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Radiographers' Acceptance on the Integration of Artificial Intelligence into Medical Imaging Practice

Hairenanorashikin Sharip[1*], Wan Farah Wahida Che Zakaria[1], Leong Sook Sam[1], Maida Ali Masoud[2], Mohamad Zafran Hakim Mohd Junaidi[1]
** Corresponding Author*

[1] Faculty of Health Sciences, Universiti Teknologi MARA (UITM) Malaysia
[2] Mnazi Mmoja Hospital, Kaunda Rd, Zanzibar, Tanzania

hairena@uitm.edu.my, farahwahida@uitm.edu.my, sooksam@uitm.edu.my, maida.ally@live.co.uk, zafff9712@gmail.com
Tel: +60332584484

Abstract
Artificial intelligence (AI) integration in medical imaging is a promising field for enhancing patient care, performance, and efficiency. Radiographers, on the other hand, are concerned about AI's acceptance and potential to replace them. This study assessed radiographers' acceptance of AI integration by considering their knowledge, attitudes, and job security. Based on demographic characteristics, there were no significant differences in knowledge, attitude, or job security level. Completing AI training, on the other hand, had a considerable influence. Overall, radiographers have a good level of knowledge and are enthusiastic about using AI tools into their regular activities.

Keywords: Artificial Intelligence (AI); Radiographer; Knowledge and Attitude; Job Security

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1.0 Introduction

Artificial intelligence (AI) involves creating intelligent machines that mimic human cognitive functions. It uses algorithms to interpret and make decisions similar to humans, enhancing medical imaging practices. Medical imaging is essential for scientific research, allowing us to observe hidden anatomical structures and biological processes. However, the increasing volume of radiological data and decreasing reimbursements have burdened radiographers (Hosny et al., 2018). AI tools are employed to tackle these challenges to improve imaging workflows, disease recognition, radiation reduction, and overall care quality (Botwe et al., 2021). As the implementation of AI is very significant in medical imaging field, radiographers are the key players in its integration. However, several challenges occur among radiographers towards AI integration in terms of the unsatisfactory level of knowledge (Coakley et al., 2022), insufficient awareness of AI application (Ahmed et al., 2022), and some of them have concerns in terms of job security as AI might replace their duties (Coakley et al., 2022). Thus, this study aims to assess radiographers' knowledge, attitudes, and job security concerning AI integration into medical imaging practice. Radiographers must comprehend AI fundamentals and how AI-based solutions can enhance

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patient outcomes. Successful AI implementation requires addressing these challenges and preparing radiographers to collaborate effectively with AI technologies.

2.0 Literature Review

Artificial intelligence (AI) is the science and engineering of creating brilliant machines that mimic human cognitive functions involved in algorithms or a set of rules (Bajwa et al., 2021). Mechanisms like thought, deep learning, adaptation, engagement, and sensory understanding are usually applied to computational technologies using AI with some equipment that can carry out a role that typically involves human interpretation and decision-making (Secinaro et al., 2021).

According to Pesapane et al. (2018), the application of AI in medical imaging, including image processing and interpretation, is an essential area of health innovation. Wang et al. (2021) state that medical imaging enables us to recognize anatomical structures, organs and biological processes that cannot be seen by the naked eye, providing massive chances for scientific research, including diagnosis and treatment of diseases. They add that common modalities in medical imaging like magnetic resonance imaging (MRI), computational tomography (CT) and positron emission tomography (PET) bring out various unlimited information, covering from structure and morphology to physiological function. AI is predicted to extensively impact the radiologist's daily live due to its broad range of applications (Pesapane et al., 2018).

According to Abuzaid et al. (2020), AI helps radiologists improve their performance and reduce time consumption on repetitive tasks, enabling them to carry out more complicated task and allocate extra time to interact with patients and physicians. With the help of AI in medical imaging practice, the identification and characterisation of abnormalities can be accurately and sensitively detected, resulting in improved service delivery and quality of patient care (Antwi et al., 2021).

