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## Declarations

No funding was received for this study. The authors declare no conflict of interest. The study received ethical approval. All participants provided informed consent.

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# Assessment of Knowledge among Final Year Nursing Students Regarding Diabetes Mellitus in Nursing Institutions of Peshawar

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## ABSTRACT

**Background:** Diabetes mellitus is a major global chronic disease associated with substantial morbidity and mortality, and nurses play a key role in diabetes prevention, education, and complication management; however, inadequate diabetes knowledge among nursing students may compromise clinical preparedness. **Objective:** To assess the level of knowledge regarding diabetes mellitus among final-year nursing students across KMU constituent and affiliated nursing institutes in Peshawar and to explore associations with educational engagement factors. **Methods:** A descriptive cross-sectional study was conducted among final-year nursing students using a validated diabetes knowledge questionnaire. A total of 329 participants from 13 institutes completed the survey (response rate 87.2%). Knowledge was categorized as good (14–16), average (12–13), and poor (<12). Descriptive statistics were reported, correlation analysis examined associations between interest and teacher satisfaction, and regression evaluated the relationship between workshop attendance and knowledge score. **Results:** The mean age was  $22.9 \pm 1.519$  years and 59.3% were male. Good knowledge was observed in 28.9% ( $n=95$ ), average in 28.9% ( $n=95$ ), and poor in 42.2% ( $n=139$ ). Most students were interested in diabetes (76.9%) and satisfied with teachers (64.7%), with a positive correlation between satisfaction and interest ( $r=0.199$ ,  $p<0.001$ ). Workshop attendance was low (15.5%) and was not significantly associated with higher knowledge scores ( $B=-0.393$ ,  $p=0.056$ ). **Conclusion:** A substantial proportion of final-year nursing students demonstrated poor diabetes knowledge, highlighting the need for strengthened curriculum delivery and competency-based training.

## Keywords

Diabetes mellitus; knowledge assessment; nursing students; Peshawar; KMU.

## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to impaired insulin secretion, insulin action, or both, and it continues to expand as a major global health burden because of lifestyle transitions, population aging, and increasing obesity prevalence (1,5–7). The disease is broadly categorized into type 1 diabetes mellitus (T1DM), an autoimmune condition involving pancreatic  $\beta$ -cell destruction commonly presenting in childhood or adolescence, and type 2 diabetes mellitus (T2DM), which is driven predominantly by insulin resistance combined with progressive  $\beta$ -cell dysfunction and accounts for the majority of cases globally (2,3). Persistent hyperglycemia contributes to serious macrovascular and microvascular complications affecting multiple organ systems, including cardiovascular disease, nephropathy, neuropathy, retinopathy, and diabetic foot disorders that can result in ulceration and limb amputations, collectively causing substantial disability, health system strain, and economic loss (4,8–13,16). Evidence also supports a strong association between diabetes risk and modifiable behaviors such as physical inactivity, unhealthy diet, smoking, and obesity, reinforcing the importance of prevention and early education across populations and healthcare systems (6,7,14,15).

Global epidemiologic data show a steadily rising diabetes burden, with large-scale estimates indicating hundreds of millions currently living with DM and projections suggesting a further increase over the next decades (15,18). Regional variations are pronounced, with the Middle East and North Africa demonstrating among the highest prevalence rates in global federation reports, while neighboring countries have reported substantial proportions of undiagnosed diabetes, emphasizing gaps in screening and awareness (19,21). Although diabetes care depends on multidisciplinary management, nurses remain central to patient education, medication monitoring, prevention of complications, and long-term lifestyle guidance. As frontline healthcare professionals, their competence can directly influence outcomes such as glycemic control, adherence, risk recognition, and complication prevention (22,23). Consequently, it is critical that nursing graduates possess strong foundational and applied knowledge of diabetes pathophysiology, symptom recognition, risk factors, complication prevention, and self-management education strategies.

