



Perception of Medical Students about Artificial Intelligence Use in Radiology

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ABSTRACT

Objective: The study aimed at evaluation of the perception of medical students regarding impact of AI on radiology.

Study Design: Cross-sectional study.

Place and Duration of Study: Northern Border University (NBU), Arar, Saudi Arabia from 6th January 2024 to 6th March 2024.

Methodology: The study was conducted among the medical students of clinical years at NBU, Arar. After taking their consents, the students were asked to fill a pre-designed online questionnaire. The data collected from the online questionnaire was evaluated using Statistical Package of Social Sciences Version 20. The continuous data was analyzed with the help of Student's t-test while Pearson's Chi-square was applied on nominal data. P value of <0.05 was considered significant.

Results: Total of 188 medical students responded online to this study. Radiology was among top 3 priorities for specialization for 29.8% of the students and AI was a known entity for 66.5% of the medical students. Almost 59.6% of the students believed that AI cannot replace radiologists. Majority of the students agreed that AI should be a part of medical curriculum.

Conclusion: The medical students at NBU, Arar were knowledgeable about AI and its potential applications in radiology. They were not apprehensive about how it might affect the employment of radiologists and physicians. However, they believed that AI should be integrated into medical curriculum to ensure better understanding and utilization in clinical practice.

Keywords: Radiology, Artificial Intelligence (AI), Medical Students, Perception.

INTRODUCTION

In 1956, artificial intelligence (AI) was officially recognized as the field encompassing the development of advanced machines capable of performing tasks that traditionally require human intelligence, including but not limited to robotics and diagnostics. (1). AI both in form of ML



(machine learning) and DL (deep learning) is penetrating the specialty of radiology to aid better diagnosis (2).

The radiologists today have to face a huge work load on a daily basis (3). AI can reduce the workload of the radiologists and their ancillary staff. AI can improve techniques of examination, reduce exposure, control workflow in times of reduced staff and equipment (4). Artificial intelligence excels at automatically detecting complex patterns in images and providing quantitative assessment of diseases, rather than qualitative (5, 6). Despite the potential benefits of this technology, the viewpoint has started to emerge that AI can make more accurate diagnosis than actual doctors (7). These opinions are cause of anxiety among medical students as well and they have concerns to choose radiology as a future specialty (8). Almost 53% students in a study conducted in the United Kingdom believed that the AI will read MRI and Computed Tomography imaging (9). According to a study, only 26.9% students considered radiology as a future residency option (10). According to a previous Saudi study, 44.8% students were of the opinion that AI will replace radiologist in coming future (11).

Several studies have been conducted in various parts of the world regarding use of AI and perception of medical students, but our national data is still depleted in this regard. This study was aimed to assess the perception of medical students in clinical years of Northern Border University regarding the role of AI and its impact on radiology. This research will contribute to the existing national data and assist in creating educational materials aimed at reducing anxiety associated with the use of AI in radiology.

MATERIALS AND METHODS

The topic was reviewed from multiple databases including Google scholar, PubMed and Science Direct. The study used a questionnaire (Annexure) as the data collection tool, which was created after reviewing existing literature and previous research. The questionnaire was developed, and its face validity was confirmed by a panel consisting of 2 radiologists. It was further validated by a Pilot study with 20 participants. The questionnaire had six sections; each section had a particular objective. The first section collected demographic data (gender, age, year of study) and preference for specialty of radiology. The second section had questions on participant's previous knowledge about Artificial Intelligence, the third section contained question related to possible applications of AI in radiology. The fourth section contained a set of questions about impact of AI on radiology, fifth section contained questions about impact of AI on choosing radiology as a specialty and sixth was a comment section. The third, fourth and fifth section had answers in Likert scale from Strongly Disagree to Strongly agree (five-level scale). The total number of questions was twenty-eight. The questionnaire sought to analyze the views of medical students regarding the influence of Artificial Intelligence on radiology as a choice for specialty.

