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Development and application of a core competency evaluation index system for pediatric asthma specialist nurses in China: a mixed-method study

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Abstract

Background Specialist nurses' core competencies are crucial for pediatric asthma management, yet no evaluation system exists for these competencies.

Objective To construct a core competency evaluation index system for pediatric asthma specialist nurses.

Design A mixed-method study using semi-structured interview, Delphi method and cross-sectional survey.

Methods Literature review and semi-structured interviews were performed to developed the initial competencies evaluation index system for pediatric asthma specialist nurses. A two-round Delphi survey was conducted from May 2022 to August 2022, with 21 experts from four provinces in China to rate the importance of each indicator and propose modifications to the evaluation index system. A questionnaire survey with the evaluation indicators was conducted to investigate the level of nurses' core competency after pediatric asthma specialist training.

Results The effective questionnaire recovery rates were 100% and 95% in two rounds of expert consultation, with expert authority coefficients of 0.892 and 0.910, respectively. The core competency evaluation index system for pediatric asthma specialist nurses included 2 definitions, 6 first-level indicators, 16 second-level indicators and 63 third-level indicators. The Kendall's W coefficients were 0.343 and 0.384 for the first- and second-level indicators in the second round of consultations. Of 80 questionnaires, 69 were valid, wtith Cronbach's α coefficients of the first-level indicators ranging from 0.896 to 0.968.

Conclusion A core competency evaluation index system for pediatric asthma specialist nurses was developed, and demonstrated to be scientific, reliable, and applicable.

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Statement of implications The core competency index system for pediatric asthma nurses standardizes the assessments, and supports professional development, ultimately enhancing patient outcomes.

Keywords Pediatric asthma, Specialist nurses, Core competencies, Delphi method, Analytic hierarchy process

Introduction

Asthma, featured by wheeze, shortness of breath and cough, is the most common chronic respiratory disease in childhood in the world, with about 14% of children and young individuals affected [1]. The overall prevalence of pediatric asthma in American is around 25% [2]. Asthma can be typically triggered by a number of possible stimuli, and lead to heavy burdens including direct medical costs (e.g., hospitalizations, emergency room visits, medical practitioner visits and medication), and indirect nonmedical costs (e.g., time lost from work/school, decreased productivity at work/school, premature death) [3]. Therefore, the management of pediatric asthma is of vital important.

Since pediatric asthma control is a long-term process, well management of asthma is essential for children's health and development. Notably, clinical specialist nurses with advanced education and training in specialized nursing areas [4] play a key role in educating, advising, and directly intervening in disease management. Pediatric asthma specialist nurses are able to undertake and guide clinical pediatric asthma nursing work since they have undergone the training with professional knowledge and specialist practical skills of pediatric asthma on the basis of practicing qualifications. The specialist nurses have advanced expertise in their specific areas, whose core competence level concerns the quality of nursing [5].

Nurses' core competency directly affects nursing quality and lead to a great impact on clinical outcomes [6]. Core competence in the field of nursing refers to the knowledge, skills and attitude and personal quality that a nurse must possess in clinical nursing work [7]. Core competencies usually need to be assessed by using systematic and standardized evaluation indexes. The construction of core competencies evaluation index for nurses has been a hot topic of nursing. The core competencies evaluation indexes for clinical nurse educator [8], advanced practice nurse [9], infection control specialist nurse [5], specialist nurses in pediatric emergency care [10], blood purification nurse [11], and trauma [12], have been constructed in China. However, the core competencies evaluation index for pediatric asthma specialist nurses has not been reported.

The competencies evaluation index system can serve as not only a foundation for educating and training pediatric asthma specialist nurses, but also a scientific measure of the effectiveness of nurse education. A framework ----"The Essentials: Core Competencies for Professional Nursing Education", emphasizing the importance of competency-based education (CBE) and encompassing 10 areas of nursing practice with expected competencies (see Fig. 1), was referred to assign competencies to individual levels of education. Nurses at different levels require distinct competencies in pediatric asthma: (1) Basic Level (Undergraduate Nursing Education): Undergraduate Level: They need to understand respiratory anatomy, asthma pathophysiology, and treatment. They must master asthma assessment, manage exacerbations, educate families, and communicate effectively. (2) Graduate Level: They should use tools like the Asthma Control Test, develop personalized management plans, and lead multidisciplinary teams. (3) Professional Development: Nurses should update their knowledge, engage in research, and strive for quality improvement in asthma care. Through the cultivation of these core knowledge and skills, nurses at different educational levels can provide high-quality nursing care in the field of pediatric asthma, promoting the health and well-being of children.

To date, the evaluation of pediatric asthma-related core competencies lacks systematic standards, which is not conducive to the standardized management and certification of pediatric asthma specialist nurses. Therefore, this study aims to construct an evaluation index system for the core competencies of pediatric asthma specialist nurses, and then apply this evaluation index system to conduct a survey among pediatric asthma specialist nurses.

Methods

Design

A mixed-method study was performed. Semi-structured interview, literature review and Delphi method were used to establish the core competencies evaluation index system of pediatric asthma specialist nurses. The Delphi method [13], known as the expert consultation, is widely used to establish various evaluation systems and determine specific indicators via obtaining high-quality responses from a panel of experts. The consolidated criteria for reporting qualitative studies (COREQ) [14] was followed.

The semi-structured interview is to perform interview according to the prepared outline to understand interviewees' attitude, emotion and motivation to a research question. This method could produce powerful data by providing insights into the participants' perceptions, experiences or opinions.

