Sudan Journal of Medical Sciences
Volume 20, Issue no. 2, DOI 10.18502/sjms.v20i2.18178
Production and Hosting by KnE Publishing

KnE Publishing

Check for updates

Research Article

Knowledge, Attitudes, and Concerns of Sudanese Doctors Regarding the Use of Artificial Intelligence Tools in Sudan

Taha Ibrahim Yousif[1]*, Amani Mohammed[2], and Imad Brema[3,4]

[1]Consultant Pediatrician, Johns Hopkins Aramco Hospital, Dhahran, Saudi Arabia
[2]Consultant Family Medicine, Coole Medical Surgery, Ireland
[3]Consultant Endocrinologist, King Fahad Medical City, Riyadh, Saudi Arabia
[4]Adjunct Associate Professor of Medicine and Endocrinology, Alfasial University, Riyadh, Saudi Arabia

Abstract

Background: Artificial intelligence (AI) is revolutionizing medical practice and the healthcare industry. The World Health Organization expects AI to help developing countries and rural communities bridge the gaps in healthcare access. The ongoing conflict in Sudan has exposed shortcomings in the country's healthcare system, underscoring a pressing need for improvement and the adoption of innovative technologies. We have conducted this research to assess the knowledge, attitudes, and concerns of Sudanese doctors regarding the use of AI in Sudan.

Methods: This research is an online questionnaire-based study aimed at assessing Sudanese doctors' perceptions of the use and application of AI. A 34-question Google Form survey was created and distributed via social media platforms, primarily WhatsApp, Facebook, LinkedIn, and personal emails, to Sudanese doctors, both within and outside Sudan, from July to December 2024. Data were analyzed using SPSS software.

Results: One hundred ninety-five participants responded to the questionnaire. The results reflected poor knowledge about AI and its applications, but showed a good level of acceptance after training prior to its adoption in Sudan. Participants' main concerns were related to training and legal matters, mainly accountability and consent.

Conclusion: The research revealed significant deficiencies in the knowledge of AI applications among Sudanese doctors. However, it also demonstrated the doctors' readiness to adopt AI in practice. We recommend incorporating AI education into the curricula of medical schools and postgraduate programs.

Keywords: artificial intelligence, Sudanese doctors, deep learning, AI acceptance in healthcare, impact of war on medical practice in Sudan, ethical implications of AI in healthcare

Corresponding Author: Taha Ibrahim Yousif; email: Drtaha2002@yahoo.com

Received: 18 February 2025
Accepted: 24 April 2025
Published: 30 June 2025

Production and Hosting by KnE Publishing

Editor-in-Chief:
Prof. Nazik Elmalaika Obaid Seid Ahmed Husain, MD, M.Sc, MHPE, PhD.

OPEN ACCESS

1. Introduction

Artificial Intelligence (AI) is anticipated to advance medical practice to a new, unprecedented level [1]. The World Health Organization (WHO) states that AI could help bridge the gaps in healthcare access in rural areas and underdeveloped communities, where people have limited access to medical personnel and healthcare services [2]. AI's potential to enhance diagnostic precision, optimize treatment regimens, and personalize patient care has made its application in medicine a groundbreaking frontier that is transforming healthcare delivery. Deep learning, machine learning, and natural language processing are just a few of the technologies that fall under the umbrella of AI. These technologies analyze vast amounts of medical data to identify trends, predict outcomes, and assist medical practitioners in making critical decisions [3]. The use of AI in radiology, pathology, and genomics has garnered significant attention, with studies demonstrating its ability to achieve diagnostic accuracy comparable to or exceeding that of human practitioners [4]. Sudan's healthcare system faces numerous challenges, including inadequate infrastructure, a lack of healthcare professionals and medical supplies, and regional disparities in access to healthcare. Like many developing countries, Sudan also suffers from the migration of doctors and medical staff, an issue that has only been worsened by the war. The use of AI tools could help fill some gaps in healthcare in Sudan [5]. Benefits include enhanced diagnosis, improved clinical decision-making, and reduced costs, among others.

