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The Role of Artificial Intelligence in Enhancing Diagnostic Radiology: Applications and Advancements in Medical Imaging in Saudi Arabia

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Abstract **Objectives:** Artificial Intelligence (AI) is altering the playing field of healthcare, specifically in radiology, with an efficacy of medical image reading. In the case of Saudi Arabian healthcare, AI is changing workflows in the ability of moving on with early detection of disease as well as minimize the number of human errors. However, there are issues such as regulations and special training requirements. **Purpose:** This research is to explore the AI awareness and knowledge of diagnostic radiologists in Saudi Arabia with focus on the AI and medical imaging. It evaluates the AI awareness among trainees and professionals of imaging: Radiology and discusses the possibility of integrating AI in teaching curriculum. Apart from the key highlight, the study was aimed to find regional variations in the perceptions relating to the role of AI in diagnostic radiology. **Methods:** This study has a cross-sectional online survey design, conducted for five months (June-September 2024) with a survey group size of 500 (including resident and senior physicians) radiologists. Data were collected using surveys that were distributed via radiological societies and social media. The statistical analysis was performed the version 26 of the statistical package Statistics Package for the Social Sciences (SPSS) and with a p-value of less than 0.05. Ethical permits were approved by the University of Hail. **Results:** For example, out of 433 respondents, 80.6% were aware of the existence of AI and 82.2% were aware of the potentially positive effects of AI for improved diagnosis. However, concerns about job displacement and machine errors were noticed. Moreover, there was a greater proportion of interest in AI education, with a total of 81.5%, radiologists in the central areas showing a higher level of knowledge in the northern region ($p = 0.023$). Those with more education had greater awareness of AI ($p = 0.001$). **Conclusion:** AI has a lot of potential for being helpful to the field of diagnostic radiology in Saudi Arabia, but there are challenges in terms of regulation, training and privacy to be overcome. The study emphasizes the importance of adopting Artificial Intelligence (AI) educational content in the medical curriculum, which is in line with the Saudi Vision 2030.

Key Words Artificial-Intelligence (AI), Diagnostic Radiology, Medical Imaging, Saudi Arabia, Radiologists' Knowledge, AI Integration in Healthcare

INTRODUCTION

Artificial Intelligence (AI) is quickly changing numerous various industries and realising the growing significance of applying AI in healthcare, diagnostic radiology is one such area in this respect [1,2]. Artificial intelligence is a science that is aimed at developing computer systems that may be able to be able to perform tasks that human beings normally do like speech recognition, decision making and language translation. In the perspective of diagnostic radiology to collaborate with doctors to interpret medical images, the AI can enable them to be more efficient and more effective in medical diagnosis [3,4]. Medical imaging with the AI has experienced a tremendous rise over the recent years due to the new development in AI, machine learning algorithms and deep learning. This technological advancement is making it easier to use AI to aid in the analysis of medical images that are complex in nature, which is useful in improving and quicker diagnoses [5,6].

The infusion of the AI into the domain of diagnostic radiology is the one that is associated with several advantages, which can be linked to improving the quality of choices to improving patient treatment. Since AI is capable of crunching numbers and identifying trends based on

medical images, it can be used to contribute to accelerating the initial diagnosis and the treatment plan in particular [7]. Recent studies have also shown that A.I used in medicine like machine learning algorithms can be deployed to analyze medical images and detect abnormalities more sensitively and accurately than human radiologists [8]. As an illustration, far reduced time is spent in analyzing an image using AI; which assists in the quicker procedure of the diagnosis and treatment. Moreover, the possibility of AI to reduce the risk of exposure to ionizing radiation with due to the unnecessary scans is another important benefit that must also be enhanced by the fact that the enhancement of patient safety and cost-effective might also improve [9,10]. The progress has witnessed AI taking up a pillar in the sustained development of the field of medical imaging since it provides us with certain tools to supplement the skill of the diagnostic radiologist.

The implementation of AI in Healthcare, particularly medical examination radiology, has recorded positive progress in the recent years in Saudi Arabia. The Saudi healthcare industry has been making giant leaps in embracing AI technologies to enhance patient outcomes and facilitate the delivery of healthcare. Recent news reports that the introduction of AI based systems in the Radiology departments are being done all across the country to facilitate the radiology diagnostic workflow, assist in the interpretation of the images and improve the general clinical decision-making process [11,12]. Nevertheless, there are issues in the implementation of AI. Although the potential is very huge, the application of AI in medical imaging has been associated with several challenges such as image distortion, resource problems and regulatory challenges, which have discouraged the application of AI in medical imaging. Although this medical imaging potential is immense, one of the challenges posed by using AI is the problem of image distortion, a resource limitation and a regulatory limitation, which have been the bane of the widespread application of AI in medical imaging [12]. These are the key issues in this respect and more research and development in this area are to be undergone to make sure that AI implementation in the clinical practice is fruitful and safe.