The questionnaire along with the study was approved from the Local Committee of Bioethics of Northern Border University, Arar, Saudi Arabia vide letter no.119/23/H. The questionnaire was then transformed to online format using platform of Google Forms and shared with students of clinical years 4,5 and 6 through social media WhatsApp. The sample size of one hundred and



eighty-eight was calculated with 90% confidence level, 6% margin of error and by taking expected percentage of clear understanding of AI among study participants as 51.9% (12) respectively using the formula $n = Z^2 \cdot 1-\alpha/2P(1-P)/d^2$. The medical students at NBU, Arar studying in clinical years i.e. 4th, 5th and 6th year were involved in this study while the students studying in junior years were not included in the study. The selection of these students was done using non-probability convenient sampling. The complete submission of online form meant students' consent for inclusion in the study. Confidentiality was maintained during the study.

The data was entered into and analyzed using IBM SPSS Statistics for Windows, Version 20 (released in 2011; IBM Corp., Armonk, New York, United States). All the qualitative data was presented as frequency and percentages and compared using chi-square test, while all the quantitative data was presented as mean and its standard deviation and compared using independent sample t-test. A p-value of ≤ 0.05 was considered statistically significant. To rule out confounders like age, gender and year of study, stratification was used.

The whole process of this study spanned from 6th January 2024 to 6th March 2024 after approval of synopsis.

RESULTS

The mean age was 22.21 ± 0.99 years. The maximum number of students (35%) were of the age 22 years. 63.8% (n = 120) were females, the majority, compared with 36.2% (n = 68) of males.

Table-1: Personal Details of Study Participants

	n=188
Age (Mean$\pm$SD)	22.21 $\pm$ 0.99
Gender (Male/Female)	68/120 (36.2%/63.8%)
Year of Study	
4 th year	90(47.9%)
5 th year	73(38.8%)
6 th year	25(13.3%)
Specialty preferences	
I am not interested in pursuing radiology as a specialty.	60(31.9%)
Radiology is below my top three choices when it comes to selecting a medical specialty.	72(38.30%)
Radiology is one of my top three choices when it comes to selecting a medical specialty.	56(29.8%)

The maximum participation was from 4th year showing 47.9% (n= 90) participation.

The students were asked about their preference for radiology as a specialty. About 29.8% of medical students (n= 56), claimed that radiology was one of their top 3 priority for choosing as specialty. Radiology was below top 3 choices for specialty for 38.3% (n= 72) of medical students.

**Table-2: Previous knowledge of the topic in relation to year of study**

	Total (n=188)	4 th Year		5 th Year		6 th Year		p- value
		n	%	n	%	n	%	
Artificial Intelligence is already in use in several applications of daily use								0.941
No	10.1%	9	10%	7	9.6%	3	12%	
Yes	89.9%	81	90%	66	90.4%	22	88%	
Do you know the ongoing discussion about Artificial Intelligence and its possible Radiology-related applications?								0.099
No	43.6%	43	47.8%	33	45.2%	6	24%	
Yes	56.4%	47	52.2%	40	54.8%	19	76%	
I understand well what Artificial Intelligence is								0.165
Agree	41%	43	47.8%	22	30.1%	12	48%	
Neither agree nor disagree	25.5%	20	22.2%	24	32.9%	4	16%	
somewhat disagree	5.9%	6	6.7%	5	6.8%	0	0%	
Strongly agree	25.5%	20	22.2%	19	26%	9	36%	
Strongly Disagree	2.1%	1	1.1%	3	4.1%	0	0%	
Deep Learning is defined as a set of involuntary identification methods for specific patterns which have already been applied successfully in many areas of expertise such as interpretation of biomedical images.								0.085
False	10.1%	8	8.9%	11	15.1%	0	0%	
True	89.9%	82	91.1%	62	84.9%	25	100%	
Deep Learning when applied in radiology needs large collections of medical images								0.717
False	5.9%	4	4.4%	5	6.8%	2	8%	
True	94.1%	86	95.6%	68	93.2%	23	92%	
The systems of Deep Learning are very blurred: the thought process can be difficult to define.								0.953
False	21.3%	20	22.2%	15	20.5%	5	20%	
True	78.7%	70	77.8%	58	79.5%	20	80%	
The technology of Deep Learning can recognize Very good patterns but can't do deductive reasoning.								0.189
False	18.1%	12	13.3%	15	20.5%	7	28%	
True	81.9%	78	86.7%	58	79.5%	18	72%	

