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Medical Students' and Radiology Technologists' Perspectives on the Use of Artificial Intelligence in Diagnostic Radiology in the Hail Region, Saudi Arabia

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Abstract **Objectives: Background:** Artificial Intelligence (AI) is currently driving diagnostic radiology towards a new era, but there is no evidence about the knowledge, attitudes and preparedness levels of healthcare trainees and radiology professionals in Northern Saudi Arabia. **Methods:** A cross-sectional study was conducted using questionnaires administered to medical students, radiology technology students, radiology technologists and radiologists in Hail and the corresponding Northern Saudi institutions. A validated 27-item questionnaire was used to evaluate AI knowledge, awareness of imaging use in healthcare, attitudes, educational needs and readiness to use AI. SPSS version 29.0 was used for data analysis. Descriptive statistics, Chi-square test and One-way ANOVA were used and the p-level was set at <5% for statistical significance. **Results:** Moderate-to-high overall AI knowledge was observed in 55.1% of participants, while 61.7% demonstrated moderate-to-high knowledge of AI applications in medical imaging. 46.2% of the respondents indicated prior AI-related training. Neither the benefits of using AI in radiology nor its role in advancing medicine were lost on most participants, though there was a general concern about the ethical implications, as well as the impact on the workforce. About 45.7-46.1% said that advancement in AI decreased their interest in pursuing a career in radiology. Overall, the level of readiness for the use of AI was moderate to high in 58.6%. **Conclusion:** Participants demonstrated moderate AI knowledge and readiness, but significant educational gaps and career-related concerns persist. Incorporation of structured AI education into medical and radiology curricula is necessary for making informed career choices, fostering ethical understanding and for safe clinical use of AI.

Key Words Artificial Intelligence, Diagnostic Radiology, Knowledge, Attitude, Saudi Arabia, Medical Students

INTRODUCTION

The modern healthcare industry has witnessed the development of artificial intelligence as a groundbreaking technology that has radically changed the diagnostic and clinical practice [1]. In radiology, AI can be applied in image interpretation or additional data acquisition, analysis and reporting [2]. The AI tools have significant potential for detecting cerebrovascular accidents, aneurysms, mammographic irregularities, chest X-ray abnormalities and estimating bone age in pediatrics, among other clinical uses [2].

Despite AI's technical potential, there are major difficulties in translating laboratory efficacy into clinical practice. The studies show that a gap remains between the development of AI algorithms and their real-world applications and that little attention is paid to human and ethical aspects [3]. Radiologists need to remain clinically prudent and provide interpretative context, since AI systems require human oversight to be used safely [4]. In addition, international studies indicate that medical students' motivation to pursue employment in diagnostic radiology has declined sharply due to fears of AI-driven unemployment [5].

The results of a multinational survey of 4,596 healthcare students across 48 countries showed that students have positive attitudes towards AI in healthcare, but there is significant disparity in AI education worldwide and students have different perceptions and levels of educational readiness across regions [6]. A study conducted among 491 medical students at Jizan University, in particular, showed that AI exposure had a negative impact on specialty choice and students preferred radiology, with a high percentage reporting anxiety about the effect of AI on career opportunities [7].

Although the use of AI to assist with radiology is on the rise, there is scarce evidence reporting the knowledge, attitudes and readiness of medical students and radiology professionals of Northern Saudi Arabia for this AI.AI knowledge, attitudes and readiness among medical students and radiology personnel in Northern Saudi Arabia are not known. Most research based on Saudi studies has concentrated on other regions or the general student population. Hence, it fills a significant regional gap in understanding AI knowledge, attitudes, training needs, readiness and career perceptions, of medical students, radiology technology students, radiology technologists and radiology physicians in the Hail region and neighboring Northern Saudi provinces of the country.

Gap Analysis

The awareness of AI among students and healthcare professionals has been reported as being variable by international and previous Saudi studies, but there is limited evidence from Northern Saudi Arabia. This regional gap is significant because the exposure that individuals have to education and the workforce requirements might vary between Saudi regions. The current research study, therefore, adds to the "localized evidence" to inform curriculum planning and workforce preparation.

METHODS

Study Design, Objectives and Ethics

A cross-sectional study was conducted at the University of Hail and affiliated institutions in Hail, Tabuk, Arar and Al-Jawf provinces, using questionnaires. This study evaluated the knowledge, attitudes, perceptions, educational needs and readiness to apply AI in diagnostic radiology. The participants were recruited using the convenience sampling concept as they were selected from the institutional mailing list, from classrooms and from the radiology departments. Such an approach could also have created a sampling bias since those with an existing interest or exposure to AI might have been more readily available. The objectives of the study were to:

- Evaluate knowledge and understanding of AI in radiology
- Understand attitudes, trust and acceptance of AI tools
- Quantify education gaps and training needs
- Gauge impact on radiology career choice
- Detect differences in perceptions and preparedness of students Vs professionals
- Outline recommendations on how to include AI education into the medical and radiology curriculum.

