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Medical Students' Knowledge and Attitudes about Artificial Intelligence: A Cross-Sectional Survey

Tıp Öğrencilerinin Yapay Zeka Konusundaki Bilgi ve Tutumları: Kesitsel Bir Araştırma

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Abstract

Aim: Artificial intelligence (AI) may be explained as robotic systems that are made by humans. These robotic systems are designed based on statistics and used for executing functions of human-like behavior. AI has the potential to improve medicine and healthcare. AI is used in medical fields such as surgical areas and medical education. In the future, it will play a larger role in the field of medicine, as it does in many other fields. However, it is not discussed enough in today's medical education. The purpose of this study was to analyze the knowledge and attitude of medical students about AI in medicine.

Methods: A cross-sectional study was conducted among all the medical students in the international joint medical program of Eastern Mediterranean University carried out with Marmara University by using an online questionnaire. Students who were informed before the survey were asked to fill out the survey if they agreed to participate. The questionnaire included 3 parts; participant demographics, knowledge about AI, and attitudes toward AI. The results were collected and inspected via Microsoft Excel. The data from the survey were analyzed by chi-square tests using SPSS v26.

Results: 88 medical students responded online survey. Most of the survey responders (77%) were already aware of information related to AI in medicine. The majority of the participants acquired this information from mainly social media and media. Only 26.1% of students indicated that they learned something about AI from lectures. 29.5% of preclinic phase students believe that the human physician will be replaced by AI in the foreseeable future, but the percentage is decreased to 18.5% among clinic phase students. Male students significantly stated that they have a basic understanding of AI ($p<0.05$). Additionally, the participants who understand the technologies significantly thought that these developments make medicine more exciting ($p<0.05$).

Keywords: Artificial Intelligence, Medical Education, Medical Students, Cyprus

Anahtar Sözcükler: Yapay Zeka, Tıp Eğitimi, Tıp Öğrencisi, Kıbrıs

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Conclusions: The majority of medical students believe that AI would improve medicine. The students with more knowledge find the subject more exciting and less afraid. Since medicine and AI will more often be mentioned together in the future, future doctors should be equipped with information about AI during their medical education.

Özet

Amaç: *Yapay zeka, insanlar tarafından yapılan robotik sistemler olarak açıklanabilir. Bu robotik sistemler, istatistiklere dayalı olarak tasarlanır ve insan benzeri davranış işlevlerini yerine getirmek için kullanılır. Yapay zeka, tıp ve sağlık hizmetlerini iyileştirme potansiyeline sahiptir. Günümüzde yapay zaka, cerrahi alanlar ve tıp eğitimi gibi tıpla ilgili alanlarda kullanılmaktadır. Gelecekte, birçok alanda olduğu gibi tıp alanında da daha çok rol alacağı düşünülmektedir. Ancak günümüz tıp eğitiminde henüz yeterince tartışılmamaktadır. Bu çalışmanın amacı, tıp fakültesi öğrencilerinin tıpta yapay zeka konusundaki bilgi ve tutumlarını incelemektir.*

Yöntem: *Doğu Akdeniz Üniversitesi'nin Marmara Üniversitesi ile yürüttüğü uluslararası ortak tıp programında yer alan tüm tıp öğrencileri arasında çevrimiçi anket kullanılarak kesitsel bir çalışma gerçekleştirildi. Anket öncesi bilgilendirilen öğrencilerin, katılmayı kabul edenlerinin anketi doldurması istendi. Anket 3 bölümden oluşmaktaydı. Bu bölümler şu şekildeydi; katılımcıların demografik özellikleri, yapay zeka hakkında bilgi ve yapay zekaya yönelik tutumlar. Sonuçlar çevrimiçi olarak toplandı ve Microsoft Excel aracılığıyla incelendi. Anketten elde edilen veriler SPSS v26 kullanılarak ki-kare testleri ile analiz edildi.*

