

Original Paper

# Nursing Students' Insulin Therapy Knowledge and Practices in Jordan



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**Citation** Khutaba'a GA, Ali TA, Hani SB, Salameh FB, Garaleah EM. Nursing Students' Insulin Therapy Knowledge and Practices in Jordan. *J Holist Nurs Midwifery*. 2026; 36(1):17-25. <https://doi.org/10.32598/jhnm.36.1.2913>

**Running Title** Nursing students' Knowledge and Practice of Insulin Therapy

**doi** <https://doi.org/10.32598/jhnm.36.1.2913>

## Article info:

**Received:** 02/05/2025

**Accepted:** 29/08/2025

**Available Online:** 01/01/2026

## ABSTRACT

**Introduction:** Insulin is the cornerstone treatment for hyperglycemia among individuals with Diabetes Mellitus (DM). Despite being one of the most commonly prescribed medications in clinical practice, insulin can be highly hazardous if misused.

**Objective:** This study aimed to assess the level of knowledge and practices regarding insulin therapy among nursing students in Jordan.

**Materials and Methods:** This is a cross-sectional study was conducted on 500 nursing students at Jordanian universities in 2024. A researcher-made online self-report questionnaire was used to collect data. It surveys three main types of information: Demographic information, knowledge of insulin, including side effects, complications, and storage conditions (18 items), and practices related to insulin therapy (9 items). Data were analyzed by using descriptive statistics and logistic regression analyses (to identify the predictors of knowledge and practice scores).  $P < 0.05$  (two-tailed) was considered statistically significant.

**Results:** Among participants, the majority were female (66.6%), aged 20–25 years (91.4%), in their third academic year (61.2%), and unemployed (87.2%). The mean knowledge score was  $12.6 \pm 2.84$  (out of 20), with 84.4% demonstrating moderate knowledge. The mean practice score was  $8.32 \pm 1.35$  out of 9. Ordinal logistic regression model showed that the university was significantly associated with knowledge scores. For example, education at Al-Hussein Bin Talal University was significantly associated with higher knowledge than education at Mutah University ( $b = 1.92$ , 95% CI: 1.59, 2.25,  $B = 0.001$ ). Higher academic year (fourth year) was also a significant predictor of knowledge ( $b = 0.85$ , 95% CI: 0.09, 1.6%,  $P = 0.03$ ). Additionally, a history of DM treated with insulin ( $b = 1.88$ , 95% CI: 0.75, 3%  $P = 0.001$ ), a history of DM in first-degree relatives ( $b = 0.87$ , 95% CI: 1.13, 2.6%,  $P = 0.001$ ) and history of attending DM-related educational courses or workshops ( $b = 0.79$ , 95% CI: 0.16, 1.42%,  $P = 0.01$ ) showed significant association with knowledge scores.

**Conclusion:** Enhancing DM-related education through curriculum modification and practical training can substantially improve Jordanian nursing students' knowledge of insulin therapy and, consequently, patient outcomes.

## Keywords:

Diabetes, Insulin therapy, Knowledge, Nursing, Practice

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## Highlights

- Nursing students in Jordan had moderate knowledge of insulin therapy.
- Most Jordanian nursing students showed good practice levels despite some misconceptions about insulin types.
- Knowledge of insulin therapy could be significantly predicted by higher academic year, university, and history of diabetes.

## Plain Language Summary

Insulin is a medicine used to control blood sugar in people with diabetes, and giving it correctly is very important to avoid complications. This study surveyed how well nursing students in Jordan understand insulin therapy and how they perform insulin-related practices. A total of 500 nursing students participated in this study. Most students had a moderate level of knowledge about insulin, but many still had misunderstandings, especially about the different types of insulin and how they work. Despite these gaps, their actual practices—such as checking insulin expiry dates, rotating injection sites, and preparing injections properly—were mostly correct. Having a family or personal history of diabetes, attending diabetes-related educational workshops, or being in higher academic years were associated with higher knowledge of insulin therapy.

