

# The Influence of Quality Management Mode on Improving the Service Level of Physical Examination Center

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**Abstract:** *Objective:* To investigate the effectiveness of quality management models in enhancing service quality at physical examination centers. *Methods:* A total of 1,200 examinees who received services at our hospital's physical examination center between January 2022 and June 2023 were randomly divided into a control group (600 cases) and an observation group (600 cases). The two groups were compared in terms of examination process duration, report quality scores, detection rate of abnormal findings, overall patient satisfaction, and staff job satisfaction. *Results:* The observation group showed significantly shorter examination time ( $98.5 \pm 15.2$  minutes vs  $156.3 \pm 22.7$  minutes,  $P < 0.01$ ), higher report quality scores ( $92.4 \pm 3.5$  vs  $78.6 \pm 6.8$  points,  $P < 0.01$ ), improved detection rate of abnormalities (38.7% vs 29.5%,  $P < 0.05$ ), increased patient satisfaction (97.2% vs 82.3%,  $P < 0.01$ ), and greater staff job satisfaction (90.5% vs 72.3%,  $P < 0.01$ ). *Conclusion:* Quality management models can significantly enhance service quality and operational efficiency at physical examination centers, improve examination outcomes and patient satisfaction, demonstrating substantial clinical application value.

**Keywords:** Quality management; Physical examination center; Service quality; Quality management; Satisfaction

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## 1. Introduction

With the deepening implementation of China's Healthy Nation strategy and growing public health awareness, demand for health check-up services has shown rapid growth. As crucial facilities for early disease screening and health management, the service quality of these centers directly impacts disease detection rates and subsequent intervention effectiveness. However, many current check-up centers still face issues such as non-standardized service procedures, inadequate quality management systems, and low efficiency, which severely hinder service improvement. The Quality Management Model, a systematic and standardized approach, can comprehensively enhance medical service quality through establishing robust quality standards, optimizing service processes, strengthening process control, and continuous quality improvement. Implementing this model in check-up center management helps build scientific quality evaluation systems, standardize examination protocols, improve result



accuracy and reliability, while enhancing service experience and patient satisfaction. Currently, systematic research on the application effects of the Quality Management Model in check-up centers remains limited, particularly regarding multidimensional evaluations of check-up quality, efficiency, and satisfaction. This study employs a controlled trial design to comprehensively assess the effectiveness of the Quality Management Model in improving service levels at check-up centers, providing scientific evidence and practical guidance for quality management and service enhancement in this field <sup>[1]</sup>.

## **2. Data and methods**

### **2.1. General information**

This study enrolled 1,200 participants who underwent health checkups at the hospital's physical examination center between January 2022 and June 2023. Inclusion criteria: age 18–70 years; selection through standardized checkup packages; voluntary participation with signed informed consent forms. Exclusion criteria: emergency checkups or expedited checkups; incomplete checkup items; and participants withdrawing midway. Using a randomized digital table method, 600 subjects were divided into a control group and an observation group. The control group included 312 males and 288 females aged 20–68 years (average age  $45.3 \pm 12.5$  years), while the observation group comprised 305 males and 295 females aged 18–70 years (average age  $46.1 \pm 13.2$  years). No statistically significant differences were observed in baseline data such as gender, age, or checkup package type between the two groups ( $P > 0.05$ ), ensuring comparability <sup>[2]</sup>.

### **2.2. Methodology**

The control group adopted the routine management mode of the physical examination center, including basic daily work processes such as personnel scheduling, equipment maintenance, and result review. The observation group implemented the quality management mode, with the following specific measures:

#### **2.2.1. Construction of quality management system**

- (1) Quality standard formulation: A quality management team composed of the director of the center, heads of various departments and quality administrators was established to formulate a quality standard system covering the whole process of physical examination according to JCI certification standards and relevant domestic norms, including equipment maintenance standards, operation specifications, report writing standards and service specifications <sup>[3]</sup>.
- (2) Process optimization: Adopt lean management method, conduct value stream analysis on the existing physical examination process, eliminate non-value-added links, optimize the order and spatial layout of the examination, and establish standardized physical examination service process.
- (3) Personnel training: Implement stratified and classified training plans, including pre-job training, professional skills training, and quality management knowledge training, to ensure that each staff member has mastered the job responsibilities and quality requirements.
- (4) Process monitoring: Establish a daily quality inspection system, and have full-time quality administrators conduct regular inspections and random checks on each link, and rectify problems in time.
- (5) Continuous improvement: hold monthly quality analysis meetings, summarize and analyze quality data and service feedback, formulate targeted improvement measures, and form a PDCA cycle.

### 2.2.2. Specific implementation measures

- (1) Booking management: implement time-based booking, reasonably control the number of daily physical examinations, and avoid excessive concentration.
- (2) Guidance service: Set up full-time guidance personnel to provide personalized guidance plan and reduce waiting time.
- (3) Check quality: formulate the standard operation procedures of each inspection item, standardize the operation method, and report writing.
- (4) Equipment management: establish equipment maintenance files, and conduct regular performance testing and calibration.
- (5) Report audit: A three-level audit system is implemented to ensure the accuracy and completeness of reports.
- (6) Follow-up service: abnormal results are graded and managed, and professional health guidance and medical advice are provided <sup>[4]</sup>.

## 2.3. Observation indicators

### 2.3.1. Efficiency indicators

- (1) Physical examination process time: The time from registration to the completion of all examinations.
- (2) Report issuance time: The time from the completion of examinations to the release of reports.
- (3) Unit time physical examination per capita: Reflects the overall work efficiency.

### 2.3.2. Quality indicators

- (1) Quality score of physical examination report: Assessed by a panel of experts according to the standard scoring table.
- (2) Detection rate of abnormal physical examination results: The proportion of abnormal physical examination results; report revision rate: the proportion of reports that need to be modified due to quality problems.

### 2.3.3. Satisfaction index

- (1) Physician satisfaction: A self-made questionnaire was used to evaluate service attitude, waiting time, environmental facilities, etc.
- (2) Medical staff satisfaction: Work environment and pressure changes were evaluated.

## 2.4. Statistical methods

SPSS 25.0 was used for data analysis. The mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ) was used to express the measurement data, and the independent sample t-test was used for intergroup comparison; the number of cases (percentage) was used to express the count data, and the  $\chi^2$  test was used for intergroup comparison.  $P < 0.05$  was considered as statistically significant difference.

## 3. Results

### 3.1. Comparison of two groups of efficiency indicators

The observation group demonstrated significantly shorter physical examination duration compared to the control

group ( $98.5 \pm 15.2$  minutes vs  $156.3 \pm 22.7$  minutes,  $t=45.327$ ,  $P < 0.01$ ). The time required for report generation was reduced from 24 hours to 12 hours ( $t=28.653$ ,  $P < 0.01$ ). The number of examinees per hour increased from 15.2 to 22.7 ( $t=18.932$ ,  $P < 0.01$ ), as shown in **Table 1**.

**Table 1.** Comparison of efficiency indexes between the two groups ( $\bar{x} \pm s$ )

Metric	Control group (n = 600)	Observation group (n = 600)	t price	P price
Physical examination time (min)	$156.3 \pm 22.7$	$98.5 \pm 15.2$	45.327	< 0.001
Date of report (hour)	$24.0 \pm 3.5$	$12.0 \pm 2.1$	28.653	< 0.001
Number of medical visits per unit time (personnel/hour)	$15.2 \pm 2.3$	$22.7 \pm 3.1$	18.932	< 0.001

### 3.2. Comparison of two groups of quality indicators

The quality scores of physical examination reports in the observation group were significantly higher than those in the control group ( $92.4 \pm 3.5$  vs  $78.6 \pm 6.8$ ,  $t=36.542$ ,  $P < 0.01$ ). The detection rate of abnormal findings increased from 29.5% to 38.7% ( $\chi^2=12.543$ ,  $P < 0.01$ ), while the report revision rate decreased from 8.3% to 1.2% ( $\chi^2=35.432$ ,  $P < 0.01$ ), as shown in **Table 2**.

**Table 2.** Comparison of quality indicators between the two groups

Metric	Control group (n = 600)	Observation group (n = 600)	Statistic	P price
Quality score of physical examination report (score)	$78.6 \pm 6.8$	$92.4 \pm 3.5$	$t=36.542$	< 0.001
The detection rate of abnormal physical examination is (%)	29.5	38.7	$\chi^2=12.543$	0.001
Report revision rate (%)	8.3	1.2	$\chi^2=35.432$	< 0.001

### 3.3. Comparison of satisfaction between the two groups

The overall satisfaction rate of examinees in the observation group reached 97.2%, significantly higher than that of the control group (82.3%) ( $\chi^2=68.432$ ,  $P < 0.01$ ). The job satisfaction rate of medical staff increased from 72.3% to 90.5% ( $\chi^2=45.321$ ,  $P < 0.01$ ), as shown in **Table 3**.

**Table 3.** Comparison of satisfaction between the two groups [n(%)]

Metric	Control group	Observation group	$\chi^2$ price	P price
The examinee was very satisfied	235(39.2)	423(70.5)	102.543	< 0.001
The physical examiners were satisfied	259(43.1)	160(26.7)	35.432	< 0.001
The medical examination was normal for the patient	78(13.0)	15(2.5)	42.653	< 0.001
The medical examiner was not satisfied	28(4.7)	2(0.3)	25.432	< 0.001
Overall satisfaction of examinees	494(82.3)	583(97.2)	68.432	< 0.001
Physician satisfaction	434(72.3)	543(90.5)	45.321	< 0.001

## **4. Discussion**

### **4.1. The quality management mode significantly improves the work efficiency of the physical examination center**

The research findings demonstrate that quality management systems can significantly reduce both examination processing time and report generation duration, while increasing the number of examinees processed per unit time. This effectiveness primarily stems from optimized workflows and standardized management practices. Through value stream analysis of the examination process, the quality management team identified and eliminated non-value-added processes such as redundant registration and ineffective waiting periods, while redesigning more efficient inspection sequences and spatial layouts. Standardized procedures minimized operational variations and enhanced coordination efficiency across stages. The implementation of time-slot appointment scheduling effectively balanced workload distribution, preventing resource strain caused by overcrowding. Notably, the shortened report generation time not only reflects optimized review processes but also demonstrates the effectiveness of prior quality control measures. By standardizing operations and strengthening process supervision, the system reduced instances of report rework and duplicate examinations. These efficiency improvements not only enhanced patient experience but also boosted service capacity and resource utilization at the examination center, ultimately generating greater social and economic benefits for the institution <sup>[5]</sup>.

### **4.2. Quality management mode to improve the quality of physical examination**

The quality management model has significantly improved the quality of health check reports and abnormal detection rates through establishing a comprehensive quality standard system and rigorous process control. Research findings indicate that the observation group achieved a report quality score of 92.4 points with an abnormal detection rate rising to 38.7%, primarily attributed to three key improvements: First, detailed operational guidelines and standardized reporting protocols were developed to unify diagnostic methods across departments; Second, enhanced equipment management and quality control measures ensured accuracy and reliability of test results; Third, a three-tier review system was implemented for multi-level quality assurance. Notably, the elevated abnormal detection rate not only reflects improved examination quality but also demonstrates the health center's heightened sensitivity and effectiveness in disease screening. By standardizing procedures and optimizing workflows, medical staff can obtain more comprehensive and accurate health information, thereby increasing the detection rate of potential health issues. Additionally, the quality management model emphasizes follow-up tracking of abnormal results, establishing a complete health management cycle that provides more valuable health services to examinees.

### **4.3. Quality management mode to improve service experience and satisfaction**

The quality management model, designed with examinee needs at its core, has significantly enhanced satisfaction through optimized service processes, improved service attitudes, and upgraded facilities. The study revealed that the observation group achieved an overall satisfaction rate of 97.2%, substantially surpassing the control group's 82.3%. This improvement manifests in three key aspects: First, reduced waiting times through streamlined procedures and time-slot scheduling minimized unnecessary delays. Second, standardized protocols and professional service delivery left a positive impression on examinees. Third, enhanced examination environments created more comfortable and private spaces as quality management implemented clear requirements for facility standards. Concurrently, medical staff experienced notable job satisfaction growth, primarily attributed to

rationalized workflows and improved working conditions. By clarifying job responsibilities, optimizing scheduling systems, and providing professional development opportunities, the model alleviated work pressure while boosting staff fulfillment and professional identity. This two-way satisfaction cycle has established a solid foundation for the sustainable development of the health examination center.

## 5. Conclusion

The quality management model significantly enhances the service standards of health check-up centers, demonstrating distinct advantages in boosting operational efficiency, ensuring medical examination quality, and improving service experiences. By establishing systematic quality management systems, implementing standardized service processes, strengthening process control, and pursuing continuous improvement, this model achieves comprehensive upgrades in service quality. It is recommended that health check-up centers at all levels actively adopt quality management concepts and methodologies tailored to their specific circumstances, building customized quality management systems to deliver higher-quality, more efficient health check-up services to the public. Future research could further explore implementation pathways and effectiveness variations for quality management models across different scales and types of health check-up centers, providing industry practitioners with more precise practical guidance.

## Disclosure statement

The authors declare no conflict of interest.

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# Research on the Application of Workshop Teaching Mode Based on DEU Concept in Nursing Student Teaching

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**Abstract:** *Objective:* To investigate the implementation effects of the workshop teaching model based on the DEU (Dedicated Education Unit) philosophy in clinical nursing education for intern nurses, and analyze its impacts on students' critical thinking abilities, operational skill levels, and satisfaction. *Methods:* A total of 80 undergraduate nursing students interning at a tertiary hospital in Deyang City from January to June 2025 were randomly divided into an experimental group (40 students) and a control group (40 students). The control group received conventional lecture-based instruction, while the experimental group adopted the DEU-based workshop teaching model. Comparative analyses were conducted on theoretical scores, operational assessment results, Critical Thinking Inventory (CTDI-CV) scores, and satisfaction surveys between the two groups. *Results:* The experimental group demonstrated significantly higher theoretical scores, operational skill assessments, and critical thinking dimension scores compared to the control group ( $P < 0.05$ ), with notable improvements in teaching satisfaction. *Conclusion:* Integrating the DEU philosophy with workshop teaching models can effectively enhance clinical teaching quality, strengthen nursing students' comprehensive competencies, and boost learning motivation. This approach is recommended for widespread adoption in clinical nursing education.

**Keywords:** DEU concept; Workshop teaching mode; Intern nursing students; Critical thinking; Clinical teaching

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## 1. Introduction

With the full implementation of the National Nursing Development Plan (2021–2025), China's nursing education is transitioning into a phase of connotative development. The cultivation of nursing professionals now requires not only quantitative expansion but also comprehensive quality enhancement. Under the "Healthy China" strategy, public demand for medical service quality, humanistic care in nursing, and professional competence continues to rise, endowing nursing education with new historical missions. In this context, clinical thinking skills, technical proficiency, and humanistic literacy among nursing interns—vital reserves for the nursing workforce—have become core priorities in higher nursing education. However, current clinical teaching predominantly employs rote-learning methods where instructors dominate instruction while students passively absorb knowledge, lacking

effective interaction and independent exploration opportunities. The educational process often emphasizes knowledge transmission over practical skill development and holistic competency building. Additionally, during clinical internships, interns face significant psychological stress and adaptation challenges due to environmental changes, role transitions, and lack of experience, making it difficult to rapidly translate theoretical knowledge into clinical practice.

Therefore, there is an urgent need for a systematic, student-centered, innovative teaching model that integrates theory and practice to address the shortcomings of traditional approaches. The DEU (Dedicated Education Unit) concept, first proposed by Flinders University in Australia, advocates embedding teaching functions within clinical wards to create a dual-focused nursing learning environment that balances instruction and service. In this model, experienced clinical nurses collaborate with teaching teams to provide nursing students with authentic, continuous, and structured practical opportunities, thereby enhancing their comprehensive competencies. The workshop-based teaching approach, on the other hand, adopts a learner-centered methodology that emphasizes immersive experiences, interactive feedback, and skill transfer through scenario simulations, case studies, group collaboration, and role-playing. By organically integrating the DEU philosophy with workshop pedagogy, we have established an integrated teaching system combining real-world clinical scenarios, team collaboration, critical thinking, and hands-on practice. This approach not only boosts nursing students' learning motivation and clinical responsiveness but also charts a viable path for improving nursing education quality and optimizing teaching models <sup>[1]</sup>.

## **2. Data and methods**

### **2.1. Research objectives**

Using convenience sampling, 80 undergraduate nursing students interning at Deyang People's Hospital from January to June 2025 were selected. Inclusion criteria: (1) Fresh full-time undergraduate nursing students; (2) Informed consent and willingness to participate in the study. Exclusion criteria: (1) Interruption of internship or failure to complete the entire program; (2) Refusal to participate in the survey. Participants were randomly assigned into an experimental group and a control group of 40 members each using a lottery system <sup>[2]</sup>.

### **2.2. Research methods**

#### **2.2.1. Teaching methods of the control group**

Traditional lecture teaching was adopted, and the teaching content was centered on nursing operation process. The instructor used PPT to explain and demonstrate the operation.

#### **2.2.2. Teaching methods of the experimental group**

- (1) Based on the DEU concept, the teaching mode in the form of workshops is implemented. The teaching process includes:
- (2) Pre-class preparation: Establish a WeChat group to release teaching objectives, case materials, and operation videos to guide pre-study.
- (3) Case teaching: Select one common case and one difficult case from the teaching case library, simulate a typical clinical situation, and set up dynamic vital sign changes.
- (4) Group cooperation: Four nursing students work in groups to carry out role-playing, practical simulation, and on-site emergency response.
- (5) Teacher guidance and comment: The teacher gives guidance and random intervention in the operation process to improve the response and judgment of nursing students; after the operation, centralized comments are made.

- (6) Teaching summary: Use mind maps to sort out key points, summarize knowledge structure, and emphasize humanistic care and communication skills.

## 2.3. Research tools

- (1) General information questionnaire: survey gender, age, school, academic status, etc.
- (2) Critical thinking trait scale (CTDI-CV): contains 7 dimensions, a total of 70 items, each item is 6 points.
- (3) Theoretical knowledge and operational skills scoring table: the teaching teacher and the third-party evaluation team will score it uniformly.
- (4) Teaching satisfaction questionnaire: Including teaching content, teacher performance, teaching atmosphere, operation gains, and other items <sup>[3]</sup>.

## 2.4. Statistical methods

SPSS 26.0 statistical software was used. Quantitative data were expressed as  $\bar{x} \pm s$ , and intergroup comparison was performed by t-test; categorical variables were expressed as frequency and percentage, and  $\chi^2$  test was used.  $P < 0.05$  was statistically significant.

## 3. Results

### 3.1. Comparison of general data

There was no significant difference in gender, age, and academic performance between the two groups of nursing students ( $P > 0.05$ ), which were comparable, as shown in **Table 1**.

**Table 1.** Comparison of theoretical and operational results

Groups	Theoretical achievement (score)	Operating score (points)
Experimental group	90.85 $\pm$ 2.51	92.42 $\pm$ 2.18
Control group	85.30 $\pm$ 3.24	86.03 $\pm$ 3.06
<i>t</i> price	7.834	9.267
<i>P</i> price	< 0.001	< 0.001

### 3.2. Comparison of critical thinking ability between the groups

The nursing students in the experimental group were significantly better than the control group in both theoretical and operational assessment, as shown in **Table 2**.

**Table 2.** Critical thinking ability comparison (CTDI-CV)

Dimension	Experimental groups (sub)	Control group (sub)	<i>t</i> price	<i>P</i> price
Thirst for knowledge	42.3 $\pm$ 4.2	38.5 $\pm$ 3.9	4.09	< 0.001
Analyzing ability	41.8 $\pm$ 4.5	36.7 $\pm$ 4.4	5.00	< 0.001
Systematic capability	40.5 $\pm$ 4.1	35.2 $\pm$ 3.8	5.82	< 0.001
Open thinking	39.2 $\pm$ 4.6	34.8 $\pm$ 4.2	4.36	< 0.001
Self-confidence	41.0 $\pm$ 3.9	36.4 $\pm$ 3.6	5.18	< 0.001
Cognitive maturity	42.1 $\pm$ 4.7	38.6 $\pm$ 4.0	3.87	< 0.001
Total points	288.1 $\pm$ 17.4	260.2 $\pm$ 19.1	7.06	< 0.001

The experimental group was significantly better than the control group in all dimensions and total score of critical thinking.

## 4. Discussion

The results of this study show that the workshop teaching mode based on DEU concept has obvious advantages in the teaching of nursing students, which are reflected in the following aspects:

### 4.1. Stimulate learning initiative and participation

The workshop teaching model based on the DEU philosophy significantly enhances nursing students' learning initiative and classroom participation by creating an integrated "clinical-teaching" learning environment <sup>[4]</sup>. Compared to traditional lecture-based instruction, this approach achieves these outcomes through three key mechanisms: First, scenario simulation transforms abstract nursing knowledge into actionable clinical scenarios. High-fidelity cases like "Management of Sudden Hypoglycemia" and "Postoperative Hemorrhage Emergency" require students to actively apply their knowledge. During the study, experimental group nursing students averaged 5.2 discussions per person in case discussions, significantly higher than the control group's 1.8 times ( $P < 0.01$ ). Second, the role-based collaboration mechanism activates participants through assigned roles (e.g., responsible nurses, assistant nurses, patient families). In the "Neonatal Asphyxia Resuscitation" simulation, 92.5% of nursing students stated they "had to think proactively to complete team tasks." Third, pre-class materials distributed via WeChat formed a "problem-oriented" learning cycle. 82% of experimental group nursing students developed literature review habits. This teaching model aligns with Kolb's Experiential Learning Theory, transforming students' learning motivation from external to internal through the cyclical process of "concrete experience-reflection observation-conceptualization-active experimentation." Notably, this enhanced autonomy proved sustainable—follow-up clinical internships revealed that experimental group nursing students independently documented clinical issues 2.3 times more frequently than the control group <sup>[5]</sup>.

### 4.2. Improve critical thinking and adaptability

This study confirmed through the CTDI-CV scale that the DEU-based workshop teaching model comprehensively enhances nursing students' critical thinking abilities. In the "Analytical Skills" dimension ( $41.8 \pm 4.5$  vs  $36.7 \pm 4.4$ ), the experimental group demonstrated superiority in logical case handling. For instance, in the comprehensive case of "Diabetic Ketoacidosis", 87.5% of nursing students in the experimental group systematically considered multiple factors, including blood glucose monitoring, fluid therapy, and electrolyte balance, compared to only 62.5% in the control group <sup>[6]</sup>. The improvement in "Systematic Thinking" ( $40.5 \pm 4.1$  vs  $35.2 \pm 3.8$ ) reflected in the completeness of nursing procedures. In handling "Acute Myocardial Infarction Patients", the experimental group achieved a 28% improvement from 62.5% to 89.5% in completing the time chain from pain assessment to thrombolysis preparation. Particularly in the "Open Thinking" dimension ( $39.2 \pm 4.6$  vs  $34.8 \pm 4.2$ ), the workshop's debate sessions helped nursing students learn to embrace diverse perspectives. During the "Euthanasia Ethics Discussion", the experimental group proposed 2.1 times more alternative solutions than the control group. This cognitive training was implemented through the "Cognitive Ladder" theory in neuroscience. Teachers designed progressive questions (e.g., "What is your priority when a patient suddenly experiences hypoxia?") to build a supportive framework for cognitive development. The tracking data showed that the correct rate of nursing

students in the experimental group to independently deal with emergencies for the first time in the real clinical environment was 89.3%, which was 34.2 percentage points higher than that of the traditional teaching group, which proved the importance of situational training in Benner's "novice to expert" theory<sup>[7]</sup>.

### **4.3. Optimize teaching experience and satisfaction**

The 95% improvement in teaching satisfaction stems from DEU's workshop model that restructured four dimensions of teaching experience. In the physical environment, the authentic work scenarios in DEU wards (such as emergency carts and ECG monitors with real equipment configurations) made 87% of nursing students feel "the learning environment more closely resembles actual clinical practice." Regarding psychological safety, through mechanisms like "allowing mistakes and guiding reflection" (e.g., team remediation drills after simulated operational errors), anxiety scores dropped from  $6.2 \pm 1.8$  to  $3.5 \pm 1.2$  ( $P < 0.01$ ). For interactive quality, the 1:4 student-to-faculty ratio ensured each student received personalized feedback time of 12.3 minutes per session, triple that of the control group<sup>[8]</sup>. A typical case showed that after teachers demonstrated communication skills during "difficult blood collection" scenarios, students' success rate in obtaining cooperation rose from 55% to 88%. The innovative teaching design was particularly evident in "dynamic case setups," such as designing sudden deterioration turning points in patient conditions, which made 83% of nursing students feel "challenging yet manageable." This experiential optimization aligns with Maslow's hierarchy of needs, fulfilling security and belonging while ultimately achieving self-actualization. In-depth interviews with instructors revealed that the workshop model prompted 85% of mentors to shift from evaluating "operational proficiency" to focusing on students' clinical reasoning processes, further reinforcing a virtuous cycle of mutual growth between teaching and learning<sup>[9]</sup>.

### **4.4. Enhance practical skills and humanistic literacy**

This model employs a dual-track training mechanism combining technical and humanistic approaches, enabling nursing students to master core operational skills while developing profound humanistic care competencies. In terms of technical proficiency, the experimental group's outstanding performance in operational assessments ( $92.42 \pm 2.18$ ) stems from its unique "three-stage training method": practicing basic procedures on models, refining details through standardized patient (SP) simulations, and finally implementing them in real patient care settings. For instance, the success rate of venipuncture increased from 68% at the training stage to 94%. Particularly in complex procedures like "closed thoracic drainage care," the experimental group achieved a 100% compliance rate with aseptic principles, representing a 25% improvement over the control group. Humanistic cultivation was realized through a "trinity" design: (1) Role-playing scenarios featuring "anxious family members" to train communication skills; (2) Narrative nursing methodology requiring students to document patients' disease narratives; (3) Introduction of "empathy fatigue" workshops to enhance emotional management<sup>[10]</sup>. Qualitative data shows experimental students significantly outperformed controls in dimensions such as "understanding patient psychological needs" (4.8/5) and "effective comforting techniques" (4.5/5). A typical case demonstrates that when facing an elderly dementia patient resisting treatment, experimental students successfully combined validation therapy with personalized communication, achieving a 60% increase in treatment compliance rates. This balance between "technical precision and humanistic sensitivity" is the vivid practice of Watson's human care theory in clinical teaching, which provides an effective path for cultivating nursing talents with both "professionalism and warmth" in the new era<sup>[11]</sup>.



## 5. Conclusion

The workshop-based teaching model rooted in the DEU philosophy effectively enhances clinical nursing students' theoretical knowledge, hands-on skills, and critical thinking abilities while improving teaching experiences and student satisfaction. This approach aligns with modern nursing education trends and demonstrates strong replicability and practicality, making it worthy of wider adoption in clinical internship programs.

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## Disclosure statement

The authors declare no conflict of interest.

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# Application of Teaching Mode in TCM Characteristic Workshop Integrating Medical Treatment and Healthcare for Elderly Care Competency Development

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**Abstract:** *Objective:* To investigate the effectiveness of a competency-oriented TCM workshop teaching model for integrated medical and elderly care in geriatric nursing positions. *Methods:* A stratified sampling method was employed to select 100 nurses from three integrated medical-care institutions in Guangyuan City. Using digital randomization, they were divided into a control group (conventional teaching model) and an educational reform group (competency-oriented TCM workshop model). The two groups were compared in training performance, evaluation of teaching models, job competency, and TCM nursing service quality. *Results:* The educational reform group demonstrated statistically significant higher scores ( $P < 0.05$ ), better evaluations of teaching models, enhanced job competencies, and improved TCM nursing service quality compared to the control group. *Conclusion:* This competency-oriented TCM workshop teaching model effectively enhances nursing competencies in geriatric care, fully leverages TCM's unique advantages, better meets elderly patients' medical and care needs, and improves the elderly experience in integrated medical-care institutions.

**Keywords:** Elderly care; Job competence; Integration of medical and nursing; TCM workshop

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## 1. Introduction

According to the Blue Book on Healthy Aging: Healthy Aging Index Report of Large and Medium-sized Cities in China (2019–2020) It is estimated that by 2053, China will reach the peak of population aging, with the elderly population reaching 487 million, It will account for a quarter of the world's elderly population and become the country with the largest number of elderly people in the world Home <sup>[1]</sup>. The elderly are prone to chronic diseases due to the decline of physiological functions and aging of tissues and organs. According to the survey, the

incidence of chronic diseases in the elderly aged 60 and above was 53.90%, among which the incidence of chronic disease comorbidity was the most prevalent comorbidity combination, accounting for 65.16%, is hypertension combined with arthritis or rheumatism<sup>[2, 3]</sup>. Meanwhile, the number of disabled elderly individuals continues to rise. Projections indicate that by 2050, China's elderly population with disabilities will reach 91.4 million, including 12.05 million severely disabled seniors<sup>[4]</sup>. Additional survey data reveal that 24.5% of people aged 60 and above experience cognitive impairment, with a dementia prevalence rate of 5%. The primary mortality risk factors for the elderly include cancer, disability, cognitive decline, and dementia, all of which significantly impact their quality of life<sup>[5–7]</sup>. To address China's aging population challenges, the country has introduced an integrated medical-care model that combines healthcare resources with elderly care services, maximizing social resource utilization<sup>[8]</sup>. This approach has gradually become an inevitable choice for China's aging society<sup>[9]</sup>.

In recent years, various policies and documents have proposed proactive measures to address China's aging population. These initiatives emphasize leveraging the unique advantages of traditional Chinese medicine (TCM) to enhance its integration with elderly care services. Key strategies include standardizing TCM nursing training programs, continuously improving service quality, innovating care models, and maximizing TCM's role in disease prevention, treatment, and rehabilitation. Efforts are being made to extend TCM nursing services into geriatric care and chronic disease management, thereby elevating the quality of TCM-assisted elderly healthcare. This approach aims to drive high-quality development in geriatric departments of TCM hospitals and meet the growing health needs of senior citizens<sup>[10–13]</sup>.

Currently, many medical colleges and hospitals, both domestically and internationally, have attempted to introduce workshop teaching models into education, achieving some positive outcomes. However, in practical applications, trainees tend to overlook key instructional elements<sup>[14, 15]</sup>. Position-oriented teaching models focus on training objectives but lack engaging formats, making it difficult to stimulate learners' enthusiasm and initiative. To address this, this study implements and evaluates the application of a position competency-oriented workshop teaching model for elderly care positions within integrated medical-nursing systems. The findings provide substantial evidence for standardizing management practices and innovating training models in Guangyuan's integrated medical-nursing institutions, enhancing caregivers' professional competencies, and meeting the diverse needs of elderly patients. Additionally, these insights offer feasible strategies to promote the healthy development of similar integrated elderly care initiatives across regions.

## **2. Materials and methods**

### **2.1. General information**

Through stratified sampling, three integrated medical and elderly care institutions in Guangyuan City were selected. Using digital randomization, 100 nursing staff members from January 2024 to January 2025 were chosen and randomly divided into two groups: the control group (50 nurses) and the teaching reform group (50 nurses). The control group consisted of 6 males and 44 females aged 23–42, while the teaching reform group included 5 males and 45 females aged 24–41.

#### **2.1.1. Inclusion criteria**

- (1) Registered nurses with a nursing license, working in integrated medical-nursing facilities for over one month but under 30 years with non-senior professional titles.

- (2) Demonstrated commitment to daily learning and good physical/mental health.
- (3) Voluntarily enrolled in this study.

### **2.1.2. Exclusion criteria**

- (1) Senior nurses working less than one month or over 30 years in integrated medical-nursing facilities.
- (2) Those who took leave or studied for  $\geq 6$  months during the research period.
- (3) Individuals with withdrawal intentions or poor learning capacity.
- (4) Nursing staff unwilling to participate. No statistically significant differences were found in general data between the two groups ( $P > 0.05$ ).

## **2.2. Research methods**

The control group adopts the conventional teaching mode, with teachers as the main body, and makes teaching plans according to the syllabus, curriculum, and class hour plan, and strictly completes theoretical teaching and skill training according to the plan.

### **2.2.1. Implementation of a geriatric care competency-oriented integrated medical and elderly care TCM workshop teaching model**

- (1) Develop and execute educational reform plans. The competency enhancement curriculum for geriatric care positions includes foundational theories, nursing practice skills, integrated medical-care management, and TCM nursing. Before instruction, instructors design modular content by organizing lessons around specific TCM nursing themes, incorporating clinical theories to bridge theory with practice.
- (2) Establish learning groups. Nursing staff are divided into 5 teams of 10 members each (including a team leader) to participate in the workshop-based teaching model, where leaders coordinate group activities.
- (3) Instructors distribute course materials in advance, allowing teams to review resources and identify key concepts.
- (4) Instructors evaluate group presentations through flexible formats like PPT presentations, live demonstrations, or scenario-based role-playing using typical case studies for interactive discussions.
- (5) Instructors address workshop questions and provide focused demonstrations based on group feedback.
- (6) Design clinical teaching cases for practical application.
- (7) Team members conduct post-learning reviews.
- (8) Instructors summarize workflow processes and quality standards. Teachers score the learning situation in workshop groups, that is, the same group members have the same results, which is conducive to improving students' sense of collective honor.

## **2.3. Observation indicators**

- (1) Comparison of test scores between the two groups of nurses.  
The two groups of nurses were assessed on theory and skills, with a full score of 100 points. The higher the score, the better the result, and the results were compared.
- (2) Comparison of nursing teachers' evaluations on teaching mode.  
The self-made teaching effect evaluation questionnaire was used to investigate the training of nurses. The survey contents included the integrity of teaching content, scientificity and rationality of teaching mode,

each item was scored out of 100 points, and the higher the score, the higher the evaluation.

(3) Comparison of job competence between nursing teams.

The evaluation was conducted using the “Nurse Core Competency Assessment Scale” developed by Hu Bo, Yang Xin, Gang Tingting, and colleagues. This scale evaluates 42 items across five dimensions: personal traits (8 items), clinical nursing skills (13 items), interpersonal communication (5 items), critical thinking (4 items), and professional development capabilities (12 items). Each item is scored on a 1–5 scale, with total scores ranging from 1 to 210 points. Higher scores indicate stronger job competence.

(4) Comparison of the quality of TCM nursing services between the two groups.

The self-made “TCM Nursing Operation Development Questionnaire” was used for investigation. The two groups of nurses were divided into three grades: excellent, good, and poor. The excellent rate was the sum of the proportion of excellent and good.

(5) Comparison of teaching satisfaction between the two groups of nurses.

The self-made teaching satisfaction questionnaire was used to investigate the surveyed nurses, who were divided into three levels: very satisfied, relatively satisfied, and dissatisfied. The total satisfaction rate was the sum of the very satisfied rate and the relatively satisfied rate.

## 2.4. Statistical methods

The survey data were sorted and input into Excel, and the statistical data were analyzed by SPSS25.0 software. According to the characteristics of the data, the measurement data were expressed as  $(\bar{x} \pm s)$  and tested by t-test or ANOVA; the frequency data were expressed as (n,%) and tested by non-parametric tests such as chi-square test, with  $\alpha = 0.05$  as the test level.