Furthermore, AI-powered mobile health applications could be developed to enhance maternal and child health services, offering accessible information and support to remote populations. In Sudan, AI application is still in its infancy, and there is a significant gap in research regarding AI in the country. Although AI represents a massive transformation in healthcare, only a few studies have discussed its utilization in Sudan. The ongoing war in the country has led to serious health problems for the Sudanese population. The consequences of the war could have been lessened if AI systems had been adopted for diagnosis, advice, and management. This research aims to assess Sudanese doctors' knowledge, attitudes, and concerns regarding the use of AI in medical practice, both in general and specifically in Sudan.

2. Methods

This is a cross-sectional, questionnaire-based study. The target population consisted of Sudanese doctors, both in Sudan and abroad, regardless of their age, medical degree, specialty, or career status. A 34-items questionnaire was designed using Google Forms to collect participants' demographic data, medical qualifications, current job information, and their knowledge, practices, and concerns regarding AI and its applications in Sudan. The form can be found through the following link: https://forms.gle/xNKmwKeA5PQNPgGe7. After designing the questionnaire and establishing its face validity, we piloted it with a group of doctors experienced in research and refined it based on their feedback. We then identified its components using principal components analysis. No personally identifiable data was collected. Since this study is based on an anonymous questionnaire, no ethical approval was required.

After validation, the form link was shared via email and social media platforms such as WhatsApp, LinkedIn, and Facebook. Multiple Sudanese doctors' specialized and generalized group platforms were used. Members of these groups were also asked to share the form among their subgroups. Additionally, Sudanese doctors were contacted through the doctors' union's social media platforms in various countries where this was feasible. All Sudanese graduates were also targeted. Responses were collected and analyzed using SPSS® software. Multiple reminders were sent during the study period to increase response rates.

3. Results

3.1. Demographics of participants

A total of 195 participants responded to the questionnaire, with two-thirds being male. One-third of the participants were in the age group of 41–50 years, and another third was between the ages of 51–60 years. The younger age groups of 21–30 and 31–40 years made up 6% and 17%, respectively. Among this population, 188 (96%) had graduated from Sudan. Pediatrics, general medicine specialties, and surgical specialties accounted for nearly 75% of the participants, while the remaining 25% consisted of other specialties. As shown in Figure **1**, the majority of respondents (82, 41%) were employed in the Gulf region.

Regarding qualifications and roles, more than half of the respondents hold a Doctor of Medicine (MD) degree, or their highest academic qualification is membership in a Royal College, and the majority of participants are consultants (51%; Figure **2**).

3.2. Knowledge and training

More than half of the participants (55%) had not received any AI training, while 3.1% reported having received formal training (Table **1**).

Only seven participants (4%) rated their knowledge of AI as excellent, while 83 participants (43%) stated that their knowledge is poor or very poor. Results from knowledge of machine learning and deep learning are similar, as illustrated in Figure **3**.

3.3. Practice and attitude

Half of the participants had never used AI tools during their practice. Participants indicated that they would use AI tools to analyze patients' data (68%), monitor treatment progress (73%), and in medical education, if available (92%). Figure **4** illustrates the results of the participants' practice and perception.

3.4. Concerns and obstacles

Regarding Sudanese doctors' concerns about the use of AI in medical practice, participants were asked whether they worry that the use of AI may lead to breaches of patient confidentiality, unjustified decisions, a decrease in clinicians' enthusiasm for continuous professional development, a loss of human factors in medicine, job losses, diminished clinical and communication skills, and an increase in legal issues. Most respondents (40–50%) expressed concerns about these issues. Incorrect decision-making by AI tools and a decline in clinical skills were the most frequently reported concerns (58% and 57%, respectively), while job loss was the least reported concern (31%). This is illustrated in Figure **5**.