## Introduction

**P**ersistent hyperglycemia and abnormalities in fat, protein, and carbohydrate metabolism are the main characteristics of diabetes mellitus (DM) [1]. These abnormalities arise from insulin resistance, inadequate insulin secretion, or a combination of both [2]. Globally, DM is among the most prevalent chronic diseases and poses a major public health challenge [3]. It occurs when the body is unable to produce sufficient insulin or cannot utilize it effectively, leading to consistently elevated blood glucose levels and subsequent long-term complications. These metabolic disorders also affect the way the body processes fats, proteins, and carbohydrates, underscoring the importance of understanding disease mechanisms to improve prevention and management strategies. The two most common types of DM are type 1 and type 2. Type 1 DM involves an absolute deficiency of insulin, whereas type 2 DM results from insulin resistance and relative insulin insufficiency [2]. Insulin therapy remains essential for diabetes management; it is the cornerstone treatment for type 1 DM and is frequently required to achieve optimal glycemic control in type 2 DM [4]. Proper insulin injection techniques are essential for achieving effective glycemic control in individuals with DM [5]. Inadequate or improper injection practices may lead to complications such as subcutaneous fat hypertrophy, lipoatrophy, and injection-site pain, all of which can negatively affect insulin absorption and subsequently disrupt blood glucose

regulation [6]. According to Yu et al., nurses' knowledge, attitudes, and practice play a significant role in ensuring the safety and effectiveness of insulin administration [7]. Insulin formulations vary in their onset and duration of action and are classified as rapid-acting, short-acting, intermediate-acting, or long-acting [8, 9]. In addition, multiple delivery devices—including syringes, insulin pens, and insulin pumps—require proper handling, storage, and administration techniques to ensure both therapeutic safety and clinical efficacy [10-12].

Insulin is among the most commonly prescribed medications in hospitals; however, it is also one of the most potentially harmful when administered incorrectly [13]. Mastering correct insulin administration is therefore a core clinical competency that nursing students must acquire during their academic and clinical training [14]. Adequate knowledge regarding insulin therapy—including its preparation, storage, and administration—is essential for improving diabetes management, enhancing patients' Quality of Life (QoL), and reducing complications and treatment non-adherence [15, 16]. In Jordan, previous research assessing DM-related knowledge among registered nurses reported notable gaps in both knowledge and practice [17]. Continuous professional education remains a key requirement for maintaining competence in the management of complex conditions such as DM. Therefore, the present study aimed to assess nursing students' knowledge and practices regarding insulin therapy in Jordan.

## Materials and Methods

This is a cross-sectional study. The study population consisted of all undergraduate nursing students enrolled at Jordanian universities in the academic year of 2024. Students who were willing to participate in the study and were eligible were included. Participants were required to be able to read and understand English (as the questionnaire was presented in English). Students not currently studying nursing and those with incomplete questionnaires were excluded. The sample size was calculated using the [RaoSoft](#) online calculator, considering a 5% margin of error, 95% confidence interval (CI), and an assumed response rate of 50% [18]. The estimated minimum sample size was 380. However, to account for potential sample dropout, 500 nursing students were recruited. All participants provided written informed consent before participation. All responses were anonymous and used solely for research purposes.

Data were collected using an online self-administered questionnaire over two months, from June to August 2024. The questionnaire was prepared electronically using Google Forms to ensure accessibility and convenience for participants. The survey link was distributed through social media applications such as Facebook and WhatsApp. The questionnaire was developed following an extensive review of previous literature on similar studies [5, 6, 8-16]. It consisted of three main sections with both open-ended and closed-ended questions. The demographic section collected data on age, sex, academic year, university, employment status, and DM-related experiences. The knowledge section comprised 18 items evaluating insulin therapy knowledge, including knowledge of indications, types, administration routes, side effects, complications, and storage conditions [8-13]. Each answer was scored as 1 point if correctly answered, and 0 points if incorrectly answered. Two items had multiple correct responses. The total score of this section ranged from 0 to 20 and was categorized as: poor knowledge (a score <8), moderate knowledge (score 9–15), excellent knowledge (score 16–20). The practice section had 9 items assessing students' performance in insulin administration [5, 6, 12, 13]. Responses were scored as 1=correct answer, 0=incorrect answer, with a total possible score of 0–9, categorized as: Poor practice (score <4) and good practice (score 5–9).