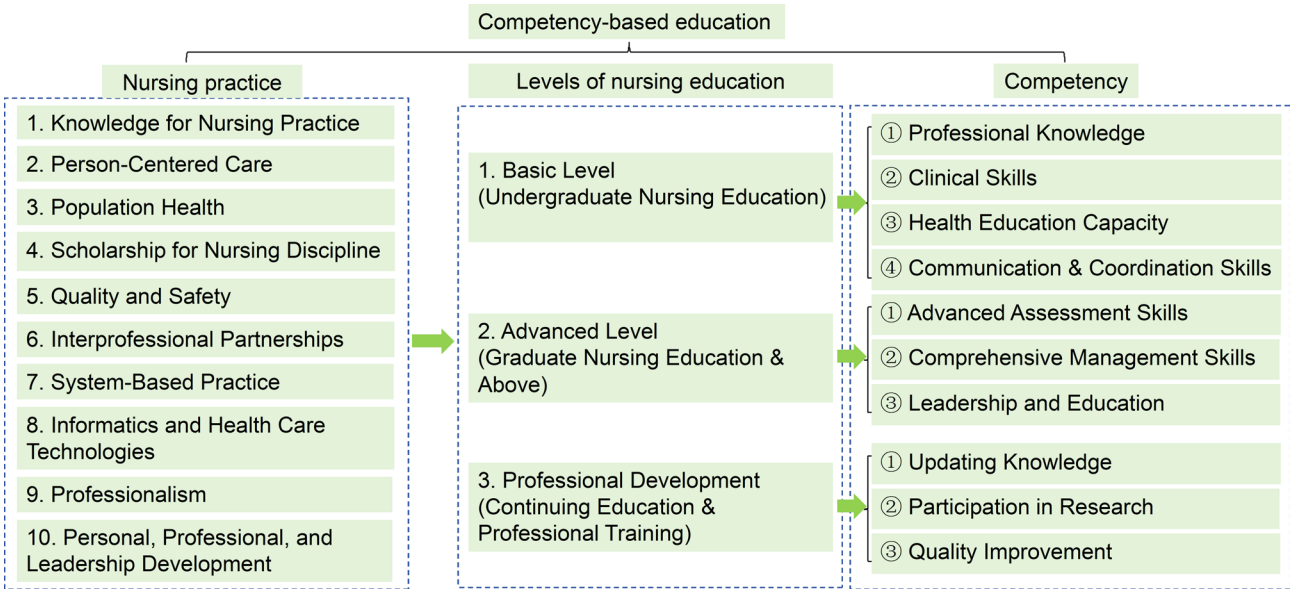

Fig. 1 Nursing practice with expected competencies based on the competency-based education

A cross-sectional study was performed in Guangdong by using a well-designed self-rating questionnaire consisting of the evaluation index, so as to investigate the status of core competencies of nurses who attended to pediatric asthma specialist training.

Establish a research team

This research team consisted of 6 nurses, including 3 deputy chief nurses, 2 charge nurses and 1 nurse practitioner in the department of pediatric respiratory. Among them, two are head nurses of asthma specialist, whose department receives more than 200 children with asthma every year; the third one is an asthma specialist nurse, serving for asthma children about 100 persons per year. The two charge nurses are specialist nurses, working in the field of pediatric asthma nursing, and have received training and assessment on the standardized construction of asthma clinics. The research team is responsible for constructing a pool of core competency index items for pediatric asthma specialist nurses, inviting experts for inquiries, and preparing inquiry questionnaires.

The research team prepared the draft of the competency evaluation index for pediatric asthma specialist nurses, designed the expert consultation questionnaire, selected and contacted the expert panel members, analyzed the collected opinions and data, and revised the evaluation index according to experts' suggestions.

Draft the evaluation index of pediatric asthma specialist nurses' core competency

Semi-structured interview to primarily determine the evaluating index for pediatric asthma specialist nurses' core competency

To ensure the rationality of the evaluation index, the semi-structured interviews were performed by inviting the experienced doctors and nurses in pediatric asthma and asthma children's parents in a tertiary hospital in Guangdong Province.

(1) Inclusion criteria of interviewees

Criteria for asthma specialist doctors: (1) work in the field of medical treatment of pediatric asthma for ≥ 10 years; (2) have deputy senior or above level of job title; (3) with bachelor's degree or above.

Criteria for asthma specialist nurses: (1) work in the field of nursing of pediatric asthma for ≥ 5 years; (2) have intermediate or above level of job title; (3) provide nursing service for ≥ 100 asthma children per year.

Criteria for nursing manager: (1) serve as the head nurse of the asthma specialist for ≥ 5 years; (2) have deputy senior or above level of job title; (3) in the department with ≥ 200 asthma children per year.

Criteria for asthma children's parents: (1) have children diagnosed with asthma; (2) regularly sent asthma children to the asthma nursing clinic for further consultation for ≥ 1 year; (3) with normal understanding ability and a certain education level.

(2) Interview details

The sample size of the interviewees was determined according to the principle of "saturation" of the

information, that is, no new themes appeared in the interview. The outline with clear topics was prepared for the interview (see Supply material S-1). During the interview, inducing language was avoided; the conversations were recorded; the tone, expression, and body movements of the interviewees were paid attention to; notes were taken to avoid miss key points. Each interview lasted for about 20–30 min. After the interview, the audios were translated into text within 24 h, and the information was confirmed as necessary to ensure its accuracy and reliability.

Colaizzi's 7-step analysis method was applied to analyze the contents of the semi-structured interviews, which is a commonly used data analysis method used in descriptive phenomenological research to reveal participants' experiences and to construct the basic structure of research results. This method includes the following steps: ① Become thoroughly familiar with the data; ② Identify significant statements; ③ Construct meaning units; ④ Cluster themes; ⑤ Detailed description; ⑥ Produce basic structures; ⑦ Verify the basic structures.

Determine the specific indicators of evaluation index

The three levels of evaluation indicators of the core competencies of pediatric asthma specialist nurses were constructed by reviewing literature to ensure the scientificity of the evaluation indicators in each dimension. The keywords "pediatric asthma", "nurse specialist", "nurse practitioner", "advanced practice nurse", "core competence", and "Core Capa*" were used to search for relevant studies published from 2001 to October 2021 in PubMed, Web of Science, CNKI, and Wan Fang databases. The Global Asthma Initiative Report [15], expert consensus on the clinical application of Chinese Children Asthma Plan (CCAAP) [16], relevant studies on pediatric asthma control and management [3, 17], and previous studies on the evaluation index of respiratory specialist nurses' core competence [18] were referred to draft the preliminary second and third-level indicators of the evaluation index for pediatric asthma specialist nurses' core competence.

On the basis of the retrieved results, the entry of core competency for pediatric asthma specialist nurses were preliminarily determined.

Design expert consultation questionnaire

The contents of expert inquiry questionnaire included: (1) Experts' status questionnaire. (2) The evaluation index. The five-point Likert scoring method (5 = very important, 4 = important, 3 = general, 2 = less unimportant, 1 = unimportant) was used to rate the importance of each indicator. The "Modify", "Delete" and "Add" columns were set up for expert to propose changes of each indicator. (3) Experts' judgment basis and familiarity with the survey indicators. The degree of judgment basis was divided into three levels (large, medium and small), which were quantified as theoretical analysis (0.3, 0.2, 0.1), work experience (0.5, 0.4, 0.3), referring domestic and foreign data (0.1, 0.1, 0.1), intuitive judgment (0.1, 0.1, 0.1), respectively. The degree of familiarity was divided into five levels (very familiar, relatively familiar, average, not very familiar, and unfamiliar), which were assigned as 1.0, 0.8, 0.5, 0.2, and 0, respectively.

