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Original Article

Awareness, Perceptions, and Concerns among medical students regarding Artificial Intelligence integration in Healthcare: A Comprehensive Analysis

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Abstract

Background: Artificial intelligence (AI) is increasingly integrated into healthcare, creating a demand for AI technology literacy among healthcare professionals. This study aimed to investigate undergraduate medical students' awareness, concerns, and perceptions of AI in healthcare.

Methodology: This cross-sectional study was conducted on 356 undergraduate medical students at a constituent medical college of a health university in India. Data were collected using various sections of a structured questionnaire (Google Forms). The questionnaire was validated to ensure its authenticity and alignment with the study's aim. To assess reliability and readability, a pilot study was conducted. Before the study, ethical approval was obtained, and each participant gave their informed consent. SPSS-26 was used to analyze the data.

Results: There was a 41.88% valid response rate, but the overall response rate 45.05%, and a fairly balanced distribution of sexes. Across AI domains, combined awareness ranged from 48.6% to 58.1%, whereas combined disagreement ranged from 22.8% to 32.9%. Most students did not receive formal training in AI. The major concerns noted were job security (43.8%), patient data privacy (47.2%), and errors in medical diagnosis and treatment (44.1%). However, 53.8% of the students perceived AI as a valuable tool for improving healthcare delivery and patient outcomes.

Conclusion: Undergraduate medical students show moderate awareness of AI in healthcare but lack formal training and in-depth understanding. Concerns persist regarding ethics, job displacement, loss of empathy, and clinical errors, despite recognition of AI's potential to improve healthcare outcomes. These findings highlight the need for structured AI education within medical curricula and further research on its long-term impact.

Keywords: Healthcare, artificial intelligence, education, medical, questionnaires, awareness

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Introduction

Artificial intelligence (AI) refers to the use of computers to model intelligent behaviour with minimal human intervention.[1]AI technologies are now widespread, influencing many aspects of daily life, and their applications continue to expand across sectors. In healthcare, the growing integration of digital data science and emerging AI tools underscores the need for AI literacy among health professionals.

In the era of the Fourth Industrial Revolution, advances in medical technology—primarily driven by AI and machine learning—support the 4P model of medicine: predictive, preventive, personalised, and participatory.[2-3] Clinical practice is shifting from the information age to the AI age, accompanied by the rapid accumulation of healthcare data. [4]As AI becomes more prominent in medicine, healthcare professionals must be able to use medical AI systems effectively, assess their outputs, and recognise their limitations.[5-6] Ensuring fairness and minimising bias in these systems is essential to avoid health disparities and promote equitable care. Medical students, as future healthcare providers, must therefore be equipped with accurate and up-to-date scientific knowledge about emerging technologies.[7]

The integration of AI also requires interdisciplinary collaboration among healthcare stakeholders. Gathering perspectives from a diverse group of healthcare students is crucial. [8-9]. Artificial Intelligence (AI) is rapidly transforming healthcare, yet Indian medical students—who will soon enter an AI-enabled clinical environment—receive limited formal training on these technologies. This results in significant gaps in awareness, understanding, and preparedness. Existing studies broadly examine general attitudes toward AI or focus on specific specialities, offering little comprehensive insight into the broader concerns and perceptions of Indian undergraduate medical students who will work in a high-burden healthcare system, a context that has been underrepresented in prior studies. Moreover, current research seldom considers the unique challenges of Indian medical education, including uneven digital literacy and variability in resources. This study addresses these gaps by systematically focusing on Indian medical students and evaluating their awareness, perceptions, and concerns regarding AI integration in healthcare, thereby providing context-specific evidence to support curriculum enhancement and informed policy development.

Methods

Study setting: This cross-sectional study was conducted via an electronic survey (Google Form) of undergraduate medical students at the Rajasthan University of Health Sciences, College of Medical Sciences, Rajasthan, India.

Sample Size: A total of 850 male and female undergraduate medical students were approached. All students who provided written informed consent and completed the questionnaire were enrolled. In total, 383 students completed the survey (completion rate: 45.05%). After excluding incomplete or incongruent questionnaires (Incongruent answers refer to survey responses that were internally inconsistent, contradictory, or logically incompatible with other answers provided by the same respondent. These discrepancies indicate a lack of coherence in the response pattern and may arise from misunderstanding of questions, carelessness, random responding, or deliberate misreporting. Data from 356 participants were retained, giving a valid response rate of 41.88%.

