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RESEARCH ARTICLE

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Reliability and validity of the Chinese version of the instrument of health literacy competencies for health professionals

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Abstract

Aims: This study aimed to evaluate the reliability and validity of the Chinese version of an instrument of health literacy competencies for health professionals.

Design: This study utilized a cross-sectional design.

Methods: Authorization was obtained from the authors of the original scale to translate the scale and perform cross-cultural debugging. From August 2020 to November 2020, 573 health professionals were randomly selected from primary, secondary and tertiary hospitals in Huzhou to examine the reliability and validity of the Chinese version of an instrument of health literacy competencies for health professionals.

Results: The Chinese version of the scale contains 49 items. The internal consistency Cronbach's α was 0.958 for the total scale and 0.791–0.956 for each dimension. The test–retest reliability was 0.973. Confirmatory factor analysis showed that the fitness degree of the model is good ($\chi^2/df = 1.347$, IFI = 0.924, TLI = 0.913, CFI = 0.922, GFI = 0.841, AGFI = 0.815, RMR = 0.011, RMSEA = 0.035).

Conclusion: The Chinese version of an instrument of health literacy competencies is reliable and valid, which is a credible and effective tool to assess the level of health literacy competencies in Chinese health professionals.

Patient or public contribution: Health professionals with good health literacy competencies can provide patient-specific treatment and guidance to promote healthy outcomes for patients.

KEYWORDS
competency, factor analysis, health literacy, health professionals, reliability, validity

Huan Qi and Shengguang Chen contributed equally.

Huan Qi and Shengguang Chen authors as joint first author.

Current Work Unit of Huan Qi and Ting Chen, this study was conducted in Huzhou during their master's studies.

1 | INTRODUCTION

Health literacy has been extensively discussed worldwide and is defined by the WHO as the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways that promote and maintain good health (Commission, O. S. D. O., 2007). Health literacy has been demonstrated to be a core element of self-management, and patients' health literacy is positively associated with self-management behaviours (Mackey et al., 2016; Zou et al., 2017), especially in chronic diseases. Available evidence points to the critical role that self-management holds for those with chronic diseases in achieving or maintaining enhanced health status outcomes (Brady et al., 2018). Patients with adequate health literacy were 24.4 times more likely to have a better level of self-management behaviours than patients with inadequate health literacy, indicating that health literacy is a strong predictor of self-management behaviours (Yuting et al., 2022). Patients with high levels of health literacy are able to acquire extensive knowledge and have good self-care awareness (Rajah et al., 2017). Therefore, improving the health literacy of all people is an important prerequisite for improving the health of the entire population (Jianfeng, 2022). On the one side, low health literacy contributes to adverse health-related impact, poor treatment adherence, inadequate preventive behaviours, inability to comply with medical staff guidelines, inferior quality of life, high hospitalization rates, increased morbidity and elevated mortality rates (Rohringer et al., 2021). On the other side, weak health literacy can cause a huge economic implication, as some studies have estimated that approximately 5% of annual healthcare costs, compared with adequately health literate patients, may be up to $7,798 per year in additional expenses for patients with insufficient health literacy (Eichler et al., 2009). Medical staff are the disseminators of health knowledge, trainers of health skills and advocates of healthy lifestyles and behaviours, and their own health literacy level has a significant impact on the health literacy level of residents (Yijie et al., 2022). In this study, nurses were the main population. The standard on health literacy of medical staff directly affects the medical instructions and interventions they will provide to patients.

2 | BACKGROUND

According to one research, in the United States, nearly 90 million people are assessed to be health literacy deficient, resulting in up to $69 billion in unnecessary medical economic losses each year due to inadequate health literacy (Primack et al., 2007). In Europe, those lacking health literacy skills account for about 12% of the total population, and those with questionable knowledge of health literacy skills reach 35%. In the EU countries (Veenker & Paans, 2016), where people in a deficit of health literacy skills account for 10%–30% of the overall population, health service utilization is high, yet treatment has poor outcomes, and morbidity and mortality are negatively correlated with health literacy levels. A report shows that the health literacy of the Chinese population is at a low degree only 6.48%, and more seriously, less than 5% of them have chronic disease health literacy (2010). In the 2020 report, it is indicated that the health literacy level of Chinese residents reached 23.15%, of which 26.73% was for chronic disease prevention and treatment, which is still unsatisfactory, although it has been raised. The report clearly points out that the deficiency of our residents in the knowledge of chronic disease prevention and treatment is more obvious (2021). Not only our country but also the whole world urgently demands the popularization of health literacy knowledge, which can either reduce the waste of medical resources or enhance the prevention and management of people's chronic illnesses, to reduce morbidity and mortality. The consistent health guidance programme for all patients was probably the root cause of the slowly improving health literacy of patients, the implementation of customized health guidance for patients with various levels of health literacy is the priority task in front of every health professional.

