

Original Research Article

Evaluation of awareness, perceptions and opinions of artificial intelligence (AI) among healthcare students – A cross-sectional study in Saudi Arabia

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Abstract

Purpose: To ascertain the views, knowledge and opinions of healthcare students (HCs) regarding artificial intelligence (AI).

Methods: The cross-sectional survey designed to assess awareness, perceptions and opinions of HCs towards AI was conducted between April to June 2023. A pre-tested, validated structured questionnaire was distributed electronically to HCs across different universities in Saudi Arabia. Responses were compiled using a 5-point Likert scale. Cronbach's alpha score of 0.80 was used to establish the reliability of the questionnaire. Mean scores were determined by calculating each item in the perceptions compiled.

Results: Majority of HCs had a positive perception towards AI in healthcare and agreed that AI could improve diagnostic accuracy (73.4 %), reduce errors in medical practice (65.2 %) and facilitate patient education (70.8 %). However, some concerns were expressed that AI has a harmful impact on healthcare practitioners' relationships with patients and potential ethical implications (44.3 %) and also allows patients to increase control over their health (51 %). Most students (85 %) believe that if AI is integrated into healthcare, there is a risk of losing jobs. The analysis of multiple linear regression shows that course of study ($B = 0.311$; $SE = 0.132$; $t = 2.360$; $p = 0.019$; $CI = 0.052$ to 0.570), awareness of AI ($B = -1.822$; $SE = 0.785$; $t = -2.320$; $p = 0.021$; $CI = -3.366$ to -0.279) were predictors of perception score of AI.

Conclusion: Healthcare students show positive perceptions towards AI and agree that AI helps in various aspects of healthcare. However, students revealed some concerns about AI. Therefore, addressing concerns related to ethics, workforce impact and patient privacy is crucial for successful AI implementation in the healthcare sector.

Keywords: Artificial intelligence, Healthcare, Students, Perceptions, Awareness

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INTRODUCTION

The field of artificial intelligence (AI) has great promise for transforming the healthcare industry. [1,2]. By leveraging AI technologies, healthcare systems can experience numerous benefits.

Artificial intelligence can enhance patient care by enabling early disease detection, providing personalized treatment plans and improved monitoring of chronic conditions [1,2]. It also highlights the potential for cost reduction, increased efficiency and improved patient outcomes [1,2]. Studies on AI in healthcare have

grown exponentially in recent years. One notable study conducted at Stanford University focused on using deep AI learning algorithms to detect skin cancer and demonstrated the potential in diagnosing skin cancer and providing timely treatment [3,4]. A study conducted by Syed Basil surveyed healthcare students (HCs) to assess their perceptions of AI [5]. The findings revealed that students demonstrated an excellent understanding of AI [5]. Similarly, another recent systematic review conducted on HCs showed that they had a positive and promising attitude towards AI in clinical profession and its use in the future [6]. On the other hand, another study conducted on HCs reported that there is need to incorporate AI-focused educational programs in healthcare curricula to bridge this knowledge gap. These programs can equip students with the necessary skills to effectively utilize AI tools and technologies in their future careers [7]. Saudi Arabia ranked first in the government sector in a recently published AI global report [8] and also ranked second in AI awareness [9]. As AI continues to advance, HCs must be aware of its applications and implications in their field. To foster AI awareness among healthcare students, educational institutions should incorporate AI-related coursework and training programs. Students should be exposed to the fundamentals of AI, machine learning and data analysis. Additionally, hands-on experience with AI tools and technologies can provide practical knowledge and enhance their problem-solving abilities. Studies are scanty on perceptions, awareness and opinions of HCs towards AI in Saudi Arabia. The present study aims to evaluate the perceptions, awareness and opinions of HCs towards AI in the Kingdom of Saudi Arabia.

METHODS

Study setting, design and population

An online cross-sectional study was conducted among HCs at Taibah University between April to June 2023 to evaluate the knowledge, opinions and awareness of students towards AI. Google Forms was used to create a self-administered survey. Social media and email were used to distribute the survey surveys to HCs among different universities in Saudi Arabia. Incomplete responses as well as those from students who did not belong to any healthcare centre were excluded from the study.

Ethical considerations

The study was approved by the Research Ethics Committee in the College of Pharmacy, Taibah University, Saudi Arabia (COPTU-REC-67-

20230423). Informed consent forms were presented to students before data collection, emphasizing the confidentiality of their responses and their right to withdraw from the study.