Before data collection, compliance with the standards of participant information, confidentiality, and ethical data processing was ensured. The design guaranteed respondents' anonymity. Participation was voluntary and unrelated to students' curricular activities.

Ethical Consideration: Ethical approval for the study was obtained from the institutional ethics committee (reference number: RUHSCMS/Ethics Comm. /2023/249 dated 28.11.2023). This study complied with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants who agreed to participate in the study.

Data collection tool: The study used a **convenience sampling** approach by electronically surveying (via Google Forms) all undergraduate medical students at Rajasthan University of Health Sciences, College of Medical Sciences, who were accessible via WhatsApp groups. Participation was voluntary, and only those who completed the questionnaire with informed consent were included. This non-probability sampling method involved approaching 850 students and retaining data from 356 valid responses. The survey comprised five sections, which included a Likert scale and multiple-choice questions. All Likert scale questions presented five options: disagree, somewhat disagree, neither agree nor disagree, agree, and agree entirely.

The questionnaire encompassed various aspects of its different subsections. The first section gathered information on the respondents' demographics. The second section assessed AI in healthcare. The third section focused on the participants' concerns about AI. The final section addressed the participants' perceptions of AI. The students were presented with various statements and were asked to indicate their level of agreement on a five-point Likert scale.

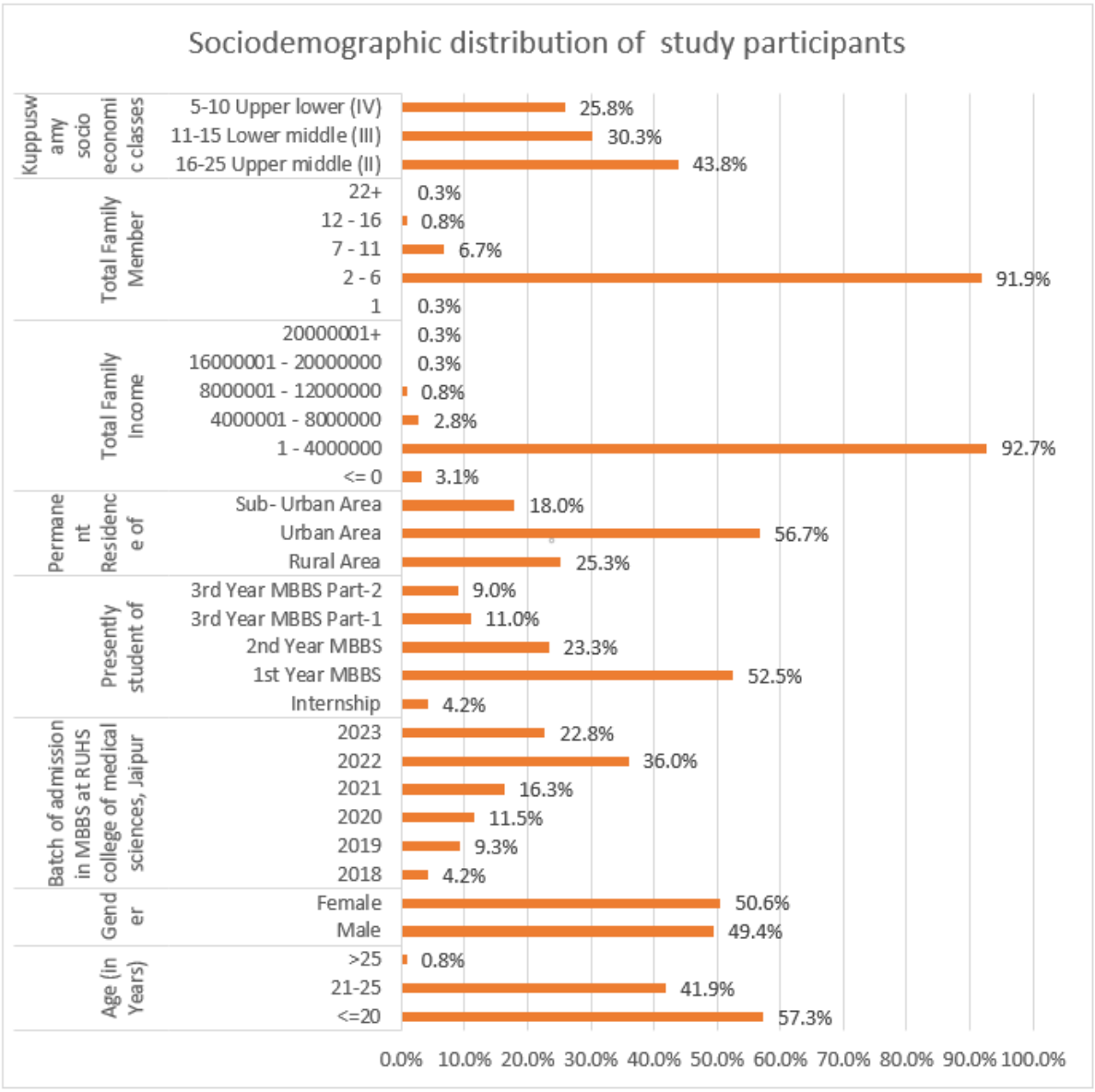
Data Collection Procedure:
Confidentiality was ensured during the data collection through several measures. Firstly, a secure online survey tool (Google Forms) was employed. The study's purpose was clearly explained to the participants, and they were required to provide informed consent before commencing the questionnaire. Participants could withdraw from the survey at any time. The questionnaire was designed to be completed in an average of 5 minutes, and each participant was allowed to complete it only once. The data collection was conducted between December 2023 and January 2024. The findings should be interpreted with caution and may not be generalizable to populations without similar digital access. Data confidentiality was maintained through anonymous data collection, restricted access to response files, password-protected accounts, and reporting of aggregated results. Google Forms' secure HTTPS-based data transmission was utilised during survey administration. All data was saved on Google Drive after processing for security reasons.

