Study on the Development Status and Influencing Factors of Traditional Chinese Medicine Service Ability in Jilin Province Based on Logistic Regression Algorithm

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Abstract. Objective from the perspective of doctors' perception and institutional development, the current situation and influencing factors of the development of Traditional Chinese Medicine service ability in Jilin Province were analyzed to provide a reference for the targeted development of primary health care services. Method: three hundred and thirty-seven primary care physicians in Jilin Province were selected for the study by random sampling method. The χ^2 test was used to conduct single factor analysis on sixteen indicators. And Logistic regression algorithm was used to construct a model of influencing factors of traditional Chinese medicine service ability at the grassroots level in Jilin Province. Results: χ^2 test showed that fourteen indicators were statistically significant. Logistic analysis further screened out the main factors affecting the ability of primary health services: doctors' specialty, business qualification, average daily TCM service visits, average daily TCM consultation ratio, availability of independent TCM rooms, implementation of system and norms, total annual training hours, and annual training times. Conclusion: TCM services ability in Jilin Province needs to be improved, and there is a large gap with the relevant national regulations.

Keywords: Primary health · TCM service ability · Logistic regression algorithm · Machine Learning

1 Introduction

Primary health care service is an important vehicle for providing public health and basic medical care. Primary Chinese medicine service is an important part of primary health care service [1]. Improving the ability of primary Chinese medicine service is important to deepen the reform of the medical system, improve the equity, accessibility and convenience of the primary medical care, and better meet the needs of the primary residents of Chinese medicine service. During the COVID-19 epidemic, traditional Chinese Medicine (TCM)has played a major role in the process of fighting epidemics and has been fully affirmed by the Party Central Committee. Implementing the spirit of "Opinions of the CPC Central Committee and State Council on Promoting the Inheritance

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and Innovative Development of Chinese Medicine", enhancing the capacity building of primary Chinese medicine services has become the focus of national attention to primary medical reform [2, 3]. Meanwhile, improving the ability of primary Chinese medicine service is also a hot academic topic in the field of public health at present. Previous studies have found that the field of TCM service programs is shrinking day by day [4]. The limited percentage of actual financial allocations applied to primary TCM [5] and the failure of TCM class physicians to meet demand [6] can directly constrain the ability of primary TCM services. In this paper, from the perspective of doctors' perceptions and institutional construction, we screen out important factors affecting TCM service ability with Logistic regression algorithm, analyze the current situation of primary TCM service ability and the main influencing factors in Jilin Province which could provide a basis for upgrading the work path of primary medical and health services.

2 Sample and Method

2.1 Sample

In this paper, the primary TCM doctors who attended the "Jilin Provincial TCM Society Training Course on Improving the TCM Service Ability of Primary Care Doctors in 2021" were the subjects of the study. Representatives from primary care institutions throughout Jilin Province were selected to attend the conference, the data were considered to be representative of the current situation of the development of primary care TCM in Jilin Province. A total of 349 questionnaires were distributed. After eliminating invalid questionnaires, 337 valid questionnaires were obtained with a valid return rate of 96.56%.

2.2 Measure

On the basis of the relevant literature, we compiled our own Questionnaire on Chinese medicine service ability of primary doctors in Jilin Province, which includes the quality of doctors (four evaluation indicators), outpatient efficiency (three evaluation indicators), institutional development (five evaluation indicators) and training feedback (four evaluation indicators), in combination with the detailed criteria of the *Guidelines for evaluating the service ability of township health centers (2019 version)* (hereinafter collectively referred to as the standards) issued by the General Office of the National Health and Health Commission on April 28, 2019.

2.3 Model Algorithm

Logistic regression (LR) is a probability-based linear binary classification algorithm, The binary variable y, which represents whether an event occurs or not, follows a Bernoulli distribution, the probability of event A occurring is p(A) and the probability of it not occurring is p(a). If $y = 1$ and $y = 0$ represent the occurrence and non-occurrence of the event respectively, the distribution function of the Bernoulli distribution is:

$$p(y|x;\theta) = p(A)^y[1 - p(a)]^{1-y} \tag{1}$$

Logistic regression uses the Sigmoid function h(θ) to describe the probability of something A happening.

$$p(A) = p(y = 1|x; \theta) = h^{\theta}(x) \tag{2}$$

$$p(a) = 1 - p(A) = p(y = 0|x; \theta) = 1 - h^{\theta}(x) \tag{3}$$

$$\text{Among them} : h^{\theta} = 1/(1 + e^{-(\theta^T x + b)}) \tag{4}$$

$$\text{Therefore} : p(y|x; \theta) = [h_{\theta}(x)]^{y}[1 - \mathrm{h}_{\theta}(x)]^{1-y} \tag{5}$$