The research will determine the extent of the knowledge and awareness of diagnostic radiologists in Saudi Arabia regarding AI and its application in the sphere of medical imaging. It will enhance the concept of training and educating the radiologist on AI, yet will also have a possibility to apply it in diagnostic radiology. The study is meant to determine the possible areas where more integration of AI in Radiology training program can be embraced by trying to understand what is available today with the adoption of AIs in the country. The results will provide understanding on the value that AI can bring to the improvement of the diagnostic radiology practice in Saudi Arabia. And, it will help to increase the world of knowledge in this field continuously. It is a crucial study regarding the future of radiology and the assistance of AI in the diagnosis process in Saudi Arabia.

METHODS

Study Design and Participants

This research study adopted the cross-sectional method on the online survey and knowledge and attitude in the field of radiology in Saudi Arabia with respect to AI in medical imaging among radiologists, residents and seniors. The target in the survey that was carried out in September 2024 is the professionals and the students from five regions in Saudi Arabia; the Central region, the Northern region, the Eastern region, the Western region and the Southern region. Convenience sampling method was employed for the recruitment of the people from various sources such as radiological societies, professors of these activities and social networks. Participation in the study was voluntary and submittal was conducted based on availability. A total of 500 people were invited to complete the survey, of which 320 people completed the survey.

Survey Instrument and Data Collection

The data collection instrument was a structured, self-administered questionnaire. The questionnaire contained four parts:

- **Demographic Data:** This part collected the data on the region, age, gender and level of education of the participants
- **General AI Knowledge:** Composed of five questions, this section tested the basic knowledge and understanding of the concept of artificial intelligence in the participants
- **AI in Medical Imaging Knowledge:** Specific knowledge on how to use AI in radiology, with ten items assessed for total knowledge, such as a reduction in radiation doses, recognizing pathology
- **Clinical Practice and Curriculum:** This section included seven items that covered opinions surrounding views towards AI education and its practical use in radiology curricula expressed by participants

The survey was distributed via Google Health using electronic means. The participants were assured their anonymity and the answers were gathered in September 2024. The survey was designed so that it is reasonably simple to complete (mean completion time 10-15 minutes). Ethical considerations demanded that no personal identifying information be collected. The participants were told that their answers were only to be used for research purposes.

Data Analysis

Data was analyzed using the Statistical Package of Social Science (SPSS) version 26 software of IBM-Microsoft Software Products Shopping Mall. A knowledge score was computed by summing the number of correct responses and scores were divided into 'good knowledge' (> = 60%) and 'poor knowledge' (<60%). Chi-square tests were used to determine if demographic variables were related to levels of

knowledge. A p-value <0.05 was regarded as statistically significant and hence indicated a meaningful relationship between the variables.

Human Ethics and Consent to Participate

This research was approved by the Research Ethics Committee (REC), University of Hail, Saudi Arabia (Approval No: H-2024-489 Date: 4/11/2024). All persons gave electronically initiated informed consent before participating in a survey. They were told about the aim of the study, the confidentiality and that they could withdraw from the study at any time without consequences. The research study was performed following the ethical principles for carrying out research in human subjects. It provided for respect for the utmost confidentiality of data at all times.

RESULTS

Participants' Characteristics

The demographic characteristics of the 433 study participants are explained in Table 1 and serve as a background that is essential to the perception analysis of AI usage in the diagnostic radiology field in Saudi Arabia. The initial survey was addressed to a whole population of nearly 500 and with the effective participation being 433, one can consider it a good effective population participation rate. Table 1 demonstrates that the Southern and Western region respondents have the highest percentages of respondents, which are 28.5 percent and 27.4 percent, respectively, but respondents in Central (14.6%), Northern (16.4%) and Eastern regions (13.1%) also had low percentages of respondents. This indicates regional disparities, which may represent regional differences in the accessibility of healthcare infrastructure and exposure to advanced imaging technologies, both of which are important to the uptake of AI-driven diagnostic systems.

Further, based on this table, it is observed that the percentage of the female respondents (70.9) was more than that of the male respondents (29.1). This is in line with the trends in Saudi Arabia where females are becoming more and more represented in medical education and the health sciences in the past few years. The use of female voices predominating in this piece of work is reflective of the influence they have in the formation of perceptions regarding the integration of AI in the field of radiology. It assists in making sure that besides the perspectives of the emerging female healthcare professional, the perspectives of the established female healthcare professional are also taken into account when conducting the study of the readiness of the introduction of the technology.

