Society of Medical Education & Research

2024, Volume , Issue 4, Page No: 95-107
ISSN: 3108-4850

Annals of Pharmacy Education, Safety, and Public Health Advocacy

Educational Background and Clinical Pharmacy Workload among Clinical Pharmacists in Chinese Tertiary Hospitals: A Nationwide Survey

Moses K. Otieno[1]*, Grace A. Njeri[1], Samuel P. Mwangi[1]

[1]Department of Pharmacy Practice and Public Health, School of Pharmacy, University of Nairobi, Nairobi, Kenya.

***E-mail** ✉ moses.otieno@outlook.com

Abstract

The workload borne by healthcare professionals can influence the standard of medical care. Practical evidence suggests that providers experience varying levels of workload depending on differences in education and training. Clinical pharmacists constitute a vital component of multidisciplinary medical teams. In China, clinical pharmacists commonly face imbalanced clinical pharmacy workloads; however, how workload relates to differences in their educational backgrounds has not been clearly defined. This study sought to examine the association between educational background and clinical pharmacy workload among clinical pharmacists in China. Data on educational background and clinical pharmacy workload were collected through an on-site questionnaire survey based on stratified sampling, using a self-designed survey instrument. Ordinary least squares regression analysis was applied to assess the relationship between participants' educational background and their clinical pharmacy workload. In total, 625 clinical pharmacists from 311 tertiary hospitals across China were included. Two educational categories—less than a bachelor's degree in general pharmacy and a doctoral degree in clinical pharmacy—showed significant associations with participants' clinical pharmacy workload. Those who had completed national-level or provincial-level specialized clinical pharmacist training undertook heavier workloads compared with those without such credentials. In addition, specialization areas, including respiratory medicine and nephrology, were also associated with differences in clinical pharmacy workload. Strengthening specific aspects of education and training for clinical pharmacists in tertiary hospitals in China may enhance their capacity to deliver clinical pharmacy services. Further efforts are required to optimize and完善 the education and training framework for clinical pharmacists in China.

Keywords: Education background, Workload, Clinical pharmacist, China

Introduction

The workload experienced by healthcare professionals is closely linked to medical outcomes [1]. Excessive workload can generate occupational stress by affecting both work performance and quality of life [2], ultimately impacting the quality of healthcare delivery [3]. Clinical pharmacists play an essential role within medical teams [4]. Their duties encompass involvement in clinical decision-making, documentation of medication-related information, teaching, conducting research, and continuous professional development, among others [5]. The clinical workload of pharmacists is commonly reflected by the coverage rateFootnote1 and the breadth of their clinical responsibilities [6].

Pharmacy education enhances the knowledge base and skill set of clinical pharmacists [7–9], thereby influencing their professional competence [10, 11]. Competency-oriented training models have been shown to help increase the effective workload of healthcare providers [12, 13]. Consequently, educational background may represent a key determinant of clinical pharmacists' workload. Given that pharmaceutical care practices differ

Access this article online https://smerpub.com/

Received: 21 October 2023; **Accepted:** 05 February 2024

How to cite this article: Otieno MK, Njeri GA, Mwangi SP. Educational Background and Clinical Pharmacy Workload among Clinical Pharmacists in Chinese Tertiary Hospitals: A Nationwide Survey. Ann Pharm Educ Saf Public Health Advocacy. 2024;4:95-107. https://doi.org/10.51847/GRvQqIKOfr

across countries [13], national contexts require tailored educational content and expertise. In developed settings, consultation-based prescribing skills improve pharmacists' efficiency [14, 15]. In contrast, pharmacists in developing countries tend to rely more heavily on drug-centered knowledge [16], although those with higher levels of education typically engage in a broader scope of clinical activities [17].

Delays in pharmacy education development can constrain the overall advancement of clinical pharmacy [18]. In China, clinical pharmacists are required to hold at least a bachelor's degree in pharmacy or clinical pharmacy and to complete standardized training [19]. The Chinese clinical pharmacist workforce includes individuals with a wide range of educational levels—from below bachelor's degree to doctoral degree—and diverse academic backgrounds, such as pharmacy, clinical pharmacy, medicine, pharmacy-related disciplines (e.g., pharmacology, nursing, medical English), as well as non-pharmacy fields [20]. Identifying workload differences among clinical pharmacists with varied educational backgrounds may therefore provide valuable insights into future training priorities in China.

Regulations defining the roles and requirements of clinical pharmacists in China remain insufficiently clear. On one hand, the lack of explicit role definitions results in considerable variability in pharmacists' daily work [21]. Many clinical pharmacists face heavy dispensing workloads [22–24] and lack sufficient capacity to participate fully in clinical treatment [25, 26]. On the other hand, the development of clinical pharmaceutical care programs in China has been uneven and incomplete [6], highlighting the need for greater standardization of clinical pharmacists' work. Hospital pharmacists in China are responsible for a wide array of tasks, including drug administration and dispensing, clinical pharmacotherapy, and patient education related to medication use. In recent years, the professional role of hospital pharmacists has been shifting from a focus on drug management toward pharmaceutical care [27, 28]. Improving the quality of pharmaceutical care and cultivating well-trained pharmacy professionals have become central concerns in Chinese pharmacy education [29].

Formal education in clinical pharmacy began relatively late in China, and the educational system has yet to be fully unified [18, 30]. Currently, a national standard exists only for undergraduate clinical pharmacy education (5 years, Bachelor of Science) [31]. Academic degrees, curricula, competencies, and practical training requirements differ substantially among pharmacy, medicine, and clinical pharmacy programs, resulting in marked variation in the knowledge and skills of graduates. Consequently, many clinical pharmacists in China are not yet adequately prepared to assume full clinical pharmacy responsibilities [32–34].

