Derna Academy Journal for Applied Sciences

E-ISSN: 3006-3159

DAJAS

Evolution of Libyan Pharmacists' Perception, Concerns, and Practice of ChatGPT: A Cross-Sectional Study in Libya

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Volume : 7 **Issue: 2** **Page Number: 149 - 163**

Keywords:
Pharmacists, Perception, Concerns, Practice, ChatGPT, Libya

Received: 20\08\2026
Accepted: 05\09\2026
Published: 06\09\2026

https://doi.org/10.71147/bgkxz309

ABSTRACT

Artificial intelligence (AI) technologies are increasingly being integrated into healthcare systems, including pharmacy practice. This study aimed to evaluate Libyan pharmacists' perceptions, concerns, and practices regarding the use of ChatGPT in pharmaceutical settings. A cross-sectional survey was conducted among pharmacists working in different professional settings across Libya. A structured questionnaire consisting of four sections (demographic characteristics, perceptions, concerns, and practice). A total of 370 pharmacists participated in the study. Descriptive statistics were used to summarize the data, and Chi-square tests were applied to examine associations between demographic characteristics and study variables. The results showed that awareness of ChatGPT was very high among participants (99.2%), although levels of prior understanding of artificial intelligence and natural language processing varied. Overall, pharmacists demonstrated positive perceptions regarding the potential usefulness of ChatGPT, particularly in educational activities, information retrieval, and content generation. However, participants expressed significant concerns regarding the possibility of misleading information, privacy violations, algorithmic bias, and cybersecurity risks. In terms of practice, ChatGPT was moderately used in pharmaceutical contexts, primarily for obtaining drug and disease information and checking drug interactions, while its use for more complex clinical tasks remained limited. Statistical analysis indicated that demographic variables had minimal influence on pharmacists' perceptions, concerns, and practices, although age, city of residence, and education level showed some significant associations with specific dimensions. In conclusion, Libyan pharmacists demonstrate high awareness and generally positive attitudes toward the potential applications of ChatGPT in pharmacy practice.

1. INTRODUCTION

Artificial intelligence (AI), a multidisciplinary field encompassing computer science and linguistics, aims to develop systems able to perform tasks that demand human intelligence (Sarker,. 2022). These tasks include learning, adaption, reasoning, comprehension, understanding abstract ideas, and responding to complex human characteristics such as

attention, emotion, and creativity. are examples of tasks (Korteling et al., 2021). Recently, the idea of artificial intelligence chatbots has gained attention in the context of improving patient care and the administration of medicinal therapies (Pestkam,. 2021). ChatGPT is one of the popular chatbot models that has been designed utilizing the GPT language model by researchers. This chatbot is designed to assist patients in answering health-related inquiries. Nevertheless, the experience of pharmacists plays an essential role in the effective and appropriate of ChatGPT (Wu et al., 2020; Kocaballi et al. 2019). The use of artificial intelligence (AI) in healthcare has grown quickly and has the potential to revolutionize pharmacy practice (Aaina et al., 2021). AI systems have shown promise in improving clinical judgment, expediting administrative work, and improving patient care via tailored therapies and efficient pharmaceutical administration (Giordano., 2021). Among these resources, ChatGPT from OpenAI has been a popular option for patient counseling, clinical education, and medication information management. (Hadi et al., 2023; Lin, 2023). As AI-driven tools grow more prevalent, it is essential to assess healthcare personnel's preparedness to adopt these technologies for successful deployment (Ibeneme et al., 2021; Mikava & Mamulaidze, 2023). The application of AI in pharmacy practice offers unique opportunities to improve pharmacists' work, boosting productivity in duties including prescription reconciliation, evaluation of medication interactions, and patient engagement. (Hatem, 2024). A promising tool in pharmacy practice is ChatGPT, a large language model created by OpenAI. Its potential uses, such as medication counseling, prescription review, and patient education, have been investigated (Abu Hammour et al., 2023). According to Huang et al. (2024), a study that assessed ChatGPT's effectiveness in clinical pharmacy, it performs well in drug counseling but poorly in prescription review, patient medication education, and the identification of adverse drug reactions (Huang et al, 2024). These results demonstrate the revolutionary potential of AI in pharmacy practice, providing new opportunities for individualized treatment regimens and improving patient outcomes. However, pharmacy professionals' knowledge, attitudes, and practices (KAP) are crucial to the safe and ethical integration and secure incorporation of AI technologies like ChatGPT into clinical practice (Laymouna et al., 2024; Kor & Kor, 2024). In 2023, ChatGPT, which is licensed to Microsoft, took the Taiwanese Pharmacist Licensing Examination to test its pharmaceutical knowledge. The limitations of large language models in specialized areas are evident. These include potential translation errors and difficulties in assessing ChatGPT's performance on image-based questions. Despite achieving higher accuracy in the English version than the Chinese one, ChatGPT ultimately failed the exam (Wang et al., 2023). It shows promise for inclusion in the pharmacists' toolkit because of its strong ability to handle complex language tasks and its training on a large database (Vaswani et al., 2017). However, there are concerns about possible mistakes (Deng & Lin., 2023) and challenges in understanding complicated medical situations (Wogu., 2017). Issues of fairness, transparency, and data privacy also raise ethical questions (Deng & Lin, 2023; Tai, 2020). To ensure that ChatGPT effectively supports pharmacists, it is important to maintain a careful balance between using IA capabilities and exercising caution. This requires focusing on thorough training, clinical oversight, and ethical considerations (Howard., 2019). Ultimately, this approach will lead to more effective, personalized, and accessible healthcare in the future (Zawiah., 2023). This study aims to evaluate Libyan Pharmacists' Perception, Concerns, and practice of ChatGPT.