Expert consultation

Inclusion criteria for experts

The criteria for the invited experts included: (1) in the field of medical treatment, nursing or nursing management of pediatric respiratory asthma, engaged in medical or nursing work related to pediatric asthma, and with working experience of 10 years or more; (2) has intermediate or above level of job title; (3) with bachelor's degree and above; (4) informed consent and voluntary participation in this study.

Pre-consultation

Six experts including pediatric asthma specialist doctors, pediatric asthma specialist nurses and nurse managers, were invited via email or WeChat to evaluate the readability and feasibility of the preliminary draft of the evaluation index in February 2022. Specifically, the aim of pre-consultation was to determine the rationality of setting three levels of indicators, the accuracy of description, and the representativeness of indicators in evaluating the pediatric asthma specialist nurses' core competencies. In the pre-consultation, experts put forward two opinions including: (1) Pediatric asthma specialist nurses should have a more comprehensive and in-depth mastery of nursing knowledge related to asthma; (2) Some indicators have duplicate contents, which should be simplified. After receiving feedback, the researcher revised and improved the first draft of the letter inquiry questionnaire, and finally formed a formal expert letter inquiry questionnaire.

Formal expert consultation

A modified Delphi method was used by implementing two rounds of anonymous, web-based expert inquiry, which enhanced the efficiency of the consensus reached. The formal expert inquiry questionnaire was sent to experts via email or WeChat between May and August in 2022. Each expert was required to evaluate the importance of each indicator and send back the questionnaires within two weeks. The inquiry questionnaire in the second round of consultation was revised based on the results of the first round. The screening criteria of indicators were based on the coefficient of variation (CV) < 0.25 [19] and the mean score > 3.5 at the same time.

Here was a brief overview of our process: ① Identification of experts: Potential experts were identified based on their published work in the field of pediatric asthma management and their professional experience. ② Initial contact: The experts were initiated contact through WeChat or email with a personalized message explaining the purpose of this study and inviting them to participate in the Delphi process. ③ Invitation and consent: Those who expressed interest were then formally invited to participate and were provided with detailed information about this study, including the nature of their involvement and the expected time commitment. ④ Ongoing communication: Throughout the Delphi process, communication with the experts were maintained via WeChat or email to ensure that they received reminders and support as needed. ⑤ Feedback and iteration: The experts' feedback was gathered, and the questionnaires were iterated based on their feedback. Leveraging WeChat and email can ensure a high response rate and efficient communication, which was crucial for the reliability of expert consultation process.

Questionnaire survey

A questionnaire survey was conducted from July to September in 2022. The questionnaires, consisting of the final evaluation index, were sent to the nurses who finished the standardized outpatient capacity improvement training course of pediatric asthma specialist. The course was organized by the Pediatric Respiratory Infection Professional Committee of the Guangdong Association of Primary Medicine.

Table 1 Basic information of participants in the semi-structured interview

Number	Role	Education	Working years
N1	Doctor	Bachelor's degree above	>20
N2	Doctor	Bachelor's degree above	>20
N3	Doctor	Bachelor's degree above	>20
N4	Doctor	Bachelor's degree	>20
N5	Doctor	Bachelor's degree above	>20
N6	Nurse	Bachelor's degree above	10 ~ 20
N7	Nurse	Bachelor's degree	>20
N8	Nurse	Bachelor's degree	>20
N9	Nurse	Bachelor's degree	10 ~ 20
N10	Nurse	Bachelor's degree	10 ~ 20
N11	Parents of children with asthma	-	-
N12		-	-
N13		-	-

Note: To ensure participant anonymity, specific details such as position, educational qualification, and working years have been generalized

Statistical analysis

Statistical analysis was conducted by R software (Version 4.1.1) and SPSSAU website (http://spssau.com). The experts' degree of activeness, authority coefficient, and coordination degree of experts' opinions were calculated. The degree of activeness was determined by the questionnaire recovery rate and the ratio of experts making suggestions. The authority coefficient of experts (Cr) was calculated by using the coefficients of experts' judgement-making ability (Ca) and familiarity with the surveyed indicators (Cs) and following formula: $Cr = (Ca + Cs)/2$ [19]. The coordination degree of experts' opinions was determined by Kendall's W coefficient (ω) [20] and the coefficient of variation (CV). The concentration degree of their opinions was described by using the mean and standard deviation (SD). The weight of each indicator was determined based on the importance value assigned by experts [21, 22]. The judgment matrix was constructed and the analytic hierarchy process (AHP) to calculate the weight of the indicators.

Results

Basic information of participants in the semi-structured interview

This study included 13 interviewees in the semi-structured interviews, including 5 doctors, 5 nurses, and 3 parents of children with asthma, and their basic information was presented in Table 1.

Results of the semi-structured interview

Definition of a pediatric asthma specialist nurse

The interview results indicate that experts believe the definition of a pediatric asthma specialist nurse should encompass three aspects: educational background, clinical experience, and training and certification.

Core competencies of pediatric asthma specialist nurses

The 13 interviewees provided their perspectives on the core competencies of pediatric asthma specialist nurses, which were distilled and summarized into five first-level indicators of core competencies evaluation index for pediatric asthma specialist nurses, including clinical professional ability, full-process asthma management ability, communication and health education ability, professional development ability, and clinical management ability, were primarily concluded. The detailed information was provided in the supplementary material S-2.

Basic information of experts in the pre-survey

This study selected 6 experts working in a tertiary hospital for a small-scale pre-survey, including pediatric asthma physicians, nurses of respiratory department, and pediatric asthma nurses. The basic information of the pre-survey participants is shown in Table 2.

