بسم الله الرحمن الرحيم

كلية نبتة
NAPATA COLLEGE

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Medicine Program

Community Medicine Department

Title:
Knowledge, attitude and practice of medical students in Sudan about Artificial Intelligence in Radiological Image Analysis in 2024–2025

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Dedication

We dedicate this research to

Our beloved family, whose unwavering support and encouragement have been our foundation throughout this journey

To our mentor and teacher, thank you for your guidance and inspiration

To all the medical students in Sudan striving to embrace innovation

To all the soldiers who cheapen their lives on a very long fight for Sudan,

To Everyone who lost whatever he lost during this warfare time,

To Everyone who spend time reading this, may this find you all well and safe.

ACKNOWLEDGEMENTS

First and Foremost, We Would like to express our sincere gratitude to Allah for giving us strength and patience to complete this research paper, and peace and belssig be up on the best of mankind, our prophet Mohammed (PBUH)

We are deeply thankful to our supervisor, Dr. Marwan Eissa Osman, for his invaluable guidance and continuous support. We highly appreciated your support and remarkable patience in following up with and guiding us through every step of this research, which has a significant impact on the completion of this research.

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To our family and friends, thank you for your endless encouragement, understanding and belief in us.

Lastly, I acknowledge all those who, in one way or another, contributed to the success of this research. Your support has made this journey meaningful. And we ask Allah to reward all of us on our effort and may Allah accept our deeds.

Abstract

Background: Now days, Artificial Intelligence is one of the increasingly integrated areas in the field of image analysis, pathology and ophthalmology, offering enhanced diagnostic accuracy and efficiency. Despite the advantage of AI, the readiness of future healthcare professionals to use and accept those changes, and the fear of human labor been replaced with AI, remains unclear especially in area of low resource like Sudan.

Objective: This study aims to assess the knowledge, attitudes and practices (KAP) of medical students in Sudan regarding the use of AI in radiological image analysis.

Methods: A cross-sectional study was conducted among the medical students at Sudanese universities, Data was collected using a structured questionnaire forum shared with the willing students to participate, to assess their KAP exposure to AI in radiology.

Results: the surveyed 311 participants, with 206 (66.45%) are female and 105 (33.55%) are male. Ranged in the age of above 21 to the age of 44, in the 4^{th}, 5^{th} and graduate years, showed a significant variety and association between Gender and Familiarity with AI and as well as between Education and Familiarity, AI was perceived as non-beneficial in about 70.21% of the participant answering "No" and only 29.79% answered "YES", 44.4% were concerned about cost implementation while 25% about privacy, as only 26.9% reported that it help in early detection and 25% in reducing overload from radiologist.

Conclusion: Even though Participant recognize the AI as a valuable tool in Radiology but still the uncertainty in the area of cost of implementing (44.4%) and data privacy (25%) was a big concern letting about 70% to say NO to the beneficial aspect of AI, with The Likert scale questions showed a neutral to slightly positive response about the utility safety and integration of AI in medical image analysis, however internal consistency was very low about Cronbach's alpha=0.26, indicating a divergent view across individual items.

Key Words: Artificial Intelligence, Radiology, Medical Students, Knowledge, Attitude, Practice, Sudan.

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List of Abbreviation

Abbreviation	Full Form
AI	Artificial Intelliganec
ANOVA	Analysis of variance,
SPSS	Statistical Package for Social Science

Chapter One

Introduction

Introduction

1.1 Background

Artificial intelligence has emerged as a changing force across numerous sectors across the globe, demonstrating remarkable capabilities in problem-solving, automation, and data analysis [1]. Within the realm of healthcare, AI is rapidly growing and advancing, providing an innovative solution to enhance diagnostics, treatment planning, drug discovery, and healthcare management [2]. A particularly promising application of AI lies in medical imaging and radiological image analysis.

Over the past decade, significant changes in AI algorithms, especially within the area of machine learning and deep learning, have revolutionized the field of computer vision. Convolutional Neural Networks (CNNs), a type of deep learning architecture, have shown exceptional proficiency in analyzing medical images, segmentation of anatomical structures, and even prediction of disease outcomes with increasing accuracy [3]. This capability holds immense potential to augment the work of radiologists, who are tasked with interpreting a vast and ever-growing volume of medical images

The integration of AI in radiological image analysis offers several potential benefits. These include the possibility of improving diagnostic accuracy by reducing human error and identifying subtle lesions that might be missed by the naked eye. AI can also enhance efficiency by automating routine tasks, prioritizing critical cases, and reducing the time required for image interpretation, ultimately leading to faster diagnoses and treatment initiation. Furthermore, AI algorithms can provide quantitative analysis of medical images, offering objective measurements that can aid in disease monitoring and treatment response assessment [4].

In Sudan, the healthcare system is continuously striving to improve diagnostic capabilities and patient care. Radiology plays a crucial role in this endeavor, providing

essential imaging services for a wide range of medical conditions. As the global landscape of medical technology evolves, it is imperative for future medical professionals in Sudan to be equipped with an understanding of these advancements, including the potential impact of AI on their respective fields. Medical education in Sudan is adapting to incorporate new technologies and prepare graduates for the future of healthcare [5]. Understanding the perspectives of medical students, who represent the next generation of physicians, is crucial for the successful integration of AI in radiology within the Sudanese healthcare system.

