




Medicine and Pharmacy Students' Knowledge, Attitudes, and Practice regarding Artificial Intelligence Programs: Jordan and West Bank of Palestine

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Background: Artificial intelligence (AI) programs generate responses to input text, showcasing their innovative capabilities in education and demonstrating various potential benefits, particularly in the field of medical education. The current knowledge of health profession students about AI programs has still not been assessed in Jordan and the West Bank of Palestine (WBP).

Aim: This study aimed to assess students' awareness and practice of AI programs in medicine and pharmacy in Jordan and the WBP.

Methods: This study was in the form of an observational, cross-sectional survey. A questionnaire was electronically distributed among students of medicine and pharmacy at An-Najah National University (WBP), Al-Isra University (Jordan), and Al-Balqa Applied University (Jordan). The questionnaire consisted of three main categories: sociodemographic characteristics of the participants, practice of AI programs, and perceptions of AI programs, including ChatGPT.

Results: A total of 321 students responded to the distributed questionnaire, and 261 participants (81.3%) stated that they had heard about AI programs. In addition, 135 participants had used AI programs before (42.1%), while less than half the participants used them in their university studies (44.2%): for drug information (44.5%), homework (38.9%), and writing research articles (39.3%). There was significantly (48.3%, $P < 0.005$) more conviction in the use of AI programs for writing research articles among pharmacy students from Palestine compared to Jordan. Lastly, there was significantly more (53.8%, $P < 0.05$) AI program use among medicine students than pharmacy students.

Conclusion: While most medicine and pharmacy students had heard about AI programs, only a small proportion of the participants had used them in their medical study. In addition, attitudes and practice related to AI programs in their education differs between medicine and pharmacy students and between WBP and Jordan.

Keywords: artificial intelligence, education, Jordan, medical students, West Bank of Palestine

Introduction

Chat Generative Pretrained Transformer (ChatGPT) is a revolutionary language model based on artificial intelligence (AI) that was publicly released in November 2022.¹ Using deep learning and natural language processing, AI programs generate responses to input text, showcasing their innovative capabilities. These capabilities encompass a range of functions, including facilitating education, enabling communication, and enhancing user interaction. In this context, "communication" refers to the broader exchange of information and ideas, while "user interaction" encompasses the specific engagement and interaction between the user and the AI system, which may involve such tasks as answering questions, providing assistance, or engaging in conversation. Based on user feedback from various sources, AI programs demonstrate many potential benefits, particularly in the fields of medicine and pharmacy education. They provide

personalized learning, improved comprehension of complex medical concepts, interactive content, immediate feedback, and skill development.²

The knowledge, attitudes, practices, and confidence assessment tool is a vital instrument for evaluating individuals' knowledge, attitudes, practices, and confidence levels concerning the use of AI programs in the medicine and pharmacy fields. Gathering such data facilitates the identification of knowledge gaps, misconceptions, and concerns, which can then be used to play a crucial role in ensuring the responsible and effective integration of AI technology into health-care practice and education. Furthermore, it provides valuable insights that inform the development of education, training, and implementation strategies.³

The use of AI programs has become a pressing global topic, with countries in the Middle East leading the discussion. It evokes both hope and apprehension about transforming education, research, and medicine and pharmacy practices in the region.^{4,5} While there is optimism about the opportunities AI programs present for improved learning strategies, there are also concerns about potential shifts in educational approaches, the impact on research methods, and the alteration of traditional medicine and pharmacy practices in Middle Eastern countries.⁶

Evaluating ChatGPT awareness among medicine and pharmacy students in Jordan and Palestine is of great importance. The health-care systems in these regions attract students from various backgrounds, emphasizing the need to understand their familiarity with ChatGPT, considering its potential relevance in their future health-care careers. In this context, the progress of pharmacy education in Jordan is evident, as supported by Al-Wazaify et al, Kheir et al, and Jarrar et al.⁷⁻⁹ Their studies highlight several key points related to pharmacy education and employment in Jordan, revealing growth in pharmacy programs, a spectrum of degree offerings including BPharm and PharmD, a mix of teaching methods, well-staffed faculties, a predominantly female student body, a private-sector dominance in pharmacist employment, Jordan's appeal to international students, and a thriving local pharmaceutical manufacturing sector.