Bulgular: *Bu çalışmada 88 tıp öğrencisi çevrimiçi anketi yanıtladı. Ankete yanıt verenlerin çoğu (%77) tıpta yapay zeka ile ilgili bilgilerin zaten farkındaydı. Katılımcıların çoğunluğu bu bilgileri ağırlıklı olarak sosyal medya ve medyadan edindiğini belirtmişti. Öğrencilerin yalnızca %26,1'i derslerden yapay zeka hakkında bir şeyler öğrendiğini belirtti. Preklinik faz öğrencilerinin %29,5'i öngörülebilir gelecekte doktorun yerini yapay zekanın alacağına inanıyor, ancak bu oran klinik faz öğrencileri arasında %18,5'e düşüyor. Erkek öğrenciler anlamlı bir şekilde kız öğrencilere göre daha fazla temel bir yapay zeka anlayışına sahip olduklarını belirtmişlerdir ($p<0.05$). Ayrıca teknolojilerden anlayan katılımcılar bu gelişmelerin tıbbı daha heyecanlı hale getirdiğini düşünmektedir. Bu ilişki de anlamlıdır ($p<0.05$).*

Sonuç: *Tıp öğrencilerinin çoğu yapay zekanın tıbbı ileriye görüteceğine inanıyor. Daha fazla bilgi sahibi olan öğrenciler konuyu daha heyecanlı ve daha az korkutucu bulurlar. Tıp ve yapay zeka gelecekte daha sık bir arada anılacağı için, geleceğin doktorları tıp eğitimleri sırasında yapay zeka ile ilgili bilgilerle donatılmalıdır.*

INTRODUCTION

The term artificial intelligence (AI) AI was first used by John McCarthy and defined as 'the science and engineering of making intelligent machines, especially intelligent computer programs.' (1). In other words, AI is a system that simulates human intelligence and can learn to interpret a vast amount of data and then use it to perform specific tasks. And AI does all this work very quickly and reliably (2-4). Although it was established for the first time only half a century ago, its importance and usage have increased exponentially due to the increasing data in every field recently also in medicine (2,3,5). There is no doubt that it will be used more intensively in the medical field in the future.

AI has the potential to improve many aspects of medicine and healthcare. The subfield of AI deep learning can interpret a huge amount of clinical data and information (5,6). Besides, AI can improve every field of medicine like diagnosis, decision-making, and treatment. Since AI Contributes to the processing of huge amounts of data, it will be a pioneer in personalized medicine by providing the processing of different combinations of this

data (3,5). Furthermore, medical robots and devices can assist patients and doctors. Robots can communicate with patients and help them without the need for staff to be there. Robots can also be used in surgery and assist surgeons. Moreover, AI can be adapted to nanotechnology for diagnosis and new drug delivery routes (3,5,7).

AI is classified into 2 main branches based on its usage areas that are discussed above; virtual and physical. The virtual branch is related to data interpretation. The physical branch is best represented by assistant robots (2,7).

Artificial intelligence can speed up the process in every step of medicine like diagnosis, decision-making, and treatment, and also has the ability to reduce human errors. In another way, these systems can improve precision medicine and monitor the healthcare system and are helpful also in medical education (3,5,8). Along with medicine, the knowledge to be learned in medical education also increases. Recording and processing this information with AI using the machine learning/deep learning method also contributes to medical education and supports individual learning. Additionally, it is possible to prepare physician candidates for the future with simulations using robotics training and virtual reality methods in this training, where practice is important (9).

There are two different views about AI in medicine among healthcare personnel. A pessimistic view of AI in medicine is that AI will replace physicians and cause ethical confusion. But a more common optimistic view supports that we can benefit from its opportunities (4). But we know that humans can have a realistic view with enough knowledge gained from the right source.

Current medical students will be affected by AI. Therefore, medical students and young doctors need to be prepared for these changes by acquiring the appropriate and more knowledge and experience about AI. It is observed that AI applications that have become so involved in medicine are not included in many classical medical education curricula. Opinions on how it will take place in medical education are also new and there is no consensus on it yet (4,6,8,10). Any feedback received on this subject is valuable for shaping the training and its content. Although AI has been in our lives for many years, it is noteworthy that articles about its place in medical education and students' opinions on this subject have entered the literature more intensively in the last two years.

The main aim of the study is to search the medical students' knowledge, information sources, and perceptions of AI in medicine in this international joint medical program.

METHODS

This cross-sectional study was conducted in the 2020 – 2021 academic year for all preclinic and clinic phase medical students in the international joint medical program of North Cyprus Eastern Mediterranean University carried out with Turkey Marmara University. The questionnaire was obtained from Daniel Pinto dos Santos with his permission (11). Consent also be taken from all the participants before the survey. The online questionnaire was designed using Google Forms. The responses were collected anonymously. The survey consists of two parts. The first part includes demographic questions that ask about the age, gender, nationality, and classes of the participants. The second part of the survey was composed of 12 questions regarding awareness and attitudes toward AI. The questionnaire consists of multiple-choice, multi-select, and Likert questions.