Table 2 Basic information of experts in the pre-survey

No.	Education	Role	Specialty direction	Working years
1	Bachelor's degree above	Doctor	Asthma medical treatment	>20
2	Bachelor's degree above	Doctor	Asthma medical treatment	>20
3	Bachelor's degree	Nurse	Nursing Management	10 ~ 20
4	Bachelor's degree above	Nurse	Asthma Nursing	10 ~ 20
5	Bachelor's degree	Nurse	Asthma Nursing	10 ~ 20
6	Bachelor's degree	Nurse	Asthma Nursing	10 ~ 20

Note: To ensure participant anonymity, specific details such as position, educational qualification, and working years have been generalized

Table 3 Sociodemographic and professional characteristics of the experts

Item	Range / Category	Number	Percentage (%)
Working years	10~	9	43
	20~	8	38
	30~	4	19
Education	Bachelor	10	48
	Master	9	43
	Doctorate	2	9
Job title	Intermediate level	3	14
	Deputy senior level	12	57
	Senior level	6	29
Job position	(Deputy) Head of departments	2	10
	Head nurse of department	6	28
	Other	13	62
Professional field	Pediatric asthma treatment	11	52
	Pediatric asthma nursing	3	14
	Nursing management	6	29
	Nursing education	1	5
Supervisor	Doctoral supervisor	1	5
	Graduate supervisor	3	14
	No	17	81

Results of pre-consultation

In the pre-consultation, the opinions raised by the experts included: ①The definition of pediatric asthma specialist nurses should be in line with the national conditions of our country, and the educational requirement should be changed to a college degree; ②In terms of knowledge, the theory is too profound, and specialist nurses do not need to make diagnoses, so there is no need for too much theoretical knowledge; ③Some items have repetitive content, and it is suggested to simplify them.

Base characteristic of experts in the consultation

A total of 21 experts were invited for consultation. These experts came from seven tertiary hospitals and one university in four provinces or municipalities, including Guangdong, Beijing, Shanghai, and Sichuan, where pediatric asthma nurses provide education and follow-up asthma management. The basic information of the experts is shown in Table 3.

Reliability of expert consultation results

Experts' positive degree

Figure 2 presented the flow chart of this study. In the first round, 21 questionnaires were sent to experts and all were returned. Both the recovery rate and the validity rate were 100%. A number of 12 (57%) experts put forward 30 revision opinions. In the second round, 21 questionnaires were sent, of which 20 (95%) were returned. The validity rate was 100%, and six (30%) experts proposed 8 opinions for revision.

Experts' authority coefficient

In the two rounds of consultations, the coefficients of familiarity were 0.876 and 0.910. The coefficients of judgment were 0.907 and 0.910, respectively. The authority coefficients were 0.892 and 0.910, respectively.

Coordination degree of experts' opinions

The CV of the first-level indicators were 0.04–0.12, 0.06–0.20 of the second-level indicators is between, and 0-0.22 of the third-level indicators. After two rounds of expert consultation, the Kendall's W coefficient of the first-level indicator was 0.343, and 0.384 of the second-level indicators. The P values of the consistency test were both less than 0.001.

Results of expert consultation

In the first round of expert consultation, 12 experts put forward 30 opinions in total. After the first round of consultation, "occupational attitude" was added to the first-level indicators; "professional cognition" and "professional emotions" were added to the second-level indicators. Regarding to the third-level indicators, "supervision and management ability" was deleted; at the same time, 1 item about theoretical knowledge, 2 items about clinical nursing operation skills, 1 item about assessment ability, 1 item about planning ability, 1 item about supervision and disease management ability, and 1 item about scientific research ability, were modified according to experts' advice. Additionally, 9 items were added to the third-level indicators as follows: 1 item about theoretical knowledge, 2 items about assessment ability, 3 items about supervision and disease management ability, 1 item about nurse-patient communication, 1 item about scientific research ability, and 1 item about efficiency and quality control ability. Finally, the core competency evaluation index for pediatric asthma specialist nurses included 2 definitions,

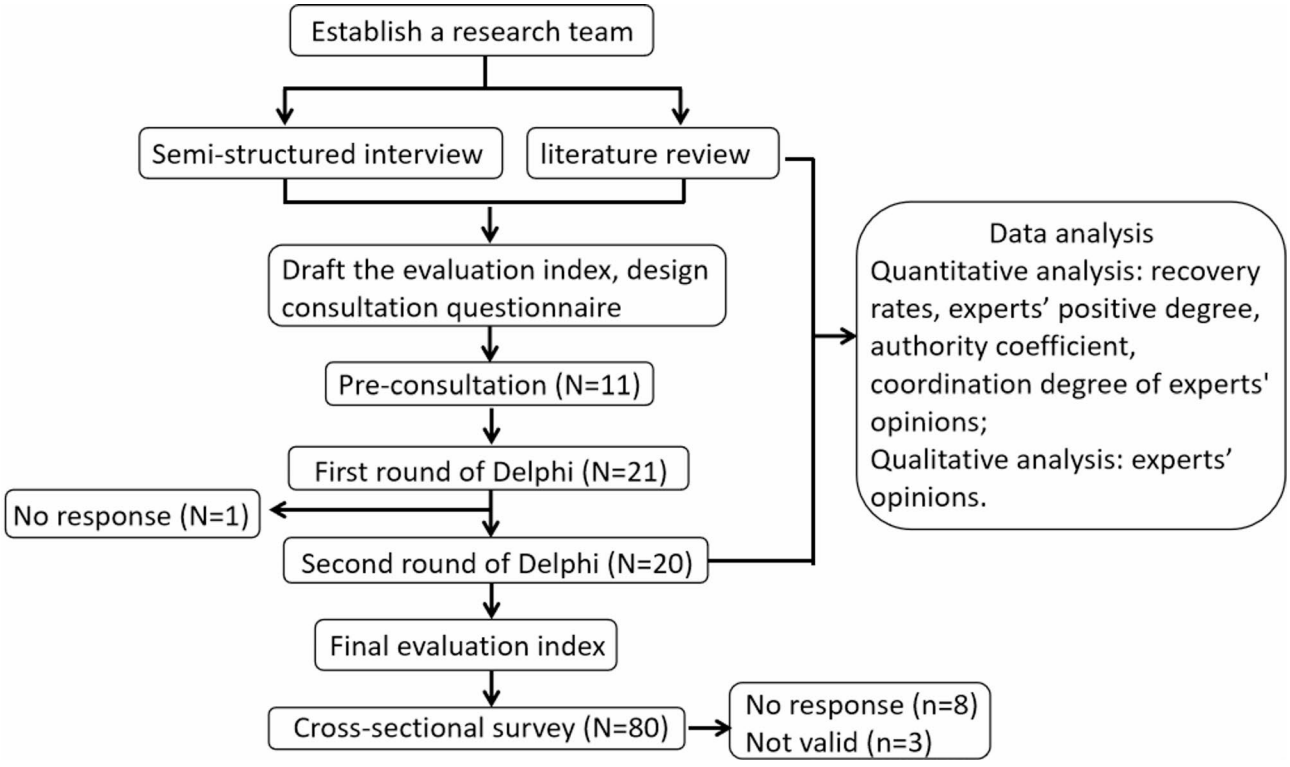

Fig. 2 The flow chart of this study

6 first-level indicators, 16 second-level indicators, and 63 third-level indicators.