However, despite advancements in pharmacy education and employment in Jordan and Palestine, the limitations in our understanding of AI extend globally. This knowledge gap impacts the readiness of future health-care professionals worldwide to leverage AI programs in various sectors, including health care. This study aims to bridge this global research gap by examining students' awareness and use of AI programs in a regional context. The findings will inform not only Jordan and Palestine but also contribute, at least partially, to the broader global dialogue on responsible AI integration in health-care practice and education.

Methods

This study was in the form of an observational, cross-sectional survey. The questionnaire was electronic and is available online as a Google Form: <https://forms.gle/mPzdKV5j7pMqiXjk9>. The questionnaire was open for responses between May 1 and June 29, 2023. Eligible participants were pharmacy and medicine university students in the West Bank of Palestine (WBP) and Jordan. A total of 321 students were asked to complete the online questionnaire, which was distributed by researchers in the three universities in the WBP and Jordan: An-Najah National University in the WBP, and Isra University and Al-Balqa Applied University in Jordan. These universities have medicine and pharmaceutical programs and agreed to participate in the study.

Participation was voluntary, and participants were informed that they had the option not to answer the questions. Also, an introductory section describing the purpose and objectives of the study as well as a consent form were included in the beginning of the online questionnaire. The survey consisted of three main categories: sociodemographic characteristics of the participants, AI practices, and perceptions of AI programs, such as ChatGPT.

A pilot study was performed. The questionnaire was translated into Arabic. The Arabic version was translated back into English by two English lecturers holding master's degrees in English. An English lecturer at An-Najah National University who is a native English speaker checked the congruence between the original and the back-translated English versions. Two pharmacists, two physicians, two nurses, and those who are experts in AI programs in An-Najah National University reviewed the translated Arabic questionnaire and checked it for understandability, readability, and clarity to ensure reliability and validity.

Thereafter, it was sent to 30 students for identification of errors and misunderstood questions. Its Cronbach α was calculated to be 0.72, which indicated consistency. In addition, the study protocol was approved by the Institutional

Review Board of An-Najah National University (NU-2023-1845). All students provided written informed consent to be involved in the study.

Data Analysis

Statistical analyses were conducted using SPSS 25 and began with a comprehensive descriptive analysis of primary variables. Categorical variables were meticulously characterized in terms of their frequency and corresponding percentages. Both descriptive and comparative statistical analyses for all variables were performed, elucidating categorical variables through frequencies and percentages. The significance level was set at $P < 0.05$. Subsequently, the χ^2 test was employed to discern the statistical significance of the differences in proportions pertaining to various dimensions of AI program practices.

AI program practices encompassed awareness of AI programs, their utilization, and their application in diverse contexts, including hearing about AI programs, AI program use, AI use in a study, for finding drug information, for homework on drugs, for finding exam questions about drugs, and in writing research articles. These were coded 1 for yes and 2 for no. They were also evaluated among students from Jordan and Palestine and coded 1 for Jordan and 2 for Palestine, as well as among medicine and pharmacy students, coded 1 for medicine students and 2 for pharmacy students.

The χ^2 test was also employed to investigate perceptions toward AI programs. This encompassed accuracy in AI data on drugs, whether data might be erroroneous, and whether ChatGPT is helpful in students' education, cheating, or understanding and motivation. These perceptions were coded 1 for yes, 2 for no, and 3 for "not sure" and examined among students from Jordan and Palestine, coded 1 for Jordan and 2 for Palestine, as well as among medicine and pharmacy students, coded 1 for medicine students and 2 for pharmacy students. Therefore, this methodological framework investigated associations and distinctions within study data, yielding valuable insights into the dimensions of AI practices and associated perceptions across two countries and specializations.

