Original Article

Awareness and Practice of Proper Insulin Self-Administration among Patients with Diabetes Mellitus in Al-Ahsa, KSA

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ABSTRACT

Introduction: This study assessed the awareness and practices of subcutaneous insulin self-administration among diabetes mellitus (DM) patients in Saudi Arabia. The key objectives were to evaluate patients' knowledge, correlate it with glycemic control, and address gaps to enhance overall patient care for this highly prevalent condition in the region.

Methodology: This was a cross-sectional study conducted in Al-Ahsa, Saudi Arabia, using an online questionnaire to assess diabetes management in randomly selected adult DM patients aged 18-65. Ethical approval and informed consent were obtained prior to the study.

Results: The study involved 380 DM patients from Al-Ahsa, Saudi Arabia. Most were female (59.5%) and Saudi nationals (96.3%), with over half married (53.4%). While 42.1% had type 2 and 45.5% had type 1 diabetes, 12.7% were unsure of their type. 38.7% showed high insulin self-administration awareness, and 42.4% were diagnosed over 10 years ago. Patients heavily relied on healthcare professionals (75.5%) for insulin info, preferred insulin pens (91.3%), and adhered to instructions (65.3%). Factors like age, marital status, and medication use significantly impacted insulin practices. Many counted carbs (40.5%) and adjusted doses before meals (41.3%).

Conclusion: The current study highlights that 38.7% of DM patients show a comparatively high level of awareness. Carbohydrate counting and pre-meal insulin adjustments are practiced by an average of 40% of patients. There is considerable variability among patients regarding insulin practices.

Keyword: Diabetes mellitus; insulin; DM1; DM2; glycemic control; injections.

Introduction

Diabetes mellitus (DM) is a condition characterized by chronic high glucoseemia. [1, 2]. It is a heterogeneous group of disorders due to an absolute or relative deficit in insulin production or its action [3]. According to World Health Organization (WHO) data, Saudi Arabia has the second highest rate of diabetes in the Middle East, and is seventh globally for this disease. Insulin is one of the commonly used anti-diabetic medications And is the most effective agent in dropping blood glucose levels when used in hyperglycemia [5]. Insulin is the primary treatment for patients with Type 1 diabetes, it's also frequently used as an add-on to other hypoglycemic agents in patients with Type 2 diabetes that haven't achieved their desired glucose levels [6].

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Furthermore, Patients with diabetes type 2 are reportedly able to transition to using insulin. The route of insulin administration can be via subcutaneous, intravenous, and intramuscular routes. However, in non-emergency cases, it is administered subcutaneously in one or more daily doses by self-administration [7]. Insulin misuse and inadequate awareness may result in potentially avoidable complications and poor patient outcomes [8]. Subsequently, this emphasizes the significance of patient education as a crucial component of DM care programs, which are frequently provided at primary healthcare centers where more than 90% of DM patients receive their care and treatment [9, 10]. There is a critical requirement to examine the practice of proper insulin use in patients with both type 1 and 2 DM, which is highlighted by the likelihood that inadequate understanding regarding insulin usage will affect its acceptance and adherence, as well as the outcome of therapy [11]. Various studies of patient knowledge attitudes and practices regarding insulin self-administration have been conducted worldwide. One study that has been done in India found that" The average knowledge score was 9.06±1.88 out of 22 and the practice score was 7.75±1.24 out of 11." [3]. According to a different study done in Jordan, a considerable percentage of DM patients had inadequate insulin injection procedures; around 36.6% of patients with type 1 DM and 50.5% of patients with type 2 DM reported using the same insulin needle more than three times. Patients with type 1 diabetes had a prevalence of lipohypertrophy of 57.0%, whereas those with type 2 diabetes had a prevalence of 55.5%. [8]. In Saudi Arabia, the knowledge and practice of the use of insulin therapy varied according to the regions studied. A hospital-based study conducted in Riyadh revealed that "The mean knowledge score was 6.5 ±1.6. Participants demonstrated generally positive practice, with 92.5% rotating injection sites, 83.3% sterilizing the injection site, and 95.7% consistently adhering to their insulin regimen [12]. Another cross-sectional study conducted in Makkah Region revealed that "About 35.3% of patients experienced lipohypertrophy, and 58.7% experienced injection-related problems" [13]. Despite the previously mentioned importance of proper insulin injections, the extent of patients' knowledge, awareness, and practices (KAP) regarding this topic is not well-studied in Saudi Arabia. Thus, the purpose of this study is to evaluate patients' awareness of and adherence to appropriate subcutaneous insulin self-administration strategies with either type of DM and to evaluate the relationship between glycemic control and KAP scores in Al-Ahsa DM patients as a representative sample of a KSA region with a diversified population.