1.2. Problem Statement

The use of AI in radiology is expanding globally, with so many companies focusing on investment in this area, yet the true challenge is its acceptance and readiness among future healthcare professionals in Sudan which remain unclear. There is a need to assess medical students' awareness, perceptions, and concerns regarding AI in radiology to ensure its successful integration into the healthcare system of the country.

There is a little or none of information regarding the knowledge, attitude and practice as well do awareness, perceptions, and opinions of medical students in Sudan towards this transformative technology. As future healthcare providers, their acceptance and understanding of AI will significantly influence its adoption and integration into clinical practice [6]. Without a clear understanding of their perspectives, it is challenging to develop medical education curricula and develop effective strategies for the future implementation of AI in radiology departments across Sudan.

This study aims to address this gap by investigating the KAP of medical students in Sudan about the applications, benefits, and challenges of AI in radiological image analysis during the academic year 2024-2025. Understanding their level of awareness, perceived advantages and disadvantages, and attitudes towards learning about AI in radiology is essential for preparing them for the evolving landscape of medical practice and ensuring the successful integration of AI technologies in the Sudanese healthcare system [7].

1.3. Justification

The need for this research is crucial for several reasons, mentioned below there will be some.

With the advancement of the world and the race in the area of AI, The opinions of medical students will provide valuable insights into the potential acceptance and future utilization of AI in radiology within Sudan. Their perspectives can highlight potential barriers and facilitators to the integration of this technology.
The findings will help identify the current level of knowledge and any misconceptions among medical students regarding AI analysis in radiology or the perception they have regarding the fear or losing their job to an AI in the unpredicted future. This information can guide the development and integration of relevant educational content into the undergraduate medical curriculum, ensuring that future doctors are well-prepared to work alongside AI-powered tools.

Understanding the perspectives of future physicians can inform healthcare policymakers and institutions in Sudan about the needs and concerns related to the adoption of AI in radiology. This can contribute to the development of informed strategies for technological implementation and workforce planning in addition to giving the chance to bring the area of AI more implemented in the curriculum of the country with more regulation and polices being made to cope with the fast development of the world and the sector of machine learning and Artificial Intelligence.

Due to the limited access of medical students to the world of Artificial Intelligence, there can be many fears and uncertainty among the future medical students or professionals of losing their job to the AI or robots and this study will show the presence or absence of those uncertainties.

The Sudanese healthcare context has its unique challenges and opportunities. This study will provide context-specific data on how medical students perceive AI in relation to these factors, contributing to a more tailored approach to technology integration.

While research on AI in radiology is growing, studies focusing on the perspectives of medical students in developing countries like Sudan are limited those leading to bias result for research that has been carried out in developed countries. This study will contribute valuable data to the global understanding of this important topic.

1.4. Research Questions

1. What is the level of awareness among medical students in Sudan regarding the applications of Artificial Intelligence in radiological image analysis?
2. What are the perceptions of medical students in Sudan about the potential benefits of using AI in radiological image analysis (e.g., improved accuracy, efficiency)?
3. What are the concerns of medical students in Sudan about the potential challenges or risks associated with the use of AI in radiological image analysis (e.g., job displacement, ethical considerations)?
4. How do medical students in Sudan perceive the impact of AI in radiology on the future role of radiologists and the overall healthcare system in Sudan?
5. What is the perceived need and preferred methods for incorporating education and training on AI in radiology within the undergraduate medical curriculum in Sudan?
6. Do students believe AI can replace radiologists, or do they see it as an assistive tool?

1.5. Objectives

1.5.1 General Objective

To assess the Knowledge, attitude and practice of medical students in Sudan about Artificial Intelligence in radiological image analysis in 2024-2025.

1.5.2 Specific Objectives

1. To determine the level of awareness of medical students in Sudan regarding the applications of AI in radiological image analysis.
2. To explore the perceptions of medical students in Sudan about the potential benefits of AI in radiological image analysis.
3. To identify the concerns of medical students in Sudan regarding the potential challenges and risks of AI in radiological image analysis.
4. To assess their willingness to integrate AI-assisted radiology into their future clinical practice.
5. To analyze factors influencing their perception of AI in radiology.
6. To determine if students feel adequately trained to work with AI-assisted radiology systems

Chapter Two

Literature Review

Definition and History

The term "artificial intelligence (AI)" was coined nearly 70 years ago to refer to using of computers to imitate human reasoning [8]. The first application of AI was in mathematics in 1956 when it was utilized for proving thermos [9]. Integrating of AI in medicine was a gradual process [10] that began with the development of a software program that guided doctors on appropriate antimicrobial therapy [11].

Since the invention of computers, there has been always an attempt to replace human efforts and expertise with machines run by computers. In advance of all these efforts is the attempt to simulate human intelligence capabilities. These efforts are best known by the name of Artificial Intelligence. Human intelligence capabilities include understanding language, applying logic, learning from experience, accumulating knowledge, have memory, recognizing patterns, recognizing problems, plan, make decisions sometimes complex ones, retain information and communicating. The science of artificial intelligence tries to develop systems that can think like humans and act like humans. These systems are known by the name of artificial intelligence systems.

