International Conference on Business and Economics - Hellenic Open University

Vol 4, No 1 (2024)

Proceedings of the ICBE-HOU 2024

A survey on the knowledge, aspects and attitude of radiologists and radiology residents in Greece and Cyprus about the use of Artificial Intelligence in Radiology

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Abstract

Artificial intelligence is defined as the ability of machines to perform tasks that require human intelligence, and its application in Radiology has shown over the years promising enhancements in diagnostic and therapeutic capabilities. The aim of the research was to study the opinions and attitudes of Radiologists, both residents and specialists, in Greece and Cyprus. The research conducted in Greece and Cyprus includes the participation of 102 radiologists. Data were collected through a 36-question questionnaire, distributed between January 2024 and April 2024. Data were statistically analyzed using IBM SPSS Statistics, focusing on exploring primary and secondary variables related to the research. The study found that radiologists in Greece and Cyprus generally have a positive attitude toward AI, with 91.2% believing it will improve radiology, though concerns about its role as a secondary analyst and potential job displacement persist. Additionally, younger radiologists and residents demonstrated higher AI knowledge, greater willingness to undergo AI training, and a stronger inclination to integrate AI into clinical practice compared to their older and specialized counterparts. The results of the research highlight a correspondence of opinions, knowledge, and attitudes of Radiologists in Greece and Cyprus with corresponding international data. Therefore, the final integration of AI into clinical practice will depend on targeted education, regulatory clarity, and collaboration between radiologists and AI developers to address existing concerns and barriers.

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JEL Classifications: I10

Keywords: Artificial Intelligence, Medical Imaging, Radiologists, Radiology

1 Introduction

The field of radiology has undergone significant transformations in recent years, primarily due to advancements in technology. Among these technological innovations, Artificial Intelligence (AI) stands out as a revolutionary tool that has the potential to dramatically alter the practice of radiology (Mutasa et al., 2020). AI, particularly in the form of machine learning and deep learning algorithms, offers new opportunities for enhancing diagnostic accuracy, optimizing workflow, and improving patient outcomes. The increasing complexity of medical data and the demand for faster and more accurate diagnostic tools have driven the adoption of AI technologies in radiology (Rezazade et al., 2021).

AI in radiology primarily involves the use of sophisticated algorithms to analyze medical images and assist radiologists in identifying abnormalities, predicting outcomes, and suggesting possible diagnoses (Esteva et al., 2017). These systems are trained on large datasets of medical images, allowing them to learn patterns and features that may not be immediately apparent to the human eye. As a result, AI has been increasingly integrated into various radiological tasks, including image interpretation, lesion detection, and the assessment of treatment response (Hosny et al., 2018).

However, the integration of AI into radiology is not without challenges. Ethical concerns, such as patient privacy and data security, are paramount, especially given the sensitive nature of medical information (Mazurowski, 2020). Additionally, there are significant technical hurdles, including the need for large, high-quality datasets and the development of algorithms that can generalize across different populations and imaging modalities (Letzen, 2019). The "black box" problem, where the decision-making process of AI algorithms is not fully transparent, further complicates their acceptance in clinical practice (Iezzi et al., 2019).

Moreover, the role of the radiologist is evolving. While AI can augment the capabilities of radiologists, there is ongoing debate about the extent to which AI might replace certain aspects of their work (Tang et al., 2018). Some experts argue that AI will primarily serve as a tool to enhance radiologists' efficiency and accuracy, allowing them to focus on more complex cases and patient interactions (Geis et al., 2019). Others warn of the potential for job displacement and the need for radiologists to acquire new skills to stay relevant in an AI-driven future (Jha & Topol, 2016). The aim of the research is to explore the knowledge, aspects and attitude of both radiologists and radiology residents in Greece and Cyprus about the use of AI in Radiology.

