarding diabetes mellitus does not increase medication adherence in patients of Pakistan

Graphical Abstract

surge in the levels of glucose in the blood which brings its associated complications and risks along with an episode of hyperglycemia.⁵ Studies have established the link between DM and diseases such as hypertension HTN, Parkinson's disease PD, etc.^{6,7} Hence, the medication adherence in DM is very important. Patients with DM are more prone to indulge in non adherence and studies report that these patients have the lowest adherence to their medication regimen.⁸ It is so because pharmacotherapy of DM includes challenging tasks such as remembering the medications, their frequency of administration and use of many drugs pose a challenge. Studies conducted on the subject identify these issues as major barriers to compliance.⁹ Failure to adhere to diabetic medication regimen leads to poor glycemic control which further adds to disease and economic burden on the patients.^{3,10}

Several tools have been established to measure the medication adherence in patients. One of the tools to measure adherence is the Morisky 8-item medication adherence scale or MMAS-8 scale[®]. The scale consisted of 8 simple questions tailored to be answered by patients. Each question carried a score of 0 or 1 depending upon the answer and sum of all 8 questions yield a final score which interpreted medication adherence of the patient. A score of 0 represented high adherence and 1-2 meant medium adherence to medication. Scores of 3-8 represented low adherence.¹¹

The treatment of DM along with medications also encompass patient education which is aimed at providing basic disease information to the patient given that the

disease is chronic i.e. lifelong and needs to be properly managed. Since diabetes mellitus DM requires patient counseling, physicians are deemed to perform this role. In the past, various studies have reported low patient knowledge regarding DM and emphasized on improving patient education regarding the disease.¹² However, with recent developments in the health care system, pharmacists have taken the role of patient counseling to some extent and are being recognized by the health care professionals (HCPs), patients and the general public as well.¹³⁻¹⁶ It is hypothesized that the current standard of knowledge of DM patients has dramatically improved now as compared to what it was in the past.

Pakistan currently ranks 7th in the world in terms of DM disease burden.^{17,18} The health care system struggles to cope up and treat the disease population.¹⁴ The diabetic population of the country hardly gets treated and prescribed rationally for their ailments but adherence to medication is normally not a focal point of disease state management for the health care professionals (HCPs) and alike situation of the globe, non adherence to medications by patients was reported by earlier studies in Pakistan as well along with low knowledge.^{19,20} However, no study established a link between the two. The need to know about the medication adherence level and current knowledge of patients of DM and, if knowledge improves adherence becomes prime focus.

The present study was aimed at documenting the medication adherence among ambulatory patients of DM in Karachi, Pakistan by employing Morisky 8-item medication

adherence MMAS-8 scale and reporting the current standard of knowledge of the diabetic patients regarding the ailment. It was done by developing a novel scale known as the Patient 10-item knowledge assessment PKA-X scale for recording patient knowledge in terms of scores and later interpreting them in context of knowledge standard.

MATERIALS AND METHODS

A quantitative cross sectional study was conducted for 3 months i.e. July 2014 to September 2014 with the aim of documenting the medication adherence of ambulatory patients with diabetes mellitus DM and reporting their standard of knowledge regarding the disease.

Location

The study was conducted among ambulatory patients who were approached in tertiary health care setting of Karachi, Pakistan namely Ziauddin Hospital Clifton, North Nazimabad and KILB campuses, Clifton Hospital and Health Avenue, Karachi, the largest city of Pakistan having about 23.5 million people from all ethnic compositions of Pakistan and is most developed city in terms of infrastructure.^{3,21}

Target population, sampling, inclusion and exclusion criteria

The target population consisted of only DM diagnosed patients. All other patients were excluded from the study. It was done through convenience sampling technique.

Research instrument

The research instrument consisted of a survey questionnaire adopted and translated to Urdu from the English version of Morisky 8 item Medication Adherence MMAS-8 scale[®] where each variable carried a single score and sum of all the individual variable scores yield a final score which was interpreted in the context of medication adherence. A score of 0-1 represented high adherence and score of 2 represented medium adherence. Scores 3-7 represented low adherence and a score of 8 meant no adherence.

The research instrument used to assess the knowledge consisted of a data questionnaire containing questions related to the demographic information and diabetes awareness which was especially developed to measure patient knowledge. The scale was termed as Patient 10-item Knowledge Assessment PKA-X scale. It consisted of 10 research variables where each variable carried a score and sum of all the individual variable scores yield a final score which was interpreted in the context of patient knowledge. A score of 0-4 represented very low knowledge and score 5-7 represented low knowledge, however score of 7-8

meant adequate and score of 9-10 counted as excellent knowledge.