The research was accepted by the Ethics Committee of the University of Hail (No. H-2025- 992, December 1, 2025), according to the standards of the Declaration of Helsinki. Electronic informed consent was required for voluntary participation; responses were anonymous and stored securely.

Participants

Undergraduate medical/radiology technology students of northern Saudi universities and practicing radiology technologists/radiologists from regional hospitals/clinics were eligible. Informed consent was required for inclusion and incomplete responses to the primary outcome necessitated exclusion. A total of 394 complete responses were included in the final analysis. Given that recruitment was done via open channels in the institutions' electronic communication systems and the exact numbers of individuals receiving/viewing the survey link were not ascertained, an exact response rate could not be calculated.

Sample Collection

Medical students, radiology technology students, practicing radiology technologists and radiologists from various universities, hospitals and clinics of Northern Saudi Arabia were included in the study. All participants had to give electronic informed consent to access the questionnaire. Cases with missing primary outcome data were excluded from data analysis.

Data Collection

Participants were invited through institutional mailing lists, the classroom and the radiology department. Access to a secure web link that provided study information, voluntary participation information and confidentiality assurances prior to electronic consent (Yes/No). The literature- derived, self-administered questionnaire comprised 27 items across four domains: AI knowledge (5 items), imaging applications (3 items), attitudes (10 items) and perceptions/readiness/education (9 items). Indices of content validity were 0.86- 0.93; Pilot testing (n = 40) Cronbach 0.79- 0.90. No identifiable data were obtained.

No personal information was gathered. Survey responses were entered into a password-protected electronic database with limited access for the research team only. Analysis was conducted anonymously and reporting in an aggregated form.

Questionnaire

The questionnaire was self-administered and developed from the literature, comprising 27 items across four categories: AI knowledge, AI applications in medical imaging, attitudes towards AI and perceptions/readiness/educational needs. The content validity indices obtained ranged from 0.86 to 0.93. Pilot testing of the scale was conducted in a group of 40 subjects and the Cronbach's alpha values were in a good range between 0.79 and 0.90.

Statistical Analysis

Data were analyzed using SPSS version 29.0, with descriptive statistics, means±SD, frequencies and dichotomized domain scores (50th percentile). Data from categorical variables were described using frequencies and percentages and from continuous scores using mean±standard deviation. Scores in each domain were split

into low and moderate/high categories at the 50th percentile. Comparisons between the categories in the various professional groups were made using chi-square tests. Continuous score distributions and group comparisons were found to be suitable for the use of one-way ANOVA. Effect sizes were used to provide interpretations beyond the statistical significance wherever appropriate. Responses that were missing or inconsistent were discarded before the analysis to test the relevant outcome measure and only primary outcome responses were used in the final data analysis. A p-value <0.05 was considered statistically significant.

RESULTS

Participant Characteristics

Table 1 presents the sociodemographic and professional characteristics of 394 Northern Saudi Arabian respondents, which are necessary for understanding views on AI in diagnostic radiology. The cohort represents the demographics of medical education in the region (primarily 1821 years: 61.7 percent, n = 243), females (55.1 percent, n = 217) and Hail-based (91.6 percent, n = 361), with 83.2 percent of the cohort medical students (n = 328), 9.6 percent radiology technology students (n = 38), 4.1 percent technologists (n = 16) and 3.0 percent of radiologists Interestingly, 46.2 percent (n = 182) had previous AI training, as it may indicate growing exposure to it during the push of digital health in Saudi Vision 2030.

The sociodemographic and professional characteristics of the 394 subjects included in the study are summarized in Table 1. Most respondents were aged 18–21 years (61.7%), female (55.1%) and residents of Hail (91.6%). A total of 83.2% of the professional students were medical students, followed by 9.6% radiology technology students, 4.1% radiology technologists and 3.0% radiologists. 46.2% of the participants reported prior training in AI or related technologies. Figure 1 shows a breakdown of participants by age group, gender, place of residence, previous AI training and profession.

Table 1: Sociodemographic and Professional Characteristics of Participants (N = 394)

Parameters	Parameter	Statistics N = 394
Age (years)	18-21	243 (61.7%)
	22-25	124 (31.5%)
	26-29	8 (2%)
	≥30	19 (4.8%)
Gender	Male	177 (44.9%)
	Female	217 (55.1%)
Residence	Al Jawf	6 (1.5%)
	Hail	361 (91.6%)
	Tabuk	18 (4.6%)
	Arar	9 (2.3%)
Current profession	Medical student	328 (83.2%)
	Radiology technologist	16 (4.1%)
	Radiologist	12 (3%)
	Radiology technology student	38 (9.6%)
Previous training in AI or related technologies	No	212 (53.8%)
	Yes	182 (46.2%)

