

Article

Artificial Intelligence-Related Literacy and Fears Among Critical Care Nurses in Oman: A National Study

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Abstract

Background: Artificial intelligence (AI) is increasingly embedded in critical care nursing through monitoring, decision support, and documentation systems, yet nurses' readiness to use it remains uncertain, particularly in the Middle East region. Critical care nurses are central to AI implementation at the bedside, and their AI-related literacy and fears can influence safe and ethical integration into clinical practice. **Aim:** To assess AI-related literacy and fears among critical care nurses in Oman and the associated factors. **Methods:** A nationwide cross-sectional survey was conducted among critical care nurses ($N = 477$) working in tertiary hospitals in Oman. The Multidimensional Artificial Intelligence Literacy Scale and the Fear towards AI Scale were used to measure AI literacy and fears, respectively. **Results:** The participants had low overall AI literacy (146.62 ± 84.03), and low AI self-efficacy and AI self-competency. The lowest level of literacy was related to creating AI (2.43 ± 2.63). On the other hand, participants reported moderate overall fear towards AI and moderate levels of fear related to job issues and humanity and ethics. Age, marital status, levels of education, receipt of prior computer or information technology, AI-related training, and work experience, were significant predictors of AI literacy. The predictors of AI self-efficacy and AI competence are presented. **Conclusions:** Nurses working in critical care settings in Oman reported low levels of AI literacy, but moderate fears related to AI, and this provides an opportunity to build AI competencies and capacity. There is need for deliberate and structured continuing education programs to build capacity for AI utilization, competence, and self-efficacy among critical care nurses. Structured, hands-on AI training that integrates ethical reflection for older nurses with more experience but limited professional education is needed and essential to support safe and equitable AI utilization by critical care nurses in Oman.

Keywords: artificial intelligence; AI literacy; fear of AI; critical care nurses; Oman; intensive care; nursing practice



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1. Introduction

Artificial intelligence (AI) is increasingly embedded in healthcare through applications such as clinical decision support, patient monitoring, documentation, and education across multiple specialties [1]. In critical care settings, AI-enabled systems are deployed to support continuous patient monitoring, early detection of deterioration, and streamlining of routine documentation, potentially improving patient safety and allowing nurses to devote more time to direct care and clinical judgment [2]. Thus, critical care nurses (CCNs), who provide continuous, high-acuity care and rapid decision-making for patients with life-threatening conditions, are key end-users of AI-supported healthcare technologies and need sufficient AI-related literacy to interpret and safely use AI in clinical practice [3].

AI literacy has been described as a multidimensional competency that includes understanding AI concepts, evaluating AI-generated information, using AI tools meaningfully, and integrating ethical considerations into practice [4–6]. Emerging evidence suggests that nurses in various settings often report only fair or moderate knowledge about AI and its applications, and many identify unmet needs related to training in AI concepts, capabilities, and limitations [7]. Recent studies among healthcare professionals and nursing students have documented limited AI literacy, uneven access to AI-focused education, and anxiety about technology adoption. Reviews of AI literacy among health professionals and students generally indicate low levels of AI competence and highlight the lack of nursing-specific data, particularly in high-acuity environments such as ICUs [8]. The lack of data is a concerning gap that affects healthcare system improvement. Moreover, insufficient AI literacy among CCNs may compromise their ability to question AI recommendations, detect potential errors or biases [9,10], and these can affect patient safety, healthcare outcomes, and cost care.

In parallel with literacy, affective responses such as fear and anxiety towards AI are increasingly recognized as important influences on how healthcare professionals engage with AI technologies [11]. Studies among healthcare workers and nursing students have documented fears related to job displacement, loss of clinical autonomy, decline in cognitive skills, and concerns that AI could erode human empathy or disrupt ethical norms in healthcare [12,13]. Fear towards AI has been conceptualized as including both job- and autonomy-related fears [14]. For instance, reduced decision-making authority or overreliance on AI may be perceived as an approach that can lead to a reduction in the number of nursing positions in the intensive care unit (ICU). Regarding humanity and ethics-related fears, CCNs may fear that AI could lead to loss of compassion or increased ethical conflicts [14]. Higher levels of AI fear and anxiety have been associated with more conservative attitudes and reluctance to engage with AI-enabled tools, even when potential benefits are acknowledged [15]. In critical care, where decisions are time-sensitive and the stakes are high, such fears may further complicate efforts to integrate AI into everyday nursing practice [11,16], or impact the quality of patient care.

Available studies from various countries show that nurses' AI literacy and AI-related fears vary by education level, prior exposure to AI, and contextual factors, but data specific to CCNs remain limited. A systematic review reported generally low AI literacy among health professionals and students and noted the absence of nursing-focused studies in many contexts, while other work has highlighted fear towards AI among nurses and nursing students, particularly when educational preparation is limited [8]. These findings suggest that both literacy and fear must be considered together, since insufficient understanding of AI may intensify fears, and high levels of fear may discourage nurses from seeking or applying AI-related knowledge [8].

In Oman, a country of approximately 5.5 million people and located in the Middle East, AI and digital health are increasingly aligned with national strategies such as Oman Vision

2040, which emphasize innovation and technology in healthcare. Moreover, in nursing practice the critical care units and intensive care units in major tertiary hospitals manage complex, high acuity, and high-risk patients, and AI-enabled healthcare technologies, monitoring and decision systems, and documenting systems could be particularly valuable when used by nurses who know how to use them [17]. However, current evidence about AI literacy among nurses from Oman is extremely limited. There is only one multi-country study which included Omani nursing students and it examined AI knowledge, attitudes, and intentions [18]. There are no published studies focusing on AI literacy or fear towards AI among practicing nurses, especially CCNs. This gap is important because safe and effective use of AI in critical care depends not only on the availability of technology, but also on the CCNs' AI literacy, self-efficacy, competence, ethics, and emotional response to AI.

Available studies suggest that AI literacy among health professionals is generally low to moderate, with important unmet needs for training; however, most research aggregates diverse professionals or focuses on students, and rarely examines the specific demands of critical care nursing. Moreover, studies of AI fears highlight concerns about job security and ethics, but seldom link these fears to measured literacy levels in ICU nurses.

