BMC Public Health

RESEARCH

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Current status of pharmacists in community pharmacies in China in the health management of chronic respiratory diseases

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Abstract

Background Effective management of chronic respiratory diseases (CRDs) is critical, and community pharmacists play a key role. This study evaluates pharmacists' knowledge, attitude, technology use and patient education in CRDs management across various regions in China.

Methods This cross-sectional study conducted a survey of pharmacists across nine provinces and two municipalities in China from January to September 2024, using a stratified convenience sampling method based on regional GDP. A total of 733 questionnaires were distributed through online platforms and pharmacy networks, yielding 699 valid responses, resulting in a response rate of 95.4%.

Results 61.5% of pharmacists correctly answering 5 or fewer questions on knowledge-related topics. Additionally, 68.1% of the pharmacists demonstrated an accuracy rate of less than 50% in COPD-related questions, and 58.7% had an accuracy rate below 50% in asthma-related questions. Pharmacists in developed regions showed higher scores in knowledge, attitude, and patient education compared to those in underdeveloped areas ($P < 0.05$). Higher education and professional certifications were associated with better scores ($P < 0.05$). Frequent CRDs patient management and positive attitudes enhanced technology use, while longer working hours were linked to lower technology use and patient education scores ($P < 0.05$). Higher knowledge and attitude scores were significantly associated with better patient education ($P < 0.05$).

Conclusion Community pharmacists display significant knowledge gaps in managing CRDs, particularly COPD and asthma. Developed regions, higher education, certification, and frequent CRDs management correlate with better scores. These findings highlight the need for ongoing education and improved working conditions to strengthen pharmacists' roles in CRDs management, aligning with the Healthy China initiative.

Keywords Chronic respiratory diseases, Pharmacy pharmacists, Knowledge, Attitude, Technology use, Patient education

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Introduction

Chronic Respiratory Diseases (CRDs) encompass chronic conditions that affect the airways and lungs, marked by sustained airway inflammation and airflow obstruction, resulting in breathing difficulties [1, 2]. Common examples of CRDs include chronic obstructive pulmonary disease (COPD), asthma, pulmonary fibrosis, and bronchiectasis [3, 4]. CRDs have emerged as a growing global public health concern, imposing substantial burdens on individual health and exerting significant social and economic impacts, especially in countries and regions facing accelerated aging and urbanization [5, 6].

Patient education is widely acknowledged as a critical factor in the effective management of CRDs. Effective patient education should encompass essential information about the disease, recognition of warning signs and symptoms, an understanding of pathophysiology, and appropriate treatment options [7]. The China Pulmonary Health Study (CPHS), a large-scale nationwide epidemiological survey, found that the prevalence of COPD among adults aged 40 years and older in China is 13.6%, while the awareness rate remains as low as 2.6%. Additionally, the study showed that the prevalence of asthma among adults aged 20 years and older is 4.2%, but less than one-third of these patients had been diagnosed by a physician [8, 9]. A study across three low- and middle-income countries showed that 95.3% of COPD patients had not been previously diagnosed [10]. In a study of 1,448 respondents, two-thirds reported a clear lack of information and resources regarding pulmonary fibrosis at diagnosis. Over half of respondents reported insufficient understanding of treatment options, the role of supplemental oxygen, pulmonary rehabilitation, and transplantation [11]. Moreover, patient education and collaboration with healthcare providers in implementing treatment plans are crucial for the effective management of bronchiectasis. Collaboration between primary and secondary care providers in developing personalized treatment plans is essential for optimizing care and delaying the progression of bronchiectasis [12]. Additionally, the BREATHE study, conducted across 10 countries in the Middle East and North Africa region, revealed low levels of disease awareness and low treatment expectations among COPD patients, underscoring the need for improved patient education and communication between patients and healthcare providers [13]. Several randomized controlled trials have demonstrated that pharmacy-led patient education significantly improves treatment outcomes, particularly by enhancing COPD knowledge, increasing medication adherence, improving quality of life, and reducing hospitalization and emergency visit rates [14, 15]. A study in Australia found that community pharmacy management of COPD significantly improved inhaler use, vaccination rates, adherence to COPD action plans, and COPD knowledge, while effectively reducing acute exacerbation rates [16]. A nationwide study in Belgium demonstrated that community pharmacist consultations effectively improved medication adherence and asthma control in real-world settings [17]. A study in Japan found that collaborative management between pharmacists and physicians prevented idiopathic pulmonary fibrosis outpatients from discontinuing pirfenidone treatment [18].

In summary, out-of-hospital management encompasses services and technologies, including patient education, medication guidance, disease monitoring, and rehabilitation training. Although these services are essential for managing CRDs, they encounter significant challenges, primarily because CRDs are not included in national basic public health services. Community healthcare institutions often face difficulties in screening and providing medication guidance. Furthermore, patients with CRDs frequently have multiple comorbidities, which increases the risk of drug interactions [19, 20]. The significance of pharmacists in managing drug interactions and providing medication guidance within hospitals has not been adequately acknowledged, and their role in out-of-hospital settings is even more challenging to implement. This situation exacerbates the challenges of medication management for patients with CRDs, resulting in increased medication risks outside hospital settings. According to the Annual Data of Drug Supervision and Administration Statistics (2023) published by the National Medical Products Administration (NMPA), the total number of pharmacies in China reached 666,960 by the end of 2023 (https://www.nmpa.gov.cn/). However, there is a notable shortage of pharmacists nationwide, coupled with high turnover rates, particularly among community-based pharmacists. Additionally, the pharmacist-to-population ratio remains relatively low [21, 22]. As of July 31, 2024, the CRDs program had only been implemented in 144 pharmacies nationwide, highlighting the inadequacy of the current CRDs training system to meet the needs of CRDs patients. In China, community pharmacists undergo formal education and training, typically requiring a degree in pharmacy and passing the national licensing exam. Continuing education is also mandatory to maintain their professional qualifications [23]. However, their scope of practice is generally limited. Community pharmacists do not perform lung function tests, as these require specialized equipment and are usually conducted by respiratory specialists. They also cannot prescribe medications directly, except in certain collaborative settings with doctors. Their main roles involve medication management, patient counseling, and health education. Pharmacists provide medication advice, monitor outcomes, and offer lifestyle guidance to improve patient health. Therefore, this study provides a comprehensive

evaluation of pharmacists' knowledge, attitudes, technology use, and patient education (KATP) to address critical gaps in CRDs management. By identifying key factors that influence pharmacists' performance, the study establishes a solid foundation for developing targeted training programs and policy interventions. These findings are crucial for enhancing the quality of CRDs management in China, improving patient outcomes, and ultimately alleviating the burden of chronic respiratory diseases on the healthcare system.