2. METHOD

2.1 Study design

This cross-sectional study was carried out between 18 November and 3 December 2025, and approximately 10,000 pharmacists from Libya were included, according to estimates. This study was reported in accordance with the STROBE guidelines (Cuschieri, 2019; Skrivankova et al., 2021).

2.2 Collection of data and study population

All researchers in this study were provided with a training session on the study's objectives and procedures. Moreover, the questionnaire was distributed via student networks, emails, and social media (Facebook and WhatsApp) using a convenience sampling technique. This study includes pharmacists employed in various settings, including hospitals, community, and academic institutions.

2.3 Data Collection Tool

The questionnaire used in this study was adapted from previous studies (Mohammed et al., 2024), Cronbach's alpha was used to gauge the questionnaire's reliability and the scales' internal consistency (Forero, 2024). yielding acceptable values for perception, concerns, and practice ($\alpha = 0.82$).

The study tool was translated utilizing the forward-backward translation method in compliance with World Health Organization (WHO) principles to ensure cultural adaptation. (Tung, 2020). The questionnaire was available in Arabic.
The questionnaire was divided into four sections**.** The first section collected the study of the population's demographic data. The second section included statements assessing pharmacists' perceived benefits of incorporating ChatGPT into pharmacy practice**.** The third section examined pharmacists' comments regarding integrating ChatGPT into clinical practice. The last section evaluated the extent of ChatGPT use among pharmacists. A 5-point Likert scale was used to assess benefits, concerns, and practice of pharmacists, ranging from disagree to strongly agree, scoring 1, 2, 3, 4, and 5, respectively.

2.4 Determination of sample size and Ethical considerations

An online sample size calculator was used to calculate the required sample size (https://www.calculator.net/sample-size-calculator.html). The minimum required sample size was estimated to be 370, based on a 5% margin of error, a 95% confidence level, and a 50% response distribution. All the participants in this research provided informed consent via a Yes/No question to confirm participation. Participants who answered "YES" were considered to have agreed, and the survey was conducted. Participants could not be identified, as all data were anonymized.

2.5 Statistical analysis

All data analysis via used IBM SPSS Statistics software (version 26). A combination of descriptive and inferential statistical methods was employed in the analysis. For categorical data, frequencies and percentages were computed. Data normality was assessed using the Kolmogorov-Smirnov test and histogram inspection, which showed that the data were not normally distributed, indicated by a p-value ≤ 0.05. To examine the relationship between the participants' baseline characteristics and their level of awareness of ChatGPT, as well as their perception, concerns, and practice, the Chi-square test was used due to its suitability in examining the relationship between categorical variables.

3. ETHICS APPROVAL

Approval was obtained from a scientific research ethics committee located in the same area where the research is being conducted. The data was collected from pharmacists in the city of Derna after their approval

4. RESULT

3.1 Socio-demographic features

The study cohort was mostly composed of females (81.6%, n=302). With a high young adult were between 20 and 35 years (96.8%, n=358). The participants were employed in several Libyan cities, with the highest percentage from Misrata (23.5%, n=87), followed by Benghazi (18.4%, n= 68) and Tobruk (16.8%, n=62). Moreover, (95.4%, n=353) of participants held a baccalaureate degree. Professionally, 54.9% of participants were working in community pharmacies, 23.5% in academic settings, and 19.5% in hospital pharmacies.
The results related to understanding artificial intelligence (AI) and natural language processing (NLP) demonstrated a range of knowledge. about (28.4%, n= 105) indicated no prior understanding, while a high percentage of participants had some level of awareness, either within the medicines field or outside the medical field by percent (34.1%, n= 126; 30.0%, n=111, respectively). A smaller percentage (7.6%, n= 28) reported extensive experience. Furthermore, most respondents reported competence with computers and digital technology as very good or excellent, with a (61.6%, n=174), signifying a generally high level of digital knowledge. Almost all participants (99.2%, n=367) had heard of ChatGPT, indicating the widespread awareness of artificial intelligence tools among pharmacy students and professionals, as shown in Figures 1, 2, 3, 4, 5, 6, and 7.