Therefore, this national study is addressing a gap in the literature in Oman and the greater Middle East region about CCNs' AI literacy. This study focuses on AI-related literacy and fears among CCNs in Oman. It provides empirical evidence that can be used to develop targeted healthcare system-level interventions to boost the AI literacy, self-efficacy, and competence among CCNs, and this can subsequently increase the quality of nursing care and patient outcomes, and reduce healthcare costs. Despite growing interest in AI in healthcare, there is a lack of empirical data on AI literacy and AI-related fears among practicing critical care nurses, especially in Middle Eastern countries such as Oman. Existing studies focus mainly on students or mixed healthcare samples, leaving a gap in our understanding of how bedside critical care nurses perceive and are prepared for AI integration in high-acuity environments.

Purpose of This Study

Therefore, this national study aimed to assess AI literacy and fear towards AI among critical care nurses in Oman and to examine the associated factors.

2. Materials and Methods

2.1. Study Design

This study used a cross-sectional, descriptive–correlational survey design to assess AI-related literacy and fears in a nationwide sample of CCNs in Oman. A cross-sectional approach was chosen to provide a snapshot of nurses' AI literacy and fear towards AI in the country and this helped to explore associations between these two constructs without inferring causality [19,20]. The survey targeted CCNs working in intensive care units and critical care units of major governmental tertiary hospitals, where high-acuity care and rapid technology adoption make AI literacy and AI-related fears particularly salient to safe practice.

2.2. Study Population and Setting

This national study was conducted in critical care units of major governmental tertiary hospitals in Oman, including Khoula Hospital, Royal Hospital, Nizwa Hospital, Sohar Hospital, Rustaq Hospital, and University Medical City. These hospitals are the main settings where patients that require high-acuity services and with complex critical conditions are referred for care in the country. This study focused on registered nurses working in

intensive care and critical care units in these hospitals. Eligible participants were CCNs aged 18 years or older, with at least one year of experience in an ICU or critical care unit, and able to read and write English to complete the questionnaire.

Nurses with prior work experience in Western healthcare systems (such as the United States, United Kingdom, Australia, or Canada) were excluded to reduce potential bias related to substantially different exposure to AI technologies, digital health infrastructures, and training approaches. In many Western hospitals, the level of AI integration, digital documentation, and decision support systems, as well as the availability of structured AI training, may differ markedly from that in Omani tertiary hospitals. Including nurses who had worked in such environments could therefore introduce considerable heterogeneity in baseline AI literacy and familiarity, making it more difficult to interpret differences that are specifically related to the Omani health system context. For this reason, the sampling strategy intentionally focused on nurses whose professional experience was primarily within Omani tertiary hospitals, allowing this study to more accurately characterize AI-related literacy and fears in relation to local clinical workflows, technology availability, and system-level support.

2.3. Sample Size and Sampling Technique

The sample size for this national survey was determined using the single population proportion formula, assuming a 95% confidence level, 5% margin of error, and an expected proportion of 50% for AI-related literacy and fears due to the absence of prior Omani data and studies. Based on an estimated population of 2185 eligible critical care nurses, the minimum required sample was 288, and this was adjusted by 10% to account for possible non-response, yielding a final target sample size of 317 participants. The participants were selected using probability sampling from the ICU and critical care unit nurse rosters of the seven tertiary hospitals. Nurses selected through the sampling procedure were approached during non-clinical periods (before/after shifts or during breaks), informed about this study, and invited to participate. Those who consented completed the questionnaire, resulting in a final analytic sample of 477 critical care nurses. A proportional allocation approach was applied to determine the number of nurses to be recruited from each hospital according to the size of its eligible nurse population, and then simple random sampling was used within each site to generate the list of nurses invited to participate. This strategy enhanced representativeness of the sample across hospitals while minimizing selection bias in estimating AI literacy and AI-related fears.

2.4. Instruments Used for Data Collection

Data were collected using a structured, self-administered questionnaire in English composed of a demographic data sheet and two standardized scales measuring AI literacy and AI-related fears. The demographic data sheet collected data about the participants' age, gender, total years of nursing and critical care experience, highest level of professional education, ICU type, work shift pattern, and prior exposure to AI-related workshops or AI-integrated technologies in healthcare settings. AI literacy was assessed using the Meta AI Literacy Scale (MAILS), a 34-item instrument that captures multiple domains of AI competence, including understanding AI concepts, using AI tools, detecting AI content, AI ethics, and AI-related learning and problem solving [5,21]. The domains can be further grouped as AI literacy (Use and apply, Know and understand AI, Detect AI, AI ethics, and Create AI), AI self-efficacy (AI problem solving and AI learning), and AI self-competency (AI persuasion literacy and AI emotional intelligence). Items are rated on a Likert-type scale, with higher scores indicating greater AI literacy. In the original validation studies, the MAILS demonstrated excellent internal consistency, with Cronbach's alpha coefficients

ranging from 0.89 to 0.93 across subscales [21]. In the current study, the MAILS showed excellent reliability, with a Cronbach's alpha of 0.98.

The fear towards AI was measured using the Fear towards AI Scale (FtAIS), a 10-item Likert-type scale designed to assess emotional and cognitive apprehensions about AI in healthcare [22,23]. The scale comprises two subscales: Job Issues (five items), reflecting fears related to job security and clinical autonomy, and Humanity (five items), reflecting concerns about empathy, depersonalization of care, and ethical implications of AI. Higher scores in each domain indicate a high level of fear. Previous studies reported good internal consistency for the FtAIS, with a Cronbach's alpha around 0.80 for the total scale and its subscales [22]. In the present study, internal consistency was excellent, with a Cronbach's alpha of 0.92 for the total FtAIS, 0.91 for the Job Issues subscale, and 0.92 for the Humanity subscale.

