Knowledge and Attitude of Ain Shams University Medical Students towards Artificial Intelligence and its Application in Medical Education and Practice

المعرفة والتوجهات لدى طلاب كلية الطب بجامعة عين شمس تجاه الذكاء الاصطناعي وتطبيقاته في التعليم الطبي والممارسة الطبية

Aya S. Khater[1]; Ayman A. Zaaqoq[1]; Maha M. Wahdan[2]; Soha Ashry[13]

[1] Department of Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Ain Shams University, Cairo, Egypt

[2] Department of Community Medicine, Environmental and Occupational Medicine, Faculty of Medicine, Ain Shams University, Cairo, Egypt

[3] Department of Medical Education, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Abstract

Background: Artificial intelligence (AI) is rapidly evolving with the potential to revolutionize various aspects of healthcare. Despite the increasing use of AI in medicine, research on the knowledge and attitudes of medical students towards AI remains limited. **Aim:** This study aims to evaluate the level of knowledge and attitude towards AI and its use in medical education and future medical practice among Ain Shams University undergraduate medical students. **Methods:** A Cross-sectional study using a self-administered questionnaire. **Results:** A total of 410 medical students completed the questionnaire. The mean age of participating students was 19.7 ± 1.5, of which 56.1% were females. Students in the first and second years represented 75.3% of the total participating students. Most of the students demonstrated moderate (41.2%) to good (57.7%) knowledge and attitude regarding AI and its application in medical education, and similarly moderate (67.5%) to good (28.9%) knowledge and attitude regarding AI and its application in medical practice. Over 80% of students emphasized the need to integrate teaching about AI in their medical curricula and thought that AI will soon revolutionize education. In addition, over 85% showed enthusiasm to learn about the applications of AI in medicine. **Conclusion:** The findings from the current study highlight the crucial need for medical schools to adapt to the changing technology and ensure that future physicians are ready for these changes. Medical curricula must evolve to prepare students effectively by providing comprehensive knowledge and understanding of AI and its applications, ensuring students are well-prepared for their future careers.

Keywords: AI, medical education, healthcare, technology.

المستخلص:

الخلفية: ازداد استخدام الذكاء الاصطناعي في المجالات الطبية وسيحدث ثورة في مختلف جوانب الرعاية الصحية. وعلى الرغم من الاستخدام المتزايد للذكاء الاصطناعي في الطب، لا تزال الأبحاث حول معرفة وتوجهات طلاب الطب تجاه الذكاء الاصطناعي محدودة. **الهدف:** تهدف هذه الدراسة إلى تقييم مستوى المعرفة والتوجهات للذكاء الاصطناعي واستخدامه في التعليم الطبي والممارسة الطبية المستقبلية بين طلاب الطب في جامعة عين شمس. **الطرق:** دراسة مقطعية باستخدام استبيان ذاتي. **النتائج:** أكمل 410 طالب من طلاب الطب الاستبيان. كان متوسط عمر الطلاب المشاركين 19.7 ± 1.5، منهم 56.1٪ إناث. مثل طلاب الفرقتين الأولى والثانية 75.3٪ من إجمالي الطلاب المشاركين. أظهر معظم الطلاب معرفة وتوجه معتدل (41.2٪) إلى جيدة (57.7٪) فيما يتعلق بالذكاء الاصطناعي وتطبيقاته في التعليم الطبي، وبالمثل معرفة وتوجه معتدل (67.5٪) إلى جيدة (28.9٪) فيما يتعلق بالذكاء الاصطناعي وتطبيقه في الممارسة الطبية. أكد أكثر من 80٪ من الطلاب على الحاجة إلى دمج تدريس الذكاء الاصطناعي في مناهجهم الطبية واعتقدوا أن الذكاء الاصطناعي سيحدث ثورة في التعليم قريباً. بالإضافة إلى ذلك، أظهر أكثر من 85٪ من المشاركين حماسًا للتعرف على تطبيقات الذكاء الاصطناعي في الطب. **الخلاصة:** تسلط نتائج الدراسة الحالية الضوء على الحاجة الماسة لكليات الطب للتكيف مع التكنولوجيا المتغيرة والتأكد من أن أطباء المستقبل مستعدون لهذه التغييرات. يجب أن تتطور المناهج الطبية لإعداد الطلاب بشكل فعال من خلال توفير المعرفة والفهم الشامل للذكاء الاصطناعي وتطبيقاته، مما يضمن استعداد الطلاب جيدًا لمهنهم المستقبلية.

