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Medical Students' Knowledge of Artificial Intelligence and Their Perspectives towards Applying It in The Medical Field

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Abstract

Background:
The current applications of Artificial intelligence (AI) in medical practice is limited, reflecting a resistance to change and possibly misperceptions. This limited AI exposure during study and practice impacted students' future career decision-making. This study aims to evaluate the baseline knowledge of the medical students of AI and their perspectives.

Methods:
This is a cross-sectional study that was conducted at Suez Canal, Cairo and King Salman International Universities, Faculties of Medicine, Egypt. A structured valid online questionnaire was used to collect data.

Results:
Regarding perception towards AI application in medical teaching, 44% to 81% of students have positive perception with the lowest was for "artificial intelligence can replace traditional teaching methods" and the highest was for "It is important for universities to integrate artificial intelligence into their medical education". A range from 47% to 83% of students have positive perception towards AI application in clinical practice, with the lowest was for "artificial intelligence will replace some specialties" and the highest was for "artificial intelligence can aid in medical research". Perceptions of participants towards the possible influences of AI on patients, a range 48% to 76% of students have positive perception with the lowest for "AI negatively affects the relationship of the physician with the patient" and the highest was for "artificial intelligence facilitates patients' access to the service".

Conclusion:
Almost half of the responses were positive concerning the general perception towards AI and its utility in medical teaching and clinical practice and also towards its possible influences on patients.

Keywords:
Artificial intelligence (AI), perspectives, medical students.

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Introduction:

Artificial Intelligence (AI) comprises technologies that empower computers to conduct many advanced tasks, encompassing comprehension and translation of spoken and written language, computer vision, data analysis, problem-solving, and generating recommendations. It helps humanity and simplifies some operations rather than replacing human positions (1). In contrast to traditional technology, AI algorithms can adapt to new information and follow "thought processes" like to those of the human brain, therefore assisting professionals in making informed data-driven decisions (2). AI diverges from psychology due to its focus on computing, while it distinguishes itself from computer science via its emphasis on perception, reasoning, and action. It enhances the intelligence and utility of machines via the use of artificial neurons and scientific principles. AI technology has advanced enough to provide real practical benefits across several applications (3).

The principal domains of AI include computer vision and scene recognition, expert systems, natural language processing, voice recognition, intelligent computer-aided instruction, robotics and sensory systems, and neural computing (4). The AI is spreading worldwide in many sectors including economics, transportation, manufacturing, education, and healthcare (5). Developed countries have allocated substantial resources towards the research and application of AI in the healthcare sector (6,7). While in developing countries, the scarcity of current resources has been exacerbated by the Covid pandemic, and knowledge in AI and its practical use in healthcare is crucial for alleviating workload and minimizing diagnostic mistakes (8).

AI in the medical field is advancing swiftly, with the capacity to revolutionize several aspects of healthcare, such as diagnosis, treatment planning, and personalized medicine (9). The AI utility is increasing and becoming popular in several medical sectors; encompassing dermatology, ophthalmology, pathology and others (10).

This deep integration of AI and medicine must have its impact, as it can spare time for busy doctors, help in remote diagnosis of patients, and allow the spread of medical services into rural regions, while also mitigating certain limitations associated with traditional diagnostic and treatment methods (11). But besides these advantages there are many concerns such as the ethical implications regarding privacy and data security and the possibility for bias in the algorithms used and the risk that AI may replace physicians, leading to the loss of human input and empathy in medical practice, (12). Despite the improvement of AI in medicine, the use of its applications in medical practice is relatively limited, reflecting a resistance to change and possibly misperceptions with negative attitudes held by physicians and future doctors. (12) and this limitation had been found to stimulate anxiety in undergraduate medical students, impacting their future career decision-making (13).

In the field of medical education, artificial intelligence (AI) has several implications and is integrated into many aspects. It can assist teachers in their teaching journey from curriculum development to teaching and learning to student assessment, or it can assist students in their learning journey by giving them access to various learning resources and assisting them with their assignments. (14).

AI tools have advanced recently; some, like ChatGPT and other chatbots, can assist with content creation, while others, like Packback Questions, can facilitate discussions and give students feedback (15).

AI writing tools may assist with sentence paraphrasing, argument construction, and advanced grammatical checks to guarantee linguistic precision and clarity. AI may assist in the construction of presentations, diagrams, and graphics during the last phases of research to help spread the results and effectively explain complicated material. Those AI tools are either free or incur a financial charge, such as ChatGPT (or any other chatbot), (16).

Awareness of AI is growing among medical students, and earlier studies regarding the knowledge and perspectives of medical students in many countries around the world showed they have a positive attitude towards AI, they had good information about AI and were keen to learn more, but minimal education was included in their medical curriculum (17,18). Medical education must evolve with advancements in medical practice, necessitating the incorporation of AI into medical school curriculum to ensure that both medical professionals and students comprehend the principles and applications of AI for optimal use. Future physicians need to possess expertise in both biomedical and clinical sciences, as well as the ability to adapt to evolving technologies (19, 20).