2 Literature review

The study of radiologists' attitudes and knowledge regarding AI, although not yet explored in Greece nor in Cyprus, is an area of growing interest with numerous publications in international literature. Below, we present a summary of such studies conducted both in Europe and other continents.

The European Society of Radiology (ESR) conducted a large-scale study in 2018 to investigate its members' expectations regarding AI's impact on radiology over the next 5–10 years. A total of 675 radiologists from various European countries participated. The results were mixed: while 56% anticipated an impact of AI on job opportunities, 58% expected an increase, and 42% predicted a decrease. Additionally, 75% expected AI to influence workload, with 51% anticipating a reduction and 49% predicting an increase. More than half of the participants (54%) believed that the role of the radiologist would become more clinical, while 42% thought it would become more specialized (ESR, 2019).

In the United Kingdom, a study in 2021 surveyed 149 radiology residents to understand their perceptions of AI, focusing on the need for AI education. The findings showed that 83.9% were interested in using AI in radiology, but 71.1% had no experience with it. Furthermore, 98.7% agreed that AI should be incorporated into their training, although only one participant reported that their educational program included AI instruction. The primary concerns raised were IT/implementation issues (87.1%) and ethical/regulatory matters (74.8%). Additionally, 74.2% of residents believed AI would enhance and improve the work of diagnostic radiologists over the next 20 years (Hashmi et al., 2023).

Another large-scale study was conducted in Europe, with 1,041 participating radiologists, both specialized and residents, from various European countries. The study aimed to investigate radiologists' knowledge and attitudes toward AI in radiology and their concerns about job replacement. The results indicated that 48% of participants had a positive and proactive attitude toward AI, while 38% expressed fears of replacement. Basic AI knowledge was associated with increased fear of replacement, while intermediate and advanced AI knowledge correlated with reduced fear. Participants with intermediate or advanced AI knowledge were also more likely to have a positive stance on AI. Furthermore, 85% of participants were willing to use AI in clinical practice, and 79% believed that radiologists should lead AI development (Huisman et al., 2021).

Waymel et al. studied the perspectives of radiologists in France regarding AI use, surveying 270 specialized and residents radiologists. The findings revealed that 73.3% of radiologists felt they had received insufficient AI education, while 94.4% stated they would attend continuing medical education courses on AI. Additionally, 79.3% believed AI would have a positive impact on their practice in the future. The greatest expectations included reducing imaging-related medical errors

(81%), decreasing the time needed for image interpretation (74.4%), and increasing patient interaction time (52.2%). Most participants (84.8%) expressed interest in receiving regular newsletters about AI-related publications and reviews (Waymel et al., 2019).

A similar study was conducted in Ghana, where 77 radiologists completed a related questionnaire. The findings showed that 97.4% of participants were familiar with the concept of AI, with conferences being the primary source of exposure (42.9%). A total of 61.0% reported using AI in their practice, although most (44.2%) rated their experience level as moderate. Additionally, 54.5% of radiologists stated they did not use AI in their practice, while 48.1% had experience with AI in radiological services and reporting. In assessing AI's usefulness, 27.3% found it very helpful, while 22.1% did not find it useful at all (Edzie et al., 2023).

Comparing the findings of these studies on radiologists' views on AI highlights common themes and differences. All studies emphasize the need for AI education. Radiologists and students acknowledge that AI will be an integral part of their future work and express a strong desire for more training and skill development in this field (Waymel et al., 2019; Huisman et al., 2021; Hashmi et al., 2023; Edzie et al., 2023). The majority of radiologists view positively AI integration in radiology and recognize its benefits, such as improved diagnostics, reduced errors, and increased efficiency (Waymel et al., 2019). Despite this positive outlook, significant concerns remain about the potential replacement of human radiologists by AI. This finding is consistent across all studies, indicating that radiologists see AI more as a supportive tool rather than a substitute (Huisman et al., 2021; Hashmi et al., 2023; Edzie et al., 2023).