Radiographers would be required to help the integration process for the AI systems to be effectively integrated into medical imaging, as they serve as the link between the patients and the technology (Botwe et al., 2021). However, research on radiographers and AI systems remains scarce, as several previous studies showed that AI acceptance among radiographers was still moderate. Coakley et al. (2022) stated that level of knowledge regarding different concepts of AI was still low. This is supported by Ahmed et al. (2022), as some radiographers have zero knowledge regarding AI concepts such as machine learning (ML) and deep learning (DL) concept, and are unconcerned about AI applications in medical field. In addition, few radiographers are still in doubt to accept AI integration since it could replace their duties and affect their profession (Coakley et al., 2022).

Indeed, the implementation of AI will not replace radiographers even in the future, but they must fully understand on fundamentals of AI and how AI-based solutions can assist them at work to produce better outcomes for patients (Ahuja, 2019). A few challenges need to be fixed before AI becomes broadly implemented in medical imaging, including methods to arrange and process information gained from different analyses and ways to encourage more sharing of image data due to the limitation of image data sharing (Tang, 2019).

3.0 Methodology

This study was a cross-sectional study of a sample of radiographers in a northern region hospital in Malaysia. This study was conducted by using structured questionnaires based on levels of knowledge, attitudes and job security, adapted from Botwe et al. (2021). Section A, which was demographic characteristics, consisted of age, gender, academic qualifications, working experiences, specialization, and completion of AI training. Section B was the vital question to assess the level of knowledge of AI (4 items), Section C was to assess the level of attitude towards acceptance of AI by radiographers in practice (6 items), while Section D which was to assess the relationship between job security and AI in radiographers' field (4 items). For Sections B, C and D, the items were evaluated using the Likert scale (1=severely disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree).

The data collection began with approaching all the radiographers in the Department of Radiology electronically via WhatsApp media. Then, the questionnaire was distributed by using a Google form link. The aim and purpose of this study were clearly explained to the radiographers, and the agreement to participate in this study was handed in the Google form. Despite this, participation in the study was entered voluntarily, and the information collected was kept private.

The survey data were analyzed using version 28 of the IBM Statistical Package for Social Science (SPSS)® software package. Descriptive analysis was used for demographic characteristics in section A. Level of knowledge, attitudes and job security concern were determined based on mean score interpretation by Hamzah et al. (2016), which are 1.00-1.80 = very low, 1.81-2.60 = low, 2.61-3.20 = medium, 3.21-4.20 = high and 4.21-5.00 = very high).

On the other hand, statistical analysis was measured using Mann-Whitney U Test, Kruskal-Wallis H Test and ANOVA test to assess the significant difference between demographic data and the acceptance level of AI. A pilot study was conducted to test the reliability. The sample value on Cronbach's Alpha was 0.82 based on the internal consistency of the Likert Scale. The value of internal consistency is based on the range of reliability of Cronbach's Alpha (Mirza et al, 2021). Thus, a value of 0.82 is considered a good reliability level. This study's authorization and ethical issues were requested and approved by the Research Ethics Committee, Faculty of Health Sciences, UITM Puncak Alam (FERC/FSK/MR/2021/0009).

4.0 Findings

Table 1 shows the level of knowledge, attitudes, and job security concern in accepting AI integration based on demographic characteristics. Even most respondents are male (69%). However, females' knowledge, attitude and job security score are higher than males. Most respondents came from 31-40 years old (41.4%), while the least came from the age group of 51-60 years old (10.3%). The youngest age group (20-30 years old) has the highest level of knowledge and job security, while the age group of 41-50 years old secured the highest score of attitudes. For the level of education, most respondents are diploma holders (79.3%), and they have the highest level of knowledge, attitude and job security compared to degree and master holders. In terms of working experience, most respondents are those who have been working for ten years and above (58.6%). Even those with 4-5 years of working are the least (10.3%). However, this group has the highest score on the level of knowledge and job security in accepting AI compared to others. Those with less working experience (1-3 years) have the highest score of attitudes.

