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The Role of Artificial Intelligence in Radiology Residency Training: A National Survey Study

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ABSTRACT

Objective: Artificial Intelligence (AI) offers opportunities for radiologists to enhance workflow efficiency, perform faster and repeatable segmentation, and detect lesions more easily. The aim of this study is to investigate the current knowledge and general attitudes of radiology resident physicians towards AI. Additionally, it seeks to assess the current state of AI/ML/DL education in radiology residency, the awareness and use of available educational resources.

Methods: A cross-sectional study was conducted using an online survey from October 2023 to February 2024. The survey included demographic data, AI knowledge, attitudes towards AI, and the role of AI in medical education. Survey questions were developed based on literature and reviewed by experts in medical education and radiology.

Results: The study included 155 participants (38.7% female) with an average age of 28.81±4.77 years. About 80.6% were aware of AI terms, with a mean knowledge score of 3.02±1.39 on a 7-point Likert scale. Most participants (90.3%) had no programming knowledge. Only 22.6% used AI tools occasionally. The majority (73.4%) believed AI would change radiology's future, though only 10.3% felt radiologists' jobs were at risk. Regarding AI education, 84.5% reported no formal training, and awareness of online resources was low.

Conclusion: The study found that while awareness of AI among radiology residents is high, their knowledge and practical use of AI tools are limited. AI education is largely absent from residency programs, and awareness of online educational resources is low. These findings highlight the need for integrating AI training into radiology education and increasing awareness of available resources.

Keywords: Artificial Intelligence, Radiology, Medical Education

INTRODUCTION

Deep Learning (DL) and Machine Learning (ML), which are generally part of Artificial Intelligence (AI) algorithms, have

shown promising performance when applied to medical imaging techniques [1,2]. AI offers opportunities for radiologists to make their workflow more efficient, perform faster and repeatable

segmentation, and detect lesions more easily [3]. Although these advancements are progressing rapidly, their integration into routine workflows is not happening at the same pace. Currently, most studies are presented at scientific meetings like conferences and at an academic level. Clinically, it can be said that the adoption of AI tools in practical operations is still in its early stages [4,5]. In the face of these changes in AI, the literature and, more frequently, the media often highlight its negative aspects, leading medical students, interns, and even radiologists in some cases to fear that their roles might be taken over by AI [6].

Alongside these developments, the popularity of Large Language Models (LLMs) developed in the last two years has significantly increased, and they have become frequently used in our lives. LLMs, using DL, have the ability to understand, generate, and interact with human language. Their success continues to grow day by day [7]. There are many studies conducted in the field of radiology as well. Primarily, it is said that LLMs assist radiologists in learning and education, optimizing and simplifying tasks, and aiding with non-interpretative tasks [8,9]. Considering all these developments, AI, LLM, DL, and ML are increasingly showing their impact in radiology, as in all fields. With the increasing integration of AI, interest in including AI education in radiology curricula is also growing. Therefore, various national and international resources are provided for education [10,11].

The aim of this study is to investigate the current knowledge and general attitudes of radiology resident physicians towards

AI. Secondly, it aims to assess the current state of AI/ML/DL education in radiology specialty training, evaluate the awareness and use of provided educational resources by residents, and understand the residents' perspectives on the scope of AI education and their preferred learning methods/tools.

MATERIALS AND METHODS

Ethical approval was obtained from the Gazi University Ethics Committee (Date 03.10.2023/No: 2023 – 1171). The study was conducted cross-sectionally using an online survey form created via Google Forms. Data collection took place between October 2023 and February 2024. The survey included an informed consent form that provided brief information about the study and explained its purpose. The survey consisted of four main sections: demographic data, AI knowledge, attitudes towards AI, and the role of AI in medical specialty training.

The survey form was developed by two individuals considering literature data related to AI in radiology: a medical doctor with a Ph.D. in medical education and a radiology specialist medical doctor who is a Ph.D. student in medical education. The survey questions were then reviewed and finalized by another faculty member working in medical education. The survey form was prepared in Turkish.

The survey inquired about the inclusion of AI in radiology residency training and participants' knowledge levels on AI/ML/DL topics using a 7-point Likert scale (1 = very poor / definitely should not be included, 7 = very good / definitely should be included). The survey was distributed to members via email through the Turkish Society of Radiology.

RESULTS

Participant Data

The study included 155 participants who consented to take part. The average age of the participants was 28.81 ± 4.77 years, with 94 (60.6%) being male, 60 (38.7%) female, and one person (0.6%) not specifying their gender. The years of specialty training and institutions of the participating resident physicians are presented in Table 1.

