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Original Article

Perception Toward Artificial Intelligence and Its Application in Medical Field Among Female Medical Students at Al-Azhar University

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ABSTRACT

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Background: Artificial intelligence [AI] is a new field. It has been incorporated into healthcare and medicine with significant impact on health-related issues [e.g., diagnosis, prevention, and control]. For their future careers, medical students' perceptions of AI and how it will be applied practically and ethically are crucial.

Aim of the work: The purpose of our study was to assess undergraduate female medical students' perception toward AI in the medical field at Al-Azhar University in Cairo.

Patients and methods: A cross-sectional study was conducted among 414 medical students selected through electronic platforms to fulfill self-administered questionnaire including demographic data, data about familiarity with AI tools and their use in the medical field, and questions assessing perception towards AI regarding individual patient care, health systems, population health, and impact of AI on ethics and medical education.

Results: The median age of the students studied was 22 years, and 47.3% were in their fifth academic year. Familiarity with AI terms and use in medical field was recorded for 58.7% and 53.6% & 52.4% had a positive perception either toward AI application in medical practice or its impact on ethics & medical education respectively. Although, there was no significant difference in students' perception as regards residence and academic year but significantly students who received training on AI in undergraduate education showed a positive perception toward AI. Furthermore, there was a very weak positive correlation between familiarity and perception toward AI in the medical field [p-value < 0.05].

Conclusion: About half of medical students were familiar with AI terms and had a positive attitude toward AI applications in medical practice and its impact on ethics and medical education. Nonetheless, there was a very weak positive correlation between familiarity and attitude toward AI in the medical field.

Keywords: Artificial intelligence; Perception; Female; Medical Students.



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INTRODUCTION

Healthcare systems globally are encountering obstacles in achieving the 'quadruple aim,' which involves enhancing population health, patient and caregiver experience, and cost reduction. The challenges arise from aging populations, the increasing burden of chronic diseases, and the escalating costs of healthcare. These challenges were exacerbated by the recent pandemic revolution. Consequently, the integration of technology and artificial intelligence [AI] in healthcare holds promise for addressing some of these pressing supply-and-demand issues [1].

AI is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. Some applications of AI include automated interfaces for visual perception, speech recognition, decision-making, and translation between languages. AI is an interdisciplinary science [2].

The application of [AI] in medicine is growing, it is an umbrella term that describes the use of algorithms and software that analyze data and digital information to make diagnoses and suggest therapies [3].

AI-enabled medical technologies are still emerging, mostly in radiology, anesthesiology, dermatology, surgery, and pharmacy [4].

These AI-based tools exhibit substantial potential in refining precision, reducing errors, and enhancing overall efficiency throughout diverse healthcare phases, spanning from diagnosis to treatment planning and management [5].

Integrating AI tools in medical educational settings can improve students' comprehension of difficult medical concepts and their knowledge and skill development. AI has become a crucial component of healthcare education in recent years, and many medical schools throughout the world have embraced it [6]. However, there is an ongoing debate about whether AI should be used within existing ethical frameworks or if a new category with unique features and implications should be created.

Four key ethical issues must be addressed to fully utilize AI in healthcare: gaining informed consent for data usage; maintaining safety and transparency; encouraging algorithmic fairness and reducing biases; and protecting data privacy. The classification of AI systems as legal entities is not merely a legal matter but also a politically charged issue, as highlighted in the European Parliament resolution in 2017 [7,8].

Because of artificial intelligence's rapid advancement, medical students face a great challenge, they fear being replaced by it. Therefore, medical graduates must be well-versed in AI applications in medicine and adept at utilizing basic AI tools to enhance patient care [9,10].

Furthermore, discerning the perspectives and attitudes of medical students toward AI can help educators and policymakers create efficient plans for integrating AI into medical education and reducing any barriers to its adoption [11].

Despite the escalating adoption of AI in medicine, research investigating the perception of medical students toward AI remains scant. It is imperative to comprehend how medical students, the forthcoming healthcare professionals, perceive and engage with these innovative technologies. Hence, the present study aims to evaluate the familiarity and perception of undergraduate medical students toward AI in the medical field at the Faculty of Medicine for Girls, Al-Azhar University in Cairo.

METHODS

Study Design and Setting: A cross-sectional study was conducted among female medical students at the Faculty of Medicine for girls, Al-Azhar University during the academic year 2023-2024.