Different studies have recently discussed medical students' perspectives towards AI. In Ain Shams university research indicates that the majority of students exhibited moderate (41.2%) to good (57.7%) knowledge and attitudes about AI and its use in medical education, as well as moderate levels of knowledge and attitude regarding AI and its application in medical practice). (21), while at Kuwait University, over fifty percent of students comprehended the fundamental principles of AI, with the majority believing that AI education would enhance their career prospects (1). In China, nearly two-thirds of studies indicated a 65% or greater awareness of clinical AI applications (11).

Several factors may influence medical students' perspectives, such as their exposure to AI in medical education, their comprehension of the advantages and disadvantages of AI, and their own career ambitions (22). Studies on the knowledge and attitude of medical students are limited in Africa, especially in Egypt where limited AI applications in the curriculum and practice are observed, which can lead to a broad knowledge gap of misconceptions. There is a significant need to evaluate medical students' perspectives of AI, and therefore the aim of this study is to evaluate the baseline knowledge of the medical students about AI and their perspectives towards applying it in the medical field.

Subjects and methods

Study design:

This is a cross-sectional descriptive study.

Study setting:

Faculty of Medicine at Suez Canal, Cairo, and King Salman International University, Egypt.
Study duration: The study was conducted from February 2024 to October 2024.

Study population:

Medical students at Suez Canal, Cairo, and King Salman International University, Faculty of Medicine.

Inclusion criteria:

-Participants Consent to participate
-Undergraduate medical students from the 3 medical institutions (Suez canal, Cairo and King Salman)
-Both males and females are included

Exclusion criteria:

-Participants that are not included in the selected universities or in other faculties rather than the faculty of medicine
-Fifth year medical students who were busy in final exams of bachelor's degree of medicine

Sample size:

The sample size was estimated by utilizing Epi Info Software for sample size calculation (Version 7.2.5.0) available at www.openepi.com, setting the confidence level at 95%, margin of error ± 0.05, and assuming total population in three selected faculties to be 15000 students. After reviewing previous study results (23) showing that the percentage of Arab medical students believed in the importance of AI in revolutionizing medicine was (84%); Based on that, a sample size of at least (204) undergraduate medical students was calculated. After adding a no-response rate of 10%, a sample of 225 participants was required.

Sampling technique:

A convenience sample was used to select three faculties for easy accessibility for the investigators. Then by a stratified fixed random sample method, participants were enrolled from the three selected faculties. The list of all students in each faculty of medicine was obtained. Then, by using a computerized list of medical students in each university to obtain the targeted sample size. The selected students were contacted via student's E-mail address to be enrolled in the study. Throughout the research duration, reminders were sent to complete the questionnaire.

Data collection tool:

An online structured questionnaire (Google form) was sent to the students. The questionnaire was derived from a valid questionnaire used by Buabbas et al., 2023 and Khater et al, 2023 (1, 21). At the start of the study there were some questions to confirm the agreement of the participants, if there were students at Suez Canal, Cairo, and KSIU and if they studied medicine and surgery course. We used an internal feature in Google form to prevent multiple responses from a single participant

The online questionnaire included:

-Informed consent form.
-First part: Socio-demographic characteristics such as: (name, sex, age, residency, study year level, family education and occupation)
-Second part: questionnaire assessed students' general perception towards artificial intelligence including six questions. The first question was asking if they have ever thought about AI before or not and response was yes, no or I don't know, while responses to other five items are on a five point Likert scale from strongly agree to strongly disagree.
-Third part: questionnaire assessed students' perspectives about application of AI in teaching including seven questions. Responses on a Likert scale from strongly agree to strongly disagree.
-Fourth part: questionnaire assessed students' perspectives about application of AI in medical field practice and effect on the patients including fifteen questions. Responses on a Likert scale from strongly agree to strongly disagree.

Statistical analysis:

Data was statistically analyzed utilizing the SPSS software (Ver. 23). Descriptive statistics were used to analyze the data, including frequencies and percentages for qualitative data. Means and standard deviations or median and interquartile range for quantitative data according to Shapiro-Wilk normality test were calculated. P values of ≤ 0.05 were considered statistically significant with confidence interval 95%. Chi^2 test was used to compare the groups as data was not normally distributed.

Results:

A total sample of 249 medical students were included. The mean age of the participating students was 20.14 (±1.28). In terms of gender, about two thirds were males (64.7%) with nearly two thirds of the students live in urban areas (61%). Regarding the academic achievement in the last year, (42.2%) of students got "Excellent" degrees followed by one third of students getting "Very Good" degrees (32.5%). As for father and mother's educational level, about three quarters having high education (77.9% and 75.1% respectively). With regard to Father and mother's occupation, close to half of fathers have professional work (54.2%) whereas two fifths of mothers don't work (41.4%). Slightly more than one third of the students (38.6%) were from third grade followed by nearly one quarter from the first grade (26.1%) (Table 1). Concerning the general perception towards AI, the responses of students who have positive perception (agree and strongly agree) ranged from 54% to 77% with lowest was for "I am familiar with AI limitations" and the highest was for "I am familiar with the concept of artificial intelligence (AI)" (Table 2). Regarding perception of the study participants towards AI application in medical teaching, the responses of students who have positive perception (agree and strongly agree) ranged from 44% to 81% with lowest was for "AI can replace traditional teaching method" and the highest was for "It is important for universities to integrate AI technologies into their medical education" (Table 3). The results about perception towards AI application in clinical practice ranged from 47% to 83% for students who have positive perception with the lowest was for "AI will replace some specialties in healthcare" and the highest was for "AI can aid in medical research" (figure 1). As for perceptions of study participants towards the possible influences of AI on patients, our study revealed that responses of students who have positive perception (agree and strongly agree) ranged from 48% to 76% with the lowest for "AI negatively affects the relationship of the physician with the patient and violations of patients' confidentiality may occur more" and the highest was for "AI facilitates patients' access to the service (figure 2). Concerning medical students who have been taught about AI, about two thirds mentioned that they have never been taught about AI and there was no statistical significant difference between three universities (figure 3& Table 4). Regarding source of knowledge about AI, over half of participant reported extracurricular source of knowledge about AI (149, 59.8%), less than quarter (36, 14.4%) reported curricular in my collage and almost one-quarter reported both (64, 25.7%).

