



Investigating the factors affecting the competence of a traditional Chinese medicine practitioner using structural equation model

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Background: Compared with other medical sciences, Chinese medicine provides professional advantages in disease prevention and the diagnosis of chronic diseases. The training of Chinese medicine practitioners is worthy of investigation. The present study focused on how structural equation modelling (SEM) can be used to analyze the competencies of traditional Chinese medicine (TCM) practitioners to help training an eligible TCM doctor and select suitable staff for TCM hospital.

Methods: Before the analysis of competence factors for TCM, we developed the scale, including literature review, expert consultation, item pool for the proposed competency model, pilot test of the item pool, and finalization of the scale items. We analyzed questionnaires from 400 TCM practitioners in Hangzhou, Guangzhou, and Wuhan, and then performed an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA) to extract the valuable items for TCM practitioners. Finally, SEM was employed to develop a competency structure.

Results: A total of 21 items in this study's questionnaire were identified as being closely related to the competencies of TCM practitioners, which were further categorized by principal component analysis into five categories: (I) professional values; (II) basic medical knowledge; (III) communication skills; (IV) clinical skills; and (V) information management. Subsequent analyzes showed that clinical skills were the most important competency metric for TCM practitioners; additionally, the mediating role of basic medical knowledge and communication skills could not be ignored in both theory and practice.

Conclusions: This research presents a preliminary methodology for evaluating the competence of TCM practitioners and provides hospitals with criteria theoretical reference for training and finding TCM practitioners.

Keywords: Competency; traditional Chinese medicine (TCM); structural equation modelling (SEM)

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Introduction

Traditional Chinese medicine (TCM) carries the experience and theoretical knowledge of ancient Chinese people in fighting against diseases. As a treasure of the Chinese nation, TCM plays an active role in disease prevention and treatment (1,2). TCM has unique advantages in the field

of modern medical treatment due to its low cost, small side effects and personalized diagnosis and treatment. TCM plays an irreplaceable role in China's medical and health undertakings (3,4).

TCM doctors have traditional advantages in preventive treatment, basic medical treatment, chronic disease

treatment, health care and rehabilitation. The thought of preventive treatment of disease is an important part of the theory of TCM (5). TCM emphasizes prevention before disease, prevention of change after disease, prevention and recovery after disease, which is consistent with the three-level prevention of modern medicine (6). In terms of basic medical treatment, TCM can effectively treat most common diseases, and the natural properties of TCM can effectively avoid drug resistance and other side effects brought by modern medicine (7). In the treatment of chronic diseases, the application of TCM special therapy and the promotion of TCM appropriate technology provide a broad space for TCM doctors. In the aspect of health care and rehabilitation, TCM pays attention to health care, which emphasizes the balance of Yin and Yang (8).

The theoretical source of competency evaluation is the empirical research on competency from psychology. With the development of psychology, competency is gradually combined with the post of TCM (9). At the same time, TCM also gradually pays attention to the examination of internal core competencies, emphasizing that staff should be able to meet the relevant requirements of their posts (10).

Structural equation modelling (SEM) can study both observable variables and variables that cannot be directly observed. It can not only study the direct effect between variables, but also study the indirect effect between variables, and show the relationship between variables intuitively through the path diagram; through the SEM, researchers can construct the relationship between hidden variables, and verify whether the structural relationship is reasonable (11).

In our research, we take competency theory into application to analyze the TCM doctors using SEM. The factors required for TCM doctors can be evaluated through SEM model. So, how much the effects of identified factors contribute to TCM doctors' competency can be evaluated and standard of a proper candidate of TCM doctor can be explored.

In this study, we applied SEM to the analysis of Chinese medicine practitioners' competence to assess the necessary factors for Chinese medicine practitioners. To our knowledge, this is the first research on competency of TCM doctors using SEM. We present the following article in accordance with the SURGE reporting checklist (available at <https://atm.amegroups.com/article/view/10.21037/atm-23-888/rc>).