Methods

Study design: It is an observational cross-sectional study with a questionnaire that was conducted from June 2023 to December 2023. A total of 380 participants from Al-hsa have been recruited for the study using a simple random selection approach. The research was authorized by King Faisal University's institutional review board in Al Hofuf, Saudi Arabia, under project number: KFU-REC-2023-MAY-ETHICS832.

Study population: The research population consists of Al-Ahsa-based adult patients with gestational diabetes, type 1 diabetes, or type 2 diabetes. Patients between the ages of 18 and 65 were chosen at random and include both male and female patients.

The inclusion criteria: Patients who have either type 1 or type 2 DM under insulin therapy, alone or in combination with other oral medications.

The exclusion criteria: DM with only oral glycemic drug, any patients who live outside Al-Ahsa.

Sample size: A Raosoft electronic calculator is used to determine the sample size based on the following values: 5% as the allowable margin of error and 95% as the confidence level and population size = 17000. By using these data, the sample size of 374 patients is expected to be the minimum sample size to consider the generalizability of the results.

Data collection: A self-administered survey was implemented with questionnaire items validated by consultants, and a pilot study of 20 participants was carried out. The pilot study participants had been excluded from taking part in the study. The online self-administered questionnaire was used to obtain data, and before beginning to fill it out, participants had to consent to participate in the study. The questionnaire was distributed online to randomly selected DM patients who use insulin injections in Al-Ahsa. The questionnaire is filled out by a patient or by the caregiver. There are three sections to the questionnaire. Sociodemographic data were included in the first part (age, sex, nationality, educational status, marital status, and chronic disease). The second part of the questionnaire included patient health data specifically on DM, its type, duration of the disease, duration of insulin use, and frequency of insulin administration. The third part is dedicated to the assessment of knowledge and practices. Ethical approval

Ethical approval: was obtained from the Institutional Review Board (IRB) at King Faisal University under project number KFU-REC-2023-MAY-ETHICS832 before distributing the questionnaire. Patients signed an informed consent before filling out the questionnaire. The research ethics within the study were based on the grounds of the World Medical Association (WMA) Declaration of Helsinki. Data

were anonymously stored, used only for scientific purposes, and were expected to add novel information that eventually would be reflected in the patient's care standards.

Statistical analysis

The dataset underwent an extensive statistical analysis using both descriptive and inferential approaches. First, the demographic details of the participants—such as age, gender, and other attributes—are compiled by a descriptive analysis. An outline of the study population is given here. The difference between the variables' awareness and practice scores is then examined using inferential analyses such the Independent Sample T-test (for two groups) or ANOVA (for more than two groups). A p-value of 0.05 or less and a 95% CI are considered to be statistically significant. Version 29.0.0 of IBM's SPSS software was used for all statistical studies.

Results

The current study included 380 insulin-treated patients with either type of DM who are living in Al-Ahsa region, KSA. The sociodemographic profile reveals that out of the total number, females were 226 (59.5%), and Saudi nationals were 366 (96.3%) of the population. Married people were 220 (53.4%), a diagnosis with type 2 diabetes, 160 (42.1%), and type 1 DM 173(45.5%). A number of 47 (12.7%) need to know exactly what their DM type is As regards the occupation, 124 (32.6%) reported unemployment. As regards the duration of DM, patients diagnosed over ten years ago represent (42.4%). Overall, 147 (38.7%) participants showed a comparatively high level of awareness which is above the median. (Table 1).