Studies have shown that education and training influence the quality of clinical pharmaceutical care delivery [35]; however, much of this evidence is now outdated. In addition, prior research has demonstrated that the breadth of clinical pharmaceutical care is related to the educational background of pharmacy department directors [36], yet the population examined in that study did not include clinical pharmacists. Another investigation concluded that clinical pharmacy education serves as an important driver for pharmacists to provide pharmaceutical care [37], but this conclusion was limited to theoretical discussion. To date, no empirical study has examined the association between the educational background of clinical pharmacists and their clinical pharmacy workload in China.

The present study aimed to evaluate the relationship between clinical pharmacists' educational background and their clinical pharmacy workload through an empirical survey conducted in tertiary hospitals in China. The results are intended to inform education authorities and medical colleges regarding training orientation and curriculum development for clinical pharmacists in China, and may also provide insights applicable to other developing or underdeveloped countries.

Materials and Methods

Study design and participants

China's healthcare system is organized in a three-tier hierarchical framework. This study focused exclusively on clinical pharmacists working in tertiary hospitals, as clinical pharmacy services remain underdeveloped in most primary and secondary healthcare institutions [38, 39].

The inclusion criteria were: (1) employment as a full-time clinical pharmacist in one of the sampled hospitals; (2) responsibility for defined tasks involving pharmaceutical management, patient care, or medical information; (3) availability to complete the questionnaire, which required approximately 15–30 minutes; and (4) willingness to provide written

informed consent. Clinical pharmacists undergoing training (such as interns or clerks) and visiting clinical pharmacists were excluded from participation.

A stratified sampling approach was implemented. First, all 31 provincial-level administrative regions in mainland China (including provinces, autonomous regions, and municipalities) were included. Subsequently, cities within each provincial administrative region were evenly categorized into three groups based on their 2018 per capita gross domestic product, yielding a total of 93 groups. One city or district from each group was randomly selected using a random number method, resulting in 93 selected cities or districts. Within each selected city or district, 2–4 tertiary hospitals were chosen by convenience sampling, subject to approval from hospital administrators. In each participating hospital, two clinical pharmacists were recommended by the administrator(s) or by another respondent who had completed the questionnaire [40]. In total, 744 questionnaires were distributed.

Instrument

The questionnaire was developed in consultation with an expert panel consisting of two administrators and two teaching clinical pharmacists from tertiary hospitals, along with three university-based experts in clinical pharmacy education. The finalized questionnaire included three sections:

Covariates

Information on sociodemographic characteristics (gender, age, marital status), professional title, years of practice, specialized field, and hospital characteristics was collected.

Education background

The training framework for clinical pharmacists in China comprises three components: formal medical and pharmaceutical education, standardized base training, and individualized training programs offered by training or academic institutions [41]. Accordingly, this study assessed pharmacists' educational background using three indicators: highest educational attainment, practice qualifications, and training experience.

Regarding higher education, respondents were asked whether they had obtained a degree at a specific educational level and the type of degree held. Given the wide diversity of degree types among clinical pharmacists [20], this item was designed as a fill-in-the-blank question based on expert recommendations. Degree types were subsequently classified into seven categories according to guidance from the expert panel: (general) pharmacy, clinical pharmacy, Chinese materia medica, other pharmacy specialties (excluding the preceding three), clinical medicine, other medical specialties (excluding clinical medicine), and other specialties (excluding the prior six).

Practice qualifications included completion of national-level or provincial-level standardized training in either specialized or general practice. Training experience encompassed certification of clinical pharmacist training issued by the Ministry of Health, advanced clinical pharmacist training certificates, certification as training faculty for clinical pharmacists from the National Health and Family Planning Commission, any overseas clinical pharmacist training, and other forms of training not listed above.

Workload

At present, no validated tool is available for assessing the workload of clinical pharmacists working in tertiary hospitals in China [42, 43]. Consequently, this study operationalized workload based on the breadth of clinical pharmacy activities actually performed. The Standards of Practice for Clinical Pharmacists (SPCP), originally developed in English, was translated independently by two translators: a native English speaker proficient in Chinese and a Chinese translator experienced in Chinese–English translation. These two versions were subsequently compared, merged, and revised through iterative discussion between the translators and an expert panel until full agreement was reached. Drawing on the finalized SPCP translation and the Provisions on the Administration of Pharmaceutical Affairs of Medical Institutions, the final workload assessment scale was constructed.

Twelve items representing core routine responsibilities of clinical pharmacists in Chinese tertiary hospitals were selected to quantify the extent of clinical pharmacy services delivered. Each item was presented as a complete task description and asked in the form, "Have you ever undertaken the task?", with responses recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The cumulative score across all items was used as the dependent variable in regression analyses.

Pretest

Prior to formal data collection, the questionnaire was pilot-tested in April 2019 among 47 clinical pharmacists from 24 tertiary hospitals located in six cities in Jiangsu Province, China, using convenience sampling. The internal consistency of the workload scale was acceptable, with a Cronbach's alpha of 0.63.

Data collection

Forty-six undergraduate students majoring in either general pharmacy or clinical pharmacy were recruited as survey investigators. All investigators received standardized training to ensure proficiency in participant recruitment, survey administration procedures, and consistent clarification of participant questions. During July and August 2019, investigators worked in pairs, with each pair assigned to a cluster of geographically adjacent cities or districts.

Following approval from hospital administrators, investigators screened potential respondents by collecting basic information to confirm eligibility. Eligible clinical pharmacists were then informed in detail about the aims, contents, and requirements of the study, after which their willingness to participate was reconfirmed. Participants who consented signed informed consent forms and jointly scheduled an appropriate time and quiet location for the survey.