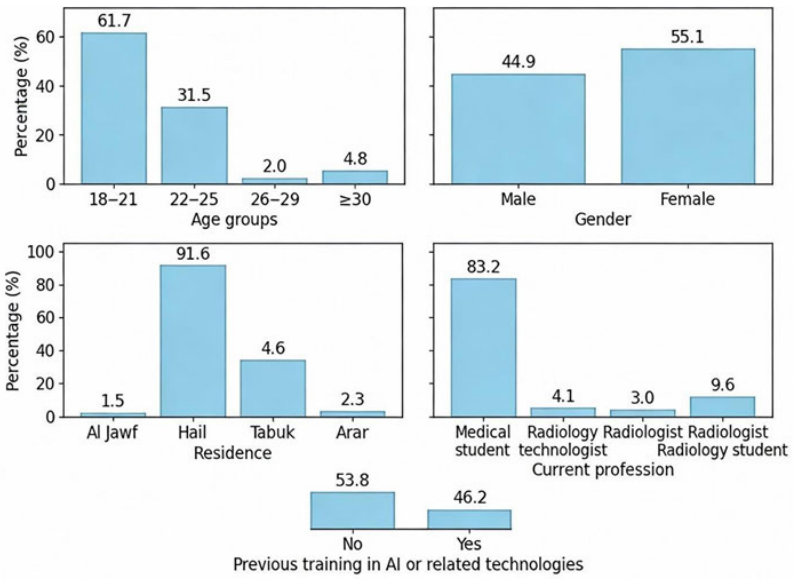

Figure 1: Distribution of Participants by Age (N = 394), Sex, Living Area with Partner, Professional Category and Training in AI-Related Fields (yes or no)

Table 2: Knowledge of AI used in Radiology by Professional Category (N = 394)

Variable	Parameter	Medical student N = 328	Radiology technologist N = 16	Radiologist N = 12	Radiology technology student N = 38	Total N = 394	p-value (Test)
I understand the basic computational principles of artificial intelligence?	Strongly disagree	8 (2.4%)	0 (0%)	0 (0%)	1 (2.6%)	9 (2.3%)	0.97 (4.54)
	Disagree	24 (7.3%)	2 (12.5%)	0 (0%)	3 (7.9%)	29 (7.4%)	
	Neutral	92 (28%)	5 (31.3%)	3 (25%)	10 (26.3%)	110 (27.9%)	
	Agree	122 (37.2%)	4 (25%)	4 (33.3%)	15 (39.5%)	145 (36.8%)	
	Strongly agree	82 (25%)	5 (31.3%)	5 (41.7%)	9 (23.7%)	101 (25.6%)	
I have an understanding of the limitations of artificial intelligence?	Strongly disagree	5 (1.5%)	0 (0%)	0 (0%)	1 (2.6%)	6 (1.5%)	0.49 (11.45)
	Disagree	21 (6.4%)	2 (12.5%)	0 (0%)	6 (15.8%)	29 (7.4%)	
	Neutral	82 (25%)	6 (37.5%)	3 (25%)	6 (15.8%)	97 (24.6%)	
	Agree	137 (41.8%)	5 (31.3%)	5 (41.7%)	19 (50%)	166 (42.1%)	
	Strongly agree	83 (25.3%)	3 (18.8%)	4 (33.3%)	6 (15.8%)	96 (24.4%)	
Were you already aware of these topics in radiology?	No	131 (39.3%)	5 (31.3%)	0 (0%)	9 (23.7%)	145 (36.8%)	0.01(11.39)
	Yes	197 (60.1%)	11 (68.8%)	12 (100%)	29 (76.3%)	249 (63.2%)	
Do you personally have a basic understanding of the technologies used in these topics?	No	146 (44.5%)	6 (37.5%)	0 (0%)	11 (28.9%)	163 (41.4%)	0.006 (12.32)
	Yes	182 (55.5%)	10 (62.5%)	12 (100%)	27 (71.1%)	231 (58.6%)	
Total score	Mean±SD	7.57±1.69	7.31±1.57	8.25±1.60	7.34±1.89	7.56±1.70	0.39 (0.99)
	Min-max	2-10	4-10	6-10	2-10	2-10	
	Low level (<50th Percentile)	148 (45.1%)	9 (56.3%)	3 (25%)	17 (44.7%)	177 (44.9%)	
	Moderate/high level (≥ 50th Percentile)	180 (54.9%)	7 (43.8%)	9 (75%)	21 (55.3%)	217 (55.1%)	

This distribution is evidence of a student-focused sample, which is best suited to investigate the future readiness of the radiology workforce. The urban-rural gradient (Hail dominance Vs minorities in Al-Jawf, Tabuk and Arar) suggests it can be generalized to Northern tertiary centers, where AI tools such as automated triage may be used to address staffing issues. Gender equilibrium goes in hand with the increased female involvement in Saudi medical disciplines, which may have implications on later attitudinal differences. Stratification of professionals also allows the professional to make strong intergroup comparisons, which show that experience moderates AI perceptions, which can be considered a methodological strength.

Knowledge of AI Applications in Radiology

As illustrated by Table 2, 62.4% agreed or strongly agreed that they comprehended the underlying principles of computation for AI, while 66.5% said they comprehended the restrictions of AI. Sixty-three.2% of the participants reported their knowledge of the radiology-related topics related to AI and 58.6% reported their knowledge of the technologies used in such topics. Radiologists were the group(s) with the greatest awareness of radiology topics and related technologies in relation to AI. Overall, 55.1% of the participants had moderate to high AI knowledge.

