



## Original Article



## Assessment of Readiness and Perception toward Artificial Intelligence Integration in Nursing Education: A Quantitative Study in Sindh, Pakistan

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## ABSTRACT

Artificial Intelligence (AI) is revolutionizing healthcare systems worldwide. However, its effective integration into nursing education, particularly in Low and Middle-Income Countries (LMICs), remains underexplored. **Objective:** To assess the readiness, awareness, and perceived barriers regarding AI integration among nursing students in Sindh using a structured quantitative approach. **Methods:** A descriptive cross-sectional study was conducted among 230 students using a stratified non-probability random sampling method. Data were collected via a validated Likert-scale questionnaire and analyzed using SPSS version 26. **Results:** 90% of students reported conceptual awareness of AI, and 92% expressed excitement about using AI tools in nursing education. However, only 43% had formal AI training. Perceived barriers included data privacy concerns (86%), lack of infrastructure (77%), and fear of job displacement (71%). **Conclusion:** The study findings demonstrated that it is necessary to have a regular systematic AI-oriented training in the nursing curriculum to better equip students in working with a relevant technology.

## INTRODUCTION

The healthcare sector is undergoing a paradigm shift driven by the integration of Artificial Intelligence (AI) in diagnostics, clinical decision support, patient monitoring, and personalized care delivery [1, 2]. As frontline healthcare providers, nurses are expected to function not only as compassionate caregivers but also as digitally literate professionals equipped to interact with AI systems [3]. Therefore, nursing education must evolve to incorporate digital competencies that reflect this new reality. Globally, AI is being progressively introduced into nursing curricula, particularly in high-income countries

where digital infrastructure, faculty development, and institutional frameworks are more established [4]. In contrast, Low- and Middle-Income Countries (LMICs) like Pakistan are still in the exploratory phase, with most nursing programs lacking formal AI instruction or ethical frameworks for its application [5]. Moreover, although students increasingly interact with AI-powered platforms like clinical chatbots and ChatGPT, their use is still disconnected from structured teaching methods [6]. Infrastructural constraints, such as inadequate training resources and unprepared teachers, and ethical issues,



such as algorithmic prejudice, data misuse, and the perceived dehumanization of care, further exacerbate this disparity [7-10]. Assessing nursing students' AI preparedness is crucial and timely as Pakistan speeds up its digital health ambitions. Across Sindh's varied institutional landscape, this study investigates students' awareness, willingness, and perceived impediments to AI incorporation in nursing school. The objective is to provide information for evidence-based curriculum changes and national policy suggestions that reflect the technological future of healthcare [11-15].

Despite the rapid global expansion of Artificial Intelligence in healthcare and education, empirical evidence assessing nursing students' readiness and perceptions toward AI integration in Pakistan remains scarce. Existing studies are largely concentrated in high-income countries, with limited data from LMIC contexts where infrastructural, curricular, and faculty preparedness challenges differ significantly. Moreover, few studies have simultaneously examined awareness, readiness, and perceived barriers within a single analytical framework. Addressing this gap is essential to inform context-specific curriculum reforms and digital health policies in Sindh and across Pakistan. This study aimed to assess awareness, readiness, and perceived barriers toward AI integration among undergraduate medical students in Sindh Pakistan, and to analyze correlations between these variables.

## METHODS

This descriptive cross-sectional study was conducted among nursing students enrolled in public and private institutions across Sindh, Pakistan, to assess their readiness and perceptions toward AI in nursing education. This study was conducted between January and May 2025. A total of 230 participants were selected using stratified non-probability random sampling to ensure representation across academic years and institution types. Students were eligible to participate if they were enrolled in their second year or higher and had prior exposure to at least one course involving digital technology. Students who had not completed at least one semester of clinical education or lacked any formal or informal digital learning experience were excluded. Descriptive statistics (frequencies, percentages, means) summarized participant demographics and Likert-scale responses. Inferential statistics (independent t-tests, ANOVA, Chi-square) were applied to compare groups, with significance set at a 95% confidence level ( $\alpha = 0.05$ ). The Shapiro-Wilk test confirmed normality for parametric tests. Results were considered statistically significant at  $p < 0.05$ . Data were collected using a self-developed structured questionnaire comprising four components: demographic information, an AI Awareness Scale, an AI Readiness Scale (adapted

from the Technology Readiness Index 2.0, developed by Parasuraman and Colby), and a Perceived Barriers Scale [16-19]. All the sections in the questionnaires had a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The level of AI awareness (8 items; 20-40, the range of scores used was divided into low (8-20), moderate (21-29), and high (30-40). The questionnaire on AI Readiness Scale (10 items; range, 10-50) was coded low (10-25), moderate (26-39), and high (40-50). The Perceived Barriers Scale (9 items; range: 9-45) was measured, indicating low (9- 20), moderate (21-35), and high (36-45). There was a definition of categories according to the tertile distribution of pilot data. The instrument demonstrated strong internal consistency, with Cronbach's alpha values of 0.83 for the AI Awareness Scale, 0.88 for the AI Readiness Scale, and 0.86 for the Perceived Barriers Scale. The questionnaire was validated by subject experts, and a pilot study ensured internal consistency, yielding a Cronbach's alpha above 0.80. The survey was administered electronically via Google Forms, and informed digital consent was obtained from all participants. Ethical clearance was granted by a recognized institutional review board. Data were analyzed using SPSS version 26.0, applying descriptive statistics, inferential tests such as independent t-tests, Chi-square tests to examine relationships between AI awareness, readiness, and perceived barriers.