Table 1: Comparison between the three studied groups according to Sociodemographic data (N = 249):

Sociodemographic data	Total (n = 249)	SCU (n = 83)	Cairo (n = 83)	KSIU (n = 83)	Test of Sig.	p
Age (years)						
Min. – Max.	18 – 25	18 – 25	18 – 23	18 – 24		
Mean ± SD.	20.14 ± 1.28	20.17 ± 1.30	19.83 ± 1.12	20.42 ± 1.36	$F=4.552^{*}$	0.011^{*}
Median (IQR)	20 (19 – 21)	20 (19.5 – 21)	20 (19 – 21)	20 (19.5 – 21)		
Sig. bet. grps.		$p_1=0.200, p_2=0.403, p_3=0.008^{*}$				
Gender						
Male	161 (64.7%)	55 (66.3%)	52 (62.7%)	54 (65.1%)	$\chi^2=0.246$	0.884
Female	88 (35.3%)	28 (33.7%)	31 (37.3%)	29 (34.9%)		
Residency						
Urban	152 (61.0%)	53 (63.9%)	52 (62.7%)	47 (56.6%)	$\chi^2=1.047$	0.592
Rural	97 (39.0%)	30 (36.1%)	31 (37.3%)	36 (43.4%)		
Academic achievement in the last year						
Accepted	23 (9.2%)	9 (10.8%)	8 (9.6%)	6 (7.2%)	$\chi^2=3.253$	0.776
Good	40 (16.1%)	13 (15.7%)	14 (16.9%)	13 (15.7%)		
Very good	81 (32.5%)	27 (32.5%)	22 (26.5%)	32 (38.6%)		
Excellent	105 (42.2%)	34 (41.0%)	39 (47.0%)	32 (38.6%)		
Father's educational level						
Illiterate	1 (0.4%)	1 (1.2%)	0 (0.0)	0 (0.0)	$\chi^2=4.998$	$^{MC}p=0.527$
Read and write /Primary	8 (3.2%)	2 (2.4%)	4 (4.8%)	2 (2.4%)		
Preparatory /Secondary	46 (18.5%)	18 (21.7%)	11 (13.3%)	17 (20.5%)		
High education	194 (77.9%)	62 (74.7%)	68 (81.9%)	64 (77.1%)		

Mother's education level						
Illiterate	5 (2.0%)	3 (3.6%)	2 (2.4%)	0 (0.0)	χ^2=9.913	^{MC}p=0.098
Read and write /Primary	10 (4.0%)	1 (1.2%)	5 (6.0%)	4 (4.8%)		
Preparatory /Secondary	47 (18.9%)	21 (25.3%)	10 (12.0%)	16 (19.3%)		
High education	187 (75.1%)	58 (69.9%)	66 (79.5%)	63 (75.9%)		
Father's occupation						
Not work	4 (1.6%)	1 (1.2%)	3 (3.6%)	0 (0.0)	χ^2=5.619	0.443
Employee	103 (41.4%)	35 (42.2%)	31 (37.3%)	37 (44.6%)		
Professional work	135 (54.2%)	45 (54.2%)	48 (57.8%)	42 (50.6%)		
Retired	7 (2.8%)	2 (2.4%)	1 (1.2%)	4 (4.8%)		
Mother's occupation						
Not work	103 (41.4%)	31 (37.3%)	38 (45.8%)	34 (41.0%)	χ^2=7.479	^{MC}p=0.267
Employee	84 (33.7%)	31 (37.3%)	21 (25.3%)	32 (38.6%)		
Professional work	54 (21.7%)	17 (20.5%)	23 (27.7%)	14 (16.9%)		
Retired	8 (3.2%)	4 (4.8%)	1 (1.2%)	3 (3.6%)		
Education level						
1st year	65 (26.1%)	28 (33.7%)	21 (25.3%)	16 (19.3%)	χ^2=91.045*	<0.001*
2nd year	53 (21.3%)	0 (0.0)	34 (41.0%)	19 (22.9%)		
3rd year	96 (38.6%)	55 (66.3%)	19 (22.9%)	22 (26.5%)		
4th year	35 (14.1%)	0 (0.0)	9 (10.8%)	26 (31.3%)		

IQR: Inter quartile range SD: Standard deviation χ^2: Chi square test
MC: Monte Carlo
F: F for One way ANOVA test, Pairwise comparison bet. each 2 groups was done using Post Hoc Test (Tukey)
p: p value for comparing between the three studied groups
p_1: p value for comparing between SCU and Cairo
p_2: p value for comparing between SCU and KSIU
p_3: p value for comparing between CAIRO and KSIU *: Statistically significant at $p \leq 0.05$