The results indicate that the baseline level of medical undergraduates and radiology technologists' competency with AI was at an average level in Northern Saudi Arabia. No significant differences in knowledge of AI principles and limitations were found, suggesting a general understanding of AI principles, but with significant gaps in applied AI related to radiology knowledge. This implies that existing curricula might not be adequate in equipping students and technologists with the necessary skills to apply AI for diagnostics in a real-world setting. Radiologists' better performance may be attributed to their higher levels of clinical exposure and experience in imaging practice, which also highlights the importance of a unified approach to the training of AI skills across all healthcare entities in radiology. The differences were not statistically significant (p = 0.39) but effect sizes reported (11.39-12.32) indicate that these differences could be practically or educationally significant. Please check this value, as it is likely a different statistic, as eta-squared should be between 0 and 1, 11.39-12.32 is not normal.

From a contextual perspective, the scores were higher than the previous local benchmarks and lower than some of the international reports, which shows the importance of educational reforms for the Kingdom of Saudi Arabia to keep pace with the rapid commercialization of AI in the healthcare sector. The moderate-to-high AI knowledge level above 55% suggests a potentially good starting point, particularly for students and underscores the importance of undergraduate radiology-AI teaching. Although the maximum score was set at 10, there were no ceiling effects, further confirming the questionnaire's sensitivity. Validated items, pilot testing and good internal consistency (Cronbach's alpha = 0.81) are good strengths of the study. Self-report bias, however, was a limitation, though anonymity was used to limit this concern.

Knowledge of AI Applications in Medical Imaging

Table 3 shows the knowledge regarding the applications of AI in medical imaging. When it comes to imaging modalities, over half of participants were aware of the integration of AI into CT, MRI and mammography imaging (54.1%).

Table 3: Knowledge of AI Applications in Medical Imaging by Professional Category (N = 394)

Variable	Parameter	Medical student N = 328	Radiology technologist N = 16	Radiologist N = 12	Radiology technology student N = 38	Total N = 394	p-value (Test)
AI has been incorporated into current imaging modalities such as CT machines, MRI, mammography, etc.	False/Not sure	156 (47.6%)	7 (43.8%)	2 (16.7%)	16 (42.1%)	181 (42.1%)	0.19 (4.74)
	True	172 (52.4%)	9 (56.3%)	10 (83.3%)	22 (57.9%)	213 (54.1%)	
AI helps to detect pathologies in CT and MRI scans	False/Not sure	125 (38.1%)	6 (37.5%)	3 (25%)	16 (42.1%)	150 (38.1%)	0.77 (1.13)
	True	203 (61.9%)	10 (62.5%)	9 (75%)	22 (57.9%)	244 (61.9%)	
AI has increased the accuracy and sensitivity in the identification of chest pathologies	False/Not sure	134 (40.9%)	6 (37.5%)	3 (25%)	14 (36.9%)	157 (39.8%)	0.7 (1.42)
	True	194 (59.1%)	10 (62.5%)	9 (75%)	24 (63.2%)	237 (60.2%)	
Total score	Mean±SD	1.73±1.15	1.81±1.27	2.33±1.23	1.78±1.89	1.76±1.16	0.38 (1.03)
	Min-max	0-3	0-3	0-3	0-3	0-3	
	Low level (<50th Percentile)	129 (39.3%)	6 (37.5%)	3 (25%)	13 (34.2%)	151 (38.3%)	
	Moderate/high level (≥ 50th Percentile)	199 (60.7%)	10 (62.5%)	9 (75%)	25 (65.8%)	243 (61.7%)	

AI works well to recognize the pathology in either CT or MRI scans (61.9%) and enhances the accuracy of chest pathologies recognition (60.2%), with most participants agreeing on those points. Most participants agreed these points – AI is able to detect pathologies in CT and MRI scans and improve their accuracy and sensitivity in identifying chest pathologies. The overall knowledge of the use of AI applications in medical imaging was moderate to high in 61.7% of them.

Attitudes toward AI in Radiology and Medicine

Table 4 gives an overview of attitudes towards AI in radiology and medicine. Overall, 65.0% of participants agreed or strongly agreed that AI will revolutionize radiology and 71.0% strongly agreed that AI impacts medicine in general will improve. There was general concern over ethics, with 71.8% agreeing or strongly agreeing that AI will create new ethical issues. Almost half of the respondents agreed or strongly agreed that AI may lead to less reliance on radiologists and 45.7% to 46.1% found the growth of AI a reason to be less likely to consider radiology as a career. 51.8% of participants had moderate-to-high scores on the attitude scale.

Figure 2 shows the attitudes toward artificial intelligence in radiology and medicine (N = 394). Subpanels indicate positive perceptions of AI, workforce concerns, ethical/equity concerns, emotional/career-related concerns and overall attitude scores by professional category.