Methods

Study design and participants

This study employed a cross-sectional design for data collection. A cross-sectional design is an observational research method that aims to collect data on the current status of study participants by conducting surveys or measurements at a specific point in time. The study was conducted from January to September 2024 across multiple provinces and municipalities in China, including Yunnan, Hunan, Hubei, Shaanxi, Zhejiang, Guangdong, Sichuan, Jiangsu, Shandong, Chongqing, and Shanghai. This study employed a stratified convenience sampling method to recruit pharmacists. Using GDP data from the National Bureau of Statistics of China (http://www.stats.gov.cn/), regions were classified as either developed or underdeveloped by comparing their per capita GDP with the national average. Regions with a per capita GDP above the national average were categorized as developed, while those below were classified as underdeveloped. Pharmacy locations were then categorized accordingly to ensure representation across regions with different levels of economic development and healthcare practices. The sample size was determined based on a minimum of ten times the total number of questionnaire items, a target response rate of 90%, and the feasibility of reaching pharmacists in the selected provinces and municipalities. Invitations to participate in the survey, including unique QR codes for accessing the online questionnaire, were distributed through various pharmacy professional networks and associations. The QR codes provided direct access to the survey hosted on a secure online platform, allowing participants to complete the questionnaire at their convenience. The use of these networks and the online platform streamlined the data collection process and ensured that the researchers could obtain data in a timely and widespread manner. Pharmacists who did not respond to the survey invitation, submitted duplicate responses, or failed to complete all items on the questionnaire were excluded from the analysis. A total of 733 questionnaires were distributed, and 699 valid responses were collected, yielding a response rate of 95.4% (Fig. 1).

Study instruments

Following a comprehensive review of relevant literature, the current questionnaire was developed, as shown in the supplementary materials. The questionnaire comprises five sections: demographic information, knowledge of CRDs (10 items, sourced from question banks of practicing physicians and pharmacists and covering issues related to the diagnosis and treatment of CRDs such as COPD and asthma, including 6 questions on COPD, 2 questions on asthma, and 1 question each on bronchiectasis and chronic bronchitis), attitudes toward these diseases (14 items, addressing various factors related to the impact of chronic airway diseases on treatment outcomes and the level of agreement with these factors), the use of technology in disease management (6 items, focusing on the use of electronic health records, online resources, or mobile applications in patient management), and patient education (40 items, including activities such as providing counseling on medication adherence, offering disease management information, and utilizing educational tools like pamphlets or videos). The total knowledge score was calculated by summing the scores of correct answers,

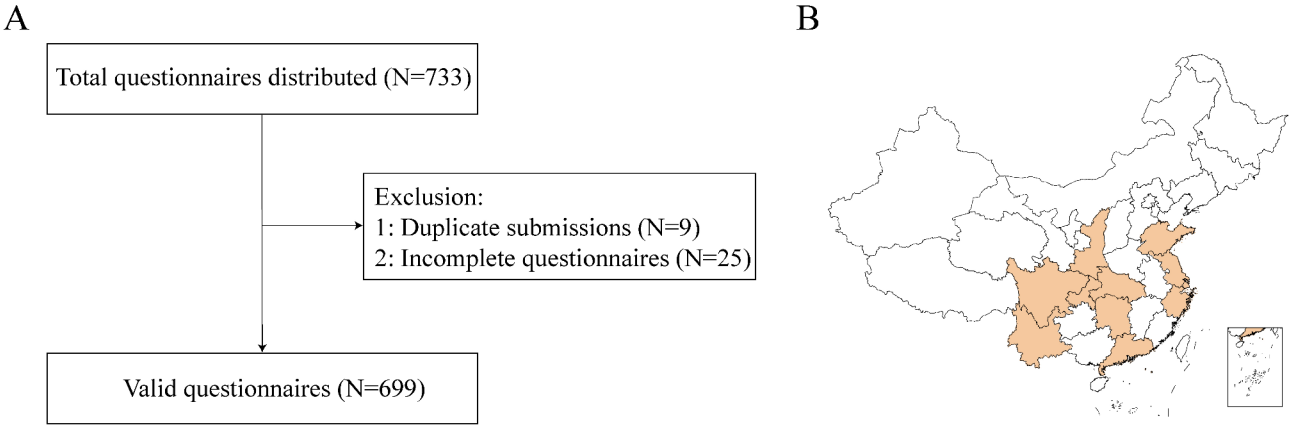

Fig. 1 **A**: Study flowchart; **B**: Geographic distribution of included community pharmacists across Chinese provinces

with a maximum possible score of 10. In the 14-item attitude section, pharmacists assessed the effectiveness of interventions for patients with chronic respiratory diseases, using a scale ranging from "strongly disagree" to "strongly agree." Only responses of "strongly agree" or "agree" were assigned 1 point, while all other responses received 0 points. The score for technology use was based on whether pharmacists were aware of or utilized new techniques or methods, with each technology or method assigned 1 point. The patient education score was derived from four multiple-choice questions regarding patient feedback, common patient needs, the use of tools to promote patient learning, and ensuring patients understand and adhere to medication usage and timing. Each selected option received 1 point, and the total score was calculated by summing all responses. The face and content validity of the questionnaire were assessed by a panel of experts, including two pulmonologists, one general internist, and two pharmacists. A pilot test involving 20 pharmacists from various regions in Hunan Province was conducted to evaluate the clarity, relevance, and completion time of the questionnaire. Data from the pilot test were excluded from the final analysis. The internal consistency of the four scales was evaluated using Cronbach's alpha: 0.62 for knowledge, 0.95 for attitudes, 0.78 for technology use, and 0.77 for patient education.