The questionnaire's face validity and content validity were assessed by a panel of experts ( $n=5$ ) in nursing and pharmacology who evaluated the items for clarity, relevance, and appropriateness. A pilot study was conducted on 10 nursing students (not from the study par-

ticipants) to assess comprehensibility and ease of completion. Based on feedback, minor wording adjustments were made. Based on their evaluations, the Content Validity Ratio (CVR) was calculated for each item using the Lawshe method, yielding an overall CVR of 0.84, while the Content Validity Index (CVI) for the entire tool was 0.89, indicating strong content validity. For testing reliability, a pilot study was conducted on 10 nursing students (not from the study participants) to assess clarity and internal consistency. The Cronbach's  $\alpha$  coefficient for the overall scale was 0.73, with values of 0.78 for the knowledge subscale and 0.70 for the practice subscale, reflecting acceptable and internal consistency for both sections [19, 20].

The collected data were analyzed in SPSS software, version 25 (IBM Corp., Armonk, NY, USA). Descriptive statistics (Mean $\pm$ SD, frequency, and percentage) were used to present demographic variables. Inferential statistics were applied to assess the associations between variables. Ordinal logistic regression was used to identify the predictors of knowledge levels. Binary logistic regression examined the predictors of practice levels.  $P<0.05$  (two-tailed) was considered statistically significant.

## Results

A total of 500 nursing students participated in the study. The majority were female (66.6%) and aged 20-25 years (91.4%). Most participants were Jordanian (95.8%), and more than half studied at universities located in the central region of Jordan (51.8%). Regarding academic year, 61.2% of students were in their third year, while 38.8% were in their fourth year. The majority were unemployed (87.2%), and approximately two-thirds (64.8%) had not attended any DM-related courses, workshops, or conferences. Only 7.8% reported having DM treated with insulin, while 52.8% had a first-degree relative with DM treated with insulin (Table 1).

The mean knowledge score was  $12.6\pm 2.84$ , out of 20. Most participants (84.4%) demonstrated a moderate level of knowledge, 5% had poor knowledge, and 10.6% had excellent knowledge. Participants showed good knowledge of basic insulin concepts. Approximately two-thirds (67.8%) correctly identified insulin as prescribed to lower blood glucose, whereas 30.3% incorrectly believed that it is for hypertension. Almost all participants correctly indicated that insulin is administered subcutaneously (96.4%) and that short-acting insulin can be given intravenously (84.4%). These results are shown in Table 2.

**Table 1.** Sociodemographic characteristics of the participants (n=500)

Variables		No. (%)
Age (y)	20-25	457(91.4)
	26-30	33(6.6)
	>30	10(2)
Sex	Female	333(66.6)
	Male	167(33.4)
Nationality	Jordanian	479(95.8)
	Non-Jordanian	21(4.2)
Location of the university in Jordan	North	86(17.2)
	Center	259(51.8)
	South	155(31)
Name of the university	Mutah University	49(9.8)
	The University of Jordan	52(10.4)
	The Hashemite University	84(16.8)
	Al-Bayt University	36(7.2)
	Al-Israa University	37(7.4)
	Al-Balqa Applied University	48(9.6)
	Al-Hussein Bin Talal University	71(14.2)
	Jordan University of Science and Technology.	46(9.2)
	Al-Zaytoonah University	69(13.8)
Academic year	3 <sup>rd</sup> year	8(1.6)
	4 <sup>th</sup> year	306(61.2)
Employment	Employed	194(38.8)
	Unemployed	64(12.8)
History of attending educational courses, workshops, or conferences related to diabetes care	Yes	436(87.2)
	No	176(35.2)
History of DM treated with insulin	Yes	324(64.8)
	No	39(7.8)
History of DM in a first-degree relative treated with insulin	Yes	461(92.2)
	No	264(52.8)
	Yes	236(47.2)
	No	