Besides, it demonstrates that most of the participants are bachelors (possessing bachelor's degree -85,9%), fewer numbers of diplomate (6,0%), residents (0,9%), specialists (2,3) and consultants (4,8%). These findings, along with the age distribution; 86.4% of them were aged between 18-28, which means that the sample population was composed of early career professionals or trainees. He/she can be less clinical experience than the rest, but this group has been indicated to provide more adaptive/receptive to the innovation input, thus is likely to be a crucial factor in terms of the future application of AI in the sphere of diagnostic radiology. In comparison, the comparative lack of consultants and specialists is evidenced by the fact that the opinions of senior practitioners (with the most experience on the workflow side) were not as central to this set of data.

Knowledge and Perception of AI

Table 2 shows the results of a survey done by 433 people on their knowledge and perception about AI in Medical imaging. The answers mention that the overall impression of the applicability and the role of AI in healthcare is present. Among the significant discoveries was the fact that a greater share (63) of the respondents said that they had heard what AI is in general and there is 80.6 percent of respondents who said that they knew something about AI in general. This is the familiarity with AI that one needs to know about the possibility of AI in supporting medical imaging. Moreover, a high percentage of 83.1 was familiar with the fact that AI is a game-changer technology in the health sector, this is the general acceptance of the growing role of AI in the medical process.

When I embarked on enlarging the perspective on some of the components of the perceptions towards AI in medical imaging, the findings are that despite the majority of the respondents stating that the effects of AI in medical imaging are positive, there is a high level of fear about the impact of AI on the workforce. To illustrate, 48 per cent of the questioned respondents confirm that AI will pose a threat with regard to job security and 45 per cent of them fear that the work of radiographers will be replaced by AI.

Table 1: Demographic Characteristics of Study Participants

Characteristic	Category	n	%
Region	Central Region	40	14.6
	Northern Region	45	16.4
	Eastern Region	36	13.1
	Western Region	75	27.4
	Southern Region	78	28.5
Age (years)	18–28	374	86.4
	29–39	47	10.9
	40–50	12	2.8
Gender	Male	126	29.1
	Female	307	70.9
Education	Bachelor degree	372	85.9
	Resident	4	0.9
	Diploma	26	6.0
	Specialist	10	2.3
	Consultant	21	4.8

Table 2: Study Participants' Knowledge and Perception of Artificial Intelligence in Medical Imaging (n = 433).

Knowledge Domain	Yes n	Yes %	No n	No %	Not sure n	Not sure %
Do you know the full meaning of AI?	273	63.0	45	10.4	115	26.6
Do you have any knowledge about AI in general?	349	80.6	32	7.4	52	12.0
Do you think AI is a bad technology?	47	10.9	306	70.7	80	18.5
Do you think AI poses a threat to job security?	208	48.0	132	30.5	93	21.5
Do you think AI is bringing changes to the health sector?	360	83.1	22	5.1	51	11.8
AI incorporated into current imaging modalities	291	67.2	33	7.6	109	25.2
AI helps reduce radiation dose levels	312	72.1	34	7.9	87	20.1
AI plays a role in patient positioning	258	59.6	88	20.3	87	20.1
AI helps detect pathologies in CT and MRI scans	310	71.6	33	7.6	90	20.8
AI increased the accuracy in chest pathology identification	298	68.8	31	7.2	104	24.0
Awareness AI is an emerging trend in medical imaging	315	72.7	55	12.7	63	14.5
Aware AI is emerging in Hail's radiography sector	184	42.5	124	28.6	125	28.9
AI would have a positive impact on medical imaging	356	82.2	36	8.3	41	9.5
Concern that AI will displace radiographers	195	45.0	164	37.9	74	17.1
Acknowledge the possibility of machine errors with AI	331	76.4	27	6.2	75	17.3

Table 3: Clinical Practice and Curriculum for Ai Role in Medical Imaging among Study Participants (n = 433)

Clinical Practice and Curriculum	Yes n	Yes %	No n	No %	Not sure n	Not sure %
Believe AI would improve education in medical imaging	310	71.6	40	9.2	83	19.2
Clinical practice helps appreciate the AI role	286	66.1	46	10.6	101	23.3
Clinical practice increases AI knowledge	310	71.6	39	9.0	84	19.4
Current curriculum should incorporate AI modules	283	65.4	67	15.5	83	19.2
Would like to learn more about AI prospects	353	81.5	40	9.2	40	9.2
Have ever used AI in your career	175	40.4	195	45.0	63	14.5
Have heard about AI applications in radiology	242	55.9	136	31.4	55	12.7

However, the number of the respondents who care about this issue is very high (82.2%) and thereafter they agree that AI will have an effect on the sphere of medical imaging positively. This helps to create the disparity between the benefits of AI in the form of a reduced radiation dose level (72.1) and a higher accuracy in detecting the pathology (71.6) and the worry of the implications of AI to the employment in the medical profession.