2.5. Data Collection Procedure

Data collection was carried out after obtaining ethical and institutional approvals and permissions from the relevant hospital nursing administrations. Eligible participants were identified from ICU and critical care rosters in each hospital, and those selected through the sampling process were approached during periods when they were not directly involved in patient care (for example, before or after shifts or during breaks) to minimize disruption of patient care activities. Trained research assistants or members of the research team explained this study's purpose, procedures, voluntary nature of participation, and confidentiality measures, and written informed consent was obtained from each participant prior to questionnaire distribution.

Following consent, participants received the self-administered questionnaire, which included demographic items, the MAILS, and the FtAIS. The participants were given the option to complete the questionnaire immediately in a quiet area of the unit or within two hours and return it in sealed envelopes to a designated secure collection box or directly to the research assistant. Periodic reminders were provided, using face-to-face contact to enhance response rates while avoiding coercion. Completed questionnaires were checked for completeness, assigned unique identification codes, and stored in locked cabinets and password-protected electronic files accessible only to the research team.

2.6. Data Management and Missing Data

Completed questionnaires were checked visually for completeness before the data were entered into the Statistical Package for the Social Sciences (SPSS) data file version 27 using double data entry by two different individuals. The discrepancies from data entry were resolved by cross-checking against the original paper forms. After entry, data cleaning procedures included running frequency distributions to identify out-of-range values, missing data, inconsistencies, and potential entry errors. Corrections were made where necessary by referring to the original questionnaires.

For the main study variables (AI literacy and fear towards AI), item-level missing responses were first examined using SPSS frequency tables to determine the proportion and pattern of missing data. Because the proportion of missing values per item was low, cases with missing responses on MAILS or FtAIS items were handled using listwise deletion for analyses that required complete scale scores, while all available data were retained for descriptive statistics where appropriate. Scale scores were calculated only when at least 80% of items within the scale or subscale were completed; otherwise, the corresponding scale score was treated as missing for the participant. These procedures were chosen to maintain data quality and preserve the validity of AI literacy and fear estimates among CCNs. For the multiple regression analyses examining predictors of AI literacy,

self-efficacy, and self-competency, standard assumptions were evaluated. Multicollinearity was assessed using variance inflation factors (VIFs) and tolerance values, which indicated no problematic collinearity among predictors (all VIFs < 10; tolerance > 0.1). Residual plots and normal probability (Q-Q) plots were inspected to verify approximate normality and homoscedasticity of residuals, and the independence of errors was evaluated with the Durbin–Watson statistic, which was within an acceptable range. These diagnostics supported the use of linear regression models for the main analyses. The details of the statistical analysis are explained in Supplementary File S2: Analytic procedures in IBM SPSS Statistics.

2.7. Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committee of the College of Nursing, Sultan Qaboos University (Ref: CON/RF/2025/4). Additional approval was granted by the Institutional Review Board and Ethics Committee of Sultan Qaboos Comprehensive Cancer Care and Research Centre (IRB/EC Project ID: SQCCRC_IRBEC_2025_0074), and no-objection/data collection permissions were secured from participating Ministry of Health hospitals, including Khoula Hospital (MoH/DGPS/CSR/PROPOSAL_APPROVED/197/2025). Eligible participants received written and verbal information about this study's aims, procedures, potential risks and benefits, and their rights; and participation was voluntary. Written informed consent was obtained before questionnaire completion. Nurses were informed about their right to withdraw at any time without consequences and the option to skip any question or discontinue participation at any time without consequences. The study questionnaires did not include personal identifiers, were coded, and stored in locked cabinets. The electronic data files were stored in password-protected computers accessible only to the research team. Data are reported in aggregate forms without reference to individual nurses, hospitals, or units.

3. Results

3.1. Participants' Characteristics

Table 1 describes the characteristics of the participants. The majority of the critical care nurses ($N = 477$) were in the 31–40-year-old age group (56.6%) and the mean age of the sample was 36.46 ± 6.91 years. Most participants reported total nursing experience of more than 11 years (57.2%), experience in critical care nursing of more than 11 years (41.7%), and they were female (87.2%) and married (82.2%). In terms of education, most participants had a bachelor's degree in nursing, while the others had a diploma or associate degree (32.9%) and very few had a master's degree (2.7%). Many participants reported that they worked rotating shifts (91.6%).

With respect to the clinical setting, most participants in the sample were working in the general ICU (63.1%), while the others were distributed across specialized units such as pediatric ICU (15.3%), NICU (10.1%), and others such as cardiac, surgical, high dependency, burns, and neuro ICUs. In terms of technology exposure, a large number indicated that their basic nursing education included a course on computer skills and information technology (61.2%) and reported using computers or automated equipment or information technology-supported equipment daily at work (84.3%). Only 15% of the participants had attended an AI-related workshop or had previous involvement with AI-integrated technology.

Table 1. Characteristics of critical care nurses in tertiary hospitals in Oman ($N = 477$).

Characteristic	Category	n (%)	M $\pm$ SD
Age in years	20–30	97 (20.3)	36.46 $\pm$ 6.91
	31–40	270 (56.6)	
	≥ 41	110 (23.20)	
Total years of experience in nursing	1–5	70 (14.7)	13.08 $\pm$ 7.41
	6–10	134 (28.1)	
	≥ 11	273 (57.2)	
Total years of experience in critical care/ICU	1–5	134 (28.1)	10.47 $\pm$ 7.00
	6–10	144 (30.2)	
	≥ 11	199 (41.7)	
Gender	Male	61 (12.8)	
	Female	416 (87.2)	
Marital status	Single	79 (16.6)	
	Married	392 (82.2)	
Highest level of education in nursing	Separated/divorced	6 (1.3)	
	Diploma/associate	157 (32.9)	
	Bachelor's	307 (64.4)	
	Master's	13 (2.7)	
Regular work shift	Day	36 (7.5)	
	Night	4 (0.8)	
	Rotation	437 (91.6)	
	High dependency unit	5 (1.1)	
Type of ICU	ICU for burns	5 (1.1)	
	NICU	48 (10.1)	
	Pediatric ICU	73 (15.3)	
	Neuro ICU	2 (0.4)	
	Cardiac ICU	33 (6.9)	
	Surgical ICU	10 (2.1)	
	General ICU	301 (63.1)	
Attended a workshop or course on application of AI in nursing or healthcare	Yes	73 (15.3)	
	No	404 (84.7)	
Previous involvement with AI-integrated technology in healthcare settings	Yes	70 (14.7)	
	No	407 (85.3)	
Basic professional nursing education included a course about computer skills and information technology	Yes	292 (61.2)	
	No	185 (38.8)	
Use computers, automated and information technology-supported equipment daily at work	Yes	402 (84.3)	
	No	75 (15.7)	

M = mean; SD = standard deviation.

