

Original Research

Knowledge, Attitudes, and Literacy regarding Artificial Intelligence and ChatGPT among pharmacy students in Lebanon: A Cross-Sectional Study

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Abstract

Background: With the rapid integration of artificial Intelligence (AI) tools in healthcare and education, pharmacy students must be adequately prepared to use these tools. However, little is known about the knowledge and attitudes of pharmacy students toward AI tools such as ChatGPT. **Objective:** This study aims to assess the knowledge and attitudes of Lebanese pharmacy students towards AI and ChatGPT and explore factors influencing their ChatGPT literacy. **Methods:** This cross-sectional study was conducted between May 2024 and June 2024, at the School of Pharmacy of the Lebanese International University (LIU). Data were collected using an online, self-administered questionnaire that was distributed to 606 pharmacy students enrolled in the third, fourth, and fifth years. The survey included five sections: demographics, awareness and experience with ChatGPT, knowledge of AI concepts, attitude towards ChatGPT, and literacy regarding the appropriate use of ChatGPT. Bivariable and multivariable analysis were conducted to identify factors associated with ChatGPT literacy. **Results:** Most participants were female (79.9%), and the median age was around 22 years. Pharmacy students were generally familiar with ChatGPT and had previous experience with it. Students had limited understanding of AI concepts such as deep learning. Students showed neutral to positive attitudes toward ChatGPT and moderate levels of ChatGPT literacy. Higher GPA was linked to higher ChatGPT literacy, while being in the third professional year (5th year) and having more positive attitudes toward ChatGPT were associated with lower literacy. **Conclusion:** This study revealed insufficient AI knowledge and ChatGPT literacy among pharmacy students in Lebanon, underlining limited readiness to adopt AI tools in education and practice. This study highlights the need to restructure pharmacy curricula to include modules on the effective and ethical use of AI.

Keywords: Artificial Intelligence, ChatGPT, Pharmacy, Education, Students, Knowledge, Attitude, Literacy

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INTRODUCTION

Artificial Intelligence (AI) refers to the capability of computational systems to perform tasks that typically require human intelligence such as learning, reasoning, problem-solving, perception, and decision making¹. AI is not monolithic field rather it represents interconnected subfields (such as machine learning (ML), deep learning (a subdivision of ML), Natural language Processing (NLP), Robotics and others that individually or in combination, add intelligence to applications². These subfields collectively drive innovations across diverse domains, including pharmacy education. AI has rapidly become one of the key contributors in innovation in healthcare and education with applications that address longstanding challenges in medical



Table 1. Demographic Characteristics of the Participants	
Variable	N(%) or M±SD
Age	21.52± 1.73
GPA	3.21± 0.46
Gender	
Male	122 (20.1)
Female	484 (79.9)
Year of Study	
First Professional Year	199 (32.8)
Second Professional Year	222 (36.6)
Third Professional Year	185 (30.5)

and pharmacy education³. For instance, ML algorithms are used in drug discovery and pharmacovigilance, deep learning supports medical image analysis and NLP powers clinical documentation, patient communication and decision- support system⁴⁻⁷.

Among AI technologies, Large Language Models (LLMs), particularly OpenAI’s Chat Generative Pre-trained Transformer (ChatGPT), have gained global attention and emerged as powerful conversational AI capable of enhancing educational experiences⁸. ChatGPT uses NLP and deep learning model trained on massive datasets to generate human-like responses to user queries in natural language, enabling real-time interactive learning⁹. Unlike earlier rule-based or domain- specific AI systems, ChatGPT exhibits generalizability, adaptability, and the ability to engage in conversational learning, making It highly attractive for use in higher education including pharmacy education¹⁰.