Data collection tool

A questionnaire was designed based on a comprehensive review of previously published literature [5-7]. The questionnaire was divided into sections. The first section covered demographic data such as age, gender, nationality, course and year of study (8 items). The second section dealt with perception towards AI using 12 questions and the final section addressed the opinions of students towards the inclusion of AI courses in the healthcare academic curriculum with 17 questions. After the initial draft, questionnaire was evaluated in two stages. First, an initial draft of the questionnaire was distributed to a group of specialists, who are experts in designing survey questionnaires, to check the content, flow and time taken to answer the questionnaires. Second, a pilot study involving thirty students was used to validate the structured questionnaire. The final analysis did not include data from the pilot study. Cronbach's alpha score, which was 0.80 when the reliability of the questionnaire was determined, showed that it was a reliable tool for conducting the study. To determine the perception score, 5 was allocated for strongly agreeing, 4 for agreeing and neutral, 2 for disagreeing, and 1 for severely disagreeing. The mean perception score was determined by calculating each item in the perception collection.

Data analysis

Statistical Package for Social Sciences, version 26.0 (SPSS Inc., Chicago, IL, USA), was used to evaluate the data. Sociodemographic characters were described using descriptive statistics, where continuous variables were shown as means and standard deviations and categorical variables as frequency (n) and percentages (%). Chi-square or the Fisher exact test was performed to determine whether the variables were related. Additionally, multiple linear regression was employed to evaluate factors influencing perception scores. $P < 0.05$ was considered significant.

RESULTS

Four hundred and sixty-three (463) healthcare professionals completed the survey. Table 1 summarizes the sociodemographic characteristics of the students. Nearly two-thirds (62.2 %) were females and more than half of

them (59.6 %) were aged between 23 – 25 years old. Most of the students (96.6 %) were Saudi nationals. Also, more than one-third of the students (35.6 %) belong to physiotherapy, one-quarter of them were nursing while 10.2 % of the students were dental students. Furthermore, most of the students were in their fifth year. In addition, the majority (89.8 %) of the students claimed that they were aware, while 10.2 % were unaware of AI. Interestingly, about two-thirds of the students claimed that AI would replace the physician, pharmacist or nurse in the healthcare system (Figure 1). Regarding the opinions, 84.9 % of the students think that there is a risk of losing jobs with the introduction of robots (AI)

leading to a decrease in the need for employees (Figure 2).

Perception of HCs about AI

Table 2 shows the perceptions of HCs about AI. About 40.6 % of the students agreed that AI devalues the medical profession. However, 73.4 % of them agreed that AI enables healthcare professionals to make more accurate decisions while 65.2 % of them believed that AI reduces errors in medical practice. When asked whether AI facilitates patient education, 70.8 % agreed with this statement.

Table 1: Sociodemographic characteristics of the students

Variable	Frequency (n)	Percentage (%)
Gender		
Male	175	37.8
Female	288	62.2
Age in years		
18–22	1	0.2
23–25	276	59.6
26–30	178	38.4
>31	8	1.7
Nationality		
Saudi	447	96.5
Non-Saudi	16	3.5
Course of study		
Pharmacy	35	7.6
Nursing	134	28.9
Medical	5	1.1
Dental	47	10.2
EMS (Emergency medical services)	17	3.7
Physiotherapy	165	35.6
Others	60	13
Level/year of study		
First	56	12.1
Second	36	7.8
Third	35	7.6
Fourth	88	19.0
Fifth	148	32.0
Sixth	49	10.6
Internship	51	11.0
You belong to which region of Saudi Arabia		
Central	330	71.3
Eastern	31	6.7
Western	48	10.4
Southern	20	4.3
North	34	7.3
Have you received any formal training in AI?		
Yes	35	7.6
No	399	86.2
Received from the Internet	13	2.8
Through seminars and presentations	16	3.4

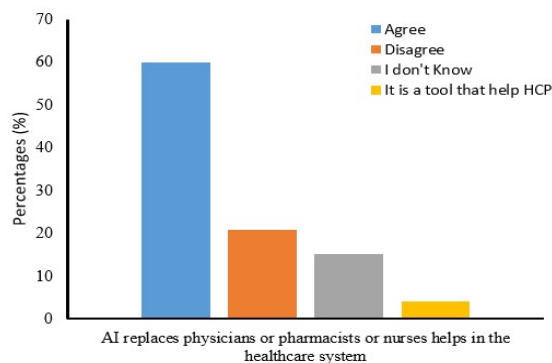


Figure 1: Opinions of HCs towards AI in the healthcare system

Furthermore, 51 % of students believed that AI allows patients to increase their control over their health. With respect to the opinions to include AI in the academic curriculum, 359 students (77.5 %) agreed that knowledge and skills about AI should be included while 79.9 % of students agreed to include a course on AI in reducing medication errors. Moreover, 73.9 % (n = 342) indicated that AI should be included in scientific studies. In addition, a similar ratio agreed upon its use for assessing genetic risk (61.6 %, n = 285) as well as analyzing health phenomena. More than half of the participants agreed that patients will be more likely to comply with their treatment when AI applications are used (Table 3). It is noteworthy that awareness of AI was not