In the face of widespread low population health literacy, the ability of health professionals to proactively identify people with low health literacy and to tailor their communication to patients with different levels of health literacy is particularly important. As further research on health literacy is conducted, the understanding of health literacy is not restricted to the characteristics of individuals (Durmuş, 2021) but covers multifaceted factors that contribute to health literacy, including the people who provide health knowledge and the health service providers. The health literacy of each individual is influenced by multiple sociodemographic elements, for example, educational level, life history and so on, which requires medical specialists to first assess the health literacy of patients and develop individualized health guidance programmes in order to help patients achieve better health outcomes. Therefore, we need to understand the characteristics of health literacy among medical professionals in China and abroad. Some figures show that in the United States, the population with insufficient health literacy is high at 80%, including 26% of health personnel, indicating that a considerable portion of medical personnel has problems with health literacy competency (McNeil & Arena, 2017). A survey by Malaysian researchers of their medical staff showed that 34.2% of the participants did not have knowledge about health literacy and 51.9% had a negative attitude towards health literacy (Rajah et al., 2017). A scientific study of registered nurses in Iran showed that although 38.9% of the participants knew the definition of health literacy, only 21.1% were aware of the importance of health literacy (Nesari et al., 2019). A survey on the health literacy level of medical personnel in a Chinese military hospital was 41.29% (Yujia et al., 2019). The results of a study of five occupational groups in Gansu Province showed that the health literacy rate of medical personnel was 30.77% (Junmei et al., 2019). From the above data, it can be seen that there is more improvement potential for the low health literacy of medical personnel at home and abroad.

A study by Turkish scholars showed that most health professionals are unfamiliar with the term "health literacy" and that the main reasons for this include lack of knowledge about health literacy, uncertainty about how to assess health literacy and lack of time (Güner & Ekmekci, 2019). Accordingly, monitoring, assessing and taking measures to improve the health level of medical personnel are crucial, WHO has incorporated health literacy competencies in the educational practices of medical personnel. Competencies are functions, knowledge and abilities and traits or motivations that are directly related to or associated with work or job performance or other important outcomes in life (McClelland, 1973). The existing universal health literacy assessment tools in China include the Chinese Public Health Literacy Assessment Questionnaire, the Chinese People's Health Literacy Questionnaire and the Chinese People's Health Literacy 66 Rules. However, there are fewer health literacy assessment tools for medical personnel, the Beijing Health Literacy Questionnaire for Medical Personnel, which focuses on measuring the health knowledge base of medical personnel but does not comprehensively measure the health competence of medical personnel (Xinlei et al., 2014). In contrast, the English version of the Instrument Of Health Literacy Competencies (IOHLC) developed by Taiwanese scholar Li-Chun Chang for medical staff includes specific content that medical staff should design lesson plans for patients with low health literacy, simple and specific teaching, creating a friendly environment, using simple and easy-to-use materials, life-oriented teaching, checking patients' understanding, encouraging patients to ask questions, designing materials for patients' self-direction and interdisciplinary collaboration. The model fits well, with Cronbach's alphas >0.80, and can be used to comprehensively and validly assess the health literacy competencies of medical professionals (Chang et al., 2017).

The purpose of this study is to provide a scientific Chinese version of a measurement tool for monitoring and evaluating the health literacy competency. We have been authorized by the original authors to translate the IOHLC scale. Explore the applicability of this scale and provide a reference for the development of a health literacy competency measurement tool for Chinese medical personnel. Assessment of health literacy competencies of healthcare professionals and corresponding interventions to enhance health literacy competencies. Thus, tailored interventions are given to patients to improve their health literacy levels and health status.

3 | METHODS

3.1 | Study design

This study used a cross-sectional survey design with randomized whole-group sampling, using Huzhou City, Zhejiang Province, as the research base. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to explore the applicability of the IOHLC scale to medical personnel in the Huzhou city area.

3.2 | Participants

In this study, the target population was health professionals (e.g., physicians, nurses, Chinese medicine practitioners, community physicians and community nurses). Random sampling was performed in primary, secondary and tertiary hospitals in Huzhou City from August to December 2020. The sample size was estimated according to the principle that the surveyed number was 10–20 times the number of items (Sousa & Rojjanasrirat, 2011). The sample size of the culturally adapted Chinese version of the IOHLC (C-IOHLC) was selected as 10 times the number of items, i.e. 490, taking into account the possibility of invalid questionnaires in clinical surveys, and increasing the sample size by 10%. At the same time, to ensure the reliability of the results of the EFA and the CFA, a sample size of more than 200 people was required for both parts. Finally, 170 patients were selected from community hospitals, 190 from secondary hospitals and 213 from tertiary hospitals, and the final sample size of this study was 573. Then, the reliability of the results of the EFA and CFA was considered. Thus, the total sample size was approximately 573. The inclusion criteria were as follows: (1) aged 18–60; (2) possession of a licence; (3) in employment; (4) working length of at least 6 months; (5) willingness to participate and provide written informed consent. The exclusion criteria were as follows:(1) a person who will leave within 1 year (2) not completing the questionnaire.

3.3 | Chinese version of IOHLC

The instrument of Health Literacy Competencies is a scale-based measure with a total of 49 items. It captures all attributes of health literacy competencies and contains two dimensions of knowledge and skill. The knowledge domain comprises nine true/false items, each item is scored 0 points for an incorrect answer and 1 point for a correct answer. The total score ranged from 0–9, a higher score reflects a greater health knowledge level. The skills domain contains 40 items with nine sub-dimensions, including "design teaching plan for LHL", "simple and concrete teaching", "build a friendly environment", "use easy-to-use resources", "life-oriented teaching", "check for understanding", "encourage clients to ask questions", "self-designed materials to clients" and "interdisciplinary collaboration". And items are rated on a five-point Likert scale: 1 = Highly disagree; 2 = Disagree; 3 = Uncertain; 4 = Agree; 5 = Highly agree. The higher scores on the scale, the better are the health literacy skills of the participants.