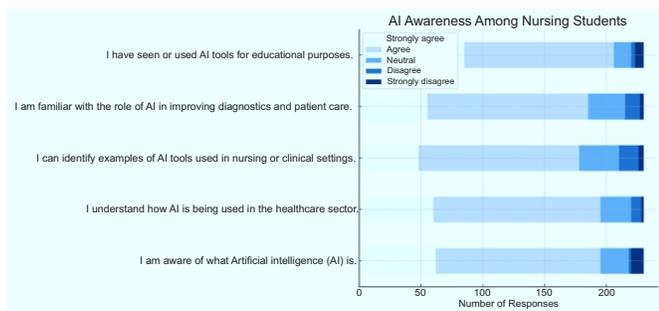
## RESULTS

This study presented a clear snapshot of AI awareness, readiness, and challenges among 230 nursing students in Pakistan. The majority were female (62.6%), enrolled in 3rd year (45.7%), and from private institutions (53%). Most students had access to digital devices (94.3%) and had used AI tools (95.2%), though only 43% received formal AI training. The results reveal high levels of AI awareness and positive attitudes, especially among female students and those in private colleges. However, institutional support is lacking, infrastructure gaps, untrained faculty, and privacy concerns remain significant barriers. This contrast highlights a critical paradox: students are ready for AI, but educational institutions are not yet equipped to support its integration effectively. Table 1 shows that female students (80%) and students from private institutions (75%) demonstrated significantly higher AI awareness than their counterparts ( $p < 0.05$  and  $p < 0.01$ , respectively), suggesting better access or support. The year of study had no significant effect, with awareness levels remaining consistent across all years. This indicates that AI exposure is likely informal rather than curriculum-driven. Overall, gender and institution type are key factors in awareness, highlighting the need for equitable AI education across all groups.

**Table 1:** Association between Demographic Factors and AI Awareness(% Agree/Strongly Agree)

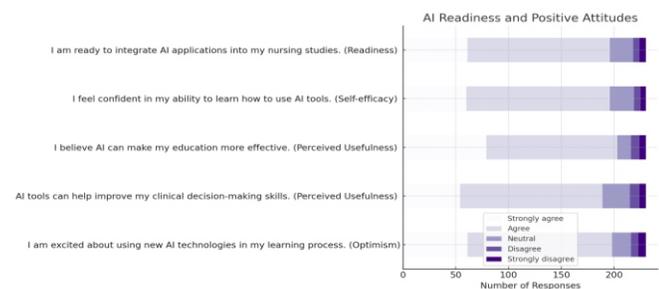
Demographic Factor	Category	AI Awareness (%)	Significance
Gender	Male	65	*p < 0.05
	Female	80*	
Institution Type	Public	60	**p < 0.01
	Private	75**	
Year of Study	2nd Year	68	NS (Not Significant)
	3rd Year	72	
	4th Year	70	

Figure 1 showed that most nursing students demonstrate a strong awareness of AI, especially in understanding its role in healthcare and identifying its applications in clinical settings. A significant proportion have also used AI tools for educational purposes, reflecting informal exposure. These results indicate a high baseline familiarity with AI among students, even without formal instruction.



**Figure 1:** AI Awareness Levels across Key Concepts in Nursing Education

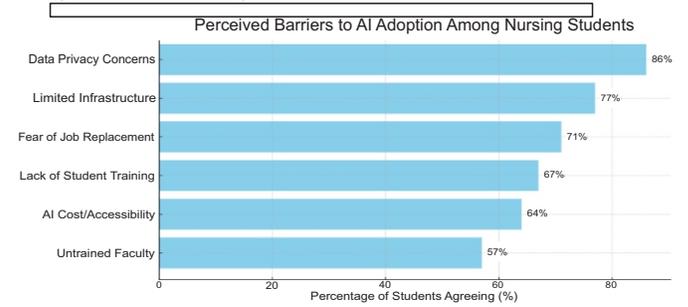
Figure 2 reflected that nursing students are highly optimistic and confident about integrating AI into their education. Most respondents agreed that AI can enhance learning and clinical decision-making, and felt ready and capable of using AI tools. This positive attitude indicates a strong foundation for implementing AI-driven learning, provided institutional support is strengthened.