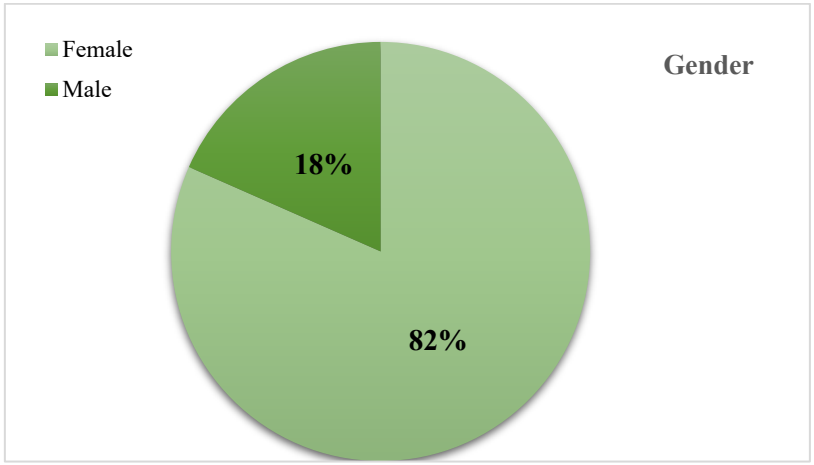

Fig 1. The percentage distribution of gender

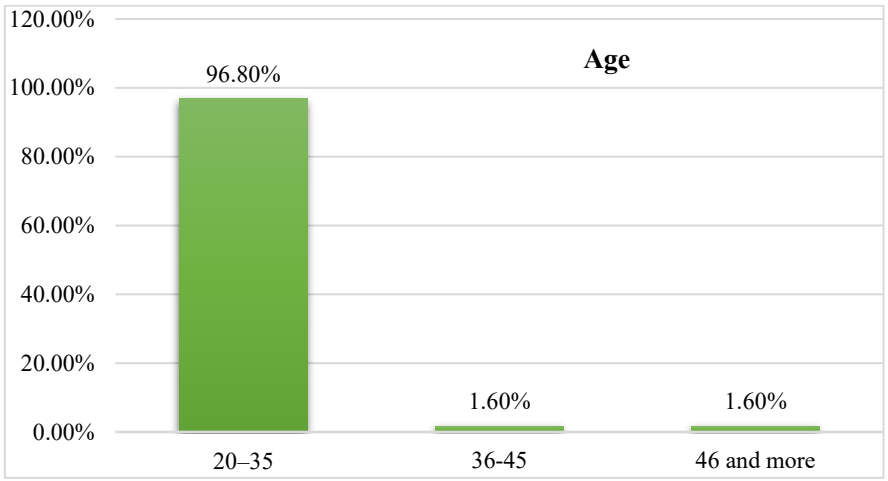

Fig 2. The percentage distribution of age

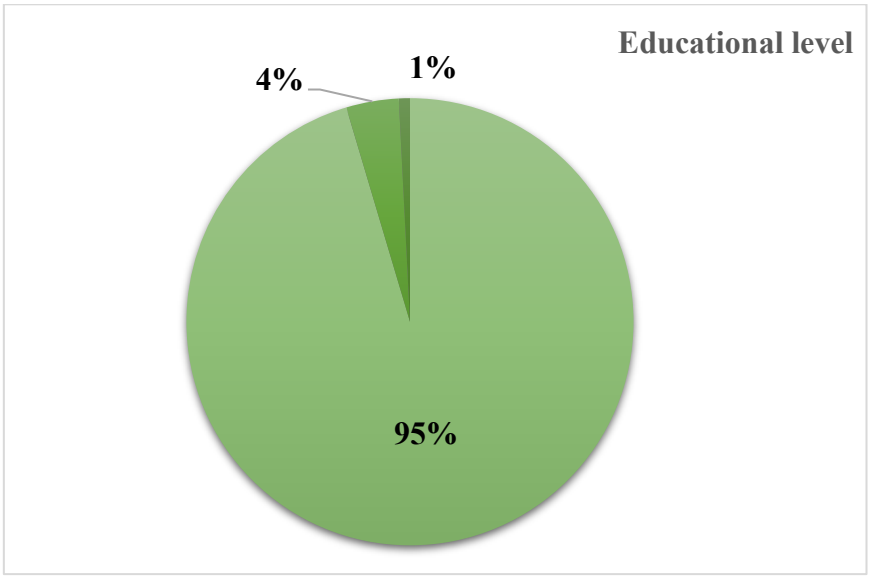

Fig 3. The percentage distribution of education level

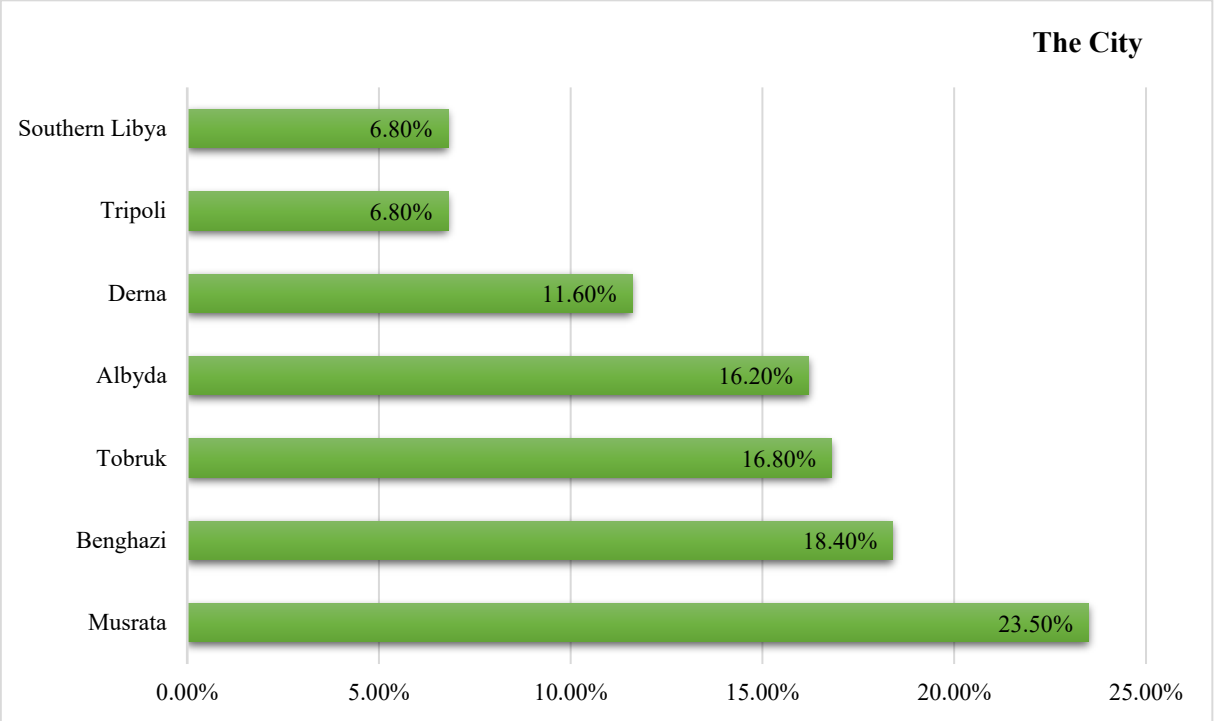

Fig 4. The percentage distribution of the city

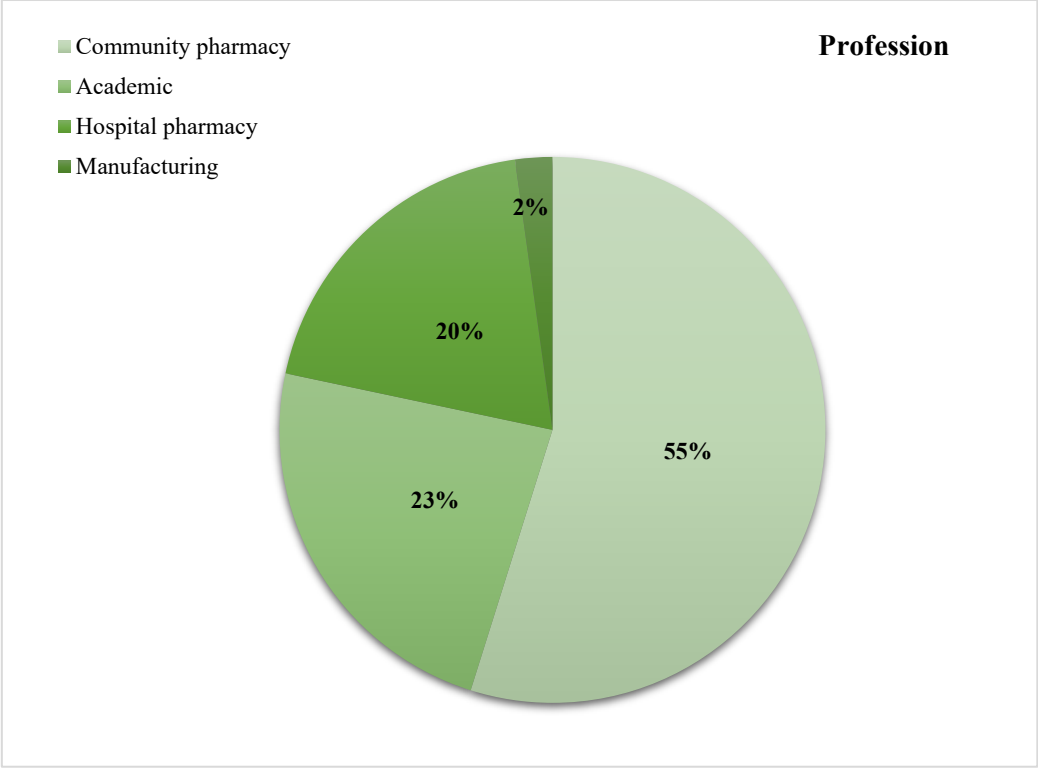

Fig 5. The percentage distribution of profession

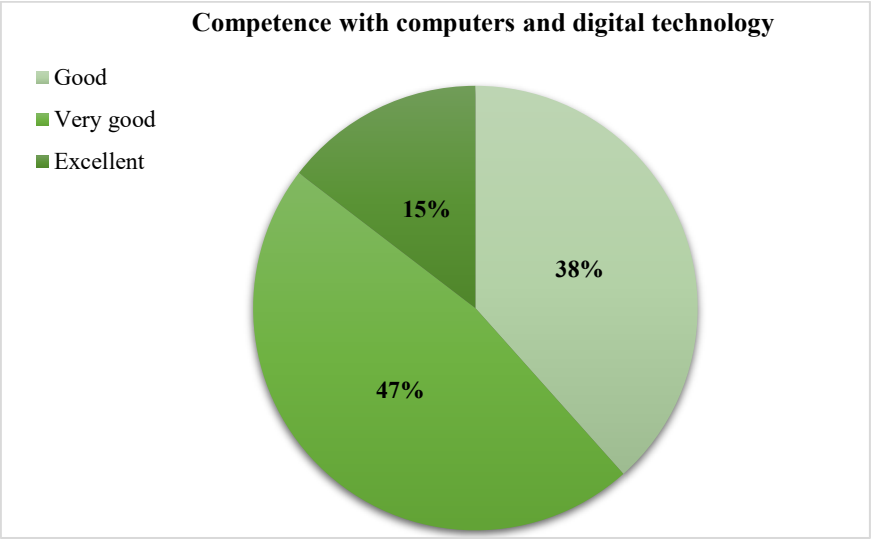