الكلمات المفتاحية: الذكاء الاصطناعي، التعليم، الرعاية الصحية.

Introduction

Artificial intelligence (AI) is imitating human actions and attitudes using technology by teaching machines how humans think, behave, and react in different situations [1]. AI has been adopted by many sectors such as economics, manufacturing, education, and health [2]. In the medical field, AI is rapidly evolving with the potential to revolutionize various aspects of healthcare, including diagnostics, treatment planning, and personalized medicine [3]. The use of AI is increasing and becoming popular in many medical fields; including ophthalmology, dermatology, pathology, and others [4].

Consequently, medical education is also undergoing a transformation, with AI being integrated into various aspects of the curricula of undergraduate medical students and trainees in post-graduate programs [5]. Introducing AI in medical education can provide specific feedback to support learning and better understand AI algorithms [6]. Over the past years, there have been multiple applications of AI in education designed to deliver content, provide feedback, and supervise progress. The use of such technology in education has proven to help students receive specialized help and identify knowledge gaps. In addition, teachers had fewer tasks but more time to respond to students more effectively and improve the personalized and adaptive teaching process [7, 8].

Medical education includes a lifelong learning continuum ranging from undergraduate to postgraduate and specialization training and beyond. As AI applications become more widespread in the medical field, it is crucial to understand how medical students—the future healthcare professionals—perceive and interact with these new technologies. Despite the increasing use of AI in medicine, research on the knowledge and attitudes of medical students towards AI remains limited. Several factors may influence medical students' perspectives, including their level of exposure to AI in medical education, their understanding of the advantages and disadvantages of AI, and their own career aspirations [9].

Accordingly, more research is needed to fully understand the knowledge and attitudes of medical students towards AI and its applications in medical education and practice. This study aims to evaluate the level of knowledge and attitude towards AI and its use in medical education and future medical practice among Ain Shams University medical students, in order to provide recommendations for educators, practitioners, and policymakers to optimize AI integration in medical education and practice.

Subjects and methods

Study design, setting, and participants

A Cross-sectional study was conducted among university undergraduate medical students in the faculty of medicine Ain Shams University during the winter semester of the academic year 2022/2023 (a convenience sample of medical students from different academic levels, age groups and genders).

Sample size

By using Power Analysis and Sample Size Software (PASS 15) (Version 15.0.10) for sample size calculation, setting confidence level at 95%, margin of error $\pm$ 0.05 and after reviewing previous study results (Al Saad et al., 2022) showing that the percentage of medical students believed in the importance of artificial intelligence was (89%); Based on that and considering 20% dropout rate due to missing data, a sample size of at least **215 undergraduate medical students** was required.

Data collection tool

A self-administered questionnaire was used.

A structured questionnaire was created which was adapted from previous research and modified to cover the required information needed to be gathered. It consisted of 3 sections covering the following:

1- Demographic information: The participants' age, gender, academic level.

2- Knowledge and attitude towards AI and its application in medical education: this part includes 15 statements concerning familiarity with AI tools and their use, as well as attitudes towards AI's use in medical education. Each statement was scored on a scale of 1 to 5, with 1 being strongly disagree and 5 being strongly agree. The total score for medical students' knowledge and attitude towards artificial intelligence (AI) and its implementation in medical education was then computed by summarizing 15 statements, and the total score was categorized by considering (≤ 37 score as a poor level, 38 - 57 moderate, and >57 good).
3- Knowledge and attitude towards AI and its use in medical practice: This part includes seven statements about knowledge with AI technologies and their use, as well as attitudes towards AI utilization in medical practice. Each statement was scored on a scale of 1 to 5, with 1 being strongly disagree and 5 being strongly agree. The overall score for medical students' knowledge and attitude towards AI and its implementation in medical practice was then computed by summarizing seven statements, and the total score was classified by considering (≤17 score as a poor level, 18 – 27 moderate, and >27 good).