Despite the centrality of nursing roles in diabetes care, previous research has repeatedly demonstrated that nursing students and even registered nurses may exhibit inadequate or inconsistent knowledge regarding diabetes care and its management, suggesting persistent gaps in pre-service education and clinical readiness (22,32,34). Studies across student populations have documented that large proportions display borderline, moderate, or inadequate knowledge, including reports from Peshawar-based settings where allied health students demonstrated predominantly borderline knowledge and a considerable minority had inadequate understanding (26). Similar evidence from other regions has shown that only a minority of students achieve good knowledge levels, and these deficiencies have been linked to weaker prevention practices and reduced clinical preparedness, supporting the need for structured educational interventions (27,30,33). Moreover, educational exposure such as structured workshops and targeted teaching strategies has been proposed as a method to enhance knowledge, though evidence is mixed and may be influenced by participation bias, workshop quality, and variation in learning environments (34,36,38). In parallel, the educational climate—including student

satisfaction with instructors and perceived engagement—may contribute meaningfully to learning outcomes, emphasizing the importance of teaching quality and student motivation (24,25).

In Peshawar, where diabetes remains increasingly prevalent and healthcare services are under pressure, final-year nursing students represent an imminent workforce expected to deliver competent diabetes care. However, limited multi-institutional evidence exists describing their diabetes knowledge levels across KMU constituent and affiliated nursing colleges, and there remains uncertainty regarding the extent of knowledge gaps and the relationship of educational exposures such as interest in the topic, satisfaction with teaching, and workshop attendance with performance. This study therefore aimed to assess the level of knowledge regarding diabetes mellitus among final-year nursing students across KMU constituent and affiliated nursing institutes in Peshawar and to examine whether educational engagement indicators, including workshop attendance and the learning environment, are associated with knowledge performance.

**Research Objective:** To determine the proportion of final-year nursing students with good, average, and poor diabetes knowledge in KMU constituent and affiliated nursing institutes of Peshawar and to evaluate the association of workshop attendance and learning engagement factors with knowledge scores.

## MATERIALS AND METHODS

A descriptive cross-sectional study was conducted to evaluate diabetes mellitus knowledge among final-year nursing students enrolled in Khyber Medical University (KMU) constituent and affiliated nursing institutes in Peshawar. The study population comprised students in their final year of nursing training who were approaching workforce entry and therefore expected to have acquired foundational theoretical and clinical knowledge relevant to diabetes care. Eligible participants were final-year nursing students of either gender who provided informed consent and were willing to participate. Students who were actively engaged in other research projects at the time of data collection were excluded to reduce contamination effects on knowledge assessment and survey participation.

Participants were recruited from 13 KMU constituent and affiliated institutes, including public and private nursing colleges, following administrative permissions from the respective institutions. A non-probability convenience sampling technique was used due to the multi-institutional nature of the study and access constraints. The target sample size was calculated using Rao's soft sample size approach with a 95% confidence level, 5% margin of error, and response distribution of 50% for a large estimated population, yielding a required sample of 377 students. Data collection resulted in 329 completed questionnaires, corresponding to an overall response rate of 87.2% (329/377).

Data were collected using a structured, self-developed diabetes knowledge questionnaire designed to assess key domains of diabetes understanding, including general definition and classification, risk factors, causes, symptoms, indicators, management principles, complications, and prevention strategies. The tool comprised dichotomous response items scored as correct (1) or incorrect (0), generating a total knowledge score. A pilot study was conducted on 37 participants, and internal consistency reliability was assessed using Cronbach's alpha. Item refinement was undertaken after pilot feedback and expert review, with two items removed to improve internal consistency, resulting in a final reliability coefficient (Cronbach's alpha) of 0.756 for the retained item set. Knowledge categories were operationally defined using the scoring criteria applied in the study: scores of 14–16 were categorized as good knowledge, scores of 12–13 as average knowledge, and scores <12 as poor knowledge. In addition to knowledge assessment, the questionnaire captured demographic variables including age and gender, institutional affiliation, self-reported interest in diabetes mellitus as a topic, satisfaction with the subject teacher, and attendance of diabetes-related workshops during coursework.

Data collection was conducted in lecture hall settings after institutional approvals and ethical clearance from the Research Ethical Committee of Ahmad Medical Institute, Peshawar. Written informed consent was obtained from each participant prior to participation, and confidentiality was maintained by using anonymous data recording without personal identifiers. Participants were provided approximately 20 minutes to complete the questionnaire and responses were collected immediately to minimize missing responses.

Data analysis was performed using SPSS version 24. Continuous variables were summarized using mean and standard deviation, while categorical variables were presented as frequencies and percentages. Associations between educational engagement variables were explored using correlation analysis as reported by the study dataset. Workshop attendance was examined as an explanatory variable for knowledge score using regression analysis, with workshop participation as the independent variable and total knowledge score as the dependent variable. Statistical significance was interpreted using a two-sided alpha level of 0.05, and effect estimates were reported with 95% confidence intervals where inferable from available statistics.