The finding of the attitude of medical students and radiology technologists from the North of Saudi Arabia did not contradict the positive side. The participants recognized the ethical, societal, practical and implementation challenges of AI along with its impact in radiology. However, there were significant differences in attitudes towards AI based on career intention ($p = 0.04$) and perceived impact of imaging ($p = 0.001$) suggesting that factors related to career and professional background may have influenced attitudes towards AI. The radiologists were more confident with their perceptions, indicating that they might be able to guide students and technologists in the application of AI in practice.

The methodology was reinforced by high internal consistency (Cronbach's $\alpha = 0.88$) and by stratified chi-square analyses. However, 46% career hesitancy suggested the application of specific educative interventions where there were lacunae in knowledge about career, which could affect career confidence. The standard deviation for the attitudes towards future jobs is 6.62 indicating some variation in attitudes related to future employment which could be helpful in further regression analysis to identify key predictors. The scores are subjective (Likert scale), however, the scores have been normally distributed and thus the overall interpretation is reliable.

Perceptions, Readiness, Education Needs, Knowledge and Workforce Implications

The majority were proponents of AI-assisted imaging in a workflow supervised by human beings. Sixty percent of people could agree to AI-based image analysis along with specialist review, 28.7% were undecided and 10.7% disagreed. Assistance was also found with the automated detection of pathology, automated diagnosis and automated indication of imaging examinations. There was a strong need for education: 77.4% wanted to see AI incorporated into the curriculum, while 81.7% were interested in getting AI lessons. On average, 58.6% of the participants showed moderate to high AI integration readiness.

There were no significant differences in AI knowledge between age groups or males and females. However, this was not the case for perception/readiness; there were significantly different ratings for those in each age group with 22–25-Year-olds having the highest moderate/high readiness rating. Additionally, moderate/high readiness was more common in females than males. No study domain was significantly related to residence.

Table 4: Attitudes toward Artificial Intelligence in Radiology and Medicine by Professional Category (N = 394)