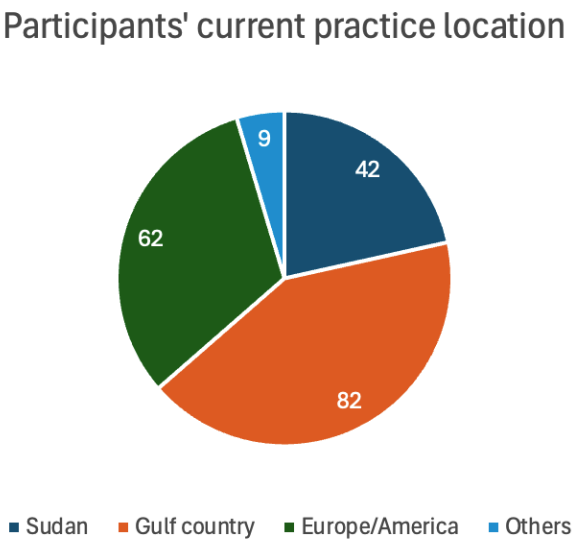

Figure 1: The practice locations of participants. The majority are employed in Gulf countries, followed by Sudan.

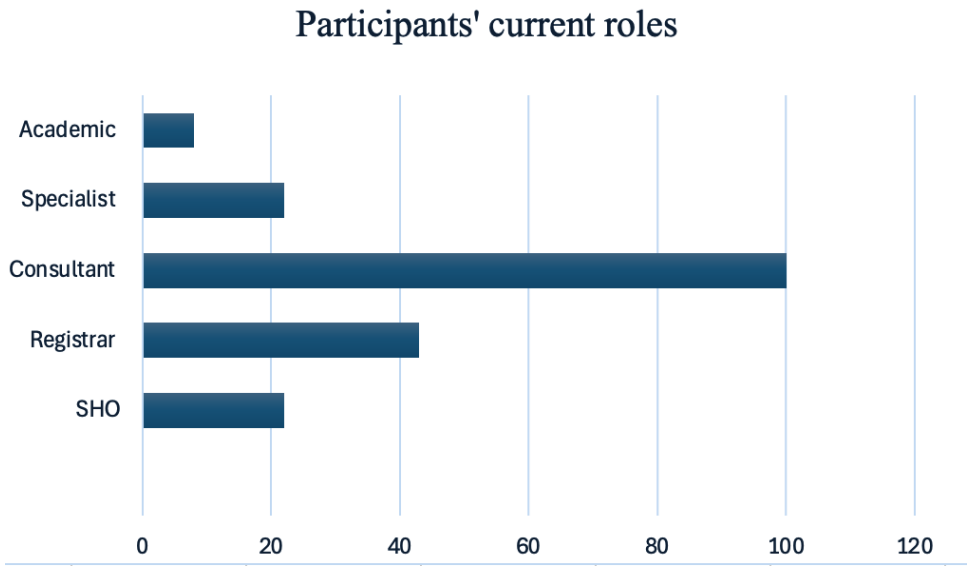

Figure 2: Current roles of the participants. The majority are consultants. SHO, Senior House Officer.

Table 1: Training status and locations. Most individuals received no formal training, while those who did were primarily self-trained.

Training locations	Numbers	Percentage (%)
Medical school	1	0.5
During residency	2	1.0
Self-learned or informal	78	40.0
Other formal learning	6	3.1
No training received	108	55.4

In terms of obstacles to adopting AI tools, the lack of infrastructure and insufficient training are the primary challenges, noted by 165 (84%) and 142 (74%) of participants, respectively. Following these, societal acceptance and legal issues were mentioned by 77 (39%) and 69 (35%), respectively.