Logistic regression assumes that each sample in the whole is independently and identically distributed, and according to the maximum likelihood estimation, the likelihood function of the parameter θ:

$$\mathrm{L}(\theta) = p(y|x; \theta) = \prod_{i=1}^{n} p(y_i|x; \theta) = \prod_{i=1}^{n} (h_{\theta}(x_i))^{y_i}[1 - h_{\theta}(x^i)^{1-y_i}] \tag{6}$$

Take the logarithm of the function L(θ) and then find the derivative to get the value of the parameter θ when the likelihood function takes the maximum value, and then get the Sigmoid function. The Sigmoid function value of 0.5 was used as the dividing line, and samples taking values greater than 0.5 were classified as one category and those less than 0.5 were classified as another category.

2.4 Statistical Method

Epidata 3.0 was used to enter and organize the data; SPSS22.0 software was used to analyze the data, and the χ^2 test was applied to compare and analyze the data, and factors with no significant effect were excluded ($\alpha = 0.05$ as the test level), and Logistic regression models were constructed using the glm function in R language.

3 Result

3.1 Basic Conditions of Survey Respondents and Results of Single Factor Analysis of Primary Chinese Medicine Service Ability

χ^2 test was used to check the indicators of physician quality, outpatient service efficiency, institutional development and training feedback whether the TCM services provided by primary care physicians met the basic needs of patients (see Table 1). 14 indicators were statistically significant ($P < 0.5$), and the source of training costs and practicality of training contents were not statistically significant ($P > 0.5$).

Table 1. Results of the χ^2 test of factors influencing the ability of primary care physicians to provide Chinese medicine service.

Dimension	Indicator	Option	Number (example)	Percent (%)	χ^2	*P*
Physician Quality	A1 Education	Master and above	56	16.62%	17.95	< 0.001
		Undergraduate	82	24.33%		
		Tertiary	126	37.39%		
		Junior college and below	73	21.66%		
	A2 Specialty	Chinese Medicine	175	51.93%	32.66	< 0.001
		Non-TCM Specialty	162	48.07%		
	A3 Practice Qualification	Practitioner	184	54.60%	13.29	0.001
		Physician Assistant	58	17.21%		
		Registered Rural Physician Student	95	28.19%		
	A4 Business Qualification	TCM-based	87	25.82%	33.14	< 0.001
		Western drug-based	114	33.83%		
		Chinese and Western medicine	136	40.36%		
Outpatient stress	B1 Average daily prescriptions	1–15 pcs	237	70.33%	20.3	< 0.001
		16–30 pcs	64	18.99%		
	B2 Daily average number of TCM service visits	1–15 times	260	77.15%	33.01	< 0.001
		16–30 times	77	22.85%		
	B3 Average daily TCM consultation rate	1–10%	150	44.51%	41.96	< 0.001
		10–20%	102	30.27%		
		21–30%	85	25.22%		

(*continued*)

Table 1. (*continued*)

Dimension	Indicator	Option	Number (example)	Percent (%)	χ^2	*P*
Agency Development	C1 Separate Chinese medicine room	Yes	223	66.17%	16.25	< 0.001
		No	114	33.83%		
	C2 Number of TCM treatment equipment	1–5 units	224	66.47%	9.57	0.008
		6–10 units	63	18.69%		
		11–15 units	50	14.84%		
	C3 Number of appropriate technology items	1–5 items	203	60.24%	9.76	0.008
		6–10 items	66	19.58%		
		11–15 items	68	20.18%		
	C4 Number of Chinese medicine doctors	1–2 pcs	234	69.44%	7.07	0.029
		3–4 pcs	45	13.35%		
		5–6 pcs	58	17.21%		
	C5 System and norm implementation	Better	203	60.24%	27.85	< 0.001
		General	104	30.86%		
		Poor	30	8.90%		
Training Feedback	D1 Total annual training hours	Two months	114	33.83%	9.99	0.007
		One month	92	27.30%		
		1 week	131	38.87%		
	D2 Number of annual training	1–4 times	192	56.97%	16.03	< 0.001
		5–8 times	52	15.43%		
		Over 9 times	93	27.60%		
	D3 Source of training fees	All self-pay	138	40.95%	1.9	0.386
		Reimbursement part	28	8.31%		
		Full reimbursement	171	50.74%		
	D4 Practicality of training content	No	268	79.53%	3.61	0.057
		Yes	69	20.47%		