Almost ninety percent (n= 169) said they have knowledge that several applications which they use regularly are already utilizing Artificial Intelligence (face and body recognition), voice algorithms like Instagram or YouTube, spam filters...). 56.4% (n= 106) medical students said that they know about the ongoing discussion about Artificial Intelligence and its possible uses in the field of



Medical Imaging. Almost sixty-seven percent (n= 125) strongly agreed/ agreed that they were well informed of AI. More than 78% students gave correct answers to questions on deep learning.

Table-3: Insight on the possible applications of artificial intelligence in the field of radiology in relation to year of study

	Total (n=188)	4 th Year		5 th Year		6 th Year		p-value
		n	%	n	%	n	%	
Automated detection of pathologies in radiological images								
Neither agree nor disagree	20.2%	22	24.4%	12	16.4%	4	16%	0.165
Somewhat agree	21.8%	21	23.3%	12	16.4%	8	32%	
Somewhat disagree	11.7%	10	11.1%	11	15.1%	1	4%	
Strongly agree	20.2%	21	23.3%	14	19.2%	3	12%	
Strongly disagree	26.1%	16	17.8%	24	32.9%	9	36%	
Automated diagnosis from radiological images								
Neither agree nor disagree	17.6%	17	18.9%	10	13.7%	6	24%	0.011
Somewhat agree	23.9%	21	23.3%	17	23.3%	7	28%	
Somewhat disagree	19.1%	25	27.8%	10	13.7%	1	4%	
Strongly agree	15.4%	16	17.8%	10	13.7%	3	12%	
Strongly disagree	23.9%	11	12.2%	26	35.6%	8	32%	
The automated indication of the corresponding radiological tests								
Neither agree nor disagree	22.9%	23	25.6%	14	19.2%	6	24%	0.183
Somewhat agree	24.5%	23	25.6%	16	21.9%	7	28%	
Somewhat disagree	20.7%	19	21.1%	15	20.5%	5	20%	
Strongly agree	11.2%	14	15.6%	5	6.8%	2	8%	
Strongly disagree	20.7%	11	12.2%	23	31.5%	5	20%	

Forty-two percent (n= 79) strongly agreed/somewhat agreed with the opinion that there can be automated detection of pathologies in radiological images using AI. Almost 23.9% (n= 45) medical students somewhat agreed that automated diagnosis can be made by AI from radiological images. This was strongly affected by year of study (p=0.011). Most of the medical students (20.7% (n= 39)) strongly disagreed with the idea that AI can be used for automated identification of the appropriate radiological examinations.

