

Knowledge of diabetes and insulin and its impact on hesitation to insulin use among patients with Type 2 Diabetes Mellitus from different healthcare facilities: A multi-center cross-sectional study from Pakistan

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ABSTRACT

Objective: To determine the Knowledge of Diabetes (KOD) and Knowledge of Insulin (KOI) and their association with hesitation to insulin use among people with Type 2 Diabetes Mellitus (T2DM) from three healthcare facilities in Karachi, Pakistan.

Methods: This multicenter cross-sectional study enrolled 767 patients from Outpatient Clinics of the Diabetes and Endocrinology Departments of Karachi, Pakistan. All consenting patients aged >18 years with T2DM taking oral hypoglycemic agents (OHAs) were enrolled. A structured questionnaire was used to assess KOD, KOI, and hesitation to insulin use. Chi-square and multiple logistic regression were used to determine the association of knowledge with the hesitation to use insulin.

Results: Fifty seven percent were females, with a mean age of 52.8 + 11.3 years. The majority were unaware of their type of diabetes (75%) and insulin pen devices (71.5%). More than 40% of study participants responded that multiple dosing is inconvenient, and insulin means too much self-care. The three most prevalent hesitations among patients include insulin not being able to be stopped (79%), insulin causing blood glucose levels to become too low (79%), and starting insulin, which means failure to control diabetes (75%). Patients with fair KOD and specifically fair KOI had significantly higher odds of having hesitation to insulin use.

Conclusion: This study identified knowledge gaps mainly for insulin use, which may lead to delayed or failure to initiate timely insulin therapy. Hence, individualized or group-focused educational activities should be implemented in hospitals to improve knowledge about the benefits of starting timely insulin therapy to prevent complications.

KEY WORDS: Knowledge gaps, structured diabetes education, lack of awareness, lack of diabetes education, glycemic control Type 2 Diabetes Mellitus.

BACKGROUND

Diabetes is one of the most prevalent non-communicable diseases worldwide.¹ According to the International Diabetes Federation (IDF-2021), 537 million adults live with diabetes globally, accounting for a 16% rise compared with the last IDF-2019 estimates.² Globally, Paki-

stan ranked 3rd in the prevalence of type 2 diabetes after China and India, with the prevalence reported at 33, 141, and 74 million, respectively.² Furthermore, one in every four adults in Pakistan resides with this chronic condition (26.7%), reaching the highest national prevalence globally.²

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Diabetes is a chronic metabolic disease characterized by elevated blood glucose levels, which, if untreated or not appropriately treated, leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves.³ Treatment options for diabetes include Oral Hypoglycemic Agents (OHAs) and insulin therapy.⁴ In people with Type 1 Diabetes Mellitus (T1DM), the daily administration of insulin is the cornerstone of treatment due to insulin deficiency in the body.⁵ Among individuals with Type 2 Diabetes Mellitus (T2DM), the body either does not produce enough insulin or cannot use it effectively, resulting in elevated blood sugar levels and impaired glucose regulation. Oral anti-diabetic medications help to a certain extent. However, despite maximal oral medications, the body eventually needs insulin as treatment due to progressive deterioration in beta cell function and resistance hyperglycemia.⁶ Insulin is an essential hormone produced by the pancreas that transports glucose from the bloodstream into the body's cells, where glucose is converted into energy.⁷ The lack of insulin or the inability of the cells to respond to insulin leads to high blood glucose levels or hyperglycemia, which is the hallmark of diabetes.⁷

Resistance or delay in initiating insulin therapy leads to poor glycemic control and the progression of micro and macrovascular complications.⁸ Literature from the west found several myths related to insulin therapy among patients with T2DM, including hypoglycemia, weight gain, social embarrassment, and loss of self-control, leading to delay in insulin initiation when required and prescribed, causing irreversible complications of the disease.⁹ However, there is a dearth of literature from Pakistan that highlights knowledge of diabetes and insulin among patients with T2DM and its association with hesitation to insulin use. Therefore, this study assessed knowledge of diabetes (KOD) and knowledge of insulin (KOI) and its association with hesitation to insulin use among patients with T2DM who attended three healthcare facilities in Karachi, Pakistan.