The data from the survey was collected using Microsoft Excel and analyzed by using SPSS v26. Descriptive statistics were calculated over the total number of answers given and presented in percentages. Pearson's Chi-Square Test was used in comparative statistics. The significance level was considered as $p < 0.05$.

RESULTS

The response rate was 37.4% in this online survey. 88 students responded to the survey out of a total number of 235. 69.3% of all the respondents were preclinic students and 60.3% of all the respondents were female. The median age is 20,8. 77.3% of the participants are Turkish and 22.7% of them are from different foreign countries including German, Iranian, Syrian, Bahraini, Nigerian, Omani, Libyan, and Uzbek.

The questions regarding their awareness revealed that 77% of the respondents indicated that they were already aware of "Deep Learning" and "Artificial Intelligence." And 79% of the respondents said that they were aware of the usage of artificial intelligence in daily life such as test recognition, recommendation algorithms, and spam filters. Another question was asked to the respondents about if they personally had a basic understanding of the technologies used in "Deep Learning" and "Artificial Intelligence." 59% of the respondents said that they had a basic understanding of the technologies used in these topics. There weren't any significant differences between AI awareness in different phases of education. But the significantly lower percentage of females than males indicates that they have a basic understanding of AI ($p< 0.05$) (Table 1).

More than half of the medical students in our study indicate that they learned or heard anything about artificial intelligence from media or social media. The percentages for these sources were 57% and 58% respectively. 26% of respondents have said that they learned from lectures and 6% of respondents have said that they don't know anything (Figure 1).

More than half of the medical students in our study indicate that they learned or heard anything about artificial intelligence from media or social media. The percentages for these sources were 57% and 58% respectively. 26% of respondents have said that they learned from lectures and 6% of respondents have said that they don't know anything (Figure 1).

The surveys' attitudes towards AI-related part evaluation revealed that the vast majority stated that they agree that AI will revolutionize and improve medicine in general with percentages of 84.1% and 88.6% respectively. While 60.2% of participants didn't agree with the foresight that human (noninterventional) physicians will be replaced in the foreseeable future, 80.7% of them disagree with the foresight of AI will replace all physicians in the near future. It is also observed that 29.5% of preclinical students said that they thought the human (noninterventional) physician will be replaced foreseeable future, but this percentage decreased to 18.5% among clinic phase students. Moreover, the majority of the participants stated that these developments make medicine more exciting for them (70.5%) and artificial intelligence should be part of medical training (78.4%). But nearly 1/3 of students (30.7%) said that the development of AI in the medical field frightens them. Moreover, preclinical phase students are significantly more confused than clinical phase students about whether the developments frighten them or not ($p<0.05$) (Table 2).

The comparisons revealed that the students who have a basic understanding significantly have less fright and more excitement about the improvement of AI in the medical field ($p< 0.05$) (Table 3).

DISCUSSION

In our study, more than two-thirds of the students said they are aware and only more than half of the students indicate having a basic understanding of AI. There are different percentages of knowledge about AI among medical students and healthcare personnel in previous studies all around the World. A study which is conducted in Korea with a great number of participants revealed that only 5.9% had good familiarity with AI (4).

Table 1. The Association Between AI Awareness and Gender, Phase of Medical Education

		"Deep Learning" and "Artificial Intelligence" are currently being broadly discussed in the medical community. Were you already of these topics in medicine? N(%)			p-value	Do you personally have a basic understanding of the technologies used in these topics? N(%)			p-value	Other applications we use in daily life already use artificial intelligence (e.g. speech-/text-recognition, spam filters, recommendation algorithms). Were you aware of this? N(%)			p-value
		Yes	**No**	**N/A**		**Yes**	**No**	**N/A**		Yes	No	N/A	
Total		68(77.3%)	10(11.4%)	10(11.4%)		52 (59.1%)	27 (30.7%)	9 (10.2%)		70(79.5%)	13(14.8%)	6(5.7%)	
Phase	**Preclinic**	43(70.5%)	9(14.8%)	9(14.8%)	0.281	33 (54.1%)	23 (37.7%)	5 (8.2%)	0.348	45(73.8%)	11(18%)	5(8.2%)	0.223
	Clinic	25(92.6%)	1(3.7%)	1(3.7%)		19 (70.4%)	4 (14.8%)	4 (14.8%)		25(92,6%)	2(7.4%)	0(0%)	
Gender	**Male**	28(80.0%)	4(11.4%)	3(8.6%)	0.797	26 (74.3%)	5 (14.3%)	4 (11.4%)	**0.024***	29(82.9%)	3(8.6%)	3(8.6%)	0.294
	Female	40(75.5%)	6(11.3%)	7(13.2%)		2 6(49.1%)	22 (41.5%)	5 (9.4%)		41(77.4%)	10(18.9%)	2(3.8%)	