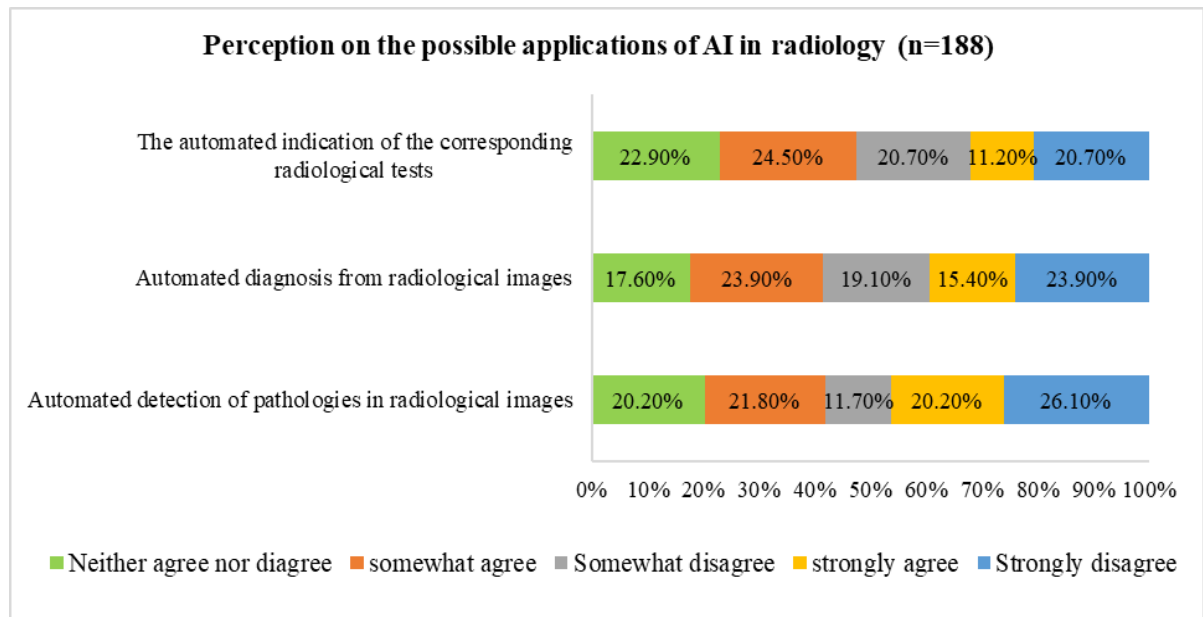


Figure 1 Medical students' Perspectives about application of AI in radiology

Table-4: Perceived impact of Artificial Intelligence on radiology in relation to Year of study

Questions	Categories	Total (n=188)	4 th Year		5 th Year		6 th Year		p-value
			n	%	n	%	n	%	
AI is going to revolutionize the field of radiology	NAD	18.6%	19	21.1%	9	12.3%	7	28%	0.063
	SWA	20.7%	19	21.1%	16	21.9%	4	16%	
	SWD	12.8%	11	12.2%	8	11%	5	20%	
	S A	26.1%	29	32.2%	18	24.7%	2	8%	
	S D	21.8%	12	13.3%	22	30.1%	7	28%	
AI is going to revolutionize medicine	NAD	18.1%	12	13.3%	16	21.9%	6	24%	0.007
	SWA	28.2%	33	36.7%	14	19.2%	6	24%	
	SWD	11.2%	10	11.1%	5	6.8%	6	24%	
	S A	22.3%	24	26.7%	16	21.9%	2	8%	
	S D	20.2%	11	12.2%	22	30.1%	5	20%	
AI has the possibility of completely replacing radiologist in the near future.	NAD	17.6%	15	16.7%	12	16.4%	6	24%	0.085
	SWA	16.5%	17	18.9%	9	12.3%	5	20%	
	SWD	18.6%	19	21.1%	11	15.1%	5	20%	
	S A	6.4%	8	8.9%	1	1.4%	3	12%	
	S D	41.0%	31	34.4%	40	54.8%	6	24%	
AI has the possibility of completely replacing the doctor.	NAD	18.6%	17	18.9%	9	12.3%	9	36%	0.020
	SWA	18.1%	21	23.3%	10	13.7%	3	12%	
	SWD	11.2%	12	13.3%	7	9.6%	2	8%	



