Factors Associated with Insulin Self-Administration Knowledge and Practices Among Hospitalized Diabetes Mellitus Patients in Peshawar, Pakistan

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LINK MEDICAL INTERFACE

Muhammad Khalil Khan[1], Kainat Asmat[2], Huma Rubab[3], Amir Rahman[4]

Correspondence
Amir Rahman
amirlnh2@gmail.com

Affiliations
1 MSN Graduate, Shifa College of Nursing, Shifa Tameer-e-Millat University, Islamabad, Pakistan.
2 Associate Professor and Assistant Dean Graduate Studies & Research, Faculty of Nursing and Midwifery, Shifa Tameer e Millat, University, Islamabad, Pakistan
3 Assistant Professor, Faculty of Nursing and Midwifery, Shifa Tameer e Millat, University, Islamabad, Pakistan.
4 Assistant Professor, Department of Nursing, CECOS University of IT and Emerging Sciences, Peshawar, Pakistan.

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Insulin self-administration, diabetes management, knowledge assessment, practice improvement, diabetes education, Pakistan, hospitalized patients.

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ABSTRACT

Background: Diabetes Mellitus (DM) has emerged as one of the fastest-growing chronic conditions worldwide. Effective DM management often requires insulin self-administration (ISA) to maintain glycemic control and reduce complications.

Objective: This study aimed to assess knowledge and practices of ISA among hospitalized DM patients and identify factors influencing ISA knowledge and practices.

Methods: An observational, analytical cross-sectional study was conducted with 116 insulin-dependent DM patients at a public hospital. Knowledge related to ISA was assessed using a validated multiple-response questionnaire administered through face-to-face interviews, while practices were observed using a structured observational checklist. ISA knowledge was categorized as poor (0-7), average (8-11), and good (12-15). Practices were categorized as poor (0-7), fair (8-10), and good (11-14). Chi-square tests were used to identify sociodemographic and clinical factors associated with ISA knowledge and practices.

Results: Participants aged above 50 (69.8%), equally represented by men and women (53.4% and 46.6%, respectively). ISA knowledge assessment revealed that 34.5% participants had poor knowledge, 50% average, and 15.5% good knowledge. Poor practices were observed in 37.1%, fair in 29.3%, and good in 33.6%. Age, education, family history, duration of DM, and prior training were significantly associated with ISA ($p < 0.05$).

Conclusion: Overall knowledge of the participants was average, while their practices were predominantly poor. Main factors influencing ISA encompassed age, education, family history, duration of DM, and prior training. Targeted educational programs focusing on identified factors are needed to improve ISA knowledge and practices among DM patients in Pakistan.

INTRODUCTION

Diabetes Mellitus (DM) represents a significant and escalating public health challenge worldwide, characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is primarily classified into Type 1 DM, an autoimmune disorder leading to absolute insulin deficiency, and Type 2 DM, which is associated with insulin resistance and a progressive decline in pancreatic beta-cell function (1). The International Diabetes Federation (IDF) has reported an alarming rise in the prevalence of DM globally, with 537 million adults affected in 2021, an increase of 16% from 2019. This number is projected to rise to 643 million by 2030 and 783 million by 2045. The Middle East and North Africa (MENA) region, including countries like Pakistan, is witnessing a particularly rapid increase in DM prevalence. In Pakistan, 33 million adults were reported to have DM in 2021, marking a 70% increase from 2019. Moreover, a significant proportion of these cases remain undiagnosed, posing a substantial risk of complications (3, 4).

Effective management of DM involves a combination of lifestyle modifications, such as diet and exercise, and pharmacological interventions. Insulin therapy is indispensable for Type 1 DM and is often required for patients with poorly controlled Type 2 DM. Insulin self-administration (ISA) is a cornerstone in the management of DM to achieve optimal glycemic control and prevent complications. However, effective ISA requires adequate knowledge and proper technique, including correct dosage, injection site selection, and disposal of syringes and needles, to avoid complications like lipodystrophy, infection, and hypoglycemia (5, 6). The American Diabetes Association (ADA) provides detailed guidelines for ISA, which emphasize the importance of rotating injection sites and ensuring proper syringe disposal to reduce complications (7, 8). Despite the availability of these

guidelines, adherence to them remains suboptimal in many settings, particularly in low- and middle-income countries (LMICs) like Pakistan, where healthcare resources and patient education are limited.