AI Knowledge and Usage

Out of the participants, 125 (80.6%) reported being aware of AI/ML/DL terms. When asked to rate their knowledge levels on a 7-point Likert scale, the average score was 3.02 ± 1.39 , indicating a moderate level of knowledge. A total of 140 participants

Main Points

- Radiology residents have high awareness of AI terms, but their knowledge levels and practical use of AI tools are limited.
- AI education is largely absent in radiology residency programs, with most participants reporting no formal training or awareness of educational resources.
- The majority of participants view AI as a tool that will transform radiology rather than a threat to radiologists' jobs.
- Findings highlight the need to incorporate AI training into residency curricula and improve awareness of available educational resources.

(90.3%) stated they had no programming knowledge, while 15 participants (9.7%) reported having basic programming knowledge.

Regarding the use of AI/ML/DL tools, 120 resident physicians (77.4%) said they never used these tools, 7 (4.5%) used them a few times, 2 (1.3%) used them daily, 7 (4.5%) used them weekly, and 19 (12.3%) used them monthly. When asked about the usage of AI tools in their institutions, 88 (56.8%) said they were not used, 28 (18.1%) said they were used, and 39 (25.2%) did not know.

Attitudes Towards AI

When asked if AI would change the future of radiology, 114 participants (73.4%) answered yes, 5 (3.2%) answered no, and 36 (23.2%) answered maybe. Of those who responded yes or maybe, 12 (7.7%) believed this change would occur in less than five years, 78 (50.3%) in 5-10 years, 43 (27.7%) in 10-20 years, and 17 (11%) in more than 20 years.

Regarding whether they thought radiologists’ jobs were at risk due to AI, 16 participants (10.3%) answered yes, 94 (60.6%) answered no, and 45 (29%) answered maybe. The reasons why resident physicians did or did not consider radiologists’ jobs at risk are detailed in Table 2.

AI Education

The presence of faculty members specializing in AI and participation in any research related to AI at the institutions is summarized in Table 3. When asked whether AI should be part of radiology education, the average response on a 7-point Likert scale was 5.09 ± 1.72 , indicating a strong desire for AI to be included in the curriculum.

Regarding AI-related resources, 131 participants (84.5%) reported that no resources were provided, 3 (1.9%) mentioned classroom lectures, 4 (2.6%) noted online materials, 1 (0.6%) attended a national-level lecture, 7 (4.5%) participated in a national congress/seminar, and 2 (1.3%) received institutional training. The duration of this training was less than 1 hour for 3 participants (1.9%) and between 1-5 hours for 7 participants (4.5%). A total of 142 participants (91.6%) stated that they did not receive any AI education outside their institutions. Of those who did, 10 received 1-5 hours of training.

When asked about their awareness of various AI educational resources, such as the ESR AI blog, ESR “Masterclass in AI” courses, RSNA AI videos, Radiology: Artificial Intelligence Journal, “AI Journal Club” managed by the ACR-Resident and Fellow section, and the ACR Data Science Institute/AI Lab, 119 participants (76.8%) reported being unaware of any of these resources.

Table 1. Years of Residency in Radiology and Institutions of Participants

Years of Residency in Radiology	Number (n)	Percentage (%)
1	43	27.7
2	49	31.6
3	25	16.1
4	18	11.6
5	20	12.9
Institution	Number (n)	Percentage (%)
University (State)	112	72.3
Ministry of Health Training Hospital	40	25.8
University (Private)	3	1.94
Number of Residents in the Institution	Number (n)	Percentage (%)
Less than 10	4	
Between 10-20	58	
Between 20-30	28	
Between 30-40	34	
More than 40	31	

Table 2. Participants' Opinions on the Impact of AI on the Future of Radiology

Reason It's at Risk (n=87)	Number (n)	Percentage (%)	Reason It's Not at Risk (n=120)	Number (n)	Percentage (%)
The number of radiologists needed will decrease with the use of AI.	23	26.44	The role of radiologists does not change with AI; it may even make their work easier.	60	50
AI tools will perform tasks such as image interpretation/comparison more efficiently, reducing the need for radiologists.	40	45.98	The role of radiologists may change, but AI cannot replace them.	60	50
The cost-effectiveness of AI will make it attractive for institutions, leading to the replacement of radiologists.	24	27.59			

Table 3. Status of Academic Interested with AI and Opinions on AI as a Sub-discipline

	Yes n (%)	No n (%)	Don't Know / Not Sure n (%)
Are there faculty members in your department interested AI in radiology?	51 (32.9)	48 (31)	56 (36.1)
Have you participated in any research related to AI/ML/DL?	19 (12.3)	136 (87.7)	
Do you think imaging informatics/AI should be a sub-specialty in radiology?	57 (36.8)	33 (21.3)	65 (41.9)

DISCUSSION

When evaluating participants' knowledge and attitudes towards AI, 80.6% reported being aware of AI terms. Similar rates have been found in literature [12]. When asked about their knowledge levels, participants were assessed to have a moderate level of understanding. Literature also indicates that radiologists generally have basic to intermediate knowledge of AI [13]. In this study, 90.3% of participants reported having no programming knowledge, whereas a study by Salastekar et al. found this rate to be 75%. Thus, radiology resident physicians in this study appear to have a comparable level of basic AI knowledge to those reported in the literature.