Content validity of the questionnaire was tested by panel of expert professors experienced in developing questionnaires. The internal consistency of the items of attitude was measured by using Cronbach's alpha coefficient (*0.785 for statements about AI in medical education and 0.679 for statements about AI in medical practice*), which demonstrated a reliable acceptable tool.

Piloting: Prior to disseminating the questionnaire to a broader sample, the questionnaire was piloted on a small group of medical students to detect any potential concerns and make any necessary changes.

The finalized questionnaire was distributed electronically to the official emails of undergraduate medical students with clear instructions and guidelines to ensure that the participants understood the purpose and nature of the survey. A paper questionnaire was also used and it was distributed to selected population of medical students who are more comfortable to using paper questionnaires.

Data management and statistical analysis

Data was tabulated and statistically analyzed using SPSS, version 20 (SPSS Inc., Chicago, IL). Quantitative data was described as mean and standard deviation. Qualitative data was expressed as frequencies (n) and percentage (%). Chi square test, fisher exact test, and liner by linear association were used to assess the relation between 2 qualitative variables. One way ANOVA test was used to assess the relation between "age" as a quantitative variable and knowledge and attitude towards artificial intelligence level. P-value ≤ 0.05 will be considered significant.

Ethics considerations

To guarantee that the research is carried out in compliance with ethical standards, approval was obtained from the research ethics committee at the faculty of medicine, ASU with approval number (FMASU: R144/2023). Informed consent was obtained from all participants, and it was embedded in the heading of the questionnaire informing participants that agreeing to participate in the survey is not mandatory and it counts as consent to use the data for research purposes. The participants' anonymity and privacy were maintained throughout the whole research process.

Results

A total of 410 medical students completed a self-administered questionnaire about their knowledge and attitudes towards Artificial Intelligence (AI) and its applications in medical education and practice. Moreover half were females, with the bulk coming from the first and second years as shown in **Table 1**.

The majority of medical students demonstrated moderate to good knowledge of and positive attitude towards AI and its

application in medical education. While the majority of students expressed strong agreement regarding their familiarity with and the utilization of artificial intelligence in medical education, a lower percentage of students agreed with statements such as feeling comfortable with the idea of AI grading their academic work, having concerns about the ethical implications of using AI in medical education, believing that AI can replace traditional teaching methods, and expressing concerns about the potential for AI to replace human teachers as stated in **Table 2.**

Regarding knowledge and attitudes towards AI and its application in medical practice, a minority of students (less than 30%) demonstrated a strong level of knowledge and attitude. Most students disagreed when it came to aspects such as being open to undergo a procedure performed by an AI machine, and believing that AI will eventually replace human medical professionals. However, there was a general consensus among students on the importance of learning about the use of AI in medicine, recognizing its significance, being willing to adopt AI in the future, and acknowledging its potential to enhance patient outcomes, as indicated in **Table 3**

Examining the students' understanding of various AI tools in medical education, over 50% of students acknowledged that "virtual patient learning" was an AI technology utilized in medical education, followed by virtual reality simulation and chatbots for student support. Conversely, "gamification tools" were the least mentioned AI tools by students. Regarding students' awareness of different AI tools in medical practice, "medical imaging analysis," "virtual assistants," and "predictive analytics" were the most commonly reported tools, as presented in **Table 4**

Table 5 shows that the knowledge and attitude score of medical students towards artificial intelligence and its use in medical education or medical practice did not have a statistically significant relationship to the student characteristics.