METHODS

This multicenter cross-sectional study was conducted at the Specialized Outpatient Clinics of Diabetes and Endocrinology in Karachi, Pakistan. Three healthcare facilities, including public sector, charity-based, and private healthcare settings, were approached from 2017 to 2019. Patients aged 18 years and above with T2DM, currently on OHAs, and willing to provide written informed consent were enrolled in the study. Those with T1DM, gestational diabetes, and T2DM patients currently on insulin were excluded. Final-year medical students and trainee fellows from the diabetes and endocrinology section were explained in detail about the objective of the study and questionnaire details. They conducted face-to-face interviews for 30 minutes through an interviewer-administered questionnaire. All patients who visited the outpatient clinics of the selected healthcare facilities were provided with

study details. Patients who met eligibility criteria and provided written informed consent were enrolled in the study.

Study questionnaire: The questionnaire used to assess KOD, KOI, and hesitation to insulin use among patients with T2DM was adapted from previous work conducted in a similar setting (10-12). Minor modifications have been made by the subject experts according to local settings and practices. The questionnaire consisted of four parts, including sociodemographic, KOD, KOI, and hesitation to insulin use. The responses were recorded as yes, no, and don't know.

Exposure Variables: The exposure variables, i.e., KOD and KOI, were later categorized as fair, satisfactory, and good knowledge. There was a total of six questions related to KOD, and the responses were later categorized according to the following scores: fair (0-2), satisfactory (3-4), and good knowledge (5-6). Similarly, there was a total of 21 questions related to KOI, and the responses were later categorized according to the following scores: fair (0-7), satisfactory (8-14), and good knowledge (15-21).

Outcome variable: The outcome variable, i.e., hesitation to insulin use, has eight questions. The responses were recorded as yes and no. Those unsure about any of the statements were considered hesitant toward insulin use due to their lack of knowledge.

Data analysis: Sociodemographic and diabetes-related data were summarized as mean $\pm$ standard deviation (SD) and frequencies with percentages as appropriate. A graphical presentation of the descriptive of KOD, KOI, and hesitation to insulin use was presented as percentages. A Chi-square test was used to check the association between KOD and KOI with hesitation to insulin use among patients. In addition, a multivariable logistic regression analysis was used to compute adjusted odds ratios for the association of KOD and KOI with hesitation to insulin use adjusted for age, gender, education, employment status, income, and duration of diabetes. A p-value of < 0.05 was considered significant. Data was analyzed using Stata® (Version 14.2 Stata Corp Texas, USA).

RESULTS

Out of the 767 patients interviewed, 57% (n=434) were females with a mean age of 52.8 ± 11.3 years. Thirty-seven percent (n=278) of patients had no formal education, while thirty-four (n=254) had intermediate and above education. A higher proportion (68.6%, n=526) of patients were not working and had a monthly household income of below 20,000 to 50,000 PKR. While comparing diabetes-related characteristics, only one-fourth of patients (25.3%, n=193) had good glycemic control as defined by HbA1c $< 7\%$ and half of them (50.2%, n=385) had a diabetes duration of fewer than five years. Sixty-three percent (n=483) had a positive family history of diabetes, and about 17% (n=128) were ever prescribed insulin. Known comorbidities among patients were hypertension (74%, n=566) and heart disease (13.4%, n=103). In terms of diabetes

Table-I: Characteristics of patients (n=767):

Characteristics	n	%
Sociodemographic		
Age (years), mean $\pm$ SD	52.8 $\pm$ 11.3	
Sex		
Female	434	56.6
Male	333	43.4
Level of Education (n=752)		
No formal education	278	36.9
Primary to Secondary	220	29.3
Intermediate & above	254	33.8
Employment status		
Working	241	31.4
Not working	526	68.6
Household monthly income PKR)		
<20,000	299	38.9
20,000 to 50,000	217	28.3
>50,000	180	23.5
Refused to disclose	71	9.3
Marital status		
Married	708	92.3
Single	59	7.7
Language		
Urdu	425	55.4
Sindhi	99	12.9
Punjabi	79	10.3
Others	164	21.4
Diabetes-related		
Glycemic control (HbA1c)		
Well-controlled (< 7%)	194	25.3
Mildly uncontrolled (7% to 9%)	299	39
Poorly Controlled (>9%)	192	25
Test not available	82	10.7
Duration of diabetes (years)		
< 5	385	50.2
5-10	192	25
>10	190	24.8
Family history of diabetes	483	63
Ever advised to use insulin	128	16.7
Comorbidities		
Hypertension	566	73.8
Heart disease	103	13.4
Diabetes Complications		
Neuropathy	158	20.6
Nephropathy	64	8.3
Retinopathy	159	20.7

complications present among patients, twenty-one percent developed neuropathy (n=158) and retinopathy (n=159), while 8% (n=64) had nephropathy (Table-I).