Piloting and validation

The research instrument was tested and validated by a team of experts for its suitability in a pilot study. The team of experts consisted of physician, clinical pharmacist and university professor. A pilot study was conducted before initiation of data collection and after validation of the research instrument, the study commenced. The research instrument was piloted on 23 patients; it took 11 minutes to fill in the responses. The results of the pilot study were not added in the main database.

Data analysis

The data thus collected was analyzed by SPSS v 20 (Statistical Package for Social Sciences version 20). The data was analyzed and central tendency, cross tabulation and chi square (X^2) test was employed on the data. The results were expressed as mean (X), standard deviation (SD), sample number (N), percentages (%) and significant P values.

Patient consent

Prior to handing the instrument to the patients, they were briefed about the study and its objectives and their consent was obtained.

Ethical approval

The study was approved by Department of Pharmacy Practice, Faculty of Pharmacy, Ziauddin University (Pharm.D. Batch-6, 2014) and Research Review Board of Clifton Hospital, Karachi, Pakistan.

Conceptual Framework

The study hypothesized that patient knowledge is now better than what it has been in the past and the medication adherence to DM therapy has improved. Furthermore, the study also hypothesized that improvement of patient knowledge has the potential to improve medication adherence of the DM patients.

RESULTS

A total of 300 questionnaires were sent and 257 questionnaires were returned back from the patients giving a response rate of 85.6%. The results are expressed as demographic information, medication adherence information, patient knowledge and cross tabulation.

Demographic information

The study incorporated equal number of male and female patients with the numbers slightly tilted towards male

patients (N=135, 52.5%) than female patients (N=122, 47.5%). The majority of patients belonged to the age above 45 years (N=147, 57.2%) followed by a third proportion of the target group between the age of 30 to 45 years (N=89, 34.6%) and less than a tenth between 16 to 30 years (N=21, 8.2%) (P value less than 0.01). Furthermore, the demographics revealed that an overwhelming majority

of the patients was married (N=250, 97.3%) and only few appeared single (N=7, 2.7%) (P value less than 0.01). Bulk of the patients (N=245, 95.3%) appeared to be educated while a small proportion (N=12, 4.7%) appeared not (P value<0.01). Major chunk of the patients were seen to suffer from type II DM (N=220, 85.6%) and less than a fifth proportion of target segment (N=37, 14.4%) were

Table 1: Summary of demographic information

Attributes	Sample (N)	Percentage (%)	Expected (N)	P value
Gender				
Male	135	52.5	128.5	>0.05
Female	122	47.5	128.5	
Total	257	100	257	
Age				
Between 16 to 30 years	21	8.2	85.7	<0.01
Between 30 to 45 years	89	34.6	85.7	
Above 45 years	147	57.2	85.7	
Total	257	100	257	
Social information				
Single	7	2.7	128.5	<0.01
Married	250	97.3	128.5	
Total	257	100	257	
Education				
Illiterate	12	4.7	128.5	<0.01
Educated	245	95.3	128.5	
Total	257	100	257	
Phenotype				
Type I Insulin dependent	37	14.4	128.5	<0.01
Type II Non Insulin dependent	220	85.6	128.5	
Total	257	100	257	
Duration of disease				
Do not know	83	32.3	51.4	<0.01
Since 1-6 month	59	23	51.4	
Since 6-12 month	41	16	51.4	
Since 1-3 years	59	23	51.4	
Since 3-9 years	15	5.8	51.4	
Total	257	100	257	
Comorbidity				
No comorbidity	18	7	51.4	<0.01
Cardiovascular disease	167	65	51.4	
Respiratory disease	5	1.9	51.4	
Musculoskeletal diseases	4	1.6	51.4	
Retinopathy	63	24.5	51.4	
Total	257	100	257	
Diagnostic test				
Hb _{A1c}	0	0	0*	**
Fasting Blood Glucose and Random Blood Glucose	257	100	257*	
Total	257	100	257	
Medications				
Insulin	37	14.4	128.5	<0.01
Oral hypoglycemic agents	220	85.6	128.5	
Total	257	100	257	

reported to suffer from type I DM (P value<0.01).

The results further reported that slightly more than a fifth proportion of the total patients (N=59, 23%) were newly diagnosed with disease i.e. less than 6 months followed by exactly the same number of patients (N=59, 23%) diagnosed with DM between 1–3 years. Some of the patients (N=41, 16%) had DM since 6–12 months and a small proportion reported presence of disease since 3–9 years. A third of the target segment (N=83, 32.3%) appeared unaware of the duration of their disease (P value<0.01). Regarding comorbidity, majority of the patients suffered from cardiovascular comorbidity (N=167, 65%) followed by a quarter of the target segment with retinopathy (N=63, 24.5%), few patients (N=5, 1.9%) had respiratory diseases as comorbidity and very few (N=4, 1.6%) suffered from musculo skeletal diseases as a comorbidity. Less than a tenth of the target segment (N=18, 7%) had no comorbidity (P value<0.01). All the patients (N=257, 100%) were diagnosed DM by the conventional fasting blood glucose FBG and random blood glucose

test RBG. Majority of the patients (N=220, 85.6%) were on oral hypoglycemic agents followed by those patients (N=37, 14.4%) on insulin (P value<0.01). The results of demographic information are summarized in Table 1.