Artificial intelligence (AI) refers to the ability of computer systems to perform tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and pattern recognition [12]. The field of AI has evolved significantly since its inception in the mid-20th century, with advancements in computing power, data availability, and algorithmic development leading to its widespread application across various domains [13]. Machine learning (ML), a subfield of AI, focuses on enabling computers to learn from data without being explicitly programmed. Deep learning (DL), a more specialized area of ML, utilizes artificial neural networks with multiple layers to extract complex features from large datasets, achieving remarkable success in tasks like image recognition and natural language processing [14].

The healthcare sector has witnessed a growing interest in leveraging the capabilities of AI to improve patient care and operational efficiency. AI applications in medicine span a wide range, including disease diagnosis and prediction, personalized treatment planning, drug discovery and development, robotic surgery, and administrative tasks [15]. In diagnostics, AI algorithms are being developed to analyze medical images (radiology, pathology, ophthalmology), interpret laboratory results, and even assist in clinical decision support based on electronic health records [16]. The potential of AI to enhance the accuracy and speed of diagnosis, personalize treatment strategies, and ultimately improve patient outcomes is driving significant research and development efforts globally [17].

However, the integration of AI into healthcare also raises important ethical and regulatory considerations. Issues such as patient data privacy and security, algorithmic bias leading to disparities in care, the transparency and interpretability of AI-driven decisions (the "black box" problem), and the accountability and liability in case of errors need careful consideration and robust regulatory frameworks [18]. Establishing trust in AI systems among both healthcare professionals and patients is crucial for their successful adoption [19].

Radiological image analysis is a domain within medicine that has seen substantial advancements through the application of AI. Medical imaging modalities such as X-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and mammography generate vast amounts of data that require expert interpretation by radiologists [20]. AI algorithms, particularly deep learning models, have demonstrated the ability to analyze these images with increasing accuracy and efficiency, often exceeding human capabilities in specific tasks [21].

AI applications in different radiological modalities are diverse. In X-ray imaging, AI can assist in detecting fractures, lung nodules, and cardiomegaly [22]. For CT scans, AI algorithms can identify tumors, hemorrhages, and other critical findings in various parts of the body [23]. In MRI, AI can aid in the segmentation of brain tumors, detection of neurological disorders, and assessment of musculoskeletal injuries [20]. AI-powered tools are also being developed for ultrasound image analysis in obstetrics, cardiology, and abdominal imaging [24]. Mammography, a crucial screening tool for breast cancer, has benefited from AI-based computer-aided detection (CADe) systems that can help radiologists identify suspicious lesions [25].

The potential benefits of AI in radiological image analysis are numerous. Enhanced diagnostic accuracy can lead to earlier and more precise diagnoses, potentially improving patient outcomes. Increased efficiency through automation of routine tasks and prioritization of critical cases can reduce radiologists' workload and turnaround times. The ability of AI to detect subtle findings that might be missed by human observers can be particularly valuable in early disease detection. Furthermore, AI can provide objective quantitative measurements from images, aiding in disease monitoring and treatment response assessment [26].

Given all the advantages mentioned, there are still room for improvement as there are challenges and limitations associated with the use of AI in medicine and radiology. The performance of AI models is heavily dependent on the quality and quantity of the training

data, and biases in the data can lead to biased results [27]. The lack of transparency in the decision-making process of some AI algorithms can hinder clinical trust and adoption. Integrating AI tools seamlessly into existing clinical workflows and addressing the cost and infrastructure requirements are also important considerations [28].
Concerns about the potential for over-reliance on AI and the impact on the future role of radiologists are also being discussed within the medical community [29].

Relevant Studies

Here's a list of similar studies about AI in the field of medicine and radiology.

Several studies have been conducted over the last years to explore the opinion and perception of medical professionals and students towards AI in healthcare and medical imaging globally. Here are some

A study by (Mani) et al. (2020) surveyed medical students in India regarding their knowledge and attitudes towards AI in medicine. The study found that while students had a general awareness of AI, their understanding of its specific applications in healthcare was limited. They expressed enthusiasm for AI's potential to improve patient care and concerns about its impact on the doctor-patient relationship [30].

A survey of medical students in Germany by (Meyer) et al. (2019)
This study investigated their perceptions of AI in radiology. The findings indicated that students were generally optimistic about the potential of AI to assist radiologists but also highlighted concerns about job displacement and the need for adequate training in AI-related topics [31].

(Park) et al. (2021) conducted a study among radiology residents in South Korea to assess their attitudes towards AI in radiological practice. The residents acknowledged the potential benefits of AI in improving efficiency and accuracy but emphasized the importance of maintaining human oversight and addressing ethical considerations [32].

A study by (Kelly) et al. (2019) explored the views of medical students in the United Kingdom on the integration of AI into the medical curriculum. The students recognized the growing importance of AI in healthcare and expressed a desire for more education and training in this area [33].

(Lee) et al. (2022) surveyed medical students in Singapore about their perceptions of AI in radiology. The study revealed that students with prior exposure to AI had more positive attitudes towards its adoption in clinical practice [34].

A study conducted in the United States by (Sitko) et al. (2023) assessed the opinions of medical students on the ethical implications of AI in radiology. The students raised

concerns about data privacy, algorithmic bias, and the potential impact on the autonomy of both patients and physicians [35].
(Tahoun) et al. (2024), investigated the awareness and perceptions of medical students in Egypt regarding AI in medical imaging. The study found a moderate level of awareness among students, with a generally positive outlook towards the potential of AI to improve diagnostic accuracy and efficiency. However, concerns about the lack of training and the potential for deskilling were also expressed [36].