Statistical analysis

The statistical analysis was performed using SPSS version 25 (IBM Corp., Armonk, NY). Descriptive statistics for continuous variables are presented as means and standard deviations, and categorical variables are presented as frequencies and percentages. For comparisons of continuous variables between two groups, an independent samples t-test was used; for comparisons among multiple groups, one-way analysis of variance (ANOVA) was applied. All *p*-values are clearly associated with the respective statistical tests (e.g., t-test or ANOVA). For comparisons between developed and underdeveloped regions, independent samples t-tests were first conducted, and if necessary, post hoc analyses (such as Tukey's HSD test) were performed to further examine group differences. Additionally, potential confounding factors (e.g., age, sex) were considered during the analysis and adjusted for in multivariable analysis. Non-parametric tests were used to assess the relationship between continuous independent variables (KATP scores) and socio-demographic variables. Variables with $P<0.05$ in bivariate analysis were included as independent variables in the multivariable linear regression model to explore factors associated with KATP scores. The assumptions of multiple linear regression, including homoscedasticity, absence of multicollinearity, no significant outliers, normal distribution of residuals, and residual independence, were all met. Multicollinearity was assessed using variance inflation factors and the VIF analysis showed: Model 1: VIF ranged from 1.101 to 2.314 (mean: 1.363). Model 2: VIF was 1.017 throughout (mean: 1.017). Model 3: VIF ranged from 1.016 to 2.292 (mean: 1.407). Model 4: VIF ranged from 1.024 to 1.125 (mean: 1.066). No VIF values exceeded 10, indicating no significant multicollinearity. The normality and independence of residuals were evaluated through graphical analysis and statistical tests. A two-tailed *P*-value of less than 0.05 was considered statistically significant.

Results

Sociodemographic and other characteristics of the participants

The analysis revealed that the median age of participating community pharmacists was 38 years, with 91.3% being female. Additionally, 87.1% of the pharmacists possessed at least a college-level education, whereas 10.9% did not hold professional qualification certificates. Of particular note, 34.8% of pharmacies were situated in less developed regions. Additionally, 70.3% of the community pharmacists had more than 5 years of work experience, 80.4% work more than 8 h on weekdays, and 66.2% handled more than 10 CRDs patients daily (Table 1).

Description of the KATP scores

The median knowledge score among pharmacists was 5 out of 10, with 61.5% scoring 5 or below. Additionally, 68.1% of pharmacists scored below 50% accuracy on the 6 COPD-related questions, and 58.7% scored below 50% on the 2 asthma-related questions, as shown in Fig. 2. The median score for pharmacists' attitudes was 5 (range: 0–14). The median score for technology use was 5 (range: 0–6). The median score for patient education was 20 (range: 5–38).

Bivariate analysis of the KATP scores

The results showed that pharmacists with a high school or vocational education scored significantly lower than those with higher education levels ($P=0.011$). Pharmacists holding dual certifications achieved the highest scores ($P=0.016$). Those working in developed regions had significantly higher scores than those in less developed regions ($P<0.001$). Additionally, pharmacists working fewer than 8 h on weekdays scored higher than those working 8 h or more ($P=0.002$). However, there were no significant differences in knowledge scores based on gender, the number of CRDs patients managed daily, or years of work experience. The analysis of pharmacists' attitudes revealed significant differences based on the location of the pharmacy. Pharmacists working in developed regions had significantly higher attitude scores compared to those in less developed regions ($P=0.009$). However,

Table 1 Characteristics of community pharmacists

Characteristics	Total (*N* = 699)
Gender	
Female, %	91.3
Male, %	8.7
Age, years	38(33,43)
Education level	
High school/vocational school and below, %	12.9
College diploma, %	61.5
Bachelor's degree and above, %	25.6
Type of professional certification	
Traditional Chinese Medicines-Licensed pharmacist, %	38.9
Western Medicine-Licensed pharmacist, %	33.3
Both obtained two licenses, %	16.9
Neither obtained licenses, %	10.9
Location of pharmacy	
Developed region, %	65.2
Less developed regions, %	34.8
Number of chronic respiratory diseases patients managed daily	
< 10, %	57.1
≥ 10, %	42.9
Average working hours on weekdays	
< 8 h, %	19.6
≥ 8 h, %	80.4
Years of work experience	
≤ 5 years, %	29.8
> 5 years, %	70.2