**Figure 2:** AI Readiness and Positive Attitudes among Nursing Students

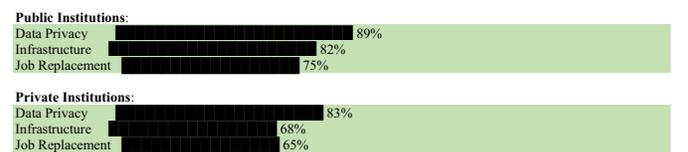
Figure 3 highlighted that while students are eager to embrace AI, they face significant institutional barriers. The most common concerns include data privacy (86%), poor infrastructure (77%), and lack of AI training (67%). These findings emphasize the need for systemic reforms in

training, resources, and policy to support effective AI integration in nursing education.



**Figure 3:** Perceived Barriers to AI Adoption among Nursing Students

Figure 4 revealed that students from public institutions face greater challenges than those in private colleges, particularly regarding data privacy (89%) and infrastructure (82%). Concerns about AI replacing nursing roles are also higher in public settings. These differences underscore the need for targeted investment in public institutions to reduce the digital readiness gap.



**Figure 4:** Comparison of Perceived AI Barriers in Public vs. Private Institutions

Table 2 showed that while most students believe in AI's importance (80%) and understand its role (75%), fewer feel ready to use AI (65%) or can identify specific tools (65%). Only 60% report AI being covered in their curriculum, revealing a gap between perception and formal education. These results suggest strong interest but underscore the need for structured AI integration in nursing programs.

**Table 2:** Key Perception Metrics on AI among Nursing Students

Key Metric	Agree	Disagree
Believe in AI's importance	80%	20%
Understand AI's role	75%	25%
Ready to use AI	65%	35%
Identify AI tools	65%	35%
AI in curriculum	60%	40%

## DISCUSSION

Significant obstacles still exist, nevertheless, especially in the areas of curriculum alignment, digital infrastructure, and teacher training. These gaps run the risk of compromising the potential of a highly motivated and attentive student body in the absence of proactive action [20]. This study offers timely insight into AI readiness among nursing students in Sindh, Pakistan, where digital integration in education remains limited. Findings show high awareness (90%) and enthusiasm (92%) toward AI, consistent with global trends [7, 10, 2]. However, a major

challenge remains: a gap between student readiness and institutional preparedness. While students exhibit digital fluency, 57% cited untrained faculty as a key barrier supporting Rony *et al.*'s findings that educators often lack AI-specific training [2]. Similarly, Salama *et al.*, reported strong student interest in Palestine despite minimal structured exposure, echoing the local context [6]. Top barriers data privacy concerns, limited infrastructure, and fear of job loss were consistent with studies in the Gulf and Southeast Asia [15, 11, 18]. Micah *et al.*, (2021) conducted a comprehensive review tracking global health spending—including development assistance, government, and private expenditures across 204 countries from 1990 to projected trends in 2050 [12]. It's crucial to distinguish between structured academic teaching and unstructured AI use, such as ChatGPT. True competence necessitates educational reform rather than only tool familiarity, as Ghimire and Qiu pointed out [1]. Clinical judgment may be compromised by unstructured use, which runs the risk of shallow comprehension and excessive dependence on AI outputs [13]. These insights suggest urgent action: integrating AI into nursing curricula, investing in faculty development, and embedding ethical and psychological preparedness. AI education must go beyond technical training to include ethical, legal, and emotional dimensions.

This study is limited by its cross-sectional design, which restricts causal inferences, and by the use of self-reported measures that may introduce response bias. Additionally, the non-probability sampling technique and regional focus on Sindh may limit the generalizability of findings to other provinces of Pakistan. Future research should employ multicenter, longitudinal, and mixed-method approaches to explore evolving AI competencies and institutional readiness over time. Intervention-based studies evaluating structured AI curriculum modules and faculty development programs are also recommended to support sustainable integration in nursing education.

## CONCLUSIONS

This study demonstrates that Pakistani nursing students are highly aware of and prepared for the incorporation of AI into healthcare education. The implementation of AI in nursing education programs through approved curriculum modules, ongoing professional development for teachers in AI and digital pedagogy, and investments in bolstering technology infrastructure, particularly in public institutions, are all necessary to meet these issues. In order to prepare students for the rapidly changing digital landscape in healthcare, it is also important to focus on the early integration of AI ethics, data protection, and responsible use.

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## Authors' Contribution

Conceptualization: ZA, JR

Methodology: IGK

Formal analysis: ZHC, JAZ

Writing and Drafting: ZA, JAZ, AK

Review and Editing: ZA, JAZ, AK, ZHC, IGK, JR

All authors approved the final manuscript and take responsibility for the integrity of the work.

## Conflicts of Interest

All the authors declare no conflict of interest.

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