Results

Descriptive Results

A total of 321 medicine and pharmacy students responded to the distributed questionnaire over a 2-week period. Table 1 shows the sociodemographic characteristics of participants. Of these, about a quarter were male (24%) and just over three quarters were female (76%). More than half the participants (53.6%) were living in Jordan and just under half (46.4%) stated that they were living in Palestine. The age of more than half the participants (53.9%) was 21–23 years. Most participants (71.7%) were studying pharmacy, while 91 (28.3%) were in medicine (Table 1).

In sum, 261 participants (81.3%) stated that they had heard about AI programs, while 135 participants had used AI programs (42.1%) before. Less than half the participants used AI programs in their own university study (44.2%): for drug information (44.5%), homework (ie, reports and assignments) (38.9%), and writing research articles (39.3%). Overall, 97 participants stated that they used AI programs in searching for exam questions. Table 2 shows a comparison between Palestine and Jordan concerning differences in practice toward AI programs. In the case of medicine and pharmacy students, the participants' country was significantly related to the use of AI programs in writing research articles. As such, there was a significantly higher frequency (48.3%, $P < 0.005$) of believing in the use of AI programs for writing research articles among medicine and pharmacy students from Palestine compared to those from Jordan (Table 2).

The participants' AI program practices based on their fields are presented in Table 3. There were no significant differences between medicine and pharmacy students in terms of whether participants had heard about AI programs or whether they had used AI in their study, to find exam questions about drugs, or for writing research articles. However, there were significant differences in AI program use, the names of AI programs used by students, AI program use for drug information, and homework on drugs. AI program use was significantly higher (53.8%, $P < 0.05$) among medicine students. The results in Table 3 show that significantly more pharmacy students (48.3%, $P < 0.05$; 43.9%, $P < 0.005$) than medicine students (35.2%, $P < 0.05$; 26.4%, $P < 0.005$) use AI programs for drug information and homework on drugs, respectively. In addition, the use of AI programs was significantly higher (21.7%, $P < 0.05$) among pharmacy students.

Table 1 Sociodemographic characteristics of study participants (n=321)

	n (%)
Country of residence	
Jordan	172 (53.6)
Palestine	149 (46.4)
Place of residence	
Capital city	131 (40.8)
City	72 (22.4)
Small city	45 (14)
Village	73 (22.7)
Age, years	
18–20	80 (24.9)
21–23	173 (53.9)
24–25	37 (11.5)
>25	31 (9.7)
Sex	
Male	77 (24.0)
Female	244 (76.0)
Specialization	
Medicine	91 (28.3)
Pharmacy	230 (71.7)

Note: Not all totals add up to 100% due to rounding.

Table 2 Students' use of artificial intelligence programs (n=321)

	Country		P**
	Jordan n (%): 172 (53.6%)	Palestine n (%): 149 (46.4)	
*Have you heard about AI programs?			
Yes	141 (82.0)	120 (80.5)	0.741
No	31 (18.0)	29 (19.5)	
*Do you use AI programs?			
Yes	65 (37.8)	70 (47.0)	0.096
No	107 (62.2)	79 (53.0)	
*AI program used			0.086
None	109 (63.4)	81 (54.4)	
Clalit AI	0	3 (2.0)	
Drawn AI	0	2 (1.3)	
Google Assistant	5 (2.9)	6 (4.0)	
ChatGPT	40 (23.3)	47 (31.5)	
Pharmee	1 (0.6)	0	
Robotic App	1 (0.6)	0	
Siri	6 (3.5)	1 (0.7)	
Unknown name	10 (5.8)	9 (6.0)	

(Continued)

Table 2 (Continued).