Investigators conducted structured face-to-face interviews, verbally presenting each questionnaire item and entering responses into an online survey platform using mobile phones or tablet computers, which automatically generated electronic datasets. Investigators were strictly prohibited from expressing personal opinions regarding questionnaire items and were limited to providing standardized instructions only. The online system incorporated response-format restrictions to improve data integrity. In addition, five postgraduate students were recruited and trained to review submitted questionnaires in real time; questionnaires containing entry errors or corrupted data were promptly returned for correction through follow-up visits when feasible [40].

Data analysis

Sample characteristics were summarized using descriptive statistical methods. Ordinary least squares regression analysis was employed to examine the relationships between independent variables and clinical pharmacy workload. Multicollinearity was evaluated using variance inflation factors (VIF). Independent variables with VIF values exceeding 10 were considered to exhibit collinearity and were removed sequentially. VIFs were recalculated after each removal until no remaining variable exceeded the threshold. Statistical significance was assessed at three predefined levels: $p < 0.1$, $p < 0.05$, and $p < 0.01$ [40].

To assess the stability of the findings, clinical pharmacists' job satisfaction was added to the regression model as an additional covariate. Consistency between models with and without this variable was interpreted as evidence of robustness. All analyses were performed using Stata version 15.0.

Results and Discussion

A total of 744 questionnaires were distributed across 311 tertiary hospitals nationwide, of which 625 were completed in full, corresponding to a response rate of 84%. The remaining 119 questionnaires were excluded due to non-collection, failure to upload to the survey system, incomplete responses, or damaged data files. Participant characteristics are presented in **Table 1**.

The average age of respondents was 35.06 years (SD = 6.44), and the mean duration of clinical pharmacy practice was 9.3 years (SD = 6.62). Females accounted for approximately two-thirds of the sample (65.6%), and most participants were married (85.1%). The mean score for clinical pharmacy workload was 44.33 (SD = 4.65). The majority of respondents held junior (30.6%) or intermediate (56.0%) professional titles, and most were employed in general hospitals (75.5%).

Table 1 Sociodemographic Data of Clinical Pharmacists (N = 625)

a Because some clinical pharmacists reported involvement in two or more specialty areas, percentages for this item do not sum to 100%.

The participants' academic qualifications are summarized in **Table 2**. The majority of respondents held a bachelor's degree (53.4%) or a master's degree (39.5%). Among those with bachelor's degrees, nearly half studied pharmacy (47.4%), while a smaller portion specialized in clinical pharmacy (20.2%). In contrast, among master's degree holders, a significant fraction focused on other pharmacy disciplines (21.1%), such as pharmacology and pharmaceutical analysis.

Table 2. Education background of clinical pharmacists

Characteristic	N (%)
Age (mean ± SD)	35.06 ± 6.4
Years of professional experience (mean ± SD)	9.3 ± 6.6
Score for completion of clinical pharmacy tasks (mean ± SD)	44.33 ± 6.5
Gender	
Male	215 (34.4)
Female	410 (65.6)
Marital status	
Single	89 (14.2)
Married	532 (85.1)
Other (divorced, widowed, etc.)	4 (0.6)
Professional title	
Junior level	191 (30.6)
Intermediate level	350 (56.0)
Associate senior level	72 (11.5)
Senior level	12 (1.9)
Hospital type	
General hospital	472 (75.5)
Specialized hospital	33 (5.3)
Traditional Chinese medicine hospital	82 (11.5)
Other	38 (6.1)
Primary clinical specialty[1]	
Anti-infective therapy	148 (23.7)
Cardiology	102 (16.3)
Respiratory medicine	89 (14.2)
Gastroenterology	83 (13.3)
Nephrology	32 (5.1)
Oncology	61 (9.8)
Organ transplantation	8 (1.3)
Intensive care unit (ICU)	39 (6.2)
Endocrinology	48 (7.7)
Neurology	43 (6.9)
Other specialties	133 (21.3)

^aCertain clinical pharmacists practice in multiple specialties simultaneously; therefore, the total percentage for this category exceeds 100%.

The educational qualifications of the respondents are presented in **Table 2**. The majority held a bachelor's degree (53.4%) or a master's degree (39.5%) as their highest level of education. Among those with a bachelor's degree, the most common majors were pharmacy (47.4%) followed by clinical pharmacy (20.2%). For participants with a master's degree, a substantial portion specialized in other pharmacy-related fields (21.1%), including areas such as pharmacology and pharmaceutical analysis.

Table 2. Educational background of clinical pharmacists

Characteristic	N (%)
Highest level of education	
Below bachelor's degree	33 (5.3)
Bachelor's degree	334 (53.4)
Master's degree	247 (39.5)
Doctoral degree	11 (1.8)
Professional practice qualifications	
National-level specialized training	253 (40.5)
National-level general training	128 (20.5)
Provincial-level specialized training	130 (20.8)
Provincial-level general training	97 (15.5)
Training credentials	
Completion certificate for clinical pharmacist training (Ministry of Health)	334 (53.4)
Advanced clinical pharmacist training certificate	190 (30.4)
Training faculty certificate for clinical pharmacists (National Health and Family Planning Commission)	149 (23.8)
Overseas clinical pharmacist training	16 (2.6)
Other training experiences	88 (14.1)
Major field for degrees below bachelor's level	
No degree	570 (91.2)
Pharmacy	31 (5.0)
Clinical pharmacy	7 (1.1)
Chinese materia medica	4 (0.6)
Other pharmacy-related fields	3 (0.5)
Clinical medicine	0 (0.0)
Other medical specialties	0 (0.0)
Other majors	10 (1.6)
Major field for bachelor's degree	
No bachelor's degree	75 (12.0)
Pharmacy	296 (47.4)
Clinical pharmacy	126 (20.2)
Chinese materia medica	26 (4.2)
Other pharmacy-related fields	70 (11.2)
Clinical medicine	24 (3.8)
Other medical specialties	3 (0.5)
Other majors	5 (0.8)
Major field for master's degree	
No master's degree	367 (58.7)
Pharmacy	53 (8.5)
Clinical pharmacy	49 (7.8)
Chinese materia medica	19 (3.0)