As regard DM complications and comorbidities, hypertension is the most common comorbidity at 21.5%, followed by retinopathy (20%), nephropathy (10.2%), neuropathy (8.4%), thyroid diseases (7.8%), coronary artery diseases (2.3%), and dyslipidemia (1.5%) (Figure 1). The majority of the studied sample (75.5%) obtained their insulin-related information from healthcare staff, indicating a reliance on healthcare professionals for therapeutic guidance. Relatives contribute to the information of 13.4%, while 7.4% of patients rely on the Internet to gain their information. Books and courses are less frequently utilized, with 2.9% and 0.8%, respectively (Figure 2).

As regard the comprehensive assessment of the awareness and practices related to proper insulin self-administration among participants, the majority (62.4%) rely solely on insulin, while 37.6% use a combination of insulin and oral antidiabetics. Pens are the most commonly used form of insulin administration (91.3%), with 82.9% of participants self-administering their insulin. A significant portion (68.9%) consult specialists or doctors, and 65.3% adhere to medical instructions. Insulin storage predominantly occurs in the fridge (73.9%). Participant's exhibit varied preferences for injection sites and techniques. Adherence to practices such as changing injection sites (78.2%) and needles daily (62.1%) is noteworthy. Additionally, a substantial percentage of patients count their meal carbohydrates (40.5%) and adjust insulin doses before meals (41.3%). (Table 3) shows a comprehensive assessment of various features among individuals with diabetes. A notable portion follows up with their diabetes doctor every three months (46.1%), while others receive medications only (12.1%) or have less frequent appointments. Cumulative blood sugar levels vary, with a significant percentage falling in the 7-8% range (47.1%). Almost half of the participants have experienced hospitalization due to diabetes (46.8%), with varying frequencies. Home blood sugar monitoring is common, with several participants checking multiple times daily (47.4%). Hypoglycemia is reported, with 55.5% experiencing it rarely. (Figure 3) shows the timing preferences for taking long-acting insulin among participants. The majority (44.5%) are taking it once at a specified time in the evening, while 20.8% opt for once in the evening with flexible timing. A fewer percentage administers it once daily at a specified time in the morning (13.2%) or twice daily at a specific time (9.2%). Other practices include twice daily with flexible timing (7.9%) and once in the morning with flexible timing (4.5%). Regarding problems experienced at injection sites among participants, the most commonly reported issues are redness (32.1%) and swelling (30.7%). A smaller percentage of participants reported encountering lumps (11.1%) and conglomerates (10.1%) at injection sites. Skin changes (1.1%), bleeding (0.5%), and pain (0.5%) are less frequently reported (Figure 4). The analysis of the awareness and practice score of proper insulin self-administration about sociodemographic and DM parameters is shown in (Table 4). Noteworthy findings include significantly higher scores among individuals aged <18 years (Mean = 12.92, $p < 0.001$), singles (Mean = 11.99, $p < 0.001$), those with no work (Mean = 11.33, $p = 0.004$), type 1 diabetes patients (Mean = 12.24, $p < 0.001$), and those experiencing hypoglycemia often (Mean = 12.37, $p < 0.001$). Health sector employees exhibit exceptional awareness (Mean = 14.00, p=0.004). The type of medications also influences scores, with insulin-only users scoring higher (Mean = 11.92, $p = 0.009$). Regular doctor visits positively impact awareness (Mean = 12.70, $p < 0.001$), while hospitalization shows a trend toward significance (Mean = 11.92, $p = 0.058$).

