Original Article

A Cross-Sectional Survey On An Insight Into The Current Perceptions Of Indian Radiologists, Radiographers, Radiology Trainee & Medical Imaging Students On The Future Impact Of Artificial Intelligence (AI) On The Profession

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Objective: This study will help in assessing the knowledge and perception of Radiologists, radiographers, trainees, and Medical imaging students about artificial intelligence.

Background: An AI is a machine that has been developed to mimic human intelligence in its thinking and behavior. This term can also be applied to any machine that demonstrates cognitive abilities like learning and problem-solving. Artificial intelligence is at its best when it can evaluate alternative courses of action and select the one that offers the greatest probability of success in reaching a given objective

Method: A questionnaire was prepared and circulated through google Forms to Radiologists, radiographers, trainees, and Medical imaging students about artificial intelligence. A total of 268 participants took part in this research.

Conclusions: In conclusion, study respondents were generally optimistic about AI. The future will depend on what we do now and shortly to take advantage of AI's many prospects for radiology, radiology residents, radiology techs, and trainees. AI will affect radiology faster than other medical areas. Residents and technologists may spearhead this shift. Radiologists' reluctance to adopt AI may be paralleled by pilots' early resistance to autopilot technology. Radiologists are acclimated to technological problems since radiology has always been a technology testing ground. Residents and technologists don't need to know the deepest aspects of these systems, but they must understand the data scientists' technical terminology to communicate effectively. Radiology needs AI immediately.

Keywords: Artificial intelligence, Radiology, Radiographers, Radiologists, Patient care

Introduction

An AI is a machine that has been developed to mimic human intelligence in its thinking and behavior. This term can also be applied to any machine that demonstrates cognitive abilities like learning and problem-solving. Artificial intelligence is at its best when it can evaluate alternative courses of action and select the one that offers the greatest probability of success in reaching a given objective. The term "machine learning" (ML) is used to describe the field of AI that is based on the idea that machines can learn and adapt to new information without any human intervention. By taking in vast volumes of unstructured data, deep learning methods make it possible for machines to learn on their own. Artificial intelligence (AI) is the process wherein machines are given a task that would normally need human intelligence (AI). The purpose of artificial intelligence is to improve computer-based processes including learning, reasoning, and perceiving. Today, artificial intelligence (AI) is applied in many different fields, from the financial sector to the medical field. When compared to strong AI, which can execute complex and human-like activities, weak AI is simple and narrowly focused. Others worry about the potential negative consequences of the broad deployment of powerful AI.

Mathematicians and philosophers were inspired to wonder how far artificial intelligence could go with the development of the first programmable digital computer in the 1940s. Do you think machines could eventually learn to think? How close do you think artificial capabilities could get to human ones? The phrase "artificial intelligence" (AI)[1] was first used during a conference in 1956 at Dartmouth College, where these topics were discussed. A dash for the finish line had begun.

For the next 60 years, interest in AI ebbed and flowed, but it has recently resurged thanks to the emergence of cheap, powerful parallel computers. The term "deep learning" was introduced into the AI lexicon to describe the ability to take advantage of increased processing power to create more advanced AI methods involving multiple layers of analysis. AI systems produced by IBM (Armonk, New York) in chess and the quiz show Jeopardy! (Deep Blue) and by Google (Mountain View, California) in the game of Go brought public attention to the field and its promise (DeepMind)[2].

Artificial intelligence (AI) technology has been adopted by major organizations and governments around the world as a key strategy for dealing with the massive volumes of digital data being generated in the information age, the age of "big data." The field of medicine is likewise on the cusp of incorporating AI. Journal publication rates are rising, and the current trickle will soon become a deluge.

The field of radiology has been instrumental in bringing medicine into the digital age, and it now has a unique opportunity to take the lead in investigating the potential medical uses of artificial intelligence. As an example of "big data," the tens of millions of radiology reports and billions of photos that are now saved digitally provide the necessary substrate for artificial intelligence research.

The primary concern is whether or not the use of AI in radiology can improve patient care. Improving patient outcomes while reducing healthcare costs is a primary goal of imaging, and adding value to the process involves discovering new knowledge and extracting more and better information from imaging examinations. Establishing more effective procedures and raising levels of job satisfaction are examples of value addition by radiologists.

Artificial Intelligence (AI) & its Types

Artificial intelligence can be divided into two different categories: weak and strong.

A single-purpose system is an example of weak artificial intelligence. Video games like chess, and digital assistants like Alexa and Siri, are examples of weak AI systems. If you have a query, you can pose it to the helper and get an answer.

Systems with a high level of artificial intelligence can complete activities that humans are often able to do with relative ease. Most of the time, these systems are more challenging and sophisticated. They have been trained to handle scenarios in which they must find answers to issues independently, without help from a human. Vehicles that drive themselves and surgical suites both make use of similar technologies.

Artificial intelligence healthcare

Improvements in clinical efficiency and effectiveness have been the key motivators for the development of AI in medical imaging. As the amount of radiological imaging data grows at a faster rate than the number of qualified readers, healthcare providers have had to compensate by raising productivity[3] in light of the decrease in imaging reimbursements. The workloads of radiologists have ballooned as a result of these causes. Research indicates that for a radiologist to achieve workload demands, they must interpret an image every 3-4 seconds during a standard 8-hour shift [4]. Since radiology requires visual perception and decision-making under uncertainty[5], mistakes are unavoidable, especially in such a time- and resource-constrained environment.