Other pharmacy-related fields	132 (21.1)
Clinical medicine	4 (0.6)
Other medical specialties	1 (0.2)
Other majors	0 (0.0)
Major field for doctoral degree	
No doctoral degree	614 (98.2)
Pharmacy	1 (0.2)
Clinical pharmacy	4 (0.6)
Chinese materia medica	0 (0.0)
Other pharmacy-related fields	6 (1.0)
Clinical medicine	0 (0.0)
Other medical specialties	0 (0.0)
Other majors	0 (0.0)

^bNote: Some respondents possess both bachelor's and master's degrees, while others reported only their highest degree. As a result, the figures for highest education level differ from the detailed breakdowns by specific degree in the table.

Regarding professional qualifications, the proportions of participants who had completed national-level specialized training, national-level general training, provincial-level specialized training, and provincial-level general training were 40.5%, 20.5%, 20.8%, and 15.5%, respectively. Additionally, 17.4% of respondents did not hold any of these qualifications.

In terms of training credentials, the largest group (53.4%) possessed a completion certificate for clinical pharmacist training issued by the Ministry of Health. Others held an advanced clinical pharmacist training certificate (30.4%) or a training faculty certificate from the National Health and Family Planning Commission (23.8%).

Findings from the regression analysis are shown in **Table 3**. For respondents whose highest education was below bachelor's level, individuals majoring in general pharmacy (coef. = −2.39, p = 0.09, 95% CI = [−5.11, 0.33]) and Chinese materia medica (coef. = −3.53, p = 0.39, 95% CI = [−11.64, 4.58]) exhibited lower clinical pharmacy workload scores, while those in other specialties (coef. = 5.40, p = 0.01, 95% CI = [1.35, 9.45]) showed significantly higher scores. Among bachelor's degree holders, majors in clinical pharmacy (coef. = 1.18, p = 0.30, 95% CI = [−1.04, 3.41]) and other fields (coef. = 1.25, p = 0.62, 95% CI = [−3.67, 6.16]) were associated with higher workload scores, whereas clinical medicine majors (coef. = −0.23, p = 0.85, 95% CI = [−2.60, 2.14]) had slightly lower scores. For master's degree holders, specialties in Chinese materia medica (coef. = 1.96, p = 0.39, 95% CI = [−2.52, 6.44]) and clinical medicine (coef. = 1.30, p = 0.39, 95% CI = [−1.69, 4.30]) corresponded to higher scores, in contrast to other medical specialties (coef. = −8.61, p = 0.16, 95% CI = [−20.61, 3.39]), which were linked to lower scores. Finally, among doctoral degree recipients, those specialized in clinical pharmacy (coef. = 7.30, p = 0.00, 95% CI = [2.73, 11.87]) achieved the highest clinical pharmacy workload scores.

Table 3. Regression results

Variable	Robustness Test			Original Research		
	Coef.	p-value	95% CI	Coef.	p-value	95% CI
Majors below bachelor's degree (ref = none)						
Pharmacy	−2.34	0.08*	[−4.98, 0.30]	−2.39	0.09*	[−5.11, 0.33]
Clinical pharmacy	−1.41	0.47	[−5.26, 2.44]	−0.23	0.90	[−3.99, 3.52]
Chinese materia medica	−3.15	0.53	[−12.56, 6.27]	−3.53	0.39	[−11.64, 4.58]
Other pharmacy	−0.64	0.84	[−6.77, 5.50]	−0.58	0.88	[−7.91, 6.75]