In the second round of consultation, 5 experts put forward a total of 5 opinions for revision. One of them proposed to replace "specific professional knowledge, skills, professional values and practical abilities of nursing services to improve asthma control level" to "nursing service capabilities that are necessary to improve asthma control level, including specific professional knowledge, skills, professional characteristics and practical ability." in the definition of pediatric asthma specialist nurses' core competencies. As the latter is more accurate, we adopted this advice. One expert pointed out that there were some electronic equipment to assist automatic calculation and replace manual calculation, and therefore suggested to delete the II-1-4 item about the ability to calculate PEF values. In view of the uneven development of economy, many hospitals do not have electronic equipment for assistance and still require manual calculations except for some hospitals in developed regions, and therefore this opinion was not adopted after discussion. Another expert proposed that "exercise and psychological factors" should be added to the predisposing factors of asthma in II-3-3. After careful discussion by the research team, this suggestion was accepted. Finally, 2 definitions, 6 first-level indicators, 16 second-level indicators, and 63 third-level indicators were determined, as shown in Tables 4 and 5.

Results of preliminary applying the evaluation index system

There were 80 pediatric asthma nurses participated in the survey. A total of 72 questionnaires were returned, of which 69 questionnaires were valid. The average scores of each first-level indicators of the core competency evaluation index were as follows: clinical professional ability (4.05 ± 0.88), full-process asthma management ability (4.08 ± 0.85) occupational attitude (4.37 ± 0.75), communication and health education ability (4.16 ± 0.84), professional development ability (3.84 ± 1.01), clinical management ability (3.68 ± 0.97). The overall Cronbach's α coefficient of the first-level indicators was 0.935, and the Cronbach's α coefficients of each first-level were from 0.896 to 0.968, as presented in Table 6.

Discussion

Reliability of the evaluation index for pediatric asthma specialist nurses' core competencies

In this study, an evaluation index system of core competencies for pediatric asthma specialist nurses was established mainly through expert consultation. As the selection of experts was a critical part to the construction of evaluation index [19], experts with extensive expertise and work experience in clinical medicine, clinical nursing, nursing management and nursing education related to pediatric asthma, were selected for this study. About 60% of them work for 20 years or more. More than 52%

Table 4 The first- and second-level indicators of the core competency evaluation index system for pediatric asthma specialist nurses

Indicator	Score of importance (M ± SD)	CV	Weight
I. Clinical professional ability	4.95 ± 0.22	0.04	0.216
I-1 Theoretical knowledge	4.90 ± 0.30	0.06	0.105
I-2 Clinical nursing operation skills	4.90 ± 0.30	0.06	0.111
II. Full-process asthma management ability	4.90 ± 0.30	0.06	0.210
II-1 Assessment ability	4.90 ± 0.30	0.06	0.060
II-2 Planning ability	4.75 ± 0.43	0.09	0.051
II-3 Supervision and management patient ability	4.75 ± 0.43	0.09	0.051
II-4 Evaluation and improvement ability	4.70 ± 0.46	0.10	0.048
△III. Occupational attitude	4.55 ± 0.59	0.13	0.151
△III-1 Occupational cognition	4.35 ± 0.57	0.13	0.079
△III-2 Occupational emotion	4.25 ± 0.54	0.13	0.071
IV. Communication and health education ability	4.80 ± 0.40	0.08	0.179
IV-1 Ability of communicating with doctors	4.85 ± 0.36	0.07	0.059
IV-2 Ability of communicating with patients	4.85 ± 0.36	0.07	0.059
IV-3 Health education ability	4.85 ± 0.36	0.07	0.061
V. Professional development ability	4.45 ± 0.50	0.11	0.131
V-1 Learning ability	4.75 ± 0.43	0.09	0.053
V-2 Professional teaching ability	4.70 ± 0.46	0.10	0.051
V-3 Research ability	3.95 ± 0.67	0.17	0.027
VI. Clinical management ability	4.30 ± 0.56	0.13	0.113
VI-1 Organization and leadership abilities	4.20 ± 0.60	0.14	0.061
VI-2 Benefit and quality control ability	4.05 ± 0.59	0.15	0.052

M: mean. SD: Standard deviation. CV: Coefficient of variation

△: Indicator that was added after the first round of consultation

of these experts had a master's degree or above. Additionally, these experts came from seven tertiary hospitals and one university in 4 provinces and cities that have launched pediatric asthma care clinics. Therefore, they can therefore be considered to be reliable and representative to some degree.

The evaluation index for pediatric asthma specialist nurses' core competencies constructed in this study is scientific and trustworthy. Firstly, a high response rate of 70% or more is of vital importance to ensure the rigor of Delphi method [23], representing experts' enthusiasm and concern for the study. The recovery rates of the two rounds of expert consultation in this study were 100% and 95% respectively, indicating that experts had good enthusiasm and actively participated in each round of consultation. Secondly, authority coefficient is 0.7 or greater meaning that the results of expert consultation are reliable [24]. The authority coefficient of two rounds of expert consultation in this study were both greater than 0.8, revealing that these experts were familiar with the content of pediatric asthma and could scientifically judge and analyze the indicators, and thereafter they had a high degree of authority and the results of expert consultation were trustworthy. Thirdly, the Kendall's W coefficients of the first- and second-level indicators in the second round of consultation both had statistical significance, suggesting a high degree of agreement among experts regarding to the evaluation indicators. Furthermore, the final evaluation index was validated by a cross-sectional survey, which confirms the reliability of our results.

Content analysis of the evaluation index for pediatric asthma specialist nurses' core competencies

According to the competency theory, the clinical professional ability and full-process asthma management ability in this study, accounting for a sum weight of 0.426, belong to "benchmark competency characteristics", and are the important qualities that pediatric asthma specialist nurses. Among the first-level indicators in this study, the weight of clinical professional ability is 0.216, accounting for the highest proportion among all first-level indicators, which is similar to the results of construction of core competency evaluation index system for respiratory specialized nurses [18]. Notably, items related to clinical professional competencies were mentioned most frequently in the semi-structured interviews. This is consistent with the current focus in cultivating specialist nurses' clinical professional abilities in China. For a specialist nurse, the most important core competency is directly providing high-quality clinical nursing services to asthma children, which is the practical requirement of pediatric asthma specialist nurses.