For pharmacy students in particular, ChatGPT may function as a supplementary learning tool from drug information, therapeutic guidelines, patient counseling simulation and literature search support¹¹. Despite its promise, ChatGPT has many significant challenges, for example concerns have been raised about its tendency to generate inaccurate or misleading, lack of contextual adaption to local healthcare systems, and ability to replace critical appraisal skills necessary in evidence- based practice¹². Furthermore, it lacks the capacity to contextualize responses to local healthcare systems or guidelines, raising concerns about reliability when applied to clinical and pharmacy-related queries. Ethical challenges such as plagiarism, academic dishonesty, overreliance on AI-generated content, and risks to critical thinking skills have also been highlighte^{13,14}. These challenged necessitate caution and underscore the importance of evaluating students’ literacy and attitudes toward responsible AI use, and awareness of its limitations¹³.

Globally, several studies have investigated students’ perceptions of AI and ChatGPT in health sciences education, reporting generally positive attitudes but limited technical knowledge and

ongoing concerns about accuracy and ethics, trustworthiness, and ethical implications¹⁴⁻¹⁷. Despite this emerging literature, most of these studies have been conducted in Western not regional contexts with different educational infrastructures, and data from Middle East, and Lebanon specifically, remains limited.

Lebanon represents a unique setting where educational institutions face resource constraints and socioeconomic challenges following the 2019 economic crisis that resulted in hyperinflation and the depreciation of the Lebanese currency¹⁸. Lebanon, a low middle income country, has a low-tech economy limiting students’ exposure and experience with advanced educational technologies and AI tools¹⁹. In this context, accessible AI tools such as ChatGPT may be especially attractive to students. However, the actual knowledge, attitude, and literacy of Lebanese pharmacy students regarding AI and ChatGPT remain poorly understood. To the best of our knowledge, no prior studies in Lebanon and the MENA region have examined how pharmacy students’ attitudes toward ChatGPT, along with other potential covariates, could influence their ChatGPT literacy.

Given the limited evidence and the rapid global integration of AI in higher education, it is critical to evaluate Lebanese pharmacy students’ awareness, perceptions, and use of ChatGPT. Therefore, this study aims to assess Lebanese pharmacy students’ knowledge and attitudes regarding AI and ChatGPT in a private university setting in Lebanon. More specifically, it seeks to examine students’ awareness of AI concepts and their prior experience with ChatGPT, and explore their perceptions of ChatGPT’s reliability, educational value, and potential role in pharmacy learning. This study also explores students’ literacy regarding appropriate and inappropriate uses of ChatGPT, identifies concerns, misconceptions, and ethical considerations associated with ChatGPT use. Highlighting gaps in ChatGPT literacy and examining the factors influencing it can provide evidence to inform curriculum development and promote the responsible adoption of AI tools in pharmacy education in Lebanon.

METHODS

Study Design and Setting

A cross-sectional study was conducted between May and June 2024 at the School of Pharmacy of the Lebanese International University (LIU), Lebanon. The LIU Bachelor of Pharmacy program is a five-year curriculum consisting of two pre-pharmacy years followed by three professional years. Data were collected using an online, self-administered questionnaire developed on Google Forms. The survey link was distributed via official university email to eligible students enrolled in the professional years (academic years 3–5). To promote participation across cohorts, one course from each professional year was used as a distribution channel, and the survey was shared with students registered in those courses.