Table 1 Level of Knowledge, Attitude and Job security in Acceptance Integration of AI based on demographic characteristics.

Demographic characteristics	Variable	Frequency (n)	Percentage (%)	Mean (SD) and P-Value					
				Level of Knowledge		Attitudes		Job Security	
Gender	Male	20	69	3.79 (0.84)	p=0.871	3.88 (0.73)	p=0.361	3.65 (0.79)	p=0.140
	Female	9	31	3.83 (0.61)		4.00 (0.53)		4.19 (0.78)	
Age	20-30 Years old	6	20.7	3.96 (0.56)	p=0.735	4.00 (0.43)	p=0.621	3.88 (0.61)	P=0.38
	31-40 Years old	12	41.4	3.60 (1.08)		3.85 (0.91)		3.75 (0.95)	
	41-50 Years old	8	27.6	3.94 (0.32)		4.08 (0.47)		4.13 (0.60)	
	51-60 Years old	3	10.3	3.92 (0.52)		3.56 (0.38)		3.17 (1.04)	
Academic qualification	Diploma	23	79.3	3.81 (0.86)	p=0.714	3.93 (0.73)	p=0.951	3.88 (0.88)	p=0.239
	Degree	5	17.2	3.80 (0.21)		3.83 (0.47)		3.75 (0.18)	
	Master and above	1	3.4	3.75 (0.00)		3.83 (0.00)		2.75 (0.00)	
Working experience	1-3 Years	4	13.8	3.81 (0.63)	p=0.137	4.13 (0.37)	p=0.229	3.75 (0.54)	p=0.858
	4-5 Years	3	10.3	4.17 (0.29)		3.83 (0.44)		4.00 (0.66)	
	6-10 Years	5	17.2	3.10 (0.72)		3.37 (0.79)		3.55 (1.16)	
	10 Years and above	17	58.6	3.94 (0.78)		4.04 (0.68)		3.88 (0.82)	
Specialization	General X-Ray	13	44.8	3.81 (0.75)	p=0.990	3.83 (0.75)	p=0.684	3.85 (0.88)	p=0.78
	MRI	2	6.9	3.63 (1.24)		3.67 (0.47)		3.50 (2.12)	
	CT	4	13.8	4.06 (0.66)		4.17 (0.64)		4.13 (0.63)	
	Other	10	34.5	3.73 (0.85)		3.97 (0.67)		3.73 (0.56)	
Complete training of AI	Complete	12	41.4	4.25 (0.55)	**p=0.002**	4.26 (0.49)	p=0.256	4.21 (0.63)	p=0.584
	Not complete	17	58.6	3.49 (0.75)		3.67 (0.68)		3.54 (0.83)	

As for the specialization, those with specialization in CT (13.8%) score the highest in knowledge, attitudes and job security compared to others. Most of the respondents are specialized in general X-rays (44.85), and only 6.9% of them are specialized in MRI. Almost half of them have completed training in AI (41.4%), and they score better than those who have yet to complete the training regarding knowledge, attitude, and job security.

Table 3. Mean item scores of Levels of Knowledge, Attitudes and Job Security in Acceptance Integration of AI