Note: *** indicates $p < 0.001$; ** indicates $p < 0.01$; * indicates $p < 0.05$

3.2 Analysis of Primary Chinese Medicine Service Ability Based on Logistic Regression Algorithm

14 statistically significant variables were included in the logistic regression analysis. The degree to which the TCM services provided by doctors meet the basic needs of patients was used as the dependent variable. And the quality of doctors, TCM clinic efficiency, institutional development and training feedback as independent variables to establish Logistic regression algorithm model. Finally, 8 indicators with significant impact were included and the results are shown in Table 2.

According to the results, primary TCM practitioners who were specialized in TCM had a better promotion effect on the TCM service ability than those who were not specialized in TCM (OR = 2.340 > 1); the practice qualification of primary TCM practitioners as TCM-based was more effective in promoting the TCM service capacity of primary care physicians, followed by both Chinese and Western medicine and finally Western medicine. The impact on TCM service capacity was more pronounced when the average daily TCM consultation percentage was 11%-20% (OR = 4.264 > 1.437), followed by when it was 1%-10%; primary health service institutions with independent TCM rooms (OR = 2.188 > 1) had a better effect on promoting TCM service ability of primary doctors than those without independent TCM rooms. The impact of primary care physicians on service capacity was higher in institutions with better implementation of TCM systems and norms (OR = 1.033 > 1 > 0.34).Differences in the average number of training sessions per year and total annual training duration had an impact on the service capacity of primary Chinese medicine, with the best effect on the service capacity of primary doctors when the total annual training duration was two months (OR = 2.177 > 1.125) and the number of training sessions per year was 5–8 (OR = 1.188 > 0.406).

Table 2. Factors influencing the ability of primary TCM services based on logistic regression algorithm

Indicator	*B*	*S.E.*	*Wald*	*P*	*OR*	*95%CI*	
						Upper limit	Lower limit
A2 Specialty (reference = non-TCM specialty)							
TCM specialty	0.850	0.312	7.443	0.006	2.340	1.271	4.311
A4 Business qualification (reference = both Chinese and Western medicine)			8.819	0.012			
Western drug-based	−0.477	0.286	2.780	0.095	0.621	0.354	1.087
TCM-based	0.741	0.368	4.058	0.044	2.097	1.020	4.312
B2 Average daily TCM service visits (refer = 16–30 times)							
1–15 times	0.86	0.307	7.851	0.005	2.362	1.295	4.31

(*continued*)

Table 2. (*continued*)

Indicator	*B*	*S.E.*	*Wald*	*P*	*OR*	*95%CI*	
						Upper limit	Lower limit
B3 Average daily TCM consultation rate (reference = 21–30%)			19.054	0			
11–20%	1.45	0.347	17.419	0	4.264	2.158	8.424
1–10%	0.363	0.308	1.391	0.238	1.437	0.787	2.626
C1 Independent Chinese medicine room (reference = no)							
Yes	0.783	0.296	7.000	0.008	2.188	1.225	3.908
C5 System, norms implementation (reference = poor)			15.189	0.001			
General	−1.08	0.6	3.243	0.072	0.34	0.105	1.1
Better	0.032	0.62	0.003	0.958	1.033	0.307	3.479
D1 Total annual training hours (reference = 1 week)			8.143	0.017			
One month	0.118	0.301	0.154	0.695	1.125	0.623	2.032
Two months	0.778	0.286	7.407	0.006	2.177	1.243	3.812
D2 Number of annual training (reference = 1–4 sessions)			13.665	0.001			
5–8 times	0.173	0.368	0.219	0.639	1.188	0.577	2.446
Over 9 times	−0.901	0.270	11.137	0.001	0.406	0.239	0.690

4 Discussion

4.1 Hardware Facilities of Grassroots TCM Service Institutions Need to Be Upgraded

There was a general lack of Chinese medicine treatment equipment and inadequate development of appropriate Chinese medicine technology in the grassroots health institutions in Jilin Province. Only 39.76% of the surveyed doctors' institutions have more than 6 appropriate technology items, only 33.53% are equipped with more than 6 kinds of TCM treatment equipment or rehabilitation equipment, 66.17% set up independent Chinese medicine rooms, and only 30.56% have more than 2 TCM physician, all of which are not up to the national construction and implementation of primary TCM Implementation of the relevant standards of the requirements. The degree of standardization of TCM-related systems in primary health care institutions and the addition of independent TCM rooms had a significant impact on improving the quality of primary TCM services. The configuration of hardware facilities for TCM services was closely related to local economic development and government support [7]. The intensity of investment in primary health resources was uneven across regions in Jilin province. Financial investment for health care institutions was referenced to health service providers [8], with the result that financial subsidies in areas with weak health infrastructure lagged behind other regions. We

suggested that the actual financial allocation should be measured by the actual medical needs of the regional population volume.