Fig 6. Percentage distribution of participants who competence with computers and digital technology

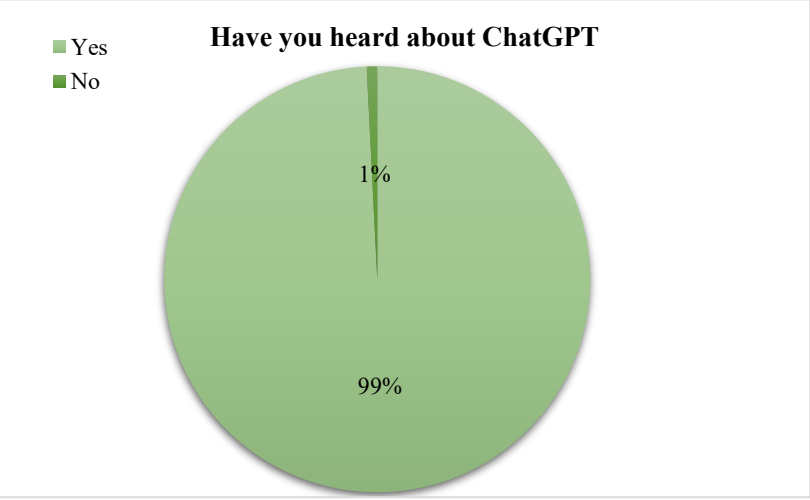

Fig 7. percentage distribution of participants who **heard about ChatGPT**

3.2 Libyan pharmacists' perceptions toward use of ChatGPT

As shown in Table 1), the results indicated overall positive perceptions about the usefulness of ChatGPT for pharmacy-related use. Most of the participants agreed about the usefulness of ChatGPT for pharmacists, with 42.4% agreeing and 22.2% strongly agreeing. Only 12.5% of the participants expressed disagreement.