Methods

In 1973, David McClelland published the article "Measuring Competence, Not Intelligence", which set off a wave of competency research and is known as the father of competency research (3). Therefore, we used literature research method, expert consultation method, empirical survey method, and relevant statistical analysis method to conduct the study. Through literature reading and expert interviews, we screened the competency indicators for evaluating the competency of TCM physicians, prepared a questionnaire about the competency of TCM physicians for questionnaire survey and conducted reliability analysis. We constructed a competency model for Chinese medicine practitioners by collecting relevant literature, consulting experts, screening and comparing expert studies, and interviewing TCM practitioners. Questionnaires were administered to Chinese medicine practitioners in Chinese medicine hospitals across several regions. The content mainly included the scores of various competency factors of TCM practitioners. A Chinese medicine practitioner qualification model was identified through data analysis. Internal consistency reliability tests, principal component analysis, and discriminant validity tests of the validity factors were also applied (12). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Hangzhou Normal University (No. 20220812). Informed consent was taken from all the participants.

Questionnaire survey

During January 2021 to January 2022, an online survey

Highlight box

Key findings

- This research presents a preliminary methodology for evaluating the competence of TCM practitioners and provides hospitals with criteria for finding and assessing TCM practitioners.

What is known and what is new?

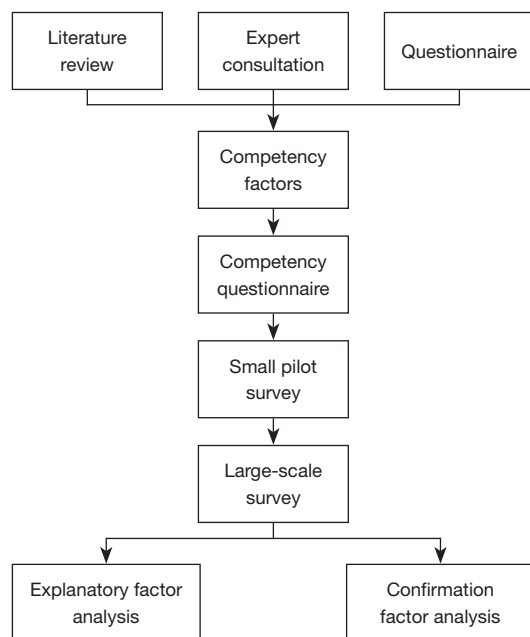
- It was known that the training and assessment of TCM practitioners were imperative.
- SEM was used to develop a competency structure for TCM practitioners.

What is the implication, and what should change now?

- Professional value attitude, basic medical knowledge, communication skills, clinical skills, and information management are important factors in becoming a TCM practitioner, especially communication skills.

Table 1 Basic characteristics of the respondents

| Category | Range | Frequency |
|------------|---------------|-----------|
| Age | <26 years | 5 |
| | 26–35 years | 313 |
| | 36–45 years | 61 |
| | >45 years | 21 |
| Gender | Male | 131 |
| | Female | 269 |
| Education | Colleges | 3 |
| | Bachelor | 45 |
| | Master degree | 352 |
| Experience | <5 years | 29 |
| | 5–10 years | 82 |
| | >10 years | 289 |

**Figure 1** Working procedure flow chart.

on TCM competency in two cities including Wuhan and Hangzhou. We conducted a small pilot study, modified the questionnaire based on the findings, and based it on a larger survey. We also collected the potential influences from different competency factors and conducted a formal questionnaire to gather the views of TCM practitioners on these issues. In this process, we analyzed the reliability

of the questionnaire and all the questions with Cronbach's coefficient alpha. To evaluate the validity, we conducted Kaiser-Mayer-Olkin (KMO) sampling adequacy and Bartlett's test.

Pilot survey

The following steps were taken to develop the TCM Professional Identity Questionnaire: (I) Initial selection of the scale and confirmation of the correctness of the content with the help of theoretical analysis and expert validation; (II) approval of the pilot survey data collection to investigate the psychometric properties; (III) respondent independence; (IV) internal consistency testing; and (V) validity and reliability testing.