Clinical medicine	–	–	–	–	–	–
Other medical specialties	–	–	–	–	–	–
Other	4.46	0.03**	[0.41, 8.51]	5.40	0.01***	[1.35, 9.45]
Bachelor's degree majors (ref = none)						
Pharmacy	0.66	0.49	[−1.21, 2.54]	0.93	0.32	[−0.91, 2.77]
Clinical pharmacy	1.13	0.32	[−1.11, 3.37]	1.18	0.30	[−1.04, 3.41]
Chinese materia medica	0.32	0.89	[−4.06, 4.70]	0.16	0.95	[−5.57, 4.89]
Other pharmacy	0.08	0.94	[−2.32, 2.40]	−0.08	0.95	[−2.36, 2.20]
Clinical medicine	−0.09	0.94	[−2.51, 2.33]	−0.23	0.85	[−2.60, 2.14]
Other medical specialties	−0.08	0.99	[−9.7, 9.55]	0.55	0.93	[−11.31, 12.41]
Other	1.68	0.46	[−2.77, 6.13]	1.35	0.62	[−3.67, 6.16]
Master's degree majors (ref = none)						
Pharmacy	−1.14	0.16	[−2.76, 0.47]	−1.10	0.17	[−2.69, 0.48]
Clinical pharmacy	0.31	0.74	[−1.55, 2.17]	0.45	0.67	[−1.59, 2.49]
Chinese materia medica	1.70	0.42	[−2.47, 5.87]	1.96	0.39	[−2.52, 6.44]
Other pharmacy	0.16	0.82	[−1.28, 1.60]	0.38	0.61	[−1.10, 1.87]
Clinical medicine	1.59	0.23	[−0.98, 4.16]	1.30	0.39	[−1.69, 4.30]
Other medical specialties	−6.82	0.17	[−16.58, 2.95]	−8.61	0.16	[−20.61, 3.39]
Other	–	–	–	–	–	–
Doctoral degree majors (ref = none)						
Pharmacy	1.98	0.31	[−1.82, 5.78]	1.17	0.54	[−2.57, 4.91]
Clinical pharmacy	6.30	0.00***	[2.09, 10.51]	7.30	0.00***	[2.73, 11.87]
Chinese materia medica	–	–	–	–	–	–
Other pharmacy	2.35	0.48	[−4.19, 8.90]	1.95	0.57	[−4.83, 8.72]
Clinical medicine	–	–	–	–	–	–
Other medical specialties	–	–	–	–	–	–
Other	–	–	–	–	–	–
Practice qualifications (ref = not obtained)						
National-level specialized training	2.56	0.00***	[1.25, 3.87]	2.42	0.00***	[1.04, 3.80]
National-level general training	0.34	0.62	[−1.01, 1.69]	0.35	0.63	[−1.08, 1.78]
Provincial-level specialized training	1.33	0.04*	[0.06, 2.60]	1.19	0.09*	[−0.17, 2.54]
Provincial-level general training	1.24	0.10	[−0.26, 2.74]	0.84	0.29	[−0.72, 2.39]
Training credentials (ref = not acquired)						
Completion certificate (Ministry of Health)	−0.27	0.72	[−1.75, 1.21]	0.03	0.96	[−1.51, 1.58]
Advanced clinical pharmacist certificate	−0.38	0.62	[−1.89, 1.12]	−0.24	0.77	[−1.80, 1.33]
Training faculty certificate (NHFPC)	0.19	0.79	[−1.25, 1.64]	0.64	0.41	[−0.89, 2.16]
Overseas clinical pharmacist training	1.29	0.48	[−2.27, 4.85]	1.67	0.34	[−1.80, 5.14]
Other training	−1.12	0.28	[−3.16, 0.92]	−0.87	0.42	[−3.01, 1.26]
Gender (ref = male)						
Female	−0.34	0.53	[−1.41, 0.73]	−0.35	0.54	[−1.45, 0.75]
Age	−0.03	0.66	[−0.17, 0.10]	−0.04	0.60	[−0.18, 0.10]
Marital status (ref = unmarried)						
Married	−0.33	0.67	[−1.83, 1.17]	−0.27	0.74	[−1.86, 1.33]
Other (divorced, widowed, etc.)	−0.21	0.95	[−6.64, 6.21]	−1.00	0.78	[−8.12, 6.11]
Years of professional experience	0.02	0.80	[−0.1, 0.13]	0.04	0.56	[−0.09, 0.16]

Professional title (ref = junior)						
Intermediate	0.48	0.48	[−0.85, 1.81]	0.35	0.61	[−1.00, 1.70]
Associate senior	1.28	0.20	[−0.68, 3.25]	1.03	0.32	[−0.99, 3.05]
Senior	1.03	0.68	[−3.83, 5.88]	0.47	0.84	[−4.25, 5.20]
Clinical specialty (ref = not engaged)						
Anti-infectives	0.77	0.23	[−0.50, 2.03]	0.85	0.20	[−0.45, 2.15]
Cardiology	−0.17	0.82	[−1.69, 1.34]	−0.01	0.99	[−1.57, 1.56]
Respiratory medicine	1.37	0.06*	[−0.06, 2.81]	1.63	0.04**	[0.08, 3.17]
Gastroenterology	0.87	0.27	[−0.68, 2.42]	1.35	0.10*	[−0.24, 2.94]
Nephrology	3.30	0.00***	[1.59, 5.01]	3.10	0.00***	[1.13, 5.07]
Oncology	0.15	0.84	[−1.37, 1.68]	0.16	0.84	[−1.4, 1.72]
Organ transplantation	−1.4	0.52	[−5.67, 2.88]	−1.86	0.33	[−5.57, 1.85]
ICU	0.92	0.30	[−0.84, 2.68]	0.77	0.39	[−0.97, 2.50]
Endocrinology	0.33	0.74	[−1.59, 2.25]	−0.15	0.88	[−2.12, 1.82]
Neurology	1.08	0.23	[−0.70, 2.87]	1.12	0.25	[−0.80, 3.03]
Other	0.01	0.99	[−1.58, 1.60]	0.58	0.47	[−0.99, 2.16]
Hospital type (ref = general hospital)						
Specialized hospital	−1.48	0.32	[−4.43, 1.46]	−1.90	0.22	[−4.93, 1.13]
Traditional Chinese medicine hospital	−0.69	0.32	[−2.03, 0.66]	−0.52	0.45	[−1.88, 0.84]
Other	−0.69	0.32	[−2.03, 0.66]	−1.19	0.45	[−4.67, 2.29]
Constant	45.62	0.00***	[41.16, 50.08]	43.10	0.00***	[38.47, 47.72]
Job satisfaction: "I am satisfied with my job" (ref = agree)						
Somewhat agree	−2.95	0.00***	[−3.97, −1.92]			
Somewhat disagree	−5.93	0.00***	[−8.82, −3.05]			
Disagree	1.17	0.64	[−3.73, 6.08]			

1. *p < .1, **p < .05, **p < .01

Participants with national-level specialized training (coef. = 2.42, p = 0.00, 95%CI = [1.04, 3.80]) or provincial-level specialized training (coef. = 1.19, p = 0.09, 95%CI = [−0.17, 2.54]) reported higher clinical pharmacy workload scores than those with national-level general training (coef. = 0.35, p = 0.63, 95%CI = [−1.08, 1.78]) or provincial-level general training (coef. = 0.84, p = 0.29, 95%CI = [−0.72, 2.39]). Additionally, respondents who had participated in overseas training programs tended to have elevated workload scores (coef. = 1.67, p = 0.34, 95%CI = [−1.80, 5.14]).

This study examined how the educational backgrounds of clinical pharmacists in tertiary hospitals in China relate to their clinical pharmacy workload. The demographic and professional characteristics of the sample—such as gender, age, and technical titles—closely resemble those reported in a national survey of Chinese clinical pharmacists [20], suggesting that the sample is reasonably representative. Findings showed that clinical pharmacists with less than a bachelor's degree in general pharmacy, those holding doctoral degrees in clinical pharmacy, participants who completed national-level or provincial-level specialized training, and those working in specific specialized fields like respiratory medicine or nephrology, exhibited a significant association with clinical workload.