Fig.1 presents KOD and KOI among patients. While comparing KOD, 75% were unaware of their type of diabetes. However, almost 50% agreed that diabetes is a condition of the body not producing enough insulin. In addition, more than 60% considered diabetes a progressive disease (68%), good glycemic control could prevent or delay complications (63%), and diet, exercise, and medications/insulin as the best way to achieve good

glycemic control (72%). Furthermore, 98% admitted that insulin should be initiated either when the person is on three or more medications due to uncontrolled diabetes or once diabetes complications have started. The overall scores for KOD among patients were good (35.3%) to satisfactory (32.5%).

While comparing KOI, more than fifty percent had knowledge about how insulin works (52%), insulin controls blood glucose levels (59%), they do not fear insulin injection (58%), and they could self-inject insulin (66%). However, a higher proportion of patients were

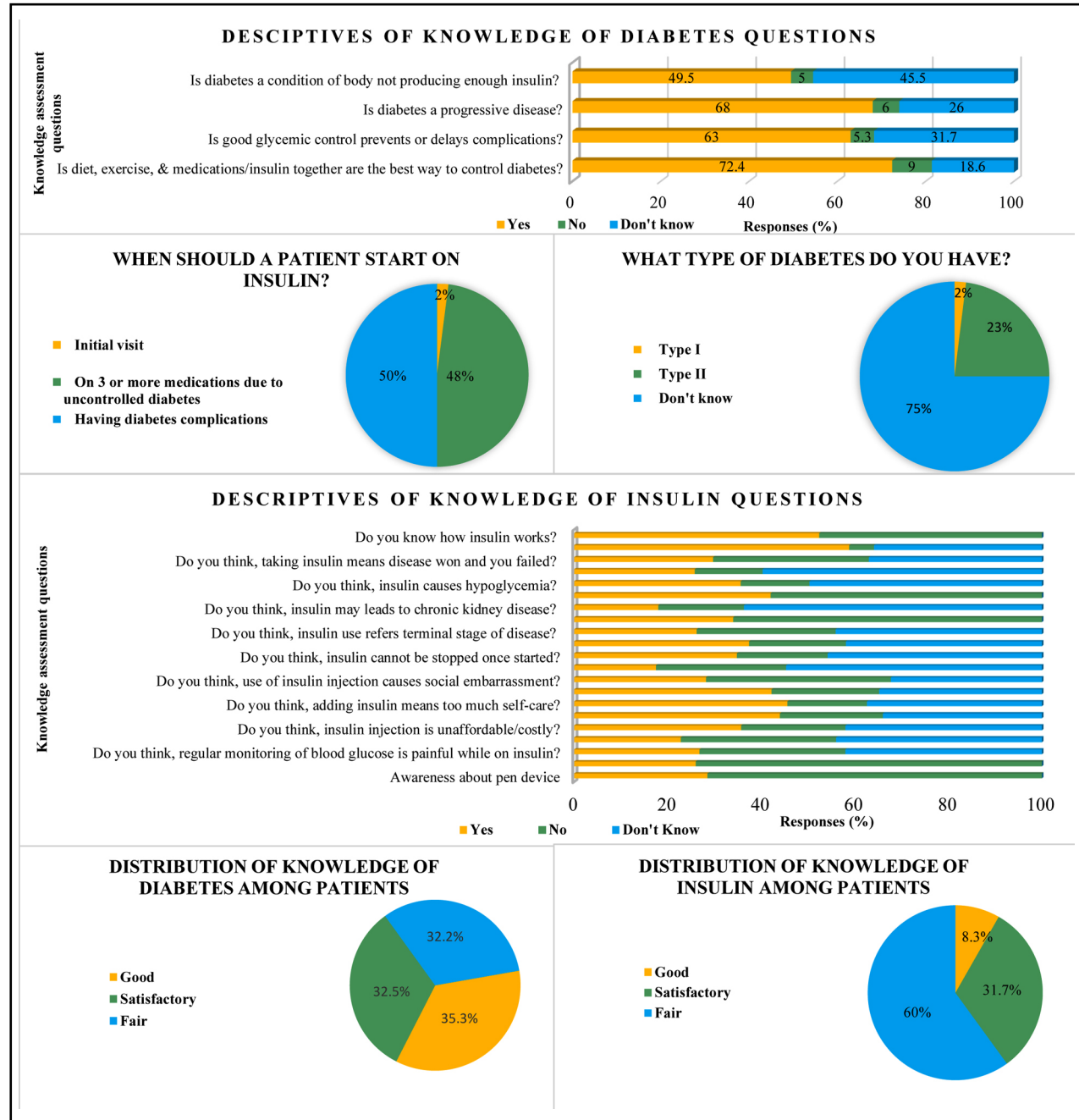


Fig.1: Knowledge of diabetes and knowledge of insulin among patients.