Discussion

With the use of Artificial Intelligence (AI), the field of medicine has entered an era of rapid technological advancements. AI has proven to be an efficient tool in various aspects of healthcare with the potential to revolutionize patient care, enhance the efficiency of healthcare systems, and improve overall health outcomes. Consequently, the integration of AI in medical education is becoming increasingly essential to prepare future physicians for the evolving landscape of healthcare [10]. The influence of AI has extended to the field of education, where it has the potential to revolutionize learning experiences, optimize teaching methods, and enhance the overall educational environment [11]. However, it remains unclear whether current medical curricula are adequately preparing students for the integration of AI in their future practice [12]. Accordingly, the current research aims to assess the knowledge and attitude of medical students towards AI, identifying areas where medical education may need to adapt to meet the changing needs of the healthcare system.

The current study was conducted among university undergraduate medical students in the faculty of medicine Ain Shams University in spring 2023 assessing their knowledge and attitudes towards AI and its applications in medical education and practice. A total of 410 medical students in different academic years filled a self-administered questionnaire. The mean age of participating students was 19.7 ± 1.5 ranging from 17 to 25 years, of which 56.1% were female students while 43.9% were male students. Students in the first and second years represented 75.3% of total participating students and the percentage declined reaching 2% for students in the final year. Similar findings were recorded by Pinto Dos Santos et al., (2019) where participant female students represented 63.1% in their survey regarding AI [13]. On the contrary Al Saad et al., (2022) reported that male students represented (52.2%) in their survey about the knowledge regarding AI and participants from the final undergraduate year represented 31.8% [14].

The gender distribution among university students differs from one university to the other, but the interest of specific groups in filling the AI questionnaires reflects different perceptions. While early year students were more enthusiastic to fill our survey, other studies referenced above, reported that final year students were more interested to fill their surveys. This could be attributed to the nature of each survey, where our questions were investigating the use of AI both in medical education and medical practice while others focused more on the use of AI in medical practice, hence the discrepancy.

Interestingly, the current study found no correlation between the students' age, sex, or academic level and their knowledge and attitudes towards AI. This suggests that AI literacy and acceptance may be more influenced by exposure and experience rather than demographic characteristics, as reported by previous studies [15, 16].

The section in the questionnaire in the current study investigating students' knowledge and attitude towards AI in medical education included questions about their familiarity with AI and its various tools, its ability to improve the quality of medical education and aid in research and their comfort with using AI in their education, in addition to inquiries about the ethical aspects and the importance of integrating AI education in their medical curricula.

Most of the students demonstrated moderate (41.2%) to good (57.7%) knowledge and attitude regarding AI and its application in medical education. Over 80% of students emphasized the need to integrate teaching about AI in their medical curricula and thought that AI will soon revolutionize education and will improve scientific research, and showed they are willing to try out new AI technologies for medical educational purposes. About half the students were not worried that AI will replace traditional teaching or human teachers, and another half were uncomfortable with the idea of AI correcting their exams and worried about the ethical aspects of using AI. Mittelstadt et al., 2019 suggested that medical schools should encourage students to participate in discussions around the ethical implications of AI use and to embed these conversations in the curriculum in order to foster critical thinking and help students navigate ethical dilemmas and have deeper understanding [17].

The concerns in the current study regarding the use of AI in grading academic work and potentially replacing traditional teaching methods, reflect a degree of worry about the role of AI in decision-making processes that have traditionally been carried out by humans. This was reported in other studies where students' discomfort with these concepts was found to reflect a common concern about AI's ability to interpret complex human thoughts, creativity, and understanding [18].

Students were asked a number of open-ended questions. One student stated that "Artificial Intelligence will ensure effectiveness and equity in medical education", another one added "Artificial intelligence tools will need infrastructure that is not available in our medical schools and will be expensive to adopt" and a third commented on the hazards of depending on AI saying "Malfunctions in the immature technology will hinder its use". These comments align with the collective opinion received by the findings of the questionnaire of the current study.