In Pakistan, factors such as limited access to education, inadequate healthcare infrastructure, and low socioeconomic status present significant barriers to effective DM management, including ISA. There is limited research focusing on the knowledge and practices related to ISA among DM patients in Pakistan. Existing studies have mostly relied on self-reported data, which may not accurately reflect actual practices (9-11). Moreover, the specific factors influencing ISA knowledge and practices among patients in Pakistan remain underexplored. This study aimed to assess the level of knowledge and the implementation of ISA practices among hospitalized DM patients in Peshawar, Pakistan. Additionally, the study sought to identify key sociodemographic and clinical factors associated with ISA knowledge and practices.

MATERIAL AND METHODS

The study employed an observational, analytical cross-sectional design, conducted in a public sector hospital in Peshawar, Pakistan, from May to September 2023. The target population consisted of adult patients with a confirmed diagnosis of either Type 1 or Type 2 DM, who were insulin-dependent and admitted to the hospital. Inclusion criteria were adult patients receiving insulin therapy for at least six months. Pregnant women, patients administering insulin via pen, those with known psychological comorbidities, and critically ill patients requiring regular haemodialysis were excluded. The sample size was calculated to be 116 using the OpenEpi software, based on a four-month census of insulin-dependent DM patients admitted to the hospital, ensuring an adequate representation of the target population. Participants were recruited using a non-probability consecutive sampling technique to minimize selection bias.

Sociodemographic data, including age, gender, education level, marital status, occupation, and monthly income, were collected through face-to-face interviews with the participants. Clinical data, such as type of DM, duration since diagnosis, family history of DM, duration of ISA, and previous ISA training, were gathered from participants and corroborated with their medical records. To assess the knowledge related to ISA, a structured questionnaire was used, which was adapted from a previously validated tool (12) and modified by the authors in accordance with the ADA guidelines (2017). The content validity of the modified questionnaire was verified through a Content Validity Index (CVI) by five experts with relevant research experience and tool development backgrounds. The item-level CVI ranged from 0.80 to 1.00, while the scale-level CVI was 0.96 for relevance. For clarity, the item-level CVI ranged from 0.80 to 1.00, and the scale-level CVI was 0.80. Reliability was determined through a pilot study involving 18 participants (10% of the sample size), who were not included in the final analysis. The Cronbach's alpha value for the modified questionnaire was 0.79, indicating acceptable internal consistency. An Urdu-translated version of the questionnaire was administered to ensure comprehension among participants with low literacy levels. The questionnaire included multiple-choice questions, with each correct response scoring one point. Total possible scores ranged from 0 to 15, categorized as good knowledge (12-15), average knowledge (8-11), and poor knowledge (0-7).

The practices related to ISA were assessed using an observational checklist adapted from a previously validated tool (13). The checklist comprised 14 items detailing the steps involved in ISA, including handwashing, checking the expiry date and type of insulin, selecting the appropriate injection site, and proper disposal of syringes. Each step was scored as ‘completely done’ (1 point), ‘partially done’ (0.5 points), or ‘not done’ (0 point), with a total score ranging from 0 to 14. Scores were categorized as good practice (11-14), fair practice (8-10), and poor practice (0-7). Each participant was observed twice during their dosing schedule to mitigate the Hawthorne effect, and the average score of both observations was considered for analysis.

The study adhered to ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board and Ethics Committee (IRB & EC) of Shifa Tameer-e-Millat University, Pakistan. Written informed consent was obtained from all participants before data collection, and participants were assured of their right to withdraw at any point without any repercussions. Confidentiality and privacy were strictly maintained throughout the study period. Hard copies of informed consent and data collection forms were securely stored in a locked cabinet, while electronic data were encrypted and stored on a password-protected computer.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) software, version 26. Descriptive statistics, such as mean and standard deviation for continuous variables and frequencies and percentages for categorical variables, were

computed to summarize the sociodemographic and clinical characteristics of the participants, as well as their knowledge and practice scores. To identify factors associated with ISA knowledge and practices, the normality of the data was assessed visually using histograms and statistically using the Shapiro-Wilk test. The Shapiro-Wilk test indicated a non-normal distribution for both knowledge and practice scores (p-values < 0.05). Consequently, the Chi-square test was used to determine associations between sociodemographic and clinical variables and ISA knowledge and practice scores, as this test is appropriate for analyzing categorical data. All statistical analyses were conducted with a 95% confidence interval, and a p-value of less than 0.05 was considered statistically significant.