In relation to the accuracy of medical information provided by ChatGPT, the results indicated moderate perceptions. A total of 26.8% of the participants agreed, while 10.8% strongly agreed about the accuracy of the medical information provided by ChatGPT. On the other hand, 27% of the participants expressed disagreement, 35.4% remained neutral. Similarly, the percentage of participants who agreed that ChatGPT can assist with product training by providing accurate and updated information was 29.2%, while the percentage who disagreed was 28.1%, and the percentage who had neutral views was 33.8%. Regarding the capability of ChatGPT for providing customer support, the percentage of participants who agreed that ChatGPT can provide 24/7 support for patients and healthcare providers was 31.1%, while the percentage who disagreed was 35.7%. The capability of ChatGPT for matching patients with clinical trials had lower percentages, with only 25.4% agreeing, while 41.1% disagreed. On the other hand, high percentages were obtained regarding the capability of ChatGPT for marketing and educational activities. Specifically, The percentage of participants who agreed that ChatGPT can assist with content creation, such as social media and blogs, was 51.4%, while the percentage who agreed that ChatGPT can provide educational content for therapeutic areas was 48.6%. Moreover, 56.2% also agreed that ChatGPT can assist salespeople in answering frequently asked product-related questions.

The participants also acknowledged the potential use of ChatGPT in research and development, as 44.1% agreed that it has the potential to help develop better pharmaceutical products.

Table 2. Summary of the participants' answers to the perception statements

Statements	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
ChatGPT is useful for pharmacists	15 (4.1)	31 (8.4)	85 (23.0)	157 (42.4)	82 (22.2)
ChatGPT can supply accurate medical information	23 (6.2)	77 (20.8)	131 (35.4)	99 (26.8)	40 (10.8)
ChatGPT contributes to product training by offering accurate and current information	23 (6.2)	81 (21.9)	125 (33.8)	108 (29.2)	33 (8.9)
ChatGPT can be utilized to provide patients, healthcare providers, and other stakeholders 24/7 customer support	20 (5.4)	112 (30.3)	104 (28.1)	115 (31.1)	19 (5.1)
Patients can match clinical trials via ChatGPTbased on their medical history and other criteria	23 (6.2)	129 (34.9)	105 (28.4)	94 (25.4)	19 (5.1)
ChatGPT can be utilized to provide training tohealthcare professionals and medical education	22 (5.9)	132 (35.7)	82 (22.2)	108 (29.2)	26 (7.0)
Healthcare professionals can get medical education and training from using ChatGPT	25 (6.8)	121 (32.7)	87 (23.5)	110 (29.7)	27 (7.3)
ChatGPT can assist with creating content by generating ideas for social media posts, blog posts, and other marketing materials	10 (2.7)	46 (12.4)	54 (14.6)	190 (51.4)	70 (18.9)
ChatGPT can be utlized to provide educational content linked to therapeutic fields or your products	10 (2.7)	45 (12.2)	78 (21.1)	180 (48.6)	57 (15.4)
ChatGPT can be used to produce role-playing scenarios where trainees can connect in a safe and controlled environment in practice their sales presentation skills	11 (3.0)	54 (14.6)	97 (26.2)	160 (43.2)	48 (13.0)

3.3 Libyan pharmacists' concerns toward use of ChatGPT.

As can be seen in Table 2, the participants showed significant concerns regarding the potential risks of using ChatGPT. The majority of the participants agreed that the answers provided by ChatGPT may be misleading, with 43.5% agreeing and 29.2% strongly agreeing, compared to 8.1% who disagreed. Furthermore, the concerns regarding the potential impact of the use of ChatGPT on the privacy of individuals were great, with 48.4% agreeing and 25.7% strongly agreeing that it may pose potential issues of violation of privacy due to data processing. The participants think that the algorithms of ChatGPT can be biased. A lot of participants, 43.5%) agree, and 17.3% strongly agree. They believe that ChatGPT gives answers because of the data it uses. Moreover, 67.3% think that ChatGPT is not safe from hacking and other security problems. The overall results suggest that despite the high benefits of the use of ChatGPT as a strong tool of technology, most of the participants investigated had high awareness of its potential limitations.

Table 3. Summary of the participants' answers to the concern statements

Statements	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
ChatGPT may generate misleading answers	7 (1.9)	23 (6.2)	71 (19.2)	161 (43.5)	108 (29.2)
ChatGPT may cause privacy issues	8 (2.2)	32 (8.6)	56 (15.1)	179 (48.4)	95 (25.7)
ChatGPT may produce biased responses	10 (2.7)	29 (7.8)	106 (28.6)	161 (43.5)	64 (17.3)
ChatGPT is vulnerable to security risks	10 (2.7)	44 (11.9)	67 (18.1)	156 (42.2)	93 (25.1)
ChatGPT may still produce inaccurate responses					

3.4 Libyan pharmacists' practice toward use of ChatGPT.

The results demonstrate that ChatGPT is being used in pharmacy practice, while its level of integration remains moderate. The high percentage of respondents reported occasional use (36.8%) and frequent use (28.1**%)** of ChatGPT. In terms of professional endorsement, the majority of participants (42.4%) said they would suggest ChatGPT to other pharmacists, compared to 36.5% who were unsure and 21.1% who would not. This indicates a cautious sense of optimism regarding its professional adoption.