Students in the current study were most familiar with "virtual patient learning," and "virtual reality simulation," as these were already introduced in their learning systems at Ain Shams medical school. Interestingly, the majority were not familiar with "gamification tools" although many of these are used in their teaching. An explanation for this might be their lack of knowledge about the nature of the tools they use in class and probably they know its brand name only. Similarly, Huang et al. (2007) emphasized that increasing student awareness about different tools in medical education is important [19]. They added that incorporating diverse AI technologies into medical teaching and learning serves to fulfill various learning outcomes.

The other section in the questionnaire in the current study investigating students' knowledge and attitude towards AI in medical practice included questions about their familiarity with AI and its various tools used in medicine, the ability of AI to improve patient outcomes and their thought of AI replacing medical professionals in the future and their willingness to be operated upon by an AI machine.

Most of the students demonstrated moderate (67.5%) to good (28.9%) knowledge and attitude regarding AI and its application in medical practice. Over 85% showed enthusiasm to learn about the applications of AI in medicine emphasizing that it is important for medical professionals to understand how AI works. Around 75% of students showed they are willing to use AI in their future medical practice and over 65% thought that AI can improve patient outcomes in Egypt. Interestingly, over 60% believe that AI will not replace human medical professionals in the future and that explains why nearly 40% of students refused the idea of being operated upon by an AI machine. This also highlights an issue of limited trust in AI's abilities in clinical practice and is consistent with studies that found public and professional skepticism about AI's role in critical medical procedures [20, 21, 22]. It is crucial to emphasize that the goal of AI is to complement, not replace human healthcare providers in order to augment their capabilities and improve patient outcomes.

The answers to the open-ended questions regarding students' opinion about the benefits and challenges of using AI in medical practice reflected the same pattern of collective findings by the questionnaire in the current study. One student said that *"Artificial Intelligence will improve the quality of healthcare"* while another student added that *"Artificial Intelligence will improve the quality of life"* and a third commented on his worries regarding the prevalence of AI saying *"AI will lead to medical professionals losing their jobs"* and a fourth added *"AI extensive use will decrease emotions and efficient communication with patients and pose ethical concerns"*.

Surprisingly, students in the current study although still in their early medical years, but they were more familiar with AI tools in medical practice than those used for educational purposes. "Medical imaging analysis," "virtual assistants," and "predictive analytics" were most frequently reported in the current study, and those are some of the most prevalent AI tools in current healthcare as stated by Jiang et al., 2017 [3].

Most students in the current study were receptive to AI technology in their education, an attitude supported by previous research suggesting that medical students are enthusiastic about new technology and innovative teaching methods, including AI [3].

The findings of the current study align with the literature stating that AI awareness is growing among medical students. Previous studies regarding the knowledge and perspectives of medical students in multiple 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 on this was included in their medical curriculum [15, 14, 23, 12, 16, 6].

Medical education must keep pace with changes in medical practice and measures should be taken to introduce AI into the medical school curricula, so that both medical professionals as well as the medical students understand the concept and applications of AI to maximize its use. The doctors of tomorrow need to be experts not only in the biomedical and clinical sciences, but also be able to deal with the changing technology [24, 12].

The current study has some limitations. The study was conducted in one medical school, which could reflect lack of generalizability of the findings. Other studies directed to other medical schools are recommended to have a broader idea of students' knowledge and perception towards AI. Additionally, the study relies on self-reported data by students which could not accurate in reflecting the real understanding of AI concepts. Future research using qualitative methods could aid in deeper

understanding of students' cognition and attitude towards AI.

In conclusion, the findings from the current study highlight the crucial need for medical schools to adapt to the changing technology and ensure that future physicians are ready for these changes. As AI becomes more prevalent in healthcare, medical curricula must evolve to prepare students effectively by providing comprehensive knowledge and understanding of AI, including its applications, potential, limitations, and ethical considerations ensuring students are well-prepared for their future careers. Such preparation will enable future doctors to effectively use AI as a tool to enhance patient care, improving outcomes and efficiency in healthcare. In addition, it should be noted that while AI has a lot to offer, it should be used to augment, not replace, human capabilities in medical education and practice.