	S A	4.8%	6	6.7%	1	1.4%	2	8%	
	S D	47.3%	34	37.8%	46	63%	9	36%	
AI has the possibility of causing a decline in demand for radiologists.	NAD	18.1%	14	15.6%	14	19.2%	6	24%	0.373
	SWA	30.9%	33	36.7%	18	24.7%	7	28%	
	SWD	16.5%	14	15.6%	14	19.2%	3	12%	
	S A	6.9%	8	8.9%	2	2.7%	3	12%	
	S D	27.7%	21	23.3%	25	34.2%	6	24%	
AI has the possibility of causing a decline in demand for doctors	NAD	22.3%	15	16.7%	23	31.5%	4	16%	0.014
	SWA	16.0%	16	17.8%	9	12.3%	5	20%	
	SWD	19.7%	22	24.4%	7	9.6%	8	32%	
	S A	7.4%	10	11.1%	2	2.7%	2	8%	
	S D	34.6%	27	30%	32	43.8%	6	24%	
Progress in the field of AI will enhance the workload capacity	NAD	24.5%	14	15.6%	27	37%	5	20%	0.043
	SWA	25.5%	25	27.8%	15	20.5%	8	32%	
	SWD	12.2%	12	13.3%	9	12.3%	2	8%	
	S A	22.9%	28	31.1%	10	13.7%	5	20%	
	S D	14.9%	11	12.2%	12	16.4%	5	20%	
Radiologists should embrace these changes and collaborate with the IT sector	NAD	19.1%	12	13.3%	19	26%	5	20%	0.196
	SWA	26.1%	31	34.4%	12	16.4%	6	24%	
	SWD	13.3%	10	11.1%	10	13.7%	5	20%	
	S A	25%	24	26.7%	17	23.3%	6	24%	
	S D	16.5%	13	14.4%	15	20.5%	3	12%	
AI should be included in the syllabi of medicine	NAD	22.9%	19	21.1%	19	26%	5	20%	0.274
	SWA	31.9%	36	40%	16	21.9%	8	32%	
	SWD	8.5%	5	5.6%	10	13.7%	1	4%	
	S A	21.8%	19	21.1%	15	20.5%	7	28%	
	S D	14.9%	11	12.2%	13	17.8%	4	16%	

NAD=neither agree nor disagree, SWA= somewhat agree, SWD= somewhat disagree, SA= strongly agree, SD= strongly disagree

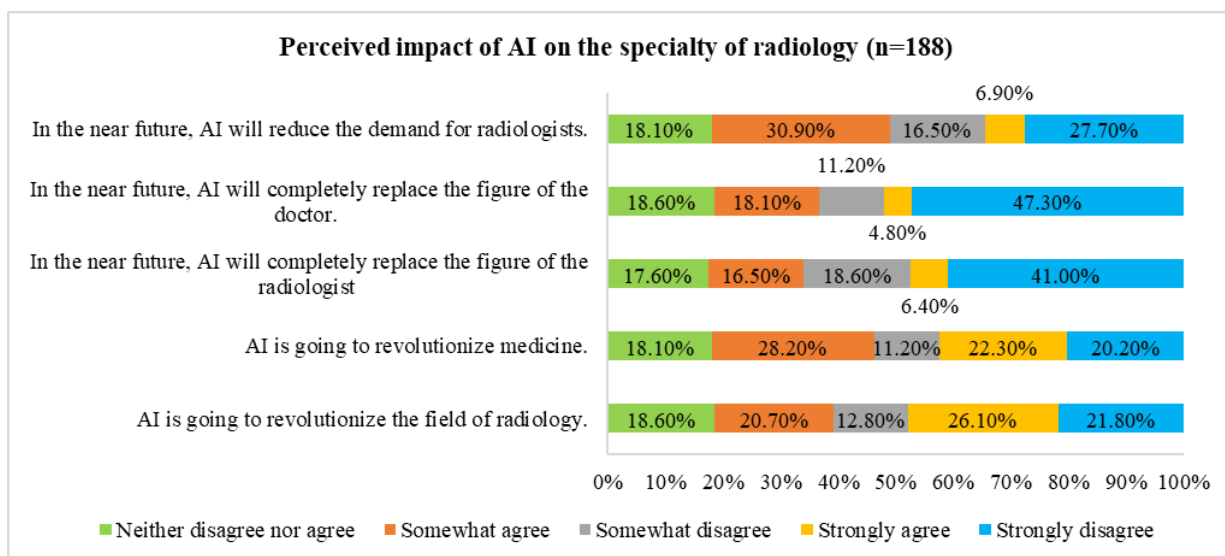


Figure 2 Perceived impact of Artificial Intelligence on the specialty of radiology