Discussion

This study in Al-Ahsa region aims to assess awareness and practices of subcutaneous insulin self-administration among DM patients, examining its

Table 1: *Sociodemographic and other parameters of all patients who were assessed for awareness and practice of proper Insulin Self-Administration.*

		Frequency (n=380)	***Percent*** (%)
Gender	Female	226	59.5
	Male	154	40.5
Age	< 18 Years	52	13.7
	18-29 Years	87	22.9
	30-39 Years	53	13.9
	40-50 Years	80	21.1
	> 50 Years	108	28.4
Nationality	Non-Saudi	14	3.7
	Saudi	366	96.3
Residence	Al Ahsa	380	100.0
Marital Status	Single	138	36.3
	Married	203	53.4
	Divorced	18	4.7
	Widow	21	5.5
Occupation	No Work	124	32.6
	Student	91	23.9
	Employee	95	25.0
	Employees in the Private Sector	35	9.2
	Employees in Health Sectors	12	3.2
	Free Business	23	6.1
Diagnosed with Type of Diabetes	Don't Know	47	12.4
	T1DM	173	45.5

	T2DM	160	42.1
When you were diagnosed	< 2 Years	57	15.0
	3-5 Years	75	19.7
	6-10 Years	87	22.9
	>10 Years	161	42.4
Over Level of Awareness (Median=12)	Below Median	233	61.3
	Above Median	147	38.7

Table 2: *Assessment of awareness and practice of proper Insulin Self-Administratio.*

		Frequency (n=380)	***Percent*** (%)
Type of Medications	Insulin Only	237	62.4
	Insulin and Oral Antidiabetics	143	37.6
Which For of Insulin do You Use?	Both of them	21	5.5
	Bottles	12	3.2
	Pens	347	91.3
Who gives you Insulin?	I Take Myself	315	82.9
	Family Members	56	14.7
	Nurses	9	2.4
Ever had a session with a specialist/doctor about the use of Insulin?	No	118	31.1
	Yes	262	68.9
Do you apply what the Doctor Tells you?	No	54	14.2
	Yes	248	65.3
Where do you Store Insulin?	At Room Temperature	99	26.1
	Fridge	281	73.9
Your Proffered Injection Site of Insulin	Arm	116	30.5
	Belly	138	36.3

	Thigh	126	33.2
How do you Inject Insulin?	Don't know	13	3.4
	Vertical	274	72.1
	With tilt	93	24.5
Do you gently mix insulin Before Using It?	No	175	46.1
	Yes	205	53.9
Do you change the Injection Site frequently?	No	83	21.8
	Yes	297	78.2
Do you sterilize the Injection Site every Time?	No	59	15.5
	Sometimes	139	36.6
	Yes	182	47.9
Do you change the insulin needle every day?	No	31	8.2
	Sometimes	113	29.7
	Yes	236	62.1
Do you Stick to your daily insulin regimen?	No	48	12.6
	Sometimes, I miss my dose	78	20.5
	Yes	254	66.8
When do you usually take meal-time insulin?	20-30 Minutes Before Meals	48	12.6
	10-20 Minutes Before Meals	111	29.2
	Immediately Before Meals	147	38.7
	Between Meals	18	4.7
	After Meals	56	14.7
Do you count Carbohydrates to Adjust your insulin dose?	No	226	59.5
	Yes	154	40.5
Adjust Meal-time Insulin	No	223	58.7
	Yes	157	41.3

Table 3: *Assessment of diabetes control, follow-up practices, and hospitalizations.*

		Frequency (n=380)	***Percen*** (%)
How often do you follow up with your diabetes doctor	Receive Medications only	46	12.1
	Every 3 months	175	46.1
	Every 6 months	111	29.2
	Once a year	48	12.6
Cumulative blood sugar level when you last measured it	5-6%	104	27.4
	7-8%	179	47.1
	9-10%	78	20.5
	>10%	19	5.0
Ever Hospitalized due to Diabetes	No	202	53.2
	Yes	178	46.8
How many times have you been Hospitalized	N/A	165	43.4
	Less than twice	132	34.7
	3-5 times	57	15.0
	More than five times	26	6.8
How often do you monitor your blood sugar level at home?	Once a day	52	13.7
	Several times daily	180	47.4
	When I feel sick	62	16.3
	Occasionally	78	20.5
	Absolutely	8	2.1
Do you suffer from hypoglycemia?	Absolutely	60	15.8
	Yes, but rarely	211	55.5
	Yes, often	109	28.7