Presently, Chinese trainings for specialist nurses are mostly based on professional skills training, communication skills, scientific research ability and inherent professional qualities needs to be strengthened. To better serve asthma children, pediatric asthma specialist nurses should not only enhance their specialist knowledge and clinical professional abilities of pediatric asthma, but also continuously improve the quality of nursing from other aspects and promote further development of the pediatric asthma discipline. The occupational attitude, communication and health education ability, professional development ability, and clinical management ability belong to "identification competency", with a total weight of 0.574, which are the implicit competency of pediatric asthma specialist nurses. The total weight of implicit competency is slightly higher than that of explicit competency, highlighting the importance of implicit competency in pediatric asthma nursing.

The most prominent feature of the evaluation indicators constructed in this study is that most indicators are comprehensive and manifests the professional

Table 5 The third-level indicator of the core competency evaluation indicator system for pediatric asthma specialist nurses

Indicators	Score of importance (M ± SD)	CV	Weight
I-1-1 The position, form, and anatomical structure of the upper and lower respiratory tract.	4.50 ± 0.59	0.13	0.079
I-1-2 The morphology and function of airway epithelial cells.	4.00 ± 0.74	0.18	0.048
△I-1-3 Classification, common causes and induction factors of pediatric asthma.	4.75 ± 0.43	0.09	0.094
I-1-4 Epidemiology, pathogenesis and pathological characteristics of pediatric asthma.	4.60 ± 0.58	0.13	0.085
I-1-5 Diagnosis and identification diagnosis of pediatric asthma	4.45 ± 0.67	0.15	0.076
I-1-6 Features and clinical manifestations of pediatric asthma.	4.75 ± 0.43	0.09	0.096
I-1-7 Period and grade of pediatric asthma.	4.70 ± 0.56	0.12	0.091
I-1-8 Methods and significance of monitoring pediatric asthma condition (e.g. lung function, allergen detection, FENO detection).	4.60 ± 0.49	0.11	0.081
I-1-9 Long -term treatment methods, goals and treatment principles of pediatric asthma.	4.70 ± 0.46	0.10	0.091
☆I-1-10 Classification of controlled drugs and alleviating drug, indications, pharmacological effects, medication pathways, adverse reactions and treatment methods of pediatric asthma.	4.85 ± 0.36	0.07	0.106
I-1-11 Methods, indications, and contraindications of pediatric specific immune therapy.	4.45 ± 0.67	0.15	0.076
I-1-12 Methods, indications, contraindications of anti -IGE targeted treatment.	4.40 ± 0.80	0.18	0.075
I-2-1 With the measurement and physical examination skills of children's life signs.	4.70 ± 0.64	0.14	0.116
I-2-2 Knowing the applicable scope and methods of using inhalation device in long -term treatment of pediatric asthma (e.g., spray inhalator, pressure quantitative aerosol, pressure quantitative aerosol combined with fog reservoir storage device, dry powder quantitative inhalation agent).	5.00 ± 0.00	0.00	0.149
I-2-3 Recognition and rescue cooperation of the acute attack of pediatric asthma.	4.90 ± 0.30	0.06	0.134
☆I-2-4 Method of self -monitoring: how to use the peak flow velocity meter, asthma diary, the mobile version and paper version of the China children asthma action plan.	4.90 ± 0.30	0.06	0.133
I-2-5 Clinical nursing for children with asthma and allergic rhinitis.	4.75 ± 0.43	0.09	0.115
I-2-6 Clinical nursing for children with asthma and allergic dermatitis/urticaria.	4.45 ± 0.59	0.13	0.086
I-2-7 Clinical nursing for children with asthma and allergic conjunctivitis.	4.50 ± 0.50	0.11	0.089
☆I-2-8 Diet and exercise guidance for children with asthma and obesity.	4.45 ± 0.67	0.15	0.088
I-2-9 Psychological dredging methods for common psychological problems in children with asthma and their caregivers.	4.45 ± 0.67	0.15	0.089
II-1-1 Evaluate and judge the severity of asthma, comorbidities and the effects on children with asthma.	4.65 ± 0.57	0.12	0.125
☆II-1-2 Find out the allergens by evaluation of asthma children's living environment, clinical detection of allergens and parents' observation in daily life, and avoid allergens as much as possible, in order to prevent asthma attack and aggravation of symptoms.	4.85 ± 0.36	0.07	0.113
II-1-3 Choose suitable clinical assessment tools to evaluate the asthma control of children according to the age and the condition.	4.80 ± 0.40	0.08	0.118
△II-1-4 Calculate the predicted PEF value, understand the significance of personal best value, assess the condition of asthma children according to the ratio of measured PEF value and the predicted value or the ratio of measured PEF value and personal best value.	4.65 ± 0.65	0.14	0.119
△II-1-5 Identify the zone (green/yellow/red) of asthma child in the Children Asthma Action Plan, and take measures to manage asthma according to the the corresponding zone.	4.75 ± 0.43	0.09	0.111
II-1-6 Evaluate the awareness and treatment compliance of asthma children and their caregivers.	4.80 ± 0.51	0.11	0.094
II-1-7 Evaluate the problems in the treatment process of asthma children by collecting the information related to health behavior.	4.60 ± 0.66	0.14	0.092
II-1-8 Recognize the psychological characteristics and needs of asthma children and their caregivers.	4.50 ± 0.67	0.15	0.112
II-1-9 Evaluate and foresee the potential health risks of asthma children.	4.45 ± 0.74	0.17	0.116
II-2-1 Jointly make practical long -term treatment and nursing plan with the medical team according to the evaluation results.	4.75 ± 0.54	0.11	0.504
☆II-2-2 Participate in making asthma action plans for asthma children with doctors, children and their caregivers, and instruct children and caregivers to correctly perform the asthma action plan.	4.70 ± 0.64	0.14	0.496
☆II-3-1 Based on the outpatient clinic of pediatric asthma, establish an asthma home, or a asthma club, or an asthma association to establish a partnership with asthma children and their caregivers.	4.45 ± 0.74	0.17	0.111
II-3-2 Establish a specialized medical record file for each asthma children, and timely improve the follow -up information management in time.	4.75 ± 0.43	0.09	0.136
△II-3-3 Instruct asthma children and their caregivers to prevent predisposing factors, such as upper respiratory infections, climate change, air pollution, irritating odor, and cigarette exposure, etc.	4.80 ± 0.40	0.08	0.143