Variable	Response	Medical students N = 328	Radiology technologists N = 16	Radiologists N = 12	Radiology technology students N = 38	Total N = 394
Artificial intelligence will revolutionize radiology	Strongly disagree	7 (2.1%)	0 (0.0%)	0 (0.0%)	2 (5.3%)	9 (2.3%)
	Disagree	17 (5.2%)	1 (6.3%)	0 (0.0%)	2 (5.3%)	20 (5.1%)
	Neutral	93 (28.4%)	5 (31.3%)	1 (8.3%)	9 (23.7%)	108 (27.4%)
	Agree	113 (34.5%)	6 (37.5%)	5 (41.7%)	16 (42.1%)	140 (35.5%)
	Strongly agree	98 (29.9%)	4 (25.0%)	6 (50.0%)	9 (23.7%)	117 (29.7%)
The human radiologist will be replaced in the foreseeable future	Strongly disagree	60 (18.3%)	3 (18.8%)	2 (16.7%)	8 (21.1%)	73 (18.5%)
	Disagree	75 (22.9%)	8 (50.0%)	1 (8.3%)	5 (13.2%)	89 (22.6%)
	Neutral	87 (26.5%)	2 (12.5%)	1 (8.3%)	11 (28.9%)	101 (25.6%)
	Agree	61 (18.6%)	1 (6.3%)	4 (33.3%)	5 (13.2%)	71 (18.0%)*
	Strongly agree	45 (13.7%)	2 (12.5%)	4 (33.3%)	5 (13.2%)	56 (14.2%)
The human non-interventional physician will be replaced in the foreseeable future	Strongly disagree	61 (18.6%)	4 (25.0%)	2 (16.7%)	6 (15.8%)	73 (18.5%)
	Disagree	68 (20.7%)	5 (31.3%)	1 (8.3%)	6 (15.8%)	80 (20.3%)
	Neutral	99 (30.2%)	4 (25.0%)	1 (8.3%)	9 (23.7%)	113 (28.7%)
	Agree	53 (16.2%)	1 (6.3%)	4 (33.3%)	12 (31.6%)	70 (17.8%)
	Strongly agree	47 (14.3%)	2 (12.5%)	4 (33.3%)	5 (13.2%)	58 (14.7%)
These developments frighten me	Strongly disagree	24 (7.3%)	0 (0.0%)	1 (8.3%)	3 (7.9%)	28 (7.1%)
	Disagree	43 (13.1%)	4 (25.0%)	1 (8.3%)	5 (13.2%)	53 (13.5%)
	Neutral	103 (31.4%)	6 (37.5%)	1 (8.3%)	10 (26.3%)	120 (30.5%)
	Agree	83 (25.3%)	4 (25.0%)	5 (41.7%)	11 (28.9%)	103 (26.1%)
	Strongly agree	75 (22.9%)	2 (12.5%)	4 (33.3%)	9 (23.7%)	90 (22.8%)
AI in medicine will raise new ethical challenges	Strongly disagree	8 (2.4%)	1 (6.3%)	0 (0.0%)	1 (2.6%)	10 (2.5%)
	Disagree	15 (4.6%)	0 (0.0%)	0 (0.0%)	1 (2.6%)	16 (4.1%)
	Neutral	68 (20.7%)	5 (31.3%)	2 (16.7%)	10 (26.3%)	85 (21.6%)
	Agree	102 (31.1%)	3 (18.8%)	4 (33.3%)	16 (42.1%)	125 (31.7%)
	Strongly agree	135 (41.2%)	7 (43.8%)	6 (50.0%)	10 (26.3%)	158 (40.1%)
AI in medicine will raise new challenges around health equity	Strongly disagree	4 (1.2%)	0 (0.0%)	0 (0.0%)	1 (2.6%)	5 (1.3%)
	Disagree	19 (5.8%)	1 (6.3%)	0 (0.0%)	2 (5.3%)	22 (5.6%)
	Neutral	82 (25.0%)	5 (31.3%)	0 (0.0%)	13 (34.2%)	100 (25.4%)
	Agree	108 (32.9%)	4 (25.0%)	6 (50.0%)	15 (39.5%)	133 (33.8%)
	Strongly agree	115 (35.1%)	6 (37.5%)	6 (50.0%)	7 (18.4%)	134 (34.0%)
The impact of artificial intelligence alone will reduce the number of radiologists that are needed	Strongly disagree	16 (4.9%)	0 (0.0%)	1 (8.3%)	3 (7.9%)	20 (5.1%)
	Disagree	49 (14.9%)	6 (37.5%)	0 (0.0%)	7 (18.4%)	62 (15.7%)
	Neutral	100 (30.5%)	4 (25.0%)	2 (16.7%)	11 (28.9%)	117 (29.7%)
	Agree	103 (31.4%)	4 (25.0%)	6 (50.0%)	14 (36.8%)	127 (32.2%)
	Strongly agree	60 (18.3%)	2 (12.5%)	3 (25.0%)	3 (7.9%)	68 (17.3%)
AI would have an overall positive impact in medical imaging	Strongly disagree	4 (1.2%)	0 (0.0%)	0 (0.0%)	2 (5.3%)	6 (1.5%)
	Disagree	16 (4.9%)	4 (25.0%)	0 (0.0%)	3 (7.9%)	23 (5.8%)
	Neutral	97 (29.6%)	2 (12.5%)	1 (8.3%)	16 (42.1%)	116 (29.4%)
	Agree	131 (39.9%)	3 (18.8%)	5 (41.7%)	14 (36.8%)	153 (38.8%)
	Strongly agree	80 (24.4%)	7 (43.8%)	6 (50.0%)	3 (7.9%)	96 (24.4%)
Artificial intelligence will improve medicine in general	Strongly disagree	6 (1.8%)	1 (6.3%)	0 (0.0%)	1 (2.6%)	8 (2.0%)
	Disagree	9 (2.7%)	1 (6.3%)	1 (8.3%)	2 (5.3%)	13 (3.3%)
	Neutral	74 (22.6%)	4 (25.0%)	2 (16.7%)	13 (34.2%)	93 (23.6%)
	Agree	140 (42.7%)	3 (18.8%)	2 (16.7%)	17 (44.7%)	162 (41.1%)
	Strongly agree	99 (30.2%)	7 (43.8%)	7 (58.3%)	5 (13.2%)	118 (29.9%)
I am less likely to consider a career in radiology, given the advancement of AI	Strongly disagree	24 (7.3%)	2 (12.5%)	1 (8.3%)	6 (15.8%)	33 (8.4%)
	Disagree	36 (11.0%)	6 (37.5%)	1 (8.3%)	4 (10.5%)	47 (11.9%)
	Neutral	112 (34.1%)	5 (31.3%)	4 (33.3%)	13 (34.2%)	134 (34.0%)
	Agree	78 (23.8%)	2 (12.5%)	1 (8.3%)	11 (28.9%)	92 (23.4%)
	Strongly agree	78 (23.8%)	1 (6.3%)	5 (41.7%)	4 (10.5%)	88 (22.3%)
Total score	Mean±SD	35.67±6.45	33.31±7.13	40.42±7.79	34.00±6.76	35.56±6.62
	Minimum–maximum	21–50	21–50	28–50	10–50	10–50
	Low level, <50th percentile	154 (47.0%)	11 (68.8%)	4 (33.3%)	21 (55.3%)	190 (48.2%)
	Moderate/high level, ≥50th percentile	174 (53.0%)	5 (31.3%)	8 (66.7%)	17 (44.7%)	204 (51.8%)

Note: $p<0.05$ Indicates Statistical Significance

Furthermore, the correlation analysis revealed significant positive relationships between overall AI knowledge and imaging-specific knowledge, attitudes and perceptions/readiness. The correlation between the constructs revealed that the highest correlation was between attitude and perception/readiness, indicating that those with more positive attitudes were also more prepared for the integration of AI.