3.4 | Trans-language adaption of IOHLC

We obtained consent and authorization to use and translate the instrument from Li-Chun Chang, the original author of IOHLC. A systematic process which included forward-translation, backward-translation, cultural adaptation, content reliability evaluation and

pretest. The specific steps are as follows. (1) Forward translation: The English version of IOHLC was translated into Chinese by two medical graduate students independently, and formed translation versions T1 and T2. (2) Reconciliation: An expert panel, including a nursing expert with doctoral degree and two forward translators, reviewed T1 and T2 and formed the first Chinese translation version T3. (3) Back-translation: two nursing graduate students, who did not read the original English scale, translated T3 back into English separately and form a back translation version T3-1 and T3-2. (4) Synthesis of the translations: The original IOHLC developer, a nursing expert with a Ph.D. and two nursing graduate students with overseas study experience compared the definition, content and semantics of the back-translation version with the original scale and revised the problematic items of the Chinese version. After reaching an agreement, it was moved to form a T3-3. (5) Cultural adaptation: The cultural adaptation version T4 was formed based on the opinions from a discussion between the research group and nine nursing experts who are familiar with the subject. (6) Scale content reliability evaluation and pretest: nine experts with more than years of working experience in this field were invited to evaluate the content validity of the scale using a 4-point Likert rating (1 = inconsistent; 2 = less consistent; 3 = basically consistent; 4 = very consistent). Then 58 clinical medical staff were selected for pre-experiment to test whether the items were semantically ambiguous or unclear and T4 were revised to form the C-IOHLC.

3.5 | Data collection

Prior to data collection, members of the research group were trained to ensure consistency of the questionnaire survey. All participants signed informed consent before completing the questionnaire. Questionnaires were collected on the spot and conducted using a uniform guideline language. The researchers personally checked for the wrong or leaked items and timely communicated with the participants. A total of 573 health professionals participated in the study, 578 questionnaires were issued and 573 valid questionnaires were retrieved with an effective recovery rate of 99%.

3.6 | Reliability evaluation

The internal consistency reliability was evaluated by using the Cronbach's α coefficient with a value above 0.70 (Hedayati et al., 2021), indicating acceptable congruence of the internal construct. For dichotomous variables, the score is 0 or 1, and the Cronbach's α coefficient is not calculated. Considering that the sample size for retesting reliability is generally 10% of the total sample size, 58 participants were randomly selected from the sample (Huijuan & Changchun, 2011) and they were re-evaluated after 2 weeks. Test–Retest Reliability was also assessed.

3.7 | Validity evaluation

3.7.1 | content validity

In this study, the content validity and construct validity of the Chinese version of the IOHLC scale were verified successively. The content validity was analysed by the item content validity index (I-CVI) and the content validity of the total item (S-CVI). Nine experts from the fields of psychology, nursing, clinical medicine and community health were invited to evaluate the content validity of C-IOHLC in this study. The items were scored based on the relevance and representativeness of each item on the scale, using a four-point Likert rating (1 = inconsistent; 2 = less consistent; 3 = basically consistent; 4 = very consistent). According to the proportion of experts who gave a score of 3 or 4 in the expert score, to calculate the I-CVI for each item. Then the S-CVI was calculated based on the average of I-CVI. We considered the content validity of the scale satisfactory when the number of consulting expert groups was ≥6, I-CVI > 0.78 and S-CVI > 0.9 (Merino-Soto & Livia-Segovia, 2022).

3.7.2 | Exploratory factor analysis

The construct validity was evaluated by EFA and CFA. In this study, the 573 questionnaires were randomly grouped, with 287 in the EFA group (Group A) and 286 in the CFA group (Group B). When conducting the EFA, the first step is to calculate the Kaiser–Meyer–Olkin (KMO) and Bartlett's sphericity test, which ranges from 0–1. The larger the KMO, the more reliable the results of EFA. Factors can be extracted by analysing the scree plot. Then, the criteria for the exploratory analysis to determine how many factors to retain should include the following five aspects:(1) the item feature value of 1 or above; (2) the total cumulative variance contribution rate of 40% or above; (3) the scree plot; (4) the factor loading of 0.40 or above; (5) at least two items per factor are retained (Zhaolun, 2017). The feature value of a factor affects the variance contribution of the factor, which is one of the bases for selecting the factor. The analysis of the scree plot focuses on observing the turning points of the line, and the number of factors corresponding to the flattening from steep. Rotate items by maximum variance method.

3.7.3 | Confirmatory factor analysis

The measurement and evaluation of CFA fit results should be judged by the following indicators: The measurement and evaluation of the CFA model fit results are based on the following indicators: (1) the chi-square to degrees of freedom ratio (χ^2/df); (2) the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the incremental fit index (IFI) and the Tucker–Lewis index (TLI); (3) root mean square error of approximation (RMSEA); (4) root of the mean square residual (RMR).