References

[1] Amisha, M., Malik, P., Pathania, M., & Rathaur, V. (2019). Overview of artificial intelligence in medicine. Family Med Prim Care, 8(7), 2328-2331.

[2] Buch, V., Ahmed, I., & Maruthappu, M. (2018). Artificial intelligence in medicine: Current trends and future possibilities. Br J Gen Pract, 68(668), 143-144.

[3] Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., ... Wang, Y. (2017). Artificial intelligence in healthcare: past, present and future. Stroke and Vascular Neurology, 2(4), 230-243.

[4] Hogarty, D., Su, J., Phan, K., Attia, M., Hossny, M., Nahavandi, S., ... Yazdabadi, A. (2020). Artificial Intelligence in Dermatology-Where We Are and the Way to the Future: A Review. Am J Clin Dermatol, 41-47.

[5] Wartman, S., & Combs, C. (2018). Medical education must move from the information age to the age of artificial intelligence. Academic Medicine, 93(8), 1107-1109.

[6] Swed, S., Alibrahim, H., Elkalagi, N., Nasif, M., Rais, M., Nashwan, A., ... Shoib, S. (2022). Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Syria: A cross-sectional online survey. Front. Artif. Intell, 5:1011524.

[7] Bayne, S. (2015). Teacherbot: interventions in automated teaching. Teaching in Higher Education, 20(4), 455-467.

[8] Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. International Journal of Artificial Intelligence in Education, 26(2), 582-599.

[9] Chan, K., & Zary, N. (2019). Applications and Challenges of Implementing Artificial Intelligence in Medical Education: Integrative Review. JMIR Med Educ, 5(1), e13930.

[10] Lee, D., & Yoon, S. (2021). Application of Artificial Intelligence-Based Technologies in the Healthcare Industry: Opportunities and Challenges. Int J Environ Res Public Health, 18(1), 271.

[11] Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. (2016). Intelligence unleashed: An argument for AI in education. London: Pearson.

[12] Ejaz, H., McGrath, H., Wong, B., Guise, A., Vercauteren, T., & Shapey, J. (2022). Artificial intelligence and medical education: A global mixed-methods study of medical students' perspectives. Digit Health.

[13] Pinto Dos Santos, D., Giese, D., Brodehl, S., Chon, S., Staab, W., Kleinert, R., ... Baeßler, B. (2019). Medical students' attitude towards artificial intelligence: a multicentre survey. Eur Radiol, 29(4), 1640-1646.

[14] Al Saad, M., Shehadeh, A., Alanazi, S., Alenezi, M., Abu alez, A., Eid, H., ... Alenezi, R. (2022). Medical Students' Knowledge and Attitude Towards Artificial Intelligence: An Online Survey. The Open Public Health Journal, 15, 1-8.

[15] Ahmed, Z., Bhinder, K., Tariq, A., Tahir, M., Mehmood, Q., Tabassum, M., ... Yousaf, Z. (2022). Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Pakistan: A cross-sectional online survey. Ann Med Surg (Lond), 76(103493), 1-7.

[16] Liu, D., Sawyer, J., Luna, A., Aoun, J., Wang, J., Boachie, L., ... Joe, B. (2022). Perceptions of US Medical Students on Artificial Intelligence in Medicine: Mixed Methods Survey Study. JMIR Med Educ, 8(4), e38325.

[17] Mittelstadt, B., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. Big Data & Society, 6(2).

[18] Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data

gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. Computers in Human Behavior, 29(6), 2156-2160.

[19] Huang, G., Reynolds, R., & Candler, C. (2007). Virtual patient simulation at US and Canadian medical schools. Acad Med, 82(5), 446-451.

[20] Meskó, B., Drobni, Z., Bényei, É., Gergely, B., & Győrffy, Z. (2017). Digital health is a cultural transformation of traditional healthcare. Mhealth, 3(38).