Large-scale survey

Before designing the questionnaire, its content was clarified by comparing the core meaning of each item based on the definitions and key functions described in the Universal Competency Dictionary (13). A cross-sectional survey of the key respondents was conducted from March 2019 to October 2019, with a multi-regional sample of mid-career practitioners.

Factor analysis

An exploratory factor analysis (EFA) was conducted on 400 self-administered questionnaires from Chinese hospitals across three regions. We then conducted an EFA and a validation factor analysis (14). Several independent measures were used for each possible structure (15). The measurement model focused on how to conceptualise and measure potential problems using explicit variables.

Survey samples

To collect the relevant data, an extensive questionnaire survey was conducted in four cities. The number of TCM practitioners in the four study sites ranged from 50 to 100. A total of 400 valid questionnaires were eventually received, providing a validity rate of 100%. *Table 1* displays the profiles of the eligible respondents. All respondents agreed to participate in the study before participation. In addition, the personal information of the respondents was kept strictly confidential. The complete research procedure was shown in *Figure 1*.

Statistical analysis

First, regression analyzes were performed on the observed data, and factor analyzes were conducted on the latent variables. Due to the complexity of the relationships between the variables, multivariate analysis was applied, and finally, SEM was utilized to determine the structural validity of the contextual factors influencing professional competence (16).

The SEM consisted of two sub-models. (I) Measurement models that map the observed data to hypothetical background factors (i.e., validating factor analysis) enable the direct calculation of measurement errors and estimation of reliable values for the underlying constructs. (II) The validation model displays the regression relationships between the measured variables, both latent and observed.

Finally, using model fitting tests, the central path of influence of potential factors and competencies was determined, forming a model of the competence of the TCM participants.

SEM provides an effective theoretical approach to comparing multiple perspectives in one model. In other words, in addition to meeting statistical criteria, it is necessary to monitor the real situation and interpret the relationships found in the SEM process from a practical perspective.

Results

Identification of the key items

Our pilot study identified 75 issues that may affect the competencies of TCM practitioners. Twenty-one items related to competencies were collected from a generic competency dictionary based on the definitions and descriptions of key functions.

Objects with the same meaning were grouped together. Most definitions are given by reference to the general competence dictionary. New terms were created for items that could not be directly linked to a single dictionary definition but were frequently mentioned in other sources.

After analysing the results of the pilot study, a list of 21 possible key points and their corresponding detailed definitions was developed for the large-scale study (Tables 2,3).

Factor analysis

EFA

Firstly, an EFA was conducted using the KMO test and

Bartlett's test to assess the fit of the factor analysis to the data (17). The KMO test value was 0.66, which satisfied the general criteria. Bartlett's test indicated a value of 8,078, which could be used to reject the original hypothesis ($P < 0.001$). Therefore, there appears to be a significant interaction between these factors (Table 4).

Principal component analysis was performed to separate items with original eigenvalues and factor loading values greater than 0.4. Factor analysis is a method of replacing multidimensional variables with major factors to reflect the information contained in the variables as broadly as possible (18). The rotated factor loading matrix is shown in Table 5. These principal components were identified as three factors representing different aspects of the safety characteristics derived from competency theory, based on the purpose of the items and grouping the results as follows.

Confirmatory factor analysis (CFA)

CFA was used to test the reliability and validity of the model. In terms of reliability, Cronbach's alpha test reflects the relationship between questionnaires belonging to a single dimension (19), which determines whether the proposed questionnaire can reliably measure the most important variables.

As a rule of thumb, some professionals require a desirable confidence level of 0.70 or higher, while 0.60 is usually considered to be the lowest acceptable threshold. The Cronbach's alpha values are shown in Table 6, and the results indicate that the developed measurement scale is reliable, which signifies that the grouping of the extracted main factors is appropriate.