p-value from Pearson's Chi-Square Test
**p <0.05*

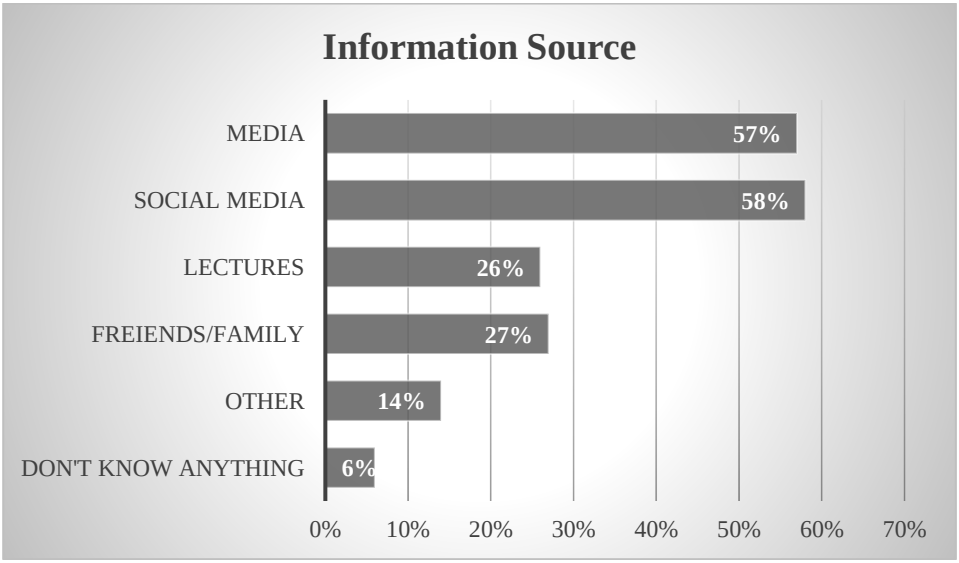

Figure 1. The Information Source of Medical Students on AI.

Table 2. Attitudes Towards AI and Deep Learning in Medicine

	Phase	**Agree** N(%)	**Disagree** N(%)	**N/A** N(%)	**p-value**
o Artificial intelligence will revolutionise medicine in general	Preclinic	50 (82%)	8 (13.1%)	3 (4.9%)	0.333
	Clinic	24 (88.9%)	2 (7.4%)	1 (3.7%)	
	Total	74 (84.1%)	10 (11.4%)	4 (4.5%)	
o The human (noninterventional) physician will be replaced foreseeable future	Preclinic	18 (29.5%)	34 (55.7%)	9 (14.8%)	0.098
	Clinic	5 (18.5%)	19 (70.4%)	3 (11.1%)	
	Total	23 (26.1%)	53 (60.2%)	12 (13.6%)	
o In the foreseeable future, all physicians will be replaced	Preclinic	7 (11.5%)	51 (83.6%)	3 (4.9%)	0.038
	Clinic	2 (7.4%)	21 (77.8%)	4 (14.8%)	
	Total	9 (10.2%)	71 (80.7%)	8 (9.1%)	
o These developments frighten me	Preclinic	19 (31.1%)	32 (52.5%)	10 (16.4%)	**0.012***
	Clinic	8 (29.6%)	18 (66.7%)	1 (3.7%)	
	Total	27 (30.7%)	50 (56.8%)	11 (12.5%)	
o These developments make medicine in general more exciting to me	Preclinic	44 (72.1%)	12 (19.7%)	5 (8.2%)	0.687
	Clinic	18 (66.7%)	6 (22.2%)	3 (11.1%)	
	Total	62 (70.5%)	18 (20.5%)	8 (9.1%)	