Table 4: *Awareness and Practice Score of Proper Insulin Self-Administration and association with different sociodemographic features.*

		Awareness and Practice Score of Proper Insulin Self-Administration			Sig. Value
		N	Mean	Std. Deviation	
Gender	Female	226	11.52	2.64	0.248
	Male	154	11.84	2.58(15)	
Age	< 18 Years	52	12.92	2.52	***<0.001***
	18-29 Years	87	11.25	2.58	
	30-39 Years	53	12.24	2.38	
	40-50 Years	80	11.57	2.45	
	> 50 Years	108	11.13	2.72	
Nationality	Non-Saudi	14	10.71	2.86	0.172
	Saudi	366	11.69	2.61	
Marital Status	Single	138	11.99	2.66	***<0.001***
	Married	203	11.67	2.52	
	Divorced	18	11.27	2.56	
	Widow	21	9.52	2.54	
Employment Status	No Work	124	11.33	2.77	***0.004***
	Student	91	12.13	2.35	
	Employee	95	11.60	2.51	
	Employees in the Private Sector	35	11.42	2.61	
	Employees in Health Sectors	12	14.00	1.70	
	Free Business	23	10.82	2.90	
Type of Diabetes	Don't Know	47	11.78	2.82	***<0.001***
	T1DM	173	12.24	2.46	
	T2DM	160	10.98	2.58	
Diagnosis Before Years	< 2 Years	57	11.98	2.85	0.161
	3-5 Years	75	12.13	2.62	
	6-10 Years	87	11.39	2.62	
	>10 Years	161	11.45	2.52	

Type of Medications	Insulin Only	237	11.92	2.63	***0.009***
	Insulin and Oral Antidiabetics	143	11.20	2.54	
Suffer from Hypoglycemia	Absolutely	60	10.76	2.97	***<0.001***
	Yes, but rarely	211	11.53	2.49	
	Yes, often	109	12.37	2.50	
Regular doctor visits	No	118	9.33	2.05	***<0.001***
	Yes	262	12.70	2.13	
Ever Hospitalized with Diabetes	No	202	11.41	2.64	0.058
	Yes	178	11.92	2.59	

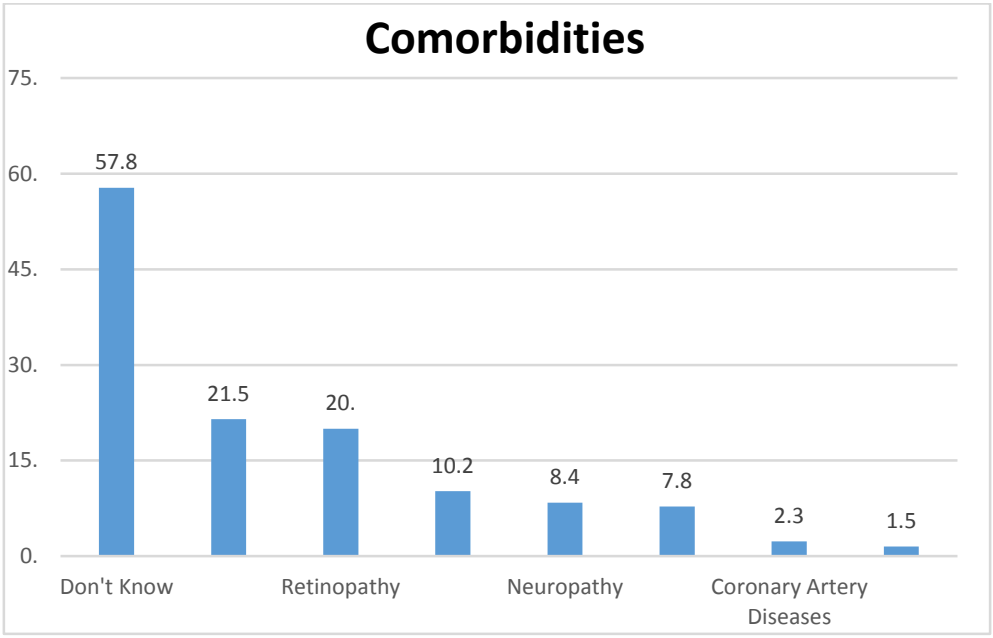

Figure 1: Comorbidities and DM complications among Diabetic Patients.