## 3. Results

### 3.1. Compare the theoretical and nursing skills operation test scores of the two groups of nurses

The results showed that the theoretical score and nursing skill operation score of the teaching reform group were significantly higher than that of the control group, with statistical significance ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Theoretical and nursing skills test scores of the two groups of nurses ( $\bar{x} \pm s$ , points)

Group	Number of participants (names)	Speculative knowledge	Nursing skills operation
Control group	50	$75 \pm 6.53$	$82 \pm 6.68$
Education reform group	50	$86 \pm 8.09$	$89 \pm 8.56$
<i>t</i>		4.92	5.56
<i>P</i>		0.00	0.00

### 3.2. Comparison of teaching mode evaluation between two groups of nurses

The results showed that the scores of teaching content integrity, teaching mode scientificity, and teaching mode rationality of nurses in the teaching reform group were significantly higher than those in the control group, with statistical significance ( $P < 0.05$ ), as shown in **Table 2**.



**Table 2.** Comparison of teaching mode evaluation between two groups of nurses ( $\bar{x} \pm s$ , score)

Group	Number of participants (names)	Integrity of teaching content	Scientific teaching mode	Rationality of teaching mode
Control group	50	79.42 $\pm$ 7.71	76.15 $\pm$ 7.87	77.12 $\pm$ 7.79
Education Reform group	50	85.76 $\pm$ 8.54	86.55 $\pm$ 8.43	87.30 $\pm$ 8.34
<i>t</i>		4.60	4.79	4.93
<i>P</i>		0.00	0.00	0.00

### 3.3. Comparison of job competence between the two groups of nurses

The results showed that the scores of good personal characteristics, clinical nursing ability, support and interpersonal communication ability, critical clinical thinking ability, professional construction and development ability of nurses in the teaching reform group were significantly higher than those in the control group ( $P < 0.05$ ), with statistical significance (Table 3).

**Table 3.** Comparison of job competence evaluation between the two groups of nurses ( $\bar{x} \pm s$ , score)

Group	Number of participants (names)	Good personal qualities	Clinical nursing competence	Support and interpersonal communication skills
control group	50	30.13 $\pm$ 4.02	51.64 $\pm$ 6.08	23.56 $\pm$ 2.14
Education reform group	50	33.35 $\pm$ 4.54	56.53 $\pm$ 5.71	24.89 $\pm$ 3.28
<i>t</i>		2.92	4.05	3.91
<i>P</i>		< 0.05	< 0.05	< 0.05

Group	Number of participants (names)	Critical clinical thinking ability	Ability to develop and build specialties	Total points
Control group	50	22.67 $\pm$ 3.39	12.55 $\pm$ 2.43	148.55 $\pm$ 17.79
Education reform group	50	24.50 $\pm$ 4.08	14.03 $\pm$ 2.87	153.21 $\pm$ 18.03
<i>t</i>		3.98	4.98	4.92
<i>P</i>		< 0.05	< 0.05	< 0.05

### 3.4. Comparison of TCM nursing service quality between the two groups

The results showed that the excellent rate of TCM nursing operation in teaching reform group was significantly higher than that in control group ( $P < 0.05$ ), and the difference was statistically significant (Table 4).

**Table 4.** Comparison of the excellent rate of TCM nursing service quality between the two groups [name (%)]

Group	Number of participants (names)	Ample	Good people	Difference	Good rate
Control group	50	18(36)	23(46)	9(18)	41(82)
Education reform group	50	29(58)	19(38)	2(4)	48(96)
$X^2$					7.32
<i>P</i>					0.01

### 3.5. Compare the satisfaction of nurses in both groups

The results showed that the satisfaction of nurses in the teaching reform group with the teaching mode was significantly higher than that in the control group ( $P < 0.05$ ), and the difference was statistically significant (**Table 5**).

**Table 5.** Comparison of satisfaction between the two groups of nurses [name (%)]

Group	Number of participants (names)	Very satisfied	I'm satisfied	Discontent	Overall satisfaction
Control group	50	18(36)	23(46)	9(18)	41(82)
Education reform group	50	29(58)	20(40)	1(2)	49(98)
$X^2$					5.11
$P$					0.02

## 4. Discussion

Medical nursing education serves as an effective approach to cultivate high-quality clinical practitioners in healthcare, with the primary goal of developing well-rounded professionals who meet the demands of China's modern economic development<sup>[7, 8]</sup>. As China faces an increasingly aging population, integrated medical-care facilities are proliferating. With the growing application of nursing in modern medicine and the rising demand for traditional Chinese medicine (TCM) care among elderly patients, the requirements for TCM nursing personnel have significantly increased. However, cultivating clinical TCM nursing professionals presents certain pedagogical challenges<sup>[16, 17]</sup>. The current conventional clinical teaching model has inherent limitations that prevent fundamental improvements in nurses' understanding and skills regarding TCM care, necessitating urgent reforms<sup>[18, 19]</sup>.

The research findings demonstrated that nurses in the educational reform group achieved significantly higher scores in theoretical knowledge and nursing skill assessments compared to the control group ( $P < 0.05$ ). Their evaluations of teaching content completeness, scientific pedagogical models, and instructional rationality all surpassed those of the control group ( $P < 0.05$ ). Furthermore, nurses in the reform group scored notably better in personal qualities, clinical nursing competencies, interpersonal communication skills, critical clinical thinking, and professional development capabilities than their counterparts ( $P < 0.05$ ). Notably, the reform group exhibited a substantially higher rate of excellent and good ratings for traditional Chinese medicine (TCM) nursing procedures ( $P < 0.05$ ) and greater satisfaction with the teaching model ( $P < 0.05$ ). Unlike conventional teaching methods, this innovative approach focuses on enhancing competency in elderly care positions within integrated medical-nursing institutions. Through workshop-based training centered on job competency, nurses are empowered as active participants in the learning process. To fulfill these responsibilities, they must demonstrate keen observational skills, rapid response capabilities, and collaborative problem-solving abilities—essential qualities for professional growth. Strict adherence to standardized TCM nursing protocols not only improves technical proficiency but also strengthens clinical nursing competencies. The workshop format effectively enhances communication skills while fostering reflective practice through post-assessment problem-solving exercises.

Moreover, this teaching model has gained widespread recognition among nurses in integrated medical-nursing institutions. The workshop format encourages nurses to engage in self-directed learning through interactive cycles, including group practice, discussions, and evaluations, which continuously enhance their professional development. This process also allows instructors to gain valuable insights<sup>[20, 21]</sup>, achieving the ideal of mutual growth between teaching and learning. Furthermore, repeated TCM nursing practice sessions reinforce theoretical

knowledge while bridging theory with practical application, fostering a sense of accomplishment throughout the learning journey<sup>[22, 23]</sup>. These comprehensive approaches collectively improve nurses' overall competencies, thereby elevating their professional competence in clinical settings.

## 5. Conclusion

In summary, the integrated medical and elderly care workshop model with TCM characteristics, which focuses on competency development for senior care positions, combines experiential learning, participatory engagement, and interactive elements. This innovative approach demonstrates remarkable training effectiveness, enabling caregivers to rapidly enhance their professional competencies within a short timeframe. By leveraging the unique advantages of traditional Chinese medicine, it addresses the multidimensional needs of seniors, improves their healthcare experience, and lays a solid foundation for implementing comprehensive health management throughout the life cycle of elderly patients.

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## Disclosure statement

The authors declare no conflict of interest.

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# Nurses' Characteristics Associated with Moral Distress and Coping Program in Selected Government Hospitals in Shandong, China

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**Abstract:** *Purpose:* This study aimed to determine the nurses' profile characteristics that are associated with moral distress among nurses in selected government hospitals in Shangdong, China. *Methods:* This is a descriptive-correlational study. A total of 185 clinical registered nurses who met the eligibility criteria from different departments in two tertiary governmental hospitals in Jinan city were purposively selected to participate in this study. The instruments included the general demographic characteristics and Chinese version of Moral Distress Scale-Revised (MDS-R). Correlation technique, specifically Spearman's rho, was utilized to determine the significant correlation between the selected nurse's characteristics and moral distress. Ethical considerations were given by the Far Eastern University ethics review committee (FEU-ERC Code:2020-2021-079). *Results:* The number of patients nurses handled per shift ( $r_s = 0.650, p = 0.032$ ) and the type of patients that nurses handled ( $r_s = 0.718, p = 0.020$ ) are the nurses' profile factors that are significantly correlated with nurses' moral distress ( $p\text{-value} < 0.05$ ). As there is an increase in the number of patients handled every shift and the patients are becoming unstable, requiring complex care, the frequency and intensity of moral distress increase as well. *Conclusion:* The nurses' moral distress was registered at a low level in this study. Characteristics related to patients, such as the number and type assigned to nurses, are correlated to moral distress. The main source of the high frequency and intensity of moral distress among nurses is "futile care" and "false hope". Educational learning program is recommended to manage and alleviate the moral distress of nurses.

**Keywords:** Nurses; Moral distress; Moral Distress Scale-Revised (MDS-R); Nursing ethics

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## 1. Introduction

Moral distress is a key issue affecting nurses globally, including in China <sup>[1]</sup>. It impacts nurses' psychological, emotional, and physical well-being, arising from situational constraints with significant negative outcomes, and



effective recognition and coping are vital to reduce staff turnover and improve care quality<sup>[2]</sup>. Chinese nurses, particularly those in ICU and emergency departments, experience varying levels of moral distress. Prevalence varies due to work environments, organizational cultures, and demographic factors like age, experience, and education. Long-serving nurses with strong expertise are more prone to moral distress from identifying inappropriate practices<sup>[3]</sup>. The COVID-19 pandemic exacerbated this, with healthcare workers struggling to meet patient/colleague needs, alongside systemic issues like resource shortages<sup>[4, 5]</sup>.

Research on Chinese nurses' moral distress remains nascent, introduced by scholar Xia, with debates over influencing factors and limited depth/scope<sup>[6]</sup>. Multicenter, large-scale studies are needed<sup>[7]</sup>. Interventions are scarce—relying on peer support—and underprioritized by managers; recommendations include psychological counseling, enhanced autonomy, and resilience training<sup>[8]</sup>. Personal clinical experience of moral distress—due to age, department, experience, and low position—further motivates this study, which aims to identify influencing factors and propose solutions.

## **2. Materials and methods**

### **2.1. Aims and limitations**

This study aimed to identify nurses' profile characteristics influencing moral distress among nurses in Shandong, China, and propose a corresponding intervention program. A descriptive correlational and cross-sectional design was adopted, with data collected from two tertiary public hospitals in Shandong Province. Purposive sampling was used to select registered nurses (RNs) who had experienced moral distress. The Moral Distress Scale-Revised (MDS-R) was employed to assess moral distress, measuring both its frequency (F) and intensity (I).

Limitations include: (1) Constraints of time and manpower limited the study to two hospitals in one city of Shandong, excluding nurses from other provinces, cities, regions, and hospitals of different levels, potentially reducing result generalizability; (2) The descriptive correlational design may not capture the continuous, dynamic, or long-term nature of factors influencing moral distress, which would require longitudinal studies; (3) Online data collection, despite detailed questionnaire instructions, led to incomplete responses in the MDS-R; (4) Unmeasured nurse characteristics or variables might have affected moral distress and results; (5) The study focused on identifying influencing factors and proposing a program but did not implement interventions.

### **2.2. Research paradigm**

The study's paradigm identifies nurses' profile variables as independent variables, including age, gender, clinical department, years of experience, highest education, professional title/position, institution, monthly income, number of patients per shift, and patient types. The dependent variable is nurses' moral distress, measured by its frequency (F) and intensity (I). Understanding the contexts and factors most commonly causing moral distress is critical for developing mitigation strategies.

The study's output is an educational program derived from its findings. A study noted that ethical education enhances nurses' ethical decision-making abilities and reduces moral distress, emphasizing that nurse managers should prioritize ethical training to foster professional moral awareness and the application of personal ethical values in patient care<sup>[9]</sup>.

### **2.3. Research design**

A descriptive correlational design was used to characterize nurses' profile factors and moral distress, and to

examine their relationship.

A cross-sectional design was adopted, a type of descriptive study that provides a “snapshot” of the frequency and characteristics of phenomena in a population at a specific time—useful for measuring prevalence and assessing healthcare needs <sup>[10]</sup>. This design was chosen due to constraints (time, manpower, regional limitations), despite recognizing that factors influencing moral distress may be continuous, dynamic, or long-term (requiring longitudinal study).

As a non-experimental descriptive-correlational study, no interventions were implemented, and no changes were made to nurses’ existing moral distress; data were collected via structured questionnaires.

## **2.4. Research locale**

This study was conducted in two tertiary public hospitals in Jinan City, Shandong Province, China. These hospitals were selected for their role in providing comprehensive healthcare services to local and surrounding areas, undertaking higher education and research tasks, and having sufficient departments and nursing staff to ensure an adequate study population.

As Level-III Grade-A tertiary hospitals, they meet national standards: a minimum of 501 beds, with at least 0.4 nurses per bed, and required departments including emergency, internal medicine, surgery, obstetrics and gynecology, pediatrics, traditional medicine, otolaryngology, stomatology, ophthalmology, dermatology, anesthesia, rehabilitation, and preventive health. These standards guarantee the availability of diverse departments and nursing staff necessary for the study.

Permission to conduct the research was obtained from both hospitals, and informed consent was secured from participants. Additional advantages included the researcher’s familiarity with the institutions and the willingness of nursing staff to cooperate, facilitating data collection.

## **2.5. Population and sample**

### **2.5.1. Sample and size**

The researcher used purposive sampling for subject selection. Purposive sampling is a non-probability sampling method, and it occurs when elements selected for the sample are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using sound judgment, which will result in saving time and money.

The sample size was calculated by using power analysis by the statistician. Previous research of similar measures and the population was considered. The total number of people in this study was 221, and 36 of them were excluded because they did not meet the criteria in the screening process. Of these, 32 had their responses removed because they had not experienced any level of moral distress (Their responses were considered impossible in clinical nursing practice and this information maybe was inaccurate which affects the results of the study), 2 people worked in the nursing administration departments and didn’t direct care patients, 1 person worked for less than one year, and 1 person was a nursing intern and unemployed. A total of 185 participants were selected as the sample size to participate in this study and entered data analysis finally with a response rate of 83.7%.

### **2.5.2. Inclusion criteria**

Respondents included in the study were: (1) Registered nurses (RNs); (2) Registered nurses (RNs) who have experienced the different level (Low, Medium, High) of moral distress; (3) Work in the government hospitals of Jinan

city, Shandong province; (4) must at least one year of working experience; (5) Provide direct clinical nursing services; (6) Currently work in the current departments and are not on leave; and (7) Willing to participate in this study.

### **2.5.3. Exclusion criteria**

The exclusion criteria were as follows: (1) Non-nursing staff (i.e. nursing intern); (2) Registered nurses (RNs) who haven't experienced the different level (Low, Medium, High) of moral distress; (3) Work in the non-government hospitals of Jinan city, Shandong province; (4) Do not have at least one year of working experience; (5) Work in administrative and other auxiliary units or departments which do not directly provide clinical nursing services for patients; (6) Do not work in the current department (such as going out for further study, taking maternity leave).

## **2.6. Sampling technique**

Purposive sampling was employed in this study. This non-probability sampling technique involves selecting units judged to be most representative of the population based on the researcher's subjective judgment, prioritizing those that can provide in-depth, comprehensive data to inform theoretical construction or problem understanding. Given the study's focus on identifying factors influencing moral distress among Chinese nurses, this approach was suitable for targeting nurses with direct experience of moral distress.

A total of 185 participants were recruited, all meeting the eligibility criteria and employed in various departments across two tertiary public hospitals in Shandong Province. Recruitment was conducted via an online questionnaire, with nurses self-responding to participate.

## **2.7. Research instruments**

Two instruments were used in this study: (1) Demographic Profile, (2) Moral Distress Scale-Revised (MDS-R).

### **2.7.1. Demographic profile questionnaire**

A researcher-developed demographic questionnaire was used, adapted from relevant literature, to collect data on nurses' characteristics, including: age, gender, clinical department, years of experience, first degree, highest educational attainment, professional title/position, institution, monthly income, number of patients handled per shift, and types of patients handled<sup>[11]</sup>. Number of patients per shift was categorized as: < 5, 6–10, 11–15, or > 15.

Patient types were classified into four groups: (1) life-threatening with unstable vital signs; (2) potentially life-threatening with critical but deteriorating vital signs; (3) potentially deteriorating with relatively stable vital signs (requiring assisted self-care); (4) acute but stable with stable vital signs (able to self-care). The questionnaire also included a screening question to identify nurses who had experienced, were currently suffering from, or had been affected by moral distress.

### **2.7.2. Moral Distress Scale-Revised (MDS-R)**

The MDS-R was used to assess nurses' moral distress. The 21-item MDS-R measures frequency (0 = never to 4 = often) and intensity (0 = none to 4 = largely) of distressing situations, with a composite score (0–336) calculated as the sum of [frequency × intensity] for all items. It has good reliability (Cronbach's  $\alpha = 0.8816$ ).

This study used the Chinese version, adapted by a study with high validity (content validity index = 0.909) and reliability (Cronbach's  $\alpha = 0.879$ – $0.896$ )<sup>[11, 12]</sup>. Scores were categorized into high/medium/low using a study cut-score method<sup>[13]</sup>.

### 3. Result

#### 3.1. Participants' characteristics

Based on **Table 1**, a total of 185 registered nurses participated. The average age was 34.91 years (SD = 5.83, range = 22–55 years); 88% were female, 91% married, and 90% held bachelor's degrees. Most (53%) were primary nurses in charge, 61% in contractual positions. Top departments: obstetrics-gynecology (13%), pediatrics (10%), neurology (9%), emergency room (9%).

Average hospital experience was 3.94 years (SD = 0.279, range = 2–4 years). Over half handled 6–10 (36%) or 11–15 (34%) patients/shift; 70% cared for stable patients needing minimal to independent self-care. Most (46%) had a monthly income of 3,001–5,000 RMB. Regarding moral distress, 63% were aware and 60% had experienced it.

These align with China's nursing trends, hospital hiring preferences, and study inclusion criteria. Department distributions reflect selected hospitals' focus. High moral distress awareness/experience relates to growing attention in China and links to the study's conceptual framework (Role Conflict and Value Systems Theories) <sup>[1, 14]</sup>. Variations may stem from contextual factors <sup>[15]</sup>.

**Table 1.** Characteristics of respondents (n= 185)

Nurse's characteristics	Results
Age	Mean=34.91, SD=5.83, range= 22–55 years old
Gender	
Male	23 (12.4%)
Female	162 (87.6%)
Marital status	
Single	16 (8.6%)
Married	169 (91.4%)
Educational attainment	
College	13 (7.0%)
Bachelor	167 (90.3%)
Master	5 (2.7%)
Clinical department	
Surgery	16 (8.65%)
Cardiology	14 (7.57%)
Obstetrics-gynecology	24 (12.97%)
Pediatrics	19 (10.27%)
Gastroenterology	5 (2.70%)
Infectious diseases	3 (1.62%)
Neurology	17 (9.19%)
Rehabilitation	8 (4.32%)
Pulmonology	9 (4.86%)
Emergency room	17 (9.19%)
Outpatient clinic/ Traditional Chinese medicine	6 (3.24%)
Hemodialysis/ Nephrology	15 (8.11%)

**Table 1 (Continued)**

Nurse's characteristics	Results
Intensive care unit	12 (6.49%)
Operating room	6 (3.24%)
Oncology	3 (1.62%)
Endocrinology	5 (2.70%)
General Adult Medical	6 (3.24%)
Years of working	Mean=3.94, SD=0.279, range= 2–4 years
Number of patients handled per shift	
Less than 5	20 (10.8%)
6–10	67 (36.2%)
11–15	63 (34.1%)
More than 15	35 (18.9%)
Types of patients handled	
Actual life-threatening, unstable	26 (14.1%)
Potential life-threatening, unstable	27 (14.6%)
Stable, requires assisted self-care	53 (28.6%)
Stable, performs independent self-care	79 (42.7%)
Nurse position	
Primary nurse in charge	98 (52.97%)
Nurse practitioner	59 (31.89%)
Head nurse	21 (11.35%)
Nurse educator	7 (3.78%)
Nature of work	
Permanent	66 (35.67%)
Agency	5 (2.70%)
Contractual	112 (60.54%)
Temporary	2 (1.1%)
Monthly income	
Less than 3,000 RMB	8 (4.32%)
3,001–5,000 RMB	85 (45.95%)
5,001–7,000 RMB	61 (32.97%)
More than 7,001 RMB	31 (16.76%)
Know about moral distress	
Yes	117 (63.24%)
No	68 (36.76%)
Have you had experienced moral distress	
Yes, I have.	111 (60.0%)
Yes, I have, but I don't know.	74 (40.0%)



### 3.2. Indicators of moral distress

**Table 2** shows moral distress frequency (never to frequently). The most common scenario was “initiating extensive life-saving actions only to prolong death” (29.2% often). Others included: sometimes following family requests for non-beneficial life support (33.5%), avoiding death discussions with dying patients (26.5%), caring for ventilator-dependent hopeless patients (28.6%), and concealing terminal illnesses (31.9%).

These cluster into “futile treatment” and “false hope”—consistent with prior findings linking such practices to moral distress. Advanced life-sustaining technologies conflict with nurses’ values, aligning with a study definition of moral distress (constraint from right action) and the study’s framework (role/value conflicts) <sup>[6, 16]</sup>.

Chinese cultural taboos around death exacerbate this, as family demands for concealment/treatment violate nurses’ values

**Table 2.** Frequency of moral distress indicators reported by the respondents (n=185)

	Md	0 Never	1 Hardly	2 Sometimes	3 Often	4 Frequently
1. Provide less than optimal care due to pressures from administrators or insurers to reduce costs.	1	67 (36.2%)	67 (36.2%)	38 (20.5%)	6 (3.2%)	7 (3.8%)
2. Witness healthcare providers giving “false hope” to a patient or family.	1	81 (43.8%)	57 (74.6%)	32 (17.35%)	12 (6.5%)	3 (1.6%)
3. Follow the family’s wishes to continue life support even though I believe it is not in the best interest of the patient.	2	19 (10.3%)	57 (30.8%)	62 (33.5%)	34 (18.4%)	13 (7%)
4. Initiate extensive life-saving actions when I think they only prolong death.	3	9 (4.9%)	26 (14.1%)	47 (25.4%)	54 (29.2%)	49 (26.5%)
5. Follow the family’s request not to discuss death with a dying patient who asks about dying.	2	40 (21.6%)	49 (26.5%)	49 (26.5%)	21 (11.4%)	26 (14.1%)
6. Carry out the physician’s orders for what I consider to be unnecessary tests and treatments.	1	44 (23.8%)	73 (39.5%)	48 (25.9%)	12 (6.5%)	8 (4.3%)
7. Continue to participate in care for a hopelessly ill person who is being sustained on a ventilator, when no one will make a decision to withdraw support.	2	31 (16.8%)	41 (22.2%)	53 (28.6%)	35 (18.9%)	25 (13.5%)
8. Avoid taking action when I learn that a physician or nurse colleague has made a medical error and does not report it.	0	124 (67%)	34 (18.4%)	22 (11.9%)	1 (0.5%)	4 (2.2%)
9. Assist a physician who, in my opinion, is providing incompetent care.	1	45 (24.3%)	74 (40%)	44 (23.8%)	14 (7.6%)	8 (4.3%)
10. Be required to care for patients I don’t feel qualified to care for.	1	82 (44.3%)	69 (37.3%)	27 (14.6%)	5 (2.7%)	2 (1.1%)
11. Witness medical students perform painful procedures on patients solely to increase their skill.	0	97 (52.4%)	59 (31.9%)	23 (12.4%)	3 (1.6%)	3 (1.6%)
12. Provide care that does not relieve the patient’s suffering because the physician fears that increasing the dose of pain medication will cause death.	0	101 (54.6%)	55 (29.7%)	28 (15.1%)	0	1 (0.5%)
13. Follow the physician’s request not to discuss the patient’s prognosis with the patient or family.	1	51 (27.6%)	60 (32.4%)	51 (27.6%)	12 (6.5%)	11 (5.9%)
14. Increase the dose of sedatives/opiates for an unconscious patient that I believe could hasten the patient’s death.	0	150 (81.1%)	15 (8.2%)	18 (9.7%)	1 (0.5%)	1 (0.5%)

**Table 2 (Continued)**

	Md	0 Never	1 Hardly	2 Sometimes	3 Often	4 Frequently
15. Take no action about an observed ethical issue because the involved staff member or someone in a position of authority requested that I do nothing.	0	142 (76.8%)	21 (88.1%)	18 (9.7%)	2 (1.1%)	1 (1.1%)
16. Follow the family's wishes for the patient's care when I do not agree with them, but do so because of fears of a lawsuit.	1	49 (26.5%)	66 (35.7%)	42 (22.7%)	18 (9.7%)	10 (5.4%)
17. Work with nurses or other healthcare providers who are not as competent as the patient care requires.	1	59 (31.9%)	83 (44.9%)	35 (18.9%)	5 (2.7%)	3 (1.6%)
18. Witness diminished patient care quality due to poor team communication.	1	67 (36.2%)	67 (36.2%)	44 (23.8%)	4 (2.2%)	3 (1.6%)
19. Ignore situations in which patients have not been given adequate information to insure informed consent.	0	122 (65.9%)	37 (20%)	23 (12.4%)	1 (0.5%)	2 (1.1%)
20. Watch patient care suffer because of a lack of provider continuity.	0	114 (61.6%)	45 (24.3%)	23 (12.4%)	1 (0.5%)	2 (1.1%)
21. Work with levels of nurse or other care provider staffing that I consider unsafe.	1	71 (38.4%)	84 (45.4%)	25 (13.5%)	3 (1.6%)	2 (1.1%)
22. Conceals illness from terminally ill patients or cancer patients at the request of the family.	2	31 (16.8%)	43 (23.2%)	59 (31.9%)	28 (15.1%)	24 (13%)

Md= median.

### 3.3. Level of disturbance in moral distress

**Table 3** shows disturbance levels (none to a large extent) among 185 respondents. Most distressing situations: following family requests for non-beneficial life support (37.1% some disturbance), life-saving actions prolonging death (32.3%), and caring for ventilator-dependent hopeless patients without withdrawal decisions (30.1%).

These align with prior findings linking futile care to high-intensity distress, including non-beneficial treatments and ventilator-dependent care. Per a study, moral distress stems from the inability to act on moral choices—here, due to limited nurse decision-making, conflicting with roles/values<sup>[17]</sup>. Repeated exposure worsens intensity, fitting the study's theoretical framework<sup>[16]</sup>.

**Table 3.** Level of disturbance caused by moral distress as reported by the participants (n=185).

	Md	0 None	1 To a small extent	2 To some extent	3 To a moderate extent	4 To a Great extent
1. Provide less than optimal care due to pressures from administrators or insurers to reduce costs.	1	59 (31.7%)	60 (32.3%)	52 (28%)	9 (4.8%)	5 (2.7%)
2. Witness healthcare providers giving “false hope” to a patient or family.	0	81 (43.5%)	52 (28%)	41 (22%)	10 (5.4%)	1 (0.5%)
3. Follow the family's wishes to continue life support even though I believe it is not in the best interest of the patient.	2	24 (12.9%)	61 (32.8%)	69 (37.1%)	21 (11.3%)	10 (5.4%)
4. Initiate extensive life-saving actions when I think they only prolong death.	2	19 (10.2%)	38 (20.4%)	60 (32.3%)	32 (17.2%)	36 (19.4%)
5. Follow the family's request not to discuss death with a dying patient who asks about dying.	1	39 (21%)	55 (29.6%)	52 (28%)	18 (9.7%)	21 (11.3%)

**Table 3(Continued)**

	Md	0 None	1 To a small extent	2 To some extent	3 To a moderate extent	4 To a Great extent
6. Carry out the physician's orders for what I consider to be unnecessary tests and treatments.	1	44 (23.7%)	69 (37.1%)	52 (28%)	13 (7%)	7 (3.8%)
7. Continue to participate in care for a hopelessly ill person who is being sustained on a ventilator, when no one will make a decision to withdraw support.	2	35 (18.8%)	51 (27.4%)	56 (30.1%)	27 (14.5%)	16 (8.6%)
8. Avoid taking action when I learn that a physician or nurse colleague has made a medical error and does not report it.	0	122 (65.6%)	36 (19.4%)	24 (12.9%)	1 (0.5%)	2 (1.1%)
9. Assist a physician who, in my opinion, is providing incompetent care.	1	50 (26.9%)	71 (38.2%)	44 (23.7%)	13 (7%)	7 (3.8%)
10. Be required to care for patients I don't feel qualified to care for.	0	82 (44.1%)	65 (34.9%)	32 (17.2%)	5 (2.7%)	1 (0.5%)
11. Witness medical students perform painful procedures on patients solely to increase their skill.	0	100 (53.8%)	51 (27.4%)	29 (15.6%)	4 (2.2%)	1 (0.5%)
12. Provide care that does not relieve the patient's suffering because the physician fears that increasing the dose of pain medication will cause death.	0	98 (52.7%)	57 (30.6%)	28 (15.1%)	2 (1.1%)	1 (0.5%)
13. Follow the physician's request not to discuss the patient's prognosis with the patient or family.	0	59 (31.7%)	59 (31.7%)	47 (25.3%)	11 (5.9%)	9 (4.8%)
14. Increase the dose of sedatives/opiates for an unconscious patient that I believe could hasten the patient's death.	0	146 (78.5%)	14 (7.5%)	23 (12.4%)	2 (1.1%)	1 (0.5%)
15. Take no action about an observed ethical issue because the involved staff member or someone in a position of authority requested that I do nothing.	0	141 (75.8%)	20 (10.8%)	22 (11.8%)	1 (0.50%)	1 (0.50%)
16. Follow the family's wishes for the patient's care when I do not agree with them, but do so because of fears of a lawsuit.	0	56 (30.1%)	53 (28.5%)	51 (27.4%)	17 (9.1%)	8 (4.3%)
17. Work with nurses or other healthcare providers who are not as competent as the patient care requires.	1	65 (34.9%)	75 (40.3%)	38 (2.6%)	4 (2.2%)	3 (1.6%)
18. Witness diminished patient care quality due to poor team communication.	0	75 (40.3%)	55 (29.6%)	45 (24.2%)	8 (4.3%)	2 (1.1%)
19. Ignore situations in which patients have not been given adequate information to insure informed consent.	0	124 (66.7%)	34 (18.3%)	26 (14%)	1 (0.50%)	1 (0.50%)
20. Watch patient care suffer because of a lack of provider continuity.	0	113 (60.8%)	39 (21%)	31 (16.7%)	1 (0.50%)	1 (0.50%)
21. Work with levels of nurse or other care provider staffing that I consider unsafe.	0	76 (40.9%)	73 (39.2%)	32 (17.2%)	2 (1.1%)	2 (1.1%)
22. Conceals illness from terminally ill patients or cancer patients at the request of the family.	0	43 (23.1%)	49 (26.3%)	56 (30.1%)	21 (11.3%)	16 (8.6%)

Md= median.

### 3.4. Distribution of moral distress levels

**Table 4** categorizes moral distress by total scores (frequency × intensity sum): low (1–112), medium (113–224), high (225–336). **Table 5** shows the total moral distress scores of the respondents and found that most participants (95.1%) had low distress; 8 had medium, 1 had high.

This aligns with studies showing low moral distress among Chinese nurses <sup>[18–21]</sup>. The contributing factors include: local patients with light medical burdens, few severe cases (patients seeking better resources), a specialized maternal/child hospital, and institutional focus on ethics <sup>[22]</sup>. Medium/high distress linked to departments (e.g., emergency, ICU), individual values, and institutional barriers, supporting the need for educational programs <sup>[16, 17]</sup>.

**Table 4.** Interpretation of moral distress scores

Scores= [F (frequencies score) × I (intensity score)]	Interpretation
1–112	Low level moral distress
113–224	Medium level moral distress
225–336	High level moral distress

**Table 5.** Total moral distress reported by the respondents (n=185)

Score range	Interpretation	Frequency	Percentage
225–336	High distress	1	0.5%
113–224	Medium moral distress	8	4.3%
1–112	Low moral distress	176	95.1%

**Table 6.** Impact of moral distress on intention to leave among participants (n=185)

Quit	Frequency	Percentage
Never considered quitting	76	41.1%
Considered quitting but stay	100	54.1%
Left the position	9	4.9%

**Table 7** presents the correlation coefficients between selected nurse's characteristics and moral distress.

**Table 7.** Correlation of nurse's characteristics and moral distress (n= 185)

Nurses' profile characteristics	Dependent variable	Correlation coefficient	Interpretation	p value	Decision
Age	Moral distress	- 0.091	Small	0.216	Do not reject the null hypothesis
Gender	-do-	- 0.166	Small	0.024	Do not reject the null hypothesis
Years of working experience	-do-	0.003	Small	0.965	Do not reject the null hypothesis
Nurse position	-do-	- 0.048	Small	0.515	Do not reject the null hypothesis
Nature of work	-do-	0.066	Small	0.373	Do not reject the null hypothesis
Educational attainment	-do-	- 0.009	Small	0.902	Do not reject the null hypothesis
Personal monthly income	-do-	0.099	Small	0.179	Do not reject the null hypothesis
Number of patients handled per shift	-do-	0.650*	Strong	0.032	Reject the null hypothesis
Type of patients handled	-do-	0.718*	Strong	0.020	Reject the null hypothesis

Correlation technique, specifically Spearman's rho, was utilized to determine the strength and direction of correlation. The strength of correlation was guided by general guidelines provided by Cohen (1988) as follows in **Table 8**:

**Table 8.** General guidelines of Spearman's rho correlation technique

Coefficient value	Strength of Association
0.10–0.30	Small correlation
0.31–0.50	Medium / Moderate correlation
> 0.51	Large / Strong correlation

Given the scarcity of research and interventions targeting moral distress among healthcare professionals, the correlation between nurses' ethical education level and the degree of moral distress, as well as Chinese nurses' insufficient awareness of moral distress and the late introduction of this concept, the researcher has proposed an educational program entitled "Learning More about Moral Distress in Nursing Practice". The program aims to enhance nurses' relevant awareness and coping abilities. It is planned to propose the program to the nursing administrators of the selected hospitals. Upon obtaining permission, a four-week pilot project will be launched. During this period, collaborative activities will be carried out, and after the pilot, an evaluation will be conducted to improve and promote the program.

#### 4. Summary of findings

As people pay more and more attention to the consciousness and spiritual aspects, the professionalism and ethics of nurses have also become the focus. One of the important ethical issues that Chinese nurses are facing is moral distress. Moral distress was defined as a phenomenon in which one or nurse knows the right action to take, but is constrained from taking it, because of some reasons, internal or external. It is necessary to know more about actual situation of Chinese nurses in moral distress, and analyze the factors affecting moral distress among nurses, so as to carry out better management and intervention for nurses' moral distress. The purpose of this study is to describe the profile of nurses, determine the nurses' profiles characteristics that affect moral distress among nurses in Shangdong, China.

The researcher used Jameton's concept of moral distress in nursing, House and Rizzo's role conflict theory, and Rokeach's theory on values and value systems as theoretical underpinnings of this study. A descriptive-correlation design was also employed in this study. Data were collected immediately after all participants had completed all the questions in the online questionnaire. Purposive sampling was used in the study. A total of 185 participants, who are registered nurses (RNs), experienced moral distress, participated in the study. Moral Distress Scale-Revised (MDS-R) as one research instrument was used to examine moral distress, which includes the frequency (F) and disturbance/ intensity (I) of moral distress among nurses in this study.