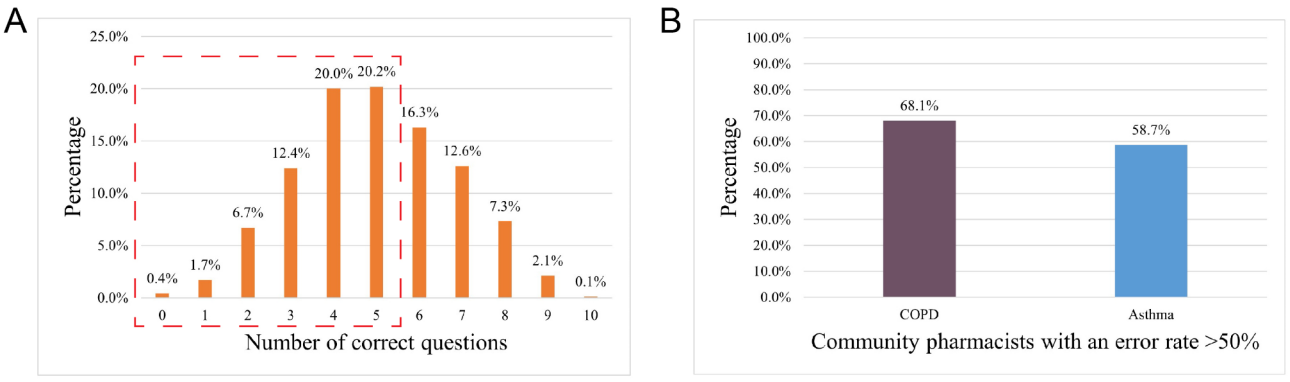

Fig. 2 (**A**) Number of correct questions by community pharmacists; (**B**) Community pharmacists with an error rate of 50% or higher in different categories of questions

no significant differences were observed in attitude scores based on gender, education level, type of professional certification, the number of CRDs patients managed daily, working hours on weekdays, or years of work experience. The analysis of technology use among pharmacists revealed pharmacists with a bachelor's degree or higher had significantly higher scores compared to those with lower education levels ($P = 0.010$). Those working in less developed regions scored higher than those in developed regions ($P < 0.001$). Pharmacists managing 10 or more CRDs patients daily had higher scores than those managing fewer ($P = 0.032$). Additionally, pharmacists working fewer than 8 h on weekdays had higher scores compared to those working 8 h or more ($P < 0.001$). However, no significant differences were observed in scores based on gender, type of professional certification, or years of work experience. The analysis of patient education scores among pharmacists revealed pharmacists in less developed regions scored higher than those in developed regions ($P = 0.014$), and those working fewer than 8 h on weekdays had higher scores than those working 8 h or more ($P = 0.002$). No significant differences were found based on gender, education level, type of

professional certification, number of CRDs patients managed daily, or years of work experience (Table 2).

Multivariable analysis

The first linear regression analysis with knowledge score as the dependent variable revealed that pharmacists working in developed regions exhibited higher knowledge levels ($P = 0.016$, Fig. 3, Model 1). The second linear regression analysis with attitude score as the dependent variable showed a significant association between pharmacists working in developed regions and higher attitude scores ($P = 0.003$, Fig. 3, Model 2). The third linear regression analysis, technology use score as the dependent variable, indicated that seeing ≥ 10 CRDs patients per day ($P = 0.015$), higher attitude scores ($P = 0.002$), and working in a developed region ($P = 0.006$) were significantly associated with higher technology use score. Conversely, working ≥ 8 h on weekdays ($P = 0.006$) was significantly associated with lower practice scores (Fig. 3, Model 3). The fourth linear regression analysis, with patient education score as the dependent variable, demonstrated that higher knowledge scores ($P < 0.001$) and higher attitude scores ($P < 0.001$) were significantly associated with better patient education scores (Fig. 3, Model 4).

Discussion

This study offers valuable insights into the sociodemographic characteristics and professional practices of community pharmacists in managing CRDs. By exploring key aspects including knowledge, attitude, technological use, and patient education, this study highlights the interaction between these factors and their impact on the effectiveness of CRDs management.

The study shows that 61.5% of pharmacists answered five or fewer questions correctly in the CRDs test, with 68.1% scoring below 50% in the COPD test and 58.7% in the asthma test. These results highlight significant gaps in pharmacists' knowledge of CRD management, especially in applying clinical guidelines. One possible reason is the insufficient professional training of pharmacists in managing chronic diseases like COPD and asthma. Existing literature indicates that continuing education

Table 2 Bivariate analysis of factors associated with the knowledge, attitude, technology use and patient education score

Variables	Knowledge	Attitude	Technology use	Patient education
Gender				
Female	5(4,6)	5(1,12)	5(3,6)	20(14,27)
Male	5(4,6)	3(0,11)	5(2,6)	20(14,27)
P-value	0.594	0.146	0.817	0.681
Education level				
High school/vocational school and below,	4(3,7)	4(1,11)	5(3,6)	22(18,30)
College diploma	5(4,6)	4(0,12)	4(2,6)	19(13,26)
Bachelor's degree and above	5(4,6)	5(1,13)	5(3,6)	21(14,27)
P-value	0.011	0.304	0.010	0.453
Type of professional certification				
Traditional Chinese Medicines-Licensed pharmacist	5(3,6)	5(1,11)	4(3,6)	21(14,27)
Western Medicine-Licensed pharmacist	5(4,6)	5(1,12)	4(3,6)	18(12,25)
Both obtained two licenses	5(4,7)	5(1,10)	5(4,6)	21(14,27)
Neither obtained licenses	4(3,6)	5(0,13)	5(2,6)	21(15,34)
P-value	0.016	0.785	0.060	0.211
Location of pharmacy				
Developed region	6(4,7)	5(1,13)	4(2,6)	22(14,26)
Less developed regions	5(4,6)	4(0,10)	5(3,6)	21(14,28)
P-value	< 0.001	0.009	< 0.001	0.014
Number of chronic respiratory diseases patients managed daily				
< 10	5(4,6)	4(0,12)	4(2,6)	20(14,27)
≥ 10	5(4,6)	5(1,12)	5(3,6)	21(14,27)
P-value	0.564	0.382	0.032	0.770
Average working hours on weekdays				
< 8 h	5(4,7)	5(1,13)	6(4,6)	23(14,30)
≥ 8 h	5(4,6)	4(1,12)	4(3,6)	20(14,26)
P-value	0.002	0.438	< 0.001	0.002
Years of work experience				
≤ 5 years	5(4,6)	4(0,13)	4(2,6)	20(13,27)
> 5 years	5(4,6)	5(1,11)	5(3,6)	21(14,27)
P-value	0.281	0.675	0.051	0.203