Medication adherence information

Regarding the medication adherence information, the majority of the patients confessed that they sometimes forget to take their medications (N=168, 65.4%) and a third segment of total patients (N=89, 34.6%) did not forget (P value<0.01). Less than half of the target group (N=124, 48.2%) revealed that they stop taking medications without informing their physician while the rest (N=133, 51.8%) did not do so (P value>0.05). In addition, more than half of the patients (N=115, 44.7%) forgot medications whilst travelling followed by slightly less than half (N=142, 55.3%) responding contrarily (P value>0.05). However, an overwhelming majority of patients (N=195, 75.9) were reported to take their complete medication the day before and while a quarter of the target segment (N=62, 24.1%) forgot (P value<0.01). To the question of stopping

Table 2: Medication Adherence information

Attributes	Sample (N)	Percentage (%)	Expected (N)	P value
Forget to take medicines sometimes				
Yes	168	65.4	128.5	<0.01
No	89	34.6	128.5	
Total	257	100	257	
Stop taking medicine without informing doctor				
Yes	124	48.2	128.5	>0.05
No	133	51.8	128.5	
Total	257	100	257	
Forget medicine while travelling				
Yes	142	55.3	128.5	>0.05
No	115	44.7	128.5	
Total	257	100	257	
Took all medicine yesterday				
Yes	195	75.9	128.5	<0.01
No	62	24.1	128.5	
Total	257	100	257	
Cease medication therapy when feel better				
Yes	132	51.4	128.5	>0.05
No	125	48.6	128.5	
Total	257	100	257	
Hassled about sticking to treatment plan				
Yes	160	62.3	128.5	<0.01
No	97	37.7	128.5	
Total	257	100	257	
Having difficulty remembering to take medicine				
Never/rarely	56	21.8	51.4	<0.01
Once in a while	54	21.0	51.4	
Sometime	107	41.6	51.4	
Usually	37	14.4	51.4	
All the time	3	1.2	51.4	
Total	257	100	257	

Table 3: Summary of Medication adherence score and interpretation

Attributes	Sample (N)	Percentage (%)	Expected (N)	P value
MMAS-8 Score				
Morisky 8-item Score 1	22	8.6	32.1	
Morisky 8-item Score 2	19	7.4	32.1	
Morisky 8-item Score 3	25	9.7	32.1	
Morisky 8-item Score 4	42	16.3	32.1	
Morisky 8-item Score 5	56	21.8	32.1	<0.01
Morisky 8-item Score 6	44	17.1	32.1	
Morisky 8-item Score 7	34	13.2	32.1	
Morisky 8-item Score 8	15	5.8	32.1	
Total	257	100	257	
Score Interpretation				
High Adherence	21	8.2	64.3	
Medium Adherence	18	7.0	64.3	
Low Adherence	204	79.4	64.3	<0.01
No Adherence	4	1.6	64.3	
Total	257	100	257	

medication therapy in response to improving health, slightly more than half of the target group (N=132, 51.4%) responded in favor while slightly less than half of the segment (N=125, 48.6%) did not do so (P value >0.05). Bulk of patients (N=160, 62.3%) felt a hassle in sticking to the pharmacotherapy of disease and more than a third proportion of the target segment (N=97, 37.7%) did not feel any hassle in doing so (P value <0.01). Furthermore, the respondents were asked if they had difficulty in remembering their medication and slightly less than half of the target group (N=107, 41.6%) sometimes had this difficulty followed by those who seldom suffered from this problem (N=54, 21.0%) and few (N=37, 14.4%) who usually dealt with the problem. Fewer patients (N=3, 1.2%) had a regular issue remembering medications while a considerable number of patients (N=56, 21.8%) never had any difficulty (P value <0.01). The medication adherence information is summarized in Table 2.

The patients were handed Morisky 8-item medication adherence MMAS-8 questionnaire to record their medication adherence and the mean score was 4.69 ($X=4.69$, 1.9 SD) which was interpreted as 'Low medication adherence'. Bulk of the patients (N=56, 21.8%) had score of 5 followed by some (N=44, 17.1%) with score of 6 and few (N=34, 13.2%) with score of 7 i.e. low adherence. Very few (N=15, 5.8%) had a score of 8 i.e. no adherence. However, some of the patients (N=22, 8.6%) had a score

of 1 i.e. high adherence while some (N=19, 7.4%) had 2 i.e. medium adherence (P value less than 0.01). In terms of collective score interpretation, major segment of the patient was seen to have low adherence (N=204, 79.4%) and some had medium adherence to their medication (N=18, 7%) while few were reported to have no adherence to their medication (N=4, 1.6%). Some patients (N=21, 8.2%) were also reported to have a high adherence to their medication (P value less than 0.01). The results are tabulated in Table 3.