3 Research Questions

This study focuses on the impact of AI on medicine, specifically in radiology, as well as the response of radiologists to this dynamic state of evolution and transformation. Despite the obvious advantages that AI offers, its practical implementation faces many challenges, ranging from technical issues to ethical and privacy concerns. Particularly in Greece and Cyprus, the approach of radiologists toward this technology and their readiness to integrate it into clinical practice remains a research field that needs further research.

The present study aims to understand the attitudes of radiologists in Greece and Cyprus regarding the use of AI in radiology through an online questionnaire, which was created using Google Forms and distributed via Greek and Cypriot radiologists' social networking groups. The objective is to collect data on their personal opinions, experience with AI, challenges, benefits, and expectations in this crucial healthcare field. By analyzing the responses, the study seeks to provide a deeper understanding of how AI can be effectively integrated into the radiology sector in the region while identifying both opportunities and challenges.

The research questions derived from the study's objectives are:

1. What is the existing knowledge of specialized and radiology residents in Greece and Cyprus regarding artificial intelligence (AI)?
2. What is the general attitude of specialized and radiology residents in Greece and Cyprus toward AI?
3. What are the correlations between gender, age, country, and AI knowledge with attitudes toward AI, willingness to implement it in clinical practice, and fear of being replaced by AI?

4 Methodology

The research design of this study is a descriptive-analytical approach aimed at capturing the current status and perceptions regarding the integration of Artificial Intelligence (AI) in the field of radiology. The study is structured to explore how radiologists perceive AI, how they use it in their practice, and what educational needs exist to facilitate its adoption. The methodology used is primarily survey-based, with data collected through questionnaires specifically designed to gather insights from radiologists working in Greece and Cyprus.

The survey was crafted to address several key areas: the familiarity of radiologists with AI, their perceptions of its utility and impact, their educational background in AI, and their concerns or fears regarding its implementation. This method allows for a comprehensive analysis of both quantitative and qualitative data, offering a broad view of the current landscape of AI in radiology within the specified regions.

The research population targeted in this study includes professional radiologists from both public and private sectors in Greece and Cyprus. The sample consists of radiologists who responded to the survey, resulting in a total of 102 valid responses. These participants were selected to ensure a diverse representation across various hospitals, health centers, and other relevant medical institutions.

Data was collected using a structured questionnaire distributed electronically to the participants after a personal translation into the Greek language and approval for its use was obtained from its creators, Huisman et al. (2021). The questionnaire was designed to be comprehensive, covering various aspects of AI usage, familiarity, and perceptions within the field of radiology. It included sections on demographic information, questions about AI knowledge and training, attitudes towards AI, and potential fears or concerns about its integration into their professional practice.

The survey ensured the anonymity and confidentiality of the respondents, encouraging honest and open responses. The data collection process was systematic and aimed at capturing a broad range of insights from the radiology community.

The data collected from the questionnaires were analyzed using IBM SPSS Statistics software, version 24.0. The analysis involved both descriptive and inferential statistics. Descriptive statistics were used to summarize the demographic characteristics of the participants and their responses to the survey questions. Inferential statistics, such as correlation analyses, were employed to identify significant relationships between variables related to AI, such as age, gender, level of education, and the degree of AI integration in their work.

A significance level of $p < 0.05$ was used to determine statistical significance. The analysis aimed to identify patterns and correlations that could provide deeper insights into the attitudes and readiness of radiologists for AI integration in their field.

5 Results

5.1 Demographics

Out of the total sample of 102 radiologists, 56.9% (58 participants) were male, and 43.1% (44 participants) were female (Figure 1). The age distribution was as follows: 19.6% (20 participants) were under 30 years old, 41.2% (42 participants) were aged 30-40 years, 25.5% (26 participants) were aged 40-50 years, and 13.7% (14 participants) were over 50 years old (Figure 2). Geographically, 84.3% (86 participants) were from Greece, while 15.7% (16 participants) were from Cyprus (Figure 3).