significantly associated with the course of study of HCs as shown in Table 4.

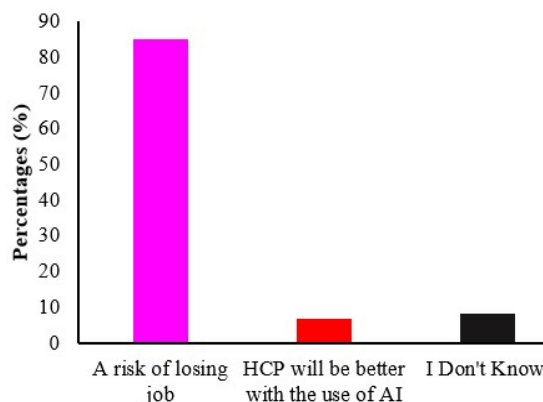


Figure 2: Healthcare student's opinion on the widespread use of AI in Saudi Arabia

To determine the relationship between perceptions of AI with a healthcare student's demographic and professional characteristics like age, gender, year & course of study, as well as student's awareness of AI, a multiple linear regression model was utilized in which age, gender, year & course of study and student's awareness of AI were considered as explanatory variables while perception of AI was set as dependent variable.

Table 2: Perceptions of HCs about AI (n; %)

Perception	Strongly agree	Agree	Neutral	Strongly disagree	Disagree
AI diminishes the value of the medical profession	52 (11.2%)	137 (29.6%)	98 (21.2%)	56 (12.1%)	120 (25.9%)
AI lowers medical practice errors	102 (22%)	201 (43.4%)	108 (23.3%)	10 (2.2%)	43 (9.3%)
AI makes the service easier for patients to access.	156 (33.7%)	243 (52.5%)	48 (10.4%)	3 (0.6%)	13 (2.8%)
AI makes information easier for medical practitioners to access	222 (47.9%)	193 (41.7%)	43 (9.3%)	1 (0.2%)	4 (0.9%)
AI helps medical professionals to make more accurate decisions.	113 (24.4%)	224 (48.4%)	93 (20.1%)	6 (1.3%)	27 (5.8%)
AI boosts patients' faith in medical professionals	50 (10.8%)	145 (31.3%)	150 (32.4%)	17 (3.7%)	101 (21.8%)
AI makes patient education easier.	127 (27.4%)	201 (43.4%)	79 (17.1%)	14 (3%)	42 (9.1%)
AI has a negative impact on the patient-provider interaction in healthcare.	55 (11.9%)	150 (32.4%)	136 (29.4%)	21 (4.5%)	101 (21.8%)
AI undermines the trust that is the foundation of the connection between a patient and a healthcare provider.	69 (14.9%)	136 (29.4%)	130 (28.1%)	23 (5%)	105 (22.7%)
AI lessens the medical profession's humanistic component.	116 (25.1%)	178 (38.4%)	77 (16.6%)	22 (4.8%)	70 (15.1%)
Professional secrecy violations may increase due to AI.	42 (9.1%)	126 (27.2%)	148 (32%)	37 (8%)	110 (23.8%)
AI gives patients more power over their well-being	73 (15.8%)	163 (35.2%)	168 (36.3%)	6 (1.3%)	53 (11.4%)

Table 3: Opinions of HCs about AI in the curriculum (n; %)