An academic team comprising five senior faculty and two AI experts from technical colleges revised the questionnaire to guarantee the questionnaire's authenticity and align with this study's aims. This process included evaluating the items for clarity of language to prevent ambiguous statements and customizing them to ensure they were unbiased, with recommendations based on their input. A pilot study was conducted with 25 students to assess the questionnaire's readability and gauge the data's dependability. The pilot group was not included in the final analysis. The reliability of the items was determined using Cronbach's alpha, which was deemed acceptable (.976) as the value was greater than 0.7.

Statistical analysis: Analysis was done using SPSS-26 software. Data were analyzed using descriptive statistics and appropriate non-parametric tests for categorical and Likert-scale variables. The degree of agreement on the Likert scale was documented. The responses were consolidated into two categories by merging the "strongly agree" and "agree" options, as well as the "strongly disagree" and "disagree" options. The responses to the questions are expressed as percentages and presented in the table. The significance level was set at a p-value of ≤ 0.05.

Results:

Figure 1: Sociodemographic characteristics of the participants



This study included a total of 356 participants. The distribution of sociodemographic variables is summarized in Figure 1. The majority of participants (57.3%, n=204) were aged 20 years or younger. The sex distribution was relatively balanced, with 49.4% (n=176) male participants and 50.6% (n=180) female participants. Most participants were 1st-year MBBS students (52.5%, n=187) and resided in urban areas (56.7%, n=202). A significant majority (92.7%, n=330) had a family income ranging from 1 to 4,000,000, and 91.9% (n=327) reported having 2-6 family members. The largest socioeconomic group was the upper middle class (II) (43.8%, n=156).

Table 1: Participants' awareness toward the use of artificial intelligence (AI) in healthcare

AI Application Area	Strongly Disagree (%)	Disagree (%)	Disagree (%) (Strongly Disagree + Disagree)	Neutral (%)	Agree (%)	Strongly Agree (%)	Agree(%) (Agree + Strongly Agree)
Medical imaging (MRI, X-ray, CT)	18.8	5.9	24.7	18.3	36.8	20.2	57.0
Telemedicine	28.9	3.9	32.8	10.1	36.0	21.1	57.1
Virtual health assistants	18.8	4.5	23.3	18.5	37.9	20.2	58.1
Electronic health record management	25.3	5.1	30.4	14.6	34.6	20.5	55.1
Assisted diagnostics	18.3	4.5	22.8	19.4	38.2	19.7	57.9
Drug discovery	29.2	3.7	32.9	14.0	34.0	19.1	53.1
Robotic surgery	15.2	7.9	23.1	24.2	34.8	18.0	52.8
Mental health apps	19.9	4.8	24.7	18.0	37.1	20.2	57.3
Predictive analytics	20.5	4.8	25.3	18.3	36.5	19.9	56.4
Medication management	21.6	4.8	26.4	15.4	37.6	20.5	58.1
Wearables (Fitbit, smart clothing)	18.0	11.0	29.0	22.5	31.5	17.1	48.6
Personalized treatment plans	20.2	4.8	25.0	18.0	34.8	22.2	57.0
Genetic research	22.2	5.1	27.3	20.8	32.6	19.4	52.0
Clinical trials and research	23.0	6.5	29.5	16.0	32.6	21.9	54.5