Patient knowledge

In addition to this, the patients were also investigated about their standard of knowledge regarding DM and it was reported that majority (N=221, 86%) seemed aware of their overall health condition being related to the ailment and less than a fifth proportion of target segment (N=36, 14%) seemed unaware (P value <0.01). Almost all the patients (N=253, 98.4%) responded that they experienced symptoms related to DM which prompted them to investigate the condition with a consultant and subsequently got diagnosed with DM however very few patients (N=4, 1.6%) did not know how their disease was diagnosed (P value less than 0.01). Furthermore, they were asked about the symptoms experienced the most and majority had polyphagia (N=142, 55.3%) followed by a quarter (N=65, 25.3%) who had polydipsia and a fifth proportion of the target segment (N=50, 19.5%) had

Table 4: Summary of patient knowledge

Attributes	Sample (N)	Percentage (%)	Expected (N)	P value
Is your overall condition related to DM				
Yes	221	86	128.5	<0.01
Donotknow	36	14	128.5	
Total	257	100	257	
How was your DM diagnosed?				
Experienced few related symptoms	253	98.4	128.5	<0.01
Donotknow	4	1.6	128.5	
Total	257	100	257	
If experienced, then which symptom?				
Polyurea	50	19.5	85.7	<0.01
Polyphagia	142	55.3	85.7	
Polydipsia	65	25.3	85.7	
Total	257	100	257	
Did you seek counseling from a pharmacist/doctor?				
Yes	242	94.2	128.5	<0.01
No	15	5.8	128.5	
Total	257	100	257	
Can you remember your medications?				
Yes	242	94.2	128.5	<0.01
No	15	5.8	128.5	
Total	257	100	257	
Do you know how to use glucometer?				
Yes	160	62.3	128.5	<0.01
No	97	37.7	128.5	
Total	257	100	257	
Are you aware of optimal blood glucose range?				
Yes	251	97.7	128.5	<0.01
No	6	2.3	128.5	
Total	257	100	257	
Aware of the consequence of mismanaged DM				
Yes	217	84.4	128.5	<0.01
No	40	15.6	128.5	
Total	257	100	257	
Did you know DM is associated with hyperlipidemia?				
Yes	220	85.6	128.5	<0.01
No	37	14.4	128.5	
Total	257	100	257	
Do you remember since when you have DM?				
Yes	174	67.7	128.5	<0.01
No	83	32.3	128.5	
Total	257	100	257	

experienced polyurea the most (P value<0.01). Bulk of the patients surveyed (N=242, 94.2%) sought counseling from doctors/ pharmacists however few patients (N=15, 5.8%) did not seek any counseling (P value<0.01).

Almost all patients (N=255, 99.2%) remembered their medication and very few (N=2, 0.8%) did not (P value <0.01). Further to this, majority seemed aware of the optimal blood glucose range (N=251, 97.7%) however some (N=6, 2.3%) appeared to be unaware of the range (P value<0.01). It was also observed that the majority of the

patients knew how to use a glucometer at home (N=242, 94.2%) followed by some patients (N=15, 5.8%) who did not know how to use the glucometer (P value less than 0.01). To the question of awareness of consequences of mismanaged DM, an over whelming number of patients responded positive (N=217, 84.4%) while some of patients (N=40, 15.6%) seemed unaware of the consequences of mismanaged DM (P value<0.01). Similarly, awareness of association of DM with hyperlipidemia was also tested, major segment of patients (N=220, 85.6%) responded with positive answer but some of the patients (N=37,

Table 5: Summary of PKA-X scale results

Attributes	Sample (N)	Percentage (%)	Expected (N)	P value
Patient 10-item knowledge assessment (PKA-X) score				
PKA-X Score 1	2	0.8	28.6	
PKA-X Score 2	1	0.4	28.6	
PKA-X Score 3	2	0.8	28.6	
PKA-X Score 4	0	0	28.6	
PKA-X Score 5	1	0.4	28.6	
PKA-X Score 6	7	2.7	28.6	<0.01
PKA-X Score 7	9	3.5	28.6	
PKA-X Score 8	34	13.2	28.6	
PKA-X Score 9	84	32.7	28.6	
PKA-X Score 10	117	45.5	28.6	
Total	257	100	257	
Score interpretation				
Very low knowledge	3	1.2	64.3	
Low knowledge	11	4.3	64.3	
Adequate knowledge	41	16	64.3	<0.01
Excellent knowledge	202	78.6	64.3	
Total	257	100	257	