In the literature, a study reports that 39% of radiologists experience fear related to AI [12]. In this study, 60.6% of participants stated that radiologists' jobs are not at risk due to AI, while 29% thought they might be at risk. The same study indicated that fear of AI was higher among those with less AI knowledge [12]. As AI knowledge and usage increase rapidly over time, it is possible that the fear of AI may decrease.

In this study, participants strongly expressed the need for AI education to be included in specialty training. In the United States, studies by Salastekar et al. and Huisman et al. found that 83% and 79% of respondents, respectively, believed that AI

should be part of radiology residency training [14,15]. Similar rates have been reported in studies from Singapore (84.8%) and Spain (92.9%) [16,17]. There appears to be a global consensus on the necessity of including AI education in specialty training programs.

Studies in the United States indicate that the inclusion of AI in specialty training curricula varies between 25% and 50% [16,18]. In this study, 84.5% of participants reported that no resources were provided for AI education. Compared to the literature, the rate of AI education provision in our country is found to be very low. Additionally, 76.8% of participants in this study stated that they were not aware of online AI resources. Similar findings in the literature indicate a lack of awareness of online resources among radiology residents [14]. Regarding the use of AI tools, 77.4% of participants reported never using any AI tools personally, and 56.8% stated that AI tools were not used in their institutions, with 25.2% not knowing about their usage status. In the literature, it is seen that the utilization rates reported in the survey studies are quite high compared to this study [19,20]. When evaluating AI education and usage in institutions, this study suggests that AI education is not adequately provided in radiology specialty training in our country, and awareness of existing online resources is low. Additionally, the usage rates of AI tools in institutions are currently low.

This study has some limitations. First, being a cross-sectional study, it cannot be generalized to the entire population. Second, given the rapidly changing and evolving nature of AI tools, the current findings may have already shifted. Third, the sample size is relatively small. However, efforts were made to distribute the survey nationwide, ensuring participation from various institutions.

CONCLUSION

Compared to the literature, this study found that participants were similarly aware of AI, but their knowledge levels and basic understanding were low. These findings are consistent with literature data. However, when evaluating specialty training, it was found that most institutions do not provide AI-related education, and many participants are not aware of online resources. Therefore, this study is important for highlighting the deficiencies in the education of the radiology department, where technology plays a significant role. It also serves as a needs analysis for future training and the creation of national AI resources.

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Author Contribution: EE: Conception, Design, Materials, Data Collection, Analysis, Literature Review, Writing, Critical Review.

ÖC: Materials, Data Collection, Literature Review.

İİB: Materials, Data Collection, Literature Review, Supervision.

REFERENCES

- [1] Liu X, Faes L, Kale AU, Wagner SK, Fu DJ, Bruynseels A, Mahendiran T, Moraes G, Shamdas M, Kern C, Ledsam JR, Schmid MK, Balaskas K, Topol EJ, Bachmann LM, Keane PA, Denniston AK (2019) A comparison of deep learning performance against health-care professionals in detecting diseases from medical imaging: a systematic review and meta-analysis. *Lancet Digit Health* 1:e271-e297. [https://doi.org/10.1016/S2589-7500\(19\)30160-8](https://doi.org/10.1016/S2589-7500(19)30160-8)
- [2] Jha S, Topol EJ (2016) Adapting to Artificial Intelligence: Radiologists and Pathologists as Information Specialists. *JAMA* 316:2353-2354. <https://doi.org/10.1001/jama.2016.17438>
- [3] Wichmann JL, Willemink MJ, De Cecco CN (2020) Artificial Intelligence and Machine Learning in Radiology: Current State and Considerations for Routine Clinical Implementation. *Invest Radiol* 55:619-627. <https://doi.org/10.1097/RLI.0000000000000673>
- [4] Lincoln CM, Chatterjee R, Willis MH (2019) Augmented Radiology: Looking Over the Horizon. *Radiol Artif Intell* 1(1):e180039. <https://doi.org/10.1148/ryai.2019180039>
- [5] Koska IO, Selver A (2003) Artificial Intelligence in Stroke Imaging: A Comprehensive Review. *Eurasian J Med* 55:S91–97. <https://doi.org/10.5152/eurasianjmed.2023.23347>
- [6] Collado-Mesa F, Alvarez E, Arheart K (2018) The Role of Artificial Intelligence in Diagnostic Radiology: A Survey at a Single Radiology Residency Training Program. *J Am Coll Radiol* 15:1753-1757. <https://doi.org/10.1016/j.jacr.2017.12.021>
- [7] Sallam M (2023) ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns. *Healthcare (Basel)* 11(6):887. <https://doi.org/10.3390/healthcare11060887>
- [8] Tepe M, Emekli E (2024) Decoding medical jargon: The use of AI language models (ChatGPT-4, BARD, microsoft copilot) in radiology reports. *Patient Educ Couns* 126:108307. <https://doi.org/10.1016/j.pec.2024.108307>
- [9] Fischetti C, Bhattar P, Frisch E, Sidhu A, Helmy M, Lungren M, Duhaime E (2022) The Evolving Importance of Artificial Intelligence and Radiology in Medical Trainee Education. *Acad Radiol* 29:S70-S75. <https://doi.org/10.1016/j.acra.2021.03.023>
- [10] Gorospe-Sarasúa L, Muñoz-Olmedo JM, Sendra-Portero F, de Luis-García R (2022) Challenges of radiology education