RESULTS:

The response rate was 100%. The majority of participants were aged above 50 years (69.8%), while 19% were between 31-40 years, and a smaller portion was aged 20-30 years (7.8%). The gender distribution was relatively balanced, with 53.4% men and 46.6% women. Education levels varied, with 37.1% having no formal education, 22.4% with primary education, 30.2% with secondary education, and only 10.3% with university-level education. Most participants were married (87.9%), while 40.5% were unemployed, and 58.6% reported a monthly income below 20,000 Pakistani Rupees. Table 1 provides a detailed breakdown of the sociodemographic characteristics.

Clinical data revealed that 53.4% of participants had Type 1 DM, while 46.6% had Type 2 DM. The duration of DM since diagnosis was 1-5 years for 36.2% of participants, 6-10 years for 31.9%, and over 10 years for 30.2%. A family history of DM was reported by 41.4% of participants, while 51.7% had not received any prior training on ISA. Table 2 summarizes the clinical characteristics of the participants.

ISA knowledge assessment data revealed that 34.5% of the participants demonstrated poor knowledge, 50% had average knowledge, and 15.5% had good knowledge. Specific knowledge gaps were noted, such as 70.7% of participants lacking awareness about the initial step of ISA (handwashing) and 86.2% not understanding the importance of letting the injection site dry after cleaning with alcohol. Conversely, 95.7% were aware of the DM definition, and 82.8% were informed about the use of insulin in hyperglycemia. Table 3 presents the distribution of correct and incorrect responses to the knowledge assessment questions.

With regards to ISA practice score, 37.1% of participants exhibited poor practice, 29.3% demonstrated fair practice, and 33.6% showed good practice. Specific practices such as proper handwashing before ISA were followed by 50% of participants and appropriate site selection for insulin injection was observed in 69% of participants. Table 4 summarizes participants' adherence to ISA steps based on the observation checklist.

The findings reveal significant associations between various sociodemographic and clinical factors with ISA knowledge and practices. Age showed significant associations with both knowledge (p-value: 0.004) and practice scores (p-value: 0.038). Education level had a significant association with knowledge scores (p-value 0.000) but not with practice scores (p-value 0.255). Monthly income in rupees was significantly associated with knowledge scores (p-value 0.019), while practice scores had an insignificant association (p-value 0.063). Both knowledge and practice scores were significantly associated with the duration of DM (p-value 0.002 and 0.025, respectively). Type of DM was only significantly associated with practice scores (p-value 0.051). Tables 5 and 6 summarized the associations between sociodemographic and clinical variables with ISA knowledge and practice scores, respectively.

Table 1: Sociodemographic Characteristics of Participants (n=116)

Sociodemographic Variables	Frequency (n)	Percentage (%)
Age in Years		
20-30	9	7.8
31-40	22	19.0
41-50	4	3.4
Above 50	81	69.8
Gender		
Male	62	53.4
Female	54	46.6
Educational Status		
No Formal Education	43	37.1
Primary Education	26	22.4
Secondary Education	35	30.2

Sociodemographic Variables	Frequency (n)	Percentage (%)
University Education	12	10.3
Marital Status		
Married	102	87.9
Unmarried	11	9.5
Occupation		
Unemployed	47	40.5
Formal Employed	17	14.7
Self-Employed	28	24.1
Others	24	20.7
Monthly Income in Rupees		
≤ 20,000	68	58.6
21,000-35,000	48	41.4

Table 2: Clinical Characteristics of Participants (n=116)

Clinical Variables	Frequency (n)	Percentage (%)
Type of DM		
Type I	62	53.4
Type 2	54	46.6
Duration of DM		
< 1 Year	2	1.7
1-5 Years	42	36.2
6-10 Years	37	31.9
> 10 Years	35	30.2
Family History of DM		
Yes	48	41.4
No	28	24.1
Don't Know	40	34.5
Previous Training on ISA		
Yes	56	48.3
No	60	51.7