Figure 1: Gender Distribution

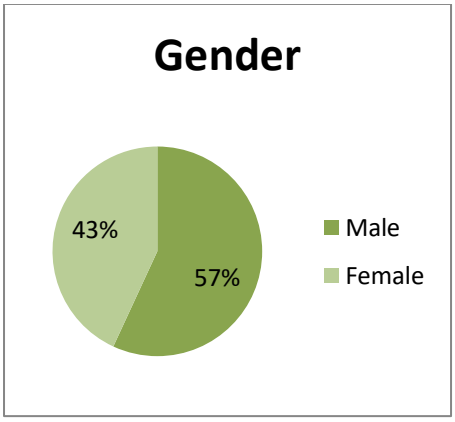


Figure 2: Age Distribution

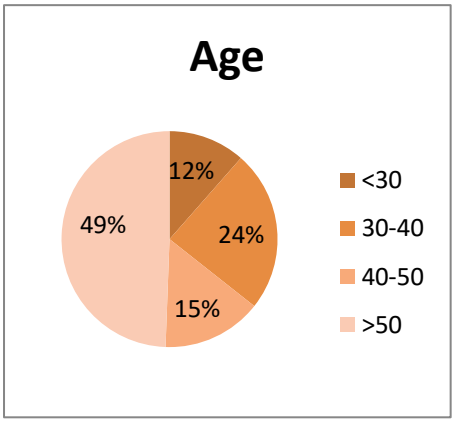
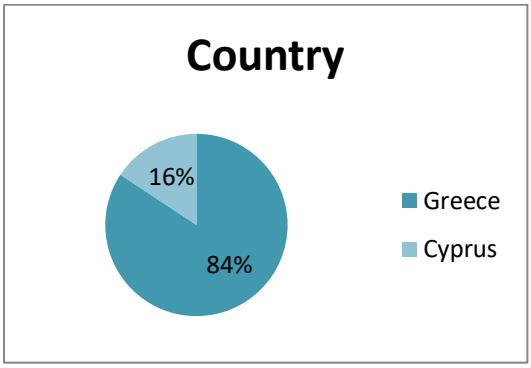


Figure 3: Country distribution



5.2 Gender and Country

The study found no significant correlation between gender or country and the perceptions or acceptance of AI in radiology. This indicates that both male and female radiologists, as well as those from Greece and Cyprus, generally share similar views on the integration of AI in their field.

5.3 Age

Age was found to have significant correlations with several variables related to AI knowledge and willingness to engage in AI-related activities. A negative correlation was observed between age and AI knowledge (correlation coefficient = -0.419, $p < 0.001$). This suggests that younger radiologists tend to have lower levels of AI knowledge. For instance, among those under 30 years old, 65% reported having some level of AI knowledge compared to only 21.4% of those over 50. A moderate positive correlation was also found between age and willingness to undergo AI training (correlation coefficient = 0.317, $p < 0.001$). This suggests that younger radiologists are more open to engaging in AI education. Specifically, 90% of those under 30 years old expressed willingness to participate in AI training, compared to only 42.9% of those over 50. A similar trend was observed in the willingness to

use AI in practice, with a positive correlation between age and this variable (correlation coefficient = 0.332, $p < 0.001$). Again, younger radiologists showed greater openness, with 90% of those under 30 being willing to use AI, versus 42.9% of those over 50.