When observing particular professional and clinical applications. A comparatively higher level of trust in ChatGPT's supportive analytical function was indicated by the majority (57.6%) who reported using it to check drug interactions. Similarly, although more than half (56.2%) had not adopted this use, 37.8% used it to help read unclear prescriptions, indicating variation in perceived reliability. Notably, 67.3% of respondents said they used ChatGPT as a source of information about illnesses and drugs, underscoring its significant function as a reference and teaching tool.

In more complex clinical assignments, 51.9% had not used ChatGPT for medication matching, whereas 38.4% had. The majority (57.3%) did not use it to define dosing regimens; only 36.8% did. Similarly, 36.2% of respondents said they used ChatGPT to manage medication side effects, while 57.8% said they did not, as shown in Table 3.

Table 3: Summary of the participants' answers to the practice statements (n=370)

Questions	N (%)
Current frequency of use of ChatGPT in pharmaceutical fields	
Never	56(15.1)
Rarely (once a month or less)	74(20.0)
Sometimes (2-3 times a month)	136(36.8)
A lot (once a week or more)	104(28.1)
Do you recommend ChatGPT for other pharmacists?	
Yes	157(42.4)
No	78(21.1)
I'm not sure	135(36.5)
Have you checked drug interactions with each other using ChatGPT?	
Yes	213(57.6)
No	138(37.3)
I'm not sure	19(5.1)
Have you used ChatGPT to read prescriptions that make it difficult for you to read the doctor's line?	
Yes	140(37.8)
No	208(56.2)
I'm not sure	22(5.9)

Have you ever used ChatGPT as a basis of information about diseases and drugs (e.g., asking ChatGPT questions about certain conditions, treatments, prescriptions, or lifestyle changes)?	
Yes	249(67.3)
No	105(28.4)
I'm not sure	16(4.3)
Have you ever utilized ChatGPT to match medications (prescription matching is a procedure that compares and examines all patient medications to guarantee accuracy and prevent prescription errors)?	
Yes	142(38.4)
No	192(51.9)
I'm not sure	36(9.7)
Have you ever used ChatGPT to define the correct dosing regimens for patients?	
Yes	136(36.8)
No	212(57.3)
I'm not sure	22(5.9)
Have you ever used ChatGPT to know or manage the side effects of drugs?	
Yes	214(57.8)
No	134(36.2)
I'm not sure	22(5.9)

2.5 The association between demographic features and awareness of ChatGPT

The results showed that there was a statistically significant relationship between gender and awareness of ChatGPT ($p = 0.030$). Females had slightly higher awareness compared to males, with 99.7% of the female participants showing awareness compared to 97.1% of the male participants. On the other hand, there were no statistically significant relationships found between awareness of ChatGPT and age ($p = 0.951$), city of residence ($p = 0.518$), education level ($p = 0.930$), and profession ($p = 0.213$). This shows that the awareness of ChatGPT was high across all the categories, with the awareness level being more than 96% for all the categories.

Among the participants, it was found that awareness was high regardless of the age category, with 99.2% showing awareness, while all the participants in the older age groups showed awareness (100%). In addition, the awareness level was high regardless of the city, education level, and profession, with the awareness level being more than 96%. All as shown in Table 4.

Table 4. Association between participants' sociodemographic features and hearing of ChatGPT (n = 370)

Variable		**Have you heard of ChatGPT?**		
		Yes (n%)	**No (n%)**	**p-value**
Gender	Female	301 (99.7%)	1 (0.3%)	**0.030***
	Male	66 (97.1%)	2 (2.9%)	
Age	20–35	355 (99.2%)	3 (0.8%)	
	36–45	6 (100%)	0 (0%)	0.951
	≥46	6 (100%)	0 (0%)	
City	Tobruk	62 (100%)	0 (0%)	
	Derna	43 (100%)	0 (0%)	
	Albyda	60 (100%)	0 (0%)	
	Benghazi	67 (98.5%)	1 (1.5%)	0.518
	Tripoli	25 (100%)	0 (0%)	
	Misurata	86 (98.9%)	1 (1.1%)	
	Southern Libya	24 (96.0%)	1 (4.0%)	
Education Level	Bachelor	350 (99.2%)	3 (0.8%)	
	Master	14 (100%)	0 (0%)	0.930
	PhD	3 (100%)	0 (0%)	
Profession	Academic	87 (100%)	0 (0%)	
	Hospital Pharmacy	70 (97.2%)	2 (2.8%)	0.213
	Community Pharmacy	202 (99.5%)	1 (0.5%)	
	Manufacturing	8 (100%)	0 (0%)	

The association between demographic characteristics and awareness of ChatGPT was examined using the Chi-square test.

3.6 Chi-square tests were conducted to examine the association between demographic characteristics (gender, age, city, education level, and profession) and the study dimensions (perception, concerns, and practice).