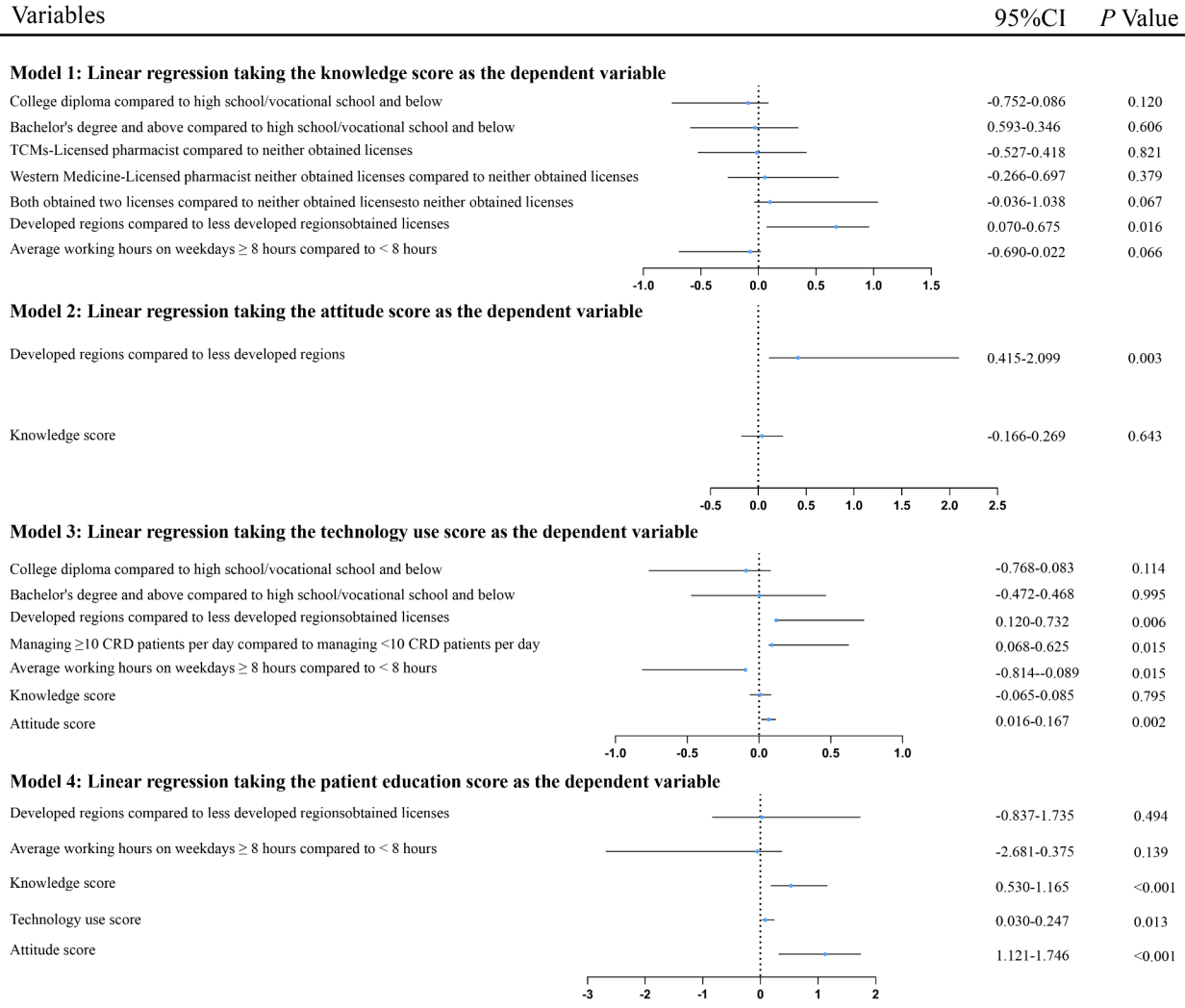

Fig. 3 Multivariable analysis

for pharmacists typically focuses on basic drug usage, with limited emphasis on chronic diseases, particularly complex conditions [24, 25]. Additionally, the diversity of COPD and asthma, along with the need for individualized treatment, further challenges pharmacists in clinical managemen [26, 27]. Finally, regional disparities and resource imbalances, especially in under-resourced areas, limit pharmacists' access to professional training and education [28, 29]. Studies show that healthcare professionals familiar with current guidelines or involved in educational activities are more likely to apply this knowledge effectively in patient care [30, 31]. Systematic reviews have further demonstrated that community pharmacists not only effectively screen high-risk COPD patients but also significantly contribute to patient management [32]. The study further underscores the crucial role of community pharmacists in smoking cessation and the management of high-risk COPD patients. The significant influence of educational attainment and professional certification on pharmacists' knowledge scores suggests that individuals with advanced education and certifications possess superior knowledge in managing CRDs. This implies that higher education equips pharmacists with more comprehensive theoretical knowledge and clinical training, allowing them to better comprehend and implement complex medical guidelines. Moreover, professional certifications, achieved through rigorous training and examinations, further augment pharmacists' expertise, especially within multidisciplinary teams managing chronic diseases [33–35]. Hence, advanced education and professional certification are essential for enhancing pharmacists' knowledge and skills in CRDs management.