3.2. Critical Care Nurses' AI Literacy and Fears

The results summarizing the participants AI-related literacy and fears are presented in Table 2. The results show that the internal consistency of the two main scales used in this study was excellent. For instance, the overall 10-item Fear towards AI Scale had a Cronbach's alpha of 0.92 while the 34-item MAILS had a Cronbach's alpha of 0.98, both indicating very high reliability for assessment. The internal consistence reliability of the subscales of the Fear towards AI Scale and the MAILS are also presented in Table 2. The mean score on the overall Fear towards AI Scale was 31.79 ± 9.52 , and the mean scores for the Job Issues and Humanity subscales were 15.23 ± 5.07 and 16.56 ± 5.19 , respectively.

On the other hand, the mean scores for the overall MAILS (146.62 ± 84.03) and the subscales were less than 50% of the range, indicating generally low AI literacy. The mean scores show that the participants had low literacy in aspects of AI such as Use and apply (4.73 ± 3.09), Know and understand (4.81 ± 2.81), Detect AI (4.67 ± 2.89), AI ethics (4.45 ± 2.88), Learning (4.26 ± 2.87), Persuasion literacy (4.77 ± 3.15), Emotion regulation (4.34 ± 2.91), AI self-efficacy (4.17 ± 2.70), and AI self-competency (4.61 ± 2.81). The lowest level of literacy was related to Create AI (2.43 ± 2.63).

Table 2. Description of AI literacy and fear towards AI scores among critical care nurses.

Scale	Subscale	Number of Items	Range	Cronbach's Alpha	M ± SD
The Fear towards AI Scale	The Fear towards AI Scale (Overall Scale)	10	10–50	0.92	31.79 ± 9.52
	Job Issues	5	5–25	0.91	15.23 ± 5.07
	Humanity	5	5–25	0.92	16.56 ± 5.19
Meta AI Literacy Scale (MAILS)	Meta AI Literacy Scale (MAILS)	34	0–340	0.98	146.62 ± 84.03
	Use and apply	6	0–10	0.93	4.73 ± 3.09
	Know and understand	6	0–10	0.96	4.81 ± 2.81
	Detect AI	3	0–10	0.97	4.67 ± 2.89
	AI ethics	3	0–10	0.97	4.45 ± 2.88
	Create AI	4	0–10	0.92	2.43 ± 2.63
	AI problem solving	3	0–10	0.82	4.07 ± 2.73
	Learning	3	0–10	0.88	4.26 ± 2.87
	Persuasion literacy	3	0–10	0.87	4.77 ± 3.15
	Emotion regulation	3	0–10	0.95	4.34 ± 2.91
Meta AI Literacy Scale (MAILS)	AI literacy	18	0–10	0.98	4.70 ± 2.73
	AI self-efficacy	6	0–10	0.97	4.17 ± 2.70
	AI self-competency	6	0–10	0.92	4.61 ± 2.81

MAILS = Meta AI Literacy Scale; M = mean; SD = standard deviation; AI = artificial intelligence.

3.3. Differences in AI-Related Fears According to Nurses' Characteristics

The results presented in Table 3 demonstrate that across all examined categories of the nurses' characteristics, there were no statistically significant differences in mean scores on the overall AI-related fear scale, and the subscales of Job Issues and Humanity. Thus, participants' fears related to Job Issues and Humanity were similar regardless of the marital status, level of educational, gender, AI training, prior AI involvement and education in computer skills and information technology during professional education ($p > 0.05$). The findings suggest that AI-related fears related to job concerns and humanity/ethics are relatively consistent across subgroups of CCNs in this sample.

Table 3. Differences in fear towards AI according to nurses' characteristics.

Characteristic		Job Issues		Humanity	
		M ± SD	t/F Test and p-Value	M ± SD	t/F Test and p-Value
Marital status	Single	14.57 ± 5.29	F = 0.84 p = 0.430	16.08 ± 5.51	F = 1.23 p = 0.290
	Married	15.34 ± 5.04		16.62 ± 5.13	
	Separated/divorced	16.00 ± 3.85		19.33 ± 4.89	
Highest level of education in nursing	Diploma/associate	15.09 ± 4.96	F = 0.10 p = 0.900	16.71 ± 5.08	F = 1.39 p = 0.250
	Bachelor's	15.28 ± 5.02		16.40 ± 5.23	
	Master's	15.54 ± 7.45		18.77 ± 5.50	
Gender	Male	14.95 ± 5.07	t = 0.46	16.07 ± 5.24	t = 0.80
	Female	15.27 ± 5.07	p = 0.650	16.64 ± 5.18	p = 0.430
Attended a workshop or course on application of AI in nursing or healthcare	Yes	14.52 ± 5.23	t = 1.29	15.55 ± 5.24	t = 1.82
	No	15.35 ± 5.03	p = 0.210	16.74 ± 5.17	p = 0.070
Previous involvement with AI-integrated technology in healthcare settings	Yes	15.11 ± 4.81	t = 0.20	16.14 ± 5.21	t = 0.74
	No	15.25 ± 5.11	p = 0.840	16.64 ± 5.19	p = 0.460
Basic professional nursing education included a course about computer skills and information technology	Yes	15.00 ± 5.14	t = 1.21	16.45 ± 5.41	t = 0.64
	No	15.58 ± 4.95	p = 0.220	16.75 ± 4.83	p = 0.530
Use computers, automated and information technology-supported equipment daily at work	Yes	15.17 ± 4.96	t = 0.52	16.56 ± 5.20	t = 0.04
	No	15.51 ± 5.63	p = 0.600	16.59 ± 5.17	p = 0.970

M = mean; SD = standard deviation.