3.8 | Statistical method

The database was established using Epidata 3.1, and the double-entry method was used to ensure the accuracy of data. SPSS 24.0 and AMOS23.0 were used for data analysis. Descriptive statistics were expressed as mean and standard deviation for measurement data and percentage (%) for counting data. Structural validity was assessed by CFA and EFA. Reliability was estimated in test–retest reliability and internal consistency, Cronbach's α coefficient. Significant differences were judged at $p < .05$.

4 | RESULTS

4.1 | Sample characteristic

The demographic data include age, gender, educational level, marital status, role at clinic, work department, years working in hospital and health status. A total of 573 health professionals, including 89 males and 484 females, aged (32.94 ± 7.47) years, were surveyed, including 368 nurses, 166 doctors and 39 other health workers, and the demographic characteristics are summarized in Table 1. The demographic characteristics of the EFA and CFA groups were not statistically different, as shown in Table 2.

4.2 | Content validity

The content validity of C-IOHLC was assessed by nine medical experts. The results showed that the I-CVI value of each item ranged from 0.89–1.00 and the S-CVI was 0.96, which indicates that the scale had good content validity.

4.3 | Exploratory factor analysis

Before the exploratory analysis, KMO and Bartlett's sphericity tests were conducted on 287 participants in the EFA group. The KMO value was 0.941, and the significance of Bartlett's sphericity was <.001. ($\chi^2 = 9{,}917.492$, $df = 1{,}176$, $p < .001$), indicating that the sample was suitable for factor analysis (Amerioun et al., 2018; Siti et al., 2016; Williams et al., 2010).

The exploratory factor analysis extracted 10 common factors with feature value >1 and factor load >0.4. The total cumulative variance contribution rate is 67.584% and a load of each factor was 0.506–0.813, indicating that the 10 extracted common factors could provide a great explanation of the content of the original scale (Bing & Leilei, 2019), as shown in Table 3. The rotating component matrix was 0.404–0.857. According to the results in Table 4, from a statistical point of view, factor 9 should be deleted and factors 6, 7, 8 and 10 should each become independent factors, but these nine items all test the knowledge of healthcare professionals and the original scale is divided into one domain, so we decided to combine the 6, 7, 8, 9 and 10 common factors into a common factor based on the original scale structure and professional perspective. All items in the dimension "Creating a friendly environment" were included in Factor 1, but from a professional point of view, it was decided to keep "Creating a friendly environment" as a separate factor. Thus, the attribution dimension of C-IOHLC changed from 10–7 factors, and the factor items and nomenclature are shown in Table 5.

TABLE 1 Demographic data of all participants ($N = 573$)

Variables	Number or mean (*SD*)	Frequency (%)
Gender		
Male	89	15.5
Female	484	84.5
Age (18–60 years old)	32.94 (7.47)	
18–30	245	42.8
31–40	239	41.7
41–60	89	15.5
Education level		
College	144	25.1
Undergraduate	410	71.6
Master and above	19	3.3
Marital status		
Unmarried	139	24.3
Married	427	74.5
Divorce	7	1.2
Place of origin		
Huzhou, Zhejiang	521	90.9
Other provinces and cities	52	9.1
Role at clinic		
Nurse	368	64.2
Doctors	166	29
Other	39	6.8
Work department		
Internal medicine	147	25.7
Surgery	59	10.3
women and children	106	18.6
Community outpatient clinic	70	12.2
Community general practice	101	17.6
Others	90	15.7
Years working in hospital	10.76 (7.98)	
0–5	176	30.7
6–10	165	28.8
11–15	81	14.1
16–40	151	26.4
Health status		
Health	411	71.7
Good	156	27.2
Poor	6	1

TABLE 2 Demographic characteristics of the two subsamples

Variables	Groups	Group A (*N* = 287)	Group B (*N* = 286)	*p*
Gender (%)	Male	48 (16.8)	41 (14.3)	.43
	Female	239 (83.2)	245 (85.7)	
Age (%)	18–30	121 (42.2)	124 (43.4)	.13
	31–40	129 (44.9)	110 (38.5)	
	41–60	37 (12.9)	52 (18.1)	
Education level (%)	College	65 (22.7)	79 (31.8)	.361
	Undergraduate	213 (74.2)	197 (66.4)	
	Master and above	9 (3.1)	10 (1.7)	
Marital status (%)	Unmarried	61 (21.3)	78 (27.3)	.111
	Married	224 (78.0)	203 (71.0)	
	Divorce	2 (0.7)	5 (1.7)	
Place of origin (%)	Huzhou, Zhejiang	266 (92.7)	255 (77.6)	.142
	Other provinces and cities	21 (7.3)	31 (22.4)	
Role at clinic (%)	Nurse	192 (66.8)	176 (61.5)	.38
	Doctors	78 (27.2)	88 (30.8)	
	Other	17 (6.0)	22 (7.7)	
Work department (%)	Internal Medicine	66 (23.0)	81 (28.3)	.687
	Surgery	32 (11.2)	27 (9.4)	
	women and children	55 (19.2)	51 (17.9)	
	Community outpatient clinic	34 (12.0)	36 (12.6)	
	Community general practice	50 (17.4)	51 (17.8)	
	Others	49 (17.2)	40 (14.0)	
Years working in hospital (%)	0–5	81 (28.2)	95 (33.2)	.629
	6–10	85 (29.6)	80 (28.0)	
	11–15	43 (15.0)	38 (13.3)	
	16–40	78 (27.2)	73 (25.5)	
Health status (%)	Health	216 (75.3)	195 (68.2)	.148
	Good	69 (24.0)	87 (30.4)	
	Poor	2 (0.7)	4 (1.4)	