Sampling Technique: The sample size was determined utilizing the software at <https://www.calculator.net/sample-size-calculator.html> considering a margin of error of 5%, a confidence level of 95%, and an assumed prevalence of positive attitudes set at 50%. Consequently, the minimum sample size required was 385 participants. A convenient sample of 414 students was selected through electronic platforms i.e., WhatsApp to distribute the questionnaires to the interested students.

Inclusion Criteria. All medical students from the first year to the final year were deemed eligible for participation.

Exclusion Criteria. Non-Egyptian medical students were excluded from the study.

Data Collection Methods: A web-based self-administered questionnaire was formulated following a thorough literature review. The questionnaire took approximately 20 minutes to complete, it included the following data:

- Demographic data i.e., age, academic year, and residence of the students.
- Data about familiarity with AI tools and their use in the medical field with responses either yes graded [1] or no graded [0]. After adding up the indicated points in relation to the total number of items, the overall familiarity score was calculated and then classified as familiar or not based on the median.
- Perception towards AI regarding two main domains.
 - I. Individual patient care, health systems, and population health
 - II. Impact of AI on ethics and medical education.

Responses to perception questions were graded from 1 [strongly disagree] to 5 [strongly agree]. The level of perception in each domain was determined by calculating the sum of obtained points relative to the total items in that domain, presented as a median and interquartile range [IQR]. The total perception score was calculated by summing up the scores of both domains, ranging from 21 [minimum score] to 105 [maximum score], with higher scores indicating a more positive perception. Participants were categorized into positive [whose scores were equal to or higher than the median] and negative attitude groups [with scores that were lower than the median]. [12,13].

Pilot Study: A pilot study was conducted to assess the clarity of the questions, and the time needed for completion. Ten percent of the total sample size was included in the pilot study, with all participants meeting the inclusion criteria. The results of the pilot study indicated that no modifications were necessary for the tools used. Participants in the pilot study were distinct from those in the main study sample.

Data Management and Analysis: Data analysis was performed using IBM Statistical Package for Social Sciences version 22. Numerical data were presented as the median [IQR] as the examined data was not normally distributed, while qualitative data were expressed as frequency and percentage. A chi-square test was employed to compare qualitative variables. Spearman correlation was done to assess the relation between students' familiarity and perception towards AI. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 414 female undergraduate students responded to the questionnaire. The median age was 22 years. Nearly half of the students [47.3%] were in their fifth academic year and 60.4% were residing in rural areas. Concerning familiarity with AI; The general term of AI was identified by most of students [92.3%] while only 28.7% were familiar with the terms machine learning and deep learning. A little over half of the students [58%] were aware of the application of AI in the medical field. Nearly two-thirds of students [63.8%] reported that they had not received formal education about AI during medical study. A small percentage of students had attended courses [34.8%] or viewed any talks and lectures on AI [28.7%] or had training in computer programming/ coding [24.4%]. Overall, 58.7% of students were familiar [Table 1, Figure1].

Regarding perception towards AI in medical practice, **First, about individual health**, most of the students [83.8%] agreed that AI can provide patients with preventative health recommendations, and over 73 % believed that AI can analyze and interpret patient information to reach diagnosis & prognosis. More than half of the students mentioned that AI will be able to monitor patient compliance with prescribed medications [63.3%]. Also, it will be able to formulate personalized treatment & medication plans [58.2%] as well as evaluate patients' referrals [59.1%]. However, 52 % of students believed in AI's role in performing robotic surgery, and only 42.5% were confident in AI's ability to provide psychiatric/personal counseling. **Second, about health systems**, most of the students believed that AI will be capable of providing documentation [91%], assisting hospitals in capacity planning and human resource

management as well as providing recommendations for quality improvement in practices [85 %]. **Third, about population health**, about two-thirds of students mentioned that AI can conduct health surveillance and outbreak prevention, and it can select the best population health interventions [Table 2].

By analysis of perception toward Ethics and Medical Education, about 42% of students agreed that AI will reduce the number of jobs available to them. Over 60 % mentioned that AI will impact physicians' choice of specialty selection and will reduce the number of jobs in certain medical specialties. Over 69 % believed that AI will raise new ethical & social challenges around health equity. More than 77% of students agreed that medical education should include training in AI competencies. Moreover, more than half of students reported that the current Egyptian healthcare system isn't well prepared to deal with the challenges of AI [58%] and current medical education is not adequately preparing physicians for working alongside AI tools [54%] [Table 3].