Variable	Include	Not sure	Don't know
Understanding and proficiency with AI	359 (77.5%)	78 (16.8%)	26 (5.6%)
AI in reducing medical errors	370 (79.9%)	82 (17.7%)	11 (2.4%)
Training to prevent and solve ethical problems that may arise with AI applications	347 (74.9%)	91 (19.7%)	25 (5.4%)
AI-assisted risk analysis for diseases	318 (68.7%)	120 (25.9%)	25 (5.4%)
Application that will increase patient compliance with treatment	238 (51.4%)	189 (40.8%)	36 (7.8%)
Applications for assisting clinical decision-making	268 (57.9%)	144 (31.1%)	51 (11%)
AI-assisted surveillance, filiation and patient isolation in epidemics	288 (62.2%)	145 (31.3%)	30 (6.5%)
AI analyses that help to understand and predict health phenomena	285 (61.6%)	153 (33%)	25 (5.4%)
AI-assisted genetic risk assessment	285 (61.6%)	151 (32.6%)	27 (5.8%)
AI-assisted emergency responses	311 (67.2%)	115 (24.8%)	37 (8%)
AI in scientific studies	342 (73.9%)	96 (20.7%)	25 (5.4%)
Widely used preventative health mobile applications	353 (76.2%)	80 (17.3%)	30 (6.3%)
Robot surgery/treatment	229 (49.5%)	150 (32.4%)	84 (18.1%)
AI applications that will increase patients' control over their health	376 (81.2%)	72 (15.6%)	15 (3.2%)
Virtual assistant	330 (71.3%)	107 (23.1%)	26 (5.6%)
AI-assisted diagnosis and treatment of psychiatric diseases	207 (44.7%)	147 (31.7%)	109 (23.5%)
A simplified lecture on AI, computer use, coding, Python language	290 (62.6%)	119 (25.7%)	54 (11.6%)

The results of multiple linear regression analysis revealed that there was a significant association between perceptions of AI, course of study ($B = 0.311$; $SE = 0.132$; $t = 2.360$; $p = 0.019$; $CI = 0.052$ to 0.570) and awareness of AI ($B = -1.822$; $SE = 0.785$; $t = -2.320$; $p = 0.021$; $CI = -3.366$ to -0.279) as shown in Table 5. All other variables were significantly not associated with the perceptions of AI.

DISCUSSION

In recent years, the field of healthcare has witnessed rapid advancements in technology, with AI playing a pivotal role in transforming various aspects of patient care. As AI continues to gain prominence in healthcare settings, it becomes increasingly important to understand the attitudes and perceptions of HCs towards this emerging technology. This study aimed to gather data on the awareness, opinions and perceptions of HCs towards AI. By exploring their views, students can gain insights into how the future generation of healthcare professionals perceives and embraces the integration of AI technologies in the healthcare sector. Studies on AI in the healthcare field have gained significant attention in recent years. Literature about undergraduate awareness, perceptions and opinions regarding AI in healthcare is scarce nationally and

internationally [5-7,10]. This study conducted on HCs concerning AI has shed light on their awareness, perceptions and opinions towards this emerging technology in the healthcare industry. While HCs generally recognize the potential benefits of AI, there is need for further education and training to equip them with necessary skills to effectively utilize AI tools.

This study revealed that almost 90 % of participants were aware of AI, which indicates the awareness level of study participants about AI. A study conducted on doctors and medical students in Pakistan concluded that 71.3 % had a basic knowledge of AI [3]. These results indicate that there is a basic adequate knowledge of AI among students. Another study among dental students concluded that 50.1 % had no basic knowledge of the working principles of AI. Additionally, the majority were unaware of the usage of AI in dentistry (55.8 %) [11]. A study in Canada among HCs concluded that 51.08 % were unaware of AI [12]. Awareness of AI among HCs is essential for their professional growth and the advancement of healthcare as a whole. By understanding the applications, benefits and ethical considerations of AI, students can harness its potential to improve patient care, enhance diagnoses and revolutionize healthcare delivery.

Table 4: Cross-tabulation between awareness of AI and course of study of the healthcare

Item	Response	Applied medical sciences	Dental	Medical	Nursing	Other	Pharma	Physiotherapy	P-value
Count (n)		17	43	4	120	53	32	147	
Are you aware of AI? (%)	Yes	4.1	10.3	1.0	28.8	12.7	7.7	35.3	
Course of the study (%)		100.0	91.5	80.0	89.6	88.3	91.4	89.1	
Count (n)		0	4	1	14	7	3	18	0.814
Are you aware of AI? (%)	No	0.0	8.5	2.1	29.8	14.9	6.4	38.3	
Course of the study (%)		0.0	8.5	20.0	10.4	11.7	8.6	10.9	

Table 5: Multivariate linear logistic regression analysis of healthcare's student's demographic and professional characteristics and Perception score of AI