3.4. Differences in AI Literacy, Self-Efficacy, and Self-Competency

AI literacy, AI self-efficacy, and AI self-competency varied significantly across several categories of participants' characteristics, as shown in Table 4. Higher mean AI literacy and self-efficacy scores were observed among nurses who were single, male, bachelor's or master's educated, attended a workshop or course on application of AI, have previous involvement with AI-integrated technology in healthcare settings, and basic professional nursing education that included a course about computer skills and information technology ($p < 0.05$). Higher mean AI self-competency scores were observed among nurses who were single, male, bachelor's or master's educated, attended a workshop or course on application of AI in nursing or healthcare, and with previous involvement with AI-integrated technology in healthcare settings ($p < 0.05$). Using or not using computers, automated and information technology supported equipment daily at work was not associated with a significant difference in AI literacy, self-efficacy, and self-competency. Moreover, having a basic nursing course on computer skills and information technology was also not associated with any significant difference in AI self-competency.

Table 4. Differences in AI literacy, self-efficacy, and self-competency according to nurses' characteristics.

Characteristic		AI Literacy		AI Self-Efficacy		AI Self-Competency	
		M $\pm$ SD	t/F Test and p-Value	M $\pm$ SD	t/F Test and p-Value	M $\pm$ SD	t/F Test and p-Value
Marital status	Single	5.84 $\pm$ 2.83		4.88 $\pm$ 2.73		5.56 $\pm$ 2.79	
	Married	4.67 $\pm$ 2.66	F = 8.63 p = 0.000	4.03 $\pm$ 2.66	F = 3.43 p = 0.030	4.41 $\pm$ 2.78	F = 5.75 p = 0.003
	Separated/ divorced	4.45 $\pm$ 3.01		3.56 $\pm$ 3.51		4.97 $\pm$ 2.45	
Highest level of education in nursing	Diploma/ associate	4.03 $\pm$ 2.72	F = 7.21 p = 0.001	3.45 $\pm$ 2.58	F = 8.60 p = 0.000	3.96 $\pm$ 2.71	F = 6.93 p = 0.001
	Bachelor's	5.02 $\pm$ 2.67		4.50 $\pm$ 2.71		4.88 $\pm$ 2.80	
	Master's	5.20 $\pm$ 2.94		4.90 $\pm$ 2.70		5.78 $\pm$ 2.92	
Gender	Male	5.74 $\pm$ 2.42	t = 3.22 p = 0.001	5.21 $\pm$ 2.26	t = 3.76 p = 0.000	5.47 $\pm$ 2.45	t = 2.88 p = 0.005
	Female	4.55 $\pm$ 2.74		4.01 $\pm$ 2.73		4.48 $\pm$ 2.84	
Attended a workshop or course on application of AI in nursing or healthcare	Yes	5.59 $\pm$ 2.45	t = 3.33 p = 0.001	4.95 $\pm$ 2.23	t = 3.13 p = 0.002	5.42 $\pm$ 2.76	t = 2.75 p = 0.007
	No	4.54 $\pm$ 2.74		4.02 $\pm$ 2.75		4.46 $\pm$ 2.79	
Previous involvement with AI-integrated technology in healthcare settings	Yes	6.51 $\pm$ 2.08	t = 7.51 p = 0.000	5.83 $\pm$ 2.11	t = 6.83 p = 0.000	6.17 $\pm$ 2.23	t = 6.08 p = 0.000
	No	4.39 $\pm$ 2.70		3.88 $\pm$ 2.69		4.34 $\pm$ 2.81	
Basic professional nursing education included a course about computer skills and information technology	Yes	5.05 $\pm$ 2.70	t = 3.61 p = 0.000	4.43 $\pm$ 2.74	t = 2.78 p = 0.006	4.77 $\pm$ 2.91	t = 1.64 p = 0.100
	No	4.14 $\pm$ 2.68		3.74 $\pm$ 2.59		4.35 $\pm$ 2.62	
Use computers, automated and information technology-supported equipment daily at work	Yes	4.80 $\pm$ 2.65	t = 1.86 p = 0.060	4.26 $\pm$ 2.72	t = 1.75 p = 0.083	4.67 $\pm$ 2.77	t = 1.14 p = 0.26
	No	4.16 $\pm$ 3.05		3.69 $\pm$ 2.55		4.25 $\pm$ 2.98	

M = mean; SD = standard deviation; AI = artificial intelligence.

In terms of gender, male nurses reported significantly higher scores for AI literacy, AI self-efficacy, and AI self-competency compared with female nurses (AI literacy: males 5.74 $\pm$ 2.42 vs. females 4.55 $\pm$ 2.74; AI self-efficacy: males 5.21 $\pm$ 2.26 vs. females 4.01 $\pm$ 2.73; AI self-competency: males 5.47 $\pm$ 2.45 vs. females 4.48 $\pm$ 2.84; $p < 0.05$ for all comparisons). At the same time, there were no statistically significant gender differences in fear towards AI in either the Job Issues or Humanity domains ($p > 0.05$), as indicated in Table 4.

Education level was significantly associated with AI literacy, AI self-efficacy, and AI self-competency. For AI literacy, the one-way ANOVA showed a significant effect of education ($F(2, 473) = 7.21$, $p = 0.001$), and post hoc comparisons indicated that diploma/associate-prepared nurses had lower literacy scores than bachelor's-prepared nurses (mean difference = -0.99 , $p = 0.001$) and nurses with master's degrees (mean difference = -1.16 , $p = 0.40$, not statistically significant), whereas bachelor's- and master's-prepared nurses did not differ significantly. Similar patterns were observed for AI self-efficacy ($F(2, 474) = 8.60$, $p < 0.001$) and AI self-competency ($F(2, 474) = 6.92$, $p = 0.001$), with diploma-prepared nurses scoring significantly lower than bachelor-prepared nurses in both domains, and

no statistically significant differences between bachelor's- and master's-prepared nurses. Taken together, these results indicate that more advanced nursing education is linked to higher AI-related literacy and confidence across multiple domains.