These studies in total can highlight a growing awareness among medical students about the potential need or use of AI in medicine or radiology. While there is enthusiasm for the benefits AI can offer, concerns regarding the ethical implications, the future role of physicians, and the need for adequate education and training are also present.

There is a lack of research focusing on the opinions of medical students in Sudan regarding AI in radiological image analysis. This proposed study aims to fill this critical gap in literature.

Chapter Three

Methodology

Study Design

3.1 Study Design

This study used a descriptive cross-sectional survey design. This design is appropriate for assessing the Knowledge, Attitude and practice as well as the awareness of medical students regarding AI in radiological image analysis at a single point in time.

3.2 Study Area/Settings

The study was conducted in selected medical schools across Sudan that have active undergraduate medical programs during the academic year 2024-2025. Specific medical schools were chosen based on access and representation of different regions and types of institutions (public and private, if possible).

3.3 Study Population

The study population consisted of undergraduate medical students enrolled in Sudanese universities during the academic year 2024-2025, as well graduate student from the area of medicine or those who are at their clinical years.

3.3.1 Inclusion Criteria:

- Currently enrolled medical students in any year of study in a participating medical school in Sudan during the academic year 2024-2025, especially medical students in their clinical years.
- Willingness to participate in the study and provide informed consent.

3.3.2 Exclusion Criteria:

- Medical students who are not currently enrolled or non-medical students or pre-clinical students.
- Students who do not provide informed consent.

3.4 Variables under the Study

- **Dependent Variable:** Opinion of medical students towards Artificial Intelligence in Radiological Image Analysis. The dependent variable was assessed through the questions provided during the study to measure their awareness, perception, and concerns if any as well their view on the future impact.

- **Independent Variables:**

    - Demographic characteristics: Age, gender, medical school, academic year.
    - Exposure to radiology: Prior clinical rotations or coursework involving radiology.
    - Familiarity with AI: Self-reported level of understanding or prior exposure to AI technologies.

- **Confounding Variables:** (need to be considered during analysis, if any are identified as potentially influencing the relationship between independent and dependent variables of the study)
    - Access to resources (e.g., internet, technology).
    - Exposure to research activities.

- **Background Variables:** Socioeconomic status (optional)

3.5 Sample Technique and Sample Size

3.5.1 Sample Technique

For this study a stratified random sampling technique was used to ensure representation from different academic years within the selected medical schools, the medical schools can be used as a stratum.

3.5.2 Sample Size

A stratified random sampling was used to ensure equal representation from different collages, the below equation can also be used to address the number of samples to be used during the study.
N = (Z^2 * P * (1-P) * N) / (E^2 * (N-1) + Z^2 * P * (1-P))

Where:

- n = required sample size
- Z = Z-score corresponding to the desired confidence level (1.96 for 95%)
- P = estimated proportion of the population with the characteristic of interest (0.5)
- E = desired margin of error (0.05)
- N = total population size of medical students in the selected institutions

3.6 Data Collection Techniques and Tools

3.6.1 Data Collection Techniques

Data was collected using a self-administered questionnaire distributed to the selected medical students. The questionnaire will be administered either online (using platforms like Google Forms) or in person, depending on the feasibility and accessibility in the selected study settings. If administered in person, questionnaires will be distributed

during convenient times, such as breaks between lectures, with clear instructions and ensuring privacy during completion. For online administration, links to the questionnaire will be shared via official student communication channels with clear instructions and a deadline for completion.

3.6.2 Data Collection Tools

3.6.2.1 Questionnaire:

The questionnaire was structured to gather information related to the research objectives. It will include the following sections:

1. **Demographic Information:** Questions on age, gender, medical school, and academic year.
2. **Awareness of AI in Radiology:** Questions assessing the students' knowledge about AI and its specific applications in analyzing radiological images (e.g., recognizing different modalities where AI is used, awareness of specific AI tasks in radiology). These questions will include multiple-choice and true/false formats.
3. **Perceptions of Benefits:** A series of statements using a Likert scale (e.g., 1=Strongly Disagree to 5=Strongly Agree) to assess students' opinions on the potential benefits of AI in radiological image analysis, such as improved diagnostic accuracy, increased efficiency, detection of subtle findings, and support for radiologists.
4. **Concerns and Challenges:** series of Likert scale statements to assess students' concerns about the potential risks and challenges of AI in radiological image analysis, such as job displacement for radiologists, ethical issues (data privacy, bias), lack of transparency, over-reliance on technology, and the need for significant infrastructure investment.
5. **Future Impact and Role:** Likert scale questions exploring students' perceptions of how AI will impact the future role of radiologists.
6. **Need for Education and Training:** Questions assessing the need for introducing education and training on AI in radiology within the undergraduate medical curriculum.
7. **Open-Ended Questions:** A few open-ended questions will be included to allow students to provide more detailed qualitative feedback on their overall opinions about AI in radiological image analysis.
8. **Prior Exposure:** Questions about any prior exposure to radiology (e.g., clinical rotations, elective courses) and their level of familiarity with AI technologies (e.g., basic understanding, some experience, no knowledge).