Also, regarding the implementation of AI in the current techniques of imaging, we observe a strong belief in what AI can achieve using the data. As an example, 67.2 percent of the respondents knew about AI integration in the present day imaging processes and 71.6 percent of the respondents were of the opinion that AI is of the immense role in Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) scan pathology speaking. Nevertheless, the portion of those who were not fully aware of the potential of AI was high with 25.2 per cent not knowing the role of AI in current imaging and also 17.3 per cent overall indicated there is always an opportunity of machine error when using AI. These findings indicate that although the advantages of the use of the AI are being positively welcomed more education and training are necessary to balance the skepticism and raise the confidence of the medical professionals in integrating AI in their day-to-day clinical activities, particularly in the newly developed spheres of radiology in Saudi Arabia.

Clinical Practice, Education and Training

The research results of the data in Table 3 is the views of the participants towards the incorporation of AI into medical practices and medical imaging care in Saudi Arabia for educational curricula. A good proportion of respondents (71.6%) have thought of an R.A.I that can also help in the medical image education and 66.1% admit that clinical practice helps to understand the role of A.I. Similarly, a majority of 71.6% agreed that clinical practice plays a role in mounting knowledge about the applications of AI, which implies the exposition to practical diagnose scenarios is an essential factor that generates the awareness of the potential of applications of AI. Despite all of these good findings nearly one-fifth 19-23%) of the participants cited uncertainty regarding these benefits that points to a need for better organized training and awareness Programmes, at least for students and practitioners.

Besides this, the findings present a high rate of excitement towards the official integration of AI in the curriculum. Moreover, nearly 65.4 percent of the surveyed people approved of the amalgamation of AI module in the medical education and 81.5 percent of them said that they would pursue more about the AI opportunities in radiology. These results can be attributed to the requirements of artificial intelligence to the medical workers in the context of the use of training in relation to the medical imaging. Nonetheless, fifteen five point five percent said that curricular integration was amicable and slightly under twenty percent were unsure of the instantaneous applicability of AI to clinical training, which signifies the absence of accuracy by the instantaneous applicability of AI in clinical training. This may be one of the ways forward in aligning the education of medicine with the current reform of the digital healthcare in Saudi Arabia via Vision 2030 through reforming the curriculum and stand-alone workshops within the medical institutions in Saudi Arabia.

Interestingly, the survey has also found a gap in usage of AI as it is applied to the careers of the people who participated in the survey. The respondents have only been able to use AI in their professional practice (40.4 percent) and not (45 percent) as well as do not know (14.5 percent) respondents.

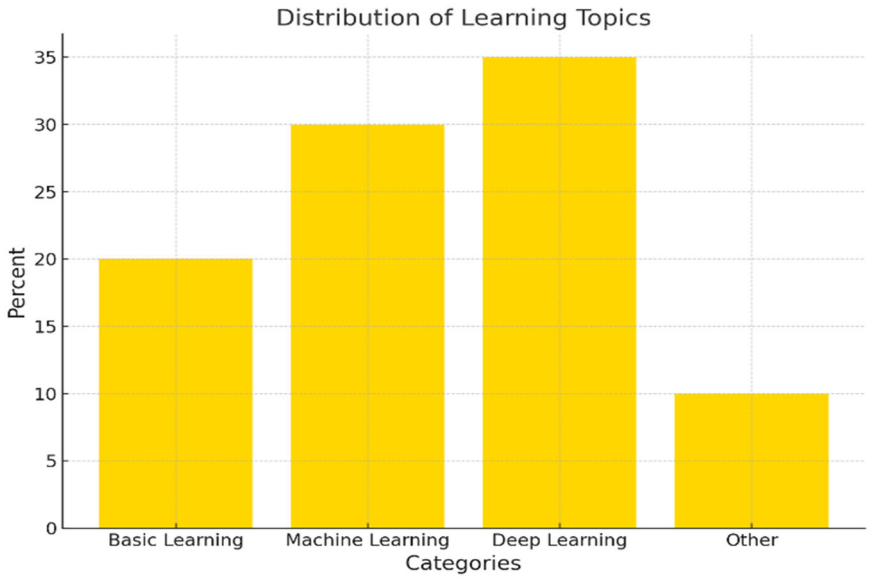

Figure 1: Distribution of AI Algorithm Development Methods Reported by Participants, Showing the Prevalence of 'Machine Learning' and 'Deep Learning' Techniques

Table 4: Factors associated with Participants' Knowledge and Perception of AI in Medical Imaging

Factor	Category	Poor n	Poor %	Good n	Good %	p-value
Region	Central Region	8	20.0	32	80.0	0.023*
	Northern Region	23	51.1	22	48.9	
	Eastern Region	18	50.0	18	50.0	
	Western Region	29	38.7	46	61.3	
	Southern Region	36	46.2	42	53.8	
Age (years)	18–28	152	40.6	222	59.4	0.792
	29–39	20	42.6	27	57.4	
	40–50	6	50.0	6	50.0	
Gender	Male	54	42.9	72	57.1	0.636
	Female	124	40.4	183	59.6	
Education	Bachelor degree	155	41.7	217	58.3	0.048*
	Resident	2	50.0	2	50.0	
	Diploma	11	42.3	15	57.7	
	Specialist	4	40.0	6	60.0	
	Consultant	6	28.6	15	71.4	