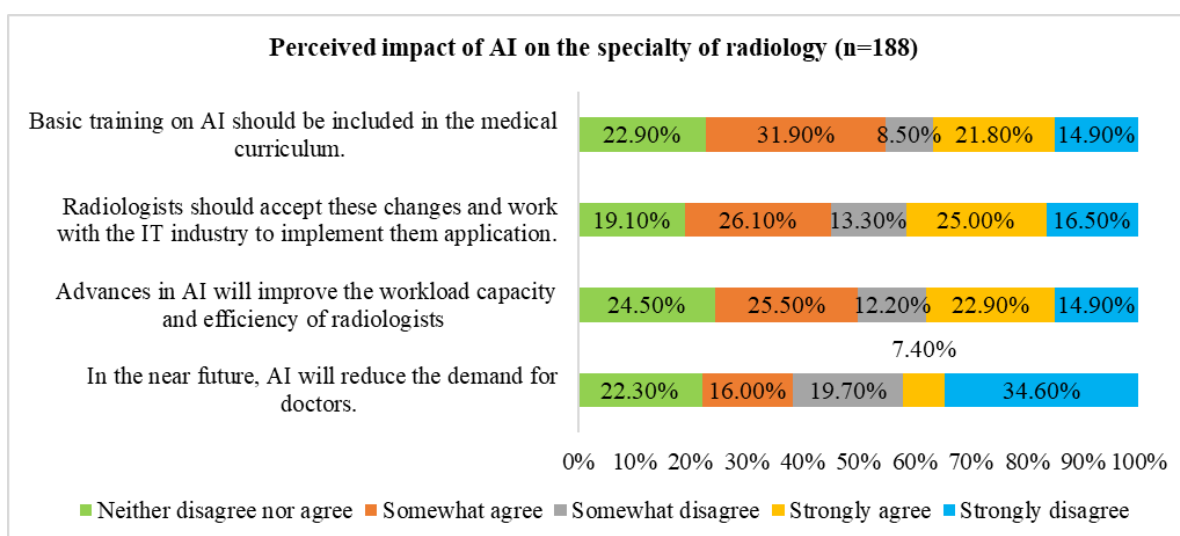


Figure 3 Perceived impact of Artificial Intelligence on the specialty of radiology

Seventy-five students (39.9%) agreed to the fact that influence of AI in radiology effects their choice of specialty. Most of the students 42% (n= 79) were of the view that the advances of AI in radiology and medicine is quite interesting for them. Almost similar proportion 40.4% (n= 85) students agreed that AI should have a specific place in curriculum. The interest in choosing radiology as specialty rose from 27.3% to 37%. On the contrary, the proportion of medical students showing the least interest in radiology as a specialty also increased from 38 to 44.9%.



Table-5: Impact of the topic on a personal level and in terms of the choice of specialty in relation to Year of study

Questions	Categories	Total (n=188)	4 th Year		5 th Year		6 th Year		p-value
			n	%	n	%	n	%	
I am concerned about this matter when considering radiology as a possible career	NAD	22.3%	20	22.2%	16	21.9%	6	24%	0.507
	SWA	22.3%	26	28.9%	11	15.1%	5	20%	
	SWD	17.6%	11	12.2%	18	24.7%	4	16%	
	S A	17.6%	15	16.7%	13	17.8%	5	20%	
	S D	20.2%	18	20%	15	20.5%	5	20%	
I became more interested in the medical field, especially radiology, because of these advancements.	NAD	26.6%	23	25.6%	22	30.1%	5	20%	0.232
	SWA	23.4%	23	25.6%	16	21.9%	5	20%	
	SWD	17.6%	14	15.6%	17	23.3%	2	8%	
	S A	18.6%	20	22.2%	8	11%	7	28%	
	S D	13.8%	10	11.1%	10	13.7%	6	24%	
Should AI be included in syllabus?	NAD	35.6%	1	1.1%	2	2.7%	0	0%	0.668
	SWA	25.5%	28	31.1%	27	37%	10	40%	
	SWD	11.2%	28	31.1%	15	20.5%	5	20%	
	S A	14.9%	9	10%	9	12.3%	2	8%	
	S D	12.8%	16	17.8%	8	11%	4	16%	

NAD=neither agree nor disagree, SWA= somewhat agree, SWD= somewhat disagree, SA= strongly agree, SD= strongly disagree