3.7. Data Management and Analysis

The Data collected during the process was managed and analyzed as per the below description.

1. **Data Entry:** The process will have two ways of data collection as said above, that includes the paper-based questionnaires, in which the data was entered into analyzing software such as the SPSS or R software. For online surveys, collected data was directly exported to the statistical software.
2. **Quantitative Data Analysis:** Descriptive statistics (frequencies, percentages, means, standard deviations) was used to analyze the demographic pattern of the participant and their response to the Likert scale and the other Multiple choice provided during the questionnaire.
3. **Qualitative Data Analysis:** thematic analysis was used to analyze Responses given to the open-ended questions.
4. Data was analyzed using the Statistical Package -SPSS latest version.

3.8 Ethical Considerations

This study was conducted as per the listed below areas to ensure the adherence to ethics.

1. **Informed Consent:** Before the process for participation is started, all necessary information was shared with the eligible medical students, that includes a link to the purpose, procedure and or any risk associated with this research. And they hold all the right to withdraw at any time without penalty. A first question was used as an informed consent before they started to answer the rest of the questions of the questionnaire.
2. **Anonymity and Confidentiality:** All data obtained during this study was kept secured, with Participants' identities being anonymous throughout the study.
3. **Privacy and Data Security:**
4. **Voluntary Participation:** Participation in this study was entirely or purely voluntary and with no one being forced.

CHAPTER FOUR
Results

This cross-sectional study the KAP of medical students in Sudan during the period of March 2025 to May 2025, for Students and graduate from the medical area, from different colleges and universities across the state of Sudan. The number of participants in this study was 311 participants, of which 206 (66.45%) are female and 105 (33.55%) are male.

The Age distribution is as per the table below

Table 1: Age Distribution (% by Age)

Age	**Percentage (%)**
44	42.55
33	17.02
35, 30, 34, 51	6.38 each
36, 40	4.26 each
25, 37, 39	2.13 each

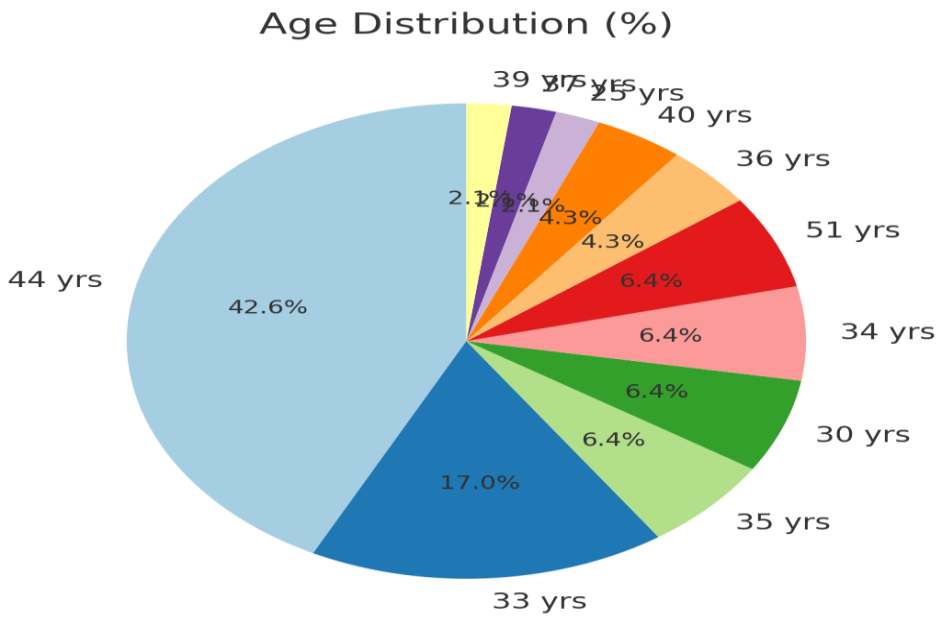
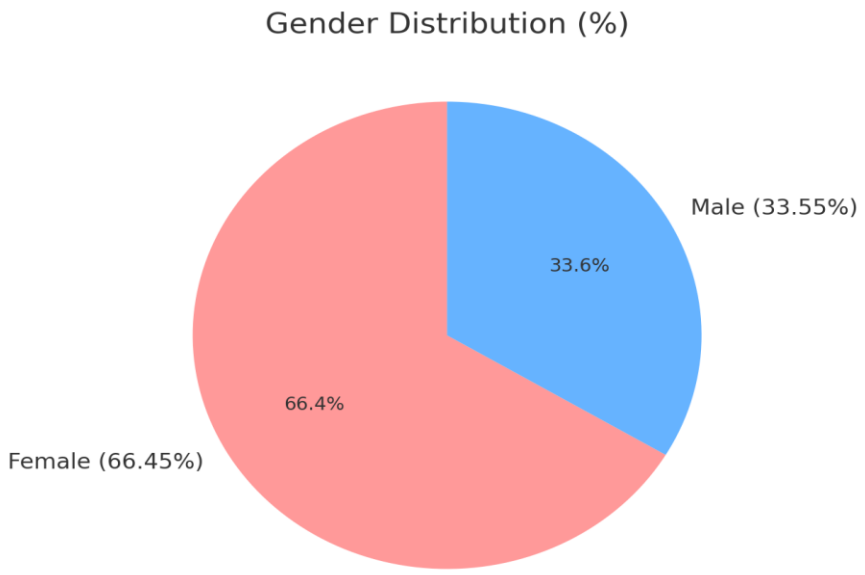


Table 2: shows Gender Distribution of the respondent

Gender	Percentage
Male	33.55
Female	66.45



The Likert Questions result shows a mean range of 2.77 to 3.24. indicating generally a neutral to slightly positive agreement with a standard deviation of 1.36 to 1.53 that shows a moderate response variability.