Regarding validity, two types, convergent validity and discriminant validity, were introduced to ensure strong correlations between items belonging to the same factor and complete variation between factors (19). Validity was confirmed by standardised factor loadings (FL > 0.5), Cronbach's α (composite reliability) (CR > 0.6), average variance extracted (AVE > 0.5), and the square root of AVE (greater than the inter-factor correlation coefficient). The results in Tables 7,8 confirm the validity of the proposed groupings.

SEM

The above results support the rationale for dividing the 21 items into three groups. An SEM was constructed based on the composition of the groups and the definition of the corresponding objects, and the relationships are shown in Figure 2.

Table 2 Definitions of the items included in the questionnaire

| No. | Items | Definition |
|-----|---|---|
| 1 | Ethics and morality | Moral code that guides a person's choices and behaviors throughout their life |
| 2 | Professional values | A generic term for the principles that are central to practicing a profession which, for medicine, includes integrity, compassion, altruism, continuous improvement, excellence, and the ability to partner with members of the wider healthcare team |
| 3 | Respect for patients | Showing respect in the clinical process |
| 4 | Ability of self-regulation | Regulation of life and work |
| 5 | Respect for other health professionals | Showing respect to other medical professionals |
| 6 | Basic theory of traditional Chinese medicine | Grasp the basic theory of traditional Chinese medicine |
| 7 | Basic knowledge of traditional medicine | Grasp the basic knowledge of traditional Chinese medicine |
| 8 | Classical books of traditional medicine | Own a number of traditional medicine books |
| 9 | Other medical knowledge | Having other medical knowledge |
| 10 | Communicate effectively with others. | Ability to communicate with others |
| 11 | Solve problems using teamwork | Possessing a collaborative spirit |
| 12 | Oral or written communication abilities | Having the ability to communicate with others in oral and written form |
| 13 | Good job in health education | Having the awareness to express health education |
| 14 | Diagnose and treat diseases with dialectical theory | Having the ability to diagnose and treat diseases with dialectical theory |
| 15 | Comprehensively diagnose disease using laboratory examination | Considering laboratory results when diagnosing disease |
| 16 | Chinese medicine skills, such as acupuncture and massage | Ability to perform some Chinese medicine and physical therapy |
| 17 | Rescue principles of Western medicine | Ability to perform cardio-pulmonary resuscitation |
| 18 | Standardized treatment | Knowing how to perform standardized treatment |
| 19 | Collect medical information through database | Ability to use the Internet to collect medical information |
| 20 | Diagnosis and treatment via networks | Ability to diagnose disease over the Internet |
| 21 | Patient record keeping | Awareness to keep patients' records |

Discussion

The advantage of Chinese medicine lies in its overall regulation of the body, improving the body's immunity, and achieving "yin and yang secretion". Some Chinese medicines have a direct inhibitory effect on disease, and under the guidance of the principles of diagnosis and treatment, a reasonable combination can achieve a clearing effect.

This study constructed a competency model for Chinese medicine hospital practitioners by collecting relevant literature, expert consultations, screening and comparing expert surveys, and interviewing Chinese medicine practitioners. The sample survey of Chinese medicine

hospitals focused on scoring the competency factors of Chinese medicine practitioners, and the competency model of these professionals was validated by analysing the collected data. The main methods applied in this study included internal consistency reliability testing, principal component analysis, and SEM. We selected 21 competency items from the competency dictionary (20-25), most of which had internal effects. These items were analyzed by examining the TCM practitioners' perceptions of their characteristics. The model focuses on internal differences between different TCM practitioners rather than external variation.