Overall, 53.6% & 52.4% had a positive perception either toward AI application in medical practice or its impact on ethics & medical education respectively as shown in Figure [2]. Table [4] illustrates that there was no significant difference in the perception of students as regards residence and academic year of students. However, students who received training on AI in undergraduate education showed a significant relation to their positive perception toward AI. Correlation analysis in Table [5] showed that there was a very weak positive correlation between familiarity and perception toward AI in the medical field [p-value < 0.05].

Table [1]: Students' Familiarity with Artificial Intelligence and its Application in the Medical Field

Questions	Familiar [N [%]]
Do you know the meaning of "artificial intelligence"?	382 [92.3]
Do you know about the terms "machine learning and deep learning"?	119 [28.7]
Do you know about any application of AI in the medical field?	240 [58.0]
Have you ever been taught about Artificial intelligence in medical school?	150 [36.2]
Do you know about the application of AI in radiology?	235 [56.8]
Do you know about the application of AI in the pathology field?	198 [47.8]
Do you know any courses where AI/ML/DL were taught or discussed?	144 [34.8]
Have you attended or viewed any talks or lectures on AI?	119 [28.7]
Have you had any other training in computer programming/ coding	101 [24.4]

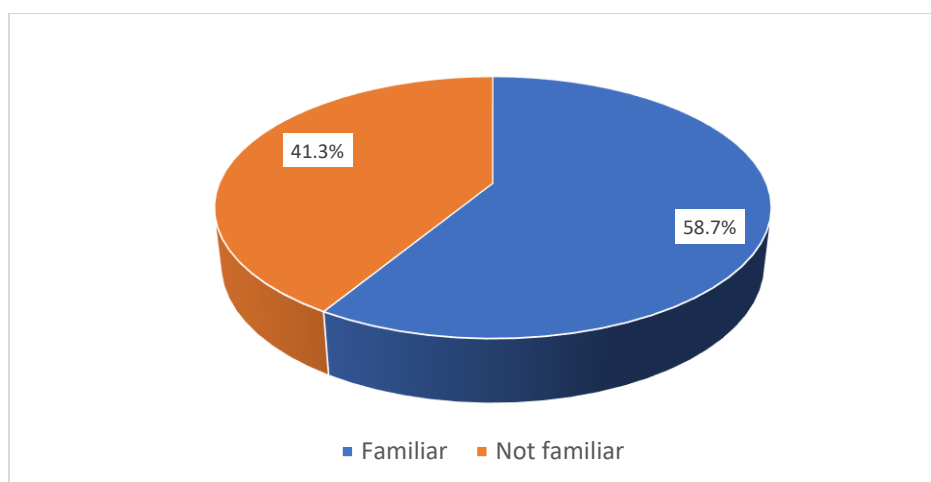


Figure [1] Students' Familiarity Classification towards Artificial Intelligence and its Application in Medical Field

Table [2]: Students’ Perception towards Artificial Intelligence application in medical practice

Statements	Strongly Agree N [%]	Agree N [%]	Neutral N [%]	Disagree N [%]	Strongly disagree N [%]
Individual patient care					
AI will provide patients with preventive health recommendation [e.g. exercise, diet, wellness]	90 [21.7]	257[62.1]	21 [5.1]	36 [8.7]	10 [2.4]
AI will analyze patient information to reach a diagnosis & establish prognosis.	63 [15.2]	240[58.0]	16 [3.9]	71 [17.1]	24 [5.8]
AI can read and interpret diagnostic imaging	71 [16.1]	238[57.5]	21 [5.1]	65 [15.7]	19 [4.6]
AI will be able to monitor patient compliance with prescribed medications, exercise, and dietary recommendations.	53 [12.8]	209[50.5]	20 [4.8]	89 [21.5]	43 [10.4]
AI will be able to formulate personalized treatment plans & medication prescriptions for patients.	58 [14.0]	183[44.2]	20 [4.8]	118 [28.5]	35 [8.5]
AI will be able to evaluate when to refer patients to other health professionals.	51 [12.3]	194 [46.9]	34 [8.2]	106 [25.6]	29 [7.0]
AI will be able to provide psychiatric/personal counseling.	34 [8.2]	142 [34.3]	31 [7.5]	129 [31.2]	78 [18.8]
AI can perform surgery [e.g., robotic surgery]	55 [13.4]	160 [38.6]	30 [7.2]	113 [27.3]	56 [13.5]
Health systems					
Provide documentation [e.g., update medical records] about patients.	149 [36.0]	228 [55.1]	16 [3.9]	19 [4.5]	2 [0.5]
Assist hospitals in capacity planning and human resource management.	118 [28.5]	234 [56.5]	18 [4.4]	37 [8.9]	7 [1.7]
Provide recommendations for quality improvement in practices/hospitals.	107 [25.9]	246 [59.4]	17 [4.1]	27 [6.5]	17 [4.1]
Population health					
Conduct population health surveillance and outbreak prevention.	61 [14.7]	221 [53.4]	43 [10.4]	82 [19.8]	7 [1.7]
Select the best population health interventions.	49 [11.8]	205 [49.5]	39 [9.4]	104 [25.2]	17 [4.1]