The chi-square test results showed a "No significant association" between gender and AI use as well as between education and AI usage that shows the AI has been used independently in age, gender or educational wise.

Table 3: chi-square test (gender Vs Familiarity)

Variable	Chi-square	P value	Degree of freedom
Gender Vs Familiarity	19.82	0.0005	4

But the **Gender × Familiarity with AI: showed a Chi² = 19.82**, **p = 0.0005,** that was statistically significant, that the familiarity of AI showed to have an association with the gender. The chi test for **Education × Familiarity: showed a Chi² = 49.16**, **p < 0.001,** that was statistically significant, that the familiarity of AI showed to have an association with the level of Education.

The t-test and Anova test, showed that the is no significant, **Gender differences (t-test)** on average Likert scores: **t = 0.71**, **p = 0.477 → Not significant, that Male and Female responded similarly on average.**

While the Education level differences (ANOVA): showed a F = 3.47, p = 0.017 → Significant, with a very significant across educational groups

The below table shows the diagrammatic figure of the familiarity among male and female in the Area of AI.

Table 4: Familiarity with AI by Gender.

The table showed that male and female differ in their familiarity level that align with the significance in chi- test

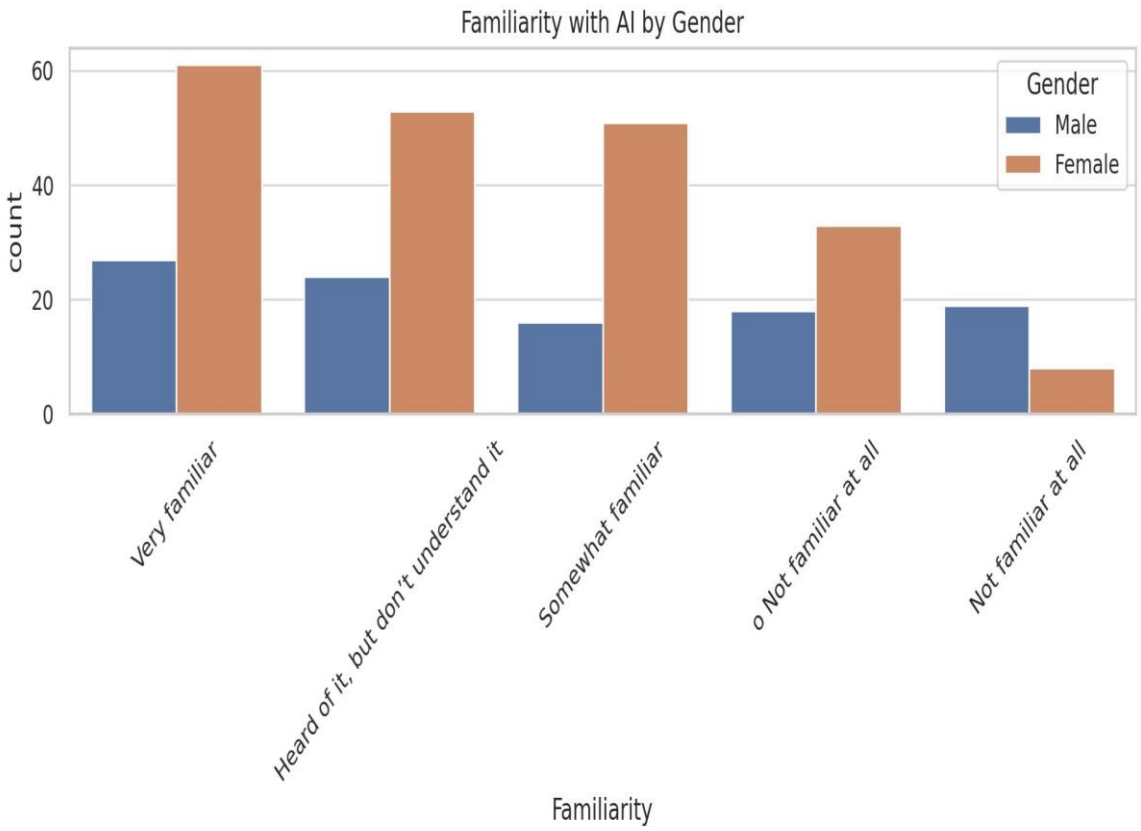
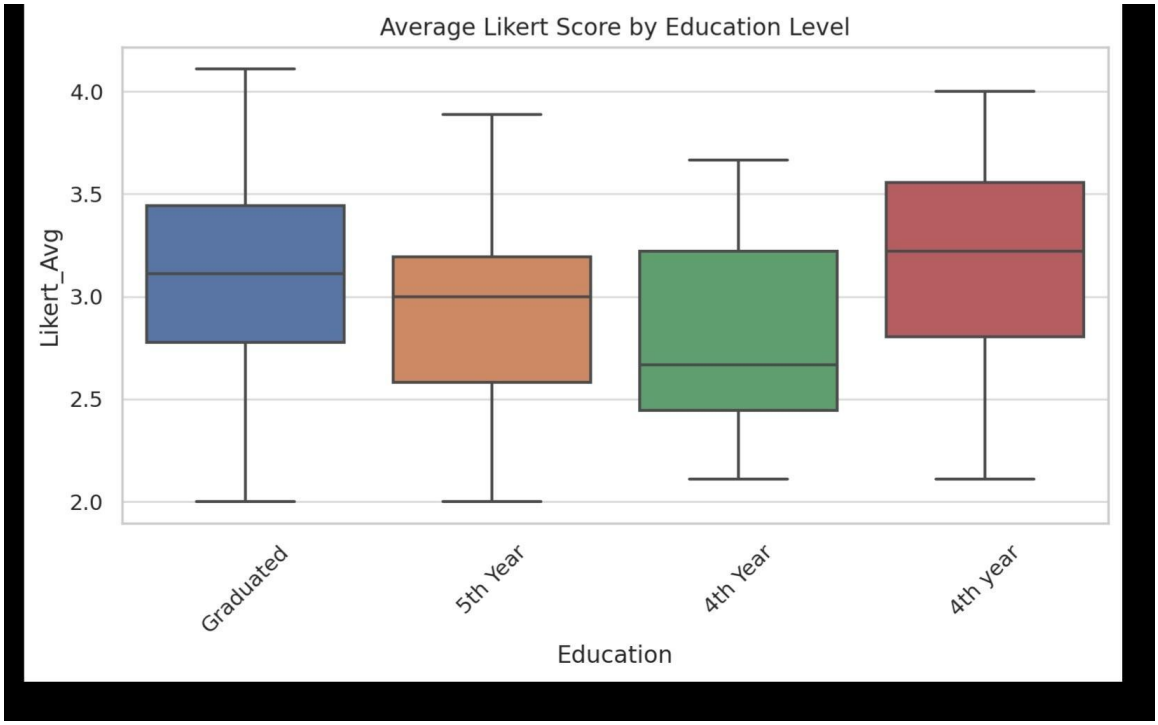