- in the era of artificial intelligence. *Radiologia* 64:54–59. <https://doi.org/10.1016/j.rx.2020.10.003>
- [11] Lindqwister AL, Hassanpour S, Lewis PJ, Sin JM (2021) AI-RADS: An Artificial Intelligence Curriculum for Residents. *Acad Radiol.* 28:1810-1816. <https://doi.org/10.1016/j.acra.2020.09.017>
- [12] Gray K, Slavotinek J, Dimaguila GL, Choo D (2022) Artificial Intelligence Education for the Health Workforce: Expert Survey of Approaches and Needs. *JMIR Med Educ.* 8(2):e35223. <https://doi.org/10.2196/35223>
- [13] Salastekar NV, Maxfield C, Hanna TN, Krupinski EA, Heitkamp D, Grimm LJ (2023) Artificial Intelligence/ Machine Learning Education in Radiology: Multi-institutional Survey of Radiology Residents in the United States. *Acad Radiol.* 30(7):1481-1487. <https://doi.org/10.2196/35223>
- [14] Huisman M, Ranschaert E, Parker W, Mastrodicasa D, Koci M, Pinto de Santos D, Coppola F, Morozov S, Zins M, Bohyn C, Koç U, Wu J, Veean S, Fleischmann D, Leiner T, Willemink MJ (2021) An international survey on AI in radiology in 1,41 radiologists and radiology residents part 1: fear of replacement, knowledge, and attitude. *Eur Radiol* 31:7058-7066. <https://doi.org/10.1007/s00330-021-07781-5>
- [15] Gallix B, Chong J (2019) Artificial intelligence in radiology: who's afraid of the big bad wolf? *Eur Radiol* 29:1637-1639. <https://doi.org/10.1007/s00330-018-5995-9>
- [16] Gong B, Nugent JP, Guest W, Parker W, Chang PJ, Khosa F, Nicolaou S (2019) Influence of Artificial Intelligence on Canadian Medical Students' Preference for Radiology Specialty: A National Survey Study. *Acad Radiol* 26:566-577. <https://doi.org/10.1016/j.acra.2018.10.007>
- [17] Waymel Q, Badr S, Demondion X, Cotten A, Jacques T (2019) Impact of the rise of artificial intelligence in radiology: What do radiologists think? *Diagn Interv Imaging.* 100:327-336. <https://doi.org/10.1016/j.diii.2019.03.015>
- [18] Pinto Dos Santos D, Giese D, Brodehl S, Chon SH, Staab W, Kleinert R, Maintz D, Baeßler B (2019) Medical students' attitude towards artificial intelligence: a multicentre survey. *Eur Radiol* 29:1640-1646. <https://doi.org/10.1007/s00330-018-5601-1>
- [19] Ooi SKG, Makmur A, Soon AYQ, Fook-Chong S, Liew C, Sia SY, Ting YH, Lim CY (2021) Attitudes toward artificial intelligence in radiology with learner needs assessment within radiology residency programmes: a national multi-programme survey. *Singapore Med J* 62:126-134. <https://doi.org/10.11622/smedj.2019141>
- [20] European Society of Radiology (ESR) (2019) Impact of artificial intelligence on radiology: a EuroAIM survey among members of the European Society of Radiology. *Insights Imaging.*10(1):105. <https://doi.org/10.1186/s13244-019-0798-3>

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