Table 5 (continued)

Indicators	Score of importance (M ± SD)	CV	Weight
△II-3-4 Instruct asthma children and their caregivers to deal with allergens (such as dust mites, pollen, mold, animal dandruff, cockroaches) and improve the home environment.	4.90 ± 0.30	0.06	0.154
II-3-5 Regularly check asthma children's operation and compliance of drug inhalation treatment, and timely correct the improper operation.	4.90 ± 0.30	0.06	0.154
II-3-6 Remind asthma children to do regular follow-up checks, supervise asthma children and their caregivers to execute asthma action plan.	4.80 ± 0.51	0.11	0.149
△II-3-7 Instruct caregivers to prepare first-aid drugs for asthma attack at homes or with asthma children.	4.90 ± 0.30	0.06	0.156
II-4-1 Evaluate and make feedback on the nursing quality of pediatric asthma nurses, and assist managers to continuously improve the quality.	4.60 ± 0.58	0.13	0.525
II-4-2 Evaluate the effect of asthma treatment, optimize and adjust nursing measures according to the actual situation.	4.50 ± 0.67	0.15	0.475
III-1-1 Have a strong sense of occupational identity, realize the serious affects of asthma on the physical and mental health of children, and be willing to make health education for asthma children and their caregivers to improve the self -management of asthma and maintain long -term control of asthma.	4.45 ± 0.67	0.15	1.000
III-2-1 Have enthusiasm for pediatric asthma care work, have a strong sense of nursing career responsibility for pediatric asthma, and put it into action with great energy.	4.50 ± 0.59	0.13	1.000
IV-1-1 Have good abilities of verbal and written expression, actively communicate with the medical team of the pediatric asthma, and jointly do a good job of long -term management of pediatric asthma.	4.55 ± 0.67	0.15	0.550
IV-1-2 Can communicate with doctors of other departments, such as otolaryngology, dermatology, and immunology, etc., and correctly refer asthma children to other departments when they have corresponding symptoms.	4.35 ± 0.79	0.18	0.450
IV-2-1 Can use easy -to -understand language and choose the right methods and tools or to explain the knowledge of asthma to children and their caregivers.	4.70 ± 0.56	0.12	0.368
IV-2-2 Master some communication skills, such as listening, non-language communication skills, etc., to encourage children and their caregivers to express their thoughts, give appropriate emotional support, and maintain good relationship with them.	4.55 ± 0.67	0.15	0.315
△IV-2-3 Can evaluate the effect of communication with patients, understand and improve the mastery degree of asthma -related knowledge of children and caregivers.	4.60 ± 0.66	0.14	0.319
IV-3-1 Make full use of professional theoretical knowledge and practical experience to jointly determine health education content and materials with pediatric asthma medical team.	4.60 ± 0.66	0.14	0.281
IV-3-2 Provide health education about early prevention and treatment of asthma prevention through a variety of methods, such as outpatient education, centralized education, media propaganda, online education and other forms.	4.55 ± 0.59	0.13	0.258
IV-3-3 Provide personalized health education and guidance for asthma children and their caregivers according to their needs, education level, and the mastery degree of asthma management knowledge.	4.55 ± 0.50	0.11	0.262
IV-3-4 Carry out fixed-site health education about pediatric asthma for children and public by cooperating with schools and community health institutions in a planned way.	4.25 ± 0.70	0.16	0.199
V-1-1 Actively learn and master new dynamics, new knowledge, and new technologies related to pediatric asthma.	4.70 ± 0.56	0.12	0.525
V-1-2 Plan for personal career development, actively seize the opportunities of learning, participate in continuing education, and continuously improve professional ability.	4.60 ± 0.58	0.13	0.475
V-2-1 The ability to provide counseling on asthma-related knowledge.	4.65 ± 0.48	0.10	0.550
V-2-2 Can use multiple teaching methods to organize teaching activities for nursing students and other nursing personnel, and effectively evaluate the teaching effects.	4.45 ± 0.74	0.17	0.450
☆V-3-1 Can perform evidence-based method searching literature and using novel and reliable nursing methods to solve practical nursing problems related to pediatric asthma.	4.50 ± 0.59	0.13	0.638
△V-3-2 Have a certain writing ability, spread nursing research results on domestic and foreign journals or academic conference.	4.00 ± 0.77	0.19	0.362
VI-1-1 Can lead team members, effectively complete nursing tasks in clinical practice, set up an example in the field of pediatric asthma nursing, and furnish an example to other nurses.	4.45 ± 0.80	0.18	0.521
VI-1-2 Supervise and make feedback on the nursing work, and timely take effective measures to correct the errors.	4.40 ± 0.86	0.20	0.479
VI-2-1 Manage benefits: make budget for controllable costs (such as the time that nurses provide nursing for asthma children, labor and consumables), estimate the corresponding benefits.	4.20 ± 0.81	0.19	0.297

Table 5 (continued)

Indicators	Score of importance (M ± SD)	CV	Weight
VI-2-2 Quality control and evaluation: train asthma specialist nurses, identify suitable nursing plans for asthma children, and evaluate the negative results of asthma children.	4.35 ± 0.73	0.17	0.349
△VI-2-3 Make health education plan and feedback: make a complete plan for health education, evaluate the children and their caregivers' feedback, clearly evaluate the effects of health education.	4.35 ± 0.79	0.18	0.354

M: Mean. SD: Standard deviation. CV: Coefficient of variation

☆: Indicators that were modified after the first round of consultation

△: Indicators that were added after the first round of consultation

Table 6 The Cronbach's α of the evaluation index in the preliminary application

First-level indicator	Number of third-level indicators	Cronbach's α
Clinical professional ability	21	0.943
Full-process asthma management ability	20	0.968
Occupational attitude	2	0.940
Communication and health education ability	9	0.931
Professional development ability	6	0.896
Clinical management ability	5	0.934

characteristics of pediatric asthma nursing. The evaluation index not only included clinical professional ability, but also personal quality. Among the index, there are 41 (65.1%) third-level items under clinical professional ability and full-process asthma management ability, which are the most important elements to ensure the safety and quality of asthma control. For instance, inhaled corticosteroids are the cornerstone of asthma treatment for children over 5 years of age, however, approximately 50% of asthmatic children aged 8 to 16 years old have poor medication compliance [25, 26]. Therefore, guiding asthma children and their caregivers to correctly use inhaled corticosteroids is one of the most important abilities of pediatric asthma specialist nurses. Finally, given the long-term control of pediatric asthma and difficulty of pediatric asthma nursing work and the need for disciplinary development, outstanding personal qualities and traits are also necessary, including communication and health education ability, occupational attitude, professional development ability and clinical management ability.