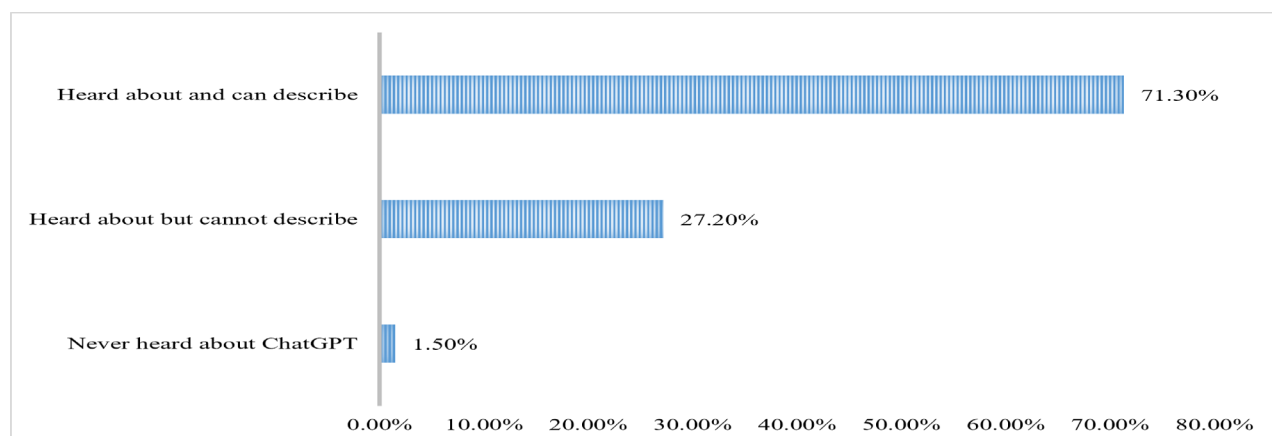


Figure 1. Awareness of ChatGPT among the Studied Participants
A total of 1120 students were invited and 606 responded and completed the data collection sheet.

Questionnaire

The questionnaire used in this study was adapted from a validated questionnaire originally developed in 2023²⁰. The adapted questionnaire was reviewed by multiple researchers for clarity and content adequacy and was pre-tested on a small group of 20 pharmacy students prior to dissemination. The final questionnaire comprised five sections: (1) demographics (age, gender, GPA, and year of study); (2) awareness of and prior experience with ChatGPT; (3) knowledge of AI-related terminology and concepts with Cronbach's alpha of 0.877; (4) attitudes toward ChatGPT assessed on a 5-point Likert scale (0 = strongly disagree to 4 = strongly agree) with Cronbach's alpha of 0.895; and (5) literacy regarding appropriate use of ChatGPT with Cronbach's alpha of 0.704. Composite (total) scores were computed for each domain. The knowledge scale consisted of 4 items and the score was calculated as the sum of correct responses (range 0-8). The 9-items attitude score was computed by summing Likert items (range 0-36), with negatively worded items reverse-coded prior to summation. The ChatGPT literacy score consisted of 12 true/false questions and was computed by assigning 1 point for each correct response and 0 otherwise (range 0-12), with reverse coding applied to items for which the correct response was "False," as specified in the instrument.

Measured Outcomes

The study assessed pharmacy students' knowledge and attitudes toward AI and ChatGPT. The primary analytic outcome for association testing was the ChatGPT literacy score. Secondary outcomes included knowledge and attitude composite scores.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics and Research Committee of the School of Pharmacy at the Lebanese International University (Protocol number: 2024ERC-

057-LIUSOP). Participation was completely voluntary, and all respondents provided informed consent before accessing the survey. The questionnaire didn't collect any identifiable personal information, such as names and mail addresses, ensuring full anonymity and confidentiality of responses.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics, version 26. Categorical variables were summarized as frequencies and percentages, and continuous variables were summarized as mean and standard deviation (SD) and range, as appropriate. Composite scores were calculated for each domain based on the study codebook. The AI knowledge score was computed as the sum of item scores (total range 0-8). The attitude toward ChatGPT score was computed by summing Likert-scale items (0 = strongly disagree to 4 = strongly agree; total range 0-36), with reverse coding applied to negatively worded items prior to summation. ChatGPT literacy was computed by assigning 1 point to each correct response to the literacy statements and 0 points otherwise (total range 0-12), with reverse coding applied to items for which the correct response was "False," as indicated in the instrument. Internal consistency reliability was evaluated for multi-item scales using Cronbach's alpha. Bivariate analyses were conducted to explore factors associated with ChatGPT literacy. For categorical predictors (e.g., gender, year of study, awareness, and prior experience with ChatGPT), mean literacy scores were compared using independent-samples t-tests or one-way ANOVA, as appropriate. For continuous predictors (e.g., age, GPA, knowledge score, and attitude score), associations with literacy were assessed using Pearson's correlation coefficient. Variables with a p-value <0.2 in bivariate analysis were entered into a multivariable linear regression model with ChatGPT literacy score as the dependent variable. Model fit was evaluated using the coefficient of determination (R^2) and adjusted R^2 to quantify the proportion of variance in ChatGPT literacy explained by the independent variables. The final model explained 31% of the variance in ChatGPT literacy ($R^2 = 0.31$), with an adjusted R^2 of 0.28. Regression coefficients were reported as unstandardized β with 95% confidence intervals (CI). Model assumptions were evaluated through residual diagnostics (linearity, normality,