Hypertension is the most common comorbidity at 21.5%, followed by retinopathy (20%), nephropathy (10.2%), neuropathy (8.4%), thyroid diseases (7.8%), coronary artery diseases (2.3%), and dyslipidemia (1.5%)

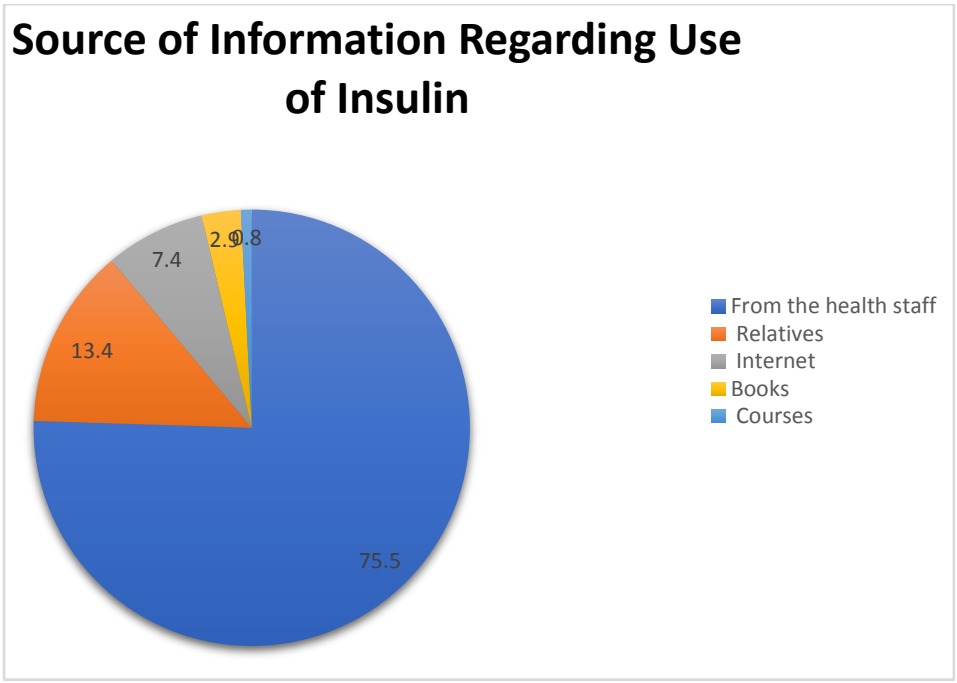

Figure 2: Reported source of Information for insulin usage.