Table 6: Summary of cross tabulation between gender and medication adherence information

Attributes	Male Patients (%)	Female Patients (%)
Gender	135 (100)	122 (100)
Age		
Between 16 to 30 years	11 (8.1)	10 (8.1)
Between 30 to 45 years	41 (30.3)	48 (39.3)
Above 45 years	83 (61.4)	64 (52.4)
Total	135	122
MMAS-8 Score		
Morisky 8-item Score 1	10 (7.4)	12 (9.8)
Morisky 8-item Score 2	12 (8.8)	7 (5.7)
Morisky 8-item Score 3	11 (8.1)	14 (11.4)
Morisky 8-item Score 4	23 (17)	19 (15.5)
Morisky 8-item Score 5	32 (23.7)	24 (19.6)
Morisky 8-item Score 6	19 (14)	25 (20.4)
Morisky 8-item Score 7	20 (14.8)	14 (11.4)
Morisky 8-item Score 8	8 (5.9)	7 (5.7)
Total	135	122
Score interpretation		
High Adherence	10 (7.4)	12 (9.8)
Medium Adherence	12 (8.8)	6 (4.9)
Low Adherence	105 (77.7)	98 (80.3)
No Adherence	8 (5.9)	6 (4.9)
Total	135	122

14.4%) were not aware of the association (P value < 0.01). The patients were asked if they remember the time since they were diagnosed with DM, more than half of the target segment ($N=174$, 67.7%) was observed to remember the time since they contacted DM while a third proportion of target group ($N=83$, 32.3%) did not remember (P value < 0.01). The results are summarized in Table 4.

With the help of a newly formulated scale known as the Patient 10-item Knowledge Assessment PKA-X scale, the patients' standard of knowledge was quantified and interpreted. Each individual variable consisted of a score of 1 and sum of all 10 variables yield a cumulative score of 10. The mean score reported was 9.0 ($X=9.0$, $SD 1.4$) which was interpreted as 'Excellent knowledge'. The summary of results is tabulated in Table 5. Moreover, an overwhelming majority of patients ($N=202$, 78.6%) was observed with their scores interpreted as excellent knowledge followed by a considerable number ($N=41$, 16%) with adequate knowledge of DM. Few patients ($N=11$, 4.3%) reported low knowledge and almost negligible number of patients ($N=3$, 1.2%) had very low knowledge (P value less than 0.01). The results tabulated in Table 5.

Cross tabulation and chi square (X^2) analysis

The cross tabulation of gender with medication adherence information revealed that female patients ($N=12$, 9.8%) with MMAS-8 score of 1 were reported to be more compliant to their medication regimen as compared to the males patients with same MMAS-8 score ($N=10$, 7.4%). However, males were more in number ($N=12$, 8.8%) in case of medium adherence with MMAS-8 score of 2 as compared to the females ($N=7$, 5.7%). The results of medication adherence information with gender breakdown are summarized in Table 6.

The cross tabulation of age with medication adherence information revealed that the patients with age above 45 years were the most compliant to their medication regimen

Table 7: Summary of cross tabulation between age and medication adherence information

Attributes	Between 16 to 30 years (%)	Between 30 to 45 years (%)	Above 45 years (%)
Age	21(100)	89(100)	147(100)
MMAS-8 Score			
Morisky 8-item Score 1	2(9.5)	8(8.9)	12(8.1)
Morisky 8-item Score 2	0(0)	7(7.8)	12(8.1)
Morisky 8-item Score 3	1(4.7)	9(10.1)	15(10.2)
Morisky 8-item Score 4	3(14.2)	14(15.7)	25(17)
Morisky 8-item Score 5	10(47.6)	10(11.2)	36(24.4)
Morisky 8-item Score 6	3(14.2)	16(17.9)	25(17)
Morisky 8-item Score 7	1(4.7)	19(21.3)	14(9.5)
Morisky 8-item Score 8	1(4.7)	6(6.7)	8(5.4)
Total	21	89	147
Score interpretation			
High Adherence	2(9.5)	8(8.9)	12(8.1)
Medium Adherence	0(0)	7(7.8)	11(8.1)
Low Adherence	18(85.7)	68(76.4)	115(78.2)
No Adherence	1(4.7)	6(6.7)	8(5.4)
Total	21	89	147