With an AI component built into the imaging workflow, efficiency, accuracy, and throughput can all be significantly increased with little to no additional effort on the part of trained radiologists thanks to the provision of pre-screened images and detected features. As a result, many people and organizations are working to develop artificial intelligence in medical imaging. Calculating and evaluating radiographic features from pictures is essential for nearly all image-based radiology tasks. When it comes to clinical tasks like disease diagnosis, characterization, or monitoring, these features may prove useful. Since the 1960s, [6, 7] numerous proposals have been made to apply logic and statistical pattern recognition to medical problems. Since the advent of personal computers in the 1980s, artificial intelligence (AI) has been used to automate numerous clinical procedures, transforming radiology from a perceptually subjective trade into a quantitatively computable realm, as shown in Examples [8,9]. As with other application domains, the tremendous expansion of both data and computer capacity is driving the rapid advancement of AI in radiology.

In the field of artificial intelligence, two main categories of approaches are now employed. In the first method, mathematically specified manufactured traits (such as tumor texture) are used, allowing for their quantification in computer programs[10]. Modern machine learning models are fed these features to better categorize patients for use in clinical decision-making. Despite their reputation for discriminative power, features that rely on expert definition are not always the best choice when it comes to quantifying features for use in discriminating tasks. In addition, the signal-to-noise ratio and other imaging-specific parameters might vary widely across imaging modalities, making it difficult for predefined features to account for these differences.

In recent years, there has been a lot of interest in the second approach, which is called deep learning. Without the requirement for manual specification by domain experts, deep learning algorithms can autonomously learn feature representations from data. With this data-driven method, features may be defined more abstractly, leading to improved clarity and scalability. This means that phenotypic properties of human tissues[11 can] be automatically quantified by deep learning, which holds great promise for enhancing diagnosis and therapeutic care. The time and effort spent on manual pre-processing processes are reduced because of too-deep learning. As an example, precise segmentation of sick tissues by experts is sometimes required to extract present features[12]. With sufficient training data, deep learning can replace the need for expert-defined segmentations by autonomously identifying sick tissues. Because of its versatility and its capacity to learn complex data representations, deep learning has many potential applications in the medical field. For instance, it is typically robust against undesirable variances, such as inter-reader variability. Deep learning has the potential to do many of the same tasks

as a professional radiologist, including the identification of image features and the weighting of the value of these parameters depending on other variables to arrive at a clinical conclusion.

Several studies have compared deep learning approaches to their present feature-based equivalents and observed large performance increases with deep learning [14, 15] as a result of the increasing number of applications of deep learning in medical imaging [13]. Research has revealed that deep learning systems can detect[16,17] and segment in ultrasonography and MRI at the same level of accuracy as human radiologists. Deep learning performed better than radiologists[18] on the sensitivity of lymph node metastasis classification tests in PET-CT, but worse on the specificity. As these techniques are further developed and fine-tuned, a firmer grasp on the sensitivity versus specificity trade-off is anticipated. Since deep learning doesn't require any knowledge of the target domain beyond that which is inherent in the data and its associated metadata, it can speed up development cycles. However, conventional predefined feature systems' performance has leveled off in recent years, meaning they no longer reliably fulfill the essential conditions for clinical utility. That's why only a select few, like number [19], have made it into actual clinical practice. In the not-too-distant future, high-performance deep learning approaches are predicted to be able to cross the clinical utility threshold, allowing for their rapid translation into the clinic.

Objective of study

This study will help in assessing the knowledge and perception of Radiologists, radiographers, trainees, and Medical imaging students about artificial intelligence.

Methodology

We conducted A cross-sectional quantitative study type on “an insight into the current perceptions of Indian Radiologists, Radiographers, Radiology Trainee & Medical Imaging Students on the future impact of Artificial intelligence (AI) on the profession” and collected responses from 268 participants by google form in from 1 August 2022. To 15 September 2022. We shared this google form with radiologists, radiographers, trainees, and medical imaging students working in the radiology department. The study was carried out in multiple hospitals and colleges in India. The questionnaire was self-structured. The questionnaire related to the basic information of the participant, knowledge of the participant about AI, the impact of AI, patient care, and overall perception of a participant regarding Artificial Intelligence in Radio-diagnosis and imaging was in the form of multiple choice. The responses given by the participants are their own. The questionnaire was self-structured. The questionnaire used in the survey included 20 multiple-choice questions. The details of questionnaire details are shown in Table 1.

Sample size: 268

Inclusion criteria:

- ✓ Radiologists
- ✓ Radiographers
- ✓ Trainee’s in Radiology
- ✓ Medical imaging students

Exclusion criteria:

People working other than the radiology department.

Statistical analysis

To generate graphs and tables for analysis, we used Microsoft Office 2021. The results were interpreted using descriptive statistics including means, frequencies, and percentages.