Emergency medicine	28.9	3.4	32.3	14.3	36.2	17.1	53.3
Healthcare administration	21.3	5.9	27.2	17.4	35.4	19.9	55.3
Epidemiology and public health	25.0	5.3	30.3	15.7	35.1	18.8	53.9

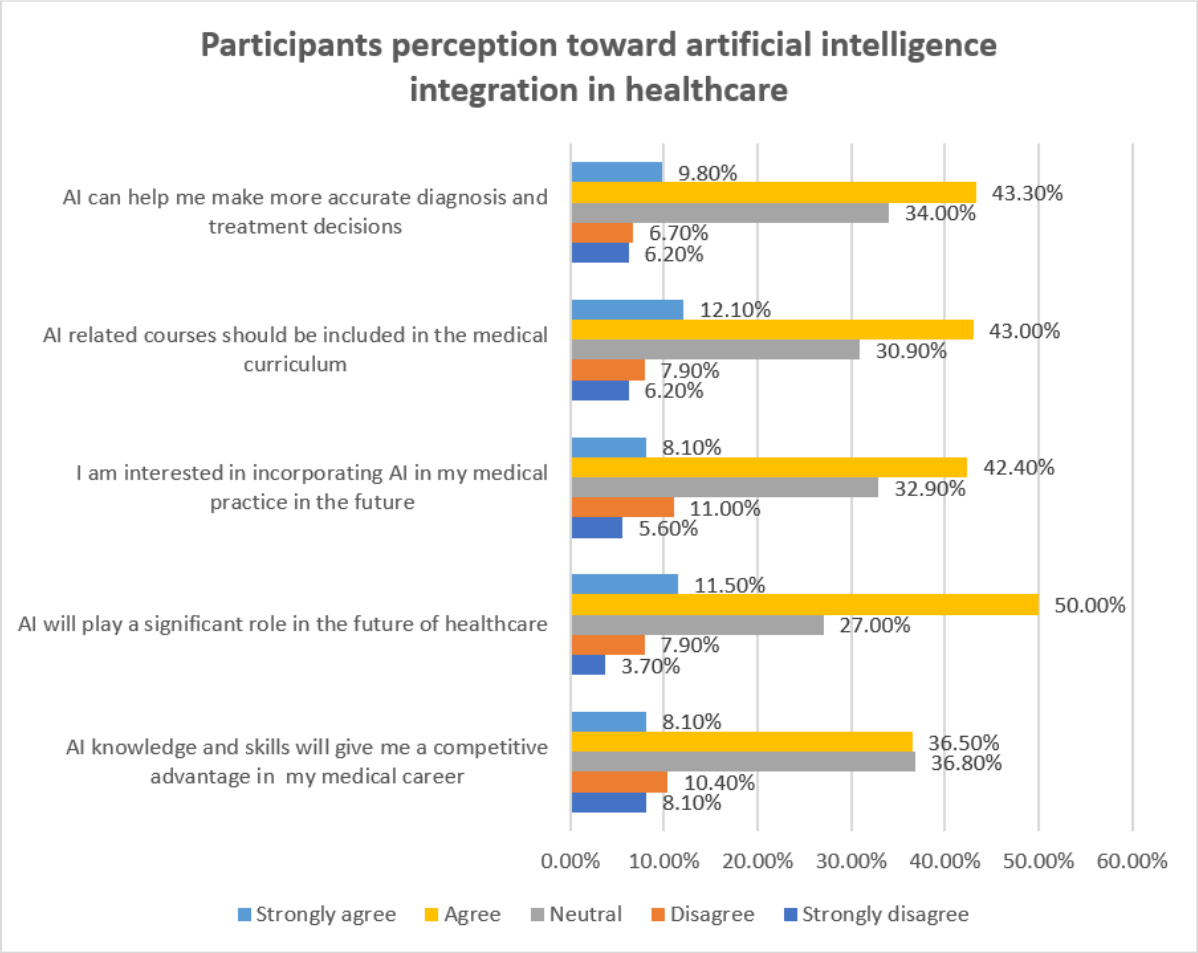
A parallel trend was evident in the data pertaining to the level of familiarity and utilization of artificial intelligence (AI) in healthcare. Combined awareness (Agree + Strongly Agree) across different AI domains ranged from 48.6% to 58.1%. The percentile breakdown indicated that a substantial number of respondents (57%, 57.1%, 58.1%, 57.9%, 53.1%, 52.8%, 57.3%, 57% 53.3%,55.3% 53.9%) knew medical imaging, telemedicine, virtual health assistants, assisted diagnostics, drug discovery, robotics technology in surgery, mental health applications, personalized treatment plans, emergency medicine, healthcare administration, and epidemiology, respectively. Less than 25% of the participants were neutral (Table 2).