Table [3]: Students’ Perception towards Impact of Artificial Intelligence on Ethics and Medical Education

Statements	Strongly agree N [%]	Agree N [%]	Neutral N [%]	Disagree N [%]	Strongly Disagree N [%]
AI will replace physicians in the future/ reduce the number of jobs available to physicians.	35 [8.5]	138[33.3]	25[6.0]	141 [34.1]	75[18.1]
AI will impact physicians’ choice of specialty selection.	43[10.4]	212[51.2]	32[7.7]	108[26.1]	19[4.6]
AI will reduce the number of jobs in certain medical specialties more than others.	47[11.4]	203[49.0]	23[5.6]	111[26.8]	30[7.2]
AI will raise new ethical & social challenges around health equity.	70[16.9]	217[52.4]	35[8.5]	77[18.6]	15[3.6]
Egyptian healthcare system is currently well prepared to deal with challenges having to do with AI.	9[2.2]	99[23.9]	66[15.9]	148[35.7]	92[22.3]
Current medical education is adequately preparing physicians for working alongside AI tools.	23[5.5]	132[31.9]	35[8.5]	138[33.3]	86[20.8]
Medical education should include training on AI competencies [e.g., what AI is, how will it impact us, and what are challenges it raises].	104[25.1]	216[52.2]	25[6.0]	58[14.0]	11[2.7]
Every medical student should receive training in AI competencies.	97[23.4]	223[54.0]	25[6.0]	51[12.3]	18[4.3]

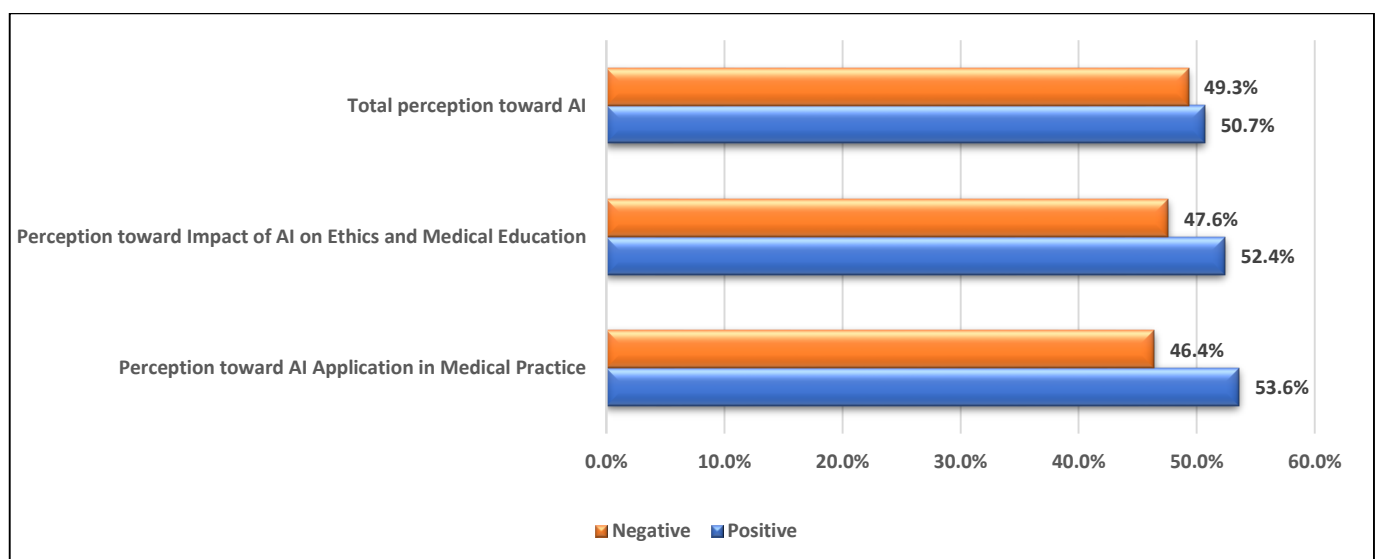


Figure [2]: Students’ perception toward artificial intelligence

Table [4]: Relation between students' perception toward artificial intelligence in medical field and student's characteristics