In terms of attitude, the observed differences based on pharmacy location indicate that pharmacists in developed regions scored significantly higher. This finding

suggests that better access to training and resources in these regions may positively influence pharmacists' attitudes. While we infer that enhanced professional development, advanced training, and greater access to resources contribute to these differences, it is important to note that our study instruments, particularly Q20, primarily measure pharmacists' beliefs in treatment effectiveness rather than workplace support or organizational resources. Therefore, the association with developed regions should be understood as reflecting improved access to these factors, aligning with other studies that highlight the role of work environment factors in shaping healthcare professionals' attitudes and job satisfaction [36, 37]. In terms of technological use, pharmacists holding a bachelor's degree or higher attained significantly better scores, underscoring the crucial role of higher education in facilitating the adoption of advanced technologies. This finding is consistent with previous research, which emphasizes the critical role of education and training in fostering the adoption of innovative practices [38]. Additionally, pharmacists managing 10 or more CRDs patients per day scored higher, suggesting that frequent patient interactions may encourage more innovative approaches. Conversely, pharmacists working over 8 h per weekday exhibited lower scores, potentially due to burnout or diminished efficiency caused by prolonged working hours [39, 40]. In terms of patient education, pharmacists in less developed regions attained higher scores, possibly due to resource limitations, which may result in greater dependence on pharmacists for patient education. This finding is consistent with studies indicating that healthcare professionals in resource-constrained settings frequently assume additional educational roles [41].

Multivariable analysis demonstrated that pharmacists in developed regions achieved higher scores in both knowledge and attitudes, underscoring the significant influence of regional development on professional practice. While previous studies have reported a significant positive correlation between the knowledge and attitudes of pharmacists and patients across various diseases [42–44], our research did not find this relationship. This discrepancy may reflect differences in research subjects and settings. For example, pharmacists managing CRDs may encounter distinct challenges and educational needs compared to those handling other diseases, potentially resulting in a different relationship between knowledge and attitudes. Instead, we observed a positive correlation between higher knowledge scores and improved patient education, emphasizing the essential role of continuing education in improving patient care outcomes. Furthermore, the significant relationships between technology use, higher attitude scores, and the number of CRDs patients managed daily suggest that a proactive work attitude and frequent patient interactions contribute to technological progress. This observation aligns with existing literature, showing a positive correlation between a positive attitude and the adoption of innovative technologies [45].

Strengths and limitations of the study

This study has several strengths. It includes a large and diverse sample of 699 pharmacists from across China, which enhances the generalizability of the findings. The study provides a comprehensive assessment of pharmacists' knowledge, attitudes, technological use, and patient education in the management of CRDs, with a particular focus on regional differences. It also highlights the positive impact of higher education and professional certifications on pharmacists' performance. Additionally, the findings underscore the importance of ongoing education, improved working conditions, and better access to resources to strengthen pharmacists' roles in managing CRDs, in alignment with national health initiatives such as Healthy China. However, the study has several limitations. First, self-reported data may introduce response bias. Second, the study does not account for all factors influencing CRD management, and unmeasured confounding variables may affect the results. Additionally, selection bias may exist among the participating out-of-hospital pharmacy stores. The knowledge scale also shows modest internal consistency (Cronbach's alpha = 0.62), lower than the typically desired threshold (alpha ≥ 0.7), meaning results should be interpreted with caution. Future studies could improve reliability by refining the measurement tool.

Conclusion

This study highlights significant gaps in community pharmacists' knowledge of managing CRDs, especially in identifying, screening, and treating COPD and asthma. Pharmacists in developed regions scored higher in knowledge and attitude, demonstrating the impact of regional development on professional practice. Higher education and certification were associated with better knowledge and use scores. Regular management of CRDs patients and a positive attitude also promoted greater use of technology. Targeted continuing education and improved working conditions are essential to support community pharmacists in managing CRDs. Policy efforts should focus on addressing knowledge gaps and enhancing the infrastructure of community pharmacies, including upgrading technology and digital systems. This research provides a foundation for integrating community pharmacies into China's CRDs management system and offers guidance for future development in this area.

Supplementary information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22272-8.

Supplementary Material 1

Supplementary Material 2

Acknowledgements
We would like to express my sincere gratitude to the China Association of Pharmaceutical Commerce for their valuable support and resources throughout this research.

Author contributions
J.W., H.N., and Y.C. contributed to the study design; J.W., T.Y., S.D., B.A., and J.C were responsible for the data collection; J.W. verified and analyzed the data; J.W. wrote the manuscript; T.Y., H.N., and Y.C. reviewed and contributed to the writing of the manuscript. All authors had full access to the study data, approved the revisions, and had final responsibility for the decision to submit the manuscript for publication.

Funding
This work was supported by the National Natural Science Foundation of China (No. 82370054 and 82070049), the Fundamental Research Funds for the Central Universities of Central South University (No. 2024ZZTS0875), the Natural Science Foundation of Hunan Province (No. 2023JJ30742), the Health Research Project of Hunan Provincial Health Commission (W20243127), the Beijing Bethune Charitable Foundation (BJ-RW2020011J), the CAMS Innovation Fund for Medical Science (No. 2021-I2M-1-049), the National Natural Science Foundation of China (No. 82090011 and 82400043), the National High Level Hospital Clinical Research Funding; Elite Medical Professionals Project of China-Japan Friendship Hospital (No. ZRJY2023-QM16), the National Key Research and Development Program of China (No. 2022YFC3702704) and the National Key Clinical Specialty Construction Projects of China.

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

Declarations

Ethics approval and consent to participate
This study was approved by the Clinical Trial and Ethics Committee of the Second Xiangya Hospital of Central South University and was performed in accordance with the Declaration of Helsinki (LYF20230119). All participants fully understood the information files. Informed consent was obtained from all participants.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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Received: 31 October 2024 / Accepted: 10 March 2025
Published online: 18 March 2025