Table 1: Questionnaire questions and answers

Questions	Answers
1. Gender	a) Male b) Female c) Other
2. Age	a) 18-25 b) 26-30 c) 31-35 d) 36-40 e) Above 40
3. Qualification	a) PG Radio-Diagnosis & Imaging b) M.Sc.- Medical Imaging Technology c) B.sc Medical Imaging Technology d) Diploma in Radiography
4. Job Description	a) Radiologist b) Radiographer c) Trainee d) Student
5. Do you know about Artificial intelligence?	a) Yes b) No c) May be
6. Did you ever attend any workshops on artificial intelligence?	a) Yes b) No
7. Does your hospital or institute use AI services in clinical practices?	a) Yes b) No
8. In which of the following fields do you think there is a need for AI?	a) MRI imaging b) CT scanning c) PET scanning d) X-ray imaging e) Mammography f) PACS system
9. Do you think, the use of AI will improve efficiency and accuracy in radiology?	a) Yes b) No c) Difficult to say
10. Do you think AI will boost patient care in Radiology?	a) Yes b) No c) May be
11. Do you think in future the AI will be used for making a diagnosis?	a) Yes b) No c) May be
12. In the future do you think patients generally acknowledge a report from AI applications without management and endorsement by a doctor?	a) Yes b) No c) Difficult to say

13. Do you think AI will affect and replace human manpower in the future?	a) Yes b) No c) May be
14. Do radiologists, or radiographers have any concerns regarding losing jobs?	a) Yes b) No c) Difficult to say
15. Do, you think AI will have a better ability to diagnose than human radiologists?	a) Yes b) No c) May be
16. Do you think, AI will improve the cost-benefit ratio for the patients?	a) Yes b) No c) May be
17. Do you think people will accept the diagnosis from an AI machine?	a) Yes b) No c) May be
18. Do you think patients will be satisfied if their exam will be performed by AI?	a) Yes b) No c) May be
19. Will you recommend the use of AI in all workplaces in health care?	a) Yes b) No c) May be
20. Do you believe artificial intelligence poses a threat to the radiologist's assistance functions?	a) Yes b) No c) May be

Result and observations

In total, 268 people were asked to fill out questionnaires for the study, and all of their responses were analyzed. The participants were aged 18 to 40 years, most of the participants were males 205 (76.5%), followed by the female participant 62 percentage was (23.1%) and other gender 1 (0.3%).

Table 2: Age distribution of participants

Characteristics	**Frequency % N=268**
18-25	257 (95.89%)
26-30	9 (3.35%)
31-36	1 (0.37 %)
36-40	1 (0.37%)
Above 40	00 (00%)

Table 3: Sex distribution of participants

Sex	
Male	205 (76.5%)
Female	62 (23.1%)
Other	01 (0.3%)