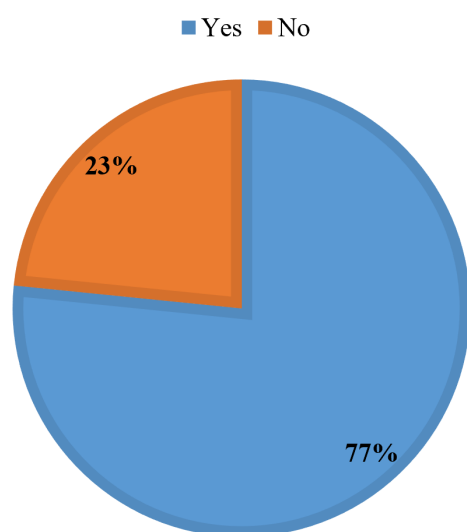


Figure 2. Students' experience with ChatGPT

and homoscedasticity), and multicollinearity was assessed using variance inflation factors and tolerance. All tests were two-sided, and statistical significance was set at $p < 0.05$.

RESULTS

Demographic Characteristics of the Participants

A total of 606 pharmacy students participated with a mean age of 21.5 years and mean GPA of 3.2. The majority were females (79.9%). Students were distributed across the first (32.8%), second (36.6%), and third (30.5%) professional years. Table 1 demonstrates the demographic characteristics of the participating students.

Awareness and Experience with ChatGPT

As shown in figure 1, the majority of the students (71.3%) have heard of ChatGPT and can describe it with only 1.5% reporting that they have never heard about this AI tool. On the other hand, figure 2 shows that 77% of the students have already utilized the tool.

Knowledge of AI Concepts

Table 2 summarizes students' knowledge of AI concepts. Across all domains, a large proportion of participants reported limited knowledge. More than half of the students (52.6%) indicated they had no idea about neural networks, followed by natural language processing (46.0%) and deep learning (43.9%). Similarly, about two in five students reported no knowledge of machine learning (40.1%). Among students who had heard of the terms but could not explain them, proportions ranged from 35.0% for neural networks to 40.9% for machine learning. A smaller subset demonstrated a higher level of knowledge, with 19.0% able to explain machine learning, 18.2% deep learning, 17.7% natural language processing, and only 12.4% neural networks. The overall AI knowledge score was low, with

a mean of 2.84 ± 2.50 (range: 0–8), indicating generally limited familiarity with AI concepts among pharmacy students.

Attitude toward ChatGPT

The overall attitude score was 23.62 ± 5.25 (range: 0–36), suggesting a generally moderate to positive attitude toward ChatGPT among pharmacy students. More than half of the respondents considered ChatGPT information to be reliable (61.1%), while about one-third (31.7%) remained neutral. Similarly, a majority believed that ChatGPT could enhance the efficiency of information gathering (74.1%) and improve comprehension of research findings (69.1%). Perceptions regarding learning efficiency (63.2%) and knowledge enhancement (69.7%) were also largely favorable. When asked about its broader educational impact, more than half of the participants (59.4%) agreed that ChatGPT positively contributes to education. In addition, around half of the students (48.9%) agreed that ChatGPT responses are suitable for pharmacy-related topics, while 38.4% were neutral. Similarly, the majority perceived that ChatGPT could help improve pharmacists work efficiency (53.7%), though a substantial proportion (36.0%) remained neutral. Interestingly, nearly half of the participants (56.7%) expressed having major queries about ChatGPT use (Table 3).