The results revealed that no significant association was found between gender and perception (p = 0.343), concerns (p = 0.241), or practice (p = 0.950). Regarding age, a significant association was found between age and perception (p = 0.037), indicating slight variations in perception among the age groups. However, no significant associations were found between age and concerns (p = 0.367) or practice (p = 0.999). Regarding city, there were no significant associations found between city and perception (p = 0.385) or concerns (p = 0.586). However, a significant association was found between city and practice (p = 0.017). In terms of education level, no significant association was found between education level and perception (p = 0.105). Conversely, highly significant associations were observed between education level and both concerns ($p < 0.001$) and practice ($p < 0.001$). Finally, profession did not show any significant association with perception (p = 0.839), concerns (p = 0.274), and practice (p = 0.265).

Overall, the results indicate that demographic factors had a minimal impact on perception, concerns, and practice; the only exceptions were age affecting perception, city influencing practice, and education level significantly impacting both concerns and practice.

Variable Pair	Category	Frequency (n)	Percent (%)	p-value
Gender * Perception	Female Male	10 1	2.7 0.3	0.343
Gender * Concerns	Female Male	20 6	5.4 1.6	0.241
Gender * Practice	Female Male	154 39	41.6 10.5	0.950
Age * Perception	20-35 36-45 46+	10 1 0	2.7 0.3 0	0.037*
Age * Concerns	20-35 36-45 46+	22 1 0	5.9 0.3 0	0.367
Age * Practice	20-35 36-45 46+	160 4 1	43.2 1.1 0.3	0.999
City * Perception	Tobruk Derna Albyda Benghazi Tripoli Misrata Southern Libya	2 1 1 3 0 1 0	0.5 0.3 0.3 0.8 0 0.3 0	0.385
City * Concerns	Tobruk Derna Albyda Benghazi Tripoli Misrata Southern Libya	4 3 1 5 2 7 1	1.1 0.8 0.3 1.4 0.5 1.9 0.3	0.586

City * Practice	Tobruk Derna Albyda Benghazi Tripoli Misrata Southern Libya	24 14 20 29 11 47 9	6.5 3.8 5.4 7.8 3.0 12.7 2.4	0.017*
Education * Perception	Baccalaureus Master PhD	6 1 1	1.6 0.3 0.3	0.105
Education * Concerns	Baccalaureus Master PhD	14 1 1	3.8 0.3 0.3	0.000*
Education * Practice	Baccalaureus Master PhD	103 6 1	27.8 1.6 0.3	0.000*
Profession * Perception	Academic Hospital pharmacy Community pharmacy Manufacturing	1 2 4 0	0.3 0.5 1.1 0	0.839
Profession * Concerns	Academic Hospital pharmacy Community pharmacy Manufacturing	3 3 9 1	0.8 0.8 2.4 0.3	0.274
Profession * Practice	Academic Hospital pharmacy Community pharmacy Manufacturing	32 13 59 6	8.6 3.5 15.9 1.6	0.265

5. DISCUSSION

The present study investigated the perceptions, concerns, and practices of Libyan pharmacists toward the use of ChatGPT in pharmaceutical practice. The socio-demographic characteristics of the participants revealed several notable findings. Female pharmacist considered the majority of the sample size, which reflects the growing participation of women in the pharmacy workforce within Libya. This result is consistent with previous studies showing that the pharmacy staff has become increasingly female-dominated over recent decades (IPF, 2022).

This demographic profile may have affected the study results, as younger pharmacists are characteristically more engaged with digital technologies and more likely to integrate AI-based tools into their professional activities. Accordingly, their familiarity with technological innovations may have contributed to a high level of awareness and acceptance of AI technologies present in this study (Topol, 2019).

Multiple Libyan cities were involved in our study, with the highest representation from Misrata, Benghazi, and Tobruk. This geographical variety suggests that the study captured perspectives from pharmacists working in different regions of Libya, although participation appeared higher in urban areas where healthcare services and professional networks are more developed. The insertion of pharmacists from different Libyan cities, especially Misrata, Benghazi, and Tobruk. This geographical variety proposes that pharmacist's perspectives across different cities of Libya. In terms of educational background, most participants had a bachelor's degree in pharmacy, and they were mostly composed of qualified pharmacists. Moreover, more than half of the participants worked in community pharmacies. The high proportion of community pharmacists may be chiefly related to the interpretation of the results, their frequent and direct interaction with patients, and their need to obtain accessible and up-to-date health information and drugs.

These professional demands may prompt pharmacists to engage with emerging digital tools, including AI-based applications, as possible sources of information and support for medication-related decisions and patient counseling.

In our study, we also showed that most of the respondents possessed good digital competence. The effective adoption and appropriate use of AI-based tools in clinical practice depended upon the levels of digital literacy of healthcare professionals (Davenport & Kalakota., 2019). Furthermore, the very high level of awareness of ChatGPT was investigated among participants, representing the rapid global diffusion of AI technologies through the healthcare sector.

Despite the elevated level of awareness of ChatGPT, the respondents demonstrated varying degrees of understanding of artificial intelligence and natural language processing (NLP). A significant proportion of respondents reported only narrow knowledge of these technologies, whereas a small percentage of respondents reported extensive experience. This result indicates a high gap between awareness and applications of AI in pharmacy practice.

findings of this study generally observed Libyan pharmacists' perceptions regarding the potential usefulness of ChatGPT in pharmacy practice. A significant proportion of participants agreed that ChatGPT useful tool for pharmacists. These findings agree with previous research that demonstrated that AI-based conversational models can assist healthcare professionals (Kung et al., 2023).

Despite the largely favorable reputation of ChatGPT, there was a higher level of wariness concerning the accuracy and reliability of its medical information. The large number of respondents who were either neutral or even skeptical about the issue might have arisen due to fears about the possible disadvantages of the use of artificial intelligence, specifically in the cases where clinical accuracy is very important. Such a viewpoint is justified, taking into consideration the fact that, according to previous studies, although ChatGPT is capable of providing clinically relevant information, there is also a possibility that it will provide erroneous information when dealing with complicated and sensitive medical questions (Gilson et al., 2023).