unaware of the insulin storage method (44%) and its cost (42%). In addition, a greater number of patients lack knowledge of whether insulin refers to the terminal stage of the disease (44%), people become addicted to insulin (42%), and insulin cannot stop once started (46%). More than half of the patients were unaware of whether insulin may lead to other complications, including weight gain (60%), hypoglycemia (50%), chronic kidney problems (64%), and organ damage (55%). Forty-four percent of patients accepted that insulin use is inconvenient due to multiple dosing and requires too much self-care, and 71.5% were unaware of the insulin pen devices. The overall scores for KOI among patients were fair (60%).

Table-II explains statements about hesitation to insulin use and patient responses. The most prevalent hesitations were that insulin could never be stopped (79%) followed by insulin, which may cause blood glucose levels to become too low (79%). Other hesitations found were that starting insulin means failure to diabetes management (75%), inability to use insulin properly (74%), might face issues in social life (73%), and insulin causing pain (71%).

Multivariable logistic regression analysis reveals that patients with fair KOD had significantly higher odds for hesitation 2 (OR: 1.9; CI: 1.1, 3.5) and hesitation 5 (OR: 3.1; CI: 1.8, 5.5) as compared to those with a good

and satisfactory KOD. On the other hand, patients with fair KOI were found with significantly higher odds for all hesitations related to insulin use, with the three highest odds reported for hesitation 1 (OR: 6.9; CI: 4.5, 10.7), hesitation 3 (OR: 6.6; CI: 4.1, 10.5), and hesitation 4 (OR: 6.4; CI: 3.8, 10.8). All models were adjusted for age, gender, education, employment status, income, and duration of diabetes (Table-II).

DISCUSSION

This cross-sectional study aimed to assess KOD and KOI and their association with hesitation to insulin use among patients with T2DM from three healthcare facilities in Karachi, Pakistan. The study findings demonstrated that patients with T2DM had adequate KOD but lacked knowledge about insulin. We found significantly higher odds for hesitation 2, i.e., insulin causes pain, and hesitation 5, i.e., insulin increases the severity of diabetes among patients who had fair KOD. However, among patients with fair KOI, there were significantly higher odds for all eight hesitations to insulin use.

We found most of the study participants with adequate knowledge about the natural progressive course of T2DM. Similarly, the majority agreed that achieving good glycemia prevents or delays

Table-II: Logistic regression of risk factors associated with hesitation to insulin use among patients.

	Hesitation 1 Insulin is harmful for body		Hesitation 2 Insulin causes social issues		Hesitation 3 Insulin causes pain		Hesitation 4 Insulin could never be stopped		Hesitation 5 Insulin increases severity of diabetes		Hesitation 6 Insulin causes low blood glucose		Hesitation 7 I could not use insulin properly or forget		Hesitation 8 Insulin means failure to diabetes control	
%	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	64	36	73	27	71	29	79	21	59	41	79	21	74	26	75	25
^OR (95% CI)																
KOD																
Satisfactory (Ref)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fair	1.5 (0.8, 2.6)		1.9 (1.1, 3.5)*		1.8 (0.9, 3.3)		1.6 (0.8, 2.9)		3.1 (1.8, 5.5)*		1.6 (0.8, 3.1)		1.4 (0.7, 2.7)		1.0 (0.5, 1.7)	
Good	0.5 (0.3, 0.8)*		0.5 (0.3, 0.7)*		1.1 (0.7, 1.8)		0.8 (0.5, 1.3)		0.7 (0.4, 1.0)		0.6 (0.4, 0.9)*		0.6 (0.4, 0.9)*		0.6 (0.3, 0.9)*	
KOI																
Satisfactory (Ref)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fair	6.9 (4.5, 10.7)*		6.2 (3.9, 10.1)*		6.6 (4.1, 10.5)*		6.4 (3.8, 10.8)*		6.0 (3.9, 9.1)*		4.8 (2.7, 7.4)*		3.3 (2.0, 5.3)*		5.2 (3.2, 8.5)*	
Good	0.1 (0.1, 0.3)		0.3 (0.1, 0.6)*		0.2 (0.1, 0.4)*		0.3 (0.2, 0.6)*		0.7 (0.3, 1.5)		0.3 (0.2, 0.6)*		0.2 (0.1, 0.5)*		0.2 (0.1, 0.4)*	