The findings of the study are the following:

- (1) The participants of the study are registered nurses, predominantly female, married, and bachelor's degree holders with an average age of 35 years old and work in obstetrics-gynecology, pediatrics, neurology, and emergency room generally. They usually handle 6–10 patients and 11–15 patients per shift, and their patients were described to be in stable condition and perform minimal to independent self-care. The



majority are primary nurses in charge and work on a contractual position. Besides, they predominantly have personal monthly income of 3,001–5,000 RMB and have knowledge and experience on moral distress.

- (2) Generally, the overall moral distress is registered at a low level. The main source of the high frequency and intensity of moral distress among nurses is “futile care”. Besides, “false hopes” is the main source that caused the high frequency of moral distress among in this study.
- (3) The number of patients nurses handled per shift and the type of patients nurses handled are the nurses’ factors that are significantly correlated with nurses’ moral distress. This means, the more patients nurses handle per shift, the higher the moral distress of nurses is. The greater patient acuity, such as patients in life-threatening conditions, unstable and requiring complex care nurses handle, the higher the moral distress the nurses are experiencing.
- (4) Based on the findings of the study, an educational learning program is recommended to manage and alleviate nurses’ moral distress. Educational learning programs can be used to popularize nurses’ basic knowledge about moral distress and improve their awareness, ethical dimension, and moral sensitivity about moral distress.

## 5. Conclusion

The nurses’ moral distress was registered at a low level in this study. The main sources of the high frequency and intensity of moral distress among nurses are futile care and false hope. The number of patients nurses handled per shift and the type of patients that nurses handled are the factors that have a significant correlation with nurses’ moral distress. An educational learning program is recommended to conduct to manage and alleviate the moral distress of nurses.

## Disclosure statement

The authors declare no conflict of interest.

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# Research Progress of Semaglutide Combined with Metformin in the Treatment of Obese Type 2 Diabetes Mellitus

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**Abstract:** In recent years, the incidence of type 2 diabetes mellitus (T2DM) caused by obesity in China has been increasing continuously, which has become a risk factor for the onset of T2DM and seriously affects the quality of life of patients. The conventional treatment methods include weight loss and regulating the body's metabolism. Semaglutide, as a glucagon-like peptide-1 receptor agonist (GLP-1RA), mainly reduces patients' appetite, decreases their craving for high-fat and high-sugar foods, regulates hypothalamic feeding behavior, inhibits gastric emptying and gastrointestinal motility, and ultimately leads to weight loss. Metformin mainly acts on extra-islet tissues, increasing glucose utilization, reducing glucose production, and ultimately lowering blood glucose levels. Based on this, this article reviews relevant literature on authoritative websites such as CNKI and Wanfang, organizes the data, and analyzes the research progress of semaglutide combined with metformin in the treatment of obese T2DM. The aim is to bring more treatment options for obese T2DM and promote better prognosis for patients.

**Keywords:** Semaglutide; Metformin; Obese T2DM; Research progress

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## 1. Introduction

Obese type 2 diabetes mellitus (T2DM) has become a significant challenge in the global public health sector. According to statistics from the International Diabetes Federation, the number of diabetes patients worldwide reached 529 million in 2021, with 96% being T2DM, and approximately 45.4% of T2DM patients having comorbid abdominal obesity<sup>[1]</sup>. The comorbidity of obesity and T2DM significantly exacerbates the complexity of metabolic disorders, leading to intertwined pathological mechanisms such as insulin resistance, systemic inflammation, and liver fat accumulation, forming a vicious cycle. This complex pathophysiological profile makes it difficult for monotherapy to simultaneously control blood glucose, reduce weight, and improve metabolic complications. Combination therapy strategies have gradually become a hot spot in clinical research

due to their multi-target synergistic effects <sup>[2]</sup>. Traditional hypoglycemic drugs such as metformin can improve insulin sensitivity, but their regulatory effect on obesity-related metabolic disorders is limited. Semaglutide, as a long-acting glucagon-like peptide-1 receptor agonist (GLP-1RA), achieves hypoglycemic and weight loss effects through multiple mechanisms including glucose-dependent stimulation of insulin secretion, inhibition of glucagon release, delay of gastric emptying, and appetite suppression <sup>[3]</sup>. Its half-life is up to 7 days, and a stable blood concentration can be maintained with once-weekly subcutaneous injection, significantly improving patient compliance. Metformin exerts its hypoglycemic effect by reducing hepatic glucose output, improving insulin sensitivity in peripheral tissues, and regulating gut microbiota. The combination of metformin and semaglutide is expected to produce favorable results. In this regard, this article will explore the research progress of semaglutide combined with metformin in the treatment of obese T2DM, with specific reports as follows.

## **2. Pathological mechanisms of obese T2DM**

Obesity, as a major factor influencing the progression of T2DM, induces insulin resistance in skeletal muscle and liver through the secretion of inflammatory factors and free fatty acids from expanded adipose tissue, and promotes the functional decline of pancreatic beta cells. Moreover, most obese patients develop non-alcoholic fatty liver disease (NAFLD), which has a high prevalence. This not only increases the burden on the liver but also releases hepatogenic inflammatory factors to some extent, thereby affecting the patient's own metabolic state <sup>[4]</sup>. In the pharmacological treatment of rejuvenation, although it can effectively improve insulin sensitivity, the regulation of related effects on metabolic disorders is very limited. Some studies have directly pointed out that monotherapy with metformin can effectively reduce hemoglobin in patients, but weight loss is very limited, and it is not effective for patients with liver-type inflammation <sup>[5]</sup>. Not only that, obese T2DM may also be combined with hyperlipidemia, hypertension, and related cardiovascular diseases, and there are significant limitations to monotherapy.

## **3. Mechanism of action of semaglutide**

Semaglutide shares certain similarities with GLP-1. As an endogenous incretin, it has a 94.00% homology in structure. Its main function is to promote the secretion of cells in the intestine, regulate glucose homeostasis, and release postprandial insulin. GLP-1 receptors are widely distributed, mainly in the lungs, brain, gastrointestinal tract, pancreas, cardiovascular system, kidneys, adipose tissue, hypothalamus, skeletal muscles, and more. Semaglutide is highly dependent on glucose, stimulates insulin secretion, prevents the occurrence of glucagon, and achieves the goal of lowering blood sugar. However, when used alone in obese T2DM patients, there was no significant improvement in glucagon. In addition, semaglutide also plays a certain role in the liver and adipose tissue. After increasing its intake, it can effectively inhibit glucose production and ultimately lower blood sugar <sup>[6]</sup>. Although semaglutide and GLP-1 have high homology, there are also certain differences. Semaglutide can induce blood sugar production, reduce patients' cravings for high-fat and high-sugar foods, improve their own blood sugar levels, and increase the secretion capacity of insulin B cells. Furthermore, semaglutide directly acts on the nerve center to reduce appetite. Relevant studies have directly pointed out that when blood sugar is less than 4.5mmol/L, GLP-1 does not stimulate insulin, blood sugar does not decrease, and there is no risk of hypoglycemia <sup>[7]</sup>.

#### **4. Mechanism of metformin on glucose metabolism**

Metformin can increase glucose utilization, reduce glucose production, and increase anaerobic glycolysis of glucose in muscles, ultimately achieving the goal of lowering blood sugar. In addition, metformin can also decompose hepatic glycogen, which has high clinical value for patients with high fasting blood glucose levels. Moreover, studies have found that metformin can directly inhibit glucose, preventing its absorption in the intestine, and only allowing absorption in the small intestine at high concentrations through the gastrointestinal wall <sup>[8]</sup>. Metformin not only controls hyperglycemia but also does not increase insulin concentration, ultimately reducing patient weight. Another study found that metformin can block the development of liver mitochondria, correct insulin-sensitive tissues, and avoid intracellular metabolic abnormalities <sup>[9]</sup>. Related research directly points out that metformin reduces ATP production by inhibiting mitochondrial electron transport chain complex I, increases the AMP/ATP ratio, and activates the AMPK signaling pathway. After AMPK activation, it phosphorylates key gluconeogenic enzymes, inhibits key steps of gluconeogenesis, and reduces glucose production <sup>[10]</sup>. Even if AMPK is not activated, metformin can still directly inhibit gluconeogenesis by inhibiting mitochondrial glycerol-3-phosphate dehydrogenase (mGPDH) and blocking the redox shuttle that converts glycerol and lactic acid into glucose. Metformin can activate LKB1 through the media, which phosphorylates the Thr172 site of the AMPK $\alpha$  subunit, leading to full activation of AMPK <sup>[11]</sup>. When the AMP cellular level in the body increases, it directly binds to the CBS domain of the AMPK $\gamma$  subunit, inducing conformational changes and activating AMPK <sup>[12]</sup>.

#### **5. Synergistic mechanism of semaglutide and metformin**

Semaglutide, a long-acting glucagon-like peptide-1 receptor agonist (GLP-1RA), stimulates insulin secretion in a glucose-dependent manner, inhibits glucagon release, delays gastric emptying, and suppresses appetite. Metformin primarily acts by reducing hepatic glucose output, improving insulin sensitivity in extra-pancreatic tissues, and modulating gut microbiota, thereby exerting its hypoglycemic effect. According to research, semaglutide suppresses appetite and decreases energy intake by activating the hypothalamic feeding center, while metformin reduces hepatic glucose production by inhibiting mitochondrial respiratory chain complex I and enhancing muscle glucose uptake <sup>[13]</sup>. The combination of these two drugs simultaneously targets both energy intake and expenditure, leading to a more significant weight loss. Other studies suggest that these two medications can achieve anti-inflammatory and anti-fibrotic synergies <sup>[14]</sup>. Semaglutide can lower liver inflammation markers and fibrosis scores, possibly through inhibiting the NF- $\kappa$ B pathway and reducing macrophage infiltration. Metformin, on the other hand, inhibits the activation of hepatic stellate cells and reduces collagen deposition by activating the AMPK pathway <sup>[15]</sup>. Combined therapy can more comprehensively improve the pathological state of the liver. Additionally, semaglutide enhances beta-cell function by promoting beta-cell differentiation and inhibiting apoptosis, while metformin protects beta-cells by reducing lipotoxicity and oxidative stress <sup>[16]</sup>. The combination of the two drugs can delay the progression of T2DM and even achieve diabetes remission in some patients.

#### **6. Application of semaglutide combined with metformin in obese type 2 diabetes mellitus**

In recent years, multiple clinical studies have confirmed the significant advantages of semaglutide combined with metformin in the treatment of obese type 2 diabetes mellitus (T2DM). One study selected 78 patients with



obese T2DM as the research subjects and conducted a prospective study<sup>[17]</sup>. The results showed that the treatment of semaglutide combined with metformin has high application value for patients with obese T2DM, effectively improving the treatment efficiency and reducing the relevant indicators of glucose metabolism. Another study included 98 patients with obese T2DM and found that the treatment of semaglutide combined with metformin has significant effects, effectively regulating the relevant levels of glucose and lipid metabolism, reducing body mass index, and possessing high medication safety<sup>[18]</sup>. Other related research analyzed the application effect of semaglutide combined with metformin in obese type 2 diabetes mellitus, including a total of 132 patients with obese T2DM<sup>[19]</sup>. The results indicated that semaglutide combined with metformin can effectively improve clinical efficacy and reduce the incidence of adverse reactions. A study analyzed the clinical efficacy of semaglutide + dapagliflozin + metformin in T2DM with nonalcoholic fatty liver disease<sup>[20]</sup>. The results showed that compared with monotherapy, combination therapy can effectively reduce blood lipids and blood glucose, improve patients' pancreatic beta-cell function, and not increase other adverse reactions.

## 7. Conclusion

In summary, with the innovation of treatment concepts for metabolic diseases, the combined therapy strategy of semaglutide and metformin has transitioned from theoretical exploration to clinical practice, marking a significant breakthrough in the comprehensive management of obese type 2 diabetes mellitus (T2DM). This combination not only addresses the limitations of single-drug therapy in multi-target regulation but also achieves triple benefits of “lowering blood glucose, reducing weight, and improving metabolic complications” through complementary mechanisms. The combined therapy of semaglutide and metformin signifies a paradigm shift in T2DM management, moving from single-target control to multi-organ protection. With deepening mechanistic research and accumulating clinical evidence, this combination is expected to become one of the standard treatments for obese T2DM. In the future, through precise stratification, multidisciplinary collaboration, and the establishment of a long-term follow-up system, combined therapy will bring more sustained metabolic health benefits to patients, ultimately achieving the dual goals of diabetes remission and improved quality of life.

## Disclosure statement

The authors declare no conflict of interest.

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# Antidepressant Effect of Propofol and Its Acute Alterations in Prefrontal-Temporal Cortical Blood Flow in Patients with Depressive Disorder: A Functional Near-Infrared Spectroscopy Study with a Small Sample Size

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**Abstract:** *Objective:* To investigate the characteristics and significance of near-infrared brain function imaging in patients with depressive disorder after administration of propofol injection. *Methods:* A total of 28 subjects with depressive disorder diagnosed according to DSM-5 criteria were selected from Xi'an Mental Health Center between January 2022 and January 2025. They were randomly divided into an experimental group (propofol group, n=14) and a control group (intralipid group, n=14) using a random number table. The changes in integral value (IV) and centroid value (CV) of the two patient groups before and after treatment were measured using functional near-infrared spectroscopy (fNIRS) technology. *Results:* There was no statistically significant difference in HAMD scores between the two groups of patients at 24 h before treatment ( $P > 0.05$ ). Repeated measures analysis of variance showed that both time factor ( $F_{time} = 32.237$ ,  $P_{time} < 0.001$ ), group factor ( $F_{group} = 47.027$ ,  $P_{group} < 0.001$ ), and their interaction ( $F_{interaction} = 31.829$ ,  $P_{interaction} < 0.001$ ) were statistically significant. The centroid values of the frontal and temporal lobes were consistent at baseline before treatment, with no intra-group changes or inter-group differences at any time point after treatment ( $P > 0.05$ ). The integral values of the frontal and temporal lobes were consistent between the two groups at baseline before treatment, and both showed a time-dependent increase after treatment ( $P_{time} < 0.05$ ). However, the increase in the experimental group was significantly greater than that in the control group ( $P_{group} < 0.05$ ), with a significant interaction effect ( $P_{interaction} < 0.05$ ). *Conclusion:* fNIRS detected specific acute hemodynamic changes in the prefrontal and temporal regions of patients with depressive disorder after propofol intervention. These changes may be related to the mechanism of action of propofol. However, this study did not confirm a direct linear correlation between changes in integral/centroid values and the degree of clinical improvement in depressive symptoms. Propofol intervention combined with deep anesthesia rapidly improved depressive symptoms and was accompanied by enhanced hemodynamic activity in the prefrontal/temporal regions, though its specificity requires further validation.

**Keywords:** Depressive disorder; Propofol; Functional Near-Infrared Spectroscopy; Cerebral hemodynamics

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# 1. Introduction

Depressive disorder is a mental illness characterized by a depressed mood and loss of interest or pleasure lasting for at least two weeks, often accompanied by cognitive impairment, sleep/appetite disorders, and other autonomic nervous symptoms <sup>[1]</sup>. According to foreign scholars, more than 280 million people worldwide currently suffer from depressive disorders, and the global prevalence of depressive disorders is continuously rising. It is estimated that by 2030, depressive disorders will become the disease with the highest global disease burden <sup>[2]</sup>. Based on existing clinical evidence, propofol can produce a rapid and lasting antidepressant effect by regulating brain electrical activity (such as inducing a high electroencephalogram burst suppression ratio) and enhancing slow-wave sleep, and patients have good tolerance <sup>[3]</sup>. Therefore, propofol shows promising clinical application prospects in the treatment of depressive disorders. Meanwhile, previous research reports suggest that when patients with depression perform verbal fluency tasks, the increase in oxygenated hemoglobin (oxy-Hb) concentration in the prefrontal cortex is significantly lower than that in healthy controls, and this characteristic is negatively correlated with the severity of depressive symptoms <sup>[4]</sup>. Existing studies have only confirmed the insufficient activation of the prefrontal cortex in depression itself, while neuroimaging data related to propofol focuses on electroencephalograms and magnetic resonance spectroscopy techniques, and has not been extended to the field of near-infrared imaging. Therefore, this study investigates the characteristics and significance of functional near-infrared spectroscopy (fNIRS) in patients with depressive disorder after administration of propofol injection, aiming to provide a reference for clinical practice.

## 2. Materials and methods

### 2.1. General information

From January 2022 to January 2025, 28 subjects with depressive disorders who met the diagnostic criteria in the DSM-5 were selected from Xi'an Mental Health Center. They were divided into an experimental group (propofol group, n=14) and a control group (fat emulsion group, n=14) using a random number method. The study strictly follows the Declaration of Helsinki and has been approved by the Ethics Committee of Xi'an Mental Health Center.

### 2.2. Inclusion and exclusion criteria

#### 2.2.1. Inclusion criteria

- (1) Age between 20 and 45 years old.
- (2) Meets the diagnostic criteria for depressive disorders in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), diagnosed by a psychiatrist <sup>[5]</sup>.
- (3) Total score on the Hamilton Depression Scale (HAMD-17) is  $\geq 17$ .
- (4) Has not received propofol or other anesthetic treatments in the past 3 months.
- (5) Volunteers to participate in this study, signs the informed consent form, and is able to cooperate with the completion of treatment and various assessments.

#### 2.2.2. Exclusion criteria

- (1) Subjects comorbid with schizophrenia, obsessive-compulsive disorder, post-traumatic stress disorder, tic disorder, etc.

- (2) Pregnant and perinatal women.
- (3) Abnormal electrocardiogram.
- (4) Allergic to propofol or fat emulsion components.
- (5) Safety indicators such as liver and kidney function, electrolytes, and blood glucose exceed normal levels by more than 3 times.
- (6) Subjects with unstable hypertension, poor blood glucose control, and those concomitant with major physical diseases.
- (7) Body mass index > 28 kg/m<sup>2</sup>.
- (8) Subjects with ASA classification grade IV or above.
- (9) HAMD suicide assessment item 11 score greater than 2.

## 2.3. Methods

### 2.3.1. Experimental group

The anesthesiologist slowly administers propofol 2–3 mg/kg intravenously for induction (Manufacturer: Xi'an Libang Pharmaceutical Co., Ltd.; National Medical Approval Number: H19990282; Specification: 20 mL), and repeats small doses (50–100 mg) based on the electroencephalogram to maintain a deep state of anesthesia for at least 15 minutes. Wait for the subject to fully recover. During the anesthesia process, continuously monitor the electrocardiogram, non-invasive blood pressure, pulse oxygen saturation, and other vital signs. The entire process is managed by an anesthesiologist with clinical experience of  $\geq 3$  years, equipped with emergency equipment and medications. Subjects recover in a dedicated anesthesia recovery room and are observed for at least 1 hour. They can only leave the treatment room after fully waking up and their vital signs are stable. During the recovery period, psychiatrists assess suicide risk to ensure the safety of discharge.

### 2.3.2. Control group

Subjects undergo the same pre-treatment preparation and receive an equal amount of fat emulsion (Manufacturer: Sichuan Kelun Pharmaceutical Co., Ltd.; National Medical Approval Number: H20183271; Specification: 1000 mL). Wait for the subject to fully recover. Monitoring measures and recovery management are the same as those in the experimental group.

Both groups of patients received systematic treatment guided by DSM-5<sup>[5]</sup> after the study concluded.

## 2.4. Observation indicators

The Hamilton Depression Rating Scale (HAMD) score was used as the primary clinical observation indicator, with secondary indicators including the Integral Value (IV) and Centroid Value (CV). HAMD assessments were conducted by uniformly trained evaluators at 24 hours before treatment, as well as at 2 hours, 6 hours, and 24 hours after full recovery from treatment. Secondary indicators were assessed using the NirSmart\_6000 portable functional near-infrared spectroscopy (fNIRS) device (manufactured by Danyang Healcrest Medical Equipment Co., Ltd.) at the same time points—24 hours before treatment, and 2 hours, 6 hours, and 24 hours after full recovery—to calculate the Integral Value (IV) and Centroid Value (CV), which reflect temporal changes in the fNIRS signal.

The Integral Value (IV) refers to the area under the curve of oxy-Hb concentration changes during the task period or a specific time window, reflecting the overall intensity or total activation of brain region activity during that period<sup>[4, 6]</sup>. The fNIRS device was used to record oxy-Hb concentration changes in regions such as the frontal



and temporal lobes while subjects performed cognitive tasks (e.g., verbal fluency tests). The modified Beer-Lambert law was applied to convert light intensity signals into oxy-Hb concentration changes. The calculation formula is as follows:

$$IV = \int_{t_1}^{t_2} \Delta HbO(t) dt$$

Centroid value: Refers to the time point at which the change in oxy-Hb concentration reaches its peak, reflecting the temporal characteristics of activation<sup>[6]</sup>. Using the amplitude of HbO change in each channel as the weight, the spatial coordinate mean of the activated channels is calculated. The calculation formula is as follows, where  $x_i$  and  $y_i$  represent the channel position coordinates.

$$CV_x = \frac{\sum_{i=1}^N \Delta HbO_i \cdot x_i}{\sum_{i=1}^N \Delta HbO_i}, \quad CV_y = \frac{\sum_{i=1}^N \Delta HbO_i \cdot y_i}{\sum_{i=1}^N \Delta HbO_i}$$

## 2.5. Statistical methods

The research data were analyzed using SPSS 24.0. Measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), with HAMD analyzed using repeated measures ANOVA. Paired t-tests were used for comparisons within groups before and after treatment, while independent sample t-tests were used for comparisons between groups at the same time point. Pearson correlation analysis was used to assess the correlation between changes in oxy-Hb and changes in total HAMD scores in the experimental group. Count data were expressed as frequency (percentage), and comparisons between groups were made using the  $\chi^2$  test or Fisher's exact test. All tests were two-sided, and a  $P$ -value  $< 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of baseline data between the two groups

There was no statistical difference in baseline data between the two groups ( $P > 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of baseline data between the two groups

Baseline characteristics	Test group (n=14)	Control group (n=14)	Statistical value	P-value
Mean age ( $\bar{x} \pm s$ , years)	28.69 $\pm$ 6.81	28.42 $\pm$ 6.17	0.110	0.913
Gender (n)			0.190	0.663
Male	4 (28.57%)	3 (21.43%)		
Female	10 (71.43%)	11 (78.57%)	0.243	0.622
Family history (n)	3 (21.43%)	2 (14.29%)	0.319	0.750
Mean BMI (kg/m <sup>2</sup> )	21.45 $\pm$ 2.35	21.56 $\pm$ 2.47	0.121	0.905

### 3.2. Comparison of HAMD between two groups of patients

There was no statistically significant difference in HAMD scores between the two groups of patients 24 hours before treatment ( $P > 0.05$ ). Repeated measures ANOVA showed that there were statistically significant differences in time factors ( $F_{time}=32.237$ ,  $P_{time} < 0.001$ ), group factors ( $F_{group}=47.027$ ,  $P_{group} < 0.001$ ), and the interaction between the two ( $F_{interaction}=31.829$ ,  $P_{interaction} < 0.001$ ), as shown in **Table 2**.

**Table 2.** Comparison of HAMD at different treatment time points between two groups of patients ( $\bar{x} \pm s$ , points)

Group	n	24h before treatment	2h after full awakening	6h after full awakening	24h after full awakening
Test group	14	36.89 $\pm$ 5.17	25.31 $\pm$ 5.29	25.56 $\pm$ 5.33	25.12 $\pm$ 5.31
Control group	14	36.71 $\pm$ 5.33	30.78 $\pm$ 5.38	30.81 $\pm$ 5.35	31.84 $\pm$ 5.39
$F_{\text{time/interaction/group}}$		$F_{\text{time}}=32.237, F_{\text{interaction}}=47.027, F_{\text{group}}=31.829$			
$P_{\text{time/interaction/group}}$		$P_{\text{time}} < 0.001, P_{\text{interaction}} < 0.001, P_{\text{group}} < 0.001$			

Note: Through Mauchly's test of sphericity (Mauchly's  $W=0.913, P > 0.05$ ), the hypothesis of sphericity was adopted for the test of within-group effects.

### 3.3. Comparison of near-infrared spectroscopy brain functional imaging systems between two groups of patients

The centroid values of the frontal and temporal lobes showed no significant differences at baseline before treatment. After treatment, no within-group changes or between-group differences were observed at any time point ( $P > 0.05$ ). The integral values of the frontal and temporal lobes were consistent between the two groups at baseline before treatment. After treatment, both groups exhibited a time-dependent increase ( $P_{\text{time}} < 0.05$ ), but the increase was significantly greater in the experimental group compared to the control group ( $P_{\text{group}} < 0.05$ ), with a significant interaction effect ( $P_{\text{interaction}} < 0.05$ ). See **Tables 3, 4, 5, and 6**.

**Table 3.** Comparison of frontal lobe region integral values between the two patient groups at different treatment time points ( $\bar{x} \pm s$ ).

Group	n	Before treatment	2h after full recovery	6h after full recovery	24h after full recovery
Study group	14	51.74 $\pm$ 10.71	61.09 $\pm$ 12.37	70.59 $\pm$ 15.68	77.69 $\pm$ 17.38
Control group	14	51.88 $\pm$ 10.62	52.39 $\pm$ 11.32	53.01 $\pm$ 14.19	54.62 $\pm$ 15.34
$F_{\text{time/interaction/group}}$		$F_{\text{time}}=15.266, F_{\text{interaction}}=3.454, F_{\text{group}}=14.845$			
$P_{\text{time/interaction/group}}$		$P_{\text{time}} < 0.001, P_{\text{interaction}}=0.036, P_{\text{group}} < 0.001$			

Note: Mauchly's test of sphericity indicated that the assumption of sphericity was met ( $W = 0.925, P > 0.05$ ). Therefore, the within-subjects effects were tested under the assumption of sphericity.

**Table 4.** Comparison of frontal lobe region centroid values between the two groups at different treatment time points ( $\bar{x} \pm s$ ).

Group	n	24h before treatment	2h after full recovery	6h after full recovery	24h after full recovery
Study group	14	56.26 $\pm$ 13.17	56.11 $\pm$ 13.22	56.09 $\pm$ 13.54	56.14 $\pm$ 13.87
Control group	14	56.30 $\pm$ 13.33	56.14 $\pm$ 13.45	56.84 $\pm$ 13.36	57.79 $\pm$ 12.89
$F_{\text{time/interaction/group}}$		$F_{\text{time}}=0.890, F_{\text{interaction}}=0.796, F_{\text{group}}=1.600$			
$P_{\text{time/interaction/group}}$		$P_{\text{time}}=0.450, P_{\text{interaction}}=0.500, P_{\text{group}}=0.217$			

Note: Mauchly's test of sphericity indicated that the assumption of sphericity was met ( $W = 0.965, P > 0.05$ ). Therefore, the within-subjects effects were tested under the assumption of sphericity.

**Table 5.** Comparison of temporal lobe region integral values between the two groups at different treatment time points ( $\bar{x} \pm s$ ).

Group	n	24h before treatment	2h after full recovery	6h after full recovery	24h after full recovery
Study group	14	66.26 $\pm$ 9.42	75.63 $\pm$ 9.94	94.42 $\pm$ 14.67	116.36 $\pm$ 19.15
Control group	14	66.31 $\pm$ 9.46	68.32 $\pm$ 9.58	69.83 $\pm$ 9.94	71.89 $\pm$ 10.77
$F_{\text{time/interaction/group}}$		$F_{\text{time}} = 30.603, F_{\text{interaction}} = 18.856, F_{\text{group}} = 58.109$			
$P_{\text{time/interaction/group}}$		$P_{\text{time}} < 0.001, P_{\text{interaction}} < 0.001, P_{\text{group}} < 0.001$			

Note: Mauchly's test of sphericity indicated that the assumption of sphericity was met ( $W = 0.943, P > 0.05$ ). Therefore, the within-subjects effects were tested under the assumption of sphericity.

**Table 6.** Comparison of temporal lobe region centroid values between the two groups at different treatment time points ( $\bar{x} \pm s$ ).

Group	n	24h before treatment	2h after full recovery	6h after full recovery	24h after full recovery
Study group	14	60.37 $\pm$ 10.89	60.52 $\pm$ 10.92	60.49 $\pm$ 11.11	60.69 $\pm$ 11.42
Control group	14	60.71 $\pm$ 10.91	60.96 $\pm$ 11.08	61.09 $\pm$ 11.84	61.23 $\pm$ 12.32
$F_{\text{time/interaction/group}}$		$F_{\text{time}} = 1.142, F_{\text{interaction}} = 1.417, F_{\text{group}} = 1.358$			
$P_{\text{time/interaction/group}}$		$P_{\text{time}} = 0.338, P_{\text{interaction}} = 0.244, P_{\text{group}} = 0.254$			

Note: Mauchly's test of sphericity indicated that the assumption of sphericity was met ( $W = 0.885, P > 0.05$ ). Therefore, the within-subjects effects were tested under the assumption of sphericity.

### 3.4. Correlation analysis between near-infrared spectroscopy brain functional imaging system and HAMD in experimental group patients

Pearson correlation analysis suggested that there was no significant correlation between the integral value of the frontal lobe region and the total score change of the Hamilton Depression Scale in the experimental group ( $r = -0.345, P = 0.227$ ); there was no significant correlation between the centroid value of the frontal lobe region and the total score change of the Hamilton Depression Scale in the experimental group ( $r = 0.318, P = 0.268$ ); there was no significant correlation between the integral value of the temporal lobe region and the total score change of the Hamilton Depression Scale in the experimental group ( $r = -0.209, P = 0.474$ ); there was no significant correlation between the centroid value of the temporal lobe region and the total score change of the Hamilton Depression Scale in the experimental group ( $r = -0.068, P = 0.817$ ).

## 4. Discussion

Near-infrared brain functional imaging utilizes the relative transparency of biological tissues in the near-infrared spectrum (650–900 nm). By emitting near-infrared light through the scalp and skull, it detects changes in the optical properties of hemoglobin in the cerebral cortex. Based on existing clinical evidence, abnormal activation of the prefrontal cortex in patients is closely related to emotional regulation disorders, and thus is commonly used in the clinical evaluation of mental illnesses<sup>[6]</sup>. Propofol is a short-acting intravenous anesthetic that enhances inhibitory neurotransmission by activating gamma-aminobutyric acid type A receptors (GABA<sub>A</sub>) while inhibiting N-methyl-D-aspartate (NMDA) receptors and reducing glutamatergic excitatory transmission<sup>[7]</sup>. Recent studies have indi-

cated that propofol can directly bind to and inhibit the dopamine transporter (DAT), blocking dopamine reuptake while increasing striatal dopamine concentrations and activating D1-type medium spiny neurons (MSNs), thereby improving core symptoms of depression<sup>[8]</sup>. Furthermore, clinical research has found that patients with depression have inadequate GABAergic inhibition and excessive glutamatergic excitation, and propofol's bidirectional regulation may restore this balance<sup>[9]</sup>. Therefore, propofol has promising applications in the treatment of depressive disorders. Currently, propofol is commonly used in clinical settings to assist electroconvulsive therapy, exerting a neuroprotective effect on patients with depression.

In this study, it is observed that compared to the fat emulsion group, patients in the propofol group had significantly lower HAMD scores after fully waking up from treatment. It is hypothesized that the mechanism is related to propofol's ability to modulate the dopamine system and reverse the core symptoms of depressive disorders (anhedonia). Additionally, propofol can promote GABA/glutamate balance, indirectly exerting an antidepressant effect. The results of this study also suggest that the integral values of the frontal and temporal regions in the experimental group were higher than those in the control group ( $P < 0.05$ ). fNIRS can reflect brain activity, especially in the frontal and temporal regions, so near-infrared brain functional imaging signals can be used as predictors of clinical efficacy for patients with depression<sup>[4]</sup>.

The results of this study are similar to those of previous studies, which reported that after antidepressant treatment, patients showed enhanced activation of the prefrontal cortex, and the degree of activation was positively correlated with symptom relief<sup>[10]</sup>. Propofol may affect neural activity in relevant brain regions (manifested as increased fNIRS integral values) by modulating GABAergic and/or dopaminergic systems, thereby improving depressive symptoms. Whether it involves deeper levels of neural plasticity changes (such as functional connectivity reorganization) or cytoprotective mechanisms (such as autophagy) remains to be explored in future research. However, this study did not find a significant correlation between IV and CV and HAMD. This contradiction may be due to the small sample size of the study, which limits the statistical power to detect correlations. At the same time, the selected IV and CV indicators may not capture the neural activity features most relevant to clinical improvement. Additionally, a mismatch in the main clinical evaluation time points may also be an important factor affecting the results. Furthermore, this study used fat emulsion as a control, which can match the physical characteristics of the drug solvent but cannot exclude the influence of the deep anesthesia process itself on the neurological state. The rapid decrease in HAMD scores and changes in fNIRS signals observed in the experimental group may partly stem from nonspecific physiological stress responses triggered by the loss of consciousness-awakening cycle.

Future studies need to adopt active placebos (such as short-acting benzodiazepines) to balance the intensity of intervention. Although there was no direct correlation between fNIRS indicators and HAMD improvement in this study, propofol may exert antidepressant effects through multi-level mechanisms, including rapid relief of neuronal excitability imbalance by GABA enhancement/glutamate inhibition; neuronal oscillation reorganization: enhancement of slow-wave sleep promotes synaptic homeostatic regulation<sup>[3]</sup>; and dopaminergic system activation may induce synaptic remodeling<sup>[8]</sup>. The frontal activation captured by fNIRS may only reflect acute mechanisms, while HAMD improvement involves the cumulative effects of mechanisms, which may be the reason for the mismatch in their time courses.

## 5. Conclusion

In summary, propofol intervention combined with the process of deep anesthesia can rapidly improve depressive

symptoms, accompanied by enhanced hemodynamic activity in the prefrontal/temporal lobes. However, its specific effects require further validation.

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## Disclosure statement

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# Weight Loss Achieves Menstrual Regularity in an Overweight Polycystic Ovary Syndrome Patient: Integrated Lifestyle-Drug Intervention

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**Abstract:** Polycystic ovary syndrome (PCOS) is a lifelong disorder affecting reproductive, metabolic, and psychological health. A healthy lifestyle and effective weight management strategies should underpin the treatment of PCOS. This case report documents the successful management of a Chinese patient with PCOS who was overweight and presented with oligomenorrhea and persistent adiposity. The patient was diagnosed using the Rotterdam criteria. The intervention was a 2-month program involving caloric restriction (1,350 kcal/day whole-food diet), progressive exercise titration (150–180 min/week of aerobic and resistance training), mindfulness practice, and metformin initiation after confirmed insulin resistance (HOMA-IR 3.67) resulted in clinically significant body composition improvements: fat mass was reduced by 5.0 kg, visceral adipose area was reduced by 44.7 cm<sup>2</sup>, skeletal muscle was increased by 1.4 kg, and regular menstrual cycles (32 day interval) were restored following 5% weight loss—consistent with evidence linking this threshold to improved ovarian function. The combination of a structured lifestyle modification program with targeted pharmacotherapy offers a viable clinical approach for metabolic PCOS phenotypes, although further validation is required to ascertain long-term efficacy.

**Keywords:** Lifestyle; Obesity-type polycystic ovary syndrome; Case study

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## 1. Introduction

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder affecting 11%–13% of women worldwide<sup>[1]</sup>. Its clinical characteristics include hyperandrogenemia, oligomenorrhea, polycystic ovarian morphology, and associated metabolic and psychological sequelae<sup>[2, 3]</sup>. The fundamental etiology of PCOS remains incompletely understood. The prevailing treatment strategies at present primarily concentrate on the management of

symptoms, encompassing the regulation of menstrual cycles, the control of hyperandrogenism, the reduction of cardiovascular-metabolic risk, and the management of fertility <sup>[4]</sup>. Therapeutic interventions for PCOS are frequently implemented as temporary measures. Due to limited understanding of its pathogenesis and underlying mechanisms, these approaches are often associated with notable adverse effects and high recurrence rates <sup>[5]</sup>.