Literacy Regarding the Appropriate Use of ChatGPT

The overall literacy score was 7.01 ± 2.06 (range: 1–12), indicating moderate literacy with considerable gaps, particularly in recognizing ChatGPT's technical limitations, reliability concerns, and ethical implications (Table 4). Several misconceptions were prevalent. A large proportion of students (75.1%) incorrectly believed that ChatGPT automatically extracts big data from websites. Similarly, 68.0% incorrectly assumed that ChatGPT is capable of performing precise computations with complex mathematical formulas. About half (50.5%) thought that elementary school students could independently use ChatGPT for self-study, reflecting uncertainty regarding its appropriateness for younger users. Concerning potential risks, 88.1% failed to recognize that ChatGPT may generate inaccurate information, and 74.1% were unaware that inputted data may be used as training data. Misconceptions about copyright were also evident, with 35.5% indicating there was no need to worry about copyright when using ChatGPT. Additionally, only 34.0% believed it is possible to distinguish AI-generated text from other information, and more than half (55.8%) incorrectly stated that ChatGPT can always provide the most up-to-date information. About 44.7% thought that ChatGPT consistently produces the same response to repeated queries, while a majority (78.5%) failed to recognize its limitations in providing medical, legal, and other professional advice.

Factors Associated with ChatGPT Literacy

Table 5 presents the bivariate analysis of factors potentially associated with ChatGPT literacy. Age, gender, year of study,

Table 2. Students' AI Knowledge

Variable	N (%)		
	I have no Idea	I have heard of it, but I cannot explain it	I know the term and can explain it
Natural language processing	279 (46.0)	220 (36.3)	107 (17.7)
Machine learning	243 (40.1)	248 (40.9)	115 (19.0)
Deep learning	266 (43.9)	230 (38.0)	110 (18.2)
Neural Networks	319 (52.6)	212 (35.0)	75 (12.4)
Knowledge Score			
M±SD	2.84±2.50		
Range (0-8)	0-8		

awareness, and prior experience with ChatGPT showed no statistically significant associations with literacy scores ($p > 0.05$). In contrast, GPA showed a positive correlation with literacy ($r = 0.143$, $p < 0.001$), suggesting that higher-achieving students tended to have better literacy. Conversely, AI knowledge score was negatively correlated with literacy ($r = -0.097$, $p = 0.017$), indicating a small but significant inverse association. Moreover, attitude toward ChatGPT was strongly and negatively correlated with literacy ($r = -0.349$, $p < 0.001$), suggesting that students with more favorable attitudes toward ChatGPT paradoxically demonstrated lower literacy about its appropriate use.

After adjusting for potential confounders (Multivariable linear regression analysis, Table 6), three variables emerged as significant predictors of ChatGPT literacy. Students in the third professional year had significantly lower literacy scores compared to those in the first professional year ($\beta = -0.402$, 95%CI -0.791:-0.012, $p = 0.044$). GPA was a strong positive predictor of literacy ($\beta = 0.545$, 95%CI 0.207:0.883, $p = 0.002$), indicating that higher academic performance was associated with better ChatGPT literacy. Conversely, attitude score showed a significant negative association with literacy ($\beta = -0.135$, 95%CI -0.165:-0.105, $p < 0.001$), suggesting that students with more favorable attitudes toward ChatGPT tended to demonstrate lower literacy regarding its appropriate use. Although AI knowledge score was negatively associated with AI literacy in the bivariate analysis, this association didn't remain significant in the multivariable model after adjusting for relevant covariates.