^Adjusted for age, gender, education, employment status, income, and duration of diabetes

*P-value <0.05.

complications. Furthermore, the majority accepted that diet, exercise, and medication/insulin together are the best way to achieve good glycemic control. However, the majority were unaware of their type of diabetes. We also found that patients with fair KOD identified insulin as a social issue that can cause problems in their daily lives and may lead to increased diabetes severity. Studies from other settings showed that patients' knowledge about diabetes and insulin significantly impacted their decision on the acceptance of insulin therapy; furthermore, adequate knowledge helps lower reluctance toward insulin initiation among patients and empowers them to manage it efficiently.^{13,14}

We found a considerable gap in insulin knowledge among patients as most were unaware of whether insulin causes weight gain, hypoglycemia, or complications/organ damage. However, most of them found insulin therapy inconvenient due to multiple dosing that requires too much self-care. Moreover, most patients were unaware of the availability of insulin pen devices. The existence of several misconceptions related to insulin use among T2DM patients has also been reported by studies from other settings.^{9,15-16} For example, Elkarim et al. found most of their study patients disagreed that insulin could control blood glucose better, and one can switch back to OHAs after initiating insulin therapy. Moreover, patients were unsure whether a person with HbA1c levels nine and above should begin insulin therapy.¹⁷

A higher proportion of patients with T2DM are reluctant towards insulin initiation due to their negative thoughts and lack of knowledge.^{18,19} For example, a study found patients unwilling to initiate insulin therapy due to the belief that insulin causes long-term diabetes complications. In addition, they felt they could not manage their insulin dosages due to lack of time, and managing their diet would be an issue while on insulin therapy.²⁰ In our study, starting insulin means failure to control diabetes, inability to manage insulin therapy, and insulin would cause pain are the most prevalent hesitations. We also found that patients with fair knowledge of insulin had significantly higher odds of being hesitant toward insulin use than those with satisfactory and good knowledge.

Our study has several strengths and limitations. To the best of our knowledge, this study is one of the first to assess knowledge gaps about diabetes and insulin and its association with hesitation to insulin use among patients with T2DM who visited three healthcare facilities. Secondly, our study sample represents people from different socioeconomic statuses and healthcare setups; hence, the findings are more generalizable. Another major strength of our study is a larger sample size. We used multivariable logistic regression to find an association between KOD and KOI with hesitation to insulin use and hence adjusted the models for the potential confounders. Our study has some limitations as the study design used in our study showed an association

between KOD and KOI with hesitation to insulin use but could not infer causation. The questionnaire used in our study to assess the knowledge and hesitation was not validated in our setting; however, it was reviewed and modified by three subject matter experts according to our setting and practices.

CONCLUSION

This multicenter study identified knowledge gaps related to diabetes and insulin associated with the hesitation to insulin use among patients with T2DM from three different socioeconomic healthcare facilities. Our study findings may provide clinicians with more insights into implementing educational activities to improve patients' knowledge to timely initiate insulin therapy for better glycemic control and prevent irreversible complications and disabilities. In addition, educating patients, discussing the natural course of the disease, and re-enforcing possible treatment options, including insulin at each visit might help improve patients' education about insulin.

Declarations:

Ethics approval and consent to participate: The study was approved by the Ethical review committee of The Aga Khan University (Ref: 4486-Med-ERC-16), The Indus Hospital (IRD_IRB_2018_07_003), and Dow University of Health Sciences (IRB-1095/DUHS/Approval/2018). Written informed consent was obtained from patients before participation.

Availability of data and materials: Data are available on reasonable request by contacting the corresponding author and following acceptance by the contributing institutions.

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Author's Contributions:

MO and SN contributed equally to this paper. MO, ZK, SB, and AS designed and supervised the study. MO, SN, ZK, and SB handled and verified the data. MO, SN, ZK, and SB did the statistical analysis and wrote the manuscript. NI, AS, and MO reviewed and provided scientific revisions to the manuscript. All authors contributed to data interpretation. All authors revised and approved the final version of the manuscript before submission.

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