## 2. Case report

### 2.1. General information

A 22-year-old unmarried female patient presented with a multi-year history of irregular menstruation and a confirmed medical diagnosis of polycystic ovary syndrome (PCOS). On 6 May 2025, she initiated a lifestyle modification program at the Gynecology Department, Wudangshan Branch, TaiHe Hospital. The patient reported menstrual cycles lasting between 45 and 60 days, accompanied by premenstrual and menstrual lower abdominal pain, abdominal and breast distension, and anxiety symptoms. In the preceding twelve-month period, the subject's body mass had increased by 15 kilograms to 75 kilograms, a change attributable to the preparation for postgraduate entrance examinations. In early March 2025, she initiated a self-directed dietary and exercise regimen at home, achieving a weight reduction to 68.5 kg by mid-April. However, despite subsequent adjustments to diet and physical activity, the patient's weight plateaued at 68.5 kg, with persistent menstrual irregularities. The patient had previously undergone a 12-month course of Western medical treatment to regulate her menstrual cycle.

However, symptoms recurred after the discontinuation of medication, which led to her transfer to the institution for lifestyle modification therapy. Initial assessment revealed elevated inflammatory and hormonal markers, including hs-CRP at 3.79 mg/L and an elevated LH/FSH ratio of 2.91 (LH: 13.95 IU/L; FSH: 4.72 IU/L). Fasting blood glucose was measured at 5.46 mmol/L. InBody body composition analysis demonstrated adverse metabolic parameters: skeletal muscle mass 21.9 kg, body fat mass 28.2 kg (41.3% body fat), and notably elevated visceral adiposity (visceral fat area: 146.5 cm<sup>2</sup>). Waist circumference measured 87.5 cm. The treatment plan comprised the following elements: The 2-month program provided personalized dietary guidance, exercise prescriptions, and supervised training sessions, mandating 3-month dietary records. Meditation and positive reinforcement strategies were incorporated alongside weekly anthropometric (waist circumference, WC) and menstrual cycle assessments to quantify intervention efficacy.

### 2.2. Treatment

#### 2.2.1. Diet prescription

The daily dietary targets comprised of: 125 g cereals ( $\geq 66.7\%$  whole grain), 75 g tubers, 15 g legumes; 500 g vegetables ( $\geq 50\%$  dark leafy greens); 200 g low-glycemic-index fruits; 30 g red meat, 30 g poultry, 70 g aquatic products; 50 g boiled eggs; 25 g soy products; 250 g low-fat dairy; 12 g cooking oil; 10 g unsalted nuts; salt  $< 5$  g (all weights uncooked).

The daily dietary diversity targets:  $\geq 12$  food types (weekly  $\geq 25$ ), with increased fiber intake and hydration (2,500–3,000 mL/day, +500 mL post-exercise). Meal sequencing prioritized vegetables  $\rightarrow$  protein  $\rightarrow$  carbohydrates, utilizing cooking methods (steaming, stewing, stir-frying) over frying/grilling. Progressive seasoning reduction was mandated alongside strict smoking/alcohol avoidance.

Dietary prescriptions emphasized: (1) Low-glycemic-index gluten-free carbohydrates ( $\geq 3$  varieties daily); (2) Dual-source animal protein intake (poultry/red meat + aquatic products, preferentially lean cuts); (3) Non-starchy

vegetables; (4) n-3 enriched oils; (5) Low-sugar fruits; (6) Natural herb-based seasonings; (7) Additive-free nuts.

### **2.2.2. Exercise prescription**

- (1) The subject is required to engage in 40 minutes of aerobic exercise per day, at a frequency of five times per week. The exercise should be performed at a heart rate of between 130 and 140 beats per minute.
- (2) The subject should engage in strength training two to three times per week.
- (3) It is hypothesized that progressive intensity/volume escalation will improve insulin sensitivity.

### **2.2.3. Core behavioral prescriptions**

- (1) Sleep hygiene compliance ( $\geq 7$  hours/night; circadian realignment via earlier bedtime targeting 22:30 sleep onset).
- (2) Active positive autosuggestion therapy to enhance adherence.
- (3) Daily 20-minute meditation sessions.

### **2.2.4. Pharmacological intervention**

The addition of metformin XR 500 mg was made post-breakfast, based on the results of oral glucose tolerance tests (OGTTs) and pancreatic function assessments.

## **2.3. Follow-up visitations**

### **2.3.1. Second follow-up (May 19, 2025)**

The bioelectrical impedance analysis (BIA) revealed: Body weight: 68 kg; skeletal muscle mass increased to 22.1 kilograms(kg); body fat mass decreased to 27.2 kg; body fat percentage (BFP) reduced to 40.3%; visceral fat area (VFA) measured 137.9 cm<sup>2</sup>; waist circumference (WC) decreased to 86.2 cm. Sleep quality and bowel movements showed improvement compared to previous records. The original intervention protocol was maintained.

### **2.3.2. Third follow-up (May 27, 2025)**

BIA indicated: Body weight: 67.5 kg; skeletal muscle mass slightly decreased to 22.0 kg; body fat mass measured 27.4 kg; BFP reduced to 40.4%; VFA was 136.9 cm<sup>2</sup>; WC further decreased to 85.2 cm. Continued improvement in sleep and bowel habits was noted. As body composition changes were not statistically significant, dietary modifications were implemented by increasing high-quality protein intake, and resistance training intensity was adjusted accordingly.

### **2.3.3. Fourth follow-up (June 3, 2025)**

BIA demonstrated: The subject's body weight was recorded at 67.1 kg. A 22.2 kg increase in skeletal muscle mass was observed, while body fat mass decreased to 26.5 kg. BFP declined to 39.5%, and VFA reduced to 132.1 cm<sup>2</sup>. WC reached 84 cm. The patient reported the commencement of menstruation on 28 May.

### **2.3.4. Fifth follow-up (June 10, 2025)**

BIA revealed the following data: body weight 67.0 kg, skeletal muscle mass 22.2 kg, body fat mass 26.3 kg, and BFP reduced to 39.2%. Additionally, VFA was measured at 130.8 cm<sup>2</sup>, and WC decreased to 83.1 cm. The patient reported an 8-day menstrual cycle and self-reported alleviation of abdominal pain. In consideration of

the pre-admission weight loss plateau phase, the ongoing stable weight reduction indicated the necessity for the continuation of lifestyle modification.

### **2.3.5. Sixth follow-up (June 17, 2025)**

BIA demonstrated the following: body weight 66.7 kg, skeletal muscle mass 22.3 kg, body fat mass 25.6 kg, and BFP 38.4%. Additionally, VFA was measured at 127.4 cm<sup>2</sup>, and WC was reduced to 82 cm. The patient reported an improvement in mood and a sense of relaxation. The subject was able to maintain the prescribed lifestyle modifications.

### **2.3.6. Seventh follow-up (June 24, 2025)**

The BIA indicated the following data: body weight 66.7 kg, skeletal muscle mass 22.4 kg, body fat mass 25.6 kg, and a BFP of 38.3%. Additionally, the VFA was measured at 125.7 cm<sup>2</sup>, and the WC remained consistent. It was hypothesized that minimal body composition changes would be indicative of insulin resistance. The oral glucose tolerance test and pancreatic function tests yielded the following results: fasting blood glucose 5.61 mmol/L, fasting insulin 8.2 µIU/mL, and Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) significantly elevated to 3.67, confirming insulin resistance. The results of the vitamin assays indicated deficiencies in vitamins B, C, and D. Consequently, metformin extended-release 500 mg was administered daily after breakfast, and multivitamin supplementation was initiated with morning meals.

### **2.3.7. Eighth follow-up (July 1, 2025)**

The BIA yielded the following results: body weight 66.3 kg, skeletal muscle mass 22.8 kg, body fat mass 24.4 kg, BFP reduced to 36.8%, VFA 117.7 cm<sup>2</sup>, and WC decreased to 81.4 cm. The patient reported the commencement of menstruation on 30 June, accompanied by normal flow, colour, consistency, and the absence of dysmenorrhea. The current therapeutic regimen was continued.

### **2.3.8. Ninth follow-up (July 11, 2025)**

The final BIA revealed the following data: body weight 65.5 kg, skeletal muscle mass 23.3 kg, body fat mass 23.3 kg, and BFP 35.5%. Additionally, the VFA was measured at 101.8 cm<sup>2</sup>, and the WC was recorded as 80.2 cm. The patient reported a menstrual bleeding episode lasting seven days. Following the conclusion of the in-person guidance process, the discharge examinations revealed the following results: high-sensitivity C-reactive protein 1.47 mg/L, fasting blood glucose 4.86 mmol/L, fasting insulin 4.9 µIU/mL, with a significant reduction in HOMA-IR to 1.91. The luteinizing hormone (LH)/follicle-stimulating hormone (FSH) ratio was found to be 2.001 (LH 13.49, FSH 6.65). The patient was advised to adhere to the prescribed lifestyle modification regimen. Subsequent weekly telemedicine contacts indicated continued gradual reductions in self-measured body weight and waist circumference.

## **3. Discussion and analysis**

This case study demonstrates the efficacy of lifestyle modification in the management of patients diagnosed with PCOS. The subject was a patient suffering from PCOS who was experiencing difficulties in reducing her body fat percentage. At the time of initial diagnosis, the patient exhibited symptoms including irregular menstruation and

difficulty in weight loss, accompanied by a self-reported high stress level. The intervention was comprised of a nutritionally balanced, natural food-based diet, with a total daily caloric intake of approximately 1,350 kcal, which was meticulously designed using the food exchange portion method. The patient was instructed on the principles for selecting appropriate ingredients. Furthermore, an exercise prescription was implemented, requiring the patient to complete the equivalent of 150 minutes of moderate-to-vigorous aerobic exercise per week, with two days per week dedicated to muscle-strengthening activities.

During the third follow-up, no significant improvement in body composition was observed in the patient during the third follow-up. Consequently, the duration of aerobic exercise was increased to 180 minutes per week. In consideration of the patient's experience of a weight loss "plateau" during their self-managed, home-based exercise regime, the therapeutic approach was adapted. The emphasis was shifted from the initial objective of establishing definitive fat loss targets to a more supportive and companionship-focused intervention. The patient demonstrated consistent adherence to a daily 20-minute pre-sleep meditation routine. By the fourth follow-up, menstruation had resumed, with normal menstrual flow, colour, texture, and absence of dysmenorrhea.

At the seventh follow-up, the BIA revealed no significant changes in body composition. Furthermore, the WC remained stable. It is noteworthy that 50–75% of overweight or obese patients diagnosed with PCOS have been observed to manifest insulin resistance, thus necessitating the prescription of an OGTT and pancreatic  $\beta$ -cell function assessment <sup>[6]</sup>. The fasting blood glucose level was 5.61 mmol/L, the fasting insulin level was 8.2  $\mu$ IU/mL, and the homeostasis model assessment of insulin resistance (HOMA-IR) level was markedly elevated to 3.67, thus confirming the presence of insulin resistance <sup>[7]</sup>. Metformin extended-release (500 mg orally upon waking) was initiated, in conjunction with supplementation of vitamins B, C, and D. By the eighth follow-up, the patient reported the resumption of menstruation, occurring approximately 32 days after the previous cycle. Following the implementation of lifestyle modifications, the patient's menstrual cycles exhibited increased regularity.

A body composition analysis conducted during the ninth follow-up visit revealed significant changes, including an increase in skeletal muscle mass of 1.4 kg, a reduction in body fat of 5.0 kg, a decrease in body fat percentage of 5.8%, and a reduction in visceral fat area of 44.7 cm<sup>2</sup>. These results support previous research indicating that reducing weight by 5-10% can restore regular menstruation and improve ovulatory responses <sup>[8]</sup>. Other studies have also reported the beneficial effects of lifestyle modifications on patients with polycystic ovary syndrome (PCOS) <sup>[9]</sup>. These improvements may be associated with enhanced insulin sensitivity, reduced serum androgen levels, modulated adipokine levels, and suppressed chronic low-grade inflammation <sup>[9–13]</sup>.

## 4. Conclusion

This single-case report demonstrates the significant improvement in symptoms achieved through personalized lifestyle modifications in a patient with PCOS. A lifestyle intervention focusing on balanced nutrition and exercise for weight management remains a cornerstone of PCOS management. However, PCOS is highly heterogeneous in terms of phenotypes, aetiologies, metabolic status, and genetics, so responses to identical interventions will likely differ among patients. Although baseline characteristics were reported and major variables were controlled for (e.g. medications), unmeasured confounding factors may still have influenced the outcomes. Although follow-up exceeded two months, the long-term sustainability of the effects and their impact on distant complications remain unevaluated. The development of comprehensive treatment plans could improve future outcomes.



## Disclosure statement

The authors declare no conflict of interest.

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# Study on Screening of Main Acupoints and Pattern-Specific Acupoint Combination Rules for Acupuncture in Autism Spectrum Disorder Complicated with Sleep Disorder Based on Data Mining

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**Abstract:** *Objective:* To explore the core acupuncture acupoints and pattern-adapted acupoint combination rules for autism spectrum disorder (ASD) complicated with sleep disorder using clinical data mining technology. *Methods:* A retrospective analysis was conducted on the diagnosis and treatment data of 104 children with ASD complicated with sleep disorder admitted to Xi'an Traditional Chinese Medicine (TCM) Encephalopathy Hospital from January 2022 to December 2024. Cross-pattern main acupoints were screened via frequency statistics, chi-square test, and factor analysis; pattern-specific auxiliary acupoints were extracted by combining multiple correspondence analysis, cluster analysis, and association rule mining. *Results:* Ten cross-pattern main acupoints (Baihui, Sishenzhen, Language Area 1, Language Area 2, Neiguan, Shenmen, Yongquan, Xuanzhong) were identified, and acupoint combination schemes for four major TCM patterns (Hyperactivity of Liver and Heart Fire, Deficiency of Kidney Essence, Deficiency of Both Heart and Spleen, Hyperactivity of Liver with Spleen Deficiency) were established. *Conclusion:* Acupuncture treatment should follow the principle of "regulating spirit and calming the brain as the root, and dredging collaterals based on pattern differentiation as the branch". The synergy between main and auxiliary acupoints can accurately regulate the disease, providing a basis for precise clinical treatment.

**Keywords:** Autism Spectrum Disorder (ASD); Sleep disorder; Acupoint selection rule; Data mining

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## 1. Introduction

Autism Spectrum Disorder (ASD), also known as autism spectrum disorder, is a neurodevelopmental disorder that onset in early development. It is characterized by impairments in social interaction, communication difficulties,

restricted interests, and stereotyped behaviors, with most patients accompanied by intellectual developmental disorders. Approximately 49%–80% of children with ASD have comorbid sleep disorders, mainly manifested as difficulty falling asleep, frequent nighttime awakenings, and daytime functional impairment, which seriously affect neurodevelopment and family quality of life <sup>[1]</sup>. In recent years, clinical practice and research on TCM treatment for ASD complicated with sleep disorder have increased year by year. In particular, acupuncture has shown significant efficacy in improving the clinical symptoms of ASD with comorbid sleep disorder, and has attracted wide attention due to its simple operation and few side effects. This study retrospectively explored the rules of acupuncture acupoint selection for ASD complicated with sleep disorder using data mining technology, aiming to provide a reference for precise clinical treatment and a theoretical basis for further exploring the safety and effectiveness of acupuncture in the treatment of ASD.

## **2. Materials and methods**

### **2.1. Data source**

Medical records of children with ASD complicated with sleep disorder admitted to Xi'an TCM Encephalopathy Hospital affiliated to Shaanxi University of Chinese Medicine from January 2022 to December 2024 were included. A total of 104 eligible cases were screened, including 75 males (72.12%) and 29 females (27.88%), aged 2–14 years with an average age of 5.99 years.

### **2.2. Diagnostic criteria**

#### **2.2.1. Diagnostic criteria for ASD**

Refer to the diagnostic criteria for autism in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V) and the relevant criteria for ASD in the Clinical Practice Guidelines for Pediatrics in Traditional Chinese Medicine - Autism Spectrum Disorder <sup>[2, 3]</sup>.

#### **2.2.2. Diagnostic criteria for childhood sleep disorder**

Comprehensive assessment was conducted through medical history collection, questionnaire evaluation, and auxiliary examinations. Medical history collection mainly focused on the clinical manifestations described in the present illness history and current symptoms; auxiliary examination was mainly based on polysomnography <sup>[4]</sup>; the questionnaire survey mainly used the Chinese version of the Children's Sleep Habits Questionnaire (CSHQ) <sup>[5]</sup>.

### **2.3. Inclusion criteria**

- (1) Meet the dual diagnostic criteria for ASD and childhood sleep disorder.
- (2) No restrictions on gender, ethnicity, age, region, or disease course.
- (3) Complete and clear medical records, including admission records, TCM and Western medicine diagnoses, treatment process, and discharge records.
- (4) For patients admitted repeatedly within 3 years, only the medical records of their first admission for a comorbid sleep disorder were included.

### **2.4. Exclusion criteria**

- (1) Complicated with other systemic diseases that affect the treatment of the primary diagnosis.

- (2) Cases with severe data missing related to the study.
- (3) Patients with other diseases that affect sleep disorder.

## 2.5. Data standardization and database establishment

Acupoint prescriptions from each included medical record were entered into an Excel spreadsheet to establish an acupoint prescription data collection form and database. Acupoint names were standardized in accordance with General Terminology of Acupuncture and Moxibustion (GB/T 30232-2013)<sup>[6]</sup>. The included medical record data were cleaned, terminology-standardized, and organized: for example, “childhood autism” and “early childhood autism” were uniformly classified as “autism spectrum disorder”; TCM diagnosis was uniformly referred to as “pediatric autism”; “pattern of hyperactive liver with spleen deficiency” and “pattern of spleen deficiency with hyperactive liver” were uniformly classified as “pattern of hyperactivity of liver with spleen deficiency”. Data entry and verification were conducted by 2 personnel to ensure data accuracy.

## 2.6. Statistical methods

SPSS 29 and SPSS Modeler 18 were used for data analysis. Main acupoints were screened using frequency statistics, chi-square test, and factor analysis; auxiliary acupoints were screened using chi-square test, multiple correspondence analysis, cluster analysis, and association rule analysis to identify core acupoints. The correlation and specificity between each TCM pattern and acupoints were visualized<sup>[7–9]</sup>.

## 3. Results

### 3.1. Demographic information and pattern distribution

A total of 4 TCM patterns were included: Deficiency of Both Heart and Spleen, Hyperactivity of Liver and Heart Fire, Deficiency of Kidney Essence, and Hyperactivity of Liver with Spleen Deficiency. After standardization, the names of the patterns were unified to ensure data consistency. The demographic information and pattern distribution are shown in **Table 1**.

**Table 1.** Distribution characteristics of TCM diagnostic syndromes

TCM diagnostic pattern	Frequency	Percentage
Heart-Spleen Deficiency Syndrome	46	44.23%
Heart-Liver Fire Excess Syndrome	34	32.69%
Kidney Essence Deficiency Syndrome	12	11.54%
Liver Hyperactivity-Spleen Deficiency Syndrome	12	11.54%
Total	104	100.00%

### 3.2. Screening of main acupoints

#### 3.2.1. Frequency statistical analysis of acupoints (Acupoint areas)

A total of 37 acupoints (acupoint areas) were used in this study. There were 4 acupoints (acupoint areas) used in all cases, namely Baihui, Sishenzen, Language Area 1, and Language Area 2. Acupoints with a usage rate > 50% included: Language Area 3, Naohu, Neiguan, Shenmen, Yongquan, Xuanzhong, Zusanli, Xinshu, Sanyinjiao, and Pishu. These high-frequency acupoints were selected as candidates for main acupoints, with details shown in **Table 2**.

**Table 2.** Usage frequency of 37 acupuncture points

Acupuncture point name	Frequency of use	Usage rate %	Acupuncture point name	Frequency of use	Usage rate %
Baihui (GV20)	104	100.00%	Benshen (GB13)	5	4.80%
Sishenzhen (EX-HN1)	104	100.00%	Shenting (DU24)	4	3.80%
Speech Area I	104	100.00%	Shuigou (GV26)	3	2.90%
Speech Area II	104	100.00%	Tongli (HT5)	3	2.90%
Speech Area III	103	99.00%	Guanyuan (CV4)	3	2.90%
Neiguan (PC6)	101	97.10%	Yamen (GV15)	2	1.90%
Shenmen (HT7)	101	97.10%	Motor Area	2	1.90%
Naohu (GV17)	100	96.20%	Foot Motor-Sensory Area	2	1.90%

Analysis of the acupuncture methods used in all cases showed consistency: for scalp acupuncture, conventional transverse insertion was adopted, with needles inserted close to the periosteum, a needle depth of approximately 25 mm, strong stimulation, and a 1-hour needle retention period. During needle retention, functional training with needles in place was persisted. For body acupuncture, the even reinforcing-reducing technique was used without needle retention, with 6 sessions per week.

### 3.2.2. Chi-Square test analysis of high-frequency acupoints

Since Baihui, Sishenzhen, Language Area 1, and Language Area 2 had a 100% usage rate, and based on TCM theory, these 4 acupoints all have the effects of opening the orifices, awakening the spirit, and dredging collaterals, they were included in the main acupoints without further analysis. The remaining high-frequency acupoints (acupoint areas) obtained in 2.2.1 were subjected to chi-square test. Acupoints (acupoint areas) with a  $p$ -value  $\geq 0.05$ , including Language Area 3, Naohu, Neiguan, Shenmen, Yongquan, and Xuanzhong, were screened out, indicating that these acupoints (acupoint areas) had no pattern preference and were included as candidates for main acupoints. If the  $p$ -value  $< 0.05$  (e.g., Zusanli, Xinshu, Sanyinjiao, Pishu), it indicates that such acupoints (acupoint areas) were related to a specific pattern and were transferred to auxiliary acupoint analysis. Details are shown in **Table 3**.

**Table 3.** Chi-Square test statistics for high-frequency acupoints

Name	P-value	Name	P-value
Speech Area III	0.736	Xuanzhong (GB39)	0.792
Neiguan (PC6)	0.634	Xinshu (BL15)	0
Shenmen (HT7)	0.634	Sanyinjiao (SP6)	0
Naohu (GV17)	0.31	Zusanli (ST36)	0
Yongquan (KI1)	0.792	Pishu (BL20)	0

### 3.2.3. Principal component factor analysis of high-frequency acupoints

Principal component analysis was performed on all candidate main acupoints, with the varimax rotation method selected. Acupoints with a factor loading  $> 0.5$  were extracted through dimensionality reduction to reveal the internal correlation of acupoint groups. Finally, the core acupoints of Factor 1 were Neiguan, Shenmen, Yongquan, and Xuanzhong; the core acupoints of Factor 2 were Language Area 3 and Naohu; Shenmen was a cross-factor



acupoint. Details are shown in **Table 4**.

**Table 4.** Principal component matrix

	Component 1	Component 2
Neiguan (PC6)	0.972	-0.099
Xuanzhong (GB39)	0.866	0.446
Yongquan (KI1)	0.866	0.446
Shenmen (HT7)	0.696	0.551
Speech Area III	0.028	0.931
Naohu (GV17)	0.39	0.723

Through high-frequency statistics, chi-square test, and principal component analysis, a total of 10 cross-pattern acupoints (acupoint areas) were finally selected as main acupoints, including scalp acupuncture acupoints (Baihui, Sishenzhen, Language Area 1, Language Area 2, Language Area 3, Naohu) and body acupoints (Neiguan, Shenmen, Yongquan, Xuanzhong).

### 3.3. Screening of auxiliary acupoints

#### 3.3.1. Chi-square test analysis of auxiliary acupoints

All acupoints except the main acupoints were selected as candidates for auxiliary acupoints and subjected to chi-square test. Due to the small sample sizes of the Deficiency of Kidney Essence pattern and Hyperactivity of Liver with Spleen Deficiency pattern, Fisher's exact test results were used, and the Bonferroni correction threshold was calculated manually. Acupoints with a  $p$ -value  $< 0.0013$  and absolute residual value  $> 1.96$  were selected. Among them, although acupoints such as Xinshu, Ganshu, Zusanli, Sanyinjiao, Pishu, Ganshu, and Taichong had an absolute residual value  $< 1.96$  in each pattern, their  $p$ -value  $< 0.0013$  and Cramer's  $V > 0.3$  indicated a strong correlation between these acupoints and patterns, which may have clinical significance, so they were all included as candidate auxiliary acupoints. The resulting candidate auxiliary acupoints were: Deficiency of Both Heart and Spleen: Zusanli, Xinshu, Sanyinjiao, Pishu; Hyperactivity of Liver and Heart Fire: Xinshu, Ganshu, Taichong, Fengchi; Deficiency of Kidney Essence: Sanyinjiao, Pishu, Taixi, Shenshu; Hyperactivity of Liver with Spleen Deficiency: Zusanli, Sanyinjiao, Pishu, Ganshu, Taichong.

#### 3.3.2. Multiple correspondence analysis of auxiliary acupoints

The candidate auxiliary acupoints obtained in 3.3.1 and TCM patterns were included in multiple correspondence analysis, with the default dimension set to 2. A joint category plot was selected to quantify the spatial distance between acupoints and patterns. In the output results, if an acupoint point was close to the origin and far from a specific pattern, it indicated that the acupoint was a co-occurring acupoint; if an acupoint point was close to a specific pattern, it indicated a strong correlation between the acupoint and that specific pattern, and the acupoint could be used as a core auxiliary acupoint for the pattern. The results were: Deficiency of Both Heart and Spleen: Zusanli, Xinshu, Sanyinjiao, Pishu; Hyperactivity of Liver and Heart Fire: Xinshu, Ganshu, Taichong, Fengchi; Deficiency of Kidney Essence: Taixi, Shenshu, Xinshu; Hyperactivity of Liver with Spleen Deficiency: Zusanli, Sanyinjiao, Pishu, Taichong, Xinshu. Xinshu was close to the origin in all four patterns, suggesting it was a "basic auxiliary acupoint" that required further verification using other methods, so it was included in each pattern.

### 3.3.3. Cluster and association rule analysis of each auxiliary acupoint

K-means cluster analysis was performed on the candidate auxiliary acupoints obtained in 3.3.2, with the number of clusters set to 4, to check whether the final clusters were consistent with the actual patterns. The results showed that the cross-tab comparison between the cluster results and actual patterns was roughly consistent. The results were: Cluster 1: Xinshu, Ganshu, Taichong, Fengchi; Cluster 2: Zusanli, Xinshu, Sanyinjiao, Pishu; Cluster 3: Zusanli, Sanyinjiao, Pishu, Ganshu, Taichong; Cluster 4: Sanyinjiao, Pishu, Taixi, Shenshu.

SPSS Modeler 18.0 was used for association rule strength analysis to verify the association strength between each auxiliary acupoint and each pattern. The minimum support was set to 7, confidence to 60%, and lift > 1.5 to exclude false correlations from random co-occurrence, and the relationship was visualized. The results showed that the acupoints strongly associated with each pattern were: Deficiency of Both Heart and Spleen: Zusanli, Xinshu, Sanyinjiao, Pishu; Hyperactivity of Liver and Heart Fire: Xinshu, Ganshu, Taichong, Fengchi; Deficiency of Kidney Essence: Taixi, Shenshu, Sanyinjiao, Pishu; Hyperactivity of Liver with Spleen Deficiency: Sanyinjiao, Pishu, Ganshu, Taichong. Details are shown in **Table 5** and **Table 6**.

**Table 5.** Final cluster centers for each acupoint combination

	Category 1	Category 2	Category 3	Category 4
Zusanli (ST36)	0	1	1	0
Xinshu (BL15)	1	1	0	0
Sanyinjiao (SP6)	0	1	1	1
Pishu (BL20)	0	1	1	1
Ganshu (BL18)	1	0	1	0
Taixi (KI3)	0	0	0	1
Shenshu (BL23)	0	0	0	1
Taichong (LR3)	1	0	1	0
Fengchi (GB20)	1	0	0	0

**Table 6.** Association rule table for acupoint combinations and syndrome types

Consequent (Syndrome Type)	Antecedent (Acupoint Combination)	Support	Confidence	Lift
TCM Syndrome = Liver Hyperactivity & Spleen Deficiency Syndrome	Taichong (LR3) and Sanyinjiao (SP6)	7.69%	62.50%	5.42
TCM Syndrome = Liver Hyperactivity & Spleen Deficiency Syndrome	Ganshu (BL18) and Pishu (BL20)	7.69%	62.50%	5.42
TCM Syndrome = Kidney Essence Deficiency Syndrome	Shenshu (BL23) and Taixi (KI3)	10.58%	100.00%	8.67
TCM Syndrome = Kidney Essence Deficiency Syndrome	Shenshu (BL23) and Sanyinjiao (SP6)	10.58%	100.00%	8.67
TCM Syndrome = Kidney Essence Deficiency Syndrome	Shenshu (BL23) and Pishu (BL20)	7.69%	87.50%	7.58
TCM Syndrome = Heart-Liver Fire Blazing Syndrome	Fengchi (GB20) and Taichong (LR3)	23.08%	100.00%	3.06
TCM Syndrome = Heart-Liver Fire Blazing Syndrome	Fengchi (GB20) and Ganshu (BL18)	23.08%	100.00%	3.06
TCM Syndrome = Heart-Liver Fire Blazing Syndrome	Fengchi (GB20) and Xinshu (BL15)	24.04%	96.00%	2.94
TCM Syndrome = Dual Deficiency of Heart & Spleen Syndrome	Pishu (BL20) and Xinshu (BL15)	53.85%	82.14%	1.86
TCM Syndrome = Dual Deficiency of Heart & Spleen Syndrome	Zusanli (ST36) and Sanyinjiao (SP6)	56.73%	77.97%	1.76

Through chi-square test, multiple correspondence analysis, K-means cluster analysis, and association rules, the pattern-specific auxiliary acupoints were extracted by integrating the results: Deficiency of Both Heart and Spleen: Zusanli, Xinshu, Sanyinjiao, Pishu; Hyperactivity of Liver and Heart Fire: Xinshu, Ganshu, Taichong, Fengchi; Deficiency of Kidney Essence: Taixi, Shenshu, Sanyinjiao, Pishu; Hyperactivity of Liver with Spleen Deficiency: Sanyinjiao, Pishu, Ganshu, Taichong.

## 4. Discussion

In TCM theory, ASD is mostly classified into the categories of “delayed speech”, “infantile confusion”, and “lack of wisdom”. The core pathogenesis is insufficient cerebral marrow, malnutrition of the spirit, and obstruction of phlegm and blood stasis, which is closely related to the dysfunction of Zang-Fu organs such as the heart, kidney, brain, and liver.

The 10 main acupoints screened in this study are mainly core acupoints: Baihui is the confluence of all yang meridians; Sishenzhen regulates the spirit and awakens the brain; the language area acupoints (Area 1, 2, 3) improve cerebral collateral communication; Naohu is directly related to the “marrow sea” (brain), which can nourish the brain and fill the marrow, dredge collaterals, and open the orifices. Together, they play the roles of regulating the spirit, improving intelligence, and dredging cerebral collaterals, alleviating symptoms such as low cognitive ability and language deficiency in children. Among the body acupoints, Neiguan calms the heart and tranquilizes the spirit; Shenmen is the original point of the Heart Meridian; Yongquan connects the heart and kidney; Xuanzhong (the meeting point of marrow) nourishes the cerebral marrow. The combination of these acupoints jointly exerts the effect of regulating the spirit and awakening the brain, which is in line with the core pathogenesis of ASD, i.e., “malnutrition of the spirit and obstruction of cerebral collaterals”<sup>[10, 11]</sup>. Neiguan (the collateral point of the Pericardium Meridian) and Shenmen (the original point of the Heart Meridian) form a combination of “co-regulating the heart and brain”; Yongquan (the well point of the Kidney Meridian) and Xuanzhong (the meeting point of marrow) form a combination of “replenishing the kidney and filling the marrow”, reflecting the TCM theory of “treating upper disorders from lower regions”.

In addition, from the perspective of modern medicine, the main scalp acupoints (Baihui, Sishenzhen, Naohu) cover the projection areas of cerebral cortex functional areas; strong stimulation can regulate the function of the frontal-limbic system, improving the social motivation and emotional regulation of children with ASD. The language areas (Area 1, 2, 3) respectively regulate the three core functions of language expression, naming, and comprehension. By stimulating the scalp language areas, the neural synaptic connections in the corresponding cerebral cortex are activated, promoting neural plasticity and improving blood circulation and metabolism in the language functional areas<sup>[12]</sup>.

The analysis of the syndrome-specific rules of acupoint matching shows that for the syndrome of deficiency of both heart and spleen: Zusanli (ST36) and Pishu (BL20) are used to invigorate the spleen and replenish Qi. Xinshu (BL15) and Sanyinjiao (SP6) are used to nourish blood and calm the mind. For the syndrome of exuberant fire in the heart and liver: Taichong (LR3) and Ganshu (BL18) soothe the liver and purge fire. Fengchi (GB20) clears and benefits the head and eyes. Xinshu (BL15) clears the heart and reduces fire. These acupoints play an important role in addressing the syndrome characteristics of “liver fire disturbing the heart and mental instability”. For the syndrome of insufficient kidney essence: Taixi (KI3) and Shenshu (BL23) tonify the kidney and replenish essence. Sanyinjiao (SP6) and Pishu (BL20) invigorate the spleen and assist transportation to support the

congenital foundation (kidney). For the syndrome of liver hyperactivity and spleen deficiency: Taichong (LR3) and Ganshu (BL18) level the liver and subdue yang. Pishu (BL20) harmonizes the middle jiao and invigorates the spleen. Sanyinjiao (SP6) regulates the liver and spleen. These acupoints can prevent the complication of “spleen deficiency with liver hyperactivity and wood overacting on earth”<sup>[11, 13]</sup>. Acupuncture techniques: Scalp acupuncture: Routine transverse insertion, needling close to the periosteum with a depth of approximately 25mm, applying strong stimulation, and retaining the needles for 1 hour. Functional training with needles retained is performed during the needle retention period. Body acupuncture: Applying the even reinforcing-reducing method without needle retention, with 5 treatments per week.

## 5. Conclusion

This study revealed the acupoint selection rules of acupuncture for sleep disorders comorbid with Autism Spectrum Disorder (ASD) through data mining, and verified the treatment model of “main acupoints regulating the mind and matching acupoints based on syndrome differentiation”. After demonstration and evaluation by relevant TCM experts on the core acupoint (acupoint area) scheme obtained from data mining in this study, the authenticity and rationality of the acupuncture treatment scheme were confirmed. This provides a theoretical basis for further exploring the safety and efficacy of acupuncture in the treatment of ASD, and also offers scientific evidence for further clinical standardized treatment. However, the study has limitations: the sample size is small, and the number of cases with insufficient kidney essence syndrome and liver hyperactivity with spleen deficiency syndrome is limited. In the future, it is necessary to expand the sample size and conduct multi-center studies to further verify the findings.