Chart 1: Age distribution of participants

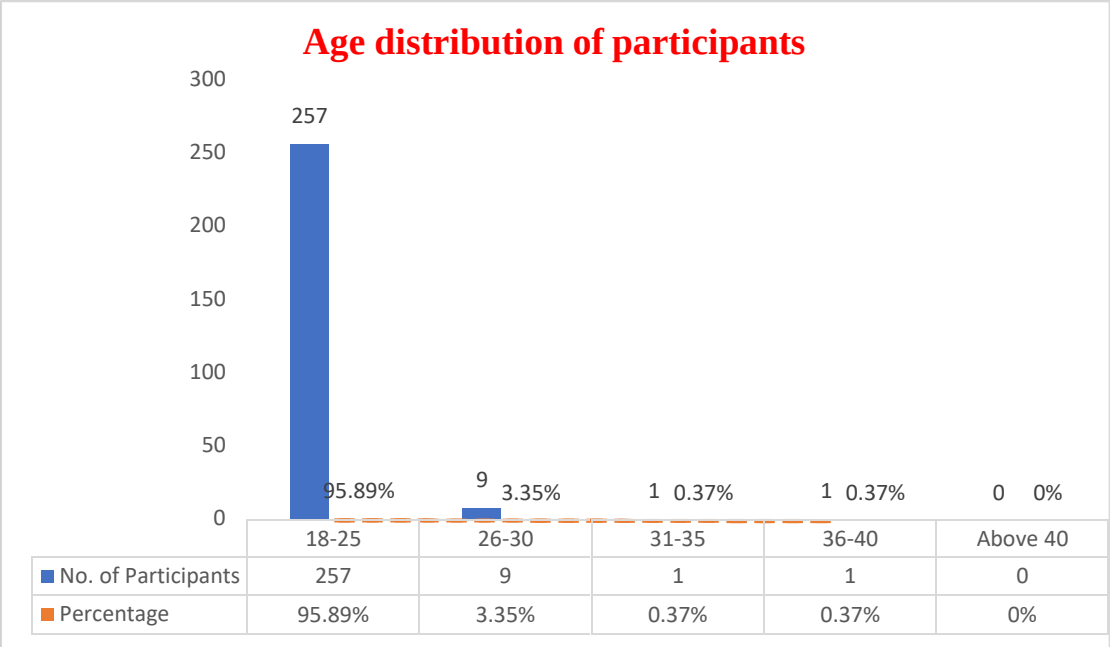
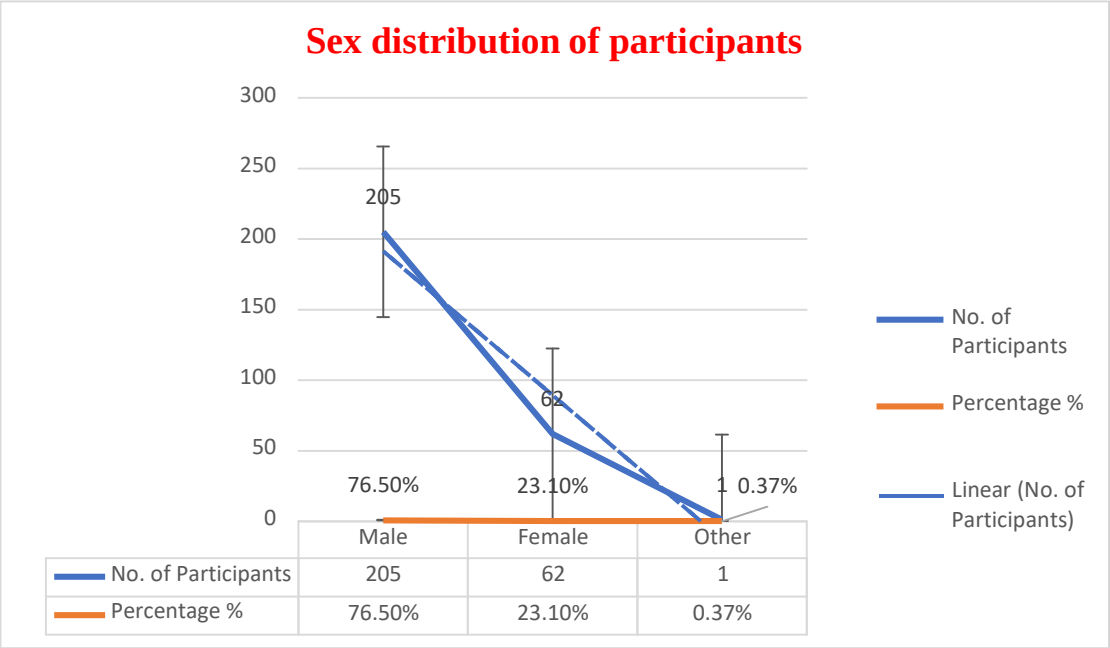
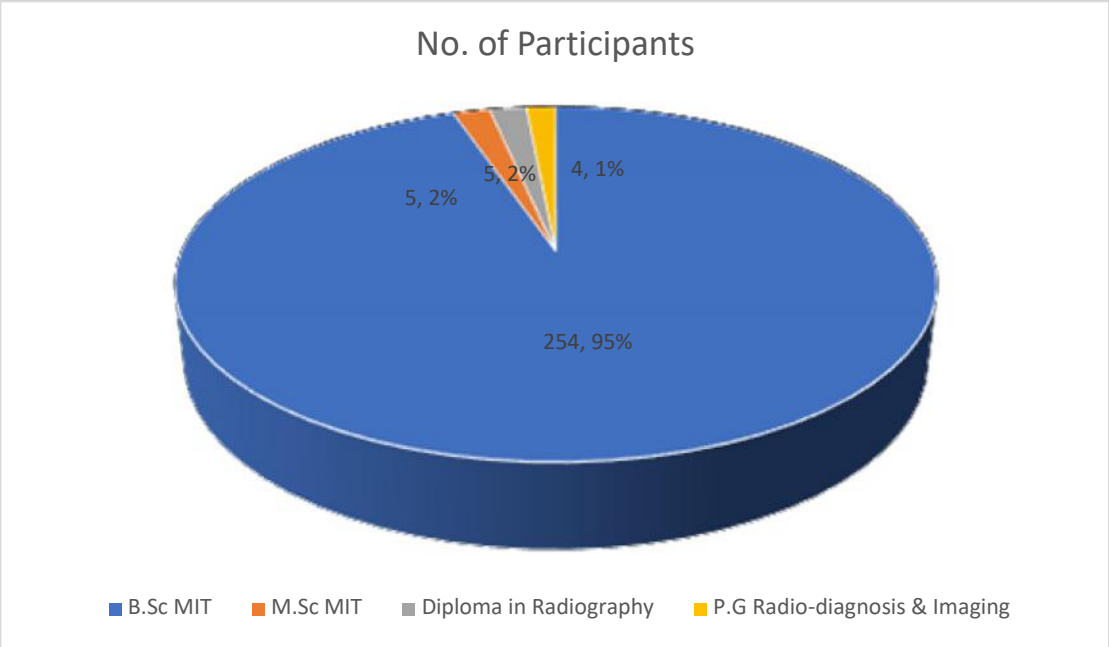