4.4 | Reliability

The Cronbach's α coefficient of C-IOHLC was 0.958, and the Cronbach's α coefficient of each factor was 0.956, 0.792, 0.826, 0.844 and 0.791. Since factor 7 is a dichotomous item, we did not calculate the Cronbach's α coefficient. Fifty-eight patients were randomly selected from the sample, and they were re-evaluated after 2 weeks. The test–retest reliability was 0.903. The test–retest reliability of each factor was 0.956, 0.880, 0.920, 0.943, 0.928 and 0.983, indicating that the reliability of C-IOHLC was acceptable.

4.5 | Confirmatory factor analysis

The seven dimensions obtained from EFA were validated to determine the fit of the factor model with maximum likelihood. And the 286 cases of CFA data were used to determine the construct validity of the scale. If GFI, CFI, TLI and NFI are all greater than 0.8 (Abedi et al., 2015; Hu & Bentler, 1999), RMR is less than 0.1, and RMSEA is less than 0.08, indicating that the model is valid. The results of CFA were as follows: χ^2/df was 1.887, GFI = 0.773, IFI = 0.793, TLI = 0.777, CFI = 0.790, AGFI = 0.749, RMR = 0.012, RMSEA = 0.056, which indicated that the model has not reached the requirements for satisfactory fitting, thereby required further model corrections.

AMOS23.0 was used to modify the model with modification index (MI) and rule of thumb (Abedi et al., 2015). For values of MI > 4, a correction is made to increase the inter-residual path to better reduce the chi-squared value. The results of the modified model showed that seven indicators satisfied the requirements for model fitting (Table 6, Figure 1).

4.6 | Participants' scores on the C-IOHLC scale

The population of this study was divided into nurses, doctors and other medical staff, and the scale consisted of knowledge domains

TABLE 3 Common factor variance ratios of C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies)

Items	Initial	Extraction
K2 Adequate health literacy is the ability to read, understand and process health information.	1	0.496
K4 A risk factor for lower health literacy is age.	1	0.54
K5 Patients with high educational levels may present with low health literacy.	1	0.611
K7 Using the right tool is the best way to assess health literacy and identify patients with low health literacy.	1	0.604
K8 People with low health literacy need additional medical support and therefore pay higher healthcare costs.	1	0.602
K9 Health education materials should be written at a level equal to or less than the reading level of a seventh-grade reading level.	1	0.657
K10 Health literacy may affect physician-patient communication.	1	0.772
A1 will say, "I can do this, there is no need to teach me" to cover up for their lack of understanding.	1	0.76
A3 will not tell you if they cannot read.	1	0.766
Q11 encourages clients to demonstrate learned skills to determine their comprehension.	1	0.63
Q13 Make eye contact with patients to ensure concentration.	1	0.712
Q14 Asks clients to retell the key points they learned.	1	0.651
Q15 Pay attention to the patient's repeated questions.	1	0.696
Q16 Observe nonverbal expressions (e.g. facial expressions) to determine whether the patient has understood.	1	0.719
Q33 Cooperate with other professionals to design health education plans.	1	0.813
Q34 Design audio-visual teaching materials.	1	0.756
Q36 Collaborates with other professionals to implement behaviour modification counselling.	1	0.738
Q38 Design computer-based teaching aids.	1	0.582
Q39 Design health education leaflets with less than 20% text.	1	0.506
Q41 Create a personal textbook file.	1	0.714
Q43 Design educational materials for illiterate people.	1	0.673
Q44 Determine the appropriate teaching time for different clients.	1	0.737
Q46 Apply appropriate tools to assess the patient's level of health literacy.	1	0.76
Q48 Identify the typical characteristics of low health literacy before teaching.	1	0.613
Q49 Establish proper evaluation criteria for health literacy practices.	1	0.732
Q51 Modify educational programs to accommodate different patients' questions.	1	0.613
Q53 Limits the curriculum to two or three new topics.	1	0.727
Q54 Different assessment methods are designed according to the health literacy level of the service users.	1	0.689
Q55 Use plain language instead of medical jargon.	1	0.766
Q58 Explain the care a patient needs with a living example.	1	0.759
Q59 Teach in a language that the client understands.	1	0.762
Q61 Connect previous experience with new learning.	1	0.735
Q64 Repeat the lesson when the service recipient cannot understand the teaching content.	1	0.615
Q66 Uses demonstration techniques.	1	0.669
Q69 Explain the plan of care and related treatments in simple terms.	1	0.666
Q71 At the end of the interview, summarize the teaching focus.	1	0.665
Q72 Guidance on what to do, rather than explaining the disease or condition.	1	0.603
Q74 Provides self-designed stickers for easy record keeping by service recipients.	1	0.745
Q75 Use the one-by-one method and pictorial image material	1	0.732
Q76 Prepare teaching materials or teaching tools in health education.	1	0.657
Q78 Uses online or Internet instruction.	1	0.681
Q81 Understand the non-compliant behaviour of service users.	1	0.663
Q82 Invite caregivers to participate in the teaching program.	1	0.734
Q85 Create an environment of mutual trust.	1	0.722
Q87 Create an environment free from embarrassment.	1	0.668
Q90 Teaches clients to ask, "What is my main problem?"	1	0.687
Q91 Teaches clients to ask, "What do I need to do?"	1	0.648
Q92 Teaches clients to ask, "What can I do to help my body?"	1	0.618
Q93 Encourage clients to talk about what the doctor say to them.	1	0.452