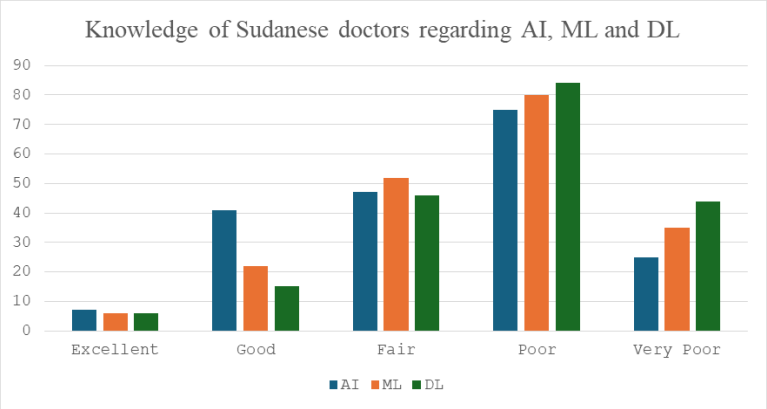

Figure 3: The knowledge of Sudanese doctors about AI, machine learning, and deep learning is generally lacking. Most respondents indicated a poor understanding in all three areas. It's worth noting the almost identical trends across all sections. AI, artificial intelligence; ML, machine learning; DL, deep learning.

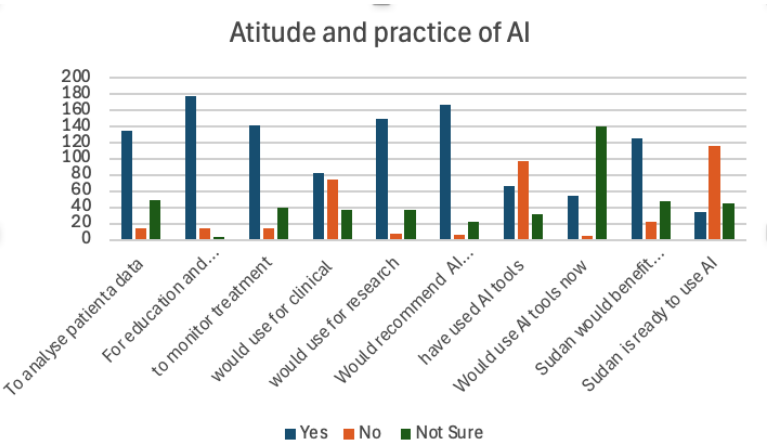

Figure 4: Practice and attitude toward the use of AI tools, showing a positive attitude and acceptance across most fields.

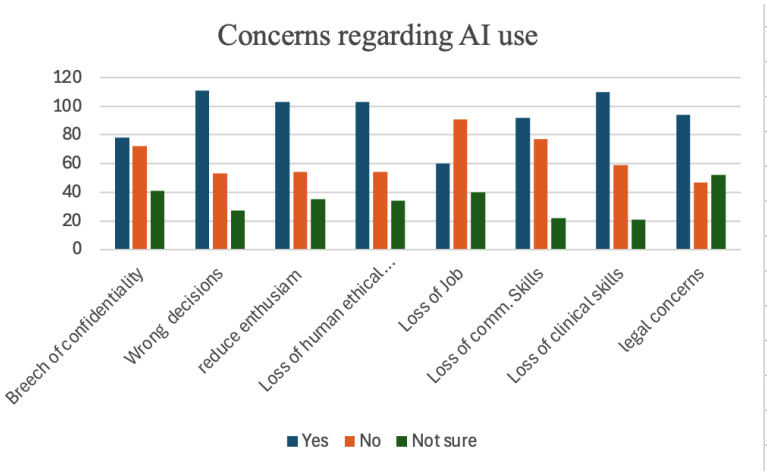

Figure 5: Concerns of Sudanese doctors regarding the use of AI. Loss of clinical skills, poor decision-making, decreased enthusiasm for continuous development and learning, and loss of the human and ethical touch were the most commonly reported concerns.