EFA and CFA were applied to mathematically divide the

Table 3 The statistical description of items

| No. | Items | Mean | SD |
|-----|---|------|------|
| 1 | Ethics and morality | 2.57 | 0.61 |
| 2 | Professional values | 2.75 | 0.47 |
| 3 | Respect for patients | 2.87 | 0.34 |
| 4 | Ability of self-regulation | 2.55 | 0.51 |
| 5 | Respect for other health professionals | 2.73 | 0.47 |
| 6 | Basic theory of traditional Chinese medicine | 2.83 | 0.4 |
| 7 | Basic knowledge of traditional medicine | 2.91 | 0.29 |
| 8 | Classical books of traditional Chinese medicine | 2.84 | 0.4 |
| 9 | Other medical knowledge | 2.86 | 0.35 |
| 10 | Communicate effectively with others | 2.85 | 0.36 |
| 11 | Solve problems with teamwork | 2.79 | 0.44 |
| 12 | Oral or written communication abilities | 2.84 | 0.41 |
| 13 | Good job in health education | 2.64 | 0.52 |
| 14 | Diagnose and treat diseases with dialectical theory | 2.74 | 0.51 |
| 15 | Comprehensively diagnose disease with laboratory examinations | 2.73 | 0.45 |
| 16 | Chinese medicine skills such as acupuncture and massage | 2.87 | 0.34 |
| 17 | Rescue principles of Western medicine | 2.68 | 0.54 |
| 18 | Standardized treatment | 2.74 | 0.55 |
| 19 | Collect medical information using databases | 2.94 | 0.25 |
| 20 | Diagnosis and treatment via networks | 2.64 | 0.58 |
| 21 | Patient record keeping | 2.55 | 0.62 |

SD, standard deviation.

Table 4 Kaiser-Mayer-Olkin sampling adequacy and Bartlett's test

| Test | Value |
|---|--------|
| Kaiser-Meyer-Olkin measure of sampling adequacy | 0.66 |
| Bartlett's sphericity test | |
| Approx. Chi-Square | 8,078 |
| Difference | 210 |
| Significance | <0.001 |

items into three possible factors, which were then formed using structural equations and validity theory. The basic medical knowledge of Factor 2 underpins the model, as the individual's role is shaped by their experience, suggesting that its function is not susceptible to external environmental influences (26,27).

These findings support the basic structure of the influencing factors present in competency theory (28), and our model provides a reasonable overview of the interactions between these factors. As such, this study presents an interpretable framework to understand the reasons for the different responses of TCM practitioners. The findings of the study also have practical implications. For human resources personnel, the competency model can be used as an assessment tool for recruitment, selection, and training. Different characteristics can influence whether a TCM practitioner is suitable for the job (29). A comprehensive understanding of these characteristics is important to improve the performance of TCM practitioners. This paper combines competency theory with EFA, CFA, and SEM to formulate a theory for assessing the competencies of TCM practitioners (30,31). The five

Table 5 Factor loading matrix following varimax rotation

| Item | Items | Component | | | | |
|------|---|-----------|-------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | Ethics and morality | 0.56 | 0.57 | 0.3 | -0.18 | -0.17 |
| 2 | Professional values | 0.61 | -0.23 | -0.12 | 0.28 | 0.33 |
| 3 | Respect for patients | 0.56 | -0.51 | 0.12 | -0.31 | -0.24 |
| 4 | Ability of self-regulation | 0.39 | 0.14 | 0.1 | -0.42 | 0.05 |
| 5 | Respect for other health professionals | 0.54 | 0.17 | -0.46 | -0.08 | 0.28 |
| 6 | Basic theory of traditional Chinese medicine | 0.33 | 0.36 | 0.18 | 0.06 | 0.22 |
| 7 | Basic knowledge of traditional medicine | 0.4 | 0 | 0.27 | 0.66 | -0.04 |
| 8 | Classical books of traditional Chinese medicine | 0.69 | -0.59 | 0.3 | -0.11 | -0.11 |
| 9 | Other medical knowledge | 0.59 | 0.08 | -0.63 | 0.14 | -0.39 |
| 10 | Communicate effectively with others | 0.37 | -0.1 | -0.14 | -0.35 | 0.17 |
| 11 | Solve problems with teamwork | 0.64 | -0.23 | -0.14 | 0.21 | 0.36 |
| 12 | Oral or written communication abilities | 0.71 | -0.59 | 0.33 | -0.07 | -0.08 |
| 13 | Good job in health education | 0.52 | -0.03 | 0.1 | -0.3 | 0.06 |
| 14 | Diagnose and treat diseases with dialectical theory | 0.56 | -0.16 | -0.13 | 0.01 | 0.15 |
| 15 | Comprehensively diagnose disease with laboratory examinations | 0.65 | 0.07 | -0.04 | 0.22 | -0.2 |
| 16 | Chinese medicine skills such as acupuncture and massage | 0.61 | 0.11 | -0.64 | 0.08 | -0.36 |
| 17 | Rescue principles of Western medicine | 0.48 | 0.23 | -0.39 | -0.1 | 0.29 |
| 18 | Standardized treatment | 0.37 | 0.56 | 0.25 | 0.17 | 0.09 |
| 19 | Collect medical information using databases | 0.43 | 0.02 | 0.33 | 0.68 | -0.03 |
| 20 | Diagnosis and treatment via networks | 0.56 | 0.2 | 0.29 | -0.34 | 0.1 |