	Phase	Agree N(%)	Disagree N(%)	N/A N(%)	p-value
o Artificial intelligence will never make the human physician expendable	Preclinic	37 (60.7%)	13 (21.3%)	11 (18.0%)	0.369
	Clinic	19 (70.4%)	4 (14.8%)	4 (14.8%)	
	Total	56 (63.6%)	17 (19.3%)	15 (17.0%)	
o Artificial intelligence will improve medicine in general	Preclinic	54 (88.5%)	1 (1.6%)	6 (9.8%)	0.551
	Clinic	24 (88.9%)	1 (3.7%)	2 (7.4%)	
	Total	78 (88.6%)	2 (2.3%)	8 (9.1%)	
o Artificial intelligence should be part of medical training	Preclinic	48 (78.7%)	6 (9.8%)	7 (11.5%)	0.649
	Clinic	21 (77.8%)	2 (7.4%)	4 (14.8%)	
	Total	69 (78.4%)	8 (9.1%)	11 (12.5%)	

p-value from Pearson's Chi-Square Test
**p <0.05*

Table 3. The Association Between AI Awareness and Attitudes

		Were you already aware of these topics in medicine? N(%)		P value	Do you personally have a basic understanding of the technologiesused in these topics? N(%)		P value
		Yes	No		Yes	No	
These developments frighten me	Agree	19 (21.5%)	6 (6.8%)	0.076	12(13.6%)	13 (14.7%)	**0.016***
	Disagree	42 (47.7%)	4 (4.5%)		35 (39.9%)	11 (12.5%)	
These developments make medicine in general more exciting to me	Agree	53 (60.2%)	5 (5.6%)	**0.019***	44 (50.0%)	13 (14.7%)	**<0.001***
	Disagree	11 (12.5%)	5 (5.6%)		5 (5.6%)	11 (12.5%)	

p-value from Pearson's Chi-Square Test
**p <0.05*

Similarly, other studies from Pakistan and Oman showed that the majority of the students (61.7%, and 75.4% respectively) had no previous knowledge of AI (12,13). On the contrary, another study from Oman revealed that 9% had no knowledge and 69% were aware of the topic (14). A quite similar study was conducted in Germany among students (11), and according to the responses they are commonly aware of daily life AI-related applications and half of the students were aware of AI in medicine. In another study from Germany, which included 844 medical students with wide participation, two-thirds of the participants think that they do not have enough information about AI in medicine (15). Most probably the survey years, participants, and the questionnaires feature influence these differences in the percentage of awareness and knowledge. Some studies include not only students but also physicians and some studies only search for awareness but some of them use self-reported questions for knowledge of AI ad also some of them evaluate it with specific knowledge-related questions. We also accept self-reported knowledge declaration in our study.

Both in our study and the German study the male participants more commonly claim that they have a basic understanding of AI (11).

Additionally, there is a significant difference between AI awareness and gender distribution similar to our results. The difference between genders is also notable in McLennan et al.'s study regarding their view of AI. Although male students think that AI has advantages, female students are worried about its disadvantages (15).

In the ındex study from Germany where we get the questionnaire, they also indicate that the majority of the students hear about something about AI and the study showed that they heard of it mainly from media and social media with percentages of 85.2% and 65.8% respectively. 55.9% of the participants of this study indicated that they heard about AI during university lectures (7). In another study among 19 United Kingdom medical schools with more than 4 hundred students revealed that only 45 students received any teaching on AI; none of the students received such teaching as part of their compulsory curriculum (16).

On the other hand, more than half of the medical students in our study indicated that they learned or heard anything about artificial intelligence from media or social media. 26% of respondents have said that they learned from lectures and 6% of respondents have said that they don't know anything. The results of a study from a medical faculty from our nearby geography, Turkey which was conducted among only preclinical students showed that 93.6% of participants have heard about AI. But 59.2% thought that they don't have enough information about AI applications in medicine (17). All these results show that, in general, medical students all over the world passively acquire information from popular platforms and there is a lack of professional training on this subject.