Table 3: Participants concerns toward the integration of artificial intelligence (AI) in healthcare

AI Application Area	Strongly Disagree (%)	Disagree (%)	Disagree % (SD+D)	Neutral (%)	Agree (%)	Strongly Agree (%)	Agree % (A+SA)
Job displacement among healthcare professionals	10.7	16.0	26.7	29.5	35.4	8.4	43.8
Over-reliance and decline in medical skills	8.1	15.4	23.5	33.7	32.6	10.1	42.7
Ethical issues (patient data privacy)	8.4	9.8	18.2	34.6	37.1	10.1	47.2
Bias and disparity in healthcare	8.1	14.6	22.7	36.5	31.7	9.0	40.7
Lack of human touch and empathy	7.0	9.0	16.0	28.7	34.3	21.1	55.4
Errors in diagnosis and treatment	8.1	12.6	20.7	35.1	30.3	13.8	44.1

A substantial proportion of participants feared job displacement due to AI (43.8%), while many remained neutral (29.5%). Concerns regarding over-reliance on AI and decline in clinical skills were reported by 42.7% of students. Ethical issues, especially patient data privacy (47.2%) and algorithmic bias (40.7%), were major apprehensions. Loss of human empathy (55.4%) and potential diagnostic or treatment errors (44.1%) further contributed to cautious attitudes toward AI adoption. (Table 3)

Figure 2: Participants' perception toward Artificial Intelligence (AI) integration in healthcare



More than half of the participants, based on combined agree and strongly agree responses, felt that AI could improve diagnostic and treatment decisions (53.1%) and would play a significant role in the future of healthcare (61.5%). Support for inclusion of AI-related courses in the medical curriculum was reported by 55.1%, and 50.5% expressed interest in incorporating AI into future medical practice. However, only 44.6% believed that AI knowledge would provide a competitive advantage in their medical careers, with a substantial proportion remaining neutral. (Figure 2).

Discussion

This cross-sectional study provides valuable insights into the awareness, concerns, and perceptions of undergraduate medical students regarding artificial intelligence (AI) in healthcare. The findings reveal a moderate level of awareness about AI applications in various medical fields. The moderate level of awareness observed in this study likely reflects the limited integration of artificial intelligence into the current Indian medical curriculum. Most undergraduate programs do not include structured instruction in AI, machine learning, or digital health, leading students to rely primarily on informal sources such as social media, popular science content, and general news coverage. In addition, exposure to AI-driven tools in clinical settings remains low in many Indian institutions, where conventional diagnostic and administrative systems predominate. The scarcity of AI-trained faculty and the absence of hands-on learning opportunities further restrict students' ability to engage deeply with AI concepts. Consequently, awareness exists at a surface or conceptual level rather than as an informed understanding of AI's capabilities, limitations, and applications in healthcare. Moderate awareness can be attributed to informal exposure to AI concepts through media, self-learning, or a general academic environment rather than structured education. Students may have encountered AI applications in healthcare indirectly (e.g., medical imaging, telemedicine) through informal coursework, resulting in basic familiarity but limited depth of understanding.

However, significant gaps in knowledge and understanding of advanced AI concepts were identified. The study highlights several concerns among medical students regarding AI integration in healthcare, emphasizing the continued importance of human intervention in patient care.