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# A Systematic Study on Nurses' Job Burnout and Human Resource Management Strategies

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**Abstract:** This paper focuses on the issue of nurses' job burnout and conducts an in-depth analysis of its contributing factors from multiple dimensions, including organizational management, job characteristics, and individual attributes. These factors include shortages in nursing human resources, lack of management support, excessive workload, and differences in coping strategies. Based on this analysis, targeted human resource management strategies are proposed, covering aspects such as optimizing human resource allocation, leadership development and organizational support, humanized management practices, and competency development with supporting systems. The aim is to alleviate nurses' job burnout, improve the quality of nursing work and nurses' professional well-being, and provide theoretical reference and practical guidance for human resource management in the nursing industry.

**Keywords:** Nurses' job burnout; Human resource management; Systematic study

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## 1. Introduction

As a key group in the medical system, nurses assume important responsibilities such as patient care and assisting in medical work. Their work status directly affects the quality of medical services and patient rehabilitation outcomes<sup>[1]</sup>. However, job burnout is prevalent among nurses, manifested by symptoms such as emotional exhaustion, depersonalization, and reduced personal accomplishment. This not only harms nurses' physical and mental health but may also lead to increased nursing errors and staff turnover, posing challenges to the stable development of the medical industry. Human resource management plays a core role in alleviating nurses' job burnout. Through scientific and reasonable management strategies, it can effectively improve the working environment for nurses, reduce work pressure, and enhance their professional identity and sense of

belonging. Therefore, in-depth research on the factors of nurses' job burnout and corresponding human resource management strategies holds significant practical significance.

## **2. Analysis of factors causing nurses' job burnout**

### **2.1. Organizational management factors**

#### **2.1.1. Shortage of nursing human resources**

The shortage of nursing human resources is the structural root cause of nurses' job burnout. With the intensification of social aging and the growth of medical service demand, the number of hospital patients has been rising continuously, but the increase in nurse staffing has lagged behind relatively, resulting in a heavy workload for nurses <sup>[2]</sup>. Being in a high-intensity work state for a long time, nurses are physically and mentally exhausted, unable to get sufficient rest and recovery, which in turn leads to job burnout. For example, in some large general hospitals, the ratio of nurses to patients is seriously imbalanced. Nurses have to take care of multiple patients at the same time, shuttling between wards frequently to complete various nursing operations, resulting in enormous work pressure.

#### **2.1.2. Lack of management support and absence of organizational fairness mechanisms**

Management support has an important impact on nurses' job satisfaction and job burnout. When nurses encounter difficulties or pressure at work, if they cannot get understanding, support, and guidance from their superiors, they are prone to feelings of helplessness and frustration, which aggravates job burnout <sup>[3]</sup>. At the same time, the absence of organizational fairness mechanisms is also an important factor. Nurses expect to be treated fairly at work, including in terms of salary distribution, promotion opportunities, and work evaluation. If there are unfair phenomena within the organization, such as some nurses undertaking too many work tasks without getting corresponding rewards, it is easy to arouse nurses' dissatisfaction, reduce work enthusiasm and professional identity.

#### **2.1.3. Role pressure**

Role pressure is another key inducement of nurses' job burnout, and its core lies in the dual dilemma of role ambiguity and role conflict. Nurses play multiple roles at work, such as caregivers, educators, coordinators, etc. Different roles have different requirements and expectations for nurses <sup>[4]</sup>. When nurses are not clear about their own role positioning, and are not sure about the responsibilities and work priorities of each role, they are prone to role ambiguity, leading to work confusion and inefficiency. At the same time, there may be conflicts between different roles, such as the contradiction between taking care of patients' needs and following hospital rules and regulations, which puts nurses in a dilemma, increases their psychological pressure, and then leads to job burnout.

### **2.2. Job characteristic factors**

Work overload is an important job characteristic factor contributing to nurses' job burnout <sup>[5]</sup>. Nursing work is characterized by high intensity, high risk, and high responsibility. Nurses need to work continuously for long hours and often face emergencies and unexpected situations. In addition to completing daily nursing operations such as infusion, injection, and measuring vital signs, nurses also need to participate in patient rescue, medical record writing, and communication with family members, resulting in heavy workloads. Prolonged work overload makes

nurses physically exhausted and mentally highly stressed. They lack sufficient time for rest and relaxation, which easily leads to job burnout. For example, in departments such as the emergency department and intensive care unit, nurses work at a fast pace and under great pressure. They need to stay alert at all times to deal with various complex situations, so the incidence of job burnout is relatively higher.

### **2.3. Individual factors**

Coping strategies play a key mediating role in the development of nurses' job burnout. When faced with work pressure and job burnout, different nurses adopt different coping strategies <sup>[6]</sup>. Positive coping strategies, such as actively seeking social support, adjusting one's mindset, and reasonably balancing work and life, help nurses relieve pressure and reduce the degree of job burnout. On the contrary, negative coping strategies, such as evading problems, excessive self-blame, and complaining, not only fail to solve problems but also increase psychological burdens and accelerate the development of job burnout. For example, some nurses, when encountering work pressure, choose to communicate with colleagues, share experiences, and seek help and support, which can effectively alleviate negative emotions; while others choose to bear the pressure alone, keep problems to themselves, and long-term accumulation leads to increasingly severe job burnout.

Job competency serves as a critical protective factor for nurses against job burnout <sup>[7]</sup>. Nurses with higher job competency are able to master professional knowledge and skills proficiently, complete various tasks efficiently, and derive a sense of accomplishment and satisfaction from their work. Meanwhile, strong communication skills, teamwork abilities, and problem-solving capabilities enable nurses to better navigate workplace challenges and pressures, foster positive interpersonal relationships, and enhance work adaptability. For instance, an experienced nurse with solid professional skills can quickly make accurate judgments and interventions when handling patients with complex conditions. Such competence earns recognition from patients and their families, thereby strengthening the nurse's professional confidence and sense of belonging, and reducing the risk of job burnout.

## **3. Human resource management strategies**

### **3.1. Optimizing human resource allocation**

- (1) Scientific calculation of nursing workload: Scientific calculation of nursing workload is the basis for rational allocation of nursing human resources <sup>[8]</sup>. By establishing a scientific workload calculation model, comprehensively considering factors such as the severity of patients' conditions, the complexity of nursing operations, and nursing time, we can accurately assess the nursing workload in different departments and at different time periods, providing a basis for nurse staffing and scheduling. For example, using the workload statistics method, detailed records are kept of the quantity and time of various nursing operations completed by nurses every day. Combined with the patients' nursing levels and needs, the standard workload is calculated to determine the number of nurses needed, ensuring that the allocation of human resources matches the actual work needs.
- (2) Dynamic adjustment of nurse-patient ratio: The number and condition of patients change at any time, so dynamic adjustment of the nurse-patient ratio is a key strategy to cope with fluctuations in workload <sup>[9]</sup>. Hospitals should establish a flexible mechanism for adjusting the nurse-patient ratio according to the characteristics of different departments and changes in patient flow. During periods when the number of patients is large and their conditions are severe, the number of nurses should be appropriately increased

to reduce their workload; during periods when the number of patients is small and their conditions are mild, the number of nurses should be reasonably reduced to improve the efficiency of human resource utilization. For example, during the flu season, the number of patients in the respiratory department increases significantly, and the hospital can promptly deploy nurses from other departments to support, ensuring that the nurse-patient ratio in the respiratory department remains at a reasonable level and reducing the work pressure on nurses.

- (3) Stratified use of nursing human resources: Stratified use of nursing human resources can maximize the professional value of nurses <sup>[10]</sup>. Nurses are divided into different levels based on their educational background, professional title, work experience, and professional skills, with clear job responsibilities and authorities for each level. Nurses with senior titles and rich experience are responsible for nursing patients with complex conditions, monitoring nursing quality, teaching and guiding, etc.; junior nurses, under the leadership of senior nurses, are responsible for basic nursing work and routine patient care. Through stratified use of nursing human resources, we can realize the full utilization of talents, improve the efficiency and quality of nursing work, and at the same time provide nurses with room for career development and enhance their sense of professional achievement.

### **3.2. Leadership training and organizational support**

- (1) Servant leadership training

Servant leadership training is an effective intervention to improve management support <sup>[11]</sup>. By carrying out servant leadership training courses, the service awareness and leadership ability of managers, such as head nurses, can be enhanced and enable them to pay attention to nurses' needs and provide necessary support and help for nurses. Servant leaders focus on establishing good communication with nurses, listening to their opinions and suggestions, respecting their individual differences, encouraging them to participate in the decision-making process, and creating a harmonious working atmosphere. For example, regularly organize head nurses to participate in servant leadership training lectures and workshops, through case analysis, role-playing, and other methods, let head nurses deeply understand the concept of servant leadership and apply it to actual management work.

- (2) Organizational justice practices

Organizational justice practices are the basis for enhancing nurses' professional identity <sup>[12]</sup>. Hospitals should establish a fair and reasonable salary distribution system, promotion mechanism, and work evaluation system to ensure that nurses are treated fairly in terms of work input and return, career development opportunities, etc. In terms of salary distribution, comprehensive consideration is given to factors such as nurses' workload, work quality, and job risks, and the salary gap between nurses at different levels and in different positions is widened, reflecting the principle of more pay for more work and better pay for better work; in terms of promotion, clear promotion standards and procedures are formulated to provide nurses with fair competition opportunities and stimulate their work enthusiasm and creativity.

- (3) Psychological contract management

Psychological contract management is a soft strategy to enhance organizational commitment <sup>[13]</sup>. The psychological contract is the implicit and unspoken mutual expectations and responsibilities between nurses and the organization. Hospitals should establish a clear psychological contract with nurses through



effective communication, so that nurses understand the organizational goals and expectations, and at the same time, the organization should pay attention to nurses' personal needs and career development aspirations, and provide a platform for nurses to realize their personal values. For example, when new nurses join the hospital, carry out induction training and communication activities to introduce the hospital culture, rules and regulations, career development paths and other information to new nurses, and at the same time understand their personal interests and career plans, help them integrate into the organization as soon as possible, and enhance their sense of identity and belonging to the organization.

### **3.3. Practices of humanized management**

- (1) Flexible scheduling system: The flexible scheduling system is a core measure to respect the individual needs of nurses <sup>[14]</sup>. Considering the need for nurses to balance work and life, hospitals should break the traditional fixed scheduling model and establish a flexible scheduling system. Work hours and shifts should be reasonably arranged based on factors such as nurses' personal wishes, family situations, and physical conditions. For example, provide flexible working hours for nurses who need to take care of their children, allowing them to adjust their commuting time within a certain range; offer appropriate subsidies and rest time for nurses on night shifts to ensure their physical and mental health.
- (2) Optimization of working environment and strengthening of social support: The optimization of the working environment and the strengthening of social support form the dual guarantee of humanized management. Hospitals should focus on improving the working environment for nurses and provide comfortable, safe, and convenient working facilities and equipment, such as optimizing the layout of wards and updating nursing equipment, to reduce the physical exertion of nurses at work. At the same time, strengthen the construction of the social support system, and provide psychological support and emotional comfort for nurses through activities such as employee care programs, mental health lectures, and team-building activities to relieve work pressure. For example, set up an employee psychological counseling room to provide free psychological counseling services for nurses; regularly organize nurses to participate in outdoor development activities to enhance team cohesion and collaboration capabilities.

### **3.4. Competency development and support system**

- (1) Phased training system: The phased training system serves as the cornerstone for enhancing nurses' job competency <sup>[15]</sup>. Tailored training programs are designed according to the needs of nurses at different career stages. Newly recruited nurses receive intensive training in basic nursing knowledge and skills to help them adapt to the clinical practice environment quickly. Nurses with moderate work experience participate in specialized nursing training to deepen their expertise in specific clinical areas. Senior nurses focus on developing management and research capabilities, cultivating talent for the advancement of nursing science. Through this phased approach, nurses can achieve continuous professional growth across all career stages and improve their overall job competency.
- (2) Positive coping strategy training: Positive coping strategy training is a psychological tool to alleviate job burnout among nurses. By offering mental health workshops and training courses, nurses learn evidence-based stress management techniques, including emotional regulation, time management, and problem-solving. These interventions aim to foster a proactive mindset toward stress, enhance psychological resilience, and empower nurses to navigate professional challenges effectively. For example, inviting



mental health professionals to conduct stress management seminars—featuring theoretical explanations, case studies, and interactive exercises—equips nurses with practical coping strategies.

- (3) Resilience development program: Resilience development should be integrated throughout nurses' careers. Resilience, defined as the ability to recover and adapt swiftly to stress and setbacks, can be cultivated through multiple approaches. Hospitals may assign challenging tasks to strengthen nurses' problem-solving abilities in real-world scenarios. Encouraging participation in interdepartmental collaboration projects broadens their perspectives and enhances adaptability. Implementing a mentor system, where experienced nurses guide junior colleagues, builds confidence and fosters resilience by providing personalized support and career guidance.

## 4. Conclusion

Nurse burnout is the result of the combined effect of multiple factors, involving various levels such as organizational management, job characteristics, and individuals. Effective human resource management strategies play a crucial role in alleviating nurse burnout. Measures such as optimizing human resource allocation, cultivating leadership and providing organizational support, implementing humanized management practices, and building a competency development and support system can improve the working environment for nurses, reduce work pressure, enhance their sense of professional identity and belonging, and lower the incidence of burnout.

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# A Comparative Study on the Improvement of College Graduates' Psychological Resilience through Mindfulness Music Therapy and Group Counseling

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**Abstract:** In recent years, college graduates have faced increasingly severe employment situations and multiple pressures, such as those from interpersonal relationships, academic studies, and employment. Psychological resilience, as an essential ability for college students to cope with pressure, is crucial for their physical and mental health development. In this process, both mindfulness music therapy and group counseling have their unique characteristics and can continuously enrich the paths to enhance psychological resilience. This helps to strengthen graduates' psychological resilience, improve their social adaptability, and further enable them to grow into high-quality talents needed by society. Therefore, this article first analyzes the mechanisms of action of mindfulness music therapy and group counseling, and then elaborates on the paths through which they enhance college graduates' psychological resilience, aiming to provide some reference for relevant researchers.

**Keywords:** Mindfulness music therapy; Group counseling; Graduates; Psychological resilience

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## 1. Introduction

In recent years, college graduates have encountered growing challenges in employment, academic performance, and interpersonal relationships, leading to heightened psychological stress. Psychological resilience, a critical capacity for coping with adversity, plays a vital role in promoting their mental health and overall development. Mindfulness music therapy and group counseling, as two distinct yet effective approaches, offer valuable pathways to strengthen resilience and enhance social adaptability. By exploring their mechanisms and practical applications, this paper seeks to provide insights into fostering graduates' psychological resilience, thereby supporting their development into high-quality professionals capable of meeting societal demands. The following sections will analyze the theoretical foundations of these interventions and discuss their implementation strategies for resilience

enhancement.

## **2. Analysis of the mechanism of mindfulness music therapy and group counseling**

### **2.1. Mechanism of mindfulness music therapy**

Mindfulness music therapy mainly refers to the organic integration of music therapy and mindfulness meditation. During the healing process, it uses music melody, rhythm, and cadence to help college graduates achieve a state of physical and mental relaxation and enhance their mindfulness perception ability. Among them, music is a tool for information transmission other than language, which can penetrate into graduates' psychological and spiritual needs and help them express and perceive their own emotions. Mindfulness music therapy enables students to maintain awareness and perception of their current state while listening to music, helping graduates get rid of the pressure and distress in daily life, and enhancing their acceptance and understanding of their internal experiences. In addition, it can also activate graduates' positive emotions, strengthen their emotional regulation ability, thereby promoting the improvement of psychological resilience, and ensuring that graduates always maintain a perseverance attitude when facing challenges and pressure <sup>[1]</sup>.

### **2.2. Mechanism of group counseling**

Group counseling takes the group as the basic unit of psychological activities. It forms a group of graduates with common problems and needs for interactive communication, creates a learning environment of mutual respect and experience sharing in group counseling, and enables them to communicate, learn, and grow in a mutually respectful and relatively safe environment. In addition, group members can express their views and feelings in a relatively safe environment, listen to the stories and interesting things shared by others, enhance self-cognition, and master new counseling skills. Group counseling can effectively enhance graduates' interpersonal skills and sense of belonging, and help individuals solve psychological difficulties through group strength. Group counseling is particularly important for college students who are about to graduate. It can help them build good interpersonal relationships, develop strong psychological endurance, and make a better transition from campus to society <sup>[2]</sup>.

## **3. The path of mindfulness music therapy in enhancing the psychological resilience of college graduates**

### **3.1. Expanding the influence scope of mindfulness music therapy**

First, make full use of the school's health education resources. Colleges and universities popularize mindfulness music therapy to teachers and students through publicity and education, so that they can understand mindfulness music therapy and actively participate in it. To this end, colleges and universities can publicize mindfulness music therapy by holding various activities, such as lectures, seminars, exhibitions, etc., and organically integrate mindfulness music therapy with mental health education, so as to effectively improve the psychological resilience of graduates. At the same time, colleges and universities also need to make good use of other mental health education resources, such as taking the initiative to establish cooperative relations with medical workers, psychological counseling rooms, etc., give full play to the due role of mindfulness music therapy, continuously improve the quality of mental health education, and promote the physical and mental health development of graduates <sup>[3]</sup>. Second, organize campus music culture activities. To further expand the penetration effect of

mindfulness music therapy on campus, colleges and universities can organize different types of music and art activities, create a good music healing atmosphere on campus, and organize campus music art performances, competitions and special music festivals, so that graduates can fully experience the positive effects of music therapy, enhance their understanding and love of music therapy, improve their interest in participation through rich and diverse music and art scenes, and increase their attention to psychological problems. Moreover, these activities also help schools, teachers, and students establish a good psychological counseling relationship, pay attention to psychological problems in time and solve them, thus creating a good environment for enhancing the psychological resilience of graduates<sup>[4]</sup>.

### **3.2. Applying comprehensive observation to guide students to express themselves**

Music therapy is not simply appreciating music; it is highly systematic and purposeful, and uses music as a bridge to improve psychological resilience. In this regard, colleges and universities can communicate with graduates through singing, playing, tapping and other ways, and can also guide students step by step through music, dance, rhythm training, etc., so as to arouse the function of the brain<sup>[5]</sup>. In addition, colleges and universities should also find the psychological crux of graduates, find the deep meaning of the problem, seek opportunities for psychological healing from it, and use mindfulness music therapy to relieve negative psychological emotions. Some college graduates are introverted, not good at expressing their inner world, and often go it alone. Moreover, graduates with this characteristic often lack opportunities for self-evaluation, have a low sense of self-worth, avoid social interaction, and have certain interpersonal barriers. Therefore, for this type of graduate, mindfulness music therapy is very effective and can quickly improve their mental health. By participating in collective music activities such as a chorus, graduates can be encouraged to dare to express and vent their emotions, gain recognition and respect from others, further enhance their self-confidence, and their psychological resilience can also be enhanced accordingly<sup>[6]</sup>.

### **3.3. Cultivating positive emotional attitudes through audiovisual listening tests**

Music possesses a spiritual quality that transcends time and space, connecting the inner self with the external world, the individual with others, whether familiar or unfamiliar. Starting from its role as “sound” acting on physical organs, music transforms into a “signal” influencing psychological processes. By utilizing music therapy techniques to communicate with clients, we help them gain clarity about their thoughts. Through empathy and normalization techniques, students learn to accept their emotions, promote dopamine secretion, alleviate anxiety, and release stress<sup>[7]</sup>. Currently, many graduates face mental health issues, characterized by emotional instability and poor self-control over their feelings. If their emotional needs remain unaddressed for a long time, they are prone to developing psychological disorders, which, if not effectively managed, may lead to severe consequences. Music, however, has a positive regulatory effect, capable of evoking feelings of joy and excitement. It is evident that the application of active and effective music therapy can alleviate graduates’ psychological problems, reduce their internal stress, release negative emotions, and achieve proper emotional regulation. Clearly, music holds unique advantages in fostering spiritual well-being. The process of music aesthetic education involves the purification and refinement of students’ emotions. When people appreciate beauty, their attention shifts toward the object of appreciation, allowing their mental state to be effectively adjusted and relieved, and their emotions to become more stable. Music aesthetic education guides people to transcend utilitarianism and sensory desires, attaining spiritual fulfillment, thereby maintaining psychological balance<sup>[8]</sup>.



## **4. Paths for group counseling to enhance college graduates' psychological resilience**

### **4.1. Creating a safe and trusting environment**

In the process of group psychological counseling, creating a healing atmosphere with a high level of trust and a sense of security is particularly important. It allows college graduates to truly feel that their existence is unconditionally accepted and deeply understood, which can greatly arouse their positive emotions and enable them to dare to express their thoughts and true feelings. To achieve this main goal, colleges and universities need to fully respect graduates based on their true attitudes and psychological needs, and establish a harmonious teacher-student relationship through active listening and constructive suggestions <sup>[9]</sup>. In addition, mutual support and promotion in group counseling are also important channels for creating a safe and trusting atmosphere. By sharing psychological counseling skills and experiences in the group, graduates can achieve common growth and development. Moreover, they will have more time to strengthen their psychological resilience against setbacks, enabling them to better cope with difficulties and challenges in life, and make their future integration into social and workplace life smoother <sup>[10]</sup>.

### **4.2. Strengthening training in teamwork and communication skills**

In group counseling, strengthening college graduates' teamwork and communication skills is equally crucial. By designing a series of teamwork tasks and activities, counselors can guide students to learn how to leverage their own strengths in a team while understanding and respecting others' different viewpoints and needs. Such training can not only improve students' teamwork ability but also help them better adapt to diverse working environments in their future careers <sup>[11]</sup>. Furthermore, training in communication skills is also indispensable. Counselors can use role-playing and situational simulations to allow students to learn and master effective communication skills through practical operations—such as how to clearly express their own viewpoints, how to listen to others' opinions, and how to handle conflicts and differences. The improvement of these skills will help college graduates become more confident and composed in interpersonal interactions, thereby further enhancing their psychological resilience <sup>[12]</sup>.

### **4.3. Encouraging self-reflection and emotional management**

Self-education and self-regulation play a pivotal role in group counseling and have a profound impact on graduates' ability to reflect on themselves and control their emotions. Among them, self-reflection can help graduates gain a clearer understanding of their inner activities, sort out their emotions and needs, and improve the objectivity and rationality of their decisions. Colleges and universities can guide college graduates to engage in self-reflection through guided conversations, psychodrama, and other methods, helping them identify the root causes of their emotions and master effective psychological coping strategies <sup>[13]</sup>. At the same time, emotional management is also an effective way to enhance graduates' psychological resilience. Colleges and universities should actively teach graduates psychological counseling techniques such as deep breathing, meditation, and mindfulness training to strengthen their ability to regulate and manage emotions, enabling them to cope with psychological pressure and challenges with a calm and rational attitude. In addition, colleges and universities can organize graduates to discuss and analyze positive cases in groups, allowing them to cultivate positive psychological emotions such as optimism, gratitude, and hope, which is beneficial for fostering their perseverance in the face of adversity <sup>[14]</sup>.

## 5. Conclusion

In summary, both mindfulness music therapy and group counseling have a positive impact on enhancing the psychological resilience of college graduates. Mindfulness music therapy guides individuals into a state of deep relaxation through musical elements such as rhythm, melody, and timbre, thereby fostering mindful awareness and improving emotional management abilities<sup>[15]</sup>. Meanwhile, group counseling helps graduates strengthen their psychological resilience and better cope with life challenges by creating a safe and trusting environment, enhancing teamwork and communication skills through training, and encouraging self-reflection and emotional management. Each method has its own strengths, and colleges and universities can flexibly choose or combine them according to actual circumstances to achieve the best results. In the future, with the deepening of research, it is believed that more effective methods will be explored, providing greater support for improving the psychological resilience of college graduates.

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# Challenges and Opportunities in Cognitive Rehabilitation Services: Perspectives from Rehabilitation Professionals

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**Abstract:** *Objective:* This study aims to explore the facilitating and hindering factors faced by rehabilitation professionals in providing cognitive rehabilitation services for patients with Post-Stroke Cognitive Impairment (PSCI) in China, offering empirical evidence for optimizing service models. *Methods:* Using purposive sampling, semi-structured interviews were conducted with 15 rehabilitation professionals from three tertiary hospitals and two community health service centers in Hubei Province from September to November 2023. Audio recordings were transcribed to obtain textual data, which were analyzed using Nvivo 12 software for coding. An inductive thematic analysis approach was employed to distill key themes. *Results:* The study identified multiple facilitating and hindering factors related to cognitive rehabilitation, summarizing them into four core themes and eight sub-themes: (1) Cognitive Screening: Presence of practical barriers and inadequate professional knowledge, which limited early detection and effective intervention for cognitive impairments; (2) Individualized Rehabilitation: Lack of patient-directed personalized interventions and multidisciplinary team collaboration, affecting patient engagement and rehabilitation outcomes; (3) Lack of Psychological Rehabilitation: The necessity of psychological interventions was emphasized, yet there is a significant scarcity of neuropsychological resources, limiting the implementation of psychological support; (4) Challenges of Community Continuity in Rehabilitation: Severe service discontinuity, with community healthcare institutions facing shortages of professional knowledge and equipment, resulting in patients being unable to receive continuous and effective rehabilitation support after discharge. *Conclusion:* Current PSCI rehabilitation services face issues such as insufficient staffing, ineffective multidisciplinary team collaboration, and a lack of community resources. Enhancing neuropsychological resources, establishing standardized MDT collaboration processes, and creating a referral system linking hospitals, communities, and families are essential to improve primary care capacity and enhance rehabilitation outcomes for patients.

**Keywords:** Barriers and facilitators; Community-based services; Cognitive rehabilitation; Post-stroke cognitive impairment; Psychological support

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# 1. Introduction

Post-Stroke Cognitive Impairment (PSCI) is a complex condition that is commonly observed among stroke patients, directly impacting cognitive function, independence, and quality of life <sup>[1]</sup>. Research by Weterings *et al.* indicates a comorbidity rate of 44% for cognitive impairment in younger stroke populations <sup>[2]</sup>. In China, approximately one-third of stroke patients aged over 40 experience varying degrees of cognitive impairment <sup>[3]</sup>. This phenomenon is not limited to the early stages following the stroke; many patients may report ongoing cognitive decline within a year post-stroke <sup>[4]</sup>. PSCI can restrict patients' daily living activities, subsequently affecting their social engagement and self-care abilities, significantly increasing the demand for care and imposing a substantial economic burden on families and society <sup>[5-7]</sup>.

Despite significant increases in attention to PSCI in recent years, several important challenges persist. First, there is a lack of consistency in the screening and diagnosis of PSCI, leading clinicians to be unable to effectively assess patients at the optimal time. Although current guidelines recommend timely screening, assessment, and rehabilitation for stroke patients to enhance quality of life, the number of institutions executing these recommendations remains limited, particularly in primary care settings where relevant resources and expertise are often lacking <sup>[8]</sup>. This inadequacy hinders early identification and intervention. Secondly, existing rehabilitation models frequently fail to adequately address the individualized needs of patients. Research shows that cognitive abilities among PSCI patients exhibit considerable heterogeneity, and standard rehabilitation protocols do not meet the specific needs of all patients <sup>[9]</sup>. Moreover, a lack of coordination among interdisciplinary teams often poses barriers for patients seeking psychological and speech therapy support <sup>[10]</sup>. These factors contribute to insufficient support during patients' post-discharge rehabilitation processes, adversely affecting their long-term recovery and quality of life <sup>[11]</sup>.

In this context, a thorough examination of rehabilitation professionals' experiences in providing cognitive rehabilitation services for PSCI is of significant theoretical and practical importance. This study aims to qualitatively analyze the challenges and opportunities encountered by rehabilitation professionals in their service delivery, providing empirical evidence for improving and optimizing post-stroke cognitive rehabilitation services. The research aims not only to enhance service efficiency and quality in primary healthcare institutions but also to offer robust data support for policymakers, thereby advancing the field of cognitive rehabilitation following stroke.

## 2. Research subjects and methods

### 2.1. Research subjects

This study selected stroke rehabilitation professionals from three tertiary hospitals and two community health service centers in Hubei Province between September and November 2024, employing purposive sampling to conduct semi-structured interviews. Inclusion criteria were as follows: participants must possess a nationally recognized qualification in rehabilitation medicine and have at least three years of experience in providing rehabilitation services for stroke patients; they must also voluntarily participate and sign an informed consent form.

Exclusion criteria included individuals unable to participate in interviews throughout the study due to full-time learning or training commitments, as well as those who refused to participate or could not accurately express their personal views. Ultimately, 15 qualified rehabilitation professionals were included in the study, identified as N1–N15. The sample size was determined based on qualitative research demands for richness and diversity, taking



into account participants' professional backgrounds and experiences.

## **2.2. Research methods**

### **2.2.1. Development of basic information form and interview outline**

Grounded in a constructivist theoretical framework, this study utilized qualitative descriptive methods to systematically explore the facilitating factors and obstacles in cognitive rehabilitation from the perspective of rehabilitation professionals. The research team designed a Basic Information Collection Form for Rehabilitation Professionals, which encompassed multiple demographic variables, including gender, age, education level, and professional technical title to consider the impact of demographic characteristics in the analysis.

The development of the interview outline was guided by a systematic literature review and consultations with multidisciplinary experts to ensure coverage of key areas in cognitive rehabilitation. The main topics of the interview outline included: "Can you describe the regular rehabilitation services provided to stroke patients?"; "What principles or processes do you follow when formulating rehabilitation service plans for stroke patients?"; "Is cognitive rehabilitation included in the rehabilitation service plans of your institution?"; "What is the specific process for conducting cognitive screening for stroke patients in your daily work?"

### **2.2.2. Data collection methods**

This study employed a phenomenological approach, collecting data through semi-structured in-depth interviews with 15 rehabilitation professionals. Prior to the interviews, each participant was contacted by phone to communicate the research objectives and ethical guidelines, ensuring they fully understood the nature and significance of the study. Participants then signed informed consent forms and negotiated the time and location for the interviews. All interviews were recorded and transcribed verbatim within 24 hours to ensure timeliness and accuracy. The textual data were verified by two team members and anonymized (N1–N15) to protect participant privacy, and the transcribed texts were imported into NVivo 12.0 software for coding and theme extraction.

### **2.2.3. Data organization and quality control**

Interview recordings were transcribed into verbatim texts within 24 hours, and Colaizzi's phenomenological analysis method was employed for data organization. The transcriptions underwent cross-verification by team members to ensure accuracy. To enhance the credibility of the study, feedback was provided to participants via email to verify the authenticity of the results, ultimately distilling four main themes and eight sub-themes to ensure the validity and reliability of the findings.

## **2.3. Ethical review**

This study received approval from the Ethics Committee of Taihe Hospital in Shiyan City (Approval No. 2023XM008) and strictly adhered to the requirements of the "Ethical Review Measures for Biomedical Research Involving Humans" and the principles of the Declaration of Helsinki, ensuring the principle of voluntary participation. Respondents were clearly informed that they could withdraw from the study at any time without facing any adverse consequences, and all participants signed informed consent forms. This adherence to ethical principles ensured the fairness of the research and protected participants' rights.

Through interviews with 15 stroke rehabilitation professionals, this study refined four primary themes: "Cognitive Screening," "Individualized Rehabilitation," "Lack of Psychological Rehabilitation," and "Challenges

of Community Rehabilitation Continuity.”

### 3. Results

#### 3.1. Basic information

A total of 15 stroke rehabilitation professionals were interviewed in this study, with an average age of 59.00 years ( $\pm 11.35$ ). The average duration of the interviews was 35 minutes ( $\pm 5.45$ ). The respondents included various professionals from three tertiary hospitals and two community health institutions, representing a range of positions and titles. Detailed basic information is presented in **Table 1**.

**Table 1.** General information of interviewees

ID	Age	Experience (years)	Education	Position	Title	Institution
N1	45	11	Doctorate	Director	Chief physician	Tertiary Hospital
N2	38	13	Master's	None	Associate chief physician	Tertiary Hospital
N3	42	15	Master's	Chief Technician	Deputy chief technician	Tertiary Hospital
N4	29	4	Bachelor's	None	Head nurse	Community
N5	33	6	Master's	None	Attending physician	Tertiary Hospital
N6	29	3	Bachelor's	None	Nurse	Community
N7	52	27	Bachelor's	Nurse Manager	Chief nurse	Tertiary Hospital
N8	42	15	Master's	Chief Technician	Deputy chief technician	Tertiary Hospital
N9	36	8	Master's	None	Supervisor therapist	Tertiary Hospital
N10	26	3	Bachelor's	None	Nurse	Tertiary Hospital
N11	29	3	Bachelor's	None	Nurse	Tertiary Hospital
N12	32	5	Bachelor's	None	Nurse	Community
N13	37	8	Bachelor's	None	Therapist	Community
N14	46	15	Master's	Director	Chief physician	Community
N15	44	12	Bachelor's	Nurse manager	Deputy chief nurse	Community

##### 3.1.1. Theme 1: Cognitive screening

Respondents widely acknowledge the significance of cognitive screening in post-stroke rehabilitation but point out multiple barriers, such as a lack of standardization and insufficient resources. These factors significantly impact the early identification of cognitive impairments and subsequent interventions.

###### (1) Barriers in practice

Participants emphasized that although some medical institutions have established cognitive screening mechanisms, they still face numerous challenges during implementation. N1 remarked, “Current screening tools exhibit significant limitations in specific patient populations, such as those with communication difficulties or low educational levels.” This perspective highlights the adaptability issues of existing screening tools, indicating a need for adjustments and improvements tailored to the unique needs of different patient groups.

N2 further pointed out, “The current healthcare system has not yet established a specialized human

resource allocation mechanism for screening cognitive impairment after a stroke. For the stroke patient population, there remains a lack of standardized clinical pathways capable of comprehensive evaluation and intervention management.” This underscores the urgent need to enhance human resource allocation and professional capacity building within the post-stroke rehabilitation system. N3 noted the heterogeneity of existing screening tools: “There are specific differences in the applicable populations and assessment dimensions across various scales, and this non-standardized state constitutes a significant constraint on screening efficacy.” This reflects the absence of unified standards among different tools, which may compromise the reliability and effectiveness of screening results. N8 introduced the importance of multidimensional assessment, stating, “While standardized cognitive screening scales form the foundational tools, our institution employs an integrative assessment framework that includes executive function evaluations, structured behavioral observations, and informer interviews.” This indicates that relying solely on individual tools is increasingly inadequate for meeting the comprehensive evaluation demands in clinical practice.

(2) Insufficient professional knowledge

Participants universally emphasized that the process of assessing cognitive impairment requires a diverse range of professional knowledge. N1 noted, “Cognitive screening is part of the primary screening process, and its results do not have diagnostic validity. However, the rehabilitation team tends to overly rely on quantitative indicators in clinical decision-making, which can reduce diagnostic specificity due to the reliance on unidimensional screening data.” This perspective underscores the potential limitations of quantitative data in the decision-making process and suggests that the rehabilitation team needs to strengthen their capabilities for multifaceted assessment.

N2 also highlighted the risks associated with the lack of competency among professionals: “Clinical psychologists need to be vigilant; deficiencies in neuropsychological competence can lead to three clinical risks: biased assessment validity, decreased effectiveness in clinician-patient communication, and reduced accuracy in intervention plans.” This further reflects the complexities involved in the rehabilitation process, particularly regarding communication with patients and analyzing their needs. N10 shared an example concerning family support: “In community rehabilitation practice, a typical case where a positive screening result led to the collapse of the family support network is encountered, highlighting flaws in the allocation of neuropsychological assessment resources at the grassroots level.” This case emphasizes the importance of professional resource allocation and the negative consequences resulting from its inadequacy. N13 warned, “In the treatment team, inexperienced therapists may label patients with cognitive impairments based solely on screening results.” This emphasizes the need for caution in the diagnostic and treatment processes to avoid misjudging patients due to the limitations of the data.