	Country		P**
	Jordan n (%): 172 (53.6%)	Palestine n (%): 149 (46.4)	
*Do you use AI for study?			0.487
Yes	73 (42.4)	69 (46.3)	
No	99 (57.6)	80 (53.7)	
*Do you use AI for getting drug information?			0.324
Yes	81 (47.1)	62 (41.6)	
No	91 (52.9)	87 (58.4)	
*Do you use AI programs for homework on drugs?			0.494
Yes	64 (37.2)	61 (40.9)	
No	108 (62.8)	88 (59.1)	
*Do you use AI programs in finding exam questions on drugs?			0.812
Yes	51 (29.7)	46 (30.9)	
No	121 (70.3)	103 (69.1)	
*Do you use AI in writing research articles?			***0.002
Yes	54 (31.4)	72 (48.3)	
No	118 (68.6)	77 (51.7)	

Notes: *AI, artificial intelligence; **obtained from χ^2 test; ***statistically significant. Not all totals add up to 100% due to rounding.

Table 3 Students' practices regarding artificial intelligence programs in the two specializations (n=321)

	Specialization		P**
	Medicine n (%): 91 (28.3%)	Pharmacy n (%): 230 (71.7)	
*Have you heard about AI programs?			0.056
Yes	80 (87.9)	181 (78.7)	
No	11 (12.1)	49 (21.3)	
*Do you use AI programs?			***0.007
Yes	49 (53.8)	86 (37.4)	
No	42 (46.2)	144 (62.6)	
*AI program used			***0.029
None	48 (52.7)	142 (61.7)	
Clalit AI	0	3 (1.3)	
Drawn AI	0	2 (0.9)	
Google Assistant	1 (1.1)	10 (4.3)	
ChatGPT	37 (40.7)	50 (21.7)	
Pharmee	0	1 (0.4)	
Robotic App	0	1 (0.4)	
Siri	0	7 (3.0)	
Unknown name	5 (5.5)	14 (6.1)	

(Continued)

Table 3 (Continued).

	Specialization		P**
	Medicine n (%): 91 (28.3%)	Pharmacy n (%): 230 (71.7%)	
*Do you use AI for study?			0.237
Yes	45 (49.5)	97 (42.2)	
No	46 (50.5)	133 (57.8)	
*Do you use AI for getting drug information?			***0.033
Yes	32 (35.2)	111 (48.3)	
No	59 (64.8)	119 (51.7)	
*Do you use AI programs for homework on drugs?			***0.004
Yes	24 (26.4)	101 (43.9)	
No	67 (73.6)	129 (56.1)	
*Do you use AI programs in finding exam questions on drugs?			0.500
Yes	30 (33.0)	67 (29.1)	
No	61 (67.0)	163 (70.9)	
*Do you use AI in writing research articles?			0.855
Yes	35 (38.5)	91 (39.6)	
No	56 (61.5)	139 (60.4)	

Notes: *AI, artificial intelligence; **obtained from χ^2 test; ***statistically significant. Not all totals add up to 100% due to rounding.

Table 4 details the perceptions of participants from Jordan and Palestine of AI programs, which were found to be more helpful in improving students' understanding and motivation among participants from Jordan (51.7%, $P<0.05$). In addition, significantly more participants from Jordan (58.1%, $P<0.005$) indicated that AI programs were useful for cheating (Table 4). Table 5 also shows significant differences between pharmacy and medicine students in terms of whether they felt that data collected using AI programs could be erroneous, which was higher among those (75.8%, $P<0.05$) who indicated that they were pharmacy students.

Table 4 Students' perceptions of AI programs in the two countries (n=321)

	Country		P**
	Jordan n (%) 172 (53.6%)	Palestine n (%) 149 (46.4%)	
Are AI data on drugs accurate?			0.111
Yes	43 (25.0)	53 (35.6)	
No	17 (9.9)	11 (7.4)	
Not sure	112 (65.1)	85 (57.0)	
Might data collection using AI programs produce erroneous information?			0.931
Yes	112 (65.1)	94 (63.1)	
No	13 (7.6)	12 (8.1)	
Not sure	47 (27.3)	43 (28.9)	

(Continued)

Table 4 (Continued).