Actually, most of the respondents of previous studies among medical students and physicians and our students agree that artificial intelligence will become more popular and improve medicine, especially with its ability to interpret a vast amount of data (4,5,11,12,16,18). On the contrary, in a study conducted with medical students and doctors in Korea, only half of the participants reported that artificial intelligence will be used more intensively in the future (4). We can also observe different opinions in different studies about the role of AI against humans in medicine. Some studies showed that the majority of students and physicians in previous surveys believed that AI will not replace human physician roles in the future (4,11). But there are also other studies that indicate the thought that AI would take doctors' places among nearly over half of the participants (5,12,19). It is interestingly observed that the studies from the developed countries show the opinion of disagreement about the replacement of humans with AI in medicine but nearly half of the participants agrees on it, in the studies form developing countries. Additionally, the study from Nepal and Pakistan whose most of the study population indicate a lack of knowledge also agree that AI may replace human (12,19). Our study revealed that slightly more than half of the respondents agree that AI will never make the human physician expandable. These results may interpret that people who have less knowledge and from developing countries agree on the possible role of AI over humans in medicine in the future. In addition, the students in the clinical phase were more opposed to the idea that "AI technologies will replace doctors in the future" compared to the students in the pre-clinical phase. We can interpret this situation as they are aware of the importance of technological approaches clinically (from diagnosis to treatment) in the education process they continue in the hospital environment and show a realistic approach.

It is also interestingly observed that one-third of respondents in the German study (11) found the developments exciting, the other hand two-thirds of respondents of our study and the Pakistan study (12) indicate it. Both our country and Pakistan are among the developing countries and also both studies were among only medical students. These factors may explain the

huge difference. Moreover, half of the people who took part in our survey thought that advances in AI made medicine more interesting in general. According to the study done in Germany, people who are aware of AI technologies and have an understanding of their applications regard artificial intelligence in medicine to be more exciting (11). According to the study conducted in Pakistan, two-thirds of medical students find AI technologies exciting and believe that incorporating them into medical education will be beneficial (12).

According to the findings of our study, those who have a basic understanding of artificial intelligence technology have less fear of AI and emerging technologies. The study conducted in Germany also found that doctors who were aware of technology had less fear (11). The reports from East and West of the World and the recent study which is conducted among medical students in Turkey Eskisehir University indicate the same results. More information about AI led to the students having less fear and all of them indicated the need to learn this topic from faculty lectures (4,11,14,16,17).

In the literature review, it is revealed that AI-related knowledge and discussions effect also the career plans of future doctors. Some doctors consider the possibility of unemployment because of AI usage and some doctors want to use AI in their work because of its opportunities. Both views are discussed as they will affect the choice of specialization in the future (3,16-18).

Lastly, by reviewing all these studies and surveys, the most comprehensive and most intensively participated study in the literature is from Turkey. In the study, where the opinions of 3018 medical students from 67 different medical schools from all regions of Turkey were examined, the majority of the students (75.6%) stated that they did not receive any training on AI in medicine. The results of the study revealed that the majority of students (87.9%) think that AI cannot replace the physician. In addition, almost half of the participants expressed their concerns about unemployment, the decrease in the value of the doctor and the trust in the doctor, and the negative impact on the doctor-patient relationship. However, three out of four of the participants agree that their professional work-life will improve with the use of AI. The study also revealed demands for training needs on AI. Almost all of the participants pointed out their need for “knowledge and skills related to AI applications”, “applications for reducing medical errors” and “training to prevent and solve ethical problems that might arise as a result of using AI” (20).

For these applications, which will probably enter the field of medicine more in the future, today's medical students and healthcare professionals do not feel adequately equipped and safe. Although the reservations mentioned about AI in medicine are mainly about the dehumanization of medicine, employment, and ethical issues, medical students generally express the need not to be worried about the developments and consider it positive and necessary to be involved with these issues.

The common result of all these studies and our study is the great demand for AI to be included in medical education so that medical graduates are more ready for AI (4,11-21). In this regard, it has been observed that scales that evaluate readiness have begun to be developed and curriculum recommendations have begun to be made (22,23). A pilot study was also conducted to evaluate the benefit of AI training after its implantation in medical education and showed great improvement in knowledge (24). Most probably, medical education content will inevitably be shaped in this direction in the near future.

Our study revealed the opinions of the students in this international program, where similar education models are applied to Turkey, but in the structure of a joint medical program, regarding this popular and important subject. Some of the limitations we observed in the study can be mentioned as follows. The response rate was low and the majority of responders were year 1 students. The other

limitation was the knowledge-related part of the questionnaire was based on the participant's own declaration instead of knowledge-related questions. Additionally, the socioeconomic environment in which the students grew up was not evaluated.

CONCLUSIONS

In conclusion, The vast majority of medical students believe that AI would improve medicine. Students who have a greater understanding of the topic find it more interesting and less intimidating. Since medicine and AI will be mentioned more often in the upcoming, future doctors should be prepared with AI knowledge during their medical education.

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