Table 8: Summary of cross tabulation of variables

Variables	Observed (Expected)	Observed (Expected)	P value
How was your DM diagnosed?			
Education	Experienced symptoms	Do not know	
Literate	245(241.5)	0(3.8)	<0.01
Illiterate	8(11.8)	4(0.2)	
Do you know how to use glucometer?			
Education	Yes	No	
Literate	235(236.7)	10(14.3)	<0.01
Illiterate	7(11.3)	5(0.7)	
Did you seek counseling from a pharmacist?	Do you know how to use glucometer?		
	Yes	No	
Yes	238(227.9)	11(14.1)	<0.01
No	4(14.1)	11(0.9)	
Did you seek counseling from a pharmacist?	Are you aware of optimal blood glucose range?		
	Yes	No	
Yes	240(236.4)	2(5.6)	<0.01
No	11(14.6)	4(0.4)	
Did you seek counseling from a pharmacist?	Are you aware of the consequence of mismanaged DM?		
	Yes	No	
Yes	209(204.3)	33(37.7)	<0.05
No	8(12.7)	7(2.3)	
Did you seek counseling from a pharmacist?	Did you know DM is associated with hyperlipidemia?		
	Yes	No	
Yes	212(207.2)	30(34.8)	<0.01
No	8(12.8)	7(2.2)	

(N=12, 8.1%) as compared to the patients falling in age groups between 16 to 30 years (N=8, 8.9%) and between 30 to 45 years (N=2, 9.5%). The results of medication adherence information with gender breakdown are summarized in Table 7.

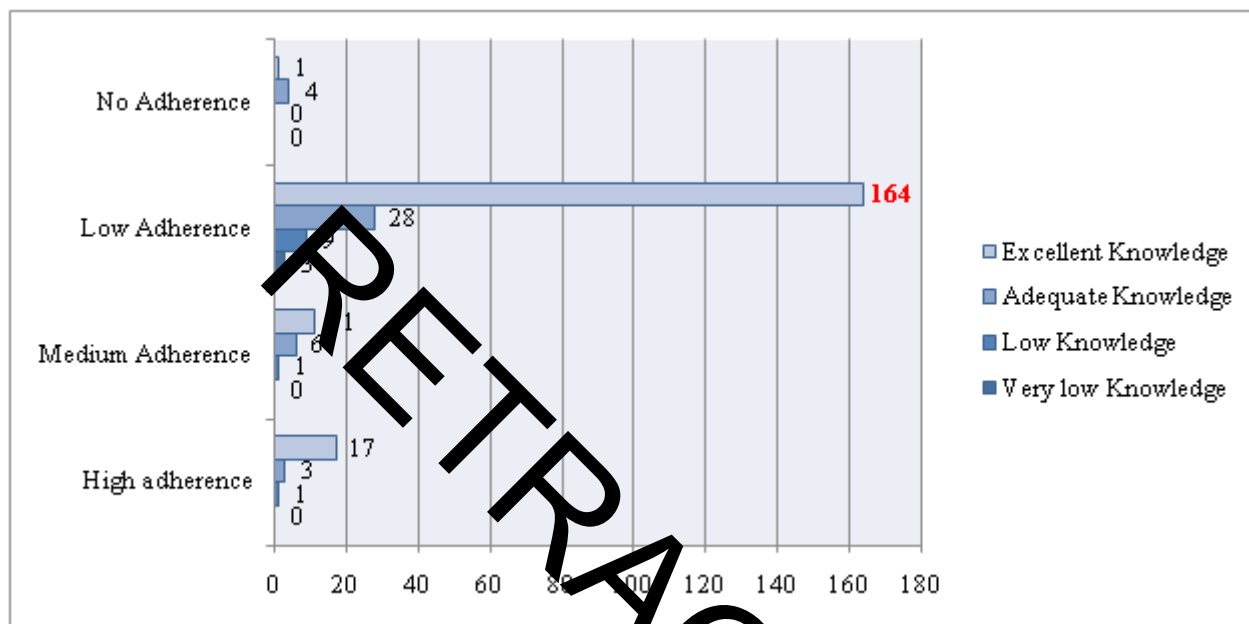
Furthermore, it was observed that the variable of education was associated with the knowledge of DM diagnosis (P value <0.05) and knowledge about using a glucometer (P-value <0.05). Moreover, the variable of seeking counseling

from a doctor/pharmacist was also statistically associated with knowledge of using a glucometer (P-value<0.01), awareness of optimal blood glucose range (P-value<0.01), awareness of consequences of mismanaged DM (P-value <0.05) and awareness of relation of hyperlipidemia with DM (P-value<0.01). The detailed values of observed and expected counts are tabulated in Table 8.

Lastly, the MMAS-8 scores were analyzed with PKA-X scores. The cross tabulation of both scores though was

Table 9: Summary of cross tabulation of MMAS-8 scores and PKA-X scores

Attributes	PKA-X Scores interpretations				P value
	Very low knowledge	Low knowledge	Adequate knowledge	Excellent knowledge	
	Observed count N (Expected count N)				
High adherence	0(0.2)	1(0.9)	3(3.4)	17(16.5)	>0.05
Medium adherence	0(0.2)	1(0.8)	6(2.9)	11(14.1)	
Low adherence	3(2.4)	9(8.7)	28(32.5)	164(160.3)	
No adherence	0(0.2)	0(0.6)	4(2.2)	10(11)	

**Figure 1: Graphical representation of cross tabulation of MMAS-8 and PKA-X score interpretations**

not significant i.e. P value greater than 0.05 but revealed that majority of the patients who had excellent knowledge regarding the disease appeared to have low adherence (N=164) followed by those patients who had adequate knowledge (N=28). The cross tabulation results are explained in Table 9 and a graphical representation is also presented in Figure 1.