DISCUSSION

This study revealed that most pharmacy students have heard of ChatGPT, can describe what it is, and have even used it before. However, students had limited understanding of AI concepts such as deep learning and natural language processing. Overall, students demonstrated a neutral to positive attitude towards ChatGPT. With respect to ChatGPT literacy, students generally had moderate knowledge about the appropriate uses of ChatGPT, with significant knowledge gaps in certain aspects. A higher GPA was associated with higher ChatGPT literacy among

pharmacy students. Conversely, being a third professional year student (5th year) and having a more positive attitude towards ChatGPT were both associated with lower literacy.

ChatGPT is a highly recognized and widely used tool among university students across the globe, including those in both developing and developed countries²¹⁻²³. In fact, this study revealed high level of experience with ChatGPT among Lebanese pharmacy students. However, the literature shows that pharmacy students' usage levels of ChatGPT vary significantly across different countries, with some reporting low utilization²⁰ and others reporting relatively higher levels of experience with ChatGPT²⁴. The varying levels of experience with ChatGPT could be due to how much students perceive ChatGPT as a reliable resource for information²⁰.

As demonstrated in this study, high experience with ChatGPT didn't translate into a good understanding of common AI concepts such as deep learning. This finding is similar to findings from other studies where healthcare students, including medical and pharmacy students, showed an inadequate understanding of basic AI terminologies^{20,25,26}. This weak understanding of AI concepts is expected, as students usually learn about AI through social media and social or colleague networks due to the lack of formal or professional AI education and training in healthcare schools, including pharmacy schools²⁷.

Having neutral to positive attitudes towards ChatGPT reflects pharmacy students' perception of its use as a supportive tool in pharmacy education. In fact, other studies have shown that pharmacy students support the integration of AI into pharmacy education and believe that using ChatGPT could enhance their learning, clinical skills, and decision-making skills, despite its pitfalls^{13,28,29}. Even with the general positive attitudes towards ChatGPT utilization in pharmacy education, pharmacy students might still have concerns about the level of accuracy of information provided by ChatGPT^{13,29}.

Pharmacy students in this study demonstrated insufficient literacy regarding the use of ChatGPT. Students had low understanding of the technical abilities of ChatGPT, including data extraction and complex computations, indicating an

Table 3. Students' Impression and Attitude toward ChatGPT					
Attitude Statement	N (%)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I think the information obtained using ChatGPT is reliable.	7 (1.2)	37 (6.1)	192 (31.7)	327 (54.0)	43 (7.1)
I believe that utilizing ChatGPT will enhance the efficiency of my information gathering.	5 (0.8)	32 (5.3)	120 (19.8)	377 (62.2)	72 (11.9)
I believe that utilizing ChatGPT will improve my comprehension of research findings.	7 (1.2)	31 (5.1)	149 (24.6)	346 (57.1)	73 (12.0)
I believe that utilizing ChatGPT will improve my efficiency in learning.	11 (1.8)	37 (6.1)	175 (28.9)	321 (53.0)	62 (10.2)
I believe that utilizing ChatGPT will enhance my knowledge and understanding.	8 (1.3)	19 (3.1)	157 (25.9)	352 (58.1)	70 (11.6)
I have concerns or queries regarding the usage of ChatGPT.*	5 (0.8)	31 (5.1)	226 (37.3)	291 (48.0)	53 (8.7)
I believe that ChatGPT has a positive impact on education.	9 (1.5)	43 (7.1)	194 (32.0)	299 (49.3)	61 (10.1)
I believe that the responses and information provided by ChatGPT are suitable for gathering information on pharmacy-related topics.	10 (1.7)	67 (11.1)	233 (38.4)	249 (41.1)	47 (7.8)
I believe that ChatGPT can assist pharmacists in improving their work efficiency.	13 (2.1)	49 (8.1)	218 (36.0)	273 (45.0)	53 (8.7)
Attitude Score					
M±SD	23.62±5.25				
Range (0-36)	0-36				
*The statement is reversely coded					

overestimation of the capabilities of ChatGPT. Moreover, students had low awareness of the unethical uses of ChatGPT, including copy write issues, retrieval of personal information, and the unsupervised use by children. Similar studies have also reported low awareness of the ethical uses of ChatGPT among pharmacy students^{20,29}. In addition, pharmacy students in this study showed inadequate awareness of ChatGPT's limitations, including the risk of generating false information and its limited ability to provide medical advice, suggesting an overreliance on the tool and insufficient critical evaluation of its outputs. Overall, the inadequate ChatGPT literacy observed in this study could be mainly attributed to the lack of formal AI education in

pharmacy schools, which adversely affects AI literacy, the key factor behind the proper use and critical evaluation of AI tools, including ChatGPT³⁰.