AI literacy, AI self-efficacy, and AI self-competency were also compared across ICU types (general ICU, NICU, pediatric ICU, cardiac ICU, surgical ICU, high dependency, burns, neuro ICUs). There were no statistically significant differences in these outcomes across ICU types ($p > 0.05$), suggesting that, within this sample of tertiary critical care settings, AI literacy and confidence were broadly similar across different ICU contexts.

AI literacy, self-efficacy, self-competency, and fear towards AI were examined across the participating tertiary hospitals. Given that all sites were government tertiary care institutions with similar structures, staffing patterns, and national policies, and to avoid inadvertently identifying specific hospitals, the results are reported in aggregate; overall, there was no evidence of large or systematic variation in AI literacy or fears between institutions.

3.5. Correlation Between AI Literacy, AI Self-Efficacy, AI Self-Competency, Fear Towards AI, and Nurses' Age and Experience

The findings about the relationship between AI literacy, self-efficacy, self-competency, fear, and nurses' age and experience are presented in Table 5. The results show that older age ($p < 0.01$), and longer experience in the nursing profession ($p < 0.01$) and in critical care or ICU nursing ($p < 0.01$) were associated with lower levels of AI literacy. Similarly, older age ($p < 0.01$), and longer experience in the nursing profession ($p < 0.01$) and in critical care or ICU nursing ($p < 0.05$) were associated with lower levels of AI self-efficacy. Moreover, older age ($p < 0.01$), longer experience in the nursing profession ($p < 0.05$) and lower levels of fear towards AI in the domain of humanity were associated with lower levels of AI self-competency.

Table 5. Correlation between AI self-efficacy, AI self-competency, AI literacy, and fear towards AI, age and experience of the Nurses.

	AI Literacy	AI Self-Efficacy	AI Self-Competency
	r	r	r
Age in years	−0.221 **	−0.185 **	−0.145 **
Overall experience in nursing in years	−0.175 **	−0.156 **	−0.094 *
Experience in critical care or ICU	−0.130 **	−0.115 *	−0.057 ^a
Fear towards AI Scale (Job Issues domain)	−0.010 ^a	−0.010 ^a	0.038 ^a
Fear towards AI Scale (Humanity domain)	0.022 ^a	0.041 ^a	0.112 *

** $p < 0.01$; * $p < 0.05$; ^a $p > 0.05$; r = Pearson's correlation; AI = artificial intelligence.

3.6. Regression Analysis of Predictors of AI Literacy, Self-Efficacy, and Self-Competency

Table 6 shows the stepwise regression analysis of predictors of AI literacy, self-efficacy, and self-competency. Regarding AI literacy, the model explained 12.3% of the variance (adjusted $R^2 = 0.123$). The findings show that younger age, being single, basic training in information technology during the nursing program, and previous involvement with AI-integrated technology were all significant predictors of AI literacy. Older age showed a negative association ($B = -0.06$, $p < 0.01$), indicating lower AI literacy with increasing age. Moreover, nurses without basic education that included a computer or information technology course ($B = -0.56$, $p < 0.05$) and without previous involvement with AI-integrated technologies ($B = -1.78$, $p < 0.01$) had lower AI literacy scores.

Table 6. Stepwise regression models predicting AI literacy, self-efficacy, and self-competency.

Dependent Variable	Predictors	Unstandardized		Standardized Coefficient	<i>t</i>	<i>p</i> -Value	95% Confidence Interval for B		Adjusted R ²
		B	SE	β			Lower Bound	Upper Bound	
AI Literacy	Constant	12.16	0.91		13.40	0.000	10.37	13.40	0.123
	Age in years	−0.06	0.02	−0.14	−3.05	0.002	−0.09	−0.02	
	Marital status/Married	−0.73	0.32	−0.12	−2.30	0.022	−1.35	−0.11	
	Basic professional nursing education included a course about computer skills and information technology	−0.56	0.25	−0.10	−2.28	0.023	−1.05	−0.08	
	Previous involvement with AI-integrated technology in healthcare setting	−1.78	0.34	−0.23	−5.28	0.000	−2.44	−1.12	
AI Self-Efficacy	Constant	8.09	1.11		7.27	0.000	5.91	10.28	0.099
	Age in years	−0.05	0.02	−0.12	−2.49	0.013	−0.08	−0.01	
	Level of education	0.56	0.25	0.12	2.26	0.024	0.07	1.05	
	Previous involvement with AI-integrated technology in healthcare settings	−1.73	0.34	−0.23	−5.14	0.000	−2.39	−1.08	
AI Self-Competency	Constant	6.78	1.05		6.50	0.000	4.73	8.83	0.099
	Marital status/Married	−0.80	0.32	−0.11	−2.54	0.011	−1.42	−0.18	
	Level of education	0.70	0.24	0.13	2.91	0.004	0.23	1.18	
	Fear of AI (Humanity)	0.07	0.03	0.13	2.85	0.005	0.02	0.12	
	Previous involvement with AI-integrated technology in healthcare setting	−1.63	0.35	−0.21	−4.62	0.000	−2.32	−0.93	

B = unstandardized regression coefficient; SE = standard error of B; β = standardized regression coefficient; 95% Confidence Interval for B = lower and upper bounds of the 95% confidence interval for the unstandardized coefficient; Adjusted R² = proportion of variance in the dependent variable explained by the model, adjusted for the number of predictors.

The model for AI self-efficacy showed that age, level of education, and previous involvement with AI-integrated technology in healthcare settings were significant predictors. The three factors were responsible for 10% of the variance (adjusted R² = 0.099) in AI self-efficacy. Younger age ($B = -0.05$, $p < 0.05$), higher education level ($B = 0.56$, $p < 0.05$) and previous involvement with AI-integrated technologies ($B = -1.73$, $p < 0.01$) were predictive of higher AI self-efficacy. The findings suggest that younger, more highly educated nurses with direct AI exposure tended to have high levels of confidence in their ability to work with AI. The significant predictors of AI self-competency were marital status, level of education, fear of AI (Humanity), and previous involvement with AI-integrated technology in a healthcare setting. The four factors were responsible for 10% of the variance (adjusted R² = 0.099). Being married ($B = -0.80$, $p < 0.05$), lower education ($B = 0.70$, $p < 0.01$), and lack of previous involvement with AI-integrated technology ($B = -1.63$, $p < 0.01$) were associated with lower self-competency, while higher levels of fear in the Humanity domain ($B = 0.07$, $p < 0.01$) were associated with a high level of AI self-competency.