References

1. Global burden of chronic respiratory diseases and risk factors. 1990–2019: an update from the global burden of disease study 2019. EClinicalMedicine. 2023;59:101936. https://doi.org/10.1016/j.eclinm.2023.101936
2. Zhang J, Chen F, Wang Y, Chen Y. Early detection and prediction of acute exacerbation of chronic obstructive pulmonary disease. Chin Med J Pulm Crit Care Med. 2023;1(2):102–7. https://doi.org/10.1016/j.pccm.2023.04.004
3. Xie M, Liu X, Cao X, Guo M, Li X. Trends in prevalence and incidence of chronic respiratory diseases from 1990 to 2017. Respir Res. 2020;11(1):49. https://doi.org/10.1186/s12931-020-1291-8
4. Prevalence and attributable health burden of chronic respiratory diseases. 1990–2017: a systematic analysis for the global burden of disease study 2017. Lancet Respir Med. 2020;8(6):585–96. https://doi.org/10.1016/s2213-2600(20)30105-3
5. Viegi G, Maio S, Fasola S, Baldacci S. Global burden of chronic respiratory diseases. J Aerosol Med Pulmonary Drug Delivery. 2020;33(4):171–7. https://doi.org/10.1089/jamp.2019.1576
6. Meghji J, Mortimer K, Agusti A, et al. Improving lung health in low-income and middle-income countries: from challenges to solutions. Lancet. 2021;397(10277):928–40. https://doi.org/10.1016/s0140-6736(21)00458-x
7. Effing T, Monninkhof EM, van der Valk PD, et al. Self-management education for patients with chronic obstructive pulmonary disease. Cochrane Database Syst Reviews. 2007;17(4):Cd002990. https://doi.org/10.1002/14651858.CD002990.pub2
8. Zhong N, Wang C, Yao W, et al. Prevalence of chronic obstructive pulmonary disease in China: a large, population-based survey. Am J Respiratory Crit Care Med. 2007;15(8):753–60. https://doi.org/10.1164/rccm.200612-1749OC
9. Huang K, Yang T, Xu J et al. Prevalence, risk factors, and management of asthma in China: a national cross-sectional study. *Lancet*. 2019;394(10196):407–418. https://doi.org/10.1016/s0140-6736(19)31147-x
10. Siddharthan T, Pollard SL, Quaderi SA, et al. Discriminative accuracy of chronic obstructive pulmonary disease screening instruments in 3 Low- and Middle-Income country settings. Jama. 2022;11(2):151–60. https://doi.org/10.1001/jama.2021.23065
11. Collard HR, Tino G, Noble PW, et al. Patient experiences with pulmonary fibrosis. Respir Med. 2007;101(6):1350–4. https://doi.org/10.1016/j.rmed.2006.10.002
12. Chalmers JD, Sethi S. Raising awareness of bronchiectasis in primary care: overview of diagnosis and management strategies in adults. NPJ Prim Care Respir Med. 2017;13(1):18. https://doi.org/10.1038/s41533-017-0019-9
13. Idrees M, Koniski ML, Taright S, et al. Management of chronic obstructive pulmonary disease in the middle East and North Africa: results of the BREATHE study. Respir Med. 2012;106(2):S33–44. https://doi.org/10.1016/s0954-6111(12)70013-6
14. Suhaj A, Manu MK, Unnikrishnan MK, Vijayanarayana K, Mallikarjuna Rao C. Effectiveness of clinical pharmacist intervention on health-related quality of life in chronic obstructive pulmonary disorder patients - a randomized controlled study. J Clin Pharm Ther. 2016;41(1):78–83. https://doi.org/10.1111/jcpt.12353
15. Davis E, Marra C, Gamble JM, et al. Effectiveness of a pharmacist-driven intervention in COPD (EPIC): study protocol for a randomized controlled trial. Trials. 2016;13(1):502. https://doi.org/10.1186/s13063-016-1623-7
16. Fathima M, Bawa Z, Mitchell B, Foster J, Armour C, Saini B. COPD management in community pharmacy results in improved inhaler use, immunization