Clinical pharmacists with doctoral degrees in clinical pharmacy demonstrated the highest levels of workload completion. This aligns with prior research on pharmacy technicians [44], likely because higher educational attainment is indicative of greater professional expertise, with doctoral-level pharmacists possessing more advanced knowledge and clinical experience. Compared to doctoral degrees in other pharmacy-related fields, clinical pharmacy training is more closely tailored to the responsibilities expected of clinical pharmacists. These results support the notion that doctoral-level clinical pharmacists are better aligned with the role of tertiary hospitals in managing complex and critical cases, and

may provide guidance for shaping the educational trajectory of clinical pharmacists in China.

Interestingly, the regression findings for clinical pharmacists with less than a bachelor's degree appear counterintuitive. This can be attributed to extensive clinical experience rather than formal education. Although a bachelor's degree or higher has been required for clinical pharmacists in China since 2011, some in-service pharmacists with lower formal qualifications were allowed to continue practicing after completing standardized training. As a result, a subset of these pharmacists, despite having substandard educational credentials, possess rich practical experience and are capable of performing clinical pharmacy duties effectively.

Participants who completed national-level or provincial-level specialized training achieved significantly higher clinical workload scores than those who received general training. This indicates that specialized training addresses practical needs more effectively and enhances professional competence [22]. The distinction likely lies in content and delivery: specialized training is highly subject-focused and provides in-depth knowledge relevant to tertiary hospital settings, whereas general training covers a broad range of pharmaceutical care topics but lacks specialization. Consequently, general training may be more suitable for clinical pharmacists in primary or secondary healthcare institutions, whereas specialized training better equips pharmacists for high-complexity care in tertiary hospitals. Specialized training thus serves as a critical link between academic education and clinical practice, enabling pharmacists to apply theoretical knowledge effectively and potentially improving clinical pharmacy workload.

Although the objectives of clinical pharmacy education align with the responsibilities of clinical pharmacists, the results showed that for participants with bachelor's or master's degrees, majoring in clinical pharmacy did not significantly correlate with clinical pharmacy workload. This may reflect the focus of undergraduate clinical pharmacy education in China on theoretical knowledge rather than practical skills [45], following a drug-centered curriculum [46], which limits students' competence in clinical treatment. Graduate-level education in clinical pharmacy emphasizes research over hands-on clinical skills or patient-centered pharmaceutical care [47], reducing students' preparedness for direct clinical responsibilities. Therefore, it is recommended to strengthen training in drug therapy and patient management skills to enhance practical competency. Drawing on international examples, such as curricula in the United States that integrate professional knowledge, technical skills, attitudes, and values [48], could help cultivate clinical pharmacists who are both skilled and service-oriented, addressing the needs of clinical pharmaceutical care in China.

Diverse professional training backgrounds characterize the clinical pharmacist workforce in China, a phenomenon likely stemming from challenges within the field, including shortages of clinical pharmacy professionals [49, 50] and the need for rapid integration into multidisciplinary clinical teams [51]. A key issue is the substantial variation in knowledge bases across different academic majors [52]. For instance, medical graduates generally lack sufficient drug-related knowledge, while pharmacy graduates outside clinical pharmacy lack practical clinical skills. Deficiencies in either pharmacological knowledge or clinical competencies hinder effective participation in clinical pharmacy activities. Consequently, ongoing in-service and continuing education programs for clinical pharmacists should place greater emphasis on enhancing both clinical knowledge and practical skills.

Clinical pharmacists specializing in respiratory medicine and nephrology reported higher clinical pharmacy workloads, whereas those in organ transplantation experienced lower workloads. This difference may be explained by the relative frequency and predictability of clinical cases in respiratory medicine and nephrology, which allows pharmacists to apply their skills more effectively. In contrast, patient conditions in organ transplantation are highly individualized and complex, making clinical pharmaceutical care and medication management more demanding and challenging. Regression results indicate that increasing the duration and intensity of training for fields such as organ transplantation, endocrinology, and cardiology could be beneficial.

Several limitations of this study should be noted. First, the use of convenience sampling within the stratified sampling framework may introduce some selection bias; however, the sample's demographic characteristics closely resemble those of clinical pharmacists in tertiary hospitals reported in prior research. Second, the SPCP was originally written in English and translated into Chinese for this study. While the translated instrument demonstrated acceptable reliability within this sample,

potential limitations remain regarding its application until further validated in larger samples.

Conclusion

This nationwide survey examined the relationship between clinical pharmacists' educational backgrounds and their clinical pharmacy workload in tertiary hospitals across China. The findings indicate that having less than a bachelor's degree in general pharmacy, holding a doctoral degree in clinical pharmacy, completing national-level or provincial-level specialized training, and working in specific fields such as respiratory medicine and nephrology are all significantly associated with clinical pharmacy workload. These insights can inform policymakers, higher education institutions, clinical pharmacist training programs, and hospital administrators in improving clinical pharmacy education and workforce development in China and potentially in other developing countries.

Acknowledgments: The authors thank the expert panel for valuable advice related to study design and the pharmacists who participated in the survey. This paper would not be accomplished without their efforts.