The participants' views on the use of ChatGPT for professional training and healthcare services were also contradictory. Some participants noted that this technology can be used for training healthcare professionals and as customer support, while others were undecided. The results indicate that pharmacists are still exploring the possible advantages and disadvantages of the use of AI technologies.

Interestingly, a higher level of consensus was seen about the use of ChatGPT in education and communication purposes. Over half of the subjects agreed that ChatGPT can help generate marketing literature and educational material related to pharmaceutical products or therapeutic areas. It has been well acknowledged by the scientific community that AI-based language models can help in content creation and scientific and educational writing (Dwivedi et al., 2023).

Moreover, the respondents identified the possible application of ChatGPT for pharmaceutical research and development. It was found that a significant percentage of respondents believed in the possibility of using AI technology in order to help develop better pharmaceutical products through analysis and pattern recognition. In recent years, AI technology has been widely used in pharmaceutical research and drug discovery and has become one of the breakthroughs in the pharmaceutical industry (Mak,& Pichika., 2019). At the same time, while recognizing the possible benefits, the respondents voiced several serious concerns related to potential problems associated with the use of ChatGPT. Misleading information generated by ChatGPT was one of the most serious issues raised by the respondents. It was found that a great number of people believe that ChatGPT can generate misleading or incorrect responses. This is based on previous research stating that AI models sometimes generate incorrect answers called "hallucinations" in AI (OpenAI, 2023).

Another topic that attracted much attention was privacy and data protection. Many participants expressed their concerns related to potential privacy problems caused by the use of ChatGPT because of the use of personal data in the training process. Issues of confidentiality of patient data are well-known in scientific literature related to digital health technologies and the application of AI in healthcare (Mesko, 2023). Furthermore, the issue of bias is another topic of great concern.

Participants expressed their concerns about potential bias in responses generated by ChatGPT depending on the data used to train the algorithm. Bias in AI is a known problem that can influence the performance of automated decision-making systems in healthcare (Topol, 2019).

Security issues have been mentioned as another important aspect of the implementation of AI technologies in healthcare. Many participants considered the possibility of AI being vulnerable to hacking and other cybersecurity issues. Overall, the results show that the perspective of pharmacists towards ChatGPT is quite balanced. Pharmacists understand that the system offers some opportunities but are not very sure about its possible drawbacks.

The findings associated with practice show that the system is currently used by some pharmacists, but the integration of ChatGPT into pharmaceutical practice is not very high. It has been seen that the most prevalent pattern of use among the pharmacists was occasional use, indicating that the technology is still being experimented with by them.

A considerable number of participants used ChatGPT to check drug interactions and gather information about diseases and drugs in general. This indicates the supportive nature of ChatGPT to provide information rather than serving as a system for clinical decision-making.

Studies conducted previously have shown that healthcare professionals tend to use artificial intelligence systems primarily for information gathering and education rather than for managing patients (Kung et al., 2023). Nevertheless, the application of ChatGPT in more complicated clinical activities like dosage determination, drug matching, and the management of adverse drug reactions has been rarely observed.

Such a conservative approach is perhaps due to the lack of trust in the quality of the advice produced by AI. It should be noted that healthcare professionals tend to use clinical databases and professional guidelines.
The second analysis investigated the association between demographic characteristics and study variables (perceptions, concerns, and practices) had only a modest influence on pharmacists' perceptions. Age showed significantly related with perception, suggesting that pharmacists from different age groups attitudes toward ChatGPT. Practice was significantly associated with city, which may reflect variances in digital infrastructure and workplace environments. Additionally, educational level showed a significant relationship with both concerns and practice, indicating that pharmacists with higher educational attainment may have greater awareness of the potential advantages as well as limitations of AI technologies. Overall, these results suggest that perception of pharmacists to ChatGPT were relatively consistent across demographic characteristics, with only a few demographic characteristics significantly effect on study dimensions.

6. Conclusion

The current research yields valuable data on how Libyan pharmacists perceive the use of ChatGPT and what issues are associated with the implementation of the technology in pharmacy practice. As seen from the results, the awareness of ChatGPT is extremely high. The phenomenon can be explained by the fast distribution of artificial intelligence-based technologies throughout the healthcare environment worldwide. In general, pharmacists' perceptions of ChatGPT were quite positive since they were focused on educational, pharmaceutical information retrieval, and content development functions of the technology. However, there are also several issues that pharmacists associate with ChatGPT use. They include concerns about the reliability of the information provided, privacy infringement, the possibility of bias in algorithms, and the issue of cybersecurity. Even though a certain number of pharmacists claim that they use ChatGPT in their work, the level of its implementation in the practice of pharmacists is relatively low. This can be explained by the fact that it is mainly used as an informational resource but not in the process of making clinical decisions.

Limitations

While the research was able to provide significant insights, there are several limitations associated with the study that must be taken into consideration when interpreting the findings. First, a cross-sectional design was used in the research, which means that the study was not able to establish a cause-and-effect relationship between variables. This implies that the results provided in the study describe participants' perception and behavior at one moment in time. Second, a convenience sampling technique was used in this study, which can lead to the presence of a sampling bias. Namely, only those participants who had technology knowledge might have been predisposed to respond to the questionnaire. Third, data was collected using self-reporting, which made the data susceptible to the presence of response bias (social desirability bias or inaccuracy in reporting real behavior). Finally, the scope of this study was limited to ChatGPT only; hence, pharmacists' perceptions of other artificial intelligence technologies used in the field of healthcare may not be covered.

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