[21] Bertsimas, D., Dunn, J., Velmahos, G., & Kaafarani, H. (2018). Surgical Risk Is Not Linear: Derivation and Validation of a Novel, User-friendly, and Machine-learning-based Predictive OpTimal Trees in Emergency Surgery Risk (POTTER) Calculator. Ann Surg, 268(4), 574-583.

[22] Luxton, D. (2013). Artificial Intelligence in Psychological Practice: Current and Future Applications and Implications. Professional Psychology: Research and Practice, Advance online publication.

[23] Doumat, G., Daher, D., Ghanem, N., & Khater, B. (2022). Knowledge and attitudes of medical students in Lebanon toward artificial intelligence: A national survey study. Front Artif Intell, 5:1015418.

[24] Burney, I., & Ahmad, N. (2022). Artificial Intelligence in Medical Education: A citation-based systematic literature review. Journal of Shifa Tameer-e-Millat University, 5, 43-53.

List of Tables

Table 1. Distribution of medical students' demographic data.

		N	%
Age Mean ± SD (min – max)		19.7 ± 1.5 (17.0 – 25.0)	
Gender	Male	180	43.9%
	Female	230	56.1%
Academic year	First year	124	30.2%
	Second year	185	45.1%
	Third year	78	19.0%
	Fourth year	15	3.7%
	Fifth year	8	2.0%

Table 2. Description of medical students' knowledge and attitude towards AI and its application in medical education.

Statements about "Knowledge and attitude towards AI and its application in medical education"	**Strongly disagree**		**Disagree**		**Neutral**		**Agree**		**Strongly agree**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Familiar with the concept of AI in education	5	1.2%	13	3.2%	57	13.9%	164	40.0%	171	41.7%
Familiar with the various AI tools available for educational purposes	7	1.7%	41	10.0%	107	26.2%	156	38.1%	98	24.0%
Believe that AI can improve the quality of medical education	3	0.7%	8	2.0%	32	7.8%	159	38.8%	208	50.7%
Believe that AI will revolutionize the way we learn in the future	3	0.7%	5	1.2%	50	12.3%	161	39.8%	186	45.9%
Willing to try out new AI technologies for medical educational purposes	4	1.0%	12	2.9%	59	14.5%	141	34.6%	191	46.9%
Confident in your ability to use AI technologies for learning purposes	8	2.0%	24	5.9%	114	28.1%	137	33.7%	123	30.3%
Comfortable with using AI in your education	9	2.2%	13	3.2%	93	22.8%	181	44.4%	112	27.5%
Comfortable with the idea of AI grading your academic work	37	9.1%	67	16.4%	120	29.4%	109	26.7%	75	18.4%
Concerned about the ethical implications of using AI in medical education	19	4.7%	57	14.1%	121	30.0%	116	28.7%	91	22.5%
Think "AI can aid in medical research"	4	1.0%	12	3.0%	41	10.1%	140	34.6%	208	51.4%
Think "it is important for universities to integrate AI technologies into their education"	2	0.5%	11	2.7%	74	18.2%	145	35.6%	175	43.0%
Think "it is important for universities to provide training on how to use AI tools"	4	1.0%	8	2.0%	39	9.5%	139	34.0%	219	53.5%
Think "it is important for universities to teach students about the ethical implications of AI"	6	1.5%	12	3.0%	45	11.1%	135	33.3%	207	51.1%
Think "AI can replace traditional teaching methods"	70	17.2%	113	27.8%	103	25.4%	67	16.5%	53	13.1%
Concerned about the potential for AI to replace human teachers	51	12.7%	93	23.1%	68	16.9%	109	27.1%	81	20.1%
Knowledge and attitude score towards AI and its application in medical education Mean ± SD (min – max)	58.6 ± 7.3 (23 – 75)									
Knowledge and attitude level towards AI and its application in medical education	**N**				**%**					
Poor (< 37)	4				1.1%					
Moderate (38 - 57)	155				41.2%					
Good (> 57)	217				57.7%					

Table 3. Description of medical students' knowledge and attitude towards AI and its application in medical practice.