DISCUSSION

Medication adherence has always been an important debate in management of patients with chronic illnesses like diabetes mellitus DM. The current study investigated this issue in the ambulatory patients suffering from diabetes mellitus DM in Karachi, Pakistan with Morisky 8-item medication adherence MMAS-8 scale[®]. The study incorporated 257 patients both male (N=135, 52.5%) and female (N=122, 47.5%). In addition, the study also incorporated patients from different age groups i.e. between 16 to 30 years (N=21, 8.2%), between 30 to 45 years (N=89, 34.6%) and majorly above 45 years (N=147, 57.2%). The reason for latter being a major chunk in the age groups was the

fact that onset of DM usually takes place in the later ages.⁴ Majority of the patients were married (N=250, 97.3%) and educated (N=242, 95.3%) suffering from type II DM for most part (N=220, 85.6%) followed by type I DM (N=37, 14.4). This is quite common in Pakistan as studies reported type II DM being more prevalent in Pakistan as compared to any other phenotype.^{5,6} Major comorbidity reported in patients of DM were cardiovascular complications (N=167, 65%) followed by retinopathy (N=63, 24.5%), few patients reported pulmonary diseases (N=5, 1.9%) and very few (N=4, 1.6%) suffered from musculoskeletal complications. A small segment (N=18, 7%) did not report any comorbidity. Studies report the association of diabetes mellitus DM with elevated cholesterol levels and blood pressure BP hence both are a major risk factor for developing cardiovascular complications. The results encored the findings of previous studies of reporting cardiovascular complications as a major comorbidity in Pakistani population.⁶ The diagnostic tests used were the conventional fasting and random blood glucose (N=257, 100%). The treatment was initiated majorly with oral hypoglycemic agents (N=220, 85.6%) which is rational

as NICE recommended oral hypoglycemic agents to be prescribed as first line drugs in type II DM.⁷

It was reported in the study that the bulk of patients sometimes forget to take their medications (N=168, 65.4%) at home and whilst travelling (N=142, 55.3%). Additionally, the study reported that sometimes the patients stop taking medications without the consent of the prescriber (N=124, 48.2%) or when they feel better (N=132, 51.4%) which is quite common in the country as there is no developed infrastructure of pharmaceutical care where a pharmacist can provide patient counseling in which the patients could be explained the consequence of non adherence and vice versa. Moreover, keeping in view the current pharmacy practice in the country, this issue of counseling though supported by the majority of the HCPs sometimes eyed with curiosity and suspicion by the prescribers, hence this suspicion is probably hindering the practice which might be adding to the ignorance of the patients towards adherence to the prescribed DM regimen.^{13,15} However, this phenomenon needs to be further investigated.

The study employed MMAS-8 scale to quantify the level of adherence and it was reported that the mean score was 4.69 ($X=4.69, 1.9 SD$) which interpreted as 'Low medication adherence' thereby holding the test hypothesis invalid. This is a common problem among DM patients in the country as well as around the globe.²² This issue reiterates the need to create awareness about medication adherence among patients and develop mechanisms to ensure its propagation among the masses. A pharmacist as a diabetes mellitus DM disease educator can counsel the prescriber about the need to educate the patients at the time of their appointments emphasizing on the adherence to therapy. Similarly, the pharmacist can also counsel the patient directly during their prescription filling.^{4,15} This concept of pharmacist as a counselor has been reported by recent studies which revealed not only the patients but the general public also paints a very positive picture of clinical pharmacists improving patient outcomes.^{16,23}

Encouragingly, the females sticking to their pharmacotherapy with high adherence reported by MMAS-8 scale were more in number (N=12, 9.8%) compared to their males counterparts (N=0, 7.4%). However the latter were more in number (N=12, 8.8%) as compared to females (N=7, 5.7%) in case of medium adherence notwithstanding the high number of non adhering patients. One of the possible explanation to the problem can be linked to the fact that the males in Pakistani society are considered to be the sole bread earners and this might shift their focus from adherence issues to the job at hand as compared

to the females who are mainly involved with household activities for most part.²⁴ In case of age groups, patients with age above 45 years were the most compliant to their medication regimen (N=12, 8.1%). It is quite evident that geriatric group is most affected by the disease and it shows compliance either due to prolonged experience in dealing with the disease, the age factor or retired life.²⁵ The case with the others who were not compliant or showed less compliance such as adolescents can be linked to depression, parental influence and influence from the peers and friends.²⁶ In this context depression has recently been reported as a major comorbidity of DM in Pakistan.