Chart 2: Sex distribution of participants



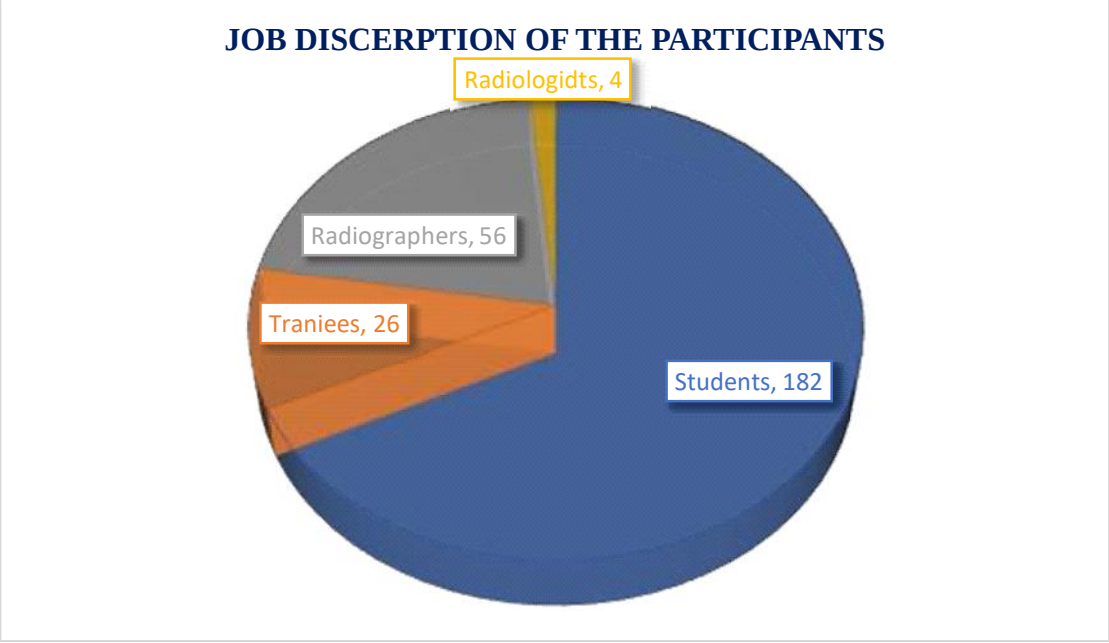
A question was asked about the qualification of the participants and responses were collected and analyzed. Most of the participants involved in this questionnaire have bachelor's degrees in medical imaging technology. Most of the participants are pursuing or completed a Bachelor's degree about 254 (94.77 %) followed by the Master's degree 5 (1.86%) and a Diploma in Radiography about 5 (1.86%) and PG Radio-diagnosis and imaging about 4 (1.49%) as shown in pie chart 1.

Pie chart 1: Shows participants perusing or completing different Courses in Radio-diagnosis and Imaging.



When asked about the job description to the participants involved in the questionnaire most of the participants are students 182 (67.9%) followed by radiographers 56 (20.8 %), trainees 26 (9.7%), and radiologists were 4 (1.4%) shown in Pie-chart 2.

Pie chart 2: Job discerption of the participants



Knowledge of artificial intelligence and workshop attended by participants.

When asked "do you know about artificial intelligence, 46.3% (124) say Yes followed by the participants who say Maybe 28.7 % (77), and 25% (67) says No they do know about AI. In this study, participants said they have good knowledge of artificial intelligence. We asked many questions related to AI, its impact, advantages and disadvantages, and its use in radiography. The question was also asked "did you

ever attend any workshop on Artificial intelligence?" for which the participant's response was received and analyzed: 20.1% (54) participants say Yes and 79.9% (214) say No as shown in table 4 below.

Table 4: Responses of the participants of the questionnaire

Variable	Response (%) n=268
Do you know about Artificial intelligence?	124 (46.3&) = Yes 67 (25%) = No 77 (28.7%) = Maybe
Did you ever attend any workshops on Artificial intelligence?	214 (79.9%) = No 54 (20.1%) = Yes
Does your hospital or institute use AI services in clinical practices?	128 (47.8%) = Yes 140 (52.2%) =No
In which of the following fields do you think there is a need for AI?	120 (44.4 %) = Mri Imaging 42 (15.7%) =Ct scanning 21 (7.8 %) = PET scanning 52 (19.4%) = X-ray imaging 21 (7.8%) = PACS system 12 (4.5 %) = Mammography
Do you think, the use of AI will improve the efficiency and accuracy in radiology?	190 (70.9%) = Yes 14 (5.2%) = No 64 (23.9%) = Maybe
Do you think AI will boost patient care in Radiology?	159 (59.3%) = Yes 22 (8.2%) = No 87 (32.5%) = Maybe
Do you think in future the AI will be used for making a diagnosis?	165 (61.6%) = Yes 27 (7.8%) = No 82 (30.6%) = Maybe
In the future do you think patients generally acknowledge a report from AI applications without management and endorsement by a doctor?	83 (31.0%) = Yes 54 (20.1%) = No 131 (48.9%) = Difficult to say
Do you think AI will affect and replace human manpower in the future?	117 (43.7%) = Yes 44 (16.4%) = No 107 (39.9%) = Maybe
Do radiologists, or radiographers have any concerns regarding losing jobs?	117 (43.7) = Yes 64 (23.9%) = No 87 (32.5%) = Difficult to say
Do, you think AI will have a better ability to diagnose than human radiologists?	98 (36.6%) = Yes 67 (25.0%) = No 103 (38.4%) = Maybe
Do you think, AI will improve the cost-benefit ratio for the patients?	112 (41.8%) = Yes 43 (16.0%) = No 113 (42.2%) = Maybe
Do you think people will accept the diagnosis from an AI machine?	123 (45.9%) = Yes 42 (15.7%) = No 103 (38.4%) = Maybe
Do you think patients will be satisfied if their exams will be performed by AI?	107 (39.9%) = Yes 54 (20.1%) = No