Table 3: Knowledge of Participants about ISA (n=116)

Knowledge Question	Correct (n)	Correct (%)
Diabetes Mellitus (DM) is a condition in which?	111	95.7
What causes DM?	75	64.7
What is the normal range of glucose (sugar) in the blood?	59	50.9
What are the symptoms of high blood sugar?	85	73.3
What are the symptoms of low blood sugar?	89	76.7
Insulin is used in the condition like?	96	82.8
The first step in insulin self-administration is?	34	29.3
Why is it necessary to clean the injection site with alcohol or spirit swab?	69	59.5
Why is it necessary to let the injection site dry for 30 seconds after cleaning?	16	13.8
Which angle should be maintained while administering insulin injection?	54	46.6
Why is it necessary to store insulin vial in a fridge or cold place?	91	78.4
The appropriate timing to administer an insulin Injection is?	84	72.4
The preferable sites for insulin injection are?	58	50.0
What will be the advantages of changing sites for insulin injection?	62	53.4
The appropriate method of disposing of the insulin syringe and needle after injection	11	9.5

Table 4: Practice of Participants Towards Insulin Self-Administration (n=116)

Steps of ISA	Not Done	Partially Done	Completely Done
Wash hands	28 (24.1)	30 (25.9)	58 (50.0)
Check expiry date and type of Insulin	13 (11.2)	55 (47.4)	48 (41.4)
Bring insulin to room temperature	12 (10.3)	45 (38.8)	59 (50.9)
Roll the bottle between hands until it is uniform	28 (24.1)	44 (37.9)	44 (37.9)
Wipe the top of the insulin bottle with an alcohol swab	40 (34.5)	35 (30.2)	41 (35.3)
Draw air into the syringe equal to the dose of insulin you take	35 (30.2)	37 (31.9)	44 (37.9)
Pierce the rubber stopper of the insulin vial at a 90° angle	26 (22.4)	37 (31.9)	53 (45.7)
Draw the dose into the syringe, remove air bubbles	22 (19.0)	39 (33.6)	55 (47.4)
Place syringe carefully without letting needle touch the surface	22 (19.0)	39 (33.6)	55 (47.4)

Steps of ISA	Not Done	Partially Done	Completely Done
Select the appropriate site	12 (10.3)	24 (20.7)	80 (69.0)
Clean the injection site with alcohol swab and let it dry	18 (15.5)	49 (42.2)	49 (42.2)
Inject insulin, count to 10, release skin fold, press alcohol swab	20 (17.2)	38 (32.8)	58 (50.0)
Clip off the syringe needle and dispose of safely	51 (44.0)	25 (21.6)	40 (34.5)

Table 5: Associations Between Sociodemographic and Clinical Variables with Knowledge Scores (n=116)

Variables	Poor Knowledge	Average Knowledge	Good Knowledge	Chi-Square	P-Value
Age (in years)	37 (92.5%)	32 (55.2%)	12 (66.7%)	19.341	0.004*
Gender	13 (32.5%)	31 (53.4%)	10 (55.6%)	0.870	0.088
Education Level	28 (70.0%)	23 (39.7%)	2 (11.1%)	32.148	0.000*
Family History of DM	6 (15%)	28 (48.2%)	14 (77.8%)	27.756	0.000*
Previous ISA Training	29 (70.7%)	21 (36.2%)	10 (55.6%)	12.613	0.002*

Table 6: Associations Between Sociodemographic and Clinical Variables with Practice Scores (n=116)

Variables	Poor Practices	Fair Practices	Good Practices	Chi-Square	P-Value
Age (in years)	37 (86.0%)	18 (52.9%)	26 (66.7%)	13.309	0.038*
Type of DM	15 (34.9%)	15 (44.1%)	24 (61.5%)	5.954	0.051
Duration of DM	10 (23.3%)	14 (41.2%)	18 (46.2%)	14.435	0.025*
Family History of DM	9 (20.9%)	19 (55.9%)	20 (51.3%)	21.673	0.000*

DISCUSSION

This study assessed the knowledge and practices related to ISA among hospitalized DM patients in Peshawar, Pakistan. The findings underscored several significant sociodemographic and clinical factors associated with the knowledge and practice of ISA. These insights are vital in guiding targeted educational interventions to enhance DM management in resource-limited settings.