Furthermore, this study has shown that higher GPA was associated with higher ChatGPT literacy. Students with high academic performance often exhibit high information literacy³¹, which includes the ability to obtain, critically evaluate, and use information effectively and ethically³². These abilities or skills are central to the appropriate use of ChatGPT, and possessing them would translate to higher ChatGPT literacy.

Table 4. Pharmacy Students' Literacy Regarding the Appropriate Use of ChatGPT

Literacy Statements	N (%)	
	TRUE	FALSE
ChatGPT automatically extracts big data from websites.*	455 (75.1)	151 (24.9)
ChatGPT can be utilized to provide medical information.*	232 (38.3)	374 (61.7)
ChatGPT can be used to provide precise computations involving complex mathematical formulas.*	412 (68.0)	194 (32.0)
ChatGPT can be used to obtain personal information.*	230 (38.0)	376 (62.0)
Elementary school students can independently use ChatGPT for self-study.*	306 (50.5)	300 (49.5)
Sometimes, ChatGPT may generate inaccurate information.	72 (11.9)	534 (88.1)
The information entered into ChatGPT may potentially be used as training data.	157 (25.9)	449 (74.1)
There is no need to worry about copyright when using ChatGPT.*	215 (35.5)	391 (64.5)
It is possible to distinguish between AI-generated text and other information obtained from ChatGPT.	206 (34.0)	400 (66.0)
By using ChatGPT, you can verify the most up-to-date information.*	338 (55.8)	268 (44.2)
If you ask the same question to ChatGPT repeatedly, you will always receive the same answer.*	271 (44.7)	335 (55.3)
ChatGPT has limited capacity to provide medical, legal, and other professional advice.	130 (21.5)	476 (78.5)
Literacy Score		
M±SD	7.01±2.06	
Range (0-12)	01-Dec	
*The statement is reversely coded (correctly false)		

Students with more positive attitudes towards using ChatGPT for educational purposes may fail to recognize its limitations, which could explain the lower literacy about the appropriate uses of ChatGPT observed among those students. The “technology effect” phenomenon could explain this counterintuitive relationship between attitude and literacy. Individuals who hold positive attitudes towards a certain technology may develop excessive optimism about its potential outcomes and benefits, which can lead to misperception and biased evaluation of the technology³³. As for the lower literacy among third year professional students, this could be due to multiple reasons. ChatGPT use is relatively new but its use among students in higher education is increasing exponentially³⁴. Thus, compared to first year professional students, third year professional students who had joined the pharmacy program earlier might had lower opportunity and less time to explore ChatGPT uses and limitations during their didactic years. Moreover, the curriculum for third year professional students mainly focuses on clinical practice with an emphasis on professional judgment, thus limiting the appropriateness and relevance of ChatGPT use.

The negative association observed between AI knowledge score and literacy in the bivariate analysis may sound counterintuitive and warrants careful interpretation. However, it is important

to note that AI knowledge and ChatGPT literacy represent distinct constructs. AI knowledge measures familiarity with AI terminologies and concepts, whereas literacy reflects students' understanding of the appropriate and ethical uses of ChatGPT. Thus, a student with good knowledge of AI concepts might still have low ChatGPT literacy. The loss of significance in the multivariable model suggests that the association between knowledge and literacy was likely confounded by other variables.