Table 5: Average Likert Score by Education

The table shows varaition in attitude across academic level confirming the ANOVA test.



The Analysis of the open question showed the students were aware of both the challenges or limitations of AI as well as bout the advantage or clinical values of AI.

With the top area of concern was the high cost of implementation, risk of over reliance and lack of training while the area of top benefits were as early detection of disease, increased diagnostic accuracy and reduced workload on radiologist.

Table 6: challenges and benefits of AI

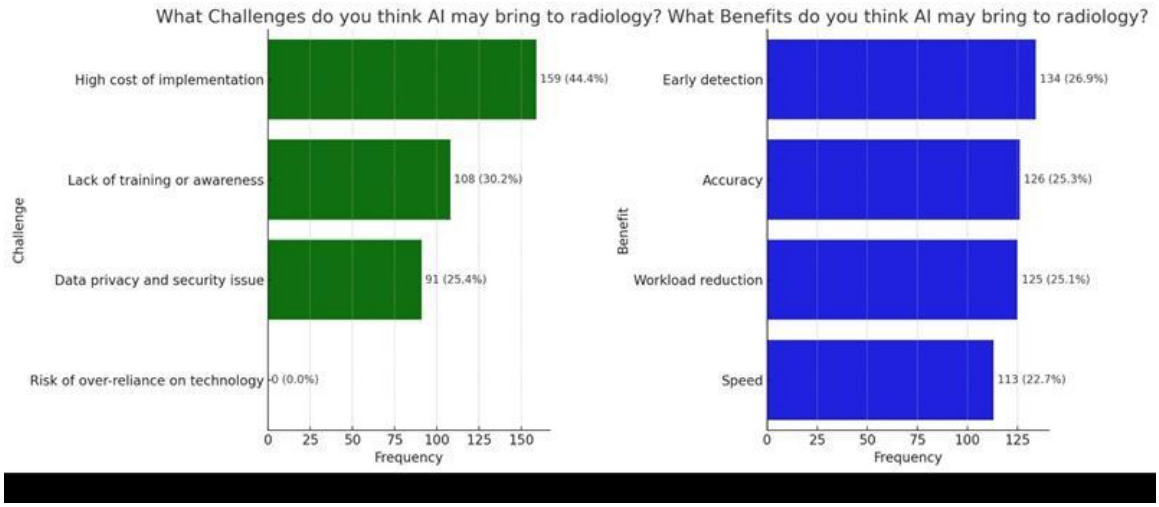


Table 7: shows the correlation analysis among Likert questions to patterns

The above table showed a weak pattern confirming low Cronbach alpha, wit the strongest but still moderate correlation was with,

Table 8: correlation and r-value

Correlations	R value
Q6 and Q9	r value of 0.13
Q7 and Q9	r value of 0.17
Q8 and Q9	R value of -0.25

This suggests that the responders on one item don't constituently predict others, so each Likert item may tap into distinct attitude or concerns

The over table of summarize for the frequency and percentage is shown in the below table.