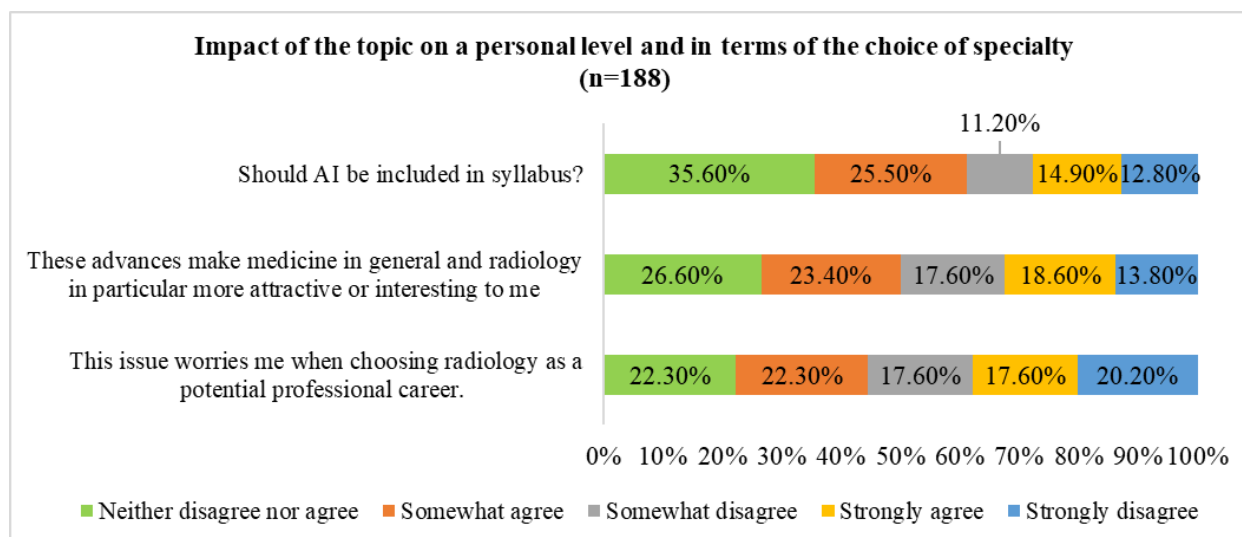


Figure 4 Impact of the topic on a personal level and in terms of the choice of specialty

DISCUSSION

AI has great potential in the field of radiology, particularly in the development of software that has been proven to be effective in clinical settings. This includes tasks such as identifying, segmenting, and classifying various types of lesions (13). More than half of the participants claimed that they were aware of the debate of potential implications of AI in radiology. The results were similar to a German study showing slightly more than 50% students knowing about the debate (14). Almost 66.5% (n=125) of the students believed that they understood well what AI was. The proportion was considerably lower in other countries, as it was 30.8% in Germany (14) and 44% in England (15). In another Saudi study, this proportion was 50.0% (11) and it was 78.9% of Canadian students (16).

Majority of the medical students 42% (n= 79) believed that AI can detect the disease automatically from radiological investigations in the future. This is the most important part of a radiologist's job; hence, AI has potential to replace radiologist. Similarly, the proportion of medical students agreeing for role of AI in diagnosis using radiological images automatically was 39.3% (n=74) and in indicating the radiological tests is 35.7% (n=67). Our results oppose the study of Galan et al according to which 83% of medical students thought that AI can detect the disease automatically (12). Our study also opposed the German study which shows agreement in percentage of 83% (14). The medical students were of the view that AI can be an adjuvant in diagnosis rather than a replacement of AI as replacement would need enhanced capabilities like improved processing and abstraction which are more humanly properties.