4.2 The Professional Level of TCM Practitioners Needs to Be Improved

The primary TCM doctors who participated in the training specialized in TCM accounted for 51.92% of the total sample, the business qualification was TCM-based accounted for only 25.83% and the education level of bachelor's degree or above accounted for 40.95%. At this stage, the primary TCM practice team and the qualification of practitioners in Jilin is confused, the professional knowledge of TCM is lacking, the business and technical guidance for them is seriously insufficient. The surveyed doctors believed that improving the specialization level of primary TCM practitioners was conducive to improving the ability and quality of TCM services. Over the years, the performance assessment mechanism and personnel allocation compensation mechanism could not be fully implemented in primary health services, especially in township health centers and village health offices, leading to a serious loss of excellent TCM talents [9] and further constrained the improvement of primary TCM service ability. Therefore, the relevant health departments should pay attention to the introduction and training of high quality TCM talents at the grassroots level and formulate preferential policies to introduce and retain high quality TCM talents. In addition, the capacity of TCM practitioners could be improved through various forms of continuing education, and primary medical institutions could also improve the professionalism of the new generation of TCM practitioners by hiring back famous veteran TCM practitioners in the form of "teacher-apprentice".

4.3 Pressure on Outpatient Clinics of Primary Care TCM Doctors

Primary TCM service doctors believed that they could provide better TCM services when the average daily consultation ratio was controlled at 11%-20% (OR = 2.362) and the average daily TCM service attendance at 1–10 times (OR = 4.264). An appropriate number of service consultations was conducive to improving the medical environment, while an unreasonable number of service consultations could lead to low efficiency of doctors' consultations and reducing the quality of TCM services. The survey showed that primary medical institutions in Jilin Province were generally equipped with only 1–2 TCM physicians (69.44%), and the imbalance between physician workload and patient volume tended to create congestion during peak visit periods. In addition, Primary Chinese medicine practitioners were not only responsible for a series of processes such as diagnosis and prescription, but also for the operation of appropriate Chinese medicine techniques. Some studies showed that the optimization of outpatient service capacity could appropriately alleviate this situation [10]. Grass-roots TCM service institutions should implement a multi-modal outpatient appointment system to reasonably allocate consultation time and optimize the consultation process; or implement a separate system for first-time and follow-up patients to optimize the allocation of medical resources.

4.4 Inadequate Training System for Primary Chinese Medicine Physicians

At this stage, the quality of TCM service ability training in Jilin Province needed to be adjusted, and 79.53% of primary care doctors believed that the training lacked practicality. In addition, the training arrangement with the number of training sessions of 5–8 times per month (OR = 1.188) and the annual training duration of 2 months or more (OR = 2.177) had the most significant impact on the training effect. Too few training sessions and too short training duration would affect the mastery of training contents by primary TCM service providers, and too many training sessions and too long training tasks would affect the work arrangement of primary TCM service providers [11]. In this regard, relevant departments should establish a multi-level training system to expand the channels of continuing education, develop online training channels, arrange training time flexibly, unify training plans, reasonably arrange training time, effectively control the number of training sessions, and clarify training content. In addition, in-service training should be linked to medical personnel's assessment, promotion, performance pay to mobilize the initiative of grassroots TCM service providers to participate in training.

5 Conclusion

Logistic regression algorithm was used to analyze the current situation and influencing factors of the development of primary TCM service ability in Jilin Province from the perspective of doctors' perception and institutional development, and then drew the conclusions: the main factors limiting the development of TCM service ability were doctors' specialty, business qualification, average daily TCM service visits, average daily TCM consultation ratio, availability of independent TCM rooms, implementation of system and norms, total annual training hours, and annual training times. Results suggest that improving the training system of primary TCM doctors, attaching importance to the introduction of highly skilled talents, upgrading the hardware facilities of primary TCM services, adopting an outpatient appointment system, reasonably allocating consultation time, optimizing the consultation process and easing the pressure of receiving consultations are effective paths to improve primary TCM service ability.

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