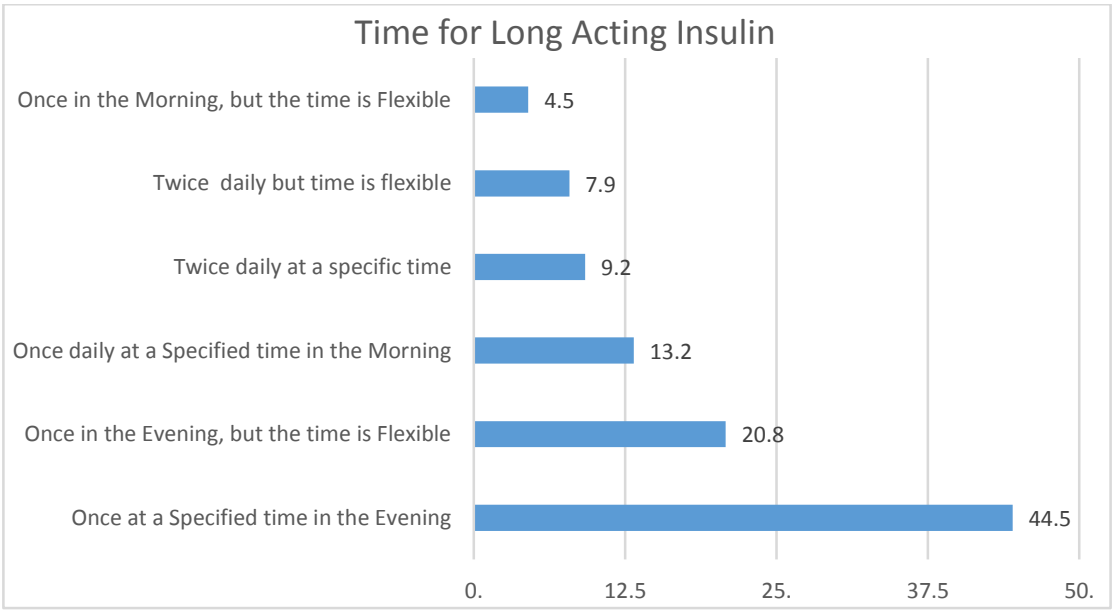

Figure 3: Time for Taking Long-Acting Insulin.

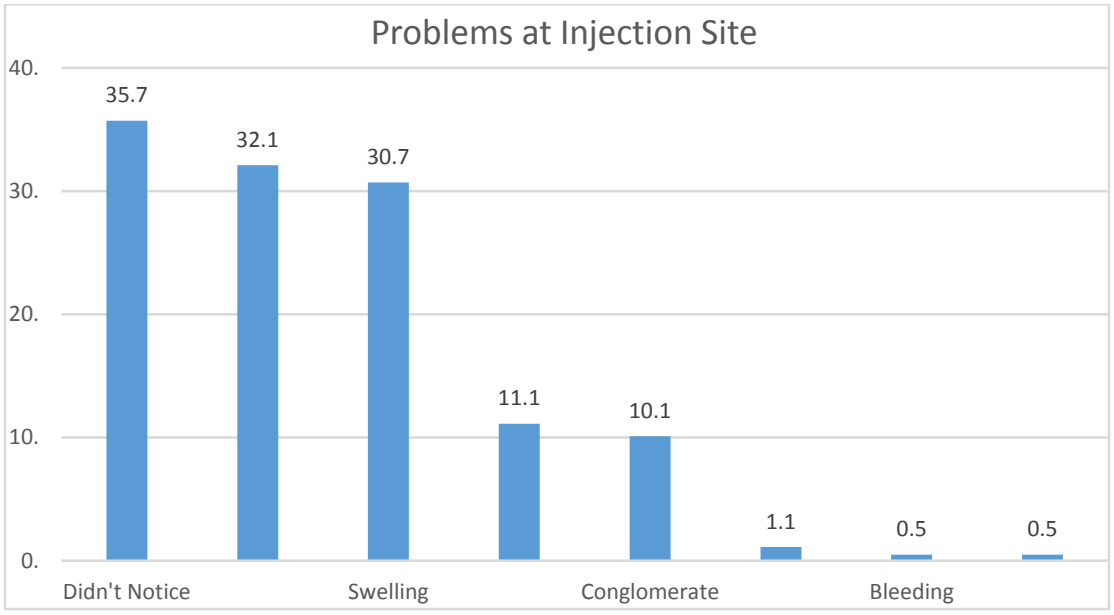

Figure 4: Experienced problems at Injection Site.