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

References

1. Han M, Zhang XP. Impact of medical professionals on Carbapenem-resistant Pseudomonas aeruginosa: moderating effect of workload based on the panel data in China. BMC Health Serv Res. 2020;20(1):1–8.
2. Gidman WK, Hassell K, Day J, Payne K. The impact of increasing workloads and role expansion on female community pharmacists in the United Kingdom. Res Soc Adm Pharm. 2007;3(3):285–302. https://doi.org/10.1016/j.sapharm.2006.10.003.
3. Elliott DJ, Young RS, Brice J, Aguiar R, Kolm P. Effect of hospitalist workload on the quality and efficiency of care. JAMA Intern Med. 2014;174(5):786–93. https://doi.org/10.1001/jamainternmed.2014.300.
4. Pharm ACC. The definition of clinical pharmacy. Pharmacotherapy. 2008;28(6):816–7.
5. American College of Clinical P. Standards of practice for clinical pharmacists. Pharmacotherapy. 2014;34(8):794–7. https://doi.org/10.1002/phar.1438.
6. Li C, Xiao-yu X, Dong-ning Y, Yuan-kai H, Yi-tao W, Wen-bing Y. National Survey on clinical pharmacy Services of Tertiary Hospitals in China: part 3. Status quo of clinical pharmacy service provision. Chin Pharm J. 2018;53(10):837–42. https://doi.org/10.11669/cpj.2018.10.016.
7. Al Khalidi D, Wazaify M. Assessment of pharmacists' job satisfaction and job related stress in Amman. Int J Clin Pharm. 2013;35(5):821–8. https://doi.org/10.1007/s11096-013-9815-7.
8. Saseen JJ, Ripley TL, Bondi D, et al. ACCP clinical pharmacist competencies. Pharmacotherapy. 2017;37(5):630–6. https://doi.org/10.1002/phar.1923.
9. Jin-liang Z, Jiu-xing Y, Xiu-yao Z, Xue-hui Z, Jun Z, Fei Y. Investigations on the work content and quality ability of clinical pharmacists. J Shenyang Pharm Univ. 2014;31(11):917–21. https://doi.org/10.14066/j.cnki.cn21-1349/r.2014.11.014.
10. Nasution A, SS SA, Shafie AA. Pharmacists' perception of their role and assessment of clinical pharmacyeducation toimprove clinical pharmacy services in indonesian hospitals. Int J Pharm Pharm Sci. 2014;6(11):177–80.
11. Xu C, Nai-tong Z, Ming H. Current situation and suggestions for clinical pharmacy undergraduate education in China. China Pharm. 2015;26(06):858–61.
12. Hong-mei Y, Huanlong Q, Ji Z. Practice of training model of medical talents based on competency model. Chin Health Qual Manag. 2019;26(05):125–127+135. https://doi.org/10.13912/j.cnki.chqm.2019.26.5.35.
13. Hughes CM, Hawwa AF, Scullin C, et al. Provision of pharmaceutical care by community pharmacists: a comparison across Europe. Pharm World Sci. 2010;32(4):472–87. https://doi.org/10.1007/s11096-010-9393-x.
14. George J, Cleland J, Bond CM, et al. Views of pharmacists and mentors on experiential learning for

pharmacist supplementary prescribing trainees. Pharm World Sci. 2008;30(3):265–71. https://doi.org/10.1007/s11096-007-9172-5.
15. Ebied M, Chan V. Multidisciplinary professional roles addressing needs in multiple myeloma: an innovative 'Virtual' pharmacist surveillance clinic. Semin Oncol Nurs. 2021;37(4):151173. https://doi.org/10.1016/j.soncn.2021.151173.
16. Lin H-W, Yang L-C, Mafruhah OR, Nguyen HTH, Cao TTB, Yam FK. Evolution of clinical pharmacy practice and pharmacy education in Taiwan, Vietnam, and Indonesia: A narrative review. J Am Coll Clin Pharm. 2020;3(5):947–58. https://doi.org/10.1002/jac5.1258.
17. Yingying Z, Bohua C, Yan Y. Investigation of the development of clinical pharmacy in nine hospitals of Nantong Jiangsu. Chin J Mod Appl Pharm. 2019;36(22):2832–8. https://doi.org/10.13748/j.cnki.issn1007-7693.2019.22.017.
18. Jian Q, Gao-feng L, Zhu Z. Construction and development of hospital pharmacy in China (III). Chin Hosp Pharm J. 2014;34(17):1423–33. https://doi.org/10.13286/j.cnki.chinhosppharmacyj.2014.17.01.
19. Provisions on pharmaceutical administration in medical institutions. China Lic Pharm. 2011;8(03):41–4.
20. Xiao-yu X, Dong-ning Y, Yuan-kai H, Xiao-jing W, Yi-tao W, Wen-bing Y. National Survey on clinical pharmacy Services of Tertiary Hospitals in China: part 2. Staffing of clinical pharmacist team. Chin Pharm J. 2018;53(06):472–6.
21. Qu Jian LG, Zhu Z. The development course and tendency of hospital pharmacy during 70 years of new China. Chin J Hosp Pharm. 2020;40(01):1–22.
22. Jia X, Bo T, Zhi-ling Y. Investigation and study on current status of clinical pharmacists and career development needs. Her Med. 2022:1–24.
23. Ying-ying Z, Liang-liang C, Yong-hong Z. Influential factors for providing pharmaceutical care in the hospital of Nantong. Cent S Pharm. 2021;19(09):1964–8.
24. Yan S, Cui-li H, Ming-hua Z, De-dong L, Shu W. Restricted factors of hospital clinical pharmaceutical care capability and discussion of improved countermeasures. Phaem Cate Res. 2016;16(05):369–74.
25. Juan L, Chengzhi Z, Qingxian C. Investigation on the demands and evaluation of medical personnel and patients towards clinical pharmacists in 56 third grade class A hospitals of 17 provinces(regions, cities). China Pharm. 2018;29(08):1136–9.
26. Suxin W, Wei F, Daoqiu H. Investigation and study on present situation of clinical pharmaceutical care in 39 medical institutions in Chongqing. China Pharm. 2020;31(01):12–7.
27. Opinions on accelerating the high-quality development of pharmaceutical services. Gaz Natl Health Comm People's Repub China. 2018;11:16–8.
28. Notice on strengthening pharmaceutical affairs management and transforming pharmaceutical service models. Gaz Natl Health Comm People's Repub China. 2017;07:22–3.
29. Lihua P, Xiaohui F, Xiangnan Z. Analysis and Prospect of the development of clinical pharmacy education in China. Pharma Educ. 2021;37(02):1–6. https://doi.org/10.16243/j.cnki.32-1352/g4.2021.02.001.
30. Jiang J, Liu Y, Deng P, Li Q. Bachelor's degree programs in clinical pharmacy in China. Am J Pharm Educ. 2012;76(8):146.
31. National Teaching Quality Standards for Undergraduate Programs in General Higher Education Institutions. 2018.
32. Rui-lin W, Chun-xia M, Si-cong L. Development status of Chinese pharmacist team under the background of healthcare reform. Chin J Hosp Pharm. 2021;41(11):1091–1096+1113. https://doi.org/10.13286/j.1001-5213.2021.11.02.
33. Qiang-hong P, Cui-yi Z, Xing J. Cross-sectional survey on cognition with clinical pharmacist services in doctors and nurses. J China Prescription Drug. 2021;19(12):42–3.
34. Fen W, Wei-min C, Guo M. Investigation on cognition of medical staffs from secondary and tertiary hospitals in Shanghai on clinical pharmacy practice and clinical pharmacists. Chin Hosp Pharm J. 2016;36(02):122–5. https://doi.org/10.13286/j.cnki.chinhosppharmacyj.2016.02.11.
35. The evolution of clinical pharmacy practice in hospitals of Pennsylvania. Directions for clinical pharmacy practice in Pennsylvania: proceedings of an invitational conference.