TABLE 4 Factor load matrix after rotation of C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies)

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
Q58	0.796									
Q55	0.795									
Q59	0.759									
Q61	0.757									
Q85	0.725									
Q46	0.661									
Q82	0.66									
Q87	0.656									
Q49	0.633									
Q71	0.626									
Q69	0.614									
Q76	0.608									
Q74	0.592									
Q92	0.588									
Q44	0.52									
Q81	0.517									
Q66	0.517									
Q54	0.493									
Q43	0.487									
Q78		0.653								
Q90		0.622								
Q53		0.619								
Q91		0.52								
Q93		0.486								
Q75			0.658							
Q38			0.653							
Q48			0.524							
Q39			0.488							
Q64			0.478							
Q72			0.454							
Q41			0.404							
Q33				0.781						
Q34				0.683						
Q36				0.611						
Q51				0.454						
Q13					0.68					
Q14					0.563					
Q15					0.556					
Q11					0.492					
Q16					0.456					
A1						0.83				
A3						0.827				
K5							0.749			
K7							−0.685			
K8								0.732		

(Continues)

TABLE 4 (Continued)

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
K9								0.633		
K4									0.684	
K10										0.857
K2										−0.457

TABLE 5 Structure of C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies)

Factor	Number of items	Items
Factor 1: Simple and practical teaching plan.	15	Q43, Q44, Q46, Q49, Q54, Q55,Q58, Q59, Q61, Q66, Q69, Q71,Q74, Q76, Q92
Factor 2: Building a friendly environment.	4	Q81, Q82, Q85, Q87
Factor 3: Life-oriented teaching.	5	Q53, Q78, Q90, Q91, Q93
Factor 4: Self-designed low literacy materials to clients.	7	Q38, Q39, Q41, Q48, Q64,Q72,Q75
Factor 5: Interdisciplinary collaboration.	4	Q33, Q34, Q36, Q51
Factor 6: Checking for understanding.	5	Q11, Q13, Q14, Q15, Q16
Factor 7: Knowledge domain.	9	A1, A3, K2, K4, K5,K7, K8, K9, K10

TABLE 6 Fitting index before and after the modification of the seven-factor model of C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies)

Statistical quantities	Ideal value	Acceptable values	Before amendment	After correction
χ^2/df	≤3.0	≤5.0	1.887	1.379
GFI	≥0.9	≥0.8	0.773	0.837
AGFI	≥0.9	≥0.8	0.749	0.811
CFI	≥0.9	≥0.8	0.79	0.915
IFI	≥0.9	≥0.8	0.793	0.917
TLI	≥0.9	≥0.8	0.777	0.905
RMR	≤0.08	≤0.10	0.012	0.011
RMSEA	≤0.08	≤0.10	0.056	0.036

Abbreviations: AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; IFI, incremental fit index; RMR, root of the mean square residual; RMSEA, root mean square error of approximation; TLI, Tucker–Lewis index.

and skill domains. The skill domain includes factors 1, 2, 3, 4, 5, 6, with 40 items and a score range of 40–200, with higher scores indicating better health literacy skills. Factor 7 belongs to the knowledge domain, with nine items and a score range of 0–9. The higher the score, the higher the level of health literacy knowledge is reflected. From Table 7, it can first be seen that the health literacy scores of nurses, doctors and other medical personnel in the Huzhou area are generally moderate to high in the knowledge domain and skill domain, indicating the need to further improve the health literacy of medical personnel. Second, we found statistically significant differences in the health literacy scores of medical personnel in different positions on the total score and skill domains.

5 | DISCUSSION

There was an urgent need for an effective and precise instrument to assess the health literacy competency of medical personnel in China, as only on the basis of knowing the health literacy level of health professionals in our country can we further identify the influencing factors to implement interventions and then improve the health literacy of medical staff and ultimately provide treatment guidance and interventions appropriate for each patient. Therefore, this study was conducted to translate and validate the IOHLC scale in mainland China to understand the accuracy and validity of the C-IOHLC scale. To the best of my knowledge, the IOHLC scale is the first specific for assessing the health literacy competency of health professionals and is highly targeted. This study was translated strictly according to equivalence and validated by Cronbach's α, retest reliability, content validity, EFA and CFA. While previous studies on medical staff health literacy have tended to include doctors as subjects, this study is a comprehensive assessment of physicians, nurses and other medical professionals from all levels of hospitals. The findings showed that the C-IOHLC scale is a multidimensional and multi-perspective scale with excellent reliability and validity.