Variable	Unstandardized Coefficients		Standardized Coefficients	T	P-value	95.0 % Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	40.555	2.274		17.833	<0.001	36.086	45.025
Sex	-.354	0.496	-0.034	-0.713	0.476	-1.330	0.622
Age in years	0.295	0.450	0.031	0.656	0.512	-.589	1.180
Nationality	2.013	1.295	0.072	1.555	0.121	-.531	4.557
Course of study	0.311	0.132	0.112	2.360	0.019	.052	0.570
Year of study	0.170	0.139	0.059	1.231	0.219	-.102	0.443
Awareness of AI	-1.822	0.785	-0.108	-2.320	0.021	-3.366	-0.279

Dependent Variable: Perception score of AI

Educational institutions play a vital role in equipping students with the necessary knowledge and skills to navigate the evolving landscape of AI in healthcare. The results of this study indicated that 65.2 % of the participants agreed with the statement that AI reduces errors in medical practice, which was in direct contrast to a study carried out in Pakistan, which indicated that AI in medicine would reduce diagnostic errors [3]. In the current study, about two-thirds of participants believed that the use of AI would soon replace the role of some specialties in the healthcare system. A previous study among medical students in Kuwait revealed that AI has the potential to take over some specialties [13].

However, according to Jha and colleagues, more than half of respondents believed that AI would result in fewer jobs for healthcare professionals [14]. Another study by Wajid and colleagues revealed that 17.8 % of the participants agreed with the statement that AI will soon replace the role of physicians, pharmacists and nurses in the healthcare system [15], whereas Bohr and Memarzadeh concluded that AI tools will complement and facilitate human labour rather than completely replace that of doctors and other healthcare professionals [16]. While AI has undoubtedly revolutionized healthcare, it is unlikely to replace healthcare professionals entirely. Rather than replacing them, AI has the potential to collaborate with healthcare professionals, augmenting their skills and improving patient outcomes. As AI continues to advance, it is crucial to strike a balance between technological innovation and preserving the human element in healthcare, ultimately delivering the best possible care to patients.

Findings from this study demonstrate that artificial intelligence (AI) has an excellent opportunity to lower medical errors. Also, majority of HCs acknowledged AI's potential to lower medical errors which is similar to a previous conclusion from Pakistani physicians and medical students [3]. Furthermore, according to results from another cross-sectional survey assessing pharmacy students' knowledge, awareness and attitudes concerning AI in Riyadh, 75.1 % of respondents agreed that AI lowers medical errors [15]. Additionally, a systematic review found that applying AI or algorithms to primary care settings, also helps to reduce drug errors, which in turn reduces hospital admissions, emergency visits and mortality [16].

In this study, 89.6 % of participants reported that AI facilitates Health Care Professionals' access to information. The current findings are in line with previous reports which concluded that AI facilitates physicians' access to information [17,18]. Even though AI plays a crucial role in facilitating physicians' access to information, clinicians may efficiently retrieve and analyze massive volumes of medical data, receive clinical decision support, communicate with information systems through natural language processing and stay up to date on the most recent medical studies via the use of AI [17,18]. This enables doctors to make informed decisions, establish accurate diagnoses and give high-quality care to their patients using AI to reduce medical errors.

Limitations of this study

This study has some limitations that must be acknowledged and addressed to ensure the credibility and validity of these findings. Firstly, the nature of the sample size which is small, may limit the generalizability of the findings. The study was conducted on a specific group of students and findings are not representative of other categories of students on a national or international level, making them not universally relevant. Sampling bias is another limitation, self-administered online sampling was used to choose HCs, which could introduce bias and reduce the sample's representativeness. The acknowledgment of these limitations will aid in the interpretation of the study's findings and guide future research in addressing these gaps.

CONCLUSION

Majority of HCs are aware of AI, show positive perceptions and agree that AI help in various aspects of medicine and healthcare. However, students revealed some concerns about AI. Therefore, it is recommended to integrate AI into healthcare education. Additionally, addressing concerns related to ethics, workforce impact and patient privacy is crucial for successful AI implementation in healthcare. The findings also support the importance of incorporating AI education into the healthcare curriculum to ensure a well-prepared future healthcare workforce. Future studies should focus on exploring strategies to enhance AI education and training in healthcare programs and address the identified concerns to foster a smooth integration of AI in Saudi Arabia's healthcare system. As the healthcare industry continues to evolve, AI will play an increasingly vital role in shaping the future of healthcare education and practice.

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Ethical approval

The study was approved by the Research Ethics Committee in the College of Pharmacy, Taibah University, Saudi Arabia (COPTU-REC-67-20230423).

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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