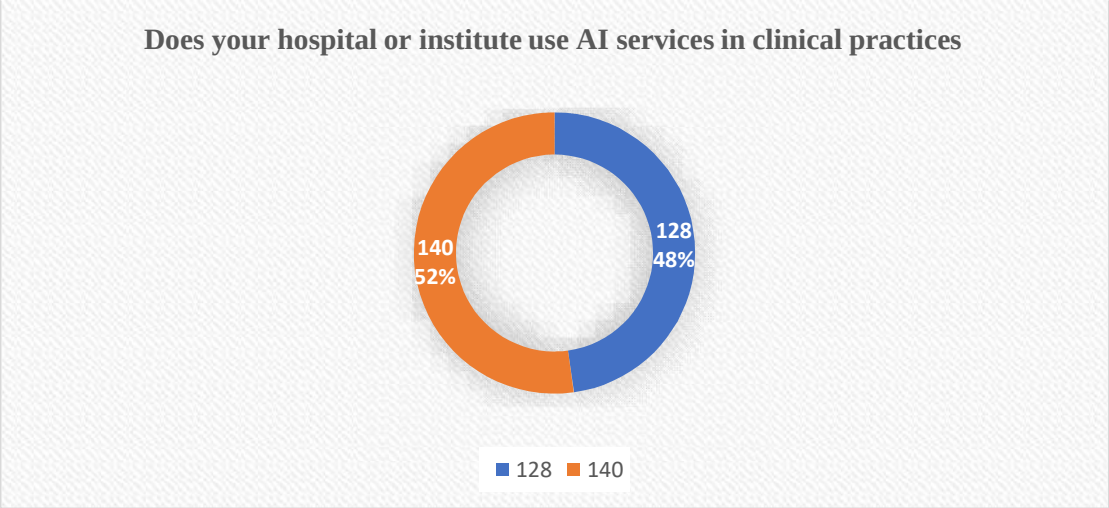
	107 (39.9%) = Maybe
Will you recommend the use of AI in all workplaces in health care?	123 (45.9%) = Yes 75 (28.0%) = No 70 (26.1%) = Maybe
Do you believe artificial intelligence poses a threat to the radiologist's assistance functions?	121 (45.1%) = Yes 49 (18.3%) = No 98 (36.6%) = Maybe

Discussion

A large proportion of the participants in this study demonstrated a good positive attitude towards the introduction of artificial intelligence in day-to-day practices however there is growing concern over job security and acceptance.

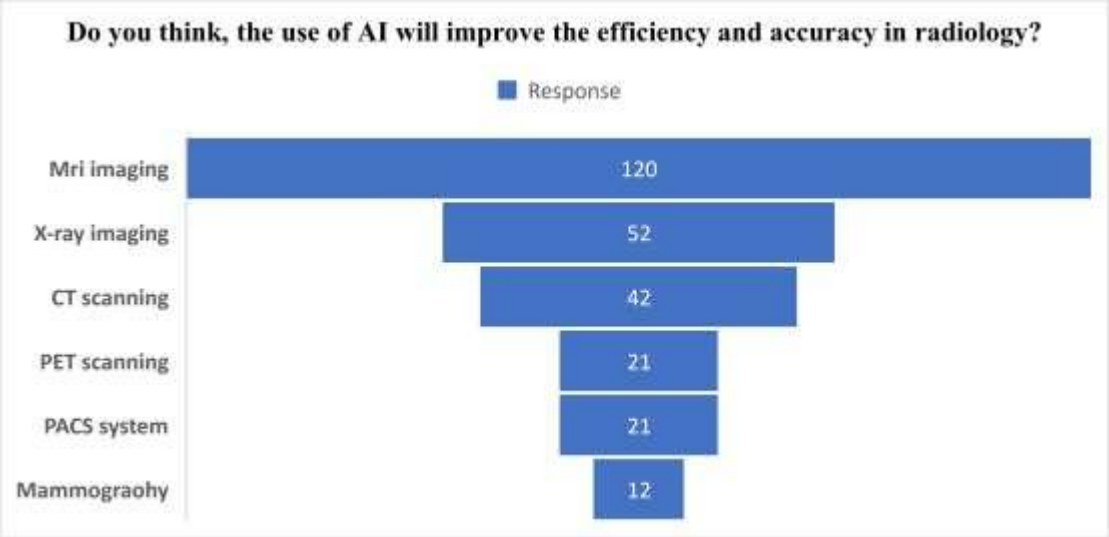
A question was asked "Does your hospital or institute use AI services in clinical practices?" for which 120 (47.8%) say yes and 140 (52.2%) says No as shown in chart 3.

Chart 3: Does your hospital or institute use AI services in clinical practices



Our research shows that the participants think there is a need for AI in radiology. When asked **"**In which of the following fields do you think that there is a need for AI," most participants think that AI can improve imaging techniques in MRI imaging 120 (44.4%) followed by x-ray imaging 52 (19.4%), Ct scanning 42 (15.7%), Pet scanning 21 (7.8%), PACS system 21 (7.8%) and 12 (4.5%) think AI can improve efficiency in mammography as shown in Chart 4.