In the study, the total Cronbach's α coefficient was 0.957, and the Cronbach's α coefficient of each dimension ranged from 0.768–0.940. The overall test–retest reliability was 0.973, and the test–retest reliability of each dimension ranged from 0.880–0.983. The results showed that the C-IOHLC had adequate reproducibility and high internal consistency reliability. Content validity and construct validity were used to examine the validity of C-IOHLC (Luo et al., 2021). The content validity of C-IOHLC was assessed by nine medical experts. The results showed that the I-CVI value of each item ranged from 0.89–1.00 and the S-CVI was 0.96, which indicates that the scale had good content validity. The exploratory factor

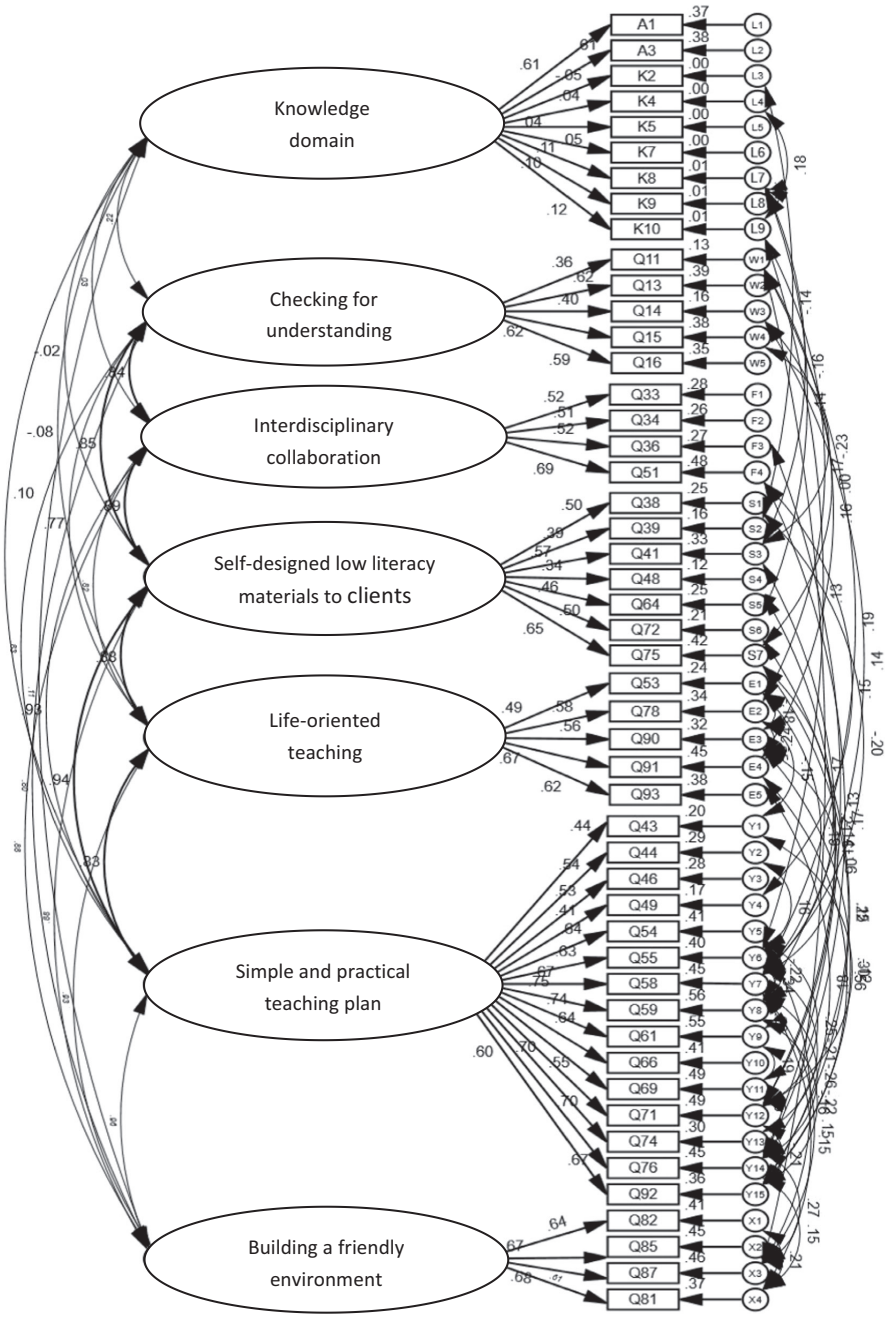

FIGURE 1 Modified seven-factor model of C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies) ($N = 286$)

TABLE 7 Scores on the C-IOHLC (Chinese version of the Instrument Of Health Literacy Competencies) scale for different positions of medical staff ($N = 573$)

Population	*N*	Total score (Mean ± *SD*)	Knowledge domain (Mean ± *SD*)	Skill domain (Mean ± *SD*)
Nurse	368	177.41 ± 13.84	5.80 ± 1.37	171.61 ± 13.60
Doctor	166	173.93 ± 18.45	5.84 ± 1.48	168.10 ± 17.87
Others	39	179.82 ± 12.28	5.97 ± 1.50	173.85 ± 12.02
*p**		.02	.743	.017

*$p < 0.05$.

analysis reclassified the scale into seven dimensions, with a total cumulative variance contribution rate of 67.584%. The results of CFA suggested that the initial model fitting was less satisfactory and required further model corrections (Weijia, 2019). The modified model showed that χ^2/df was 1.379, IFI = 0.917, TLI = 0.905, CFI = 0.915, GFI = 0.837, AGFI = 0.811, RMR = 0.011 and RMSEA = 0.036, which satisfied the requirements for model fitting.