## RESULTS

A total of 329 final-year nursing students participated, representing an overall response rate of 87.2% from the calculated target sample of 377. Participants were recruited from 13 KMU constituent and affiliated institutes in Peshawar. The age range was 19–28 years, with a mean age of  $22.9 \pm 1.519$  years. Males constituted 59.3% (n=195) and females 40.7% (n=134) of the sample (Table 1). The largest institutional contributions were from NCS (13.7%), LRH (13.4%), KTH (11.6%), and HMC (10.9%), reflecting broad coverage across the nursing institutes participating in the study (Table 2).

**Table 1. Demographic Characteristics of Participants (N = 329)**

Variable	Category	n	%
Gender	Male	195	59.3
	Female	134	40.7
Age (years)	Mean $\pm$ SD	$22.9 \pm 1.519$	—
	Range	19–28	—

Regarding educational engagement, 76.9% (n=253) of students reported being interested in diabetes mellitus, while 23.1% (n=76) reported no interest. A majority of students, 64.7% (n=213), reported satisfaction with their respective subject teachers, while 35.3% (n=116) were not satisfied (Table 3). Interest and teacher satisfaction were positively correlated ( $r = 0.199$ ,  $p < 0.001$ ), indicating a statistically significant but small association

between satisfaction with teaching and student interest in diabetes mellitus. The 95% confidence interval for this correlation was 0.093 to 0.301, supporting a consistent positive relationship in the study population (Table 4).

**Table 2. Institutional Distribution of Participants (N = 329)**

Institute	n	%
AMI	19	5.8
NWCN	18	5.5
INS	12	3.6
PGCN	26	7.9
HMC	36	10.9
LRH	44	13.4
KTH	38	11.6
LCCN	34	10.3
PINC	16	4.9
NICE	15	4.6
NCS	45	13.7
UCN	3	0.9
RMI	23	7.0
Total	329	100.0

**Table 3. Student Interest and Satisfaction with Subject Teacher (N = 329)**

Variable	Category	n	%
Interest in Diabetes Topic	Interested	253	76.9
	Not interested	76	23.1
Satisfaction with Teacher	Satisfied	213	64.7
	Not satisfied	116	35.3

**Table 4. Correlation Between Student Interest and Satisfaction with Teacher (N = 329)**

Association	Correlation coefficient (r)	95% CI	p-value
Interest ↔ Teacher satisfaction	0.199	0.093 to 0.301	<0.001

Only 15.5% (n=51) of students reported attending a diabetes-related workshop during their coursework, while 84.5% (n=278) had not attended any such workshop (Table 5). This indicates a low level of structured extracurricular training exposure in diabetes education among final-year nursing students across the participating institutes.

**Table 5. Workshop Attendance Related to Diabetes Mellitus (N = 329)**

Workshop attendance	n	%
Yes	51	15.5
No	278	84.5
Total	329	100.0

Based on the validated diabetes knowledge scale and the predefined scoring thresholds, 28.9% (n=95) of students demonstrated good knowledge, 28.9% (n=95) demonstrated average knowledge, and 42.2% (n=139) demonstrated poor knowledge (Table 6). Overall, 57.8% (n=190) were classified as having average-to-good knowledge, whereas a substantial proportion (42.2%) remained in the poor knowledge category, indicating important educational gaps among a significant fraction of soon-to-graduate nursing trainees.

**Table 6. Knowledge Level Categories of Students Regarding Diabetes Mellitus (N = 329)**

Knowledge category	Score definition	n	%
Good	14–16	95	28.9
Average	12–13	95	28.9
Poor	<12	139	42.2
Total	—	329	100.0

To examine whether workshop attendance was associated with total knowledge score, a regression model was applied using workshop attendance as the independent variable and total score as the dependent variable. Workshop attendance was associated with a negative regression coefficient (B = -0.393, t = -1.914, p = 0.056), meaning that workshop attendees scored, on average, 0.393 points lower than non-attendees; however, this

association did not reach conventional statistical significance at  $\alpha = 0.05$ . The 95% confidence interval for the regression coefficient ranged from  $-0.797$  to  $0.011$ , suggesting the estimate was imprecise and compatible with both a modest negative association and a near-null effect (Table 7). This finding should therefore be interpreted cautiously and may reflect selection effects (e.g., weaker students more likely to attend workshops), variability in workshop quality, or timing issues rather than a true negative effect of workshops.