The valid response rate of 41.88% was comparable to earlier questionnaire-based studies among medical students, being slightly higher than that reported by Jha et al. (37%) and lower than that reported by Kansal et al.[10,11]. Most respondents were first-year students, which is similar to the demographic distribution reported in earlier studies. The gender distribution was relatively balanced, and the majority of participants were within the typical undergraduate age group, consistent with prior reports.[12]

Awareness of AI applications varied across domains, with approximately half of the participants reporting awareness of commonly used applications such as medical imaging and telemedicine. Similar levels of awareness have been reported in previous studies, particularly in radiology-related applications..[13] These findings reflect exposure to visible AI-enabled healthcare tools rather than comprehensive AI literacy. Participants also expressed notable ethical concerns related to privacy, accountability, and potential bias, which align with findings reported by other studies.[14-15] Such concerns may reflect uncertainty about the reliability and governance of AI systems rather than direct experience with clinical AI tools.

More than half of the participants reported not having received formal education or training in AI, consistent with earlier studies, indicating a perceived gap between technological advancement and undergraduate medical curricula.[11-16] However, this perception alone does not establish curriculum inadequacy and should be interpreted in the context of limited formal AI exposure in most medical programs. A substantial proportion of participants in the present study agreed that integration of artificial intelligence in healthcare may lead to job displacement among healthcare professionals, which is consistent with findings reported in previous studies.[17-18] However, contrasting results were reported by Teng et al. in their countrywide survey of healthcare students in Canada, where most respondents did not perceive AI as a threat to employment but rather viewed it as a tool to assist clinicians and improve efficiency in clinical practice.[19]This difference in perception may reflect variations in exposure to AI technologies, institutional emphasis on AI as a supportive clinical aid, and greater integration of digital health education within medical curricula in high-income countries. These contextual differences may influence whether students perceive AI as a replacement for, or complement to, healthcare professionals.

Participants in this study expressed substantial ethical concerns regarding the use of AI in healthcare, particularly related to data privacy, confidentiality, patient safety, and the potential erosion of humanistic values in medical practice.[20] These findings are consistent with integrative reviews emphasizing that AI adoption must consider data security, perceived usefulness, technical limitations, and broader social and ethical implications beyond purely medical factors.[21-22] Nearly one-third of participants were concerned about algorithmic bias and healthcare disparities, which aligns with evidence that AI systems may perform poorly in underrepresented populations and that limited model transparency reduces clinician trust.[23]

Students also perceived AI-based clinical decisions as lacking human touch and empathy, reinforcing concerns that AI cannot replicate essential emotional and relational aspects of patient care.[22-24] This highlights the continued necessity of human oversight in clinical decision-making. Additionally, many participants believed that AI could generate diagnostic and treatment errors, particularly in complex or atypical cases, due to limitations in specialized training datasets.[25] Similar apprehensions have been reported among medical students, who view AI as potentially increasing medico-legal and professional risks. .[16] Systematic reviews identify gaps in interdisciplinary training, regulatory frameworks, and access to high-quality datasets as major barriers to safe AI implementation. [23] Other studies suggest that AI may reduce medical errors when appropriately deployed.[26] These contrasting views further support the need for structured education on both the capabilities and limitations of AI to promote informed, responsible clinical use.

The findings suggest that a substantial proportion of students perceive value in AI education, indicating a potential need for gradual and structured inclusion of AI-related topics in medical curricula. High neutrality may indicate uncertainty, limited personal experience with AI tools, lack of confidence in evaluating AI's benefits or risks, and unfamiliarity with technical or ethical nuances. Neutral responses may also reflect response fatigue or hesitancy to take strong positions on emerging technologies without adequate knowledge. High neutral responses likely reflect uncertainty or ambivalence among participants due to limited in-depth knowledge or experience with AI. Given the lack of formal AI training reported by most students, many may not have formed strong opinions about AI's impact, benefits, or risks, leading to a cautious or undecided stance on Likert scale items. The large proportion of neutral responses across awareness, concerns, and perception domains suggests substantial uncertainty among students. This neutrality may indicate that many students do not feel confident taking a definitive stance due to limited personal experience with AI, insufficient curricular exposure, and a lack of clarity about AI's actual use in real-world clinical practice. Neutral responses may also reflect cognitive hesitation common in emerging technologies, in which students may prefer to avoid extreme positions until they acquire more knowledge. Additionally, some degree of survey central-tendency bias—where respondents select the middle option to avoid commitment—may have contributed. Overall, the high level of neutrality underscores the need for structured instruction and practical demonstrations to enable students to form well-informed opinions.