	Country		P**
	Jordan n (%) 172 (53.6%)	Palestine n (%) 149 (46.4)	
*Are AI programs helpful for students' education?			0.355
Yes	128 (74.4)	100 (67.1)	
No	10 (5.8)	11 (7.4)	
Not sure	34 (19.8)	38 (25.5)	
*Are AI programs helpful for students' cheating?			***0.003
Yes	100 (58.1)	59 (39.6)	
No	24 (14.0)	35 (23.5)	
Not sure	48 (27.9)	55 (36.9)	
*Are AI programs helpful for students' understanding and motivation?			***0.026
Yes	89 (51.7)	55 (36.9)	
No	38 (22.1)	46 (30.9)	
Not sure	45 (26.2)	48 (32.2)	

Notes: *AI, artificial intelligence; **obtained from χ^2 test; ***statistically significant. Not all totals add up to 100% due to rounding.

Table 5 Students' perceptions of AI programs in the two specializations (n=321)

	Specialization		P**
	Medicine n (%): 91 (28.3%)	Pharmacy n (%): 230 (71.7)	
Are AI data on drugs accurate?			0.975
Yes	28 (30.8)	68 (29.6)	
No	8 (8.8)	20 (8.7)	
Not sure	55 (60.4)	142 (61.7)	
Might data collection using AI programs contain erroneous information?			***0.022
Yes	69 (75.8)	137 (59.6)	
No	4 (4.4)	21 (9.1)	
Not sure	18 (19.8)	72 (31.3)	
*Are AI programs helpful for students' education?			0.791
Yes	67 (73.6)	161 (70.0)	
No	5 (5.5)	16 (7.0)	
Not sure	19 (20.9)	53 (23.0)	
*Are AI programs helpful in students' cheating?			0.684
Yes	48 (52.7)	111 (48.3)	
No	17 (18.7)	42 (18.3)	
Not sure	26 (28.6)	77 (33.5)	
*Are AI programs helpful for students' understanding and motivation?			0.127
Yes	37 (40.7)	107 (46.5)	
No	31 (34.1)	53 (23.0)	
Not sure	23 (25.3)	70 (30.4)	

(Continued)

Table 5 (Continued).

	Specialization		P**
	Medicine n (%): 91 (28.3%)	Pharmacy n (%): 230 (71.7%)	
Are AI data on drugs accurate?			0.454
Yes	83 (91.2)	201 (87.4)	
No	1 (1.1)	8 (3.5)	
Not sure	7 (7.7)	21 (9.1)	

Notes: *AI, artificial intelligence; **obtained from χ^2 test; ***statistically significant. Not all totals add up to 100% due to rounding.

Discussion

Our study demonstrates that there is much to explore and apply in the realms of medical education and AI. While most students in our study had heard about AI programs, less than half had used them in their medical studies. Further investigation into the demographic differences revealed that in comparison to their counterparts, more medical students use AI programs in their studies, more of them use it for tasks related to general medical knowledge, such as physiology, and more of them believe that AI is prone to error. More pharmacy students, on the other hand, use AI for information regarding drugs. More pharmacy students in the WBP utilize AI for writing scientific articles, while more of them in Jordan believe that AI can be utilized for academic dishonesty.

ChatGPT is used widely to obtain information, including that which is medical,¹⁰ and notably for efficiency in answering scientific questions.¹¹ While some studies have investigated the use of AI programs among health students in many countries,^{12,13} there is a lack of studies regarding the application of AI in medical education in the WBP and Jordan. Therefore, this study explored the knowledge of, attitudes toward, and practices of medicine and pharmacy students with regard to AI programs in the WBP and Jordan and compared the results based on participants' college and country.