Table 7. Regression of Workshop Attendance Predicting Total Knowledge Score (N = 329)

Predictor	B coefficient	95% CI	t value	p-value
Workshop attendance → Knowledge score	-0.393	-0.797 to 0.011	-1.914	0.056

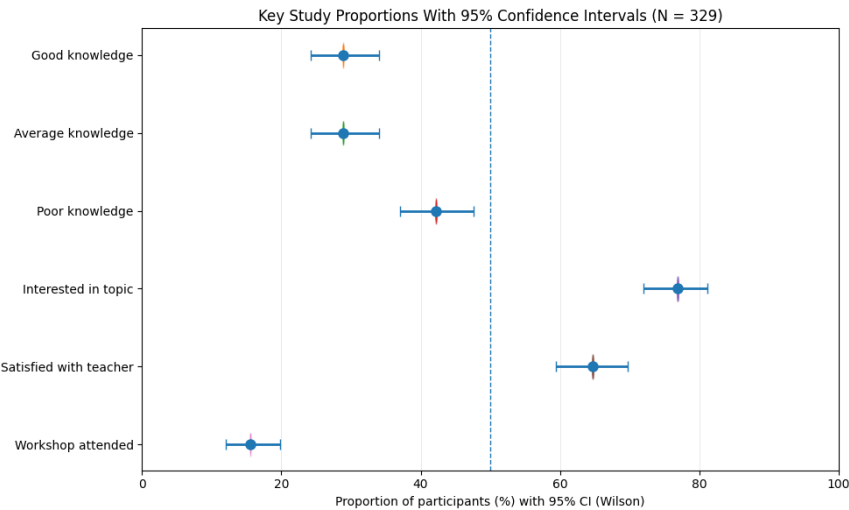


Figure 1 Key Study Proportions With 95% Confidence Intervals (N = 329)

Across 329 final-year nursing students, poor diabetes knowledge was the most frequent category at 42.2% (139/329; 95% CI 36.9–47.7), exceeding both good knowledge (28.9%, 95/329; 95% CI 24.3–34.1) and average knowledge (28.9%, 95/329; 95% CI 24.3–34.1), indicating a substantial subgroup with clinically relevant knowledge deficits. Educational engagement indicators were comparatively high, with 76.9% reporting interest in diabetes (253/329; 95% CI 72.1–81.1) and 64.7% reporting satisfaction with subject teachers (213/329; 95% CI 59.4–69.6), both well above the midline reference threshold, whereas workshop exposure was notably low at 15.5% (51/329; 95% CI 12.0–19.9), reinforcing that structured supplementary training was limited in this population and highlighting a potential area for targeted educational strengthening.

DISCUSSION

Diabetes mellitus remains a rapidly expanding global public health challenge, driven by shifting lifestyle patterns, aging populations, obesity, and metabolic risk clustering, and its rising prevalence has translated into increasing rates of preventable microvascular and macrovascular complications (5–8,14–18). Because nurses play a central role in patient education, monitoring, and complication prevention across the diabetes care continuum, their competence is directly linked to patient safety and long-term outcomes (22,23,32,34). In this context, assessing the preparedness of final-year nursing students—who are positioned to enter clinical practice—becomes essential, particularly in settings where diabetes burden is increasing and health systems require strong frontline capacity. The current study provides multi-institutional evidence from KMU constituent and affiliated nursing institutes in Peshawar, demonstrating that although more than half of respondents achieved average-to-good knowledge, a substantial proportion of soon-to-graduate students still exhibited poor diabetes knowledge. The key finding of this study is that 42.2% of final-year nursing students demonstrated poor knowledge regarding diabetes mellitus, while 28.9% had good knowledge and 28.9% had average knowledge. This pattern suggests that, despite exposure to diabetes content during nursing education, knowledge acquisition remains inconsistent across students, and a large subgroup may be underprepared to contribute effectively to diabetes education, screening, or complication prevention in early professional practice. Comparable proportions of inadequate or poor knowledge have been reported in other settings, including nursing students in Indonesia where poor knowledge was also common, and in studies of university health-related students where borderline or moderate knowledge predominated (26,27,37). Similar concerns have been identified among healthcare trainees and registered nurses across multiple regions, emphasizing that diabetes knowledge gaps are not restricted to one institution or country, but reflect broader educational and curricular challenges (22,32,34). Importantly, deficits in diabetes knowledge are clinically meaningful because inadequate awareness is associated with weaker prevention behaviors, limited screening insight, and poorer engagement with evidence-based management pathways (29,30,33). A major educational insight from this study is the statistically significant association between student satisfaction with the subject teacher and interest in diabetes mellitus ( $r = 0.199$ ,  $p < 0.001$ ). Although the effect size is modest, it remains meaningful in educational terms, suggesting that instructional quality and learning environment contribute to student engagement in chronic disease topics. In nursing education, motivation and perceived instructional effectiveness are consistently linked with deeper learning and higher retention, which is particularly relevant for complex conditions like diabetes requiring both theoretical knowledge and applied clinical reasoning (22,34). From a competence-development perspective, the finding aligns conceptually with Benner’s novice-to-expert framework, which emphasizes progression from rule-based learning toward contextualized clinical judgment through supportive learning environments, mentorship, and repeated applied exposure (2.1 Benner’s Theory section in your manuscript). In this study, the proportion of students with poor knowledge indicates that a significant fraction may still be