More than half of the medical students supported the inclusion of formal AI-related courses in the undergraduate curriculum and expressed interest in integrating AI tools into their future clinical practice, indicating a generally positive attitude toward digital transformation in healthcare[27]. These findings are consistent with previous studies reporting strong student interest in acquiring AI competencies during medical training.[28-29] A majority of participants also believed that AI would play a pivotal role in shaping the future of healthcare by enhancing diagnostic accuracy, clinical efficiency, and decision-making processes, which concurs with earlier reports highlighting AI's transformative potential in medicine.[29] However, opinions were divided regarding whether AI would provide a competitive advantage in medical careers, suggesting uncertainty about how AI skills translate into professional opportunities. Similarly, Banerjee et al. observed that while students perceived AI as beneficial for medical education and workload

reduction, perceptions regarding its direct impact on career advancement and professional differentiation remained variable.[30]

This study has several limitations. Self-reporting in surveys can introduce potential bias and cause both overestimation and underestimation. Moreover, the use of a questionnaire-based study design has inherent limitations. Distributing the Google Form through WhatsApp may introduce selection bias, as participation is limited to individuals with smartphone access, active WhatsApp use, and internet connectivity, which may affect the representativeness of the sample. Thus, a qualitative or mixed-method design might have been more suitable. The findings cannot be generalized to all medical students across different academic phases. Although high internal consistency supports reliability, it may also reflect limited item diversity. Future studies will consider refining and shortening the questionnaire to reduce redundancy while maintaining construct validity.

Conclusions

This study demonstrates that while a moderate proportion of undergraduate medical students are aware of AI applications in healthcare, significant gaps remain in formal training and in-depth knowledge. Concerns persist regarding job displacement, ethical issues such as patient privacy, potential biases, loss of human empathy, and the risk of AI errors in diagnosis and treatment. Despite these apprehensions, over half of the participants recognise AI's potential to enhance diagnostic accuracy and healthcare outcomes and support the integration of AI education into medical curricula. These findings underscore the urgent need to incorporate comprehensive AI-related training into medical education better to prepare future healthcare professionals for the evolving digital landscape, address ethical challenges, and optimise the benefits of AI in clinical practice. Further research is warranted to explore effective educational strategies and the long-term impact of AI integration on healthcare delivery and medical training.

References

1. Hamet P, Tremblay J. Artificial intelligence in medicine. Metabolism. 2017;69(Suppl):S36–40. doi:10.1016/j.metabol.2017.01.011

2. Schwab K. The fourth industrial revolution. London: Penguin Random House. 2017.

3. Briganti G, Le Moine O. Artificial intelligence in medicine: Today and tomorrow. Front Med (Lausanne). 2020;7:27. doi:10.3389/fmed.2020.00027

4. Reinsel D, Gantz J, Rydning J. The digitization of the world from edge to core. Seagate; 2018. Available from: https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf

5. Topol E. Preparing the healthcare workforce to deliver the digital future. NHS Health Education England; 2019. Available from: https://topol.hee.nhs.uk/wp-content/uploads/HEE-Topol-Review-2019.pdf

6. Benjamens S, Dhunnoo P, Meskó B. The state of artificial intelligence-based FDA-approved medical devices and algorithms: An online database. NPJ Digit Med. 2020;3(1):118. doi:10.1038/s41746-020-00324-0

7. Kolachalama VB, Garg PS. Machine learning and medical education. NPJ Digit Med. 2018;1:54. doi:10.1038/s41746-018-0061-1

8. Teng M, Singla R, Yau O, Lamoureux D, Gupta A, Hu Z, et al. Health care students' perspectives on artificial intelligence: Countrywide survey in Canada. JMIR Med Educ. 2022;8(1):e33390. doi:10.2196/33390

9. Sun L, Yin C, Xu Q, Zhao W. Artificial intelligence for healthcare and medical education: a systematic review. Am J Transl Res. 2023;15(7):4820–8.

10. Jha N, Shankar PR, Al-Betar MA, Mukhia R, Hada K, Palaian S. Undergraduate medical students' and interns' knowledge and perception of artificial intelligence in medicine. Adv Med Educ Pract. 2022;13:927–37. doi:10.2147/AMEP.S368519

11. Kansal R, Bawa A, Bansal A, Trehan S, Goyal K, Goyal N, et al. Differences in knowledge and perspectives on the usage of artificial intelligence among doctors and medical students of a developing country: A cross-sectional study. Cureus. 2022;14(1):e21434. doi:10.7759/cureus.21434

12. Amiri H, Peiravi S, Rezazadeh Shojaee SS, Rouhparvarzamin M, Nateghi MN, Etemadi MH, et al. Medical, dental, and nursing students' attitudes and knowledge towards artificial intelligence: A systematic review and meta-analysis. BMC Med Educ. 2024;24(1):412. doi:10.1186/s12909-024-05406-1