5.4 Professional Status (Specialized and Resident Radiologists)

The professional status of radiologists, whether they were specialized or still in training, also played a significant role in their perceptions and acceptance of AI. There was a moderate positive correlation between being a resident and having AI knowledge (correlation coefficient = 0.336, $p < 0.001$). Resident radiologists (58.6%) were more likely to have knowledge of AI compared to specialized radiologists (41.4%). A slight positive correlation (correlation coefficient = 0.203, $p = 0.040$) was found between being a specialized radiologist and perceiving AI as a threat to their job. Among specialized radiologists, 53.2% felt threatened by AI, compared to only 32.5% of residents. There was a moderate negative correlation (correlation coefficient = -0.241, $p = 0.015$) indicating that residents were more willing to engage in AI training than their specialized counterparts. Specifically, 90% of residents expressed willingness to undergo AI training, compared to 69.4% of specialized radiologists. Similarly, residents were more willing to use AI in their practice (90% of residents vs. 67.7% of specialized radiologists). The correlation was moderate and negative (correlation coefficient = -0.256, $p = 0.009$). Finally, a significant portion of residents (87.5%) believed that AI should be integrated as part of their specialty, compared to 67.7% of specialized radiologists. Conversely, 75.8% of specialized radiologists opposed the idea of AI being a separate specialization within radiology, compared to 50% of residents.

5.5 Academic Background (PhD and Research Experience)

The academic background of the radiologists also influenced their perceptions of AI. Radiologists with a PhD or research experience were slightly less willing to engage in further AI training. This was reflected in a mild negative correlation (correlation coefficient = -0.205, $p = 0.039$). Among those with a PhD, only 50% expressed a willingness to undergo AI training, compared to 81.6% of those without such qualifications. Those with a PhD or research experience were more likely to believe that radiologists should lead the integration of AI in their field (correlation coefficient = 0.199, $p = 0.045$). Specifically, 96.3% of those with research experience supported this idea, compared to 79.6% of those without.

5.6 Specialization

Radiologists with additional specialization beyond their basic training showed a moderate negative correlation (correlation coefficient = -0.277, $p = 0.029$) with their willingness to use AI. Among those

with specialization, 52% were willing to use AI, compared to 78.4% of those without additional specialization.

5.7 General Findings

The study's general findings indicate a generally positive attitude towards AI among radiologists, though not without reservations. A significant 91.2% (93 participants) believed that AI would improve radiology practices. However, 55.9% (57 participants) doubted the usefulness of AI as a secondary analyst in image interpretation, reflecting a split in opinions about AI's role in assisting radiologists.

Moreover, 59.8% (61 participants) did not believe that AI would replace radiologists, but 40.2% (41 participants) were concerned that it might. When it came to reducing workload, opinions were almost evenly split, with 52% (53 participants) skeptical about AI's potential to ease their work burden, while 48% (49 participants) were optimistic.

Notably, 45.1% (46 participants) of radiologists felt that AI posed a threat to their profession, while 54.9% (56 participants) did not share this concern. Continuing in this area of study, 22.5% (23 individuals) believe that AI will alter the role of radiologists but will not replace them, 10.8% (11 individuals) believe in the complete replacement of their role, while 11.8% (12 individuals) express other reasons for perceiving AI as a threat. Regarding collaboration with AI developers, 78.4% (80 participants) expressed a strong interest, indicating a proactive approach towards AI integration despite existing fears.

When considering AI's role in education, 77.5% (79 participants) were open to AI training, while 22.5% (23 participants) were not. However, only 41.2% (42 participants) were aware of AI applications being used in their workplaces, suggesting a gap between education and practical implementation.

Finally, the study identified key barriers to AI integration in radiology. The most significant were legal and ethical concerns (30.4%), followed by infrastructural deficiencies (13.7%), high development and usage costs (10.8% and 9.8% respectively), and a lack of knowledge (11.8%). Additionally, concerns about data quality (5.9%) and the availability of high-resolution images for AI training (3.9%) were also highlighted.

5 Discussion & Conclusion

From the analysis of the study's results, we can derive several key conclusions. Firstly, the findings reveal a generally positive attitude toward AI adoption in radiology, with 91.2% of participants believing that AI will improve radiology. However, despite this optimism, there is significant concern regarding the ethical and legal aspects of AI use, with 30.4% of respondents identifying this as the greatest obstacle. This reflects a global trend where AI is recognized for its potential but is met with hesitation due to the ethical and legal challenges it presents.