Elements	Item	Mean Score (SD)
Level of Knowledge	I have sufficient exposure of AI during my study time	2.69 (1.29)
	The use of AI in medical imaging could open opportunities for future research to improve practice and patient care	4.14 (0.92)
	Artificial intelligence (AI) could assist in the reduction of radiation doses while retaining optimal image quality in medical imaging	4.24 (0.74)
	Mean score for level of knowledge	3.80
Attitudes	I am aware of AI as a growing phenomenon in medical imaging, and I believe that most of my patients would be pleased about using AI in their routine care	3.93 (0.84)
	I'm looking forward to the global development of AI techniques in medical imaging	4.21 (0.86)
	I am seriously worried about AI's adoption into medical imaging practice around the world	3.59 (1.12)
	I use any AI application in my daily work as a radiographer	3.17 (1.37)
	I accept any innovation in the medical imaging field	4.28 (0.88)
	I plan to learn more about artificial intelligence and how it relates to my job	4.31 (0.81)
	Mean score for attitudes	3.92
Job Security	Rather than being a helpful tool in reducing my workload, these tools have the potential to replace most radiographers' professions and have a negative impact on the radiography profession	3.59 (1.18)
	AI tools have the potential to replace most radiographers, which would have a significant impact on the radiology profession, specifically in the context of image interpretation	3.83 (1.00)
	I am concerned that AI's function as an assistive tool may result in a reduction in my basic income and possibly loss of jobs in the future	3.90 (0.94)
	AI might alter radiographers' roles, leading to expanded practices	3.97 (0.94)
	Mean score for job security	3.82

Statistical analysis was done accordingly to assess the significant difference between demographic characteristics and respondents' level of knowledge, attitude, and job security in the acceptance of AI integration in medical imaging. There are no significant differences between all demographic characteristics of the respondents and the level of knowledge, attitude, and job security, except for the level

of knowledge among those who have completed AI training. They have significantly higher levels of knowledge (p=0.02) compared to those who have not completed the training.

Table 3 shows the result of individual item score in terms of level of knowledge, attitudes and job security in the acceptance of AI integration among respondents. The respondents generally have a high knowledge of AI (mean score = 3.8). The lowest score in the category of knowledge is the item "I have sufficient exposure to AI during my study time"; which is a medium level (2.69). They scored higher in the item of "Artificial intelligence (AI) could assist in the reduction of radiation doses while retaining optimal image quality in medical imaging" (4.24).

The respondents' attitudes towards the integration of AI show that they have an overall high score (mean score = 3.92). They got a medium level of attitude for the item "I use any AI application in my daily work as a radiographer" (3.17), the lowest score in the attitude category. Three items were ranked in the very high level of attitudes which are an item "I'm looking forward to the global development of AI techniques in medical imaging" (4.21), item "I accept any innovation in the medical imaging field" (4.28), and item "I plan to learn more about artificial intelligence and how it relates to my job" (4.31, which is the highest score in attitude category).

For the level of job security overall, the respondents have a high level of job security (3.82); with the highest score is the item "AI might alter radiographers' roles, leading to expanded practices", and the lowest score is the item "Rather than being a helpful tool in reducing my workload, these tools have the potential to replace most radiographers' professions and have a negative impact on the radiography profession" (3.59)

5.0 Discussion

This study revealed how the demographic characteristics of radiographers affect knowledge, attitudes, and job security. Demographic characteristics involved in this study were gender, age, academic qualification, working experience, specialization, and completion of AI training. The results of this study were compared to previous studies that also aimed at the effect of demographic characteristics on the level of knowledge, attitudes, and job security. Firstly, there was no significant difference between the demographic characteristics of the respondents and their level of knowledge, attitude, and job security, except for the level of knowledge among those who have completed AI training. They have significantly higher levels of knowledge (p=0.02) compared to those who have not completed the training. The result from this study is in line with Botwe et al. (2021), which suggested that attitudes towards AI were independent of demographic characteristics.

Although most respondents are male in this study, female radiographers' scores are higher than males' in all aspects. The results are contradicted by Rainey et al. (2021), who stated that males dominated computer-related fields compared to females. Thus, males tend to have more excellent knowledge of AI than females. The study also stated that female radiographers have less confidence in using technology than male radiographers since females tend to overestimate their competence and have lower expectations about their capacity for scientific reasoning.

For the following demographic characteristic, age group, this study shows that the youngest age group (20-30 years old) has the highest level of knowledge and job security, while the age group of 41-50 years old secured the highest score of attitudes. This is because young radiographer tends to spend their time with their phone. A study conducted by Alelyani et al. (2021) stated that most participants that have heard or read about AI mainly were based on media which plays an essential role in shaping the public perception towards AI. Even though their level of knowledge is high, younger radiographers strongly believe that AI threatens their careers; thus, they fear their future as they may lose their jobs (Pakdemirli, 2019). For the age group of 41-50 years, Sarwar et al. (2019) found that respondents over 40 were more optimistic as errors in the detection of diseases will minimize with the implementation of AI tools.