13. Barreiro-Ares A, Morales-Santiago A, Sendra-Portero F, Souto-Bayarri M. Impact of the rise of artificial intelligence in radiology: What do students think? Int J Environ Res Public Health. 2023;20(2):1589. doi:10.3390/ijerph20021589

14. Mehta N, Harish V, Bilimoria K, Morgado F, Ginsburg S, Law M, Das S. Knowledge and attitudes on artificial intelligence in healthcare: a provincial survey study of medical students. MedEdPublish. 2021;10:75. doi:10.15694/mep.2021.000075.1

15. Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019;6(2):94–8. doi:10.7861/futurehosp.6-2-94

16. Mousavi Baigi SF, Sarbaz M, Ghaddaripouri K, Ghaddaripouri M, Mousavi AS, Kimiafar K. Attitudes, knowledge, and skills towards artificial intelligence among healthcare students: A systematic review. Health Sci Rep. 2023;6:e1138. doi:10.1002/hsr2.1138

17. Oh S, Kim JH, Choi SW, Lee HJ, Hong J, Kwon SH. Physician confidence in artificial intelligence: An online mobile survey. J Med Internet Res. 2019;21(3):e12422. doi:10.2196/12422

18. Doganer A. The approaches and expectations of the health sciences students towards artificial intelligence. Karya J Health Sci. 2021;2:5–11.

19. Teng M, Singla R, Yau O, et al. Health care students' perspectives on artificial intelligence: countrywide survey in Canada. JMIR Med Educ. 2022;8:e33390. doi:10.2196/33390

20. Civaner MM, Uncu Y, Bulut F, Chalil EG, Tatli A. Artificial intelligence in medical education: a cross-sectional needs assessment. BMC Med Educ. 2022;22(1):772. doi:10.1186/s12909-022-03852-3

21. Lo B. Resolving ethical dilemmas: a guide for clinicians. Baltimore (MD): Lippincott Williams & Wilkins; 2012.

22. Aghabarary M, Dehghan Nayeri N. Medical futility and its challenges: a review study. J Med Ethics Hist Med. 2016;9:11.

23. Chen M, Zhang B, Cai Z, Seery S, Gonzalez MJ, Ali NM, et al. Acceptance of clinical artificial intelligence among physicians and medical students: A systematic review with cross-sectional survey. Front Med. 2022;9:990604. doi:10.3389/fmed.2022.990604

24. Wartman S, Combs C. Reimagining medical education in the age of AI. AMA J Ethics. 2019;21(2):E146–52. doi:10.1001/amajethics.2019.146

25. Sarwar S, Dent A, Faust K, Richer M, Djuric U, Van Ommeren R, et al. Physician perspectives on integration of artificial intelligence into diagnostic pathology. NPJ Digit Med. 2019;2:28. doi:10.1038/s41746-019-0106-0

26. Ahmad MN, Abdallah SA, Abbasi SA, Abdallah AM. Student perspectives on the integration of artificial intelligence into healthcare services. Digit Health. 2023;9:20552076231174095. doi:10.1177/20552076231174095

27. Al Hadithy ZA, Al Lawati A, Al-Zadjali R, Al Sinawi H. Knowledge, attitudes, and perceptions of artificial intelligence in healthcare among medical students at Sultan Qaboos University. Cureus. 2023;15(9):e44887. doi:10.7759/cureus.44887

28. Bisdas S, Topriceanu CC, Zakrzewska Z, Irimia AV, Shakallis L, Subhash J, et al. Artificial intelligence in medicine: a multinational multi-center survey on the medical and dental students' perception. Front Public Health. 2021;9:795284. doi:10.3389/fpubh.2021.795284

29. Jebreen K, Radwan E, Kammoun-Rebai W, Alattar E, Radwan A, Safi W, et al. Perceptions of undergraduate medical students on artificial intelligence in medicine: mixed-methods survey study from Palestine. BMC Med Educ. 2024;24(1):507. doi:10.1186/s12909-024-05465-4

30. Banerjee M, Chiew D, Patel KT, Johns I, Chappell D, Linton N, et al. The impact of artificial intelligence on clinical education: perceptions of postgraduate trainee doctors in London (UK) and recommendations for trainers. BMC Med Educ. 2021;21(1):429. doi:10.1186/s12909-021-02870-x