Furthermore, the study investigated the patients' standard of knowledge regarding DM. When asked about the disease, majority of the patients (N=221, 86%) knew that their current health condition is related to their disease (P value < 0.01). The trend was same when the patients were asked about the course of diagnosis of their ailment, an overwhelming majority reported to experience symptoms related to DM (N=253, 98.4%) which prompted them to seek a diagnosis (P value < 0.01). Out of those who experienced symptoms, majority of patients (N=142, 55.3%) experienced polyphagia as a major sign (P value < 0.01). An encouraging number of patients (N=242, 94.2%) sought counseling from a doctor/ pharmacist (P value < 0.01) which is a new trend in Pakistan considering the overall health care dynamics and this observable fact scores the findings of previous studies which report the same all over the country.^{13,15,16,23} Almost all patients (N=255, 99.2%) reported remembering their medications (P value < 0.01) and correct way to use a glucometer at home (N=242, 94.9%) (P value < 0.01) as well as optimal blood glucose range (N=251, 97.7%) (P value < 0.01). Major segment knew the consequence of mismanaged DM (N=217, 84.4%) (P value < 0.01) and its association with elevated cholesterol (hyperlipidemia) (N=220, 85.6%) (P value < 0.01). Surprisingly a third of the target segment (N=83, 32.3%) did not know about the duration of their illness however, majority (N=174, 67.7%) was aware of the duration (P value < 0.01).

The patients' standard of knowledge was investigated using a newly designed scale known as the Patient 10-item Knowledge Assessment PKA-X scale. The mean score reported was 9.0 ($X=9.0, SD 1.4$) which was interpreted as 'Excellent knowledge' which holds the test hypothesis valid in this case (P value < 0.01).

An overwhelming majority of patients (N=202, 78.6%) was observed with their scores interpreted as excellent knowledge followed by a considerable number (N=41, 16%) with

adequate knowledge of DM. Few (N=11, 4.3%) reported low knowledge and almost negligible number of patients (N=3, 1.2%) had very low knowledge (P value <0.01). This shows that the standard of knowledge of patients with DM regarding their disease has significantly improved which can be attributed to the recent inclusion of pharmacists in the health care system of the country.²⁷ Although, the extent to which pharmacists are responsible for improved DM patient knowledge regarding their disease needs to be verified.

Further to this, the association of variable of education with variable of diagnosis of DM was statistically significant (P<0.01). The patients who were educated could decipher the symptoms which ultimately prompted them to get tested for the disease. Awareness of correct method of glucometer usage was found to be statistically significant (P<0.01) with the variable of education and counseling by pharmacist (P<0.01). The patients who were educated or sought counseling could learn the correct method to use the glucometer at home. The variable of awareness of optimal blood glucose range, consequences of mismanaged DM and association of DM with elevated cholesterol (hyperlipidemia) was also significantly associated with the doctor/ pharmacist counseling with P values of <0.01, <0.05 and <0.01 respectively. It means that those patients were explained about the matter by a health care professional HCP.

As a final point, the MMAS-8 scores were analyzed with PKA-X scores and results revealed that patients with excellent knowledge regarding the disease appeared to have low medication adherence which ultimately lead to the conclusion that knowledge about the disease may not influence the adherence to medication (P value>0.05) and subsequently rejected the test hypothesis. Hence there are some more influential factors affecting medication adherence. The investigators recommend further studies to be carried out in this regard.

CONCLUSION

The medication adherence of the patients is very low and adequate measures are the need of the hour to address this issue. The standard of knowledge of diabetic patients has

greatly improved and it is evident that presence of a pharmacist influence patient knowledge about the disease, its treatment and management. However, having good knowledge about the disease does not guarantee adherence to medication regimen.

It is very important to identify the potential local barriers to medication adherence and further digging into the matter is required, moreover prescribers need to raise this issue with their patients during their appointments, customize the treatment regimen and build a strong relationship with the patients. The employment of pharmacists as disease educators is essential for creating awareness about the issue and its consequences.

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CONFLICT OF INTEREST

The authors declare no conflict of interests exists.

SUPPORTING INFORMATION

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ABBREVIATION

DM:	Diabetes Mellitus
MMAS-8:	Morisky 8-item Medication Adherence Scale
PKA-X:	Patient 10-item Knowledge Assessment Scale
HCP:	Health Care Professionals

Highlights of Paper

- The medication adherence of the diabetic patients of Pakistan is very low.
- The standard of knowledge regarding Diabetes Mellitus DM has greatly improved among the patients.
- However, having good knowledge about the disease does not guarantee adherence to medication regimen.

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