For the level of education, most respondents are diploma holders, and they have the highest level of knowledge, attitude and job security compared to degree and master holders. Botwe et al. (2021) stated that some respondents' opinions on job security could have been more favourable regardless of their educational background. The result of this study is contradicted by Coakley et al. (2022), who found that postgraduate participants have higher knowledge levels than undergraduate participants. The reason was that undergraduate participants needed more AI understanding since they did not receive AI education during their studies. Qurashi et al. (2021) stated that most undergraduate participants felt threatened by the use of AI in medical imaging since they needed to understand the essential AI function as they had never used this application in medical practice.

In terms of working experience, this study revealed that those with 4-5 years of working experience have the highest score on knowledge and job security, while those with 1-3 years of working experience have the highest score on attitudes. A study by Yun et al. (2019) mentioned that most respondents showed interest in AI applications in medical imaging practices despite only a few having AI skills and experience. However, based on Mirza et al. (2022), radiology trainees needed more AI knowledge since they were insufficiently exposed to AI technologies. Since radiographers with 4-5 years of working experience were familiar with their current job, they might fear that the new implementation of AI could alter their roles, leading to extra practices for AI adaptation.

As for the specialization, those with specialization in CT score the highest in the level of knowledge, attitudes and job security compared to others. According to the European Society of Radiology (2019), most respondents agreed that standardized modalities like CT are targeted for AI applications. Therefore, a higher knowledge level was required in CT than in MRI. Furthermore, based European Society of Radiology (2019), CT scans also showed the highest percentage of practising AI on daily duties. Almost half of them have completed training in AI, and they score better than those who have yet to complete the training regarding knowledge, attitude, and job security level. According to Rainey et al. (2021), radiographers were required to improve their skills with the development of AI

applications in medical imaging to increase their knowledge level since they have not received specific AI training. More training on AI principles participated by radiographers was needed so that they could easily accept AI in their daily tasks (Coakley et al., 2022).

In general, the level of knowledge, attitudes, and job security in the acceptance integration of AI among respondents is high. Although they might worry about adopting AI into medical imaging practice, and they may have average exposure to AI during their study time, they are well informed that the use of AI could assist in the reduction of radiation dose and improvement in practice and patient care. The respondents are concerned that AI tools can potentially replace radiographers, specifically in the context of image interpretation and may result in a reduction of roles and basic income. They have a high attitude to learning more about AI and how AI tools are related to their jobs. Since the usage of AI applications in their daily work as a radiographer is average, they should integrate more AI tools. More training on AI principles participated by radiographers was needed so that they could easily accept AI in their daily tasks (Coakley et al., 2022). Based on Botwe et al. (2021), radiographers were concerned about job displacement and salary reduction as they had limited knowledge of AI. However, AI will not replace radiographers because radiographers' duties, like medical judgment, quality assurance, education, etc., cannot be performed by computer programmers alone (Pesapane et al., 2018).

This study managed to include all radiographers in that particular institution. Thus, it represents well on the current situation at that particular institution. However, the sample size used was limited and not representing the overall level of knowledge, attitudes and job security concern among all radiographers. A small sample size may limit the statistical power and precisions of the result.

6.0 Conclusion & Recommendations

The study found that level of knowledge and attitude towards AI integration is high among radiographers, as well as their job security concern. Radiographers need to upgrade their level of knowledge and awareness in the integration of AI in medical imaging, and they should also be concerned that AI will not replace their duties. For recommendation, future research works could use a bigger sample size as this study involved a smaller sample size of the population. Moreover, future studies could compare knowledge, attitudes, and job security among radiographers from different hospitals.

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