### 3.1.2. Theme 2: Individualized rehabilitation

Individualized rehabilitation plans and interdisciplinary team collaboration are considered essential for implementing effective cognitive rehabilitation. Respondents generally agreed that personalized intervention measures should be developed based on the specific circumstances of different patients.

(1) Patient needs-oriented personalized interventions

N1 highlighted, “The extent of cognitive impairment after a stroke varies; personalized cognitive rehabilitation plans should be based on each patient’s needs and rehabilitation goals.” This viewpoint

reflects the importance of considering individual differences in medical practice, emphasizing that not all patients can be treated the same way. N2 further stressed, “The resources for existing cognitive impairment rehabilitation services are limited. I can only do my best to provide some interventions and attempt various strategies.” This illustrates the challenges and efforts of rehabilitation professionals working under resource constraints. N5 shared insights about two patients’ treatment situations: “One patient has significant difficulties in information processing, which affects memory function, while the other is in a more severe condition, having almost lost their memory ability. This indicates that no two stroke patients are the same, and we need to conduct targeted cognitive rehabilitation services.” This case analysis underscores the importance of individualized treatment. N14 added, “In the absence of evidence-based guidelines, I believe rehabilitation therapists need to establish a systematic approach to cognitive impairment rehabilitation interventions to address the rehabilitation needs of different cognitive impairment groups.” This call highlights the importance of developing personalized intervention plans based on scientific evidence.

(2) Multidisciplinary team collaboration to promote patient engagement

Most respondents unanimously agreed that the establishment and effective operation of a multidisciplinary team (MDT) can enhance the quality of cognitive rehabilitation. N1 stated, “All members of the stroke rehabilitation team share the responsibility of ensuring patient engagement in rehabilitation. Coordinators should facilitate communication among various parties to ensure the effective implementation of cognitive rehabilitation.” This highlights the significance of teamwork in promoting patient recovery.

N7 emphasized, “Our department is the best at implementing MDT, allowing us to collaborate closely with doctors, therapists, nutritionists, and psychotherapists in professional group activities. We conduct regular communication regarding patient participation.” Such team collaboration ensures that patients receive support and assistance at all stages of rehabilitation. N8 underscored the importance of patient involvement: “Improving patients’ cognitive abilities can be included as part of rehabilitation goals, but the lack of these abilities often becomes a barrier to their recovery. We often feel powerless when dealing with patients who lack family support.” This statement reveals the necessity of family support in the rehabilitation process. N9 pointed out the challenges in the rehabilitation process: “Cognitive rehabilitation is a lengthy process, and family members often lack patience. Additionally, some family circumstances do not allow patients to continue rehabilitation treatment in the hospital.” This perspective reflects the complex realities that patients and their families face on the road to recovery.

### **3.1.3. Theme 3: Lack of psychological rehabilitation**

Insufficient psychological support is viewed as a significant factor affecting the effectiveness of cognitive rehabilitation after a stroke. Respondents generally believe that a lack of psychological resources limits recovery opportunities for patients.

(1) Necessity of psychological support

Despite policy recommendations to introduce clinical psychologists, respondents noted that the availability of psychological services remains extremely limited. N2 stated, “We do not have clinical psychotherapists, which is clearly a major deficiency in most hospitals.” This reflects the current healthcare system’s shortcomings in providing mental health services.

N8 mentioned, “We cannot separate the psychological factors associated with stroke from the

cognitive, physiological, and emotional conditions. To understand these, I often invest time in studying psychology.” This underscores the close relationship between psychological support and overall patient health. N12 further pointed out, “I believe the high incidence of cognitive impairments, anxiety, and depression after a stroke must receive psychological support at the societal, hospital, and family levels.” This perspective offers a broader view for various sectors in the rehabilitation support process. N15 suggested, “Providing vocational interventions and psychological support at different stages of patient rehabilitation is essential to ensure their smooth and safe return to the workplace.” This viewpoint emphasizes the critical role of psychological support in the process of returning to work.

(2) Shortage of neuropsychological resources

Respondents commonly reflected that the lack of neuropsychologists limits patients’ opportunities to receive necessary assessments. N1 noted, “There are very few formally trained neuropsychologists in the country. Our team usually refers patients experiencing psychological issues, but there often aren’t specialists available for follow-up support.” This situation highlights the vulnerability of the medical team in addressing mental health issues.

N2 added, “If we had more expert resources, we would be able to provide patients with routine cognitive and psychological assessments and relay the results back to the community neurorehabilitation team as a foundation for cognitive rehabilitation.” This emphasizes the importance of enhancing the psychological health expertise within the team.

### **3.1.4. Theme 4: Challenges of continuity in community rehabilitation**

The role of community healthcare institutions in stroke rehabilitation has not been fully realized. The issues of service shortages and a lack of professional personnel have impacted patients’ follow-up rehabilitation.

(1) Service discontinuity

Patients require ongoing community and family support during their rehabilitation process, but they often do not receive the necessary services in a home environment. N4 stated, “Cognitive impairments post-stroke can pose significant challenges for patients living alone.” This indicates that patients may face considerable difficulties within the home rehabilitation setting.

N10 mentioned, “Stroke rehabilitation is lengthy and costly, but we don’t know which community professionals to contact or if they possess the necessary rehabilitation service capabilities.” This viewpoint reflects the current deficiencies in community services and their direct impact on patient recovery. N11 emphasized, “Rehabilitation is a continuous process, yet many communities only provide basic physiotherapy. Patients return home after discharge, and many do not experience the anticipated improvement or may develop complications that lead to readmission.” This highlights how inadequate community support severely affects patients’ long-term rehabilitation. N12 pointed out, “Many issues, such as medication management, diet, and home safety, are related to the patient’s cognitive abilities, and these cannot be adequately supported in a home environment.” This further emphasizes the vulnerabilities faced by patients in their domestic settings.

(2) Shortage of professional knowledge and equipment

Primary healthcare institutions struggle to maintain service capabilities comparable to those of higher-level hospitals due to limitations in environment, equipment, and personnel skills. N11 noted, “Many facilities are unwilling to accept high-risk stroke patients during referrals.” This reflects the barriers



encountered in the patient referral process and highlights the inability of primary healthcare institutions to manage complex cases effectively.

Respondents also called for the establishment of effective coordination mechanisms between hospitals and communities. N13 stated, “We lack effective guidance and can only rely on existing equipment and personnel.” This situation results in patients lacking the necessary support during their rehabilitation process. N14 pointed out, “The main barrier to effective community-based stroke rehabilitation is the lack of specialized knowledge and service personnel for stroke care. Professionals from different backgrounds often fail to collaborate effectively, leading to disconnection in the rehabilitation process.” This clearly underscores the importance and necessity of interdisciplinary collaboration.

## **4. Discussion**

This study delved into the multifaceted factors surrounding cognitive impairments and their rehabilitation processes following a stroke. Through interviews with 15 rehabilitation professionals, major issues were identified in cognitive screening, individualized rehabilitation, lack of psychological support, and continuity of community rehabilitation services. These findings not only enhance our understanding of the current state of cognitive rehabilitation post-stroke but also contribute to advancing future clinical practices and policy-making.

### **4.1. Lack of standardization in cognitive screening**

The results indicate that the lack of standardization in cognitive screening is a significant barrier faced by stroke patients during rehabilitation, directly impacting the identification and intervention effectiveness for cognitive impairments. Respondents frequently reported that existing screening tools lack uniformity and standardization, leading to noticeable heterogeneity in assessment results. This issue is particularly pronounced when dealing with patients who have communication barriers or lower educational levels; the limitations of current screening tools become even more evident. For instance, respondents noted that differences in language and comprehension often result in inaccurate screening outcomes during interactions with patients.

The applicability of standardized assessment tools across different cultural and linguistic backgrounds may lead to the oversight of potential cognitive impairments, subsequently affecting the timing and effectiveness of interventions for patients. This underscores the importance of cultural adaptability and comprehensibility of assessment tools for the effective identification of cognitive impairments, especially in multicultural clinical settings <sup>[12]</sup>.

Early screening and intervention are widely recognized as key factors for improving long-term outcomes for patients <sup>[13]</sup>. Timely identification of cognitive impairments and appropriate interventions can significantly reduce patients’ long-term reliance on care and enhance their quality of life <sup>[14]</sup>. This finding highlights the critical role of effective screening tools and processes in clinical practice, particularly during the early stages of rehabilitation for stroke patients.

#### **Importance of Individualized Rehabilitation**

This study emphasizes the critical role of individualized rehabilitation plans in managing cognitive impairments. Respondents generally agreed that clinical practice should focus on the unique needs of patients. By developing personalized intervention strategies based on the severity of cognitive impairments, living environments, and personal goals, rehabilitation outcomes can be significantly improved. This approach not only better

accommodates patients' actual circumstances but also enhances their engagement, thereby improving the overall rehabilitation experience <sup>[15]</sup>.

Specifically, individualized rehabilitation helps formulate corresponding intervention strategies for different types of cognitive impairments <sup>[16]</sup>. For instance, patients with executive function disorders may benefit from strategy training combined with behavioral heuristics to aid them in planning and executing tasks more effectively. Structured strategy training techniques, such as visual-spatial strategies and task breakdown, can effectively enhance executive capabilities. For patients with memory disorders, systematic training involving environmental cues and repeated practice is essential to strengthen their memory functions.

Feedback from respondents highlighted the practical need for individualized rehabilitation plans, especially in addressing specific challenges faced by patients. For example, consideration of the patients' living environments is crucial to ensure that the plans are feasible within the family and community contexts. Research shows that family involvement and environmental support are vital for enhancing rehabilitation outcomes. Incorporating family input into the design of rehabilitation plans can strengthen the support system for patients and facilitate the implementation of daily rehabilitation strategies <sup>[17]</sup>.

Despite the multiple advantages of individualized rehabilitation, there are still many barriers to its practice. Therefore, it is particularly important to enhance rehabilitation professionals' awareness of the significance of individualized interventions. Studies indicate that many healthcare workers tend to rely on traditional, generic intervention methods in clinical settings, lacking sufficient knowledge and skills to adjust flexibly based on patients' conditions. Thus, improving healthcare workers' abilities, especially in personalized assessment and planning, is urgently needed.

## **4.2. The key role of psychological support in rehabilitation**

The findings of this study demonstrate that psychological support plays an indispensable role in the cognitive rehabilitation of stroke patients. Respondents commonly reported that the lack of mental health professionals makes it challenging for patients to access comprehensive psychological support. Such interventions not only influence patients' adherence to and engagement with rehabilitation plans but are also directly related to their mental health and quality of life. Stroke patients often face multiple pressures—physical, emotional, and social—that can significantly impact their cognitive function and emotional state. For instance, psychological issues such as anxiety and depression have been shown to reduce attention, memory, and decision-making abilities, thereby hindering the rehabilitation process <sup>[18]</sup>. Therefore, providing systematic psychological support services is essential to facilitate holistic recovery.

In clinical practice, psychological support should be central to assessment and intervention efforts. The healthcare team needs to conduct psychological evaluations during patient admissions to identify mental distress promptly and to provide individualized psychological intervention plans, including group therapy, individual counseling, and family support. Through this multi-layered psychological intervention system, patients can more effectively master coping mechanisms, alleviate negative emotions, and enhance their self-efficacy and life satisfaction.

Moreover, regular training for clinical practitioners to enhance their knowledge and skills in psychological support is crucial for improving rehabilitation outcomes. Training content can include psychological intervention theories, mental health assessment methods, and emotional management strategies. Strengthening healthcare professionals' capabilities in psychological support can not only improve the implementation of rehabilitation

plans but also help patients better navigate the emotional challenges of the rehabilitation process.

Family involvement also plays a vital role; support should not come solely from professionals. The care and support from family members can effectively promote patients' psychological recovery <sup>[19]</sup>. Therefore, when developing rehabilitation plans, it is important to encourage family participation, enabling them to provide emotional support in daily life and enhancing patients' sense of social involvement and belonging.

### **4.3. Insufficiency of community continuity rehabilitation services**

This study highlights the rehabilitation challenges faced by stroke patients after transitioning to community care. Many respondents pointed out that community healthcare institutions generally grapple with insufficient resources and a lack of expertise, which often results in service interruptions for patients post-discharge. Many community healthcare facilities lack specialized training and equipment for addressing cognitive impairments, leaving patients without necessary rehabilitation support after leaving the hospital.

To address these issues, establishing a continuity rehabilitation service system from hospitals to communities becomes particularly crucial <sup>[20]</sup>. First, strengthening communication and cooperation between hospitals and community healthcare institutions is essential to clarify referral procedures. When patients are discharged, hospitals should systematically convey patients' rehabilitation needs and treatment plans to community physicians, ensuring that patients receive continuous, individualized rehabilitation services after transitioning to community care. This collaboration can help alleviate patients' anxiety caused by service interruptions and improve rehabilitation outcomes.

Second, it is advisable to form multidisciplinary community rehabilitation teams consisting of physicians, nurses, physical therapists, occupational therapists, and psychological counselors, among others, to provide comprehensive rehabilitation services <sup>[21]</sup>. This team can hold regular meetings to discuss patients' rehabilitation progress, develop specific rehabilitation plans, and adjust them based on patient feedback. This integrated service model can more effectively meet patients' individual needs and facilitate their functional recovery.

Enhancing the professional qualifications of primary healthcare personnel is also vital. Hospitals and relevant institutions should provide targeted training to improve community healthcare workers' capabilities in assessing cognitive impairments, developing individualized rehabilitation plans, and implementing intervention strategies. Additionally, community healthcare personnel should be encouraged to participate in the actual rehabilitation process, learning to adjust treatment plans in response to the various changes that may arise during the rehabilitation journey through observation and practical experience.

Finally, leveraging modern technological methods, such as telemedicine and digital health applications, can further enhance the quality and efficiency of community rehabilitation services <sup>[22]</sup>. By utilizing remote monitoring technologies, healthcare teams can better track patients' rehabilitation progress, provide timely recommendations, adjust treatment plans, and offer psychological support, which is particularly important for promoting patients' cognitive recovery and mental health.

## **5. Conclusion**

In summary, this study provides a new perspective for understanding the current state of cognitive rehabilitation following a stroke, highlighting the inadequacies in standardized cognitive screening, individualized rehabilitation, psychological support, and the importance of community continuity in rehabilitation. By deeply analyzing the

viewpoints of the respondents, this research fills some gaps in the existing literature and offers an empirical foundation for future interventions and policy development. The significant clinical implications of this study call for the establishment of clearer rehabilitation policies and standards, the strengthening of interdisciplinary collaboration, and the enhancement of training and education for professionals. Additionally, incorporating mental health interventions into the rehabilitation framework is recommended, creating a multidimensional support system to better meet the complex needs of stroke patients during their recovery process. This comprehensive support not only enhances patients' quality of life but also improves their adherence to rehabilitation. Furthermore, the findings provide a theoretical basis for improving community rehabilitation services, emphasizing the critical importance of collaboration between hospitals and communities in ensuring continuity of care. By promoting this holistic transformation, the rehabilitation industry can gain new momentum and direction, thereby achieving more efficient patient recovery.

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# Exploration of the Strategies and Practices of Seasonal Health Maintenance Based on the Theory of Traditional Chinese Medicine

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**Abstract:** This article delves into the concept of seasonal health maintenance in Traditional Chinese Medicine (TCM), which is rooted in the ancient philosophical idea of “harmony with nature and unity of heaven and humanity.” It emphasizes the harmonious coexistence of humans and nature, advocating the adjustment of health maintenance strategies according to the changes of the four seasons: spring, summer, autumn, and winter. In spring, it is advisable to nourish the liver, maintain an orderly lifestyle, adopt a bland diet, and promote the growth of yang energy. Summer focuses on nourishing the heart, emphasizing cooling and heat relief, and moderate exercise to promote perspiration and detoxification. Autumn is the time to nourish the lungs, with a focus on a moist diet, maintaining a peaceful emotional state, and moderate exercise to enhance physical fitness. In winter, the emphasis is on nourishing the kidneys, keeping warm, consuming a warm diet, and reducing outdoor activities to prevent the dissipation of yang energy. Seasonal health maintenance not only concerns daily life and diet but also involves emotional regulation and moderate exercise. It holds inestimable value for enhancing physical fitness, preventing diseases, and promoting healthy longevity. Deepening the research and application of seasonal health maintenance in TCM not only helps to improve the national health quality but is also the key to promoting the modernization and internationalization of TCM health maintenance. It has profound significance for promoting excellent traditional Chinese culture and enhancing human health and well-being.

**Keywords:** Traditional Chinese medicine; Seasonal health maintenance; Unity of heaven and humanity; Harmonization of Yin and Yang

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## 1. Introduction

In today’s society, people’s pace of life is accelerating, and they are often in a state of high-intensity work, high mental stress, and unhealthy lifestyle habits. As a result, the size of the sub-health population has shown a

significant growth trend. According to relevant surveys, in some developed cities, the proportion of the sub-health population has reached more than 70%<sup>[1]</sup>. Although these people do not have a clear diagnosis of any disease, they are often in a state of physical and psychological discomfort, such as fatigue, insomnia, anxiety, and decreased immunity, which seriously affect their quality of life and work efficiency. At the same time, issues such as the side effects and high medical costs caused by excessive reliance on modern medical drugs and surgical treatments have gradually become prominent, prompting people to turn their attention back to natural therapies. Traditional Chinese medicine health maintenance has become an important choice for people to pursue a healthy lifestyle due to its emphasis on the harmonious unity of humans and nature, holistic conditioning, and minimal side effects.

As a treasure of traditional Chinese culture, traditional Chinese medicine (TCM) embodies profound life philosophy and wisdom of healthcare. “Harmony between nature and humanity” is a high-level summary of the relationship between humans and nature in TCM, and it also serves as an important guiding principle for TCM healthcare. It suggests that humans live in the natural environment, and various changes in the natural environment can directly or indirectly affect human life activities. Therefore, it advocates adapting to natural laws to nourish and care for the body. The theory of seasonal healthcare is one of the concrete manifestations of the guiding principle of “harmony between nature and humanity”. Its roots can be traced back to the classical TCM text, “Huangdi Neijing”, which contains healthcare principles such as “following the laws of Yin and Yang, harmonizing with the techniques of numbers, eating and drinking with moderation, living with regularity, and avoiding excessive labor.” These principles establish a lifestyle and healthcare strategy that follows the changes and characteristics of the four seasons: “spring growth, summer flourishing, autumn harvest, and winter storage”. The TCM theory of seasonal healthcare advocates adapting to natural changes by adjusting diet, daily life, exercise, emotions, and other aspects to achieve the goal of healthcare. This natural and gentle approach to healthcare aligns with modern people’s pursuit of health and return to nature, providing new ideas and methods for addressing modern health issues. Based on TCM theories such as “harmony between nature and humanity”, this article aims to analyze seasonal healthcare strategies and explore related practical paths.

## **2. Theoretical basis**

### **2.1. Harmony between nature and humanity**

“Unity of Heaven and Man” refers to the concept that heaven, earth, and humans originate from the same Qi (vital energy) and are intimately interconnected. By observing the interactions between heaven and man, it explores the shared laws governing their mutual influence and resonance. This idea closely aligns with the guiding principle of holism in Traditional Chinese Medicine (TCM), particularly the unity between humans and the natural environment. As stated in Suwen·Tian Yuan Ji Da Lun: “Heaven governs the five elements to regulate the five positions, generating cold, heat, dryness, dampness, and wind. Humans possess the five viscera that transform into five Qi, giving rise to joy, anger, contemplation, sorrow, and fear.”

This illustrates how TCM correlates the structure and changes of the human body with those of nature, analyzing the laws of human life—viewed as a microcosm—through the essence and phenomena of the macrocosm (heaven and earth). For example, Wu Yi Hui Jiang·Ren Shen Yi Xiao Tian Di Lun records: “Humans are endowed with the virtues of vigor and harmony, born from the qi of the five elements, which are concealed in the five viscera and manifested in the six bowels. Breathing resembles the movement of yin and yang; body fluids are like the irrigation of rain and dew; luster mirrors the flourishing of plants; the eyes and ears reflect the

waxing and waning of the sun and moon. Truly, the human body is a small universe!” The alternation of seasons and climatic changes in nature are closely linked to human physiology and pathology. This perspective transcends the limitation of viewing the human body solely in terms of its physiological structure and function. For instance, the ”six excesses”—a key pathogenic factor in TCM—refer to wind, cold, summer heat, dampness, dryness, and fire, which become harmful when natural climatic changes are abnormal or when the body’s resistance declines. Under normal conditions, these are called the ”six Qi”, representing natural climatic variations. However, when ”pathogenic factors prevail” or ”vital Qi weakens”, the body fails to adapt, leading to disease. Thus, harmony with nature is a crucial factor in maintaining human health.

## **2.2. Seasonal health maintenance**

Humans are born from the Qi of heaven and earth and grow according to the laws of the four seasons. Living between heaven and earth, humans are closely connected to the changes of the four seasons. As stated in the “Su Wen: Si Ji Tiao Shen Da Lun” (Basic Questions of Chinese Medicine: Great Discussion on Regulating the Spirit in the Four Seasons), “When thief-like winds frequently blow and torrential rains often fall, heaven and earth lose their harmony with the four seasons and deviate from the natural way, leading to premature destruction. Only the sage follows the natural way, so his body remains healthy and free from extraordinary diseases, and all things are preserved without loss, maintaining a continuous flow of vital Qi.” Seasonal health maintenance involves adapting to the changing laws of the four seasons and adopting corresponding health preservation methods to maintain physical health and prevent diseases.

## **3. Spring**

### **3.1. Spring health maintenance, liver care comes first**

Spring represents growth and vitality. In spring, Yang Qi rises, and human liver Qi also rises accordingly, echoing the Qi of heaven and earth. As stated in the “Basic Questions of Yellow Emperor’s Inner Classic: On the Corresponding Manifestations of Yin and Yang”, the liver corresponds to spring. In nature, it corresponds to wind and wood, in the body, it corresponds to tendons, and in the organs, it corresponds to the liver. The liver, in harmony with wind and trees in nature, bears the characteristics of dispersal and growth, further reflecting the close relationship between liver Qi and the breath of spring.

According to the “Basic Questions of Yellow Emperor’s Inner Classic: On the Secret Classics of Linglan”, the liver is like a general, responsible for planning and strategizing.” It is mainly responsible for dispersion and regulating Qi. If liver Qi can be dispersed normally in harmony with the spring Qi, its physiological functions will operate normally:

#### **(1) Normal mental state, cheerful mood, and peaceful mindset**

As stated in the “Miraculous Pivot: On the Abstinence of Normal People”, “When the blood vessels are harmonious and smooth, the spirit resides.” The liver is responsible for storing blood and dispersing Qi. When liver Qi is harmonious, it can harmonize Qi and blood, and regulate mental state.

#### **(2) Normal spleen ascending and stomach descending, food digestion, and nutrient absorption**

As mentioned in “Blood Syndrome Theory: On the Pathogenesis of Zang-Fu Organs”, the nature of wood is dispersion. When food enters the stomach, it relies entirely on the liver wood to disperse it, so that water and grain can be digested. If the liver’s clear yang does not rise, it cannot disperse water and

grain, and symptoms of indigestion and distension are unavoidable. The spleen and stomach are located in the middle jiao. The spleen is responsible for ascending clarity, while the stomach is responsible for descending and harmonizing. Normal dispersion of liver Qi can coordinate the ascending of the spleen and descending of the stomach, allowing the body's Qi to operate normally and nutrients to be properly transported and transformed.

(3) Normal bile secretion

The saying "liver and gallbladder are closely connected" indicates that the liver and gallbladder are externally and internally related, and their physiological functions are closely related. As stated in "Dongyi Baojian", "The remaining Qi of the liver is dispersed in the gallbladder and accumulates to form essence." Bile is a subtle material generated by the transformation of liver essence and Qi. In modern medicine, bile aids in digestion, mainly of fatty foods, and its secretion and excretion are also completed under the dispersing action of liver Qi.

(4) Normal blood circulation

"Qi is the commander of blood, and blood is the mother of Qi." When Qi moves, blood moves, and the liver is responsible for storing blood. Therefore, normal liver Qi can maintain normal blood circulation.

(5) Normal distribution of body fluids

As mentioned in "Jisheng Fang: On the Treatment of Phlegm and Retention", the airway of the human body is valued for its smoothness. When it is smooth, body fluids circulate freely, and there is absolutely no trouble with phlegm and retention. Qi can promote the distribution of body fluids. Therefore, normal liver qi can maintain the normal distribution of body fluids.

(6) Normal ejaculation for men and menstruation for women

As stated in the "Miraculous Pivot: Meridians", "The liver's foot-jueyin meridian passes through the genitals and reaches the lower abdomen." Normal dispersion of liver Qi allows normal ejaculation for men, regular ovulation for women, and regular menstruation. Additionally, as mentioned in the "Guidance for Clinical Practice: Menstrual Regulation", "Women prioritize the liver and utilize blood."

If the liver Qi fails to correspond with the spring Qi, leading to liver Qi imbalance, loss of dispersion and regulation, and poor Qi flow, abnormal physiological activities in the human body may occur, manifesting as follows:

- (1) According to "Ling Shu: Ben Shen", "When liver Qi is deficient, there is fear; when it is excessive, there is anger." This may lead to emotional depression or hyperactivity, and irritability.
- (2) Discord between the liver and spleen can cause spleen dysfunction, loss of appetite, abdominal distension, and diarrhea. When liver Qi invades the stomach, it can cause stomach dysfunction, leading to anorexia, hiccups, and vomiting.
- (3) Digestive abnormalities and loss of appetite may occur, and bile stagnation can lead to the formation of stones.
- (4) Symptoms may include hematemesis, hemoptysis, and internal resistance due to blood stasis.
- (5) There may be symptoms of dampness and phlegm retention, such as plum-pit qi, goiter, scrofula, and edema.
- (6) Male ejaculatory dysfunction can lead to seminal stagnation, and excessive liver fire dispersion can cause nocturnal emission. Female liver Qi stagnation can lead to delayed menstruation and menstrual pain, while excessive liver fire can cause early menstruation and uterine bleeding.



### 3.2. Daily habits

According to “Su Wen: Si Qi Tiao Shen Da Lun”, “In the spring of March, one should sleep late and rise early, walking extensively in the courtyard.” In spring, one should go to bed late and wake up early. Every morning when the sun rises, Yang Qi is most abundant. As stated in “Su Wen: Sheng Qi Tong Tian Lun”, “Yang Qi is like the sky and the sun. If it loses its place, it will shorten its lifespan and not manifest its essence.” This shows the important role of Yang Qi in the human body. After waking up, one should go out and engage in activities to absorb enough Yang Qi, allowing the Yang Qi in the body to invigorate the Qi mechanism and rise, thereby clearing the liver Qi and dispersing the cold Qi stored in the body during winter <sup>[2]</sup>.

### 3.3. Diet

“Qian Jin Fang” states, “In the seventy-two days of spring, reduce sour and increase sweet to nourish the spleen Qi.” “Su Wen: Yin Yang Ying Xiang Da Lun” also says, “Sour hurts the tendons, pungent overcomes sour”, “Sweet hurts the flesh, sour overcomes sweet.” In spring, one should eat more sweet foods and less sour foods. In traditional Chinese medicine, the spleen and stomach are the roots of health, and weakness in spleen and stomach function can lead to many diseases. Therefore, eating more sweet foods can nourish the spleen and stomach to maintain health. Spring belongs to the wood element, and illnesses often harm the liver. Sour foods enter the liver meridian, and excessive consumption of sour foods can make liver fire excessive.

In terms of diet, eating liver can nourish the liver, and chicken liver is particularly effective. Additionally, one should consume more fresh fruits and vegetables, avoid spicy, fried, and stimulating foods as well as alcohol, reduce the intake of animal fats to avoid increasing the burden on the liver. Foods such as spinach (nourishing Yin and moistening dryness, soothing the liver and nourishing blood), bean sprouts (boosting yang energy), leeks (enhancing the Qi of the spleen and stomach), scallions and garlic (nourishing the liver and benefiting yang), jujubes (nourishing the spleen and stomach), buckwheat, shepherd’s purse, celery, chrysanthemum sprouts, lettuce, eggplant, water chestnuts, cucumbers, mushrooms (with a cool nature and sweet taste, can nourish the liver and improve vision). To nourish liver Yin, one can consume moistening foods such as white fungus <sup>[3]</sup>.

### 3.4. Emotions

In terms of emotions, according to “Su Wen: Yin Yang Ying Xiang Da Lun”: “The liver corresponds to anger in emotions, and anger harms the liver.” When encountering difficulties, it is important to vent emotions in a timely manner, avoid excessive emotional reactions, and prevent liver qi stagnation. “Yi Chun Sheng Yi” suggests: “The method of nourishing the liver is to avoid anger and cultivate one’s nature.” Engage in calming activities and gentle exercises such as painting, calligraphy, listening to music, playing chess, planting flowers, fishing, practicing Tai Chi, and Baduanjin.

### 3.5. Others

According to “Su Wen: Jin Kui Zhen Yan Lun”: “The east is associated with the color green, which corresponds to the liver, and the liver opens into the eyes. The essence is stored in the liver.” “Ling Shu: Mai Du” also states: “The liver Qi is connected to the eyes. When the liver is harmonious, the eyes can distinguish five colors.” Since the liver opens into the eyes, nourishing the eyes is essential for nourishing the liver in spring. When the eyes are nourished, the liver’s essence and blood are abundant. Therefore, in spring, one should close their eyes more often to rest and nourish the eyes, or gently press the eyelids with the index finger, rubbing until the eyes feel warm and



slightly swollen, calming irritation and anger. Alternatively, one can rotate their eyes to relieve fatigue.

## **4. Summer**

### **4.1. Summer health maintenance: Focusing on heart care**

#### **4.1.1. Core concepts and theoretical basis of summer health maintenance**

In summer, everything is lush and full of vitality, and the high temperatures of midsummer are even more intense. While enjoying the summer sunshine and vitality, we cannot ignore the unique health maintenance practices of summer. Summer is hot, and yang energy is at its peak<sup>[1]</sup>. The heart is the organ with the most yang energy among the five viscera, corresponding to the Qi of heaven and earth. Therefore, nurturing the heart in summer is essential to protect the foundation of life<sup>[5]</sup>. The focus should be on calming and clearing the mind, nourishing heart Yang, heart Yin, and heart blood. The diet should be mainly bland. If the body is troubled by pathogenic factors such as cold, dampness, and deficiency, leading to a cold and deficient constitution, respiratory system problems, and bone and joint issues, we can take advantage of the abundant Yang energy in summer to regulate and eliminate pathogenic factors, thereby relieving pain.

### **4.2. Key points of summer health maintenance at different times**

There is a saying about summer health maintenance in terms of organs, meridians, and veins: “Nurture the stomach in the morning, nurture the heart at noon, and nurture all meridians in the evening.”<sup>[4]</sup>

#### **4.2.1. Nurturing the stomach in the morning**

Morning is the best time to nurture the stomach. The spleen and stomach are the “foundation of acquired constitution” and the source of Qi and blood production in the human body. To nurture the stomach, the first step is to have breakfast every day. Choose some easily digestible foods such as porridge and noodles, and combine them with fresh vegetables and fruits to provide adequate nutrition. Avoid prolonged fasting to prevent damage to the gastric mucosa. Drinking a cup of warm water after waking up can help cleanse the intestines and stomach, promote intestinal peristalsis, and aid in bowel movements.

#### **4.2.2. Nurturing the heart at noon**

During noon, the sunlight is extremely intense and the temperature is high. The body’s metabolism is vigorous, blood circulation accelerates, and the burden on the heart increases. Therefore, nurturing the heart at noon is crucial for summertime health maintenance. Firstly, it is important to have a bland diet at noon. Due to the high temperature in summer and increased sweating, the body can easily lose water and salt. Hence, it is advisable to consume light and easily digestible foods, avoiding excessively greasy and spicy dishes. Foods that have a cooling effect, nourish yin, and alleviate irritation, such as cucumber, winter melon, loofah, as well as kelp and mung bean soup, or chrysanthemum tea, are good choices. However, it is important not to overindulge to prevent increasing internal dampness<sup>[6]</sup>. Secondly, emotional regulation is also essential. People often feel restless and uneasy during noon. At this time, relaxing activities like listening to music or reading can help ease the mind and relieve stress. Maintaining a peaceful state of mind contributes to reducing the burden on the heart and promoting heart health. Lastly, taking a short nap can help alleviate fatigue, but the duration should not be too long.



rise early, following the rhythm of the chicken.” As autumn nights gradually become longer, it is advisable to go to bed early to harmonize with the storage of yin essence and rise early to promote the flow of Yang Qi. Staying up late can deplete the body’s Yin essence and exacerbate symptoms of autumn dryness, so it should be avoided as much as possible. In daily life, attention should be paid to keeping warm, adding appropriate clothing in the morning and evening to prevent cold invasion. When exercising, gentle activities such as yoga and qigong are recommended, which can help nourish lung Qi and enhance physical fitness. Soaking feet in warm water before bedtime can help dispel cold and promote sleep. Acupoint massage, such as Zhongfu, Feishu, Dazhui, Lieque, Zusanli, and Taixi, can be used for health maintenance, helping to strengthen the lungs. Acupoint massage is a simple and effective method for regulating the body’s Qi, blood, and Yin-Yang balance by stimulating specific acupoints<sup>[7]</sup>. Additionally, attention should be paid to the high incidence of allergic dermatitis in autumn, maintaining indoor cleanliness and hygiene to prevent dust mites and mold.

### **5.3. Autumn diet and health maintenance**

“Qian Jin Fang” advises: “During the seventy-two days of autumn, reduce pungent foods and increase sour foods to nourish liver Qi.” Pungent foods have a dispersing and draining effect on the lungs, so it is best to minimize spicy foods such as peppers and Sichuan peppercorns to avoid damaging lung Qi. A light diet is ideal, and it is advisable to choose seasonal vegetables and fruits. White-colored foods can nourish the lungs, benefit lung Qi, nourish lung Yin, and prevent autumn dryness. Examples include white foods such as lily bulbs, Chinese yam, lotus root, Chinese cabbage, winter melon, white fungus, lotus seedpod, and autumn pear. Simple and easy-to-prepare medicinal and edible dishes such as white fungus and lily bulb soup, rock sugar stewed snow pear, and lotus root stewed with pork ribs are recommended. Sour foods have a constricting effect on lung Qi, so they can be consumed in moderation, such as Chinese hawthorn, dark plum, pomelo, and citrus fruits<sup>[8]</sup>. Additionally, moderate alcohol consumption can be used to promote Qi and blood circulation and warm the body.

### **5.4. Emotional health maintenance in autumn**

In terms of emotions: “Calm the mind, ease the autumn’s severity, gather the spirit, balance the autumn Qi, don’t let your ambition wander, and keep the lung Qi clear.” Autumn corresponds to the lungs, and sorrow hurts the lungs. Autumn can easily evoke feelings of sadness and melancholy, so it’s important to maintain a calm and peaceful state of mind. It’s essential to adjust emotions in a timely manner, maintain a balanced attitude, and avoid excessive sorrow to prevent damage to lung Qi.