Table 6 Cronbach's α reliability test of the identified factors

| No. | Factors | Cronbach's α |
|----------|-----------------------------|---------------------|
| Factor 1 | Professional value attitude | 0.58 |
| Factor 2 | Basic medical knowledge | 0.44 |
| Factor 3 | Communication skills | 0.65 |
| Factor 4 | Clinical skills | 0.64 |
| Factor 5 | Information management | 0.58 |

factors that significantly influence the performance of TCM practitioners are professional values and attitudes, basic medical knowledge, communication skills, clinical skills, and knowledge management. However, this research might have several limitations. First, variance methods in this research might intensify or underestimate the observed relations

between constructs, which leads to both type I and type II errors.

Conclusions

To the best of our knowledge, this study is the first attempt at a theoretical and methodological approach to the practice of Chinese medicine. The study aimed to provide a comprehensive theoretical framework based on competency theory to increase our understanding of the characteristics and behaviours of TCM practitioners. In practice, this study confirms the rationale for using targeted strategies to optimise job performance and proposes an initial site-specific assessment method for TCM practitioners. In addition, our findings highlight the need for managers and professionals to develop training systems for the proper and smooth integration of TCM professionals into hospital staff.

Table 7 Cronbach's α reliability test of the identified factors

| Factor | Items | FL | Cronbach's α | AVE |
|-----------------------------|---|------|---------------------|------|
| Professional value attitude | Ethics and morality | 0.95 | 0.58 | 0.34 |
| | Professional values | 0.14 | | |
| | Respect for patients | 0.17 | | |
| | Ability of self-regulation | 0.44 | | |
| | Respect for other health professionals | 0.24 | | |
| Basic medical knowledge | Basic theory of traditional Chinese medicine | 0.12 | 0.44 | 0.29 |
| | Basic knowledge of traditional medicine | 0.31 | | |
| | Classical books of traditional medicine | 0.93 | | |
| | Other medical knowledge | 0.2 | | |
| Communication skills | Communicate effectively with others | 0.28 | 0.65 | 0.36 |
| | Solve problems using teamwork | 0.5 | | |
| | Oral or written communication abilities | 1 | | |
| | Good job in health education | 0.41 | | |
| Clinical skills | Diagnose and treat diseases with dialectical theory | 0.5 | 0.64 | 0.28 |
| | Comprehensively diagnose disease using laboratory examination | 0.71 | | |
| | Chinese medicine skills, such as acupuncture and massage | 0.67 | | |
| | Rescue principles of Western medicine | 0.5 | | |
| | Standardized treatment | 0.37 | | |
| Information management | Collect medical information through database | 0.24 | 0.58 | 0.62 |
| | Diagnosis and treatment via networks | 0.58 | | |
| | Patient record keeping | 0.98 | | |

FL, standardised factor loadings; AVE, average variance extracted.