Practical Implications

As future healthcare professionals, pharmacy students have an ethical obligation to provide the best quality of care for their patients, that is patient centered, effective, and timely efficient. Having positive attitudes towards AI tools, such as ChatGPT, combined with inadequate knowledge and literacy of their use, provides a fertile ground for the inappropriate utilization of these tool. The inapt utilization of AI tools by healthcare professional students could negatively impact their professional judgment and potentially compromise the health of their future patients. The integration of well-structured AI program in pharmacy schools' curriculum will improve AI literacy among pharmacy students, while highlighting the limitations of AI application in healthcare and increasing students' awareness

Table 5. Bivariate Analysis of Factors Associated with ChatGPT Literacy among the Studied Participants		
Categorical Variable	Literacy Score	p-value
	M±SD	
Gender		0.176
Male	6.82±1.97	
Female	7.06±2.08	
Year of Study		0.105
First Professional Year	7.19±2.01	
Second Professional Year	7.05±2.02	
Third Professional Year	6.76±2.15	
Awareness of ChatGPT		0.517
Never heard about ChatGPT	6.44±2.06	
Heard about but cannot describe	6.91±2.18	
Heard about and can describe	7.06±2.06	
Experience with ChatGPT		0.206
Yes	6.95±2.04	
No	7.20±2.12	
Continuous Variable	Pearson Correlation	p-value
Age	0.005	0.269
GPA	0.143	<0.001
Knowledge Score	-0.097	0.017
Attitude Score	-0.349	<0.001

on the ethical aspects of AI use²⁵. AI curriculum components should encompass foundational concepts of data science and artificial intelligence, instruction on the ethical use of generative AI tools, and training in the critical evaluation and validation of data generated by AI models³⁵. In addition to student education, faculty development is essential to ensure that instructors possess the necessary knowledge and competencies to effectively integrate AI concepts into their teaching³⁶. Institutional policies must also be established to support, guide, and monitor the implementation and assessment of AI use across courses³⁶. These policies will promote and uphold high ethical and professional standards across schools that integrate AI into their curricula.

Limitations

This was a cross-sectional study, and therefore a causal relationship can't be established. Since all participants were recruited from one pharmacy school, the findings of the study can't be generalized to all pharmacy students in Lebanon. In addition, the questionnaire was distributed to pharmacy students from all professional years by selecting one course from each academic year, which may have contributed to a certain level of sampling bias.

CONCLUSION

This study demonstrated inadequate AI knowledge and

ChatGPT literacy among pharmacy students in Lebanon, highlighting their unpreparedness to adopt AI tools such as ChatGPT. As AI becomes increasingly integrated into healthcare and education, pharmacy students should be equipped with adequate knowledge of the appropriate use of basic AI tools. Restructuring pharmacy curriculum to include modules on effective and ethical use of AI tools should be executed on a national level to ensure equitable access of AI education across all pharmacy schools in Lebanon. Further studies could be conducted to identify the most effective pedagogical approaches to enhance AI literacy among pharmacy students.

AUTHORS' CONTRIBUTION

Seham Kanaan: conceptualization, investigation, and writing – original draft.

Iqbal Fahs: formal analysis and writing – review & editing.

Faten Hamed: writing – original draft.

Mariam Dabbous: writing – review & editing.

Jihan Safwan: writing – review & editing.

Mohamad Rahal: writing – review & editing.

Fouad Sakr: methodology and supervision.



Table 6. Multivariable Linear Regression Analysis of Factors Associated with ChatGPT Literacy among the Studied Participants				
Variable	Unstandardized β	Confidence Interval		p-value
		Lower bound	Upper bound	
Gender (Female)	0.063	-0.323	0.448	0.749
Second Professional Year*	-0.123	-0.494	0.247	0.513
Third Professional Year*	-0.402	-0.791	-0.012	0.044
Experience with ChatGPT	0.043	-0.334	0.42	0.824
GPA	0.545	0.207	0.883	0.002
Knowledge Score	-0.028	-0.091	0.034	0.373
Attitude Score	-0.135	-0.165	-0.105	<0.001

* First Professional Year is the reference

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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