	Characteristic	Perception toward AI		P- value
		Positive	Negative	
		N. [Row %]	N. [Row %]	
Academic year:	- 1 st year	5 [55.6]	4 [44.4]	0.9
	- 2 nd year	27 [60.0]	18 [40.0]	
	- 3 rd year	39 [52.7]	35 [47.3]	
	- 4 th year	34 [49.3]	35 [50.7]	
	- 5 th year	106 [54.1]	90 [45.9]	
	- 6 th year	11 [52.4]	10 [47.6]	
Residence:	- Urban	96 [58.5]	68 [41.5]	0.1
	- Rural	126 [50.4]	124 [49.6]	
Students had training on artificial intelligence in medical school:	- Yes	91 [60.7]	59 [39.3]	0.03*
	- No	131 [49.6]	133 [50.4]	

Table [5]: Correlation between the Familiarity and Perception Toward Artificial Intelligence in the Medical Field

	Familiarity with Artificial Intelligence	
	Rs	P-value
Perception toward AI Application in Medical Practice	0.123	0.01*
Perception toward Impact of AI on Ethics and Medical Education	0.105	0.03*

* Significant P-values < 0.05; Rs: Spearman correlation coefficient

DISCUSSION

This study highlights the diagnostic potential of ascitic calprotectin as a Physicians are crucial in integrating AI into healthcare, providing patients with reliable information [12,14]. However, a lack of knowledge and a negative mindset toward AI among medical students may lead to poorer patient outcomes [15].

The present study aims to evaluate the familiarity and perception of undergraduate medical students toward AI in the medical field. Regarding familiarity, most surveyed students [92.3%] understood the general term “Artificial intelligence” which was slightly higher than the proportion of the Canadian study where 83.3% knew the meaning of AI [4] and extremely higher than the proportion revealed by the Nepali study [53.2%][12]. But when assessing familiarity with specified terms, only 28.7% of respondents knew “Machine Learning” and “Deep learning”, which is less than the percentage found in other studies conducted in Canada [65.9%], Nepal [42.6%], and Germany [68%] [12,13,16]. This discrepancy in our study may be due to the biomedical and health-related background of medical students with the popularity of AI general terms in their curricula and through media platforms rather than other related terms.

As training has a crucial role in improving familiarity, 36.2% of students in the current study reported formal training in computer science in the medical curricula, this was higher than those in the Canadian study [only 9.4%] [13]. Furthermore, 34.8%, 28.7%, and 24.4% of students mentioned the completion of self-directed learning in the form of courses, lectures, and training in computer programming/ coding respectively. These findings agreed with the Canadian study [13] while the Nepali study found that 8.3% only % had attended or viewed any talks or lectures on AI and no training in programming/coding was given to 95.8% of the students [12]. Overall familiarity scoring recorded only 58.7% who were familiar with AI. This limited proportion may be ascribed to the restricted inclusion of AI comprehensive scope in the context of medical curricula due to resource constraints and interdisciplinary learning barriers, in addition to

the challenge of the availability of extracurricular learning and training opportunities in this area. our findings are consistent with previous studies [16-19].

By focusing on perception towards AI in a variety of medical field domains as *individual health*, most students [83.8%] agreed that AI can provide patients with preventative health recommendations which was supported by different studies [20,21], the study demonstrated that over 73% believed that AI can analyze patient information to reach diagnosis & establish prognosis and it's consistent with many studies [13,22] and more optimistic than Nepali study [12]. Also, 73.0% believed that AI can read and interpret diagnostic imaging, and hence AI is expected to have an impact on radiodiagnosis procedures [23]. Concerning other roles of AI in patient services, the current study found that above half of students perceived that AI could monitor patient compliance with prescribed medications, exercise, and dietary recommendations, formulate personalized treatment plans, and evaluate referrals to other health professionals. These findings are comparable to the Canadian study [13] while it is a higher positive attitude than the Nepali study [12].

Moreover, it is anticipated that AI will assist robotic surgeries by reducing errors, and time and ultimately improving outcomes [24]. In the current study, 52% of students believed in AI's role in performing robotic surgery which is in line with Canadian [13] and Saudi Arabian studies [25], but only 12% in Nepal believe AI can improve surgical outcomes [12].