Statements about "Knowledge and attitude towards AI and its application in medical practice"	**Strongly disagree**		**Disagree**		**Neutral**		**Agree**		**Strongly agree**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Familiar with the various AI tools used in medical practice	24	6.0%	71	17.8%	132	33.2%	113	28.4%	58	14.6%
Willing to learn about the applications of AI in medicine	5	1.2%	4	1.0%	42	10.4%	152	37.6%	201	49.8%
Think "it is important for medical professionals to understand how AI works"	1	0.2%	9	2.2%	28	7.0%	156	39.0%	206	51.5%
Willing to use AI in your future medical practice	4	1.0%	14	3.5%	60	15.0%	167	41.6%	156	38.9%
Willing to be operated upon by an AI machine	85	21.0%	68	16.8%	113	28.0%	82	20.3%	56	13.9%
Think "AI can improve patient outcomes in Egypt"	11	2.7%	29	7.2%	99	24.6%	133	33.1%	130	32.3%
Believe that AI will replace human medical professionals in the future	129	32.2%	113	28.2%	67	16.7%	48	12.0%	44	11.0%
Knowledge and attitude score towards AI and its application in medical practice Mean ± SD (min – max)	25.2 ± 4.3 (11 – 35)									
Knowledge and attitude level towards AI and its application in medical practice	**N**				**%**					
Poor (< 17)	14				3.7%					
Moderate (18 - 27)	257				67.5%					
Good (> 27)	110				28.9%					

Table 4. Medical students' recognition of AI tools in medical education and medical practice.

	N	**%**
Considered an AI tool in medical education		
Personalized learning platforms	186	45.4%
Virtual patient learning	260	63.4%
Gamification tools	87	21.2%
Chatbots for student support	212	51.7%
Interactive smartboards	196	47.8%
Virtual reality simulation	243	59.3%
Automated exam grading systems	192	46.8%
Considered an AI tool used in medical practice		
Electronic health records	202	49.3%
Clinical decision support systems	155	37.8%
Medical imaging analysis	284	69.3%
Personalized medicine	151	36.8%
Virtual assistants	212	51.7%
Predictive analytics	195	47.6%

Table 5. Relation between students' characteristics and medical students' knowledge and attitude score towards AI and its application in medical education and medical practice.

		Knowledge and attitude about medical education level						P
		Poor (< 37)		Moderate (38 - 57)		Good (> 57)		
		N	Row %	N	Row %	N	Row %	
Age†		19.1 ± 0.9		19.6 ± 1.4		19.8 ± 1.7		.869
Gender ‡	Male	2	1.2%	70	43.2%	90	55.6%	.699
	Female	2	0.9%	85	39.7%	127	59.3%	
Academic year!	First year	1	0.8%	50	42.4%	67	56.8%	.957
	Second year	2	1.2%	67	41.1%	94	57.7%	
	Third year	1	1.4%	27	37.5%	44	61.1%	
	Fourth year	0	0.0%	6	40.0%	9	60.0%	
	Fifth year	0	0.0%	5	62.5%	3	37.5%	
		Knowledge and attitude about medical practice level						P
		Poor (< 17)		Moderate (18 - 27)		Good (> 27)		
		N	Row %	N	Row %	N	Row %	
Age		19.5 ± 1.3		19.6 ± 1.5		19.7 ± 1.5		.215
Gender ^	Male	5	3.0%	112	66.3%	52	30.8%	.649
	Female	9	4.2%	145	68.4%	58	27.4%	
Academic year!	First year	5	4.2%	79	66.4%	35	29.4%	.589
	Second year	9	5.5%	110	67.1%	45	27.4%	
	Third year	0	0.0%	52	69.3%	23	30.7%	
	Fourth year	0	0.0%	9	60.0%	6	40.0%	
	Fifth year	0	0.0%	7	87.5%	1	12.5%	

(‡) Fisher exact test, (!) linear by linear association Chi square test, (^) Chi square test and (†) One way ANOVA test were used, P-value ≤ 0.05 is considered statistically significant.