Table (2): Comparison between the three studied groups according to General perception towards artificial intelligence (N=249)

General perception towards artificial intelligence		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	χ^2	p
I am familiar with the concept of artificial intelligence (AI)	SCU (n = 83)	28 (33.7%)	34 (41.0%)	17 (20.5%)	3 (3.6%)	1 (1.2%)	7.357	^{MC}p= 0.473
	Cairo (n = 83)	25 (30.1%)	36 (43.4%)	20 (24.1%)	2 (2.4%)	0 (0.0%)		
	Ksiu (n = 83)	28 (33.7%)	40 (48.2%)	10 (12.0%)	5 (6.0%)	0 (0.0%)		
I am familiar with AI terminologies	SCU (n = 83)	16 (19.3%)	32 (38.6%)	23 (27.7%)	11 (13.3%)	1 (1.2%)	8.091	0.425
	Cairo (n = 83)	11 (13.3%)	36 (43.4%)	30 (36.1%)	6 (7.2%)	0 (0.0%)		
	Ksiu (n = 83)	14 (16.9%)	41 (49.4%)	19 (22.9%)	9 (10.8%)	0 (0.0%)		
I am familiar with AI principles	SCU (n = 83)	15 (18.1%)	35 (42.2%)	22 (26.5%)	9 (10.8%)	2 (2.4%)	12.520	0.129
	Cairo (n = 83)	10 (12.0%)	32 (38.6%)	35 (42.2%)	6 (7.2%)	0 (0.0%)		
	Ksiu (n = 83)	12 (14.5%)	45 (54.2%)	19 (22.9%)	5 (6.0%)	2 (2.4%)		
I am familiar with various AI tools available for medical purposes	SCU (n = 83)	20 (24.1%)	32 (38.6%)	20 (24.1%)	10 (12.0%)	1 (1.2%)	13.962	0.083
	Cairo (n = 83)	14 (16.9%)	29 (34.9%)	34 (41.0%)	6 (7.2%)	0 (0.0%)		
	Ksiu (n = 83)	13 (15.7%)	43 (51.8%)	17 (20.5%)	9 (10.8%)	1 (1.2%)		

I am familiar with AI limitations	SCU (n = 83)	16 (19.3%)	23 (27.7%)	31 (37.3%)	10 (12.0%)	3 (3.6%)	25.917*	0.001*
	Cairo (n = 83)	6 (7.2%)	32 (38.6%)	39 (47.0%)	6 (7.2%)	0 (0.0%)		
	Ksiu (n = 83)	16 (19.3%)	41 (49.4%)	17 (20.5%)	9 (10.8%)	0 (0.0%)		

χ^2: Chi square test MC: Monte Carlo
p: p value for comparing between the three studied groups*: Statistically significant at $p \leq 0.05$

Table 3: Perception of the study participants towards AI application in medical teaching(N=249):

Characteristic	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Medical students should receive AI teaching	79, (31.73%)	114, (45.78%)	47, (18.88%)	5, (2.008%)	4, (1.60%)
Incorporating AI system in medical education would ease your learning process	68, (27.31%)	123, (49.40%)	50, (20.08%)	5, (2.008%)	3, (1.20%)
AI will prepare you for real clinical practice	56, (22.49%)	97, (38.96%)	64, (25.70%)	25, (10.04%)	7, (2.81%)
I am confident in my ability to use a technology for learning purposes	75, (30.12%)	109, (43.78%)	56, (22.49%)	7, (2.81%)	2, (0.80%)
It is important for universities to integrate AI technologies into their medical education	77, (30.92%)	124, (49.80%)	41, (16.47%)	4, (1.60%)	3, (1.20%)
It is important for universities to teach students about the ethical implications of AI	75, (30.12%)	119, (47.79%)	44, (17.67%)	7, (2.81%)	4, (1.60%)
AI can replace traditional teaching method	34, (13.65%)	74, (29.72%)	60, (24.10%)	56, (22.49%)	25, (10.04%)