It is also noteworthy that most of the participants in this study were female students. This is in line with findings from previous studies that report that most pharmacy students in the WBP and Jordan are female.^{9,14–16} The fact that most participants had heard about AI programs while only a small portion of them had used them in their study could be because most of the participants might be unaware of the advantages of using AI programs in medical education or that they are unsure of how to use AI programs to obtain accurate medical information, as supported by Swed et al. They reported that most medical students in Syria do not know the medical applications of AI programs.¹⁷

It is found in this study that there is no difference between participants from the WBP and Jordan regarding attitudes and practices regarding AI programs in medical education, except in the use of AI programs in the writing of research articles, for which more pharmacy students from the WBP than students from Jordan use AI programs. The syllabi of pharmaceutical studies are very similar in the WBP and Jordan, and the demand for AI programs in the medical education is still not considered by the higher education ministry in either country. This might explain at least partly the similarity in attitudes and practices regarding using AI programs in medical education in the WBP and Jordan.

The results of this study demonstrate that medicine students use AI, especially ChatGPT, to a greater extent than pharmacy students ($P<0.05$) to obtain general medical information. However, pharmacy students use AI programs significantly more ($P<0.05$) to obtain information regarding drugs. This is likely due to the fact that the syllabi of pharmacy students contain more courses about pharmacology and handling of drugs than the syllabi of medical students.^{18,19}

More pharmacy students in Jordan than the WBP think that AI programs can be used for cheating while completing homework and assignments. This is one of the disadvantages of AI programs in medical education,¹¹ which could result in a shift from homework and assignments in the future toward oral examinations to prevent students from using AI programs to act with academic dishonesty.

It was found in this study that more participants from colleges of medicine than colleges of pharmacy think that AI programs can make errors in generating medical information. It could be that participants found more mistakes regarding

anatomical or pathological information they obtained from AI programs than about pharmacology or drug-related information. This could also be because medicine students use AI programs more often and hence encounter more mistakes in information they obtain therefrom.^{20,21}

Aspects of the research design are relevant in consideration of the limitations of the study. Specifically, future studies would need to carefully evaluate their methods of data collection to ensure accurate and representative results from the sample population. Utilizing an online survey brings with it the advantage of accessibility for students, but also the potential for non-sampling errors. Students may be reluctant to respond accurately or at all about their ChatGPT usage if their perception of AI use in education is that it constitutes academic dishonesty, for example. Additionally, while the survey captured students' reports on their AI usage, future studies could endeavor to understand why students respond the way they do and why they feel certain ways about using AI programs in their studies.

While current research on the usage of AI programs in health care is vast, focusing on predictive health care, diagnoses, personalized treatments, decision-making, and medical administration has been less investigated in medical education, particularly in the Middle East. Studies in this domain have centered on surgical skills, prescriptions, radiology, and residency training, as well as understanding the perspectives of medical students on AI playing a role in their professional responsibilities. Our study contributes to this area, and such findings represent a crucial step in integrating the advantages of AI in medical education, determining the extent that future health-care professionals benefit from and are familiar with AI programs. Future studies could fill the gaps in the existing literature on this subject by broadening the possibilities of the applications of AI, particularly with respect to research and data analysis.

There are some limitations in this study. We did not include other medical or paramedical students, such as dentistry, nursing and, physiotherapy. In addition, this questionnaire did not include participants from Gaza city in Palestine. These limitations will be taken into consideration in future studies.

Conclusion

We investigated the current application of AI programs in medical and pharmaceutical education among students in the WBP and Jordan. It is concluded that while most medical students have heard about AI programs, only a small proportion have used them in their medical study. In addition, attitudes and practices regarding AI programs in medical education differ between medicine and pharmacy students and between pharmacy students from the WBP and Jordan. These findings help us in understanding the current situation of using AI programs among pharmacy and medicine students in the WBP and Jordan. Further studies are needed to identify barriers to using AI programs in health-profession education and strategies to improve medical education using AI.

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Disclosure

The authors declare that there are no conflicts of interest in this work.

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