The study revealed that a considerable proportion of participants had inadequate knowledge and poor practices related to ISA. Specifically, 34.5% demonstrated poor knowledge, and 37.1% exhibited poor practices, suggesting substantial gaps in the understanding and implementation of safe ISA techniques among hospitalized DM patients. These findings were consistent with previous studies conducted in other LMICs, such as Ethiopia, where a majority of participants showed suboptimal knowledge and practices concerning ISA (14). The poor knowledge and practices observed in this study may be attributed to the low literacy levels, limited access to structured educational programs, and inadequate healthcare resources available to DM patients in Pakistan. The average level of knowledge observed among 50% of the participants indicated a need for more comprehensive and tailored educational interventions.

The study also identified several key factors significantly associated with ISA knowledge and practices, including age, educational status, family history of DM, duration of DM, and prior training on ISA. Older participants, particularly those above 50 years of age, were more likely to exhibit poor knowledge and practices, which aligned with other studies reporting that older age groups often face challenges in acquiring new health-related knowledge and skills due to cognitive decline and reduced access to educational opportunities (15,16). In contrast, younger participants were more likely to have better knowledge and practices, reflecting a potential benefit from targeted education that leverages more accessible communication channels, such as digital platforms and community-based programs. The significant association between educational status and knowledge scores found in this study was consistent with findings from similar studies conducted in Sudan and Lebanon, where higher education levels correlated with better understanding and adherence to ISA guidelines (17,18).

The presence of a family history of DM was another critical factor associated with better ISA knowledge and practices. Participants with a family history of DM were more likely to have been exposed to DM management practices and education, which could explain their higher knowledge and adherence levels. This finding was in agreement with research conducted in Ethiopia, where a family history of DM was significantly associated with better self-care practices among DM patients (19). This suggested that familial support and shared experiences could be leveraged to design more effective educational interventions, particularly in resource-constrained settings where formal healthcare education might be lacking.

The duration of DM was also significantly associated with ISA knowledge and practices, with participants having a longer duration since diagnosis demonstrating better knowledge and practices. This

finding could be explained by the fact that patients who have lived longer with DM are more likely to have had multiple interactions with healthcare professionals and educational sessions over time, improving their understanding and skills related to ISA. This was consistent with findings from previous studies where longer duration of DM was linked to improved knowledge and self-care practices (16,20). However, this also suggested that there could be gaps in initial education and training for newly diagnosed patients, highlighting a need for early and frequent educational reinforcement.

Prior training on ISA emerged as a significant factor influencing knowledge but not practice scores in this study. While those who received formal training had significantly better knowledge, this did not necessarily translate into better practices. This discrepancy suggested that knowledge alone might not be sufficient to change behavior and that practical, hands-on training is critical to reinforcing correct practices. This was supported by findings from other studies that demonstrated the effectiveness of structured and repeated training sessions in improving both knowledge and practices related to insulin administration (21,22). The lack of significant association between training and practice scores in this study underscored the importance of not only providing initial training but also ensuring ongoing support and practical guidance to sustain proper ISA practices.

The study had several strengths, including a rigorous methodological approach with the use of validated tools for data collection and structured observations to minimize bias. The high response rate of 100% strengthened the reliability of the findings, as it reduced the risk of non-response bias. However, some limitations should be noted. The study was conducted in a single public sector hospital in Peshawar, limiting the generalizability of the findings to other settings in Pakistan. Additionally, the cross-sectional design precluded the establishment of causal relationships between the identified factors and ISA knowledge and practices. The relatively small sample size may have limited the power to detect associations with less common variables. Future research could benefit from a multi-center approach with a larger and more diverse sample to enhance the generalizability of the findings and further explore the causality of the associations observed.

CONCLUSION

The study concluded that knowledge and practices related to ISA among hospitalized DM patients in Peshawar were generally suboptimal, with significant gaps influenced by age, education level, family history of DM, duration of DM, and prior training. These findings underscore the urgent need for tailored educational interventions and hands-on training programs to improve both knowledge and practical skills, particularly targeting vulnerable groups such as older patients and those with lower education levels.

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