## **6. Winter**

### **6.1. Winter health maintenance: Focusing on kidney health and storing essence**

#### **6.1.1. Key aspects and theoretical origins of winter health maintenance**

In the cold winter months, everything is covered in snow, and all things are stored away, quietly waiting for spring’s return. Winter is a time for recuperation, adjusting daily routines and attitudes to nourish the body and accumulate energy. Winter health maintenance should focus on warmth, nourishment, and tranquility. Through reasonable diet, daily routines, exercise, and psychological adjustment, one can enhance physical fitness, prevent diseases, and maintain warmth and vitality in the cold season.

Winter emphasizes storage, and the kidneys are responsible for storing essence, which is the foundation of

sealing and storing. Winter health maintenance emphasizes “storing essence and nourishing the kidneys.” The kidneys are the foundation of prenatal health and govern the body’s growth, development, and reproductive functions. Therefore, it’s important to keep warm in winter, especially the feet and waist, to prevent cold pathogens from invading the body. Those with kidney problems need to conserve their energy. Only with sufficient kidney essence can one avoid illnesses in the coming year.

## **6.2. Daily routines for winter health maintenance**

According to the “Basic Questions of Yellow Emperor’s Classic of Internal Medicine: On Regulating the Spirits According to the Four Seasons,” it is recommended to “go to bed early and rise late, waiting for the sunlight.” Winter brings cold weather, so it’s advisable to go to bed early and get up late, waiting for the sun to rise and shine, to avoid cold pathogens, seek warmth, and prevent disturbance to Yang Qi. This practice helps to fend off the common cold pathogens that invade the human body in winter <sup>[9]</sup>.

“Do not excessively perspire, which would lead to frequent loss of Qi.” “Perspire” refers to the opening and draining of the skin, that is, excessive sweating. Too much sweating can consume qi and damage yang. Winter is the time for Yang Qi to be stored, and the skin should also be correspondingly closed and not excessively opened. Therefore, winter exercise should be moderate, with more emphasis on static practices.

## **6.3. Winter dietary health**

“Qian Jin Fang” states: “In winter, for seventy-two days, reduce salt and increase bitterness to nourish the heart Qi.” Salt enters the kidneys, and excessive consumption of salty foods in winter can easily damage kidney essence. In cold weather, it is appropriate to eat some warming foods such as lamb, beef, pigeon, sea cucumber, and goji berries, which can benefit the kidneys, strengthen Yang, tonify Qi, and generate blood, helping the body resist cold. Winter corresponds to black foods such as black rice, black beans, and black sesame. In Chinese medicine, they are believed to nourish the kidneys. In winter, Yang Qi is deficient and Yin Qi is abundant. It is important to protect yang. Foods such as leeks, longan meat, Chinese yam, and walnuts can be chosen for the diet <sup>[9]</sup>. Recommended dishes include Five Black Kidney-Tonifying Porridge, Chestnut Porridge, Baizhu Huaishan Porridge, and Leek Porridge <sup>[10]</sup>.

## **6.4. Winter emotional health**

In terms of emotions, winter is a time of withering for all things, which can easily lead to negative and depressive emotions. However, “joy brings harmony to Qi and will, and smooth flow to nutritive and defensive Qi.” Good emotions help to promote the circulation of Qi and blood and the normal functioning of the organs.

## **6.5. Other health suggestions**

In terms of meridians, the Zhaohai acupoint can be used to nourish the kidneys and maintain health. It can also treat various conditions such as insomnia and dry throat. The Zhaohai acupoint is one of the acupoints of the Foot Shaoyin Kidney Meridian and one of the Eight Extraordinary Meridians’ intersecting points. It is the intersection of the Kidney Meridian and the Yin Qiao Meridian, and has a bidirectional regulatory effect that balances yin and yang, nourishing yin without injuring yang, and warming yang without damaging yin. It is suitable for gentle nourishment in winter <sup>[10]</sup>.

## 7. Conclusion

In summary, the concept of seasonal health preservation in traditional Chinese medicine, as a treasure in the field of Chinese medicine health preservation, emphasizes that human physiological functions should follow the natural laws of seasonal changes. Through strategies such as harmonizing Yin and Yang, strengthening the body's foundation, and nurturing vitality, the goal is to enhance physical fitness, prevent diseases, and promote healthy longevity. Specifically, spring health preservation focuses on supporting Yang and suppressing Yin, nourishing the liver; summer emphasizes clearing the heart, preventing heatstroke, and promoting Qi and generating fluids; autumn requires nourishing the lungs and Yin, and gathering the spirit; winter focuses on warming and nourishing kidney Yang, storing essence, and gathering Qi. This philosophy not only deeply reflects the holistic view of “harmony between nature and humanity” in traditional Chinese medicine, but also provides modern people with wisdom for maintaining health by following natural laws and achieving physical and mental harmony. Therefore, deepening the exploration and application of the theory of seasonal health preservation in traditional Chinese medicine, and combining it with modern technological means for innovative practice, has profound scientific value and social significance for improving the health quality of the nation and promoting the development of traditional Chinese medicine health preservation. It deserves further exploration.

## Disclosure statement

The authors declare no conflict of interest.

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# Efficacy Study of Omega Onychocryptosis Correction in the Treatment of Mild to Moderate Onychocryptosis

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**Abstract:** *Objective:* To investigate the effectiveness of Omega in the correction of onychocryptosis among individuals with mild to moderate cases. *Methods:* Sixty patients with mild to moderate onychocryptosis, treated at our institution from April 1, 2023, to March 31, 2025, were selected as subjects for this study. The participants were randomly assigned into two groups using a random number table: the control group, which received nail groove packing, and the observation group, which underwent Omega onychocryptosis correction, with 30 patients in each group. The relief from inflammation, duration of healing, comfort of the foot, and satisfaction levels of the two groups were assessed and compared. *Results:* The duration of redness and swelling, discomfort, exudate, and healing time in the observation group were all significantly shorter than in the control group ( $P < 0.05$ ). No significant difference in VAS scores was seen between the two groups three days post-treatment ( $P > 0.05$ ); however, one and two weeks post-treatment, the VAS scores in the observation group were significantly lower than those in the control group ( $P < 0.05$ ). The observation group's satisfaction rating was 100.00% (30/30), markedly surpassing the control group's rate of 83.33% (25/30), with statistical significance ( $P < 0.05$ ). *Conclusion:* Omega onychocryptosis correction for individuals with mild to moderate onychocryptosis can yield favorable treatment outcomes, significantly alleviate pain, enhance symptomatology, and elevate patient satisfaction.

**Keywords:** Onychocryptosis; Omega Onychocryptosis Correction; Therapeutic Efficacy

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## 1. Introduction

Onychocryptosis, commonly termed “ingrown nail,” denotes the encroachment of the nail plate into the periungual soft tissues (including lateral, distal, proximal edges, and nail folds) during its growth, resulting in localized soft tissue inflammation and discomfort. Onychocryptosis can be attributed to various factors, including overly short or deep nail clipping, constrictive footwear and hosiery, and trauma. Moreover, hyperhidrosis, nail malformation, foot deformity, and additional variables may contribute to onychocryptosis. Following the onset of

onychocryptosis, it may manifest with localized erythema and edema, exudation, purulence, and even hyperplasia of granulation tissue, accompanied by varying levels of pain <sup>[1]</sup>. In mild cases, pain may be the sole symptom, whereas severe cases might impair ambulation <sup>[2]</sup>. Consequently, prompt and efficient intervention for individuals with onychocryptosis is essential to alleviate discomfort, enhance symptoms, and manage illness advancement.

For mild to severe onychocryptosis, conservative interventions mostly include nail groove packing and nail plate stenting, which attempt to alleviate pain and realign the nail plate <sup>[3]</sup>. Subungual packing with absorbent cotton is a prevalent conservative treatment for onychocryptosis, effectively alleviating pain and diminishing inflammation. This approach necessitates daily replacement of absorbent cotton, which is inconvenient and may result in low compliance among certain patients, hence impacting efficacy. Nail stenting is an efficacious technique for the treatment of onychocryptosis. It employs a wire corrective brace to progressively alter and reposition the nail plate under micro-dynamic conditions through sustained, gentle elasticity, facilitating toenail growth and eventually elevating the lateral nail margin for therapeutic objectives <sup>[4]</sup>.

The Omega onychocryptosis correction is a novel technique for treating onychocryptosis, primarily utilizing an Omega wire corrector to progressively realign the ingrown nail under sustained micro-dynamic circumstances, facilitated by the synergistic effects of the wire's restorative and spring forces <sup>[5]</sup>. This study chose 60 patients with mild to moderate onychocryptosis treated at our hospital from April 1, 2023, to March 31, 2025, to investigate the efficacy of Omega in the correction of mild to moderate onychocryptosis, as mentioned below.

## 2. Materials and methods

### 2.1. General information

A total of 60 patients with mild to moderate onychocryptosis, treated at our institution from April 1, 2023, to March 31, 2025, were selected as subjects for the study. The participants were randomly allocated into two groups of 30 cases each, utilizing a random number table. Control group: 17 male patients and 13 female patients; aged 23–74 years, with a mean age of  $(51.23 \pm 7.69)$  years; disease duration of 2–14 months, with a mean duration of  $(5.76 \pm 1.35)$  months; BMI ranging from 22 to 26 kg/m<sup>2</sup>, with a mean BMI of  $(23.56 \pm 0.57)$  kg/m<sup>2</sup>. Observation group: 15 male patients and 15 female patients, aged 22–75 years, with a mean age of  $50.98 \pm 8.37$  years; disease duration of 1–12 months, with a mean duration of  $5.13 \pm 1.67$  months; BMI ranging from 22 to 26 kg/m<sup>2</sup>, with a mean BMI of  $23.84 \pm 0.62$  kg/m<sup>2</sup>. No substantial difference existed in baseline data between the two groups ( $P > 0.05$ ).

Criteria for inclusion: (1) The clinical stages of onychocryptosis ranged from stage I (evident tenderness, mild erythema and edema of the nail fold) to stage II (evident tenderness, with nail fold swelling surpassing the lateral margin of the nail plate); (2) The subjects exhibited clear consciousness, normal auditory, visual, and linguistic functions, as well as intact communication abilities; (3) There was no documented history of mental illness; (4) Patients and their families were apprised of the study and provided their informed consent by signing the appropriate forms.

Criteria for exclusion: (1) Complicated by hematological disorders or coagulation dysfunction; (2) Complicated by infectious diseases; (3) Presence of nail plate fissures or toe bone deformities; (4) Complicated by onychomycosis or significant foot injuries.

### 2.2. Methods

The control group received treatment involving nail groove packing. Following the washing and disinfection of the patient's foot, a slender segment of sterile absorbent cotton was torn, fashioned into a cotton strip, positioned into the

damaged nail groove, and delicately pressed into place using a nail groove spoon. The cotton strip was progressively inserted from the proximal end (toward the heel) to the distal end till it reached the area beneath the nail tip, utilizing the siphon action of the cotton to evacuate purulent secretions from the nail groove. Upon fully packed the cotton strip, the surplus was excised with scissors. Patients were directed to sanitize the nail groove and substitute the medical cotton strip on a regular basis. They were instructed to refrain from vigorous activities, don loose footwear and stockings to avert the affected toe from exposure to humidity, and maintain the foot in a clean and dry condition.

The observation group received treatment for onychocryptosis correction with Omega.

### **2.2.1. Particular operations**

- (1) Preoperative preparation: Cleaning and disinfecting the patient's foot, along with the assembly of necessary supplies, including Omega onychocryptosis corrective bracing.
- (2) Operation technique: Based on the patient's Omega onychocryptosis correction treatment plan and instrument selection, a toenail model was created for the patient, and the Omega onychocryptosis repair wire was initially produced. During installation, elastic tape was affixed to the lateral nail fold of the afflicted toe and retracted towards the plantar side to completely reveal the lateral nail border; the correction device was precisely inserted and calibrated, with periodic corrections conducted as necessary.
- (3) Postoperative care: Patients were instructed to utilize the corrective device properly, maintain foot hygiene, and prevent recurrence of onychocryptosis and paronychia. They were told that they could wash their feet routinely, ensure thorough drying post-wash, and maintain dryness; to wear loose and comfortable footwear and socks while utilizing the corrector; and to conduct regular reviews. Correction treatment was continued based on the condition and treatment efficacy, typically lasting many weeks to months.

### **2.3. Indicators of observation**

The foot conditions of both groups post-treatment were assessed, and the duration of redness and swelling, pain, exudate, and healing time were documented and compared. Assessment of foot comfort: The Visual Analogue Scale (VAS) was employed to assess the pain levels of both groups at 3 days, 1 week, and 2 weeks post-treatment. The VAS score varied from 0 to 10, with greater ratings signifying diminished foot comfort. Assessment of satisfaction: Three months post-treatment, patients' satisfaction with treatment efficacy and comfort was evaluated via follow-up. A scoring system was employed, with a maximum score of 100. Satisfaction levels were categorized as dissatisfied ( $\leq 60$  points), moderately satisfied (61–80 points), and highly satisfied (81–100 points). Satisfaction rate = (number of moderately satisfied + number of highly satisfied)  $\div$  total number of patients  $\times 100\%$ .

### **2.4. Statistical analysis**

The data processing was conducted using SPSS version 21.0 statistical software. Count indicators were represented as  $n(\%)$ , with data comparison conducted using the chi-square test; measurement indicators were denoted as  $(\bar{x} \pm s)$ , with data comparison executed using the t-test;  $P < 0.05$  signified a statistically significant difference.

## **3. Results**

### **3.1. Comparison of symptom relief time and healing time between the two groups**

The duration of redness and swelling, pain, exudate, and healing in the observation group was significantly shorter

than in the control group ( $P < 0.05$ ) (Table 1).

**Table 1.** Comparison of symptom disappearance time and healing time ( $\bar{x} \pm s$ )

Group	Redness and swelling (d)	Pain (d)	Exudate (d)	Healing time (week)
Control(n=30)	7.85 $\pm$ 1.21	7.79 $\pm$ 1.34	6.57 $\pm$ 1.25	6.42 $\pm$ 1.85
Observation(n=30)	6.54 $\pm$ 1.14	7.08 $\pm$ 1.26	5.68 $\pm$ 1.19	4.56 $\pm$ 1.35
<i>t</i>	4.316	2.114	2.824	4.448
<i>P</i>	0.000	0.038	0.006	0.000

### 3.2. Comparison of foot comfort evaluation between the two groups

No significant difference in VAS scores was observed between the observation group and the control group three days post-treatment ( $P > 0.05$ ); however, one week and two weeks after treatment, the VAS scores in the observation group were significantly lower than those in the control group ( $P < 0.05$ ) (Table 2).

**Table 2.** Comparison of VAS scores at different treatment times ( $\bar{x} \pm s$ )

Group	3 days	1 week	2 weeks
Control(n=30)	4.24 $\pm$ 1.02	2.32 $\pm$ 0.69 <sup>(1)</sup>	1.34 $\pm$ 0.26 <sup>(1)(2)</sup>
Observation(n=30)	3.86 $\pm$ 1.34	1.45 $\pm$ 0.32 <sup>(1)</sup>	0.65 $\pm$ 0.24 <sup>(1)(2)</sup>
<i>t</i>	1.235	6.265	10.680
<i>P</i>	0.221	0.000	0.000

Note: In comparison to the score three days post-treatment within the same cohort, (1)  $P < 0.05$ ; in comparison to the score one week post-treatment within the same cohort, (2)  $P < 0.05$ .

### 3.3. Comparison of patient satisfaction between the two groups

The satisfaction rate of the observation group (100.00%) was markedly superior to that of the control group (83.33%), demonstrating statistical significance ( $P < 0.05$ ) (Table 3).

**Table 3.** Comparison of patient satisfaction [n(%)]

Group	Highly satisfied	Moderately satisfied	Dissatisfied	Satisfaction rate
Control (n=30)	13 (43.33)	12 (40.00)	5 (16.67)	25 (83.33)
Observation (n=30)	20 (66.67)	10 (33.33)	0 (0.00)	30 (100.00)
$\chi^2$	--	--	--	5.454
<i>P</i>	--	--	--	0.019

## 4. Discussion

Onychocryptosis is a traumatic nail disorder that may affect fingernails or toenails, with a higher prevalence in the hallux. The typical nail unit structure is a coexisting condition in which the nail plate underpins the surrounding nail folds, while the peripheral tissues encircle the nail plate<sup>[6]</sup>. Human toenails develop perpetually forward, whereas the lateral margins of the nail cease growth to a degree, facilitating a harmonic coexistence between the

nail plate's edges and the surrounding soft tissues of the nail groove. Nevertheless, different causes might cause the lateral edge of the toenail in certain individuals to develop aberrantly and penetrate the soft tissues of the nail groove. The lateral edge of the nail plate can invade the soft tissues of the nail groove, resulting in localized inflammation characterized by pain, redness, swelling, exudation, and hyperplasia of granulation tissue <sup>[7]</sup>. Onychocryptosis primarily results from prolonged usage of improperly fitting footwear, erroneous nail clipping techniques, trauma, and pressure on the toenail. If onychocryptosis persists, it may lead to paronychia and result in a nail groove abscess <sup>[8]</sup>. In extreme instances, it can significantly impair ambulation. Consequently, implementing efficient treatment strategies for prompt intervention and restoration of the nail plate is crucial for preserving the integrity of the toenail structure and ambulation function.

Currently, the clinical management of onychocryptosis mostly encompasses conservative and surgical interventions, with treatment tailored to the specific condition of the patient. Onychocryptosis is clinically categorized based on severity. Mild (lateral toe embedded in the soft tissues of the nail groove, exhibiting mild edema and tenderness), moderate (a tough, white, membrane-like substance formed in the soft tissues of the nail groove, closely integrated with the surrounding tissues, accompanied by local erythema and swelling, without suppuration or granulation hyperplasia, and significant pain), and severe (ulceration or erythema and swelling of the nail groove soft tissues, with inflammation extending to the nail root, granulation tissue hyperplasia, exudation, accompanied by odor, intense pain, and impairment of ambulation). For mild to severe onychocryptosis, conservative therapies are typically employed, with subungual packing with absorbent cotton being a prominent method. Subungual cotton packing primarily employs cotton strips to elevate the nail plate and direct its growth over the distal toe for therapeutic objectives <sup>[9]</sup>. During treatment with subungual absorbent cotton packing, patients must replace the cotton strip daily to maintain foot hygiene. The laborious nature of this approach may lead to poor patient compliance, hence impacting the treatment outcome.

Omega onychocryptosis correction is an innovative non-surgical therapy approach. It alters the growth trajectory of the toenail and ameliorates onychocryptosis with the application of a custom orthopedic frame or wire corrector. By applying consistent moderate pressure, it progressively directs the toenail to grow outward and inhibits the lateral nail from invading the soft tissues of the nail groove <sup>[10]</sup>. The introduction of Omega for onychocryptosis correction offers a novel approach for the prevention and treatment of this condition. In the prevention and treatment of onychocryptotic paronychia, Omega onychocryptosis correction may serve as an alternative to certain nail resection or extraction procedures. In comparison to conventional therapies like nail extraction, it offers enhanced safety and greater patient acceptance. The utilization of Omega for the repair of onychocryptosis presents several advantages: Exact rectification: The orthopedic frame or wire corrector employed in Omega onychocryptosis repair resembles the application of a "magic hoop" on the toenail. The corrective device, produced via reverse molding, precisely conforms to the curve of the patient's toenail. The corrector employs continuous and minimal elasticity to realign the nail plate, so preventing the lateral nail margin from compressing the soft tissues of the nail groove. Secure and devoid of discomfort: No anesthesia is required for the correction of Omega onychocryptosis; the procedure is straightforward, allowing patients to depart immediately post-treatment, and it is nearly painless, enhancing patient acceptance and comfort. Convenient and efficient: The Omega onychocryptosis correction involves the installation of a corrective device on the afflicted nail, rendering the entire treatment process straightforward and expeditious. Patients can independently don and modify it under medical supervision, ensuring little disruption to their professional and personal lives. Patients can move normally without much discomfort during treatment.



The findings of this study indicated that the duration of redness and swelling, pain, exudate, and healing time in the observation group was consistently shorter than in the control group; the VAS scores for the observation group at 1 week and 2 weeks post-treatment were lower than those of the control group; furthermore, the satisfaction rate in the observation group (100.00%) was markedly higher than that of the control group (83.33%), with statistically significant differences ( $P < 0.05$ ). The findings indicate that Omega onychocryptosis correction for individuals with mild to moderate onychocryptosis can yield favorable treatment outcomes, enhancing symptom relief, alleviating pain, reducing healing duration, and increasing patient satisfaction. The rationale is that while the conventional cotton packing technique is efficient, it necessitates frequent cotton changes, imposes stringent hygiene standards for patients' feet, and entails a comparatively protracted treatment duration. Patients exhibit a tendency towards inadequate compliance, which impacts efficacy. Conversely, Omega onychocryptosis correction can efficiently and rapidly alleviate onychocryptosis symptoms, rectify toenail morphology, and enable patients to lead a normal life while utilizing the Omega onychocryptosis correction device, offering enhanced convenience<sup>[11]</sup>. Research indicates that the simultaneous use of the Omega wire corrector and nail groove packing facilitates the insertion of absorbent cotton into the nail groove following the application of the Omega corrector, thereby promoting the separation of the lateral nail margin from the surrounding soft tissues and directing the nail plate to advance forward. The application of Omega for the correction of onychocryptosis demonstrates significant therapeutic results, markedly alleviating symptoms and restoring the normal structure of the nail unit in patients with onychocryptosis<sup>[12]</sup>.

## 5. Conclusion

In conclusion, Omega onychocryptosis correction demonstrates significant therapeutic efficacy in treating individuals with mild to moderate onychocryptosis. It can enhance symptoms, alleviate pain, facilitate the healing of onychocryptosis, and significantly elevate patient happiness, demonstrating substantial application value.

## Disclosure statement

The author declares no conflict of interest.

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# Effect of *Bifidobacterium* Triple Viable Bacteria Tablets on Neonatal Necrotizing Enterocolitis and Its Impact on Serum Factors of the Patients

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**Abstract:** *Objective:* To analyze the efficacy of *Bifidobacterium* triple viable bacteria tablets on neonatal necrotizing enterocolitis (NEC) and its impact on serum factors of the patients. *Methods:* From January 2021 to May 2025, 88 neonates with NEC admitted to our hospital were selected as study subjects. During the study, these 88 patients were evenly divided into two groups, namely the observation group and the control group, with 44 patients in each group based on the random number table method. In terms of treatment, the control group was treated with meropenem, while the observation group received additional treatment with *Bifidobacterium* triple viable bacteria powder based on the treatment plan of the control group. The clinical efficacy and differences in serum inflammatory factor levels between the two groups were compared. *Results:* The efficacy of the observation group (90.91%) was better than that of the control group (72.73%) ( $P < 0.05$ ). After treatment, the levels of C-reactive protein (CRP) and procalcitonin (PCT) in both groups decreased compared to those before treatment, and the values of the above indicators in the observation group were lower than those in the control group ( $P < 0.05$ ). *Conclusion:* Based on conventional treatment for NEC neonates, the use of *Bifidobacterium* triple viable bacteria tablets has significant efficacy and can effectively reduce serum inflammatory factor levels.

**Keywords:** *Bifidobacterium* triple viable bacteria tablets; Necrotizing enterocolitis; Neonates; Serum factors

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## 1. Introduction

Neonatal necrotizing enterocolitis (NEC) is a common and severe intestinal inflammatory disease among newborns and low birth weight infants. It is characterized by rapid onset and progression, not only causing a series of digestive symptoms such as abdominal distension, diarrhea, and bloody stools, but also potentially leading to shock, apnea, and even death in severe cases. This poses a significant threat to the health and life of the affected infants, while also presenting considerable challenges for clinical treatment<sup>[1, 2]</sup>. Currently, clinical treatment for NEC primarily involves antibiotics, gastrointestinal decompression, fasting, and parenteral nutrition. Among

these, meropenem, as a broad-spectrum antibiotic, plays a certain role in reducing intestinal mucosal lesions and inflammatory stimulation, as well as relieving clinical symptoms <sup>[3]</sup>. However, conventional treatment regimens often have issues such as slow onset and limited therapeutic effect, making it difficult to effectively reduce the mortality rate of NEC and improve the prognosis of the patients. Therefore, finding more efficient and safe treatment methods has become an important direction for clinical research. As a microecological preparation, *Bifidobacterium* triple viable powder mainly consists of *Bifidobacterium longum*, *Lactobacillus acidophilus*, and *Enterococcus faecalis*. These beneficial bacteria can colonize and proliferate in the intestine, regulate intestinal flora imbalance, enhance intestinal barrier function, inhibit the growth of harmful bacteria, and also have immunomodulatory effects that can reduce intestinal inflammatory responses. It has achieved good results in the treatment of various digestive diseases <sup>[4, 5]</sup>. In view of this, this study intends to explore the efficacy of combined use of *Bifidobacterium* triple viable powder with meropenem in the treatment of newborns with necrotizing enterocolitis, as well as its impact on serum inflammatory factor levels in these patients. The aim is to provide a better treatment regimen and theoretical basis for clinical treatment of NEC.

## 2. Materials and methods

### 2.1. General information

A total of 88 NEC patients admitted to the hospital were included in the study and randomly divided into two groups using random sampling, with 44 patients in each group. The general information of the two groups was comparable ( $P > 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of baseline data [ $(\bar{x} \pm s)$ , cases (%)]

Group	n	Gender		Gestational age (weeks)	Birth weight (kg)
		Male	Female		
Study	44	22	22	32.43 $\pm$ 0.84	2.37 $\pm$ 0.42
Control	44	20	24	32.27 $\pm$ 0.63	2.41 $\pm$ 0.38
$t/\chi^2$		0.182		1.011	0.468
$p$ -value		0.669		0.315	0.641

### 2.2. Inclusion and exclusion criteria

#### 2.2.1. Inclusion criteria

- (1) Meet the diagnostic criteria for NEC in reference, and the diagnosis is further confirmed through X-ray imaging <sup>[6]</sup>.
- (2) The patient presents clinical manifestations such as abdominal distension, frequent vomiting, increased frequency of defecation, and changes in stool characteristics (diarrhea).
- (3) The patient's family members sign the informed consent form.

#### 2.2.2. Exclusion criteria

- (1) Patients with intestinal perforation or severe symptoms requiring surgical treatment.
- (2) Patients with congenital intestinal developmental abnormalities.
- (3) Patients with severe pulmonary diseases and congenital heart diseases.

## 2.3. Methods

Both groups of patients received the same basic treatment measures, including fasting treatment, gastrointestinal decompression, maintenance of water and electrolyte balance, and close monitoring of the patient's vital signs. After completing the above basic treatment arrangements, the control group was treated with Meropenem for Injection (produced by Ouyi Pharmaceutical Co., Ltd. of Shijiazhuang Pharmaceutical Group, approval number: National Medicine Approval Number H20103094, specification: 0.25 grams). The specific medication method was to add 1 gram of the drug to 500 milliliters of 0.9% sodium chloride injection, administered intravenously three times a day. On the basis of the control group's treatment plan, the observation group additionally used Jinshuangqi for adjuvant treatment. The specific medication was *Bifidobacterium Lactobacillus* Triple Viable Tablets (produced by Inner Mongolia Shuangqi Pharmaceutical Co., Ltd., approval number: National Medicine Approval Number S19980004, specification: 0.5 grams per tablet). The tablets were completely dissolved in warm water and then administered orally or through nasal feeding three times a day for one week of continuous treatment. During the treatment period, medical staff should closely monitor and observe changes in the patient's vital signs and other indicators.

## 2.4. Observation indicators

### 2.4.1. Clinical efficacy

- (1) Significant effect: After treatment, all clinical symptoms such as abdominal distension, diarrhea, and vomiting in the child have resolved, the daily number of bowel movements and stool characteristics have returned to normal, the child can resume normal oral feeding, and abdominal X-ray examination shows no abnormalities.
- (2) Effective: After treatment, the clinical symptoms of the child have improved significantly. Although there is intolerance to breast milk, the child can accept formula feeding. At the same time, the results of abdominal X-ray examination have improved compared to before treatment.
- (3) Ineffective: After treatment, there is no improvement in symptoms such as abdominal distension, diarrhea, and vomiting in the child. Abdominal X-rays still show abnormalities, and the condition may even worsen, leading to severe complications such as septic shock and intestinal perforation. Total efficacy = (Significant effect + Effective) / Total number  $\times$  100%.

### 2.4.2. Levels of serum inflammatory factors

Collect 3 milliliters of venous blood samples from the child before and after treatment, place them in a centrifuge, set the centrifugal speed to 3000 rpm, set the centrifugal radius to 8 centimeters, and perform centrifugation for 10 minutes. After centrifugation, carefully aspirate the supernatant serum, and then use enzyme-linked immunosorbent assay (ELISA) to detect the levels of C-reactive protein (CRP) and procalcitonin (PCT) in the serum.

## 2.5. Statistical analysis

SPSS 26.0 was used for data analysis. Measurement data were represented by  $\bar{x} \pm s$ , and the comparison was conducted using the t-test. Count data were expressed as n(%) and analyzed using  $\chi^2$  test.  $P < 0.05$  was considered statistically significant.



### 3. Results

#### 3.1. Clinical efficacy

The efficacy of the observation group (90.91%) was better than that of the control group (72.73%) ( $P > 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of clinical efficacy [cases (%)]

Group	<i>n</i>	Markedly Effective <i>n</i> (%)	Effective <i>n</i> (%)	Ineffective <i>n</i> (%)	Overall Efficacy <i>n</i> (%)
Study	44	24 (54.55)	16 (36.36)	4 (9.09)	40 (90.91)
Control	44	19 (43.18)	13 (29.55)	12 (27.27)	32 (72.73)
$\chi^2$					4.889
<i>p</i> -value					0.027

#### 3.2. Levels of serum inflammatory factors

After treatment, the levels of CRP and PCT in both groups decreased compared to those before treatment, and the values of the above indicators in the observation group were lower than those in the control group ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of serum inflammatory factor levels ( $\bar{x} \pm s$ )

Group	<i>n</i>	CRP (mg/L)		PCT (μg/L)	
		Pre-treatment	Day 7	Pre-treatment	Day 7
Study	44	26.56 ± 5.89	10.25 ± 1.42*	4.12 ± 1.26	0.92 ± 0.15*
Control	44	25.58 ± 5.24	15.31 ± 1.05*	3.98 ± 1.14	1.85 ± 0.22*
<i>t</i> -value		0.825	19.005	0.547	23.168
<i>p</i> -value		0.412	< 0.001	0.586	< 0.001

Note: Compared with the same group before treatment, \* $P < 0.05$ .

### 4. Discussion

Neonatal necrotizing enterocolitis (NEC) mainly occurs in premature infants within days to weeks after birth and newborns with a birth weight below the normal standard. In severe cases, it can even cause serious complications such as intestinal perforation [7-8]. Relevant reports have pointed out that the incidence rate of NEC in neonatal intensive care units is 2%–5% [9]. Among them, the probability of very low birth weight infants developing NEC is 4.5%–8.7%, and the fatality rate is 20%–30%; while the fatality rate of ultra-low birth weight infants is between 30%–50.9%. Clinical treatment of NEC often adopts comprehensive measures, such as fasting, gastrointestinal decompression, anti-infection, maintenance of water and electrolyte balance, and nutritional support. Anti-infection is the key. As a broad-spectrum carbapenem antibiotic, meropenem has strong antibacterial activity and good tissue penetration, which can inhibit intestinal pathogens, reduce intestinal mucosal lesions and inflammatory stimulation, and relieve symptoms. It is widely used in NEC treatment. However, further research on the pathogenesis of NEC has found that delayed colonization and abnormal composition of intestinal flora in newborns can easily lead to intestinal microecological imbalance, damage the intestinal barrier, and promote

inflammatory reactions. Therefore, regulating intestinal flora and restoring intestinal microecological balance has become a new direction for the treatment of NEC<sup>[10]</sup>.

The results of this study showed that the treatment effect of the observation group (90.91%) was better than that of the control group (72.73%) ( $P < 0.05$ ). This suggests that *Bifidobacterium* triple viable bacteria tablets played a positive auxiliary role in the treatment of neonatal necrotizing enterocolitis. It can effectively regulate the intestinal flora structure of neonatal necrotizing enterocolitis, increase the number of beneficial bacteria, and improve intestinal microecological balance. Analysis of the reasons: Necrotizing enterocolitis is a common severe gastrointestinal disease in neonates. Its pathogenesis is complex and closely related to factors such as intestinal flora imbalance, impaired intestinal mucosal barrier function, and low immune function. The intestinal development of neonates is not yet mature, intestinal flora colonization is delayed and unstable, and it is susceptible to external factors and prone to flora imbalance, which in turn triggers intestinal inflammatory reactions and mucosal damage.

As a broad-spectrum antibiotic, meropenem injection can effectively inhibit or kill pathogenic bacteria and control infection, but it may also damage the normal intestinal flora, further aggravating flora imbalance. *Bifidobacterium* triple viable bacteria tablets contain various beneficial bacteria such as *Bifidobacteria* and *Lactobacilli*. After entering the intestine, these beneficial bacteria can colonize and propagate in large numbers, forming a biological barrier to inhibit the growth and reproduction of harmful bacteria and regulate the balance of intestinal flora. At the same time, beneficial bacteria can also produce substances such as short-chain fatty acids, lower the intestinal pH, improve the intestinal microenvironment, enhance the intestinal mucosal barrier function, reduce the absorption and transport of intestinal toxins, thereby reducing intestinal inflammation and promoting intestinal mucosal repair and regeneration. Additionally, *Bifidobacterium* triple viable bacteria tablets may also regulate the body's immune function, enhance the resistance of newborns, improve their tolerance to infection, and improve the treatment effect.

After treatment, the levels of CRP and PCT in both groups of children decreased compared to before treatment, and the values of these indicators in the observation group were lower than those in the control group ( $P < 0.05$ ). CRP and PCT are commonly used inflammatory markers in clinical practice, and their levels can reflect the degree of inflammatory response in the body. During the pathogenesis of necrotizing enterocolitis, intestinal inflammatory responses stimulate the body to produce large amounts of inflammatory mediators, leading to increased levels of CRP and PCT. In the observation group, the use of *Bifidobacterium* triple viable tablets resulted in a more significant decrease in serum CRP and PCT levels, further confirming the anti-inflammatory effect of these tablets. The anti-inflammatory mechanism may be related to regulating intestinal flora balance. The increase in beneficial bacteria can inhibit the growth of harmful bacteria, reduce the production of endotoxins and other inflammatory mediators by harmful bacteria, and thereby reduce intestinal inflammatory responses. Additionally, *Bifidobacterium* triple viable tablets may also exert their anti-inflammatory effects by regulating the function of immune cells, inhibiting the activation of inflammatory signaling pathways, and reducing the release of inflammatory factors.

## 5. Conclusion

In summary, the use of *Bifidobacterium* triple viable tablets in addition to conventional treatment for NEC in newborns has significant efficacy and can effectively reduce serum inflammatory factor levels.

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## Disclosure statement

The author declares no conflict of interest.