36. Raehl CL, Bond CA, Pitterle ME. Hospital pharmacy services in the Great Lakes region. Am J Hosp Pharm. 1990;47(6):1283–303.
37. Nasution A, SA SS, Shafie A. Pharmacists'perception of their role and assessment of clinical pharmacy education to improve clinical pharmacy services in Indonesian hospitals. Int J Pharm. 2014;6(11):177–80.
38. Xiao-yu X, Dong-ning Y, Yuan-kai H, et al. National survey on clinical pharmacy Services of Second-level Hospitals in China: part 1. Introduction of survey and basic conditions of clinical pharmacy service provision. Chin Pharm J. 2018;53(23):2058–64.
39. Yuankai H, Yanhai L, Meiling L, Xinxin W, Tian W, Xiaoyu X. National survey on pharmaceutical care of primary healthcare institutions in China: part 3. Status quo of pharmaceutical care provision. Chin J Hosp Pharm. 2018;39:109–15.
40. Huang Y, Yao D, Zhou H, Xi X, Wang Y, Yao W. Association of hospital pharmacy-related knowledge and skills with occupational stress of clinical pharmacists in tertiary hospitals of China. J Am Pharm Assoc (2003. 2021;61(3):266–75. https://doi.org/10.1016/j.japh.2021.01.011.
41. Xin L, Qi-neng P. Review and Prospect of clinical pharmacy service effect evaluation research. Her Med. 2010;29(05):691–5.
42. Pharmacists' Perception of Pharmaceutical Care in Community Pharmacy:a Questionnaire Survey in China. Proceedings of the 2010 China Pharmaceutical Congress and the 10th China Pharmacist Week.
43. El Hajj MS, Al-Saeed HS, Khaja M. Qatar pharmacists' understanding, attitudes, practice and perceived barriers related to providing pharmaceutical care. Int J Clin Pharm-Net. 2016;38(2):330–43. https://doi.org/10.1007/s11096-016-0246-0.
44. Chang Yu FY. Current status of clinical pharmacy and strategy research in China based on KAP analysis. Chin J Ration Drug Use. 2015;12(10):27–31.
45. Leilei C, Jiaxin Z, Naitong Z, et al. Investigation on cultivation mode and cognitive status of clinical pharmacy in Sichuan Province. Chin Pharm Aff. 2018;32(05):694–700. https://doi.org/10.16153/j.1002-7777.2018.05.021.
46. Wu HS, Zhu KL, Fan XH, Gao JQ. Pharmaceutical science research training: an early practice course for first-year students. Med Educ. 2018;52(11):1200–1. https://doi.org/10.1111/medu.13696.
47. Zunpeng S, Yanni Y, Zihr D, Renxing Z, Tianyi X, Yi W. The status quo and improvement of postgraduate training forClinical pharmacy. Pharm Educ. 2021;37(03):18–22. https://doi.org/10.16243/j.cnki.32-1352/g4.2021.03.005.
48. Accreditation Standards And Guidelines For The Professional Program In Pharmacy Leading To The Doctor Of Pharmacy Degree 2006. http://www.acpe-accredit.org/pdf/ACPE_Revised_PharmD_Standards_Adopted_Jan152006.pdf.
49. Hu M, Yee G, Zhou N, Yang N, Jiang X, Klepser D. Development and current status of clinical pharmacy education in China. Am J Pharm Educ. 2014;78(8):157.
50. Ming H, Xue-hua J, Yong-pei W, Qing Y, Xi LX-i. Survey on Hospital Pharmaceutical Care in China and the status quo of clinical pharmacy practice (part 2):survey on status quo of clinical pharmacy practice. China Pharm. 2009;20(13):1030–2.
51. Guangqing D, Luwen S, Aiping H. Rethought on establishing matching national situation clinical pharmacist system. Chin Hosp. 2011;15(09):71–3.
52. Yu-jing L, Yue Y, Jing-yu Y, Chun-fu W. Analysis of the current situation of clinical pharmacy education in China. China Univ Teach. 2017;05:89–92.