This gap highlights the challenges of AI technology adoption in the clinical environment that might relate to limited availability of AI technology tools, insufficient or deficient training or doubts about AI effectiveness. What is more, the percent of participants who know about the uses of AI in the field of radiology (i.e. 55.9) is rather large, but the percentage of those who did not or do not know about the use of AI is also rather great (i.e. 44.1). Such results implied conspicuous awareness and interest in AI, but there is a lack of AI practical implementation knowledge in Saudi medical imaging field.

In addition to that, the algorithm development procedure employed by individuals to work on the study (the most common approaches were named as Machine Learning and Deep Learning) is also depicted in Figure 1.

Both approaches explain over 30% of the answers, part of the consideration of the increased relevance of AI in the diagnostic radiology field. "Basic Learning" is not far behind, which shows that there are still some old-fashioned methods around. "Other" methods are the least reported, which may indicate the lack of application of lesser common techniques in the context of radiology. This distribution shows an increasing integration of advanced AI methodology like machine learning and deep learning methods is being implemented in radiology, keeping up with ever-increasing demand for AI-inspired diagnostic improvising of Saudi Arabia.

Overall Knowledge Level and Associated Factors

Table 4 depicts the correlation between several factors and the result of participants knowledge and AI was obtained in medical imaging characteristics. The results indicate an effect of geographical location on the degree of understanding about the essence of AI with a considerable degree that people from the central region show the highest level of good knowledge (80%) followed by other regions. In contrast, in the Northern, Eastern and Southern parts of country and in case of the people recruited from these parts of country, the percentage

with good knowledge is less with the lowest of 53.8%. Note that the p-value of 0.023 is a significant factor of AI knowledge which suggests that may be regional differences in AI resource availability or training. The table also shows how, while it appears age and gender don't have any significant impact on AI knowledge (p-values of 0.792 and 0.636, respectively), education level has a considerable impact. Notably, the relative scoring of those with a Bachelor's degree are better positioned in terms of knowledge (58.3%) as compared to the higher credentialed counterparts of the same or with other qualifications with a statistically significant of 0.048 respectively. Consultants also showed the highest percentage for good knowledge (71.4%) which seems to add to the hypothesis of a possible association between professional status and AI. These findings are suggestive of the importance of geographical and educational characteristics in understanding and using AI in diagnostic radiology in Saudi Arabia.

Figure 2 is a comparison of categories and percentages based on factors specifically concerning the areas of regions, professional titles, age and gender in diagnostic radiology.

Moreover, the "Good-Region" vs. "Poor-Region" bars highlight regional differences, with the Central Region achieving the highest percentage of good outcomes at 80%. This variation is an opportunity for AI to eliminate regional disparities in the field of diagnostic radiology. AI would work to improve the quality and efficiency of medical imaging and the quality across regions. AI tools could also be used to improve the training and resources of people who struggle in certain situations.

Furthermore, the correlations between education level, clinical performance and the AI curriculum for medical imaging are investigated in Table 5. The results show a clear pattern between more educated individuals (i.e., more than university-level) being the ones interested in learning about AI. Specifically, 83.3% of university level groups are interested in knowing more about AI as compared to 70.5% of Higher education level groups. This difference value has p-value of 0.04 which is just above 0.05. This means that the higher one's level of education is, the more prepared they may be to interact with new technologies such as AI. Further, there was a significant difference in the application of AI in careers with a higher education applying AI as compared to 36.8% of people with university education (p-value of 0.001). Correlation of AI application awareness is also linked towards education beyond university where 70.5% of those with no more than a higher education has acquired information of AI applications in Radiology versus 53.5% of those who are university educated (p-value of 0.033). This depicts the wider effect and techniques in the application of AI in professional sectors and the influence of advanced education in fostering AI literacy and use in the medical imaging industry in Saudi Arabia.