Table 9: overall summarize for the frequency and percentage

Variable	**Option**	**Frequency**	**Percentage (%)**
Age	44	20	42.55
	33	8	17.02

	35.0, 30.0, 34.0, 51.0	3 each	6.38 each
	36.0, 40.0	2 each	4.26 each
	25.0, 37.0, 39.0	1 each	2.13 each
Gender	Female	35	74.47
	Male	12	25.53
Education	Graduated	41	87.23
	5th Year	4	8.51
	4th year	2	4.26
Believe Beneficial	No	33	70.21
	Yes	14	29.79

Chapter Five

Discussion and Conclusion

The Aim of this study was to assess the KAP of medical students in AI usage in Radiological image analysis, the data collected from the participants through a structured questionnaire, were analyzed statistically revealing some notable insights.

As far as the demographic aspect is concerned, a higher proportion of participants were **female (66.45%) and (33.55%) are male**, indicating a gender skew in the respondent base or reflective demographic in certain medical school or department. The most common age was **44 (42.5%) years**, that followed **33years (17.02%)** and others in the 30's suggesting a mixed mid of carrier professionals and young trainers, also indicating that most of the participants were either graduate or in the **4th and 5th year** of their medical career.

As we are concerned with the perception toward AI in radiological image analysis, the response indicates that there was a moderate level of familiarity among the participants with gender showing a statistically significant relationship **(chi-square=19.82, P=0.0005)** with male being slightly more familiar with AI then Female. When asked whether AI is beneficial in the Area of AI, about **70.21%** of the participant answered "**No"** and only **29.79%** answered **"YES",** this showed strong uncertainty in the role of AI image analysis with possible rooted to the limited exposure or misconception in its capabilities.

The Likert scale questions showed a neutral to slightly positive response about the utility safety and integration of AI in medical image analysis, however internal consistency was very low about **Cronbach's alpha=0.26,** indicating a divergent view across individual items.

In overall statement, the research reveals a cautiously skeptical outlook on AI in radiology, with most of the people who participated in the study recognizing the theoretical benefits but expressing some concerns about its practical usage particularly focusing on the cost and impact on job. Addressing those concerns through a well-structured education and hand on exposure with open discussion can bridge the gap between perception and adoption.

Chapter Six

Recommendations

Based on the findings of this study, we can recommend that AI needs to be integrated in the medical curriculum, especially knowing that the world is running and investing in this area which shows a promising future. So, introducing AI modules and practical workshops in those undergraduate and post graduate programs to build a foundation knowledge and confidence in the future medical student and profession should be a future priority.

Finding cost to the most addressed issue by most of our participants , collaboration with policymakers and tech companies to provide affordable cost can be a solution to the most addressed issue, Also 25% of the participant showed concerns with data and private privacy, with the development of clear data policy and including ethics training on AI usage to endure responsible implementation can solve this problem.

Although concerns regarding job loss were low, general skepticism remained, emphasizing Ai as a supportive tool, not as a replacement and involving radiologist in AI development can bring back the trust and acceptance of this new skyrocket development of AI to the medical side.

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Questionnaire

Part A: Demographic and Background Questions

Question A. Do you will in participate in this study of KAP of medical school in AI in Radiological Image Analysis

A. Yes
B. NO

1. **What is your age?**
    - Under 20
    - 20–22
    - 23–25
    - Above 25
2. **What is your gender?**
    - Male
    - Female
    - Prefer not to say

3. **Which university are you currently enrolled in?**
    - [Short answer]
4. **Which year of study are you currently in?**
    - 3rd year
    - 4th year
    - 5th year
    - 6th year / Final year
5. **Have you received any formal education or training about Artificial Intelligence (AI)?**
    - Yes
    - No
    - Not sure
6. **Have you been exposed to AI topics during your medical training (lectures, workshops, online courses)?**
    - Yes, multiple times
    - Occasionally
    - No exposure
7. **Have you used or interacted with any AI-based tools for radiology or imaging (even if just in a lecture/demo)?**
    - Yes
    - No
8. **How familiar are you with the concept of AI in radiology?**
    - Very familiar
    - Somewhat familiar
    - Heard of it, but don't understand it
    - Not familiar at all
9. **Do you plan to specialize in radiology or imaging-related fields?**
    - Yes
    - Maybe
    - No
10. **Do you have access to the internet and online resources for self-learning about AI?**

- Always
- Occasionally
- Rarely
- Never

🟧 Part B: Opinion & Perception Questions

11. I believe AI can improve the accuracy of radiological diagnoses.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

12. AI can help reduce the workload and reporting time for radiologists.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

13. AI might pose a risk of job displacement for future radiologists.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

14. The use of AI in radiology raises ethical concerns (e.g., patient privacy, decision-making accountability).

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

15. I believe radiologists will still be essential even with advanced AI technologies.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

16. Sudan's healthcare system is ready to adopt AI technologies in radiology.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

17. AI education should be incorporated into the undergraduate medical curriculum.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

18. I would be interested in attending workshops or online courses about AI in radiology.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

19. I see AI as a helpful tool rather than a replacement for radiologists.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree

20. Medical students in Sudan are generally aware of the uses of AI in medical imaging.

- Strongly Disagree – [ ] Disagree – [ ] Neutral – [ ] Agree – [ ] Strongly Agree