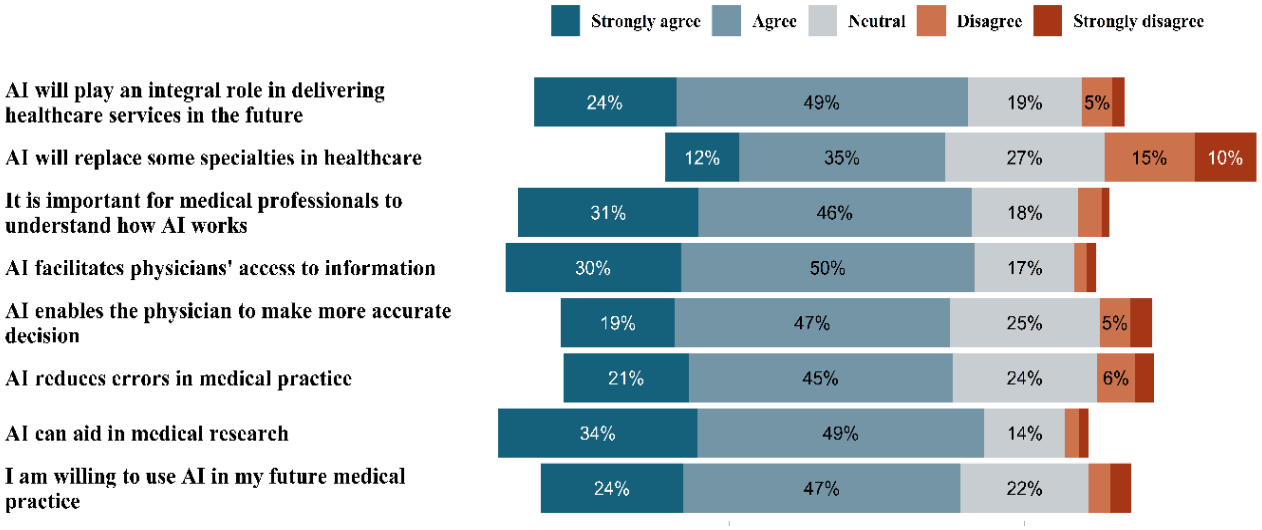

Fig. 1: Perception of study participants towards AI application in clinical practice.

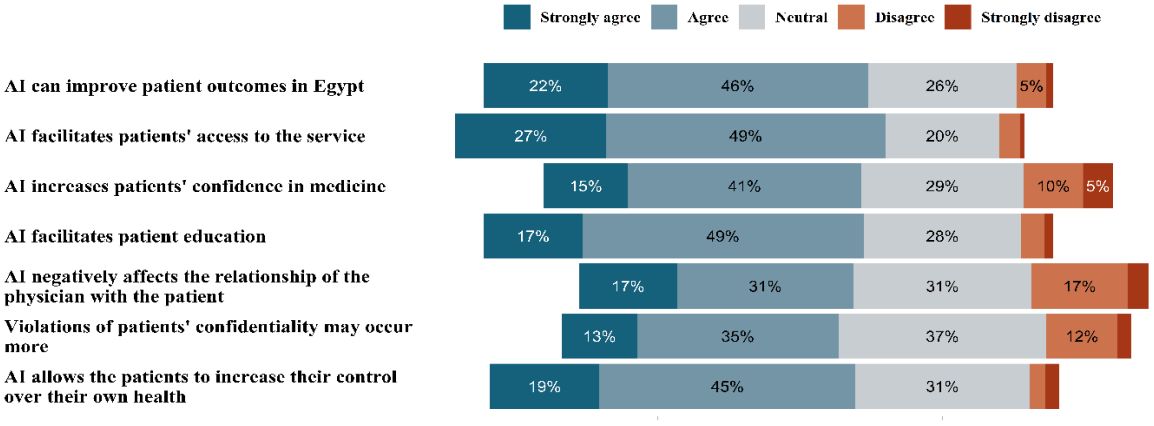

Fig. 2: Perceptions of study participants towards the possible influences of AI on patient.

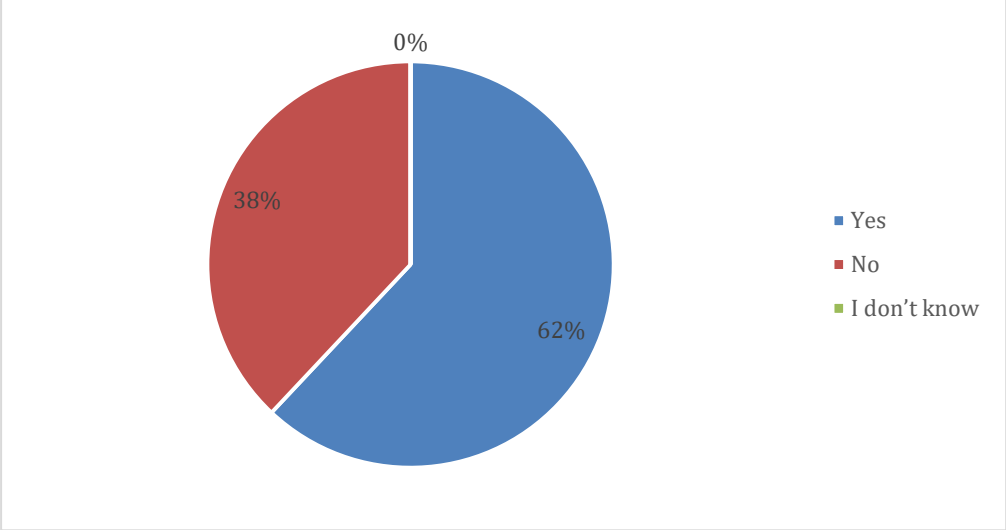

Figure3: Percent distribution of medical students had ever been taught about AI (N=249)

Table (4): Comparison of the three groups under study based on their prior AI education

	Total (n = 249)	SCU (n = 83)	Cairo (n = 83)	KSIU (n = 83)	χ^2	p
Have you ever been taught about AI?						
Yes	155 (62.2%)	48 (57.8%)	55 (66.3%)	52 (62.7%)	1.265	0.531
No	94 (37.8%)	35 (42.2%)	28 (33.7%)	31 (37.3%)		

χ^2: Chi square test
p: p value for comparing between the three studied groups

Discussion

The growing incorporation of AI into medical practice, particularly in recent decades, has resulted in a rise in the utility of various AI tools in medical education. Here, we aim to assess the AI' baseline knowledge of medical students and their perspectives on the utility of AI in the medical field.