4. Discussion

This study examined AI-related literacy and fears among CCNs in Oman and found low AI literacy and moderate AI-related fears that were broadly shared across demographic groups. The findings expand our understanding of AI literacy and readiness in critical care nursing in the Middle East, where digital health and AI are strategic priorities but nurse-level preparation is still evolving. CCNs showed low overall AI literacy with strong

reliability, indicating gaps in foundational AI knowledge, skills, and competencies. Nurses reported particularly low literacy in domains such as using and applying AI, knowing and understanding AI, detecting AI, and creating AI, suggesting limited capacity to act as confident end-users or to contribute to the development of AI tools.

This pattern is similar to studies among nursing students, where AI literacy is typically moderate and concentrated in basic understanding and simple use. The mean scores on the Fear towards AI Scale fell in the mid-range, indicating that critical care nurses in this study experienced moderate fears related to job or role concerns and to humanity and ethics, rather than very low or very high levels of fear. For example, Berdida et al. (2026) [24] reported moderate AI literacy among nursing students, and Chen et al. (2026) [25] found that AI literacy in undergraduate nursing students was modest and closely linked to their ability to cope with AI-related academic demands. These studies, together with the present findings, support the view that nurses are at an early stage of building AI literacy and remain below the level needed for full, critical engagement with AI in complex clinical contexts [24,25].

The domain pattern in this study indicating low literacy in aspects such as using and applying AI, knowing and understanding AI, and creating AI echoes international evidence showing that nurses and nursing students mainly engage with AI at the level of interpreting and using outputs rather than designing or configuring systems. Regionally, a study conducted in Saudi Arabia found that CCNs were aware of AI benefits but had variable knowledge and attitudes, suggesting that CCNs in the Middle East are still in the early phases of developing AI capacity and literacy and remain below the depth required for full, critical, and safe use of AI in ICUs [24–26]. In this context, the low AI literacy scores observed among CCNs in Oman and similar settings present an opportunity for healthcare system improvement through targeted AI education and capacity-building programs.

This opportunity for capacity building is further supported by the moderate levels of AI-related fears among critical care nurses. Nurses in the current study reported mid-range fear scores in both the Job Issues and Humanity domains, indicating concerns about job security, autonomy, empathy, and ethical implications that are present but not extreme. Other studies have reported that nurses and nursing students commonly worry about job displacement, over-reliance on technology, and loss of compassion when AI is introduced into care. A notable feature of this study is that AI-related fears did not differ significantly by marital status, education, gender, AI workshop attendance, or prior AI exposure, whereas other research has found variation in AI anxiety and attitudes by demographic factors [27,28]. In the present study, fears appear to be moderate and relatively similar across subgroups, which may reflect limited direct exposure to AI-enabled systems and incomplete understanding of AI. It may be difficult for nurses to experience strong, differentiated fears about technologies they have not yet encountered or fully understood in practice.

Correlation and regression analyses showed that AI-related fears were only weakly related to AI literacy. Job-related fears were essentially unrelated to literacy, and the Humanity domain showed only a small positive association with some literacy domains, suggesting that nurses who know more about AI may also be more aware of its ethical and humanistic implications. This aligns with findings by Nurgiz et al. (2026) and Yigit and Acikgoz (2024), who reported that anxiety about AI is linked to attitudes but is not determined solely by knowledge [27,28]. These authors argue that AI fear requires targeted, reflective interventions that address job-related and humanity-related concerns, rather than assuming that fear will disappear automatically as knowledge increases [27]. The present findings support this view: raising AI literacy alone is unlikely to eliminate fears, especially those rooted in values and ethics. For CCNs in Oman, AI education should

therefore combine technical content with structured dialogue on ethics, professional roles, and the nurse/patient relationship in AI-enabled care.

In interpreting the regression findings, it is important to note that the models explained only a modest proportion of variance in AI literacy, self-efficacy, and self-competency (approximately 10–12%). This pattern is consistent with the multifactorial nature of these constructs, which are likely influenced by a wide range of individual, educational, organizational, and technological factors beyond those measured in the present survey. The modest R^2 values suggest that, while age, marital status, education, and exposure to AI-related training are significant predictors, additional variables such as organizational culture, leadership support, availability of structured AI training, and specific experiences with AI-enabled systems may account for further variation and should be examined in future research.

Several demographic and professional characteristics influenced AI literacy. Younger nurses and those with fewer years of nursing and ICU experience had higher AI literacy scores, and age and experience were negative predictors in the regression models. This pattern suggests a possible generational effect, where younger, more digitally immersed nurses feel more comfortable with AI. Li et al. (2025) similarly showed that AI literacy and attitudes mediate the relationship between career self-efficacy and job-seeking anxiety, with more digitally engaged individuals demonstrating stronger AI-related efficacy and more adaptive attitudes [29]. Together, these findings highlight the need for targeted support for older and more experienced nurses in Oman and across the region, so that AI adoption does not exacerbate generational gaps in critical care practice.

Higher education was another consistent predictor: bachelor's- and master's-prepared nurses had higher AI literacy than diploma/associate-prepared nurses. This echoes findings by Berdida et al. (2026), who linked higher AI literacy in students with more advanced engagement, and by Alrashedi et al. (2026), who reported that higher qualifications and training were associated with better AI knowledge and attitudes among Saudi critical care nurses [24,26]. These results suggest that educational stratification in AI readiness is emerging in nursing workforces. Gender and marital status were also associated with AI literacy: male and single nurses reported higher literacy than female and married nurses. Although causality cannot be inferred, these patterns, together with results from other studies, point to possible differences in access, confidence, and time for AI-related learning that may disadvantage female or married nurses [26,29]. For Oman and neighboring countries, this underlines the need for equity-focused AI capacity building, including flexible, accessible training (e.g., modular online content and protected learning time) that reaches nurses with heavier family responsibilities and addresses potential gender-related differences in confidence and opportunity.