The previous studies conducted in European countries shows that the radiologists are quite apprehensive about role of AI in radiology that it may affect their jobs (17, 18). Most of the medical students who were part of this study do not expect replacement of radiologist (59.6%) (n= 112) or even a reduction in their demand (44.2%) (n=83). Most of the students 46.8% (n= 88) believed radiology could be revolutionized with incorporation of AI but will have no impact on employment



of radiologists. However, these numbers are much lesser as compared to Galen showing 81% disagreement (12) and German studies showing 76% disagreement (14). The European radiologists expressed that Artificial Intelligence will help to save their time and improve communication with other doctors and patients (17). The Saudi students in this study agreed 48.4% (n= 91) to the statement that AI will decrease the workload of radiologists and 51.1% (n=96) agreed that radiologists should collaborate with IT industry to adapt to AI and implement it in the industry. These numbers were much lower as compared to 87% and 77% respectively for the statements in Spanish study (12). Majority of the medical students in this study 53.7% (n=101) were of the view that AI should be integrated into medical curriculum as the radiologists need to be trained for clinical use and about technicalities of AI applications. This similarity was found in previous studies too (11, 14-16, 19).

Another important aspect of our study was to know the effect of AI's influence over the choice of radiology as a future specialty(20). It may be due to lesser exposure or lesser importance in curriculum. In Saudi Arabi, on an average only 14% of medical students take radiology as their future specialty choice (21). According to our study, radiology is one of the top choices of specialty in 38% (n=71) of the students. It is higher than previous studies in which this range is between 3.3% and 8.0% (12, 22-24).

Half of the students 50% (n=94) were worried about unemployment due to AI. The concern ranges from 25% to 55% depending on the interest in choosing the specialty. Our numbers are lesser than a previous Saudi study (60%) (11) while being similar to those of a Canadian study (55%) (16). Gong et al., in their study has shown that approximately 16% of medical students who previously chose radiology as their specialty are likely to rethink their decision because of the effects of AI on the job prospects for radiologists. (16). Similar results were also seen in study conducted in the UK (15). The results of our study show that 42% (n= 79) of medical students think that AI makes medicine more interesting. The proportion is higher than that of Spanish study (36.7%) while lower than German (44.5%) study (12, 14). A large number of students (40%) (n= 75) agreed that AI should be integrated into medical curriculum. At the end of the study, it was found that radiology gained position in below top three specialties for 44.9% of the students as compared to 38% in the beginning. This was after considering the influence of artificial intelligence on the radiology domain. It contrasts the Spanish study in which there were no significant changes (12).

Differences in perception between subgroups

Some significant differences exist between groups depending on year of clinical study. Greater number of sixth-year students n= 19 (76%) were aware of on-going debate of impact of AI on radiology (p=0.09). All the senior students gave correct answer to the statement that deep learning has been applied to biomedical image analysis (p=0.085). The youngest students were more of the opinion that AI can be used for automated diagnosis from images of radiology (p=0.011). Fourth year students (62%) agreed with the statement that AI will revolutionize medicine (p=0.007). Seventy-two percent of the medical students disagreed with the notion that AI can replace radiologists (p=0.02). The fourth-year students (58%) were more of the opinion that AI can help improve the workload of radiologists (p= 0.04).



Limitations and future considerations

This type of extensive study about perception of medical students about AI has not been conducted in Saudi Arabia to the best of our knowledge. There are some limitations in this study. The sample size of this study is small and does not encompass the other universities. Hence this study opens prospects for multi-centric or even international studies. More fourth-year students were included in the study. Some future study should include equal number of students from all years to remove this selection bias. A study should include questions related to the practical, clinical, ethical, and legal aspects of AI. The curriculum at present needs amendments for basic (25) in addition to advanced radiology which may be done using online training as well. To sum up the following comment of a medical student gives best idea of AI:

“I think AI is a great tool to utilize regardless of the concerns about the replacement of both radiologists and doctors. However, having a subject about its implications and importance in the medical field is very crucial, because it almost always eliminates errors, and whenever something wrong happens a physician is there to fix the issue.”

CONCLUSION

The medical students at NBU, Arar were knowledgeable about AI and its potential applications in radiology. They were not apprehensive about how it might affect the employment of radiologists and physicians. However, they believed that AI should be integrated into medical curriculum to ensure better understanding and utilization in clinical practice.

Conflict Of Interest: None

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