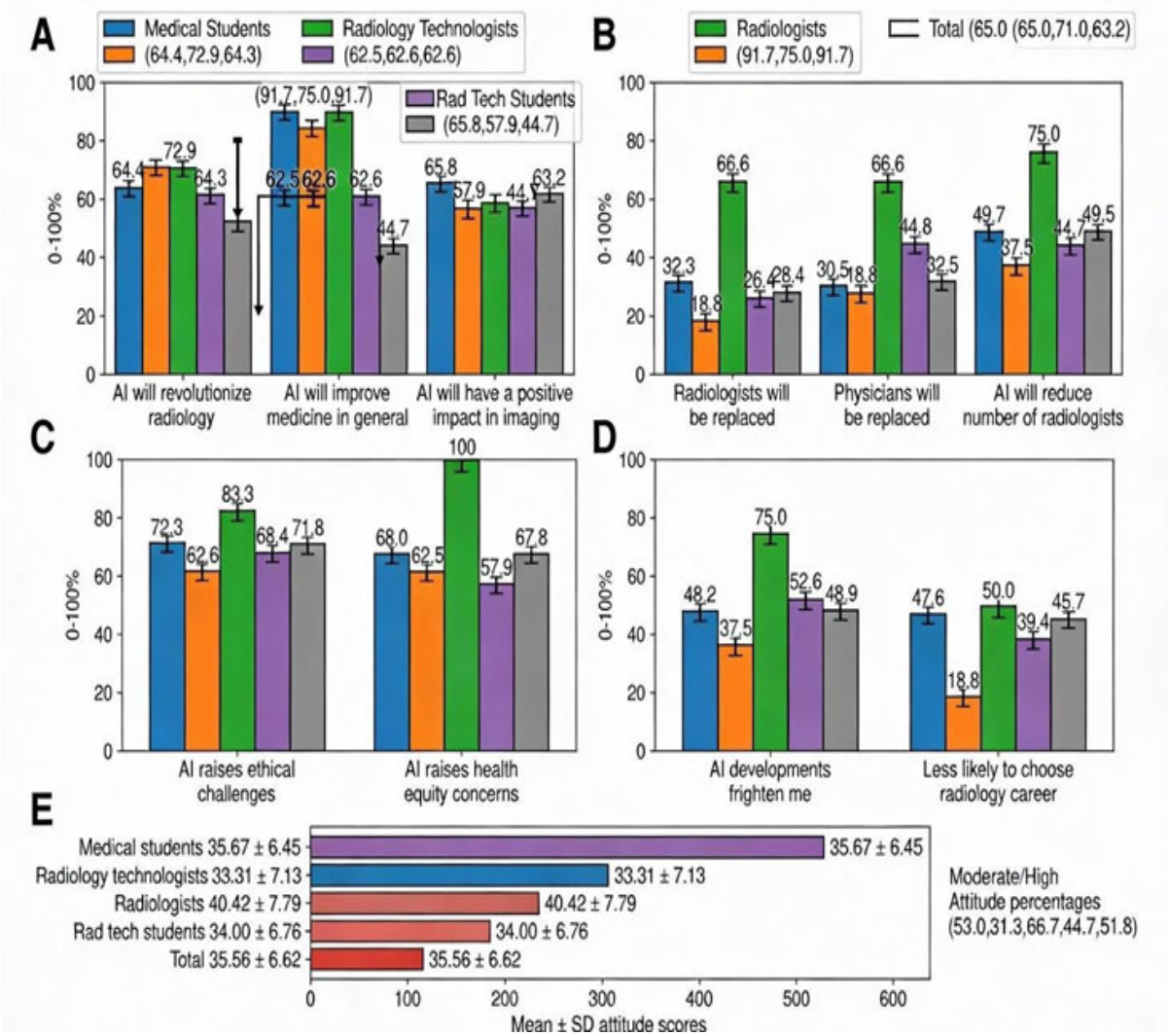

Figure 2: Attitudes toward Artificial Intelligence in Radiology and Medicine (N = 394)

DISCUSSION

The findings of this study showed that medical students and radiology professionals in Northern Saudi Arabia had moderate knowledge about AI, general positive attitudes and moderate readiness to tolerate AI integration. While most of the participants understood the impact AI could have in diagnostic imaging, the comprehension of the principles and limits of AI, as well as its validation and clinical governance, was not complete. The terminology difference between awareness and deeper technical knowledge indicates that exposure to AI is primarily occurring informally and not as part of the curriculum.