AI-specific exposure emerged as the strongest and most consistent predictor of AI literacy. Nurses who had attended AI-related workshops or had prior experience with AI-integrated technologies scored substantially higher, and previous AI involvement remained a robust predictor after adjusting for demographic factors. This parallels findings by Liu et al. (2025), who showed that AI literacy predicts attitudes and that fear towards AI mediates this relationship [12], and by Zhu et al. (2026) and Berdida et al. (2026), who found that deliberate AI education and exposure move learners into higher-literacy profiles [24,30]. In contrast, more general digital exposure (basic IT courses, daily computer use) showed weak or inconsistent associations, supporting the view that AI literacy is a specific competence rather than a simple extension of general informatics skills [30,31]. For Oman and the GCC, these findings argue for AI training that emphasizes hands-on experience with actual AI tools in the ICU, embedded in real workflows and coupled with explicit ethical and humanistic reflection. Such an approach can help ensure that rising AI

literacy is accompanied by thoughtful, value-sensitive use rather than either avoidance or uncritical adoption.

The finding that male nurses reported higher AI literacy, self-efficacy, and self-competency than female nurses, while AI-related fears did not differ significantly by gender, suggests that gender-related differences in AI readiness may reflect disparities in exposure, confidence, or access to AI-focused training rather than differences in fear alone. Recent work on AI literacy and digital health adoption has reported gender-linked patterns in technology use and training opportunities, with women and female health professionals sometimes facing structural barriers to digital and AI education [12,31]. In our context, these results indicate that female critical care nurses may benefit from targeted support and equitable access to AI training to prevent emerging gender gaps in AI competence and confidence. Future research should explore why these differences arise, for example, differences in prior exposure to digital tools, institutional support for training, and perceptions of technology and evaluate interventions designed to reduce gender disparities in AI literacy and self-efficacy [7,32].

5. Limitations

Several limitations should be considered when interpreting these findings. First, the cross-sectional design captures AI literacy, confidence, and fears at a single point in time, so causal relationships (for example, whether higher literacy leads to lower fear or vice versa) cannot be established. Second, all measures relied on self-report, which may be influenced by social desirability or inaccurate self-assessment; actual AI skills in real clinical situations were not observed. Third, this study was conducted among CCNs in selected tertiary hospitals in Oman, so the results may not be generalizable to nurses working in primary care, non-critical units, private facilities, or other countries. Fourth, although the AI scales showed excellent internal consistency, they were used in the Omani context for the first time; subtle cultural or contextual nuances in how nurses understand AI-related items may not have been fully captured. Finally, some potentially relevant factors such as detailed prior exposure to specific AI tools, types of AI technologies used in clinical practice, organizational culture, and leadership support for innovation were not measured, and could help explain additional variation in AI literacy, confidence, and fear beyond the variables included in this study. In addition, this study did not collect data on the country where nurses obtained their basic nursing diploma, so potential differences in AI literacy and fears according to country of initial education could not be examined; future studies should include this variable to allow more detailed analysis of educational background. Finally, the exclusion of nurses with previous work experience in Western healthcare systems may limit the generalizability of the findings, as concerns and experiences related to AI are also present in highly developed settings with varying levels of AI integration. Future studies should consider including nurses with diverse international experience to compare AI literacy and fears across different healthcare systems. An additional consideration is that all participating hospitals were governmental tertiary care institutions, which may share similar organizational and policy environments. Institutional characteristics such as local leadership, resources for AI training, and technology infrastructure were not examined in detail, and future studies could explore these factors while ensuring that specific hospitals are not identifiable.

We have structured the reporting of this observational study in line with the STROBE Statement (Supplementary File S1), including detailed description of participant flow, variable selection, missing data handling, and limitations related to confounding and bias.

Implications for Practice

Critical care nurses in this study reported low levels of AI literacy, self-efficacy, and self-competency, and this could be limiting their ability to use AI supported healthcare technologies, hence limiting the quality of patient outcomes. Thus, practice settings need structured AI-focused training that explains what AI can and cannot do, how to interpret outputs, and how to integrate AI into bedside decision-making. The findings showed that younger, more educated, male, and single nurses reported higher AI literacy and confidence, demonstrating that AI capacity building initiatives should be designed in a manner that ensures equitable access to training to avoid widening gaps between junior and senior nurses, highly educated and moderately educated nurses. Nurse managers and educators can help to ensure access and equity by offering protected learning time, flexible online options, and active encouragement for older, diploma-prepared, female, and married nurses to participate.

Hands-on exposure to AI-enabled systems was the strongest predictor of better AI literacy and confidence, so units should create guided opportunities to use real AI tools such as simulations and supervised use of AI-based monitoring or decision support, plus debriefings about cases that involved AI. Such approaches can help to reduce fears and build confidence among nurses. The moderate AI-related fears were common and did not disappear with higher literacy alone, so training should always include space to discuss ethics, job concerns, and the impact on empathy and human relationships, not just technical skills. Finally, involving CCNs directly in selecting, piloting, and refining AI tools can increase trust, ensure better fit with workflows, and support safe, person-centered use of AI in Oman's ICUs.

6. Conclusions

Overall, this national study shows that critical care nurses in Oman currently have low AI literacy and moderate AI-related fears, with literacy influenced by age, education, gender, and AI-specific exposure. These findings suggest that healthcare organizations and nursing education programs may need to prioritize structured, hands-on AI training and ethically grounded dialogue to prepare nurses for AI-enabled care. Given the cross-sectional design, future longitudinal and interventional research is required to assess how such initiatives affect nurses' AI competence, fears, and clinical practice over time.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/sci8080194/s1>, Supplementary File S1: STROBE Statement—Checklist of items that should be included in reports of cross sectional studies; Supplementary File S2: Analytic procedures in IBM SPSS Statistics.

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