functioning closer to “novice-level” understanding regarding diabetes, even at the final year of training, suggesting a need for improved scaffolding and applied learning strategies.

Workshop exposure was limited in this sample, with only 15.5% reporting attendance. This is similar to prior findings from Jordanian nursing students, where workshop attendance was also low, and contrasts with contexts where structured diabetes education is more widely embedded (38). Workshops are often intended to strengthen clinical application through case-based learning and practical exposure, yet the regression result in this study showed a negative coefficient for workshop attendance ( $B = -0.393$ ,  $p = 0.056$ ), which did not reach statistical significance and should be interpreted cautiously. This near-null association may reflect selection effects where students with weaker baseline knowledge may be more likely to attend workshops, heterogeneity in the quality and content of workshops, limited duration, or lack of reinforcement following training. Similar variability has been noted in prior educational studies, where short interventions improve perceived knowledge but may not consistently translate into measurable performance without structured follow-up and clinical integration (34,36). Therefore, rather than suggesting workshops are ineffective, the results indicate that workshop design, standardization, timing, and reinforcement mechanisms should be evaluated before concluding educational benefit.

Taken together, the findings support a clear educational gap: although a majority demonstrated at least average knowledge, the proportion with poor knowledge remains clinically significant and may compromise diabetes care quality when these graduates enter the workforce. Strengthening diabetes education within undergraduate nursing curricula should focus not only on factual knowledge but also on clinical application through simulation-based learning, structured case discussions, standardized workshops with post-session evaluation, and competency-based assessment aligned with real-world diabetes management responsibilities (22,32–34). Additionally, the observed link between satisfaction and interest reinforces the value of faculty development programs that enhance teaching effectiveness, promote interactive learning, and cultivate supportive teacher–student engagement to improve motivation and learning outcomes, particularly for complex chronic disease care (34,36).

This study has limitations that should be considered. The use of non-probability convenience sampling may limit representativeness and introduces potential selection bias. In addition, self-reported measures such as interest and satisfaction may be influenced by social desirability or response bias. The cross-sectional nature of the study prevents causal inference regarding the relationships between educational engagement, workshops, and knowledge outcomes. Finally, the analysis did not include item-level knowledge profiling or institute-wise comparison of knowledge outcomes, which could provide deeper insight into specific curriculum weaknesses and institutional variation. Future studies should incorporate probability sampling where feasible, conduct longitudinal follow-up to evaluate progression of knowledge through training, include detailed domain-wise assessment of diabetes knowledge, and evaluate structured educational interventions with pre–post assessment designs.

## CONCLUSION

This multi-institutional cross-sectional study among KMU constituent and affiliated nursing institutes in Peshawar found that while 57.8% of final-year nursing students demonstrated average-to-good knowledge regarding diabetes mellitus, a substantial proportion (42.2%) had poor knowledge, indicating clinically important educational gaps among soon-to-graduate trainees. Student satisfaction with instructors showed a significant positive association with interest in diabetes, underscoring the importance of teaching quality and learning environment in chronic disease education, while workshop exposure was low and did not demonstrate a statistically significant positive relationship with knowledge scores. These findings support the need for strengthened curriculum delivery, structured competency-based diabetes training, and enhanced applied learning opportunities to ensure graduating nurses are adequately prepared to contribute effectively to diabetes prevention, patient education, and complication management in clinical practice.

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