Regarding the knowledge of insulin storage, 80.8% correctly stated that opened insulin vials should be kept in a cool, dark place at room temperature (15–25 °C), and 90.4% knew they should be discarded after 28 days. Nearly all participants (99%) identified the abdomen as one of the preferred injection sites, while approximately half mentioned the upper arm (51.6%) and thigh (44.2%). Most participants knew that insulin should be kept at room temperature for 10–15 minutes before in-

jection (89.8%) and that the appropriate injection angle is 45° (84%). These results are shown in [Table 3](#).

The mean practice score was 8.32±1.35 out of 9, indicating a high performance. A large majority (97%) demonstrated good practice, while only 3% showed poor practice. Most students consistently checked insulin expiry dates (97.4%), allowed vials to reach room temperature before injection (93.4%), removed air bubbles

**Table 2.** Participants' knowledge of indication, routes, types, and different related issues of insulin

Questions		No (%)
Do you know why insulin is prescribed for patients?	To treat high blood pressure	151(30.3)
	To lower blood glucose level	339(67.8)
	Don't know	10(2.00)
All types of insulins are given ....	Intravenously	2(0.40)
	Intramuscularly	11(2.20)
	Subcutaneously	482(96.4)
	Don't know	5(1.00)
The only type of insulin that is given intravenously is ...	Rapid-acting insulin	40(8)
	Short-acting insulin (regular insulin)	422(84.4)
	Intermediate-acting insulin	5(1)
	Long-acting insulin	8(1.6)
	Don't know	25(5)
Once insulin is started, diet and exercise become less important.	True	29(5.8)
	False	442(88.4)
	Don't know	29(5.8)
The insulin therapy can be stopped after normalizing blood sugar levels	True	32(6.4)
	False	446(89.2)
	Don't know	22(4.4)
Insulin glargine and insulin detemir are considered as ...	Rapid-acting insulin	384(76.8)
	Short-acting insulin (regular insulin)	23(4.6)
	Intermediate-acting insulin	11(2.2)
	Long-acting insulin	41(8.2)
	Don't know	41(8.2)
Which one is a rapid-acting insulin?	Insulin detemir	15(3)
	Insulin glargine	360(72)
	Insulin lispro	47(9.4)
	Neutral Protamine Hagedorn (NPH) insulin	32(6.4)
	Don't know	46(9.2)

before injection (97.2%), washed hands before handling injection devices (96.4%), and rotated injection sites regularly (96.2%). However, fewer students routinely sterilized the injection site (68.8%), and 28% were uncertain about its necessity. These results are shown in [Table 4](#).

The ordinal logistic regression model identified several significant predictors of knowledge levels, as shown in [Table 5](#). Students' university name was significantly associated with knowledge scores ( $P < 0.001$ ). For example, education in Al-Hussein Bin Talal University was significantly associated with higher knowledge compared to education in the Mutah University ( $b = 1.92$ , 95% CI; 1.59%, 2.25%,  $P = 0.001$ ). The academic year was also

a significant predictor ( $b = 0.85$ , 95% CI; 0.09%, 1.6%,  $P = 0.03$ ). Being in the fourth academic year was associated with higher knowledge. Additionally, a history of DM treated with insulin was strongly associated with higher knowledge levels ( $b = 1.88$ , 95% CI; 0.75%, 3%,  $P = 0.001$ ). Having a first-degree relative with a history of DM ( $b = 0.87$ , 95% CI; 1.13%, 2.6%,  $P = 0.001$ ) and a history of attending diabetes-related educational courses or workshops ( $b = 0.79$ , 95% CI; 0.16%, 1.42%,  $P = 0.01$ ) also had a significant association with knowledge scores. The binary logistic regression model showed that none of the sociodemographic characteristics had significant associations with the practice scores.