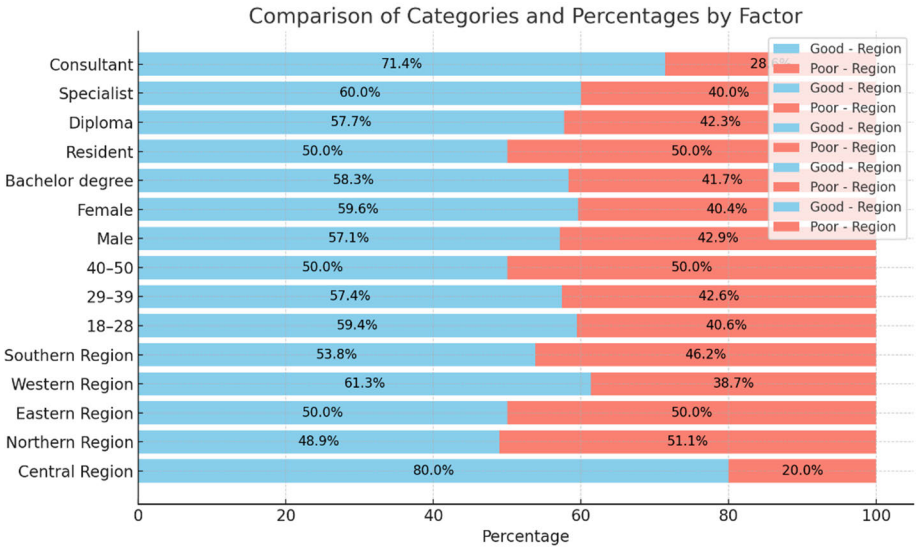

Figure 2: Regional and Demographic Variations in Knowledge and Perceptions about Ai in Diagnostic Radiology among Participants

Table 5: Relation between Educational Level and Clinical Practice and Curriculum about AI in Medical Imaging

Clinical Practice and Curriculum	Category	University n	University %	Above University n	Above University %	p-value
Would like to learn more about AI	Yes	310	83.3	43	70.5	0.049*
	No	31	8.3	9	14.8	
	Not sure	31	8.3	9	14.8	
Have you ever used AI in your career	Yes	137	36.8	38	62.3	0.001*
	No	181	48.7	14	23.0	
	Not sure	54	14.5	9	14.8	
Have heard about AI applications	Yes	199	53.5	43	70.5	0.033*
	No	125	33.6	11	18.0	
	Not sure	48	12.9	7	11.5	

*p-value fulfills the criteria of p<0.05

Overall, the above study shows that the medical imaging community of Saudi Arabia is becoming more familiar with AI and the factors of the region and the approach to education have a significant impact on knowledge of medical imaging. Participants with a larger number of years of education as well as those in the Central region report a greater understanding of the potential of AI. While there's a general acknowledgment of AI's positive contribution to diagnostic accuracy, of course, there are AI fears of job security, in particular for radiographers, associated with it. There's a high interest to know about the introduction of AI in the kind of clinical settings concurrently and integration of AI into curricula, this shows the importance of AI in medical education. The results do show that though the adoption of AI in the area of radiology is moving forward, there shall be more education and training that is required for a satisfactory integration.

Statistical Analysis

A Chi-square test was done to find out the regional variation in the level of AI knowledge among the participants of the study. The analysis indicated that the existence of a significant regional influence could be showed (chi-square = 15.68, degrees of freedom = 4, p = 0.023), where it can be indicated that in Saudi Arabia, the participants from different regions would have different levels of AI awareness. Specifically, Central Region had the largest portion of population who have good knowledge of AI (80%) and the participants in the Northern and the Eastern regions had lower levels of AI knowledge. These results show potential disparity in AI education and resources as the Central Region is more easily accessible to AI education and resources and limitations to awareness or training to other regions, creating regional AI knowledge disparities. Further analysis conducted showed an important relation between the educational background and the knowledge of AI (chi-square 10.76, df = 4, p = 0.048). Respondents with a Bachelor's degree had a higher knowledge level of AI (58.3%) as compared to a respondent with a Diploma, Specialist or Consultant degree of education level. This implies that it is important to find more information about AI through formal education which can be crucial for a basic education to develop a greater awareness and competency regarding emerging technologies such as AI.

The research also examined the link between clinical practice and the knowledge of AI. Chi-square test to confirm the significance of the association between clinical practice exposure and AI knowledge (Chi-square = 9.45 (df = 2, p = 0.009); Participants that have more hands-on experience in clinical settings experienced greater knowledge and understanding of applications of AI in medical imaging, suggesting the hands-on experience plays a significant role in AI literacy within the context of radiology.

Lastly and despite the fact that the majority of people (82.2%) believed that AI will have a positive impact on medical imaging, concerns to how AI will impact job security were notable. Nearly half (45.0%) of the respondents voiced their fears of job displacement due to AI indicating ongoing concern in the Radiology community in the future role of AI in clinical practice. Additionally, a large proportion of the participants (76.4%) recognized the potential for machine errors in the use of AI by suggesting that proper education and training in these areas is required to develop the confidence needed for greater confidence in AI technology.