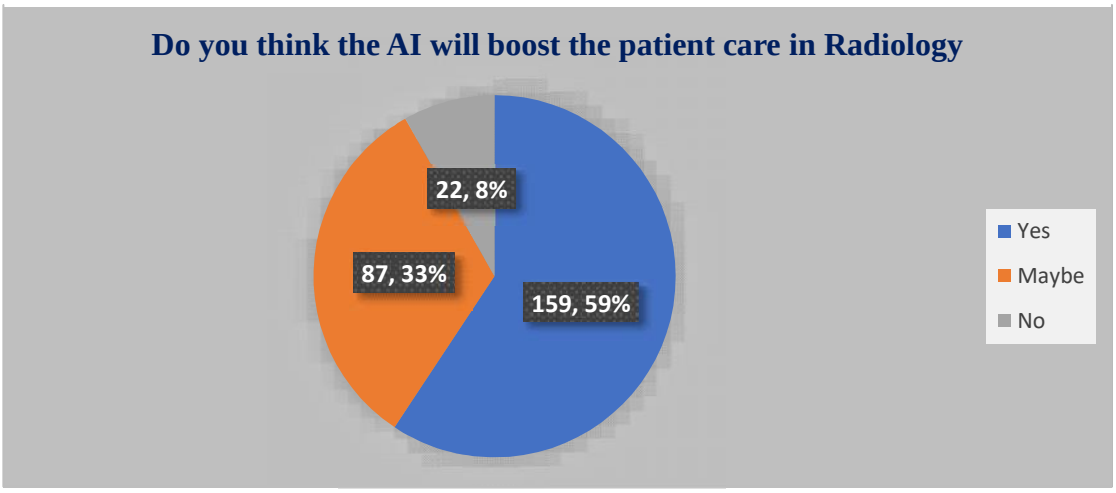
Chart 4: In which of the following fields do you think that there is a need for AI



The question was asked, "Do you think, the use of AI will improve the efficiency and accuracy in radiology". 190 (70.9%) says Yes followed by 64 (23.9%) saying Maybe and 14 (5.2%) says No as shown in table 4.

This study shows that most of the participants agree that AI will boost patient care in radiology. The question was asked **"**Do you think the AI will boost patient care in Radiology'. 159 (59.3%) participants say Yes, followed by 87 (32.5%) say Maybe and 22 (8.2%) think it will not boost patient care as shown in chart 5.

Chart 5: Do you think AI will boost patient care in Radiology

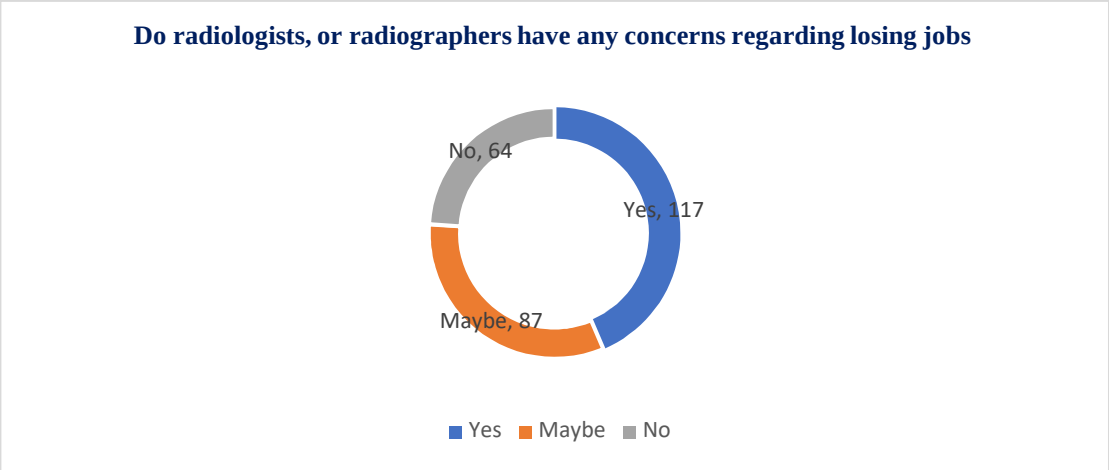


This study shows that most of the participants involved in this research think that AI can be used for making a diagnosis for patients, when asked the question **"**Do you think in future the AI will be used for making a diagnosis", 165 (61.6%) says Yes, followed by the 82 (30.6%) says Maybe and 27 (7.8%) thinks No as shown table 4. In another question, participants were asked "In the future do you think patients generally acknowledge a report from AI applications without management and endorsement by a doctor" for which 131 (48.9%) says Maybe followed by 83 (31.0%) says Yes and 54 (20.1%) says No as shown in table 4. The response to this question suggests that most of the participants are unsure that patients will acknowledge reports from a machine. This response suggests there is a need for awareness programs that can be done to aware patients and workers.

Another question was asked, “Do you think AI will affect and replace human manpower in the future”. 117 (43.7%) says Yes followed by 107 (39.9%) saying Maybe and 44 (16.4%) says No as shown in table 4. The participants involved in this research think that AI will affect and replace human manpower in the future.

When asked “Do radiologists, or radiographers have any concerns regarding losing jobs?” 117 (43.7%) says Yes followed by 87 (32.5%) saying Maybe and 64 (23.9%) says No as shown in chart 6. This is the main concern of the participants that AI machines will replace human manpower due to their low maintenance and high efficiency.