While AI can provide valuable support, the human element in psychiatric counseling is irreplaceable. The current study revealed that 42.5% of students were confident in AI's ability to provide psychiatric/personal counseling. In other studies, 77% of Canadian students [13] and 83% of global physician survey [26] believed that AI is unlikely to offer empathetic care, another study in the UK found even AI will give empathetic care, it is unlikely to replace doctors [27].

AI is playing an increasingly transformative role in *health systems*

globally, most students [91.0%] in the current study believed in AI's ability to provide documentation, and 85 % believed in its ability to assist hospitals in capacity planning and human resource management as well as providing recommendations for quality improvement in practices/hospitals. These results are in line with the Canadian study [13] but differ from the Nepali study which revealed a negative perception for the respondents as regards the previous three roles [12].

In *population health* as a large-scale role of AI, the present research illustrated that about two-thirds of students mentioned that AI could conduct health surveillance and outbreak prevention and select the best population health interventions. These findings are contrary to the Nepali study where nearly 15 % of respondents believed in AI ability [12].

Despite the previous roles of AI in all medical practices, it's undoubtful that AI will complement doctors' work does not replace it. About 42% of the studied students agreed that AI would reduce the number of jobs available to them with over 60 % positively perceiving AI's impact on physicians' choice of specialty selection and will reduce the number of jobs in certain medical specialties. A Saudi study found that 77.7% of respondents are concerned about AI replacing their jobs [28] with a percentage of 30% in another Saudi study [29], while a global survey showed 17.6% being concerned about their future job security [30]. A Syrian study found that 21.5 % agreed that AI could replace physicians in the future [31].

The development of AI should raise ethical issues as regards privacy, autonomy, and confidentiality. In the current study, over 69.0% were aware of the ethical and social implications of the application of AI to healthcare. The European Union has issued guidelines for trustworthy AI, ensuring it is lawful, ethical, and robust from both technical and social perspectives [32]. WHO has published two guidelines of ethics guiding AI in healthcare [33,34]. AI should be integrated into medical education to prepare students for future applications in the medical field. More than 77.0% of students in the present study agreed that medical education should include training about AI competencies and about 54.0% of them mentioned that current medical education is not adequately preparing physicians for working alongside AI tools. The present study findings are in concordance with the Nepali, Canadian, Spanish, German, and Egyptian studies [12, 13, 16, 35, 36]. Concerning the current Egyptian healthcare system capabilities, 58.0% of students reported that it is not well prepared to deal with challenges having to do with AI, so, it's recommended to enhance awareness about updated tools of AI utilized in our healthcare system.

There was no significant difference in the perception of students as regards residence and academic year of students which agreed with the Ain Shams University study [36]. On the other side, students who received training on AI in undergraduate education showed a significant relation to their positive perception toward AI and it is consistent with the Saudi Arabian study [37] which also reflects the role of training in enhancing perception.

There was a very weak positive correlation between familiarity and perception toward artificial intelligence in the medical field. This finding is in line with the Philippine study [38] which can be attributed to the lack of curricular content of AI tools, limited clinical experience, and fear of job displacement which widen the gap between being familiar and perceived as positive.

Limitations of the study: The current study was conducted in a single university which may limit the generalizability of its results. In addition, the perception of students might be influenced by their personal interest in technology and may change over time.

Conclusion and recommendations.

According to our findings, about half of the studied students were familiar with AI terms and a comparable percentage had a positive attitude either toward AI application in medical practice or its impact on ethics & medical education respectively. Nonetheless, there was a very weak positive correlation between the knowledge and attitude toward AI in the medical field. Hence, it is advised to improve student awareness about the updated development of AI through online courses and workshops for enhancing practical application by discussing its ethical and legal issues in healthcare. Additionally, it is crucial to integrate AI into the medical curriculum with the encouragement of future research about AI to promote all medical specialties.

Availability of Data and Material: The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests: The authors declare that there is no conflict of interest.

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Ethical Approval and Consent to Participate.

Official approvals from the ethical committees at the Faculty of Medicine for girls were secured. The study was approved by the Institutional Review Board [IRB] [2024032319]. Informed consent was obtained from all participants who agreed to partake in the study by completing the questionnaire. Participants were informed of the study's purpose and assured that their involvement was voluntary, with the collected data being used mainly for research purposes

Author Contributions: Soso Shawky Mohamed, and Doaa Sadek Ahmed were involved in the study design, data acquisition, statistical analysis, and critical revision of the manuscript.

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