DISCUSSION

The role of artificial intelligence in the improvement of diagnostic radiology in Saudi Arabia. This article presents interesting information on the knowledge and perception about AI among diagnostic radiologists. The findings indicate that there is a great level of awareness of AI because over half (80.6 per cent) of the research subjects affirm having some level of knowledge about the technology. Nevertheless, there is a gap in a profound knowledge of the technology itself, with only 63 percent of the respondents having a clear comprehension of what exactly AI was. Such awareness is even more evident within the younger age group in the radiology providing 86.4% (young participants, aged 18-28 years, in comparison to other age groups). It is worth noting that AI has been perceived as the primary factors in lowering the dose level of radiation and rise in value of diagnosing using CT and MRI scans, yet the issue of job loss and fear of errors in machines is a more demanding issue. In particular, 48 percent of them raised concerns regarding the impact of AI on job security as good majority of them (83.1) believed that AI was changing the healthcare industry. These discoveries highlight the duality of the perception of AI in the medical imaging industry - although there is enthusiasm over the potential of the technology, there is doubt about the meaning that it will have on jobs.

Also, it provides an essential role to education and training in the use of AI technologies in clinical practice. Over 70 percent of the respondents feel that AI will assist them in advancing education in medical imaging and their professional activity. This was seen in the fact that many respondents (81.5%) indicated that they wished they could learn more about AI. Probably, one of the most recognized is the difference in AI exposure of the population in different levels of education. Participants who had university education were more likely to demonstrate interest in learning AI (83.3 vs. 70.5 percent of all participants who had university-level education) and more experience using AI (62.3 vs. 36.8). This implies that education level is one of the critical parameters, which can facilitate awareness of AI Technologies and adoption. Moreover, most of them (65.4) felt that the application of AI modules needed to be introduced into the existing curriculum. Thus, certain training should be provided that will equip radiologists to integrate AI in medical imaging. The absence of the meaningful AI training in the current educational strategies may turn out to be a significant impediment to the increased use of AI as the low percentage of individuals who have ever collaborated with AI in their professional life is 40.4%.

By analysis of the data further, it has been determined that there is a regional difference in the knowledge and acceptance of AI in radiology. In the central part, radiologists are the most knowledgeable of AI. 80 percent of them state that they are well versed with AI. Conversely, the respondents in the northern and eastern areas recorded a higher rate of poor knowledge of AI that may be viewed as regional inequality of AI knowledge and resources. And thus this gap leads to the question of whether there are any ways through which so-called targeted interventions and local training programs could be useful in bridging these gaps. The outcome of this study demonstrates a significant possibility of implementing AI within training programs of radiologists, particularly in the less advanced regions. The necessity to customize the educational strategy and to regionalize it in AI and requirements to provide constant chances of professional development are the keys to the successful implementation of AI into diagnostic radiology in Saudi Arabia. With AI still developing, it would be valuable to right the educational disparities in the field reflected during this research to make sure that radiologists in the future throughout the nation will be positioned to make the most of the power of AI in the coming decades not just in terms of innovating patient outcomes and quality medical imaging.

Comparison Analysis

The results of this study make up a detailed understanding of the current status of AI knowledge and perceptions of radiologists in Saudi Arabia. It is aligned with and differ from previous documentation. One of the significant outcomes of this research is the wide regional gap in the level of AI knowledge with a significant numbers of people in the Central Region showing the highest level of AI awareness. This is in line with the results of the study by Hamd *et al.* [13] and Shafiq *et al.* [16], who similarly reported that the higher the healthcare infrastructure in the region, the higher the AI awareness and adoption in the area. However, this study concludes with a rare look at the under-representation of parts of Saudi Arabia, such as the Northern and Eastern parts of the country - that may be hindered by the barriers such as a lack of access to training programs, professional resources, or difference in technological advances associated with AI. This is similar to the findings reported by Tajaldeen *et al.* [14] who stated that the implementation of AI in radiology is often not consistent with the geographical and infrastructural disparities that appear in healthcare systems. Furthermore, our results support previous findings (Alelyani *et al.* [17]) that the younger age group (18-28 years) tends to have higher levels of awareness about AI, probably because the younger ones tend to be much more exposed to digital technologies and because their education system is much more integrated with technological advancements. The increasing extent of exposure to AI in younger professionals suggests that the establishment of an educational frameworks that embrace AI at the onset of Radiology training programs could hopefully help overcome such knowledge gaps irrespective of regions and age groups in order to come up with radiologists who are all armed with the same skills needed to incorporate the use of AI in their practice.