Our outcomes concerned the general perception towards AI. The responses of students who have positive perception (agree and strongly agree) towards AI, ranged from 54% to 77% with lowest was for "I am familiar with AI limitations" and the highest was for "I am familiar with the concept of artificial intelligence (AI)". About two thirds of medical students mentioned that they have ever been taught about AI. These outcomes are aligned with earlier studies conducted nationally, regionally, and internationally. Starting with a study in Egypt conducted at Ain Shams University that echoed our outcomes that most of medical students exhibited a moderate to good understanding and perspective regarding AI and its application in medical education and practice. Over 80% of students emphasized the need of integrating AI education into their medical curriculum and predicted that AI will lead to educational revolutionization. Furthermore, over 85% shown eagerness to comprehend the applications of AI in medicine (21).

Similarly, a research performed in Saudi Arabia across 32 universities and medical schools highlights the positive attitudes of Saudi Arabian medical students towards AI application and identifies deficiencies in AI education. To fully employ AI's capability to enhance patient care and advance the medical sciences, it is imperative that these gaps be filled in the education of upcoming healthcare professionals (24). Pharmacy students in Saudi Arabia exhibited predominantly positive perceptions regarding the concepts, advantages, and application of AI, underscoring the necessity for enhanced education and training in this domain. This includes the imperative for early exposure to AI-related content within pharmacy curricula, given the extensive integration of technology in their future careers (25).

Another study conducted in Oman support our findings as not only medical students but also working physicians exhibited positive attitudes and willingness to engage with AI applications in healthcare. Integrating AI learning objectives or brief courses into the medical curriculum would provide doctors with vital skills for an AI-enhanced healthcare system (26).

According to research done among Lebanese students, although there is a knowledge gap on artificial intelligence, students from Mount Lebanon have a more positive attitude towards technology than students from Beirut. (27). In another study targeting the Palestinian medical students, most of them believe that opportunities for learning about AI in medicine are insufficient due to a lack of educational resources. Consequently, it is essential to further study the application of AI in medicine, maintaining an optimistic outlook on its future and the expected challenges within the medical domain (28).

In our study, the perception towards AI application in clinical practice and the possible influences of AI on patients were positive. In a similar vein, a cross-sectional survey carried out at Kuwait University's Faculty of Medicine found that the majority of students thought AI would be significant to the medical field. Over 50% of the students were familiar with the language used in AI and grasped its fundamentals. When they received AI teaching or training, the majority of them thought that learning about AI would help their jobs. Most of them had favorable opinions of AI. Everyone agreed that while AI won't replace doctors, it will fundamentally alter healthcare procedures (1).

Several reasons contributed to the congruence of the results between our research and the aforementioned studies, including the new generation of students' intense interest in technology and artificial intelligence as a new age. Also, we could argue that most of them were hopeful and supported AI as a tool that would help them as future doctors to make sure they made the right diagnosis, suggest a course of treatment, save time, and minimize mistakes. They also thought AI would give them objective evaluation and improve their learning, and they wanted to learn more about AI in medicine and AI training.

Regarding perception of the study participants towards AI application in medical teaching, the responses of students who have positive perception ranged from 44% to 81% with lowest was for “AI can replace traditional teaching method” and the highest was for “It is important for universities to incorporate AI technologies into their medical education”. These results provide significant insights for curriculum creation and the establishment of learning outcomes in AI education for medical students.

This finding are in agreement with several other studies as a study done in Bursa Training and Research Hospital where medical students regarded AI applications positively, and they wanted to gain education and experience in this subject with deep curiosity (29). Allam et al. shown that Arab medical students have a significant deficiency in their understanding and education on AI. They have an optimistic view on the incorporation of AI in medicine and radiology, showing a comprehensive comprehension of its importance for the healthcare system and medical education (23).

The study conducted in Nepal revealed inadequate integration of AI and machine learning in Nepalese medical schools, leading to students' lack comprehension of AI's implications on individual patients and the healthcare system. A heightened perceived eagerness among respondents to learn about AI is a positive sign and a robust predictor of possible advantageous curricular modifications (30). Another related study supports this as there is an urgent need to integrate the teaching of AI and AI ethics into the medical curricula among medical students in Germany, Austria, and Switzerland (31). Also, a study in Western Australia appeared that AI is lacking in the present medical curriculum, and the majority of surveyed students endorsed its incorporation (32).

This is congruent with the study results of survey executed in Kerala where medical students emphasized on the demand for structured AI training in undergraduate curricula in addressing evolving healthcare needs and ethical considerations. Recognizing AI as a supportive technology in healthcare (33).

The increased interest of the medical curriculum developer to introduce courses about AI and its implications in medical education, as done in the three faculties included in our study, can be attributed to the adequate level of awareness that was measured among medical students, which was higher than the results of the aforementioned studies.