rate, COPD action plan ownership, COPD knowledge, and reductions in exacerbation rates. Int J Chron Obstruct Pulmon Dis. 2021;16:519–33. https://doi.org/10.2147/copd.S288792
17. Putman B, Coucke L, Vanoverschelde A, Mehuys E, Lahousse L. Community pharmacist counseling improves adherence and asthma control: a nationwide study. BMC Health Serv Res. 2022;26(1):112. https://doi.org/10.1186/s12913-022-07518-0
18. Satsuma Y, Ikesue H, Kusuda K, et al. Effectiveness of Pharmacist-Physician collaborative management for patients with idiopathic pulmonary fibrosis receiving Pirfenidone. Front Pharmacol. 2020;11:529654. https://doi.org/10.3389/fphar.2020.529654
19. Carmona-Pírez J, Poblador-Plou B, Ioakeim-Skoufa I, et al. Multimorbidity clusters in patients with chronic obstructive airway diseases in the epichron cohort. Sci Rep. 2021;26(1):4784. https://doi.org/10.1038/s41598-021-83964-w
20. Clofent D, Álvarez A, Traversi L, Culebras M, Loor K, Polverino E. Comorbidities and mortality risk factors for patients with bronchiectasis. Expert Rev Respir Med. 2021;15(5):623–34. https://doi.org/10.1080/17476348.2021.1886084
21. Feng Z, Ye Y, Ye H, Tang Z. Changes in pharmaceutical retail market and regional inequality of community pharmacists accessibility in Mainland China: a retrospective cross-sectional study. BMJ Open. 2022;21(11):e063739. https://doi.org/10.1136/bmjopen-2022-063739
22. Zou Q, He X, Zhang L. Community health workers' mobility in China: evidence from 2008 to 2017. Front Public Health. 2022;10:947984. https://doi.org/10.3389/fpubh.2022.947984
23. Tang Z, Lhamu P, Ye H, Hong L, Xiang X. Current perceptions and improvement approaches of pharmaceutical care capacity of community pharmacists: A quantitative analysis based on survey data at Chinese chain pharmacies. Int J Environ Res Public Health. 2020;14(20). https://doi.org/10.3390/ijerph17207482
24. Darwish RM, Ammar K, Rumman A, Jaddoua SM. Perception of the importance of continuing professional development among pharmacists in a middle East country: A cross-sectional study. PLoS ONE. 2023;18(4):e0283984. https://doi.org/10.1371/journal.pone.0283984
25. Meng W, Wang Y, Shen J, Yan M, Hu Y, Jiang R. Factors affecting community pharmacists' capacity to deliver pharmacy services in Zhengzhou, China: a cross-sectional study. BMJ Open. 2024;29(10):e083104. https://doi.org/10.1136/bmjopen-2023-083104
26. Keir HR, Dicker A, Lonergan M, et al. Clinical endotypes of exacerbation are associated with differences in microbial composition and diversity in COPD. Eur Respiratory J. 2020;56(4). https://doi.org/10.1183/13993003.00391-2020
27. Chan AHY, De Keyser HH, Horne R, Szefler SJ. Defining adherence phenotype and endotypes to personalise asthma management. Eur Respiratory J. 2024;27. https://doi.org/10.1183/13993003.01357-2024
28. Alharthi MS. Exploring challenges and enablers for community pharmacists using electronic prescriptions (Wasfaty) in Makkah region, Saudi Arabia: a qualitative study using the theoretical domains framework. Front Med (Lausanne). 2024;11:1487852. https://doi.org/10.3389/fmed.2024.1487852
29. Salem HH, Bazan NS, Addal WA, et al. Evaluation of community pharmacists' knowledge, practice and barriers towards diabetes management in Asir region, Saudi Arabia. J Eval Clin Pract. 2024;6. https://doi.org/10.1111/jep.14121
30. Moreo K, Greene L, Sapir T. Improving interprofessional and coproductive outcomes of care for patients with chronic obstructive pulmonary disease. BMJ Qual Improv Rep. 2016;5(1). https://doi.org/10.1136/bmjquality.u210329.w4679
31. Sapir T, Moreo KF, Greene LS, et al. Assessing patient and provider perceptions of factors associated with patient engagement in asthma care. Ann Am Thorac Soc. 2017;14(5):659–66. https://doi.org/10.1513/AnnalsATS.201608-602OC
32. Fathima M, Naik-Panvelkar P, Saini B, Armour CL. The role of community pharmacists in screening and subsequent management of chronic respiratory diseases: a systematic review. Pharm Pract (Granada). 2013;11(4):228–45. https://doi.org/10.4321/s1886-36552013000400008
33. Hassan F, Hatah E, Ali AM, Wen CW. The intervention strategies and service model for pharmacist-led diabetes management: a scoping review. BMC Health Serv Res. 2023;18(1):46. https://doi.org/10.1186/s12913-022-08977-1
34. Renet S, Chaumais MC, Gallant-Dewavrin M, et al. Knowledge exchange between patient and pharmacist: A mixed methods study to explore the role of pharmacists in patient education and counseling in asthma and pulmonary arterial hypertension. Ann Pharm Fr. 2023;81(1):53–63. https://doi.org/10.1016/j.pharma.2022.06.005
35. Myers G, Stevens J, Flewelling A, Richard J, London M. Evaluation and clinical impact of a pharmacist-led, interdisciplinary service focusing on education, monitoring and toxicity management of immune checkpoint inhibitors. J Oncol Pharm Pract. 2023;29(1):145–54. https://doi.org/10.1177/10781552211061133
36. Yong FR, Garcia-Cardenas V, Williams KA, Charlie Benrimoj SI. Factors affecting community pharmacist work: A scoping review and thematic synthesis using role theory. Res Social Adm Pharm. 2020;16(2):123–41. https://doi.org/10.1016/j.sapharm.2019.05.001
37. Boyle TA, Bishop A, Morrison B, et al. Pharmacist work stress and learning from quality related events. Res Social Adm Pharm. 2016;12(5):772–83. https://doi.org/10.1016/j.sapharm.2015.10.003
38. Mattingly TJ 2nd, Mullins CD, Melendez DR, Boyden K, Eddington ND. A systematic review of entrepreneurship in pharmacy practice and education. Am J Pharm Educ. 2019;83(3):7233. https://doi.org/10.5688/ajpe7233
39. Dee J, Dhuhaibawi N, Hayden JC. A systematic review and pooled prevalence of burnout in pharmacists. Int J Clin Pharm. 2023;45(5):1027–36. https://doi.org/10.1007/s11096-022-01520-6
40. Caamaño F, Tomé-Otero M, Takkouche B. Factors associated with the pharmacist counselling without dispensing. Pharmacoepidemiol Drug Saf. 2006;15(6):428–31. https://doi.org/10.1002/pds.1240
41. Bhattarai B, Walpola R, Khan S, Mey A. Factors associated with medication adherence among people living with COPD: pharmacists' perspectives. Explor Res Clin Soc Pharm. 2021;3:100049. https://doi.org/10.1016/j.rcsop.2021.100049
42. Mehralian G, Yousefi N, Hashemian F, Maleksabet H, Knowledge. Attitude and practice of pharmacists regarding dietary supplements: A community Pharmacy- based survey in Tehran. Iran J Pharm Res Fall. 2014;13(4):1457–65.
43. Fatema K, Hossain S, Natasha K, et al. Knowledge attitude and practice regarding diabetes mellitus among nondiabetic and diabetic study participants in Bangladesh. BMC Public Health. 2017;26(1):364. https://doi.org/10.1186/s12889-017-4285-9
44. Rahaman KS, Majdzadeh R, Holakouie Naieni K, Raza O, Knowledge. Attitude and practices (KAP) regarding chronic complications of diabetes among patients with type 2 diabetes in Dhaka. Int J Endocrinol Metab. 2017;15(3):e12555. https://doi.org/10.5812/ijem.12555
45. Alnobani O, Zakaria N, Temsah MH, Jamal AA, Alkamel N, Tharkar S. Knowledge, attitude, and perception of health care personnel working in intensive care units of mass gatherings toward the application of telemedicine robotic Remote-Presence technology: A Cross-Sectional multicenter study. Telemed J E Health. 2021;27(12):1423–32. https://doi.org/10.1089/tmj.2020.0469

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