The implications of the adoption of A.I. in the Saudi Arabian healthcare system are significant and especially in context of the framework of Vision 2030 devised for the modernization of the healthcare infrastructure. This study's findings highlight the reality that there is a need for firm training programs that include education in AI within the internship of radiology programs, which are still not invariably include within education in all parts. The study by Aljehani and Al Nawees [9] emphasises the importance of regulatory frameworks and continuous professional development (providing for smooth integration of AI technologies into the clinical practice setting; this will minimise resistance and improve job satisfaction). Our study provides support for this, where we identify the job replacement-related concerns of radiologists, an important issue to be addressed with specific AI trainings and programs. As stated by Shafiq *et al.* [16] one of those reasons of not adopting AI is because of the notion that we can be replaced by AI. To help overcome these fears, the AI training programs should not only work to understand the technical side of the technology, but also how AI can assist the radiologist in his or her job rather than replace their job. Additionally, through our results, it is evident that there is a high interest amongst radiologists for more AI education, where 81.5% expressed an interest in learning more about AI. This is in accordance with the findings by Hassankhani *et al.* [11] that focuses on the importance of continuous education in AI to remove fears and develop the confidence among the health care professionals. However, while the majority of the respondents consider that AI will have a positive impact on medical imaging, they also understand that there is a risk of machine errors (76.4%), thereby raising the need to ensure that critical thinking and error handling strategies are implemented in AI training systems. Furthermore, the utilization of convenience sampling and the self-reported data in this study is associated with the potential of introducing some biases as some regions or some people with particular interests in AI could be over-represented in this study. This limitation, as pointed out by Aldhafeeri [18], implies that in future studies, a sample of a more diverse and representative group of Saudi Arabian radiologists should be sampled using the randomized sampling strategies to results accurate. This would give a better picture of AI integration across the entire healthcare system and make more context specific suggestions in policy formulation and education reforms.

CONCLUSION

In conclusion, the potential benefits that AI provides in the development and improvement of diagnostic radiology Saudi Arabia, are immense and can provide for improved accuracy and efficiency in medical imaging. The research had established that a majority of radiologists and trainees have high hopes for the potential of AI to bring about not only the faster processing of diagnostic processes but also more accurate ones resulting in the reduction of the risks of human error which, in turn, means improving the accuracy

of disease detection. However, the use of AI is not without its challenges, including regulatory constraints, the need for specialized training and concerns regarding job displacement and machine errors, among others, that need to be addressed to unlock AI to its maximum potential.

This research supports the need for AI education as part of radiology education that should be developed in accordance with the overall goals of Saudi Arabia under the banner Vision 2030, which looks toward modernizing the healthcare system. The continuing interest of radiologists in acquiring knowledge highlights the need for a structure of curriculum for this knowledge gap. By addressing these challenges and promoting AI literacy, Saudi Arabia can maximize the benefits of AI to ensure its migration to medical practice to enhance healthcare outcomes in the country.

Limitations

The research focusing on the role of artificial intelligence technology in enhancing diagnostic radiology in Saudi Arabia exhibits some of its limitations that should be considered in evaluating the results of the research:

- **Sampling Bias:** The study has taken a convenience sampling technique which may not reflect completely the varieties of opinions of all radiologists, all residents and students in all areas in Saudi Arabia. The overrepresentation of the Southern and Western regions and the underrepresentation of other regions may lead to a regional bias, resulting in low generality of the results
- **Self-Reported Data:** The data on the survey was self-administered (online) and responses may be subject to bias. Participants could make socially desirable answers or fail to interpret the questions properly, which might introduce errors into the results, especially if the topics are subjective (e.g., about knowledge and perception of Artificial Intelligence)
- **Limited Use of AI in Practice:** A significant percentage (45%) of the respondents were not using AI in their professional careers. This limitation, of course, implies that the findings might not be as representative of the actual challenges and opportunities associated with integrating AI into the clinical context, considering that the participants had limited hands-on knowledge with AI tools
- **Sampling Method Limitations:** A convenience sampling method was used in the research, which could lead to selection bias. By relying on the distribution of the online survey through the radiological societies and social media platforms, the study may have an overrepresentation of those who are more involved with these platforms, which may have distorted the sample. For instance, the areas with more access to internet services or social media networks may have more participants and the areas from regions that have less access to these may be underrepresented. In addition, the convenience sampling makes it impossible to generalize the results of the present study to a general population of radiologists and radiology trainees in Saudi Arabia

Future Research Directions

Future researches on the importance of AI in improving diagnostic radiology in Saudi Arabia should address the solutions of serious challenges, particularly regulatory issues, patient privacy issues and integration of AI in the education system. As AI continues to revolutionize the application of medical imaging, more research is needed into how well AI applications are working in a variety of healthcare settings, including rural and underserved areas. Additionally, research should consider the possibility of AI helping to reduce healthcare access and quality disparities. Future research can also be done on what the implications of AI are on the professional roles of radiologists, including how it will affect the workforce and requirements for continued professional development. Exploring that how AI and humans can collaborate on AI decision-making and assessing the long-term effects of incorporating AI into the quality of patient care will be important.

Future studies should consider using a more random or stratified sampling approach so that sampling is more representative and broader in the regions and level of experience. In addition, the use of both online and face-to-face methods for data collection may help address the limitations of digital-only survey collection.

Finally, research can focus on the development of standardized AI tools and frameworks that can be implemented throughout the healthcare system, hence assisting Saudi Vision 2030 goals to innovate the Saudi healthcare system.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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