Chart 6: Do radiologists, or radiographers have any concerns regarding losing jobs



The question was asked, “Do, you think AI will have a better ability to diagnosis than human radiologists”. 103 (38.4%) says Maybe followed by 98 (36.6%) saying Yes and 67 (25.0%) says No as shown in table 4. The participants are not sure whether AI has a better ability to diagnose than a human radiologist. There is a need for further research on this concern.

Another question was asked, “Do you think, AI will improve the cost-benefit ratio for the patients”. In the response participants, 113 (42.2%) say Maybe followed by 112 (41.8%) saying yes and 43 (16.0%) says No as shown in table 4.

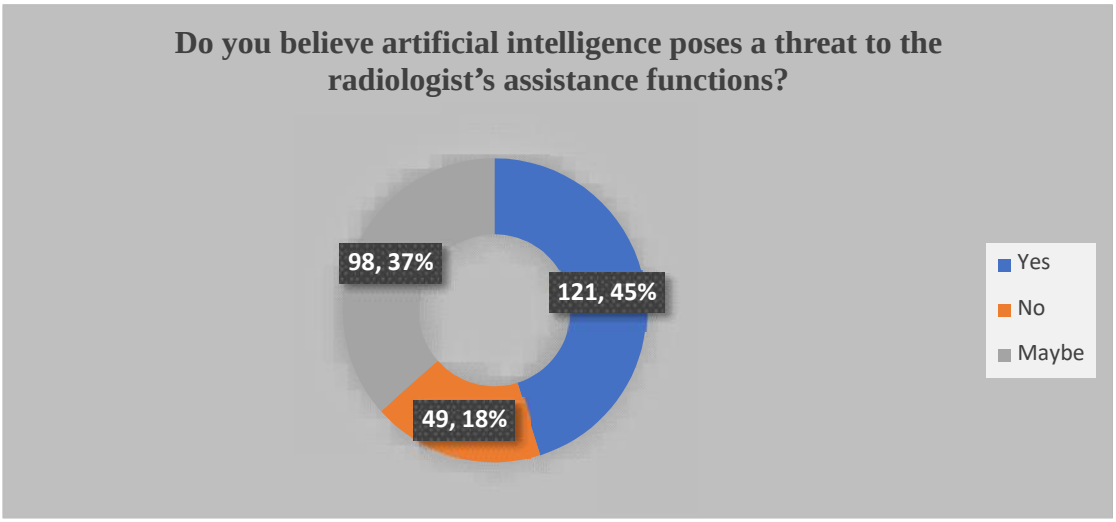
The question was asked ‘Do you think people will accept the diagnosis from an AI machine”. 123 (45.9%) says Yes followed by 103 (38.4%) saying Maybe and 42 (15.7%) says No as shown in table 4.

We asked our participants about “Do you think patients will be satisfied if their exam will be performed by AI”. 107 (39.9%) says Yes followed by 107 (39.9%) says Maybe and 54 (20.1%) says No as shown in Table 4.

When asked, “Will you recommend the use of AI in all workplaces in health care”. 123 (45.9%) says Yes followed by 75 (28.0%) saying No and 70 (26.1%) says Maybe as shown in table 4.

The last question of our questionnaire was “Do you believe artificial intelligence poses a threat to the radiologist’s assistance functions”. 121 (45.1%) says Yes followed by 98 (36.6%) saying Maybe and 49 (18.3%) says No as shown in chart 7.

Chart 7: Do you believe artificial intelligence poses a threat to the radiologist’s assistance functions



Conclusion

As a whole, research participants exhibited a favorable attitude regarding the deployment of AI systems. Good radiation clinical profile and incredibly patient AI environment beforehand. However, radiology trainees, techs, and residents do not yet fully understand how quick and upsetting the use of machine learning methods in radiology may be. This explains some of the reserved reactions to radiology residents, radiology technicians, and trainees' roles in addressing the impact of AI and in the construction of AI systems, given that many ethical and legal problems connected to the use of these systems have not been resolved. The ability to take advantage of the numerous opportunities that AI will present to radiologists, radiology residents, radiology technologists, and trainees working in the radiology department will determine the future. This ability will be based on what we do now and what we will do shortly. The impact of AI on radiology will come faster than in other medical specialties. Compared to anything since Roentgen, it will significantly alter radiology practice. In this impending transformation, residents in radiology and radiology technologists can take the lead. The hesitation of radiologists to accept AI can be paralleled to the hesitation of pilots to accept autopilot technology in the early days of flight utilizing automated planes. Despite this, radiologists are accustomed to dealing with technological difficulties because, from the start of its existence, radiography has served as a testing ground for new technologies. Radiology residents and technologists do not need to be experts in these systems' inner workings; however, to communicate with data scientists effectively, they must master the technical jargon they use. In radiology, the moment has come to work for and with AI.

Declarations

Conflict of interest: There are no financial ties between the firms whose products or services may be relevant to this article's topic and the authors of this manuscript.

Statistics and biometry: For this paper, sophisticated statistical techniques were unnecessary.

Ethical clearance: The research was survey-based, so there was no need for an ethical clearance certificate.

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