**Table 3.** Participants' knowledge of insulin storage, administration, and other related issues

Questions	Answers	No. (%)
Currently used (opened) vials and cartridges of insulin should be stored at ---	Refrigerator (2-8 °C)	57(11.4)
	Cool and dark places at room temperature (15-25 °C).	404(80.8)
	Anywhere	14(2.8)
	Don't Know	25(5)
Opened Insulin vials are discarded after 28 days	Yes	452(90.4)
	No	16(3.2)
	Don't Know	32(6.4)
Do you think it is necessary to rotate injection site?	Yes	476(95.2)
	No	16(3.2)
	Don't Know	8(1.6)
Which one is a method of insulin administration?	Insulin syringe and vial	460(92)
	Insulin pen	378(75.6)
	Insulin pump	262(52.4)
	Don't Know	18(3.6)
Insulin vials should be kept at room temperature for at least 10-15 minutes before injection.	Yes	449(89.8)
	No	30(6)
	Don't Know	21(4.2)
The correct angle for insulin injection is ...	30°	14(2.8)
	45°	445(84)
	60°	2(0.4)
	90°	34(6.8)
	Don't know	5(1)

**Table 4.** Participants' practices regarding insulin therapy (n=500)

Questions	No. (%)		
	Yes	No	Don't know
Do you usually check the expiry date of insulin?	487(97.4)	6(1.2)	7(1.4)
Do you keep the insulin vial at room temperature for at least 10-15 minutes before injection?	467(93.4)	20(4)	13(2.6)
Do you remove air bubbles from the insulin syringe before injection?	486(97.2)	9(1.8)	5(1)
Do you wash your hands well before handling the injection devices?	482(96.4)	13(2.6)	5(1)
Do you pinch the skin and put the needle in at a 45° angle?	479(95.8)	13(2.6)	8(1.6)
Do you sterilize the injection site?	344(68.8)	16(3.2)	140(28)
Do you pull the needle out and leave the syringe in place for at least 5 seconds after injection?	463(92.6)	24(4.8)	13(2.6)
Do you frequently change the injection site?	481(96.2)	8(1.6)	11(2.2)
Do you shake the insulin before injection?	470(94)	18(3.6)	12(2.4)

**Table 5.** Regression coefficients for sociodemographic factors predicting participants' insulin therapy knowledge

Variables		b	P*	95% CI Lower, Upper	SE
Age (y)	20-25	1.97	0.82	1.74, 2.19	1.07
	26-30	2.18	0.53	1.49, 2.86	1.02
	>30 (Ref.)	-	-	-	
Sex	Female	0.63	0.33	0.32, 0.93	0.77
	Male (Ref.)	-	-	-	
Location of the university in Jordan	North	3.61	0.65	2.78, 4.44	1.21
	Center	1.52	0.66	1.18, 1.85	1.23
	South (Ref.)	-	-	-	
Name of the university	Mutah University (Ref.)	-	-	-	
	The University of Jordan	4.16	0.001	2.23, 6.08	1.02
	The Hashemite University	2.52	0.01	0.61, 4.43	1.11
	Al-Bayt University	3.75	0.02	2.12, 5.37	0.93
	Al-Israa University	2.82	0.01	0.58, 5.05	1.04
	Al-Balqa Applied University	2.97	0.001	1.35, 4.58	1.18
	Al-Hussein Bin Talal University	1.92	0.001	1.59, 2.25	1.34
	Jordan University of Science and Technology	3.67	0.001	0.47, 6.86	1.76
Academic year	3 <sup>rd</sup> (Ref.)	-	-	-	
	4 <sup>th</sup>	0.85	0.03	0.09, 1.6	1.44
Employment	Employed (Ref.)	-	-	-	
	Unemployed	1.02	0.18	0.32, 1.71	0.78
History of DM treated with insulin	Yes (Ref.)	1.88-	0.001-	0.75, 3	0.98
	No	-	-	-	
History of DM in a first-degree relative treated with insulin	Yes	0.87	0.001	1.13, 2.6	
	No (Ref.)	-	-	-	1.61
History of attending educational courses, workshops, or conferences related to diabetes care	Yes	0.79	0.01	0.16, 1.42	
	No (Ref.)	-	-	-	1.55

SE: Standard error.