4. Discussion

This research was established after we recognized the effects of the war and its consequences following the destruction of hospitals, health institutions, and medical schools, which led to the displacement of doctors, medical students, and patients. This resulted in a loss of follow-up and difficulties in obtaining consultations, issues that could have been minimized with a well-implemented AI tool system. Between July and December 2024, a questionnaire was distributed, and responses were collected. The survey included 34 questions: 8 of which gathered demographic data about participants and their qualifications, 5 explored their knowledge, 9 examined their perception of and practice with AI, and 11 discussed their concerns regarding AI. The survey was distributed via a link sent through WhatsApp, Facebook, LinkedIn, and personal emails to professionals and professional groups. Only 195 responses were received. Multiple reminders were sent to ensure a higher response rate. This low response may be attributed to the ongoing war in Sudan, which is causing the displacement of and stress for Sudanese doctors. Calculating the percentage of respondents is a challenging task. However, we believe our sample is likely representative of Sudanese doctors, regardless of gender or participant level, as two-thirds of the responses came from male participants. More than half of the participants were consultants, likely reflecting the post-war situation. Only about one in five were currently practicing in Sudan, which may indicate the doctors' displacement and potential lack of internet access for those within Sudan. The survey revealed that most Sudanese doctors participating did not receive any formal AI training. These findings were consistent with the study by Mohammed Amin et al. [6], despite the differences in the age group of participants, as individuals aged 20–30 comprised the highest proportion of respondents in their study, with medical officers making up the majority. This highlights the learning gaps at all levels and the need for formal training on AI in medical schools and postgraduate institutions.

Regarding AI knowledge, our study revealed a generally poor understanding of the topic. Previous studies involving younger generations indicated a higher percentage of 80% [6]. Despite the lack of formal training, many doctors expressed a strong desire to learn about AI, findings also reported by prior studies [6]. Although their knowledge of AI was limited, the attitudes of Sudanese doctors towards utilizing AI were quite positive and encouraging. There is significant enthusiasm for incorporating AI into clinical practice, as well as education and research, consistent with earlier findings in Sudan [6]. A study in Egypt presents similar results [7].

The primary concerns regarding the use of AI tools are related to legislation and training. The issues of accountability and consent are critical in this context. Training to use these tools is also necessary, although the training requirements will vary depending on the specific tools being used. Our findings differ slightly from those of previous studies, such as that of Kamal et al., who reported that doctors' main concerns are safety and job loss [8]. Compared to previous studies, a similar percentage (30%) of our participants expressed a fear of job loss. Proper training continues to pose a significant challenge, as indicated in earlier research. The effective implementation of AI in healthcare requires training healthcare professionals in data analytics and the ethics

of AI. However, there is a substantial lack of educational programs focused on these skills in Sudan. Finally, the study indicated that the knowledge of Sudanese doctors is comparable to that of their peers in other developing countries [9, 10].

5. Limitations

We acknowledge the potential biases introduced by convenience sampling. As this questionnaire was distributed online during wartime, the limited internet access available to participants in Sudan may have influenced the responses of doctors in the country. The method of distributing the questionnaire may have also introduced bias, as it was only sent to active groups known to the authors, although participants were encouraged to share the questionnaire as widely as possible. Most respondents were male, which may reflect potential bias, as evidenced by the fact that the majority of responses came from Gulf countries. Additionally, social media access posed a limitation; those without WhatsApp, LinkedIn, or Facebook had reduced opportunities for participation. Despite sending multiple reminders, the number of responses was less than expected, possibly due to doctors' stress and anxiety about their situations and their families. The self-selection bias could not be minimized since the questionnaire was self-administered. However, using mandatory fields helped reduce the number of missing responses.

6. Conclusion

Our study addressed the significant need to adopt AI tools in Sudan as soon as possible. Despite the knowledge gap, the willingness of doctors to learn and utilize AI tools is very encouraging, as demonstrated in this research. Training and confidentiality remain challenges to overcome. We recommend incorporating AI training into medical school curricula and postgraduate training.