Furthermore, 77.5% of radiologists expressed a willingness to receive training in AI, indicating a strong inclination toward professional development and adaptation to new technologies. Similarly, 78.4% of participants showed interest in collaborating with AI developers, highlighting the recognition of the need for interdisciplinary cooperation for the successful integration of AI into clinical practice. Despite these positive attitudes, participants voiced concerns about the complete replacement of radiologists by AI, with 90.2% believing that AI will only partially replace radiologists rather than fully replace them. Additionally, 54.9% did not perceive AI as a threat to the radiology profession, suggesting that despite concerns, radiologists still view AI as a complementary tool rather than a substitute.

Moreover, the correlation analysis between various variables related to AI training and usage in radiology, as well as perceptions and concerns among professionals in this field, yields interesting insights. While no significant correlation was found between the variables "Country" and "Gender" with AI acceptance or fear, age showed a significant correlation with variables related to the willingness to train and AI knowledge among radiologists. The variable "Age" exhibits a strong negative correlation with "AI knowledge," with statistical significance below 0.001, suggesting that as age increases, AI knowledge levels tend to decrease. Conversely, age correlates positively with programming knowledge and the willingness to undergo AI training.

The professional status of participants also demonstrates significant correlations with other variables. Residents tend to have greater AI knowledge and a higher willingness to receive AI training compared to specialized radiologists. Additionally, specialized radiologists exhibit a greater sense of threat from AI, whereas residents are more willing to incorporate AI into clinical practice and integrate it as part of their specialty. The analysis indicates that residents are more open to AI integration in radiology, while specialized radiologists express greater concerns about complete replacement by technology.

It is important to highlight the study's limitations, as the sampling method via online questionnaires may have led to selection bias. Participants who were more aware of or interested in AI may have been more likely to take part in the survey, potentially skewing the results toward a more AI-informed sample. Additionally, the subjective nature of the data may lead to discrepancies between reported and actual knowledge, as participants might have overestimated or underestimated their AI proficiency.

The findings of this study align with international research in several key areas while also highlighting some notable differences. Both this study and international research indicate a generally positive stance toward AI in radiology. In this study, 91.2% of participants believed AI would improve radiology, a sentiment echoed in studies such as Waymel et al. (2019) and Huisman et al. (2021).

Additionally, both this study and international findings emphasize the importance of AI education, with radiologists expressing a strong desire for further AI training. Concerns about AI replacing radiologists were present in all researches as well as AI's potential to transform workload management, with some radiologists expecting AI to ease their workload and others fearing an increased burden.

There are, however, some differences. One key distinction is that in this study, specialized radiologists expressed greater concerns about AI as a professional threat compared to residents, with 53.2% of specialists feeling threatened. In contrast, international studies generally found that AI knowledge and expertise correlated with lower levels of fear regarding job replacement. Another difference is that this study found radiologists with a PhD or research experience were less inclined to pursue further AI training, whereas international studies often link higher education levels with greater AI acceptance and engagement.

Despite these differences, the overall trends remain consistent: radiologists recognize the value of AI but also acknowledge challenges such as education gaps, ethical and legal concerns, and infrastructure limitations. The findings reinforce the need for structured AI education, clear regulations, and interdisciplinary collaboration to ensure AI's successful integration into radiology.

In summary, the study concludes that radiologists in Greece and Cyprus are open to integrating AI into their clinical practice, recognizing both its benefits and the challenges it presents. However, more and larger researches should be conducted in the future, for safer conclusions. The need for continuous education and training is evident, as radiologists seek to enhance their knowledge and utilize AI in ways that improve patient care quality. At the same time, ethical and legal concerns must be addressed through clear regulatory frameworks to ensure the safe and responsible use of AI. AI has the potential to revolutionize radiology, but its successful integration depends on proper training, regulatory clarity, and an understanding of the limitations and capabilities of the technology.

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