\*Ordinal logistic regression.

## Discussion

The present study demonstrated that Jordanian nursing students had varying levels of knowledge about insulin therapy, a cornerstone of diabetes management. While many students had a good knowledge of basic insulin concepts, noticeable gaps existed in more complex areas such as insulin classification, side effects, and dosage control. These findings are consistent with previous studies [20, 21], which reported inadequate knowledge and practice among nursing students and nurses. Both studies emphasized the importance of training programs and regular competency evaluations to enhance nurses' skills in insulin therapy. Furthermore, our findings are in line with previous studies in Middle Eastern countries, which found that nursing students often

have a low knowledge of DM care and insulin administration. For example, a study in Saudi Arabia reported that DM-related materials were insufficiently integrated into nursing curricula [22]. Therefore, diabetes management education should be comprehensively integrated into nursing courses and should achieve higher levels of proficiency among students. There is also a need to improve nursing curricula in Jordan to strengthen theoretical and practical DM education.

In the current study, significant associations were observed between students' knowledge scores and their university, academic year, history of DM in the students or their families, and participation in DM-related educational courses or workshops. These findings align with those of Alsolais et al., who reported that academic



level, university affiliation, and direct experience with diabetic patients were significant predictors of students' knowledge [22]. These findings underscore the value of experiential learning and targeted education in enhancing competency levels. The sex factor showed no significant association with knowledge or practice of insulin therapy, contrary to Wu et al.'s findings [20]. This may indicate that nursing education programs in Jordan provide equitable opportunities for both male and female students to acquire similar levels of theoretical and practical competence. However, there is still a need for more structured educational interventions to bridge remaining knowledge gaps. The association between high academic year and knowledge scores suggests that nursing students' knowledge of insulin therapy improves as they progress academically. This observation supports earlier findings that nurses with advanced education and greater clinical experience have more comprehensive knowledge of diabetes management, pharmacology, and insulin therapy [23]. Such nurses are also better able to educate patients, recognize adverse effects, and safely adjust insulin doses in collaboration with healthcare teams.

Overall, the results highlight an urgent need to enhance the DM-related educational materials within Jordanian nursing curricula. Specifically, nursing schools should incorporate hands-on training, simulation exercises, and case-based learning focused on insulin therapy. These interventions can enhance nursing students' confidence and competence in insulin administration, leading to safer and more effective diabetes management in clinical practice. As future healthcare professionals, well-trained nursing students are key to ensuring effective glycemic control, minimizing insulin-related errors, and improving the overall quality of diabetic care [4, 21, 16, 11].

This study had some limitations. Its cross-sectional design prevents the establishment of causal relationships between variables. The samples were limited to nursing students from selected Jordanian universities, which may restrict the generalizability of findings to all nursing students in the country. Moreover, since the data were self-reported, participants may have over- or underestimated their knowledge and practices, introducing potential response bias. Future studies should employ longitudinal or interventional designs to better assess the effectiveness of educational programs aimed at improving nursing students' knowledge and practices regarding insulin therapy.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Ethics Committee of [Al-Balqa Applied University](#), Karak, Jordan (Code: 26/3/2/2378). Written informed consent was obtained from all participants prior to the study.

### Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for profit sectors.

### Authors' contributions

Data collection and data analysis: Ghida'a Al Khutaba'a and Tasneem Basheer Ali; Draft preparation: Ghida'a Al Khutaba'a and Salam Bani Hani; Supervision: Ghida'a Al Khutaba'a, Fatima Bani Salama, and Ehoud Mahmoud Garaleah; Final approval: All authors.

### Conflict of interest

The authors declared no conflict of interest.

### Acknowledgments

The authors sincerely thank all nursing students who participated in this research for their time and cooperation.

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