Declarations

Acknowledgments

The authors acknowledge the contributions of Omnia Brema, a medical student at Near East University, and Mustafa Yousif and Yousif Yousif, medical students at Lithuanian Medical Science University, who reviewed the manuscript's text and figures.

Ethical Considerations

As this study relied on an anonymous questionnaire, no ethical approval was required.

Competing Interests

None.

Availability of Data and Material

Data utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

Funding

No financial support or funding was received for this work.

Abbreviations and Symbols

AI: Artificial Intelligence

WHO: World Health Organization

MD: Doctor of Medicine

References

[1] Rajpurkar, P., Chen, E., Banerjee, O., & Topol, E. J. (2022). AI in health and medicine. *Nature Medicine, 28*, 31–38. https://doi.org/10.1038/s41591-021-01614-0

[2] WHO. (2021). *Ethics and governance of artificial intelligence for health: WHO guidance*. https://www.who.int/publications/i/item/9789240029200

[3] Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. *Nature Medicine, 25*(1), 44–56. https://doi.org/10.1038/s41591-018-0300-7

[4] Esteva, A., Robicquet, A., Ramsundar, B., Kuleshov, V., DePristo, M., Chou, K., Cui, C., Corrado, G., Thrun, S., & Dean, J. (2019). A guide to deep learning in healthcare. *Nature Medicine, 25*(1), 24–29. https://doi.org/10.1038/s41591-018-0316-z

[5] Badr, H. (2025). AI diagnostics can ease health crisis in war-torn Sudan. *Scidev.net: Middle East and North Africa Edition*. https://www.scidev.net/global/opinions/ai-diagnostics-can-ease-health-crisis-in-war-torn-sudan

[6] Jaber Amin, M. H., Mohamed Elhassan Elmahi, M. A., Abdelmonim, G. A., Fadlalmoula, G. A., Jaber Amin, J. H., Khalid Alrabee, N. H., Awad, M. H., Mohamed Omer, Z. Y., Abu Dayyeh, N. T. I., Hassan Abdalkareem, N. A., Meisara Seed Ahmed, E. M. O., Hassan Osman, H. A., Mohamed, H. A. O., Mohamedtoum Babiker, A. E., Diab Alnour, A. A., Mohamed Ahmed, E. A., Elamin Garban, E. H., Ali Mohammed, N. S., Mohamed Ahmed, K. A. H.,... Mohammed, H. H. (2024). Knowledge, attitude, and practice of artificial intelligence among medical students in Sudan: A cross-sectional study. *Annals of Medicine and Surgery (London), 86*(7), 3917–3923. https://doi.org/10.1097/MS9.0000000000002070

[7] Elareed, H. R., Salama, R. A. A., Ismaeel, A. Y., & Lotfy, A. M. M. L. (2024,). Perception and opinion of physicians regarding artificial intelligence in Egypt. *The Egyptian Journal of Hospital Medicine,97*, 3423–3428. https://doi.org/10.21608/ejhm.2024.384066

[8] Kamal, A. H., Zakaria, O. M., Majzoub, R. A., & Nasir, E. W. F. (2023). Artificial intelligence in orthopedics: A qualitative exploration of the surgeon perspective. *Medicine,102*(24), e34071. https://doi.org/10.1097/MD.0000000000034071

[9] Ooi, S. K. G., Makmur, A., Soon, A. Y. Q., Fook-Chong, S., Liew, C., Sia, S. Y., Ting, Y. H., & Lim, C. Y. (2021). Attitudes toward artificial intelligence in radiology with learner needs assessment within radiology residency programmes: A national multi-programme survey. *Singapore Medical Journal, 62*, 126–134. https://doi.org/10.11622/smedj.2019141

[10] Wood, E. A., Ange, B. L., & Miller, D. D. (2021). Are we ready to integrate artificial intelligence literacy into medical school curriculum: Students and faculty survey. *Journal of Medical Education and Curricular Development, 8*, 23821205211024078. https://doi.org/10.1177/23821205211024078