Correlation with glycemic control. The current study provides insights into the sociodemographic characteristics, comorbidities, diabetes educational information sources, and real-world practices related to insulin use among diabetes patients in Al Ahsa region, Saudi Arabia. The sociodemographic profile of the participants reveals the predominantly of females (59.5%) and Saudi nationals which aligns with previous literature, which showed the global trend of a higher prevalence of diabetes among females. According to a recent meta-analysis, the pooled prevalence rates for men and women were 9.9% (95% CI, 8.8–11.0%) and 11.6% (95% CI, 10.0–13.1%), respectively, [14, 15]. The varied age distribution reflects the widespread impact of diabetes across different age groups, emphasizing the need for age-specific interventions. The majority being married and diagnosed with type 2 diabetes is consistent with the general demographics of diabetes worldwide, where 2 DM type is more prevalent among adults. Notably, 38.7% of participants showed a comparatively high level of awareness about self-administration of insulin which is above the median of our sample. Similarly, Yosef et al. show that 38.4% of their study population shows knowledge about self-administration of insulin [5]. The occupational status with a notable percentage having no work, indicates potential implications for access to healthcare resources. Employment status can influence the financial capacity for managing diabetes, and these findings may suggest a need for targeted support for unemployed individuals with diabetes. The prevalence of type 1 and type 2 diabetes aligns with global patterns. The high percentage of participants diagnosed for over 10 years underscores the chronic nature of diabetes. Long-term management and sustained adherence to insulin practices become crucial, highlighting the need for continuous education and support for individuals with extended diabetes duration. High hypertension prevalence in diabetic patients emphasizes the interconnectedness of diabetes with other chronic conditions. This linkage significantly raises the risk of atherosclerotic cardiovascular disease, with hypertension doubling in individuals with diabetes, contributing to 35-75% of associated complications [16]. Similarly, Ejeta et al. demonstrated that diabetes patients frequently have chronic kidney disease (CKD), chronic vascular disease (CVD), obesity, hypertension, and hyperlipidemia as comorbidities [17]. Addressing these comorbidities is essential for comprehensive diabetes care. The reliance on health staff for insulin information highlights the central role of healthcare professionals in patient education. This emphasizes the importance of effective communication between healthcare providers and patients in ensuring proper insulin self-administration practices. Workneh et al. found that primary sources of information regarding the self-administration of insulin were predominantly health professionals, particularly nurses and physicians, with a 100% reliance rate [18]. The relatively low reliance on the internet suggests a potential gap in utilizing online resources for diabetes education. The preference for insulin pens for self-administration aligns with contemporary trends in diabetes management, emphasizing convenience and ease of use [19]. There is proof that, when compared to using needles and vials to administer insulin, pen devices provide clinical advantages and, less obviously, patient-reported results [19]. Ahmann et al. indicated that patients expressed a notable preference for pens compared to vial-and-syringe, while healthcare professionals (HCPs) strongly endorsed pens over vial-and-syringe ($P<0.001$) [20]. The high percentage of participants consulting specialists or doctors and adhering to medical instructions is encouraging for effective diabetes management. Participating in suggested behavioral practices, such as taking medications as prescribed, is part of diabetes self-management activities. These behaviors are essential for the effective control of the illness [21, 22]. The diverse preferences for injection sites and techniques underscore the individualized nature of insulin administration, requiring personalized guidance. The analysis of the Awareness and Practice Score about sociodemographic factors provides nuanced insights. Significantly higher scores among younger individuals, singles, those with no work, type 1 diabetes patients, and those experiencing hypoglycemia often indicate potential areas for targeted interventions. The exceptional awareness among health sector employees emphasizes the role of professional knowledge in influencing insulin practices. Nasir et al. demonstrated that individuals with greater knowledge tended to be male, unmarried, employed by government or non-governmental organizations (NGOs), and residing in urban areas, with educational attainment ranging from elementary to higher levels [23]. Study limitations include reliance on self-reported data, potentially introducing recall bias. Additionally, the study may only partially capture dynamic changes in insulin self-administration practices over time. Future research should employ longitudinal designs to track changes over time. Interventions targeting awareness and practices can enhance diabetes management. Exploring cultural influences and assessing the impact of developed technologies on insulin self-administration warrants further investigation.

Conclusion

The current study highlights that 38.7% of DM patients show a comparatively high level of awareness about self-administration of insulin, which is above

the median. Carbohydrate counting and pre-meal insulin adjustments are practiced by an average of 40% of patients. There is considerable variability among patients regarding insulin practices. In addition, there are significant impacts of age, marital status, employment, diabetes type, hypoglycemia experience, occupation, medication type, and hospitalization on insulin self-administration, awareness, and practices. Suboptimal patient knowledge and attitudes necessitate addressing gaps through regular education and demonstrations during hospital visits.

Conflict of Interest

None

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None

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