Study limitation

This research marks the initial effort to assess the knowledge and viewpoints of Egyptian students regarding AI, providing a foundation for future investigations on this topic and evaluating the long-term effects of incorporating artificial intelligence into the medical education curriculum. Nonetheless, the participants were drawn from only three universities, which means they might not accurately represent the broader population of medical students. Although, A connivance sample was used to select three faculties for easy accessibility for the authors, participants were enrolled randomly from the three selected faculties using fixed sample. Suez Canal, and Cairo universities represent governmental universities while, King Salman International University represents a national (Ahleya) university. Additional surveys will be needed to track changes in perception over time and to offer detailed analytical information, especially given the rapid advancements in artificial intelligence

Conclusion and Recommendations

Almost half of the responses were positive concerning the general perception towards AI and its utility in medical teaching and clinical practice and also towards its possible influences on patients. Students' attitudes towards AI were notably positive; they acknowledged its transformative potential and expressed a willingness to use it as an assisting tool in the future, especially for treatment recommendations and diagnostic verification. Concerns were expressed, meanwhile, about how AI would affect work responsibilities, doctor-patient interactions, and the possible loss of critical thinking abilities brought on by an over-reliance on AI.

While addressing students' concerns and guaranteeing a balanced approach to AI use in healthcare and education, the study emphasizes the significance of incorporating AI education within medical training overall.

With the increasing adoption of AI in the healthcare industry, it is crucial to incorporate this technology into medical education to ensure that healthcare professionals acquire the necessary knowledge and skills for providing high-quality care in the future. Therefore, the following were recommended considering our study's findings to improve student learning, learning management systems should first incorporate AI platforms. To address worries about possible charges of answer copying and privacy threats by putting strong data protection mechanisms in place, it is also crucial to establish clear regulations and guidelines for the ethical usage of AI tools in academic contexts.

Statements and declarations

Ethical considerations:

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Suez Canal university with ethical approval code number#5735. Participants have the right to voluntarily choose whether to join or withdraw from the study. Participants are not to be disadvantaged in any way by their participation in or withdrawal from the study. The data collected was anonymous and data confidentiality was maintained throughout the study. Completed questionnaires were accessed by the investigators only.

Ethics approval and consent:

This study was approved by the research ethics committee of faculty of medicine, Suez Canal university with ethical approval code number #5735.

Availability of data and material:

Data supporting the current study are available from the corresponding author upon a reasonable request.

Conflict of interests:

Authors affirm that they have no conflict of interests.

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Authors contributions:

HAH & RMM conceived the research idea and designed the study. NMAE, RMM, ABB, ASA, FAA, MMAE, and MMM contributed to data collection. HAH and RMM analyzed the data. All authors contributed to data interpretation. NMAE, SFM, and AAS wrote the first draft of manuscript. All authors contributed to revisions of manuscript. All authors read and approved the final manuscript.

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References

1.Buabbas AJ, Miskin B, Alnaqi AA, Ayed AK, Shehab AA, Syed-Abdul S, Uddin M. Investigating students' perceptions towards artificial intelligence in medical education. InHealthcare 2023 May 1 (Vol. 11, No. 9, p. 1298). MDPI.
2.Anifowose FA, Eludiora SI. Application of artificial intelligence in network intrusion detection. World applied programming. 2012 Mar; 2(3):158-66.
3.Francis NK, Luther A, Salib E, Allanby L, Messenger D, Allison AS, Smart NJ, Ockrim JB. The use of artificial neural networks to predict delayed discharge and readmission in enhanced recovery following laparoscopic colorectal cancer surgery. Techniques in coloproctology. 2015 Jul; 19:419-28.
4.Malik P, Pathania M, Rathaur VK. Overview of artificial intelligence in medicine. Journal of family medicine and primary care. 2019 Jul 1; 8(7):2328-31.
5.Buch VH, Ahmed I, Maruthappu M. Artificial intelligence in medicine: current trends and future possibilities. British Journal of General Practice. 2018 Mar 1; 68(668):143-4.
6.Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?. BMJ global health. 2018 Aug 1; 3(4):e000798.
7.Abid S, Awan B, Ismail T, Sarwar N, Sarwar G, Tariq M, Naz S, Ahmed A, Farhan M, Uzair M, Kumar A. Artificial intelligence: medical student s attitude in district Peshawar Pakistan. Pakistan Journal of Public Health. 2019 Jul 13; 9(1):19-21.
8.Ooi SK, Makmur A, Soon AY, Fook-Chong S, Liew C, Sia SY, Ting YH, Lim CY. Attitudes toward artificial intelligence in radiology with learner needs assessment within radiology residency programmes: a national multi-programme survey. Singapore medical journal. 2021 Mar; 62(3):126.
9.Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, Wang Y, Dong Q, Shen H, Wang Y. Artificial intelligence in healthcare: past, present and future. Stroke and vascular neurology. 2017 Dec 1; 2(4).
10. Hogarty DT, Su JC, Phan K, Attia M, Hossny M, Nahavandi S, Lenane P, Moloney FJ, Yazdabadi A. Artificial intelligence in dermatology—where we are and the way to the future: a review. American journal of clinical dermatology. 2020 Feb; 21:41-7