Table 8 Discriminant validity test of the identified factors

| Factors | Professional value attitude. | Basic medical knowledge | Communication skills | Clinical skills. | Information management |
|-----------------------------|------------------------------|-------------------------|----------------------|------------------|------------------------|
| Professional value attitude | 1 | | | | |
| Basic medical knowledge | 1.29 | 1 | | | |
| Communication skills | 1.2 | 1.13 | 1 | | |
| Clinical skills | 1.12 | 1.28 | 0.8 | 1 | |
| Information management | 1.16 | 1.18 | 0.8 | 0.97 | 1 |

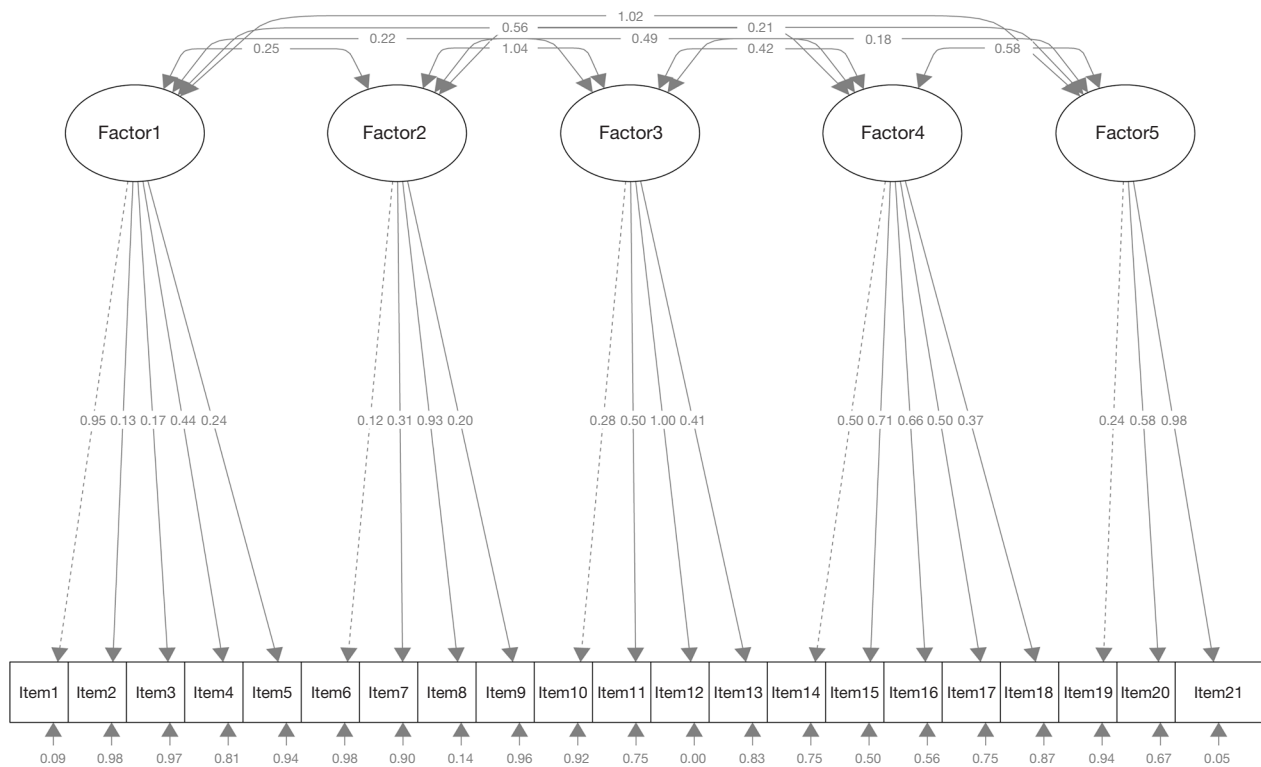


Figure 2 Structural equation model of TCM practitioner competency. TCM, traditional Chinese medicine.

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Footnote

Reporting Checklist: The authors have completed the SURGE reporting checklist. Available at <https://atm.amegroups.com/article/view/10.21037/atm-23-888/rc>

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related

to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Hangzhou Normal University (No. 20220812). Informed consent was taken from all the participants.

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