When it comes to Specific Objectives 2, 4 and 5, the attitudes towards AI were characterized by moderately positive expectations and ethical and professional anxieties. More than 70% of the participants thought that AI would be able to improve diagnostic accuracy, efficiency and around 68% of them expressed conditional trust when AI is used with human supervision. Nonetheless, ethical issues were numerous and approximately three-quarters of people anticipated issues of data privacy, accountability and fair access. Workforce anxiety was also strong and inconsistent across groups: Around 62% cited AI as a threat to future demand for radiologists and 45-50% of medical students reported less interest in radiology as a career because of AI. Technologists, on the other hand, were less concerned about their careers, which can be explained by their greater professional stability and greater familiarity with AI as an aid tool [8]. It is interesting to note that over 80% supported a human-in-the-loop perspective, which shows that augmented intelligence is collectively favored and that the view that it is more likely to be driven by uncertainty than by a real evaluation of existing AI capabilities [9]. Results associated with Specific Objectives 3 and 6 include identifying education as the key to safe AI implementation. Although less than half said they were adequately prepared to use AI clinically, willingness to complete formal AI training was extremely high (>85%). Students highlighted the need to bridge the gap in basic AI education, whereas technologists noted applied training in the

fields of workflow integration, quality assurance and regulation [10]. The preparedness of younger and female respondents is higher, indicating that competence and acceptance may develop more quickly when first introduced to the curriculum in an inclusive manner.

In addition, an important finding was concern with regard to their career. Almost half of respondents indicated that their consideration of taking up radiology as a career decreased with the advancement of AI. The worry should not be misread as an opposition to AI, it just means that the roles and local identity of workers in the future, as well as the role of the physician in the future, are not clear. These findings reinforce the importance of education early in the learning process on the role of AI as an assistive technology, the fact that they cannot work without human oversight or intervention, the medicolegal issues involved and the ongoing role of radiologists in clinical decision-making.

A practical curriculum response should include tiered AI education. Foundational knowledge about AI terminology, foundational concepts of machine learning, algorithmic biases, data privacy, ethics and clinical validation should be imparted to the students at undergraduate levels. During the radiology exposure, instruction should include how to use AI to interpret images, how to use AI to define a triage workflow, to spot errors, to know that the AI must be checked, to interact with the patient and radiologists. In conclusion, continuing education for radiology technologists and practitioners should include updates on technology practice, efficiency, regulatory compliance, patient safety and radiation safety of AI-assisted imaging systems.

Overall, the results support the optimal setting of a tiered educational approach of undergraduate literacy, radiology-specific competencies and continuous professional training and the understanding of how knowledge gaps and attitudinal uncertainty directly impact readiness and provide evidence-based insight for the alignment of AI education with national digital health strategies.

Weaknesses

The major drawbacks were the convenience sampling, a cross-sectional study design, self-reported responses, response rates and bias and a limitation of generalizability since the study was conducted in Northern Saudi Arabia.

Strengths

There are a number of strengths to this study including a relatively large sample size, representation from both students and actual radiology professionals, a questionnaire used in this study that had been previously validated, pilot testing prior to data collection and its stratified analysis based on professional group. The study is also focusing an under-represented group in the north of Saudi Arabia, giving region specific evidence for curriculum planning in AI and preparedness for the workforce.

CONCLUSION

This study indicates that, overall, medical students and radiologists in the Northern region of Saudi Arabia have good recognition of the clinical impact of AI in diagnostic radiology and suggest a diversity of knowledge and readiness levels. The adoption of AI as aiding clinician, not a clinician place-holding, seems to be generally embraced but the theme of workforce impact and sustainability of professions is present. The implications for what could come from these findings are that there is a possibility to close the gaps from exposure to knowledge through the structured and standardized learning of AI in education. The results of this study indicated moderate levels of knowledge and readiness to use AI in medical students and medical imaging professionals in Northern Saudi Arabia and positive perceptions of the value of AI in diagnostic imaging. However, some gaps in the education system, moral issues and concerns pertaining to careers were recognized. These results add value for the incorporation of structured AI education into the basic medical and radiology training programs and in ongoing professional development of radiology professionals. School policies need to be connected to clinical governance, Patient Safety, ethics and workforce planning so as to allow the safe and informed implementation of AI in the world of diagnostic imaging.

Limitations

There are a number of limitations to this study. Firstly, its cross-sectional nature makes it difficult to draw causal links between AI knowledge, attitudes and readiness and career perceptions. Secondly, the convenience sampling methodology allowed for the possibility of selection bias because people who were more interested in AI could have more readily participated in the survey. Third, a potential presence of recall and of social desirability bias in the use of self-reported measures needs to be considered. The fourth is that the study focused on Northern Saudi Arabia and might not be representative for the other regions of the country or other educational institutions with different educational environments and exposure to AI. Lastly, the study lacked a longitudinal design, which reduces the ability to measure changes in AI knowledge and attitudes following formal learning and/or clinical experience.

Future Recommendations

More longitudinal studies are needed to explore time-variant changes in attitudes, readiness and career concerns regarding AI for members of radiology-related disciplines. Participants from several regions in Saudi Arabia like university, hospital, training institutions and other institutions in various localities throughout the country should be included in studies, to enhance representativeness and generalizability. Future studies should also investigate how effective structured AI education is for clinical preparedness, ethical considerations and trusting AI-assisted radiology. Standard

AI competency tools should be used in all comparative studies that involve undergraduate students, postgraduate trainees, radiology technologists and practicing radiologists. Lastly, studying should assess whether or not AI incorporation in curriculum reduces anxiety ensuing from career and facilitates safe clinical use.

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