11. Chen M, Zhang B, Cai Z, Seery S, Gonzalez MJ, Ali NM, Ren R, Qiao Y, Xue P, Jiang Y. Acceptance of clinical artificial intelligence among physicians and medical students: a systematic review with cross-sectional survey. Frontiers in medicine. 2022 Aug 31; 9:990604.
12. Swed S, Alibrahim H, Elkalagi NK, Nasif MN, Rais MA, Nashwan AJ, Aljabali A, Elsayed M, Sawaf B, Albuni MK, Battikh E. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Syria: a cross-sectional online survey. Frontiers in artificial intelligence. 2022 Sep 29; 5:101152
13. Teng M, Singla R, Yau O, Lamoureux D, Gupta A, Hu Z, Hu R, Aissiou A, Eaton S, Hamm C, Hu S. Health care students' perspectives on artificial intelligence: countrywide survey in Canada. JMIR medical education. 2022 Jan 31; 8(1):e33390.
14. Mir MM, Mir GM, Raina NT, Mir SM, Mir SM, Miskeen E, Alharthi MH, Alamri MM. Application of artificial intelligence in medical education: current scenario and future perspectives. Journal of advances in medical education & professionalism. 2023 Jul; 11(3):133.
15. Eysenbach G. The role of ChatGPT, generative language models, and artificial intelligence in medical education: a conversation with ChatGPT and a call for papers. JMIR medical education. 2023 Mar 6; 9(1):e46885.
16. Ho CC. Learning to paraphrase with ChatGPT. Journal of Creative Practices in Language Learning and Teaching (CPLT). 2023 Nov 20; 11(2):85-105.
17. Al Saad MM, Shehadeh A, Alanazi S, Alenezi M, Eid H, Alfaouri MS, Aldawsari S, Alenezi R. Medical students' knowledge and attitude towards artificial intelligence: an online survey. The Open Public Health Journal. 2022 May 24; 15(1).
18. Ahmed Z, Bhinder KK, Tariq A, Tahir MJ, Mehmood Q, Tabassum MS, Malik M, Aslam S, Asghar MS, Yousaf Z. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Pakistan: A cross-sectional online survey. Annals of Medicine and Surgery. 2022 Apr 1; 76:103493.
19. Ejaz H, McGrath H, Wong BL, Guise A, Vercauteren T, Shapey J. Artificial intelligence and medical education: A global mixed-methods study of medical students' perspectives. Digital Health. 2022 May; 8:20552076221089099.
20. Burney IA, Ahmad N. Artificial Intelligence in Medical Education: A citation-based systematic literature review. Journal of Shifa Tameer-E-Millat University. 2022 Sep 3; 5(1):43-53.
21. Khater AS, Zaaqoq AA, Wahdan MM, Ashry S. Knowledge and attitude of Ain Shams University Medical Students towards Artificial Intelligence and its application in Medical Education and Practice. Educational Research and Innovation Journal. 2023 Jul 1; 3(10):29-42.
22. Chan KS, Zary N. Applications and challenges of implementing artificial intelligence in medical education: integrative review. JMIR medical education. 2019 Jun 14; 5(1):e13930.
23. Allam AH, Eltewacy NK, Alabdallat YJ, Owais TA, Salman S, Ebada MA. Knowledge, attitude, and perception of Arab medical students towards artificial intelligence in medicine and radiology: A multi-national cross-sectional study. European Radiology. 2024 Jul; 34(7):1-4.
24. Alghamdi SA, Alashban Y. Medical science students' attitudes and perceptions of artificial intelligence in healthcare: A national study conducted in Saudi Arabia. Journal of Radiation Research and Applied Sciences. 2024 Mar 1; 17(1):100815.
25. Syed W, Basil A. Al-Rawi M. Assessment of awareness, perceptions, and opinions towards artificial intelligence among healthcare students in Riyadh, Saudi Arabia. Medicina. 2023 Apr 24; 59(5):828.
26. AlZaabi A, AlMaskari S, AalAbdulsalam A. Are physicians and medical students ready for artificial intelligence applications in healthcare? Digital Health. 2023 Jan; 9:20552076231152167.
27. Daher OA, Dabbousi AA, Chamroukh R, Saab AY, Al Ayoubi AR, Salameh P. Artificial Intelligence: Knowledge and Attitude Among Lebanese Medical Students. Cureus. 2024 Jan; 16(1).
28. Jebreen K, Radwan E, Kammoun-Rebai W, Alattar E, Radwan A, Safi W, Radwan W, Alajez M. Perceptions of undergraduate medical students on artificial intelligence in medicine: mixed-methods survey study from Palestine. BMC Medical Education. 2024 May 7; 24(1):507.
29. Güven D, Kazancı EG, Ören A, Sever L, Ünlü P. The Knowledge of Students at Bursa Faculty of Medicine towards Artificial Intelligence: A Survey Study. Journal of Bursa Faculty of Medicine. 2024 Jan; 2(1):20-6.
30. 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. Advances in Medical Education and Practice. 2022; 13:927.
31. Weidener L, Fischer M. Artificial intelligence in medicine: cross-sectional study among medical students on application, education, and ethical aspects. JMIR Medical Education. 2024 Jan 5; 10(1):e51247.
32. Stewart J, Lu J, Gahungu N, Goudie A, Fegan PG, Bennamoun M, Sprivulis P, Dwivedi G. Western Australian medical students' attitudes towards artificial intelligence in healthcare. PLoS One. 2023 Aug 31; 18(8):e0290642.
33. Jackson P, Ponath Sukumaran G, Babu C, Tony MC, Jack DS, Reshma VR, Davis D, Kurian N, John A. Artificial intelligence in medical education-perception among medical students. BMC Medical Education. 2024 Jul 27; 24(1):804.