Application value of the evaluation index for pediatric asthma specialist nurses' core competencies

Pediatric asthma is becoming increasingly prevalent, calling for high quality nursing for asthma children to manage asthma and prevent asthma attack. Pediatric asthma specialist nurses play a critical role in pediatric asthma nursing, especially constantly follow up the asthma children and instruct them and caregivers to master asthma-related skills, in order to ensure high-quality care for asthma children. The evaluation of core competence is an essential prerequisite for improving nurses' competence. Therefore, how to assess pediatric asthma specialist nurses' core competencies presently is an essential issue. A comprehensive and objective evaluation index of nurses' core competencies ought to be determined when assessing whether nurses are capable of the requirements of nursing work for pediatric asthma. A specialist nurse must possess the core competencies involving special knowledge, skills, attitudes, and quality, therefor a thorough evaluation index and understanding of pediatric asthma specialist nurses' core competencies is essential.

This study developed the core competency evaluation indicators for pediatric asthma specialist nurses by evaluating six aspects of their core competency requirements. The overall Cronbach's α coefficient of the self-rating scale designed by including the evaluation index for pediatric asthma specialist nurses' core competencies in this study is 0.935, reflecting that the internal consistency of the evaluation indicators is good. The results of preliminary application showed that the levels of 69 pediatric asthma nurses' core competency were low. The scores of each first-level indicators from high to low were occupational attitude, communication and health education ability, full-process asthma management ability, clinical professional ability, professional development ability, and clinical management ability, suggesting that much attention should be paid to the cultivation of humanistic clinical professional abilities, professional development abilities, and clinical management abilities of pediatric asthma specialist nurses. The evaluation index system constructed in this study is innovative and practical, which can serve as a reference for training and qualify pediatric asthma specialist nurses, and may promote the professional development of specialist nurses.

Innovation and importance

The innovation of this study lies in the construction of an evaluation index system specifically designed for pediatric asthma specialist nurses in China. To our knowledge, this is the first systematic attempt to design and preliminarily apply such an evaluation system for this niche

group of nurses. The system was comprehensively constructed through literature review, semi-structured interviews, and the Delphi method, ensuring the scientific and practical nature of the evaluation indicators. This methodological innovation provides a new perspective and tool for the international nursing field, especially in the specialized area of pediatric asthma.

This research can help identify and strengthen the core competencies of pediatric asthma specialist nurses, which is crucial for improving nursing quality and patient satisfaction. This is an important issue globally, as high-quality nursing care is key to improving patient health outcomes. This study offers a framework that can be referenced and applied by international peers to assess and enhance the quality of care provided by pediatric asthma specialist nurses. This may further meet the global pediatric asthma care needs, and thereafter pose significance for the international community.

Although this study is based on the specific context of China, the core competencies of pediatric asthma specialist nurses are universally relevant across different cultures and healthcare systems. Our research results can inspire other countries to develop core competencies evaluation systems suitable for their specific cultural and healthcare environments. This core competencies evaluation index system can serve as a foundation for educating and training pediatric asthma specialist nurses, which is a valuable resource for nurse educators worldwide. Through such systematic training, nurses' professional capabilities can be enhanced, thereby better serving patients. In summary, our research is not only significant in China, but also has far-reaching implications for the training and nursing practices of pediatric asthma specialist nurses globally.

Future perspective

The future perspective of the core competency evaluation index system for pediatric asthma nurses includes expanding its application to various clinical settings such as primary care, community health centers, and specialized clinics, with adaptations to meet unique challenges in each context. International collaboration and pilot studies will assess its global applicability. Additionally, the robustness and long-term impact of this index system on patient outcomes need to tested by multicenter and longitudinal studies. Besides, technological integration with digital tools like the WeChat mini program [27] and electronic health records will enhance data collection and efficiency when this index system is applied. Moreover, specialized training programs and interdisciplinary collaboration may support effective implementation of this index system. Last but not least, policymakers and administrators are encouraged to adopt and resource this index system to improve care quality and reduce costs related to pediatric asthma. These efforts aim to enhance this index system's applicability and contribute to better pediatric asthma care worldwide.

Limitations

There are some limitations in this study. Firstly, though the number of experts was sufficient, the experts came from 4 provinces or municipality, which may not be representative enough. Therefore, our results might be biased by experts' composition [28], and their opinions might not be enough to represent the overall view. Secondly, the core competency evaluation index system for pediatric asthma specialist nurses was only applied in one city due to the limited research time and source, and therefore requires further studies to evaluate its clinical validity, expand its applicability, and make improvement for it. Thirdly, the data were collected from self-reports, in which participants may underestimate or overestimate their core competencies, and thus may cause a decline in data accuracy. More objective indicators are expected to be developed to assess pediatric asthma specialist nurses' core competencies in the future. Further studies including representative experts, are needed to confirm the validity and applicability of this evaluation index.

Conclusion

This is the first study to construct a core competency evaluation index system for pediatric asthma specialist nurses in China. This indicator includes two definitions (pediatric asthma specialist nurses, and pediatric asthma specialist nurses' core competency), 6 first-level indicators, 16 secondary indicators, and 63 third-level indicators. The research is scientific and reliable, and the weights of each indicator are reasonable. This evaluation index can be a reference for pediatric asthma specialist nurses training and assessment standard. Further studies are needed to apply and improve this evaluation index system.

Supplementary Information

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Supplementary Material 1

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Author contributions

Yi Qin, Xiaoyan Cai, and Yelin Ji: study design, investigation, formal analysis, data curation, data collecting, manuscript preparation, and revised the manuscript. Jianing Lu, Caifeng Zhang, and Yan Gao: conceptualization, data collecting, investigation, writing-editing. Shujing Yan, Rongshan Chen, Rulin Huang, and Lan Ma: investigation, data collecting and data analysis. Fengxia

Yan, and Xiao Chun: supervision, project administration, reviewed and revised the manuscript. All authors reviewed the manuscript.

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

Declarations

Ethics approval and consent to participate
This study was approved by the Research Ethics Committee of Guangzhou Women and Children's Center (Approval number: [2023] 091A01). All data were collected anonymously. Informed consents to participate in this study were attained. Participants in this study were voluntary and had the right to withdraw at any time. Our study adhered to the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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