The analysis of the health literacy profile of medical personnel revealed that the total health literacy scores of nurses and medical personnel in other positions were higher than those of physicians

and were statistically significant. This situation may be related to the fact that the nursing profession is increasingly focusing on communication with patients and is playing an increasingly important role in health education (Kim & Oh, 2020). Also, literacy is positively correlated with health literacy of medical staff, i.e. the higher the literacy level, the better the health literacy competency of medical staff (Rajah et al., 2017). Unfortunately, this study did not find a significant effect of years of service of medical personnel on health literacy. The nine dimensions of the skill domain of the original scale were named: (1) checking comprehension, (2) interdisciplinary collaboration, (3) designing low-literacy materials for clients, (4) designing lesson plans for low health literacy, (5) living instruction, (6) simple and practical instruction, (7) easy-to-use materials design, (8) creating a friendly environment and (9) testing comprehension. The EFA of this study revealed that Factor 1 had 15 items, which were related to the items of dimensions 3, 4, 5, 6, 7 and 9 of the original scale, and was named as "multi-path teaching for low health literacy clients"; Factor 2 has four items, which are exactly the same as the items in the dimension of "Creating a friendly environment" of the original scale, and is still named "Creating a friendly environment"; Factor 4 has seven items, including items in dimensions 3, 4, 6 and 7 of the original scale, and is named "Designing practical teaching materials for clients"; Factor 5 has four items, including items in dimensions 3 and 5 of the original scale, and is named "Interprofessional collaboration in designing health education programs for patients with low health literacy"; Factor 6 has five items, which are identical to the items in dimension 1 of the original scale, and is named "Checking comprehension"; Factor 7 has nine items, which are knowledge domains of the original scale, and is named "Knowledge domain". The difference in the division of dimensions may be due to some cultural differences in the health literacy competency of medical personnel in mainland China and Taiwan and may also be related to the fact that this study was conducted in Huzhou only, and the data are not representative to a certain extent.

Medical professionals want to improve patients' health outcomes through health education, to raise the quality of life and reduce financial burden. However, the existing problem is that uniform health education is applied to patients with diverse health literacy levels. Health education and disease management measures for patients with low health literacy levels may be unscientific and ineffective. In short, the health literacy competency of medical staff is insufficient, i.e. medical workers do not have the awareness to assess the health literacy of patients and are unable to proactively assess the health literacy degree of patients and deliver targeted healthcare directions. The IOHLC scale translates these concepts into measurable items that provide a comprehensive picture of medical staff health literacy competency, including communication skills, assessment and identification of patient comprehension (Schulz & Nakamoto, 2013). The C-IOHLC scale has clear score definitions, and medical staff only need to use 10–15 min of their free time to complete this Chinese version of the questionnaire to learn about their health literacy competency. The C-IOHLC provides a reliable tool for further improving medical staff health literacy implementation interventions. It allows medical staff to adopt different communication methods and health instructions when dealing with different patients, reduces ineffective communication with patients, promotes patient management, reduces waste of medical resources and improves quality of life.

This study presents certain limitations. First, the sample size of this study was obtained through random sampling of medical personnel in primary, secondary and tertiary hospitals in Huzhou City, and the representativeness of the sample size needs to be strengthened. Second, because there is no scale to assess the health literacy competency aspects of medical personnel in mainland China, the validity of the validity criteria association was not done in this study. Further research can be conducted in different regions to identify the influencing factors that affect the health literacy competency of medical personnel, which can provide a reference basis for implementing corresponding interventions to upgrade the health literacy competency of health care professionals.

6 | CONCLUSION

Our study followed the guidelines of scale cross-cultural adaption to Chinese the IOHLC scale and formed a Chinese version of the IOHLC scale. The C-IOHLC includes seven dimensions: "Knowledge domain", "Cooperate with other professionals to design health education plans", "Diverse teaching methods for low health literacy clients", "Design practical teaching materials for clients", "Confirm whether the patient has understood", "Check client's comprehension" and "Create a friendly environment", with 49 items. In summary, the Chinese version of the IOHLC scale has good reliability and validity. It is confirmed to be an effective instrument to assess the health literacy competency of health professionals. It provides evidence to identify the low health literacy competency of medical personnel and implement behavioural guidance and interventions.

AUTHOR CONTRIBUTIONS

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/recommendations/)]:

- substantial contributions to conception and design, acquisition of data or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

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CONFLICT OF INTEREST

All authors confirm that there is no conflict of interest in relation to study.

ETHICS STATEMENT

This study has been approved by the Medical Ethics Committee of Huzhou University and the ethical approval number is 20191018106.

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SUPPORTING INFORMATION

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