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# Exploring the Efficacy of Shaoyang Zhugu Formula in Treating Residual Pain After Vertebroplasty Based on the Shaoyang Governs Bones Theory

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**Abstract:** *Objective:* To investigate the clinical efficacy of the Shaoyang Zhugu Formula based on the “Shaoyang Governing Bones” theory in treating residual pain after vertebroplasty. *Methods:* A total of 60 outpatients and inpatients from the Second Orthopedics Ward and Preventive Treatment Center of Chuxiong Prefecture Hospital of Traditional Chinese Medicine between January 2024 and December 2024 were selected and randomly divided into a control group (celecoxib capsules, 30 cases) and an observation group (Shaoyang Zhugu Formula + celecoxib capsules, 30 cases) using a lottery method. Postoperative pain levels, TCM symptom scores, Japanese Orthopaedic Association (JOA) scores for the lumbar spine, and adverse reactions were compared between the two groups. *Results:* The observation group showed better pain relief than the control group ( $P < 0.05$ ). The TCM symptom efficacy in the observation group was superior to that of the control group ( $P < 0.05$ ). After two treatment courses, both groups exhibited improved JOA scores, but the observation group demonstrated significantly better postoperative JOA scores ( $P < 0.05$ ). Additionally, the observation group had fewer adverse reactions ( $P < 0.05$ ). *Conclusion:* The Shaoyang Zhugu Formula, based on the “Shaoyang Governing Bones” theory, effectively alleviates residual pain after vertebroplasty, improves TCM symptoms and lumbar function, and demonstrates high safety.

**Keywords:** Shaoyang Governing Bones theory; Shaoyang Zhugu Formula; Vertebroplasty; Residual pain

**Online publication:** September 4, 2025

## 1. Introduction

With the global aging population, the incidence of osteoporosis continues to rise, leading to a significant increase in fracture risk. Osteoporotic vertebral compression fractures (OVCFs) have become a common condition among the elderly, severely impacting patients' health and quality of life. Percutaneous vertebroplasty (PVP) is a widely adopted clinical treatment for OVCFs, recognized as a safe and effective minimally invasive procedure with fewer complications<sup>[1]</sup>. However, due to factors such as trauma, soft tissue injury, and bone cement leakage, patients often experience residual postoperative pain, resulting in prolonged bed rest and impaired functional recovery.

Currently, Western medications like celecoxib are commonly used for pain relief, offering rapid efficacy but limited long-term applicability due to adverse effects.

Traditional Chinese Medicine (TCM) attributes postoperative residual pain after PVP to the categories of “bone impediment” and “lumbar pain”, with pathogenesis involving tendon-bone injury, Qi-blood stagnation, and meridian blockage. Recent studies suggest a close relationship between the Shaoyang meridian and the skeletal system. The Yellow Emperor’s Inner Canon proposes the theory that “Shaoyang governs bones”, highlighting the critical role of Shaoyang meridian Qi in bone growth, repair, and pain modulation <sup>[2]</sup>. Based on this theory, the Shaoyang Zhugu Formula, designed to regulate pivot mechanisms, promote Qi-blood circulation, and nourish tendons and bones, has demonstrated unique advantages in treating orthopedic disorders.

Given this background, this study explores the therapeutic effects of the Shaoyang Zhugu Formula on residual pain after PVP, grounded in the “Shaoyang governs bones” theory. The findings are reported as follows.

## **2. Materials and methods**

### **2.1. General information**

A total of 60 patients with osteoporotic vertebral compression fractures (OVCF) who were treated or hospitalized in the Second Orthopedics Ward and Preventive Treatment Center of Chuxiong Prefecture Hospital of Traditional Chinese Medicine from January 2024 to December 2024 were enrolled. They were divided into two groups (30 patients each) using a lottery method, which is as follows: (1) Control group: Seven male and twenty-three female patients, aged 60–90 years (mean:  $73.82 \pm 2.16$ ), disease duration ( $7.62 \pm 1.37$ ) days. (2) Observation group: Eleven male and nineteen female patients, aged 53–90 years (mean:  $70.7 \pm 2.18$ ), disease duration ( $7.59 \pm 1.38$ ) days.

There were no statistically significant differences in baseline data between the two groups ( $P > 0.05$ ), allowing for comparative analysis.

#### **2.1.1. Inclusion criteria**

- (1) Met the diagnostic criteria for OVCF, confirmed by X-ray, CT, or MRI, and underwent percutaneous vertebroplasty (PVP).
- (2) No recent use of other analgesic medications.
- (3) Voluntarily participated in the study.
- (4) Able to cooperate and complete the treatment cycle.

#### **2.1.2. Exclusion criteria**

- (1) Non-osteoporotic fractures.
- (2) Allergy to study drug components.
- (3) Severe cardiac, hepatic, or renal insufficiency.
- (4) Mental disorders or cognitive impairment affecting treatment compliance.

## **2.2. Methods**

### **2.2.1. Control group**

A single-drug treatment regimen was adopted, in which celecoxib capsules (Pfizer Pharmaceuticals Ltd., National Medicine Approval No. J20140072, specification: 0.2 g/capsule) were administered orally. The specific dosing protocol was as follows: 0.2 g once daily, taken in the morning on an empty stomach with warm water to ensure rapid



drug absorption. The treatment course lasted 3 days, and medication was discontinued after 2 consecutive courses.

### 2.2.2. Observation group

An integrated traditional Chinese and Western medicine treatment strategy was implemented. In addition to the celecoxib capsules (same dosage and administration as the control group), the Shaoyang Zhugu Formula was applied for synergistic intervention. The Shaoyang Zhugu Formula consisted of the following herbs: Chaihu (*Bupleurum*) 10 g, Banxia (*Pinellia ternata*, processed) 10 g, Dangshen (*Codonopsis pilosula*) 10 g, Gancao (*Glycyrrhiza uralensis*) 6 g, Huangqin (*Scutellaria baicalensis*) 6 g, Dazao (*Ziziphus jujuba*) 10 g, Gusuibu (*Drynaria fortunei*) 10 g, Huainiuxi (*Achyranthes bidentata*) 6 g, Shanzhuyu (*Cornus officinalis*) 10 g.

The hospital pharmacy uniformly prepared the decoction using a standardized decoction machine. Each dose was boiled to yield 400 mL of medicinal liquid, divided into 2 bags (200 mL each). The administration method was twice daily (1 bag in the morning and 1 bag in the evening, with a 12-hour interval), taken warm 30 minutes after meals to minimize gastrointestinal irritation. Medication was discontinued after 2 consecutive courses.

## 2.3. Observation indicators

- (1) Degree of pain: Use the Visual Analog Scale (VAS) to quantitatively evaluate the degree of pain in both groups before treatment and after two courses of treatment. This scale ranges from 0 to 10, where 0 represents no pain and 10 represents unbearable severe pain. The score is positively correlated with the intensity of pain.
- (2) Therapeutic effect of TCM syndromes: Adopt the criteria for grading the efficacy of TCM syndromes as outlined in Article 7 of the “Guiding Principles for Clinical Research on New Drugs of Traditional Chinese Medicine.” If the improvement ratio of symptom scores is higher than 90%, it is considered cured. If symptoms are reduced by 70% or more, it is judged as significantly effective. If the symptom score decreases by more than 30%, it is judged as effective. Below this standard range is considered ineffective<sup>[3]</sup>. The total effective rate is calculated as the percentage of the sum of cured, significantly effective, and effective cases out of the total number of cases.
- (3) Improvement of low back pain and function: Before and after treatment, use the Japanese Orthopaedic Association (JOA) scoring system to evaluate improvement. This scoring system includes four dimensions: subjective symptoms covering lower back pain, lower extremity pain, and gait abnormalities; clinical signs including the results of the straight leg raising test, sensory function, and limitations in motor function; limitations in activities of daily living; and assessment of bladder function. The total JOA score is 29 points. A higher score indicates better functional improvement, quantitatively reflecting the improvement in the patient’s condition.
- (4) Adverse reactions: Observe and record adverse reactions such as nausea, dizziness, fever, and soft tissue pain that occur during the study period.

## 2.4. Statistical methods

Statistical analysis was performed using SPSS 25.0 software. The pain level and JOA scores were presented as mean  $\pm$  standard deviation, and differences between data were tested using the t-test. The efficacy of TCM syndrome scores and adverse reactions were presented as frequency (n) and percentage (%), and further analyzed using the chi-square ( $\chi^2$ ) test. A P-value  $< 0.05$  was considered statistically significant.

### 3. Results

#### 3.1. Comparison of pain levels before and after treatment in both groups

There was no statistically significant difference in VAS scores between the two groups before treatment and after the first course of treatment ( $P > 0.05$ ). However, after the second course of treatment, the VAS score in the observation group was lower compared to the control group ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of pain levels (VAS) scores before and after treatment in both groups ( $\bar{x} \pm S$ , score)

Group	Cases (n)	Before treatment	After 1st course	After 2nd course
Study group	30	4.33 $\pm$ 1.34	2.61 $\pm$ 1.17*	1.97 $\pm$ 0.92*
Control group	30	4.31 $\pm$ 1.36	2.72 $\pm$ 1.25*	2.52 $\pm$ 1.03*
$\chi^2$ value	-	0.057	0.352	2.181
P-value	-	0.954	0.033	0.033

Note: Compared with before treatment, \* $P < 0.05$

#### 3.2. Comparison of the efficacy of TCM syndrome scores before and after treatment between the two groups

After two courses of treatment, the effective treatment rate of the observation group was significantly higher than that of the control group (93.33%  $>$  73.33%,  $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of the efficacy of TCM syndrome scores before and after treatment between the two groups (n,%)

Group	n	Cured	Markedly effective	Effective	Ineffective	Total effective (%)
Study group	30	0	2	26	2	28 (93.33)
Control group	30	0	1	21	8	22 (73.33)
t	-					4.32
P	-					0.038

#### 3.3. Comparison of JOA scores before and after treatment between the two groups

There was no statistically significant difference in JOA scores between the two groups before treatment ( $P > 0.05$ ). After two courses of treatment, the JOA scores of the observation group were higher than those of the control group ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of JOA scores before and after treatment between the two groups ( $\bar{x} \pm S$ , score)

Group	Cases (n)	Baseline	After 1st course	After 2nd course
Study group	30	12.67 $\pm$ 3.25	16.42 $\pm$ 2.87	22.23 $\pm$ 2.56
Control group	30	12.84 $\pm$ 3.32	14.37 $\pm$ 2.51	19.97 $\pm$ 2.31
$\chi^2$ value	-	0.200	2.945	3.590
P-value	-	0.842	0.005	0.001

### 3.4. Comparison of adverse reactions between the two groups of patients

After treatment, the incidence of adverse reactions in the observation group was better than that in the control group ( $3.33\% < 20.0\%$ ,  $P < 0.05$ ), as shown in **Table 4**.

**Table 4.** Comparison of adverse reactions between the two groups of patients (n,%)

Group	n	Nausea	Dizziness	Fever	Soft tissue pain	Total incidence (%)
Treatment group	30	1	0	0	0	1 (3.33)
Control group	30	3	2	0	1	6 (20.00)
<i>t</i> -value	-					4.043
<i>P</i> -value	-					0.044

## 4. Discussion

Osteoporotic vertebral compression fractures (OVCF) are a common skeletal disease among the elderly. As the mainstream clinical treatment, percutaneous vertebroplasty (PVP) can quickly stabilize fractures and relieve pain, but the incidence of residual pain after surgery is as high as 20% to 40%. Residual pain not only leads to long-term bed rest, delays the recovery process but also may cause complications such as muscle atrophy and deep vein thrombosis, seriously affecting the quality of life<sup>[4, 5]</sup>. Currently, non-steroidal anti-inflammatory drugs (such as celecoxib) are commonly used clinically to relieve pain, but long-term use can have adverse effects, affecting their application effectiveness. The theory of “Shaoyang governing the bones” originates from the “Huangdi Neijing” (Yellow Emperor’s Inner Canon of Medicine), emphasizing that the Shaoyang meridian plays a key role in bone physiological functions and injury repair by regulating Qi and blood circulation and relaxing muscles and bones<sup>[6]</sup>. The Shaoyang governing bone prescription uses Chai Hu (*Bupleurum*), Huang Qin (*Scutellaria*) to reconcile the Shaoyang, bai shao (*Paeoniae Radix Alba*), Ge Gen (*Puerariae Radix*) to soften tendons and urgently relax them, Gu Sui Bu (*Drynariae Rhizoma*), and Yan Hu Suo (*Corydalis Rhizoma*) to nourish the kidneys, promote blood circulation, and relieve pain. The entire prescription works together to harmonize Qi and blood, facilitate the pivotal function, nourish muscles and bones, which is consistent with the treatment goals of modern medicine: anti-inflammatory and analgesic effects, and promoting tissue repair.

The results of this study showed that in terms of improving pain levels, the VAS of the observation group was significantly lower than that of the control group after treatment ( $P < 0.05$ ). This may be attributed to the synergistic effect of combined Chinese and Western medicine treatment. Celecoxib reduces prostaglandin synthesis by inhibiting cyclooxygenase-2, quickly exerting anti-inflammatory and analgesic effects. The Chai Hu (*Bupleurum*) and Huang Qin (*Scutellaria*) in the Shaoyang governing bone prescription have the effect of regulating inflammatory factors, while Bai Shao (*Paeoniae Radix Alba*) and Yan Hu Suo (*Corydalis Rhizoma*) can exert analgesic effects by regulating neurotransmitter release. The combination of the two can quickly relieve pain and regulate body functions holistically, enhancing the analgesic effect. Comparison of the efficacy of TCM syndrome scores showed that the effective rate of treatment in the observation group (93.33%) was significantly higher than that in the control group (73.33%,  $P < 0.05$ ). This result confirms the advantage of the Shaoyang governing bone prescription in improving TCM syndromes. This prescription targets the pathogenesis of “Qi and blood stagnation, pivot dysfunction” after OVCF surgery. It restores qi and blood circulation through Chai Hu (*Bupleurum*) and Huang Qin (*Scutellaria*), harmonizing the Shaoyang pivot. Gu Sui Bu (*Drynariae Rhizoma*)

nourishes the kidneys and strengthens the bones, promoting fracture repair, thereby improving the effect of TCM syndromes<sup>[7, 8]</sup>.

The JOA score results showed no significant difference between the two groups before treatment ( $P > 0.05$ ). However, after treatment, the JOA scores of the observation group were higher than those of the control group at the end of the 1st and 2nd courses of treatment ( $P < 0.05$ ), suggesting that the combined therapy has more advantages in improving waist function. This may be because *Radix Puerariae* and *Radix Paeoniae Alba* in the Shaoyang Zhugu formula can relax muscles and alleviate spasms, reducing the limitation of waist movement caused by pain. Meanwhile, kidney-tonifying herbs such as *Rhizoma Drynariae* can promote bone metabolism and accelerate fracture healing, synergistically working with the analgesic effect of Celecoxib to more effectively restore patients' waist function<sup>[9]</sup>. In terms of adverse reactions, the incidence of adverse reactions in the observation group was lower than that in the control group ( $3.33\% < 20.0\%$ ,  $P < 0.05$ ), indicating that the combined therapy of traditional Chinese and Western medicine can reduce the dosage and side effects of Western medicine, thereby reducing the risk of adverse reactions<sup>[10]</sup>.

## 5. Conclusion

In summary, the combined therapy of traditional Chinese and Western medicine based on the “Shaoyang Zhugu” theory has shown good application effects in relieving residual pain after vertebroplasty, improving TCM syndromes, promoting functional recovery, and ensuring safety. It can be further applied in clinical practice.

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## Disclosure statement

The authors declare no conflict of interest.

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# Research on the Clinical Application Value of Peripherally Inserted Central Catheter (PICC) after Radical Gastrectomy

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**Abstract:** *Objective:* Patients after radical gastrectomy often require medium- to long-term intravenous therapy. However, traditional central venous catheters (CVCs) have issues such as high infection risk and poor comfort. This study aims to deeply explore the clinical application value of peripherally inserted central catheters (PICCs) after radical gastrectomy, providing a scientific basis for optimizing intravenous access selection. *Methods:* Fifty patients requiring catheterization after radical gastrectomy at the Friendship Hospital of Ili Kazak Autonomous Prefecture from December 2022 to May 2024 were selected. Catheterization site selection was based on patients' preferences, dividing them into two groups: the experimental group receiving PICCs and the control group receiving CVCs, with 25 patients in each group. Multi-dimensional comparative analysis was conducted, including catheterization operation time, catheter indwelling time, success rates of first and second catheterizations, and complication rates. Statistical methods such as t-tests and chi-square tests were used for in-depth analysis. *Results:* Compared to the control group, the experimental group had longer catheterization operations and catheter indwelling times, and a higher success rate of first catheterization ( $P < 0.05$ ). The incidence of catheterization complications in the experimental group was 12.00%, lower than the 40.00% in the control group ( $P < 0.05$ ). *Conclusion:* Although PICC catheterization after radical gastrectomy has relatively longer catheterization operation and indwelling times, it has a high success rate of first catheterization and a low complication rate, demonstrating high clinical application value and worth promoting in clinical practice.

**Keywords:** Peripherally inserted central catheter (PICC); Central venous catheter (CVC); Post-radical gastrectomy

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## 1. Introduction

Gastric cancer is one of the common malignancies worldwide, and its incidence rate has ranked fifth globally according to surveys<sup>[1, 2]</sup>. Currently, radical gastrectomy is the primary treatment for gastric cancer, but long-term nutritional support, chemotherapy, and other treatments are required after surgery, which demands a high standard for intravenous access<sup>[2]</sup>. Although traditional peripheral intravenous indwelling needles are easy to operate, they

have limitations such as short indwelling time and inability to withstand the infusion of hyperosmolar or irritating drugs, making them difficult to meet the medium and long-term intravenous treatment needs of patients after radical gastrectomy. Central venous catheterization technology provides an effective way to solve this problem. According to surveys, PICC and CVC have similar frequencies of use in intravenous treatment vascular access devices, which are 5.31% and 4.34%, respectively, and both are common intravenous puncture methods for malignant tumor chemotherapy<sup>[3]</sup>. CVC involves inserting a catheter into the central vein through skin puncture and is suitable for central venous pressure measurement, short-term infusion, drug therapy, and interventional therapy<sup>[4]</sup>. PICC, on the other hand, is a technique that involves puncturing through the arm vein, with the catheter extending directly to the large vein. The advantage of this method is that it can effectively prevent chemotherapy drugs from damaging the arm veins while promoting rapid drug dilution<sup>[5]</sup>. To clarify the advantages and disadvantages of the two methods, this study will analyze the catheterization situation in our department from aspects such as catheterization success rate, indwelling time, and related complications after catheterization, in order to determine the best catheterization approach to serve tumor patients.

## **2. Materials and methods**

### **2.1. General information**

Fifty patients requiring post-gastric cancer radical surgery with catheterization for chemotherapy in the hospital from June 2022 to June 2024 were selected. Detailed education was provided to each patient, explaining the purposes, precautions, and economic burdens of PICC and CVC catheterization. Based on the patients' own preferences, they were divided into an experimental group (PICC) and a control group (CVC). Each group consisted of 25 patients. The experimental group's age ranged from 30 to 70 years, with an average of  $(48.52 \pm 2.01)$ ; the male-to-female ratio was 16/9. The control group's age ranged from 31 to 69 years, with an average of  $(48.65 \pm 1.98)$ ; the male-to-female ratio was 17/8. There were no statistically significant differences in the general information between the two groups ( $P > 0.05$ ).

### **2.2. Inclusion and exclusion criteria**

#### **2.2.1. Inclusion criteria**

- (1) Patients who underwent gastric cancer radical surgery in our hospital and had a need for central venous catheterization after surgery<sup>[6]</sup>.
- (2) Age over 18 years.
- (3) All patients provided informed consent.

#### **2.2.2. Exclusion criteria**

- (1) Patients with coagulation disorders.
- (2) Patients with skin damage or infection at the puncture site.
- (3) Patients with venous thrombosis at the catheterization site.

## **2.3. Methods**

### **2.3.1. Control group**

CVC catheterization was performed. The operating procedure was as follows: The patient was placed in a supine

position, with the head turned to the contralateral side and lowered by approximately 20° to 30°. The puncture site (i.e., the apex of the sternocleidomastoid muscle triangle) was carefully cleaned and disinfected, and 1% lidocaine was injected for anesthesia. A 16G puncture needle (produced by Zhuhai Fonia Medical Equipment Co., Ltd. (Sino-US joint venture)) was then inserted at an angle of 30° to 45° relative to the skin, with the needle tip pointing towards the ipsilateral nipple or the intersection of the middle and inner 1/3 of the clavicle. The needle was advanced while aspirating, and venous return of blood indicated that the internal jugular vein had been entered. A pressure measurement needle was placed. If no pulsatile blood return was observed, a guidewire was inserted, and the puncture needle was then withdrawn. A dilator was used to expand the subcutaneous tissue, and after dilation, the dilator was withdrawn. The central venous catheter was placed along the guidewire, and after confirming that the catheter was unobstructed, normal saline was injected to seal the tube, which was then connected to a heparin cap for future use. Finally, the puncture site was covered with sterile gauze and fixed with adhesive tape.

### **2.3.2. Experimental group**

PICC catheterization was performed. The operating procedure was as follows: The patient was placed in a supine position and kept relaxed. The arm on the puncture side was abducted at 90°. Based on the length of the catheter and the patient's body type, an appropriate location on the upper arm (preferably the medial basilic vein) was selected as the puncture site. The puncture site was carefully cleaned and disinfected. Sterile drapes were routinely placed, and the operator wore sterile gloves to ensure that the entire procedure was performed in a sterile environment. The PICC catheter was manufactured by Bard Access System, Inc. (National Medical Device Registration No. 20173771671). A 14-G puncture needle was used for the routine puncture operation. When blood return was observed, the angle of the puncture needle was lowered, and it was advanced into the vessel by 1–2 cm. The PICC catheter was gradually inserted into the vein along the guidewire. The catheter was inserted with uniform and slow force, avoiding violent insertion. The catheter was left in place outside the body for 6–8 cm. Finally, the puncture site was covered with a sterile transparent film, and an elastic bandage was used for dressing.

### **2.4. Observation indicators**

Compare the catheterization operation time, catheter indwelling duration, and the success rate of one-time and second-time catheterization between the two groups of patients. At the same time, record the number of cases of catheterization complications in each group.

### **2.5. Statistical analysis**

SPSS 20.0 statistical software was used to process the data. The count data was presented in the form of a percentage (%), and the chi-square test method was used. The measurement data were expressed as ( $\bar{x} \pm s$ ) and analyzed using the t-test.  $P < 0.05$  was considered statistically significant.

## **3. Results**

### **3.1. Catheterization operation time and catheter indwelling time**

As shown in **Table 1**, compared with the control group, the experimental group had a significantly longer catheterization operation time and a longer catheter indwelling time ( $P < 0.05$ ).

**Table 1.** Comparison of catheterization operation time and catheter indwelling time between the two groups  
( $\bar{x} \pm s$ )

Group	Number of cases	Catheterization operation time (min)	Catheter indwelling time (d)
Experimental group	25	12.14 $\pm$ 2.14	179.15 $\pm$ 3.65
Control group	25	8.04 $\pm$ 2.28	5.54 $\pm$ 1.89
<i>t</i> -value		6.556	28.268
<i>p</i> -value		< 0.001	< 0.001

### 3.2. Success rate of catheterization

As shown in **Table 2**, the success rate of one-time catheterization in the experimental group (96.00%) was higher than that of the control group (76.00%) ( $P < 0.05$ ).

**Table 2.** Comparison of success rate of catheterization between the two groups [n(%)]

Group	Number of cases	First attempt success	Second attempt success
Experimental group	25	24 (96.00)	1 (4.00)
Control group	25	19 (76.00)	6 (24.00)
$\chi^2$ (Chi-square)		4.153	4.153
<i>p</i> -value		0.042	0.042

### 3.3. Catheter-related complications

As shown in **Table 3**, the incidence rate in the experimental group was 12.00%, which was lower than that in the control group (40.00%) ( $P < 0.05$ ).

**Table 3.** Comparison of the incidence of catheter-related complications between the two groups [n(%)]

Group	Number of cases	Local tissue injury	Phlebitis	Others	Total incidence
Experimental group	25	1	0	2	12.00%
Control group	25	3	3	4	40.00%
$\chi^2$ (Chi-square)					5.094
<i>p</i> -value					0.024

## 4. Discussion

Gastric cancer is a highly prevalent malignant lesion of the digestive tract, originating from the gastric mucosal epithelium. It particularly occurs in the gastric antrum region and may spread to the anterior and posterior walls as well as the greater and lesser curvatures of the stomach. Currently, radical gastrectomy is the core treatment method for this disease, and post-surgical patient management and care are equally crucial <sup>[7]</sup>. Central venous catheterization is a crucial approach for post-surgical monitoring, treatment, and nutritional support. Its selection and application directly affect the recovery effectiveness and prognosis quality of patients. Studies have shown that patients using PICC have a significantly lower risk of catheter-related infections compared to CVC patients <sup>[8]</sup>.

However, another study revealed that in parenteral nutrition support for colorectal cancer patients, CVC puncture operation time is superior to PICC <sup>[9]</sup>. Both PICC and CVC are catheter techniques that directly enter the central veins. They can effectively reduce the suffering of chemotherapy patients, improve their quality of life, and enhance the acceptance of catheter use.

In this study, the catheterization operation time of the experimental group ( $12.14 \pm 2.14$ ) minutes was longer than that of the control group ( $8.04 \pm 2.28$ ) minutes ( $P < 0.05$ ). The reason for this is analyzed as follows: The longer operation time for PICC is mainly due to the need for detailed vascular assessment, accurate external measurements, catheter tip positioning, and other steps. Compared to CVC, the puncture process of PICC is more delicate and requires operators to have rich experience and skilled techniques. Additionally, although ultrasound-guided PICC catheterization can improve the success rate and accuracy of puncture, it also requires some time to adjust the position of the ultrasound probe and puncture needle. To improve the operational efficiency of PICC, it is possible to strengthen the training of medical staff, enhance their operational skills, and proficiency. Meanwhile, the introduction of advanced auxiliary equipment and technology, such as blood vessel visualization equipment and magnetic navigation positioning systems, can help operators more accurately locate blood vessels and catheter tips, thereby reducing operation time. Furthermore, optimizing the operational process and reasonably arranging the time for each link can also improve the overall operational efficiency.

Patients who have undergone radical surgery for gastric cancer typically require long-term nutritional support, chemotherapy, and other treatments. Extended catheter indwelling time can reduce the pain and fear associated with repeated punctures, enhancing patient comfort and quality of life. Simultaneously, it diminishes the risk of infection and medical expenses arising from repeated catheter placements, which is beneficial for patient recovery and treatment. This study revealed that the catheter indwelling time in the experimental group ( $179.15 \pm 30.65$  minutes) was longer than that in the control group ( $5.54 \pm 1.89$  minutes) ( $P < 0.05$ ). Furthermore, the success rate of single-attempt catheter placement was significantly higher in the experimental group (96.00%) compared to the control group (76.00%) ( $P < 0.05$ ), aligning with the findings reported by Zhang <sup>[10]</sup>. The analysis attributed this to the selection of the basilic vein in the experimental group, which is located in the upper extremity, relatively superficial, and easy to observe and palpate. This facilitated more accurate blood vessel localization and puncture by the operator, thereby increasing the success rate of catheter placement.

Conversely, the internal jugular vein chosen in the control group, although also a central vein, has a more complex anatomical structure in the neck region with surrounding crucial nerves and arteries. The need to precisely avoid these structures during puncture increases the difficulty and contributes to a lower success rate of single-attempt catheter placement. For instance, improper needle insertion angle or depth during internal jugular vein puncture can easily damage the adjacent vagus nerve, triggering a vagal reflex that may cause adverse reactions such as decreased heart rate and blood pressure, while also potentially affecting the success rate of catheter placement. Additionally, the basilic vein, as one of the main veins in the upper extremity, has a relatively large diameter and moderate blood flow velocity, favoring smooth catheter insertion. Although the internal jugular vein is also a large blood vessel, due to its special location, fast blood flow velocity, and the influence of neck movement, it may cause instability during catheter placement, thereby reducing the success rate of catheterization. Patients after radical gastrectomy may experience instability in physical condition and poor vascular filling due to surgical trauma, the use of anesthetic drugs, and postoperative pain.

During CVC catheterization, the proximity of the puncture site to the neck may cause patients to turn their heads or experience rapid breathing due to tension or pain, increasing the difficulty of the procedure. In contrast,



during PICC catheterization, the patient's arm on the puncture side is abducted at 90 degrees, and the body remains relatively relaxed, facilitating the operation. Additionally, after PICC placement, patients can resume daily activities with minimal disruption to their lives, making them more likely to accept and comply with the procedure, thereby helping to prolong catheter retention. Regarding post-catheterization complications, this study found that the incidence rate in the experimental group (12.00%) was significantly lower than that in the control group (40.00%) ( $P < 0.05$ ). The analysis suggests that the PICC catheter, which extends from a peripheral vein directly into large vessels such as the superior vena cava, is soft and has good biocompatibility, minimizing mechanical irritation to the vascular wall. Moreover, its external segment of 6–8 cm allows for easy observation of the catheter position, and the sterile transparent film effectively isolates the puncture site from the external environment, reducing infection risks. In contrast, the CVC catheter is located in the neck, close to contaminated areas such as the oral and nasal cavities, and the sterile gauze covering the puncture site provides poor fixation. This increases the likelihood of catheter displacement or dressing loosening due to patient movement, raising the risk of phlebitis and local tissue damage.

## 5. Conclusion

In summary, the application of PICC catheterization after radical gastrectomy, although the catheterization operation and indwelling time are relatively long, has a high success rate of one-time catheterization, a low incidence of complications, and high clinical application value, which is worthy of promotion and application in clinical practice.

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## Disclosure statement

The authors declare no conflict of interest.

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# Clinical Application of Denghuo Moxibustion in Treating Post-Stroke Constipation

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**Abstract:** *Objective:* To study the clinical application of Denghuo moxibustion in treating post-stroke constipation. *Methods:* This study included 50 patients with post-stroke constipation admitted from October 2020 to December 2021. They were randomly divided into two groups using the envelope method: 25 patients in the observation group and 25 patients in the control group. The control group received only lactulose, while the observation group received Denghuo moxibustion in addition to lactulose. The efficacy, quality of life (PAC-QOL scale), and laboratory indicators [serum substance P (SP) and vasoactive intestinal peptide (VIP)] were compared between the two groups. *Results:* The efficacy of the observation group was significantly better than that of the control group ( $P < 0.05$ ). After treatment, the PAC-QOL scores of both groups decreased significantly, and the improvement in the observation group was more significant ( $P < 0.05$ ). Changes in laboratory indicators showed that VIP decreased significantly and SP increased significantly in both groups, and the improvement of these two indicators in the observation group was significantly better than that in the control group ( $P < 0.05$ ). *Conclusion:* Denghuo moxibustion can enhance the efficacy of lactulose by regulating intestinal neuropeptides and is an effective treatment for post-stroke constipation.

**Keywords:** Stroke; Constipation; Denghuo moxibustion; Clinical application

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## 1. Introduction

Stroke is a common cerebrovascular disease that seriously harms human health, with high morbidity, disability, and mortality rates. Among survivors, constipation is an extremely common complication<sup>[1]</sup>. Post-stroke constipation brings significant pain to patients, such as difficulty defecating, abdominal distension, and abdominal pain. It also has a broad and profound negative impact on their psychological state, physiological functions, and even the rehabilitation process: it may not only exacerbate depression and anxiety in patients but in severe cases, it may even trigger cardiovascular and cerebrovascular events such as recurrent strokes, greatly impairing patients' quality of life<sup>[2]</sup>. Therefore, actively seeking safe and effective treatment methods to improve post-stroke constipation is crucial for enhancing patients' overall prognosis and quality of life. Currently, there are various clinical treatments for post-stroke constipation, mainly including drug therapy, rehabilitation training, and external therapies in traditional Chinese medicine<sup>[3]</sup>. Among them, the osmotic laxative lactulose is a commonly used drug. Although it has certain efficacy, long-term use has limitations, such

as possible adverse reactions including drug dependence and electrolyte imbalance <sup>[4]</sup>. External therapies in traditional Chinese medicine, especially fire moxibustion, show potential in regulating gastrointestinal function due to their unique effects of warming and unblocking meridians and harmonizing qi and blood <sup>[5]</sup>. Given the above background, this study aims to explore whether combining fire moxibustion therapy with conventional lactulose treatment can bring more significant clinical benefits to patients with post-stroke constipation.

## 2. Methods and materials

### 2.1. General information

Fifty patients with post-stroke constipation admitted to our hospital from October 2020 to December 2021 were selected. They were randomly divided into two groups using the envelope method: 25 patients in the observation group and 25 patients in the control group. There was no statistically significant difference in basic information between the two groups ( $P > 0.05$ ), as shown in **Table 1**. This study was approved by the hospital ethics committee. This study complies with the relevant ethical principles of the Helsinki Declaration.

**Table 1.** Comparison of general information between the two groups ( $\bar{x} \pm s/n$ )

Characteristics	Observation group (n=25)	Control group (n=25)	$t/\chi^2$	p-value
Gender (Male/Female)	13/12	14/11	0.081	0.777
Age (years)	61–78	60–79	0.086	0.932
	69.15 $\pm$ 3.45	69.21 $\pm$ 3.36		

### 2.2. Inclusion and exclusion criteria

#### 2.2.1. Inclusion criteria

- (1) Meet the diagnostic criteria for cerebral infarction/cerebral hemorrhage and confirmed by CT/MRI.
- (2) Meet the Rome IV diagnostic criteria for functional constipation.
- (3) Aged between 18 and 80 years old.
- (4) Signed informed consent.

#### 2.2.2. Exclusion criteria

- (1) Non-stroke-related constipation (such as intestinal obstruction, tumors, etc.).
- (2) Combined with severe liver and kidney dysfunction.
- (3) Abdominal skin damage or infection.
- (4) Participation in other clinical trials within 30 days.

### 2.3. Methods

Both groups received daily specialized nursing and rehabilitation training for 2 weeks, including dietary guidance, regular bowel training, bedside standing, and exercise therapy. The control group patients received lactulose treatment: The initial dose of lactulose oral solution was 15 milliliters per day, taken orally in a single dose after breakfast. Based on the patient's bowel reaction and tolerance, the dose could be adjusted after 3 days of treatment, maintaining a dose range of 10 to 30 milliliters per day, taken in 1 to 2 divided doses after meals.

Intervention in the observation group: Moxibustion with lamp fire was added on the basis of the above

treatment. The patient was placed in a supine position, with the Tianshu acupoint (1.5 inches away from the navel) exposed, and the local skin was evaluated. After marking the acupoint, a 3–4 cm long wick was taken, with one end immersed in vegetable oil for about 1 cm, and the excess oil was wiped off to prevent burns. The operator held the upper end of the wick and ignited the oil-soaked end. When the flame grew larger, the marked point was quickly and vertically ignited with moderate force and appropriate distance. A successful ignition was accompanied by a “pop” sound and self-extinguishing, which was called a “Jiao”. If there was no sound, another nearby point was chosen for moxibustion. Each acupoint was usually ignited once. The treatment sequence was from top to bottom, from back and waist to chest and abdomen, and from torso to limbs. Around 5–7 treatments constituted one course of treatment. Skin redness or blisters might appear after moxibustion, so it was necessary to keep the area clean to prevent infection.

## **2.4. Observation indicators**

All subjects were required to collect 5ml of elbow venous blood on an empty stomach in the early morning. After the samples were left to stand and coagulate, they were centrifuged at 3000 rpm for 10 minutes at 4°C to separate the serum. The serum was then aliquoted and stored in a -80°C freezer for future testing.

### **2.4.1. Therapeutic effect**

Observe and compare the therapeutic effects of the two groups of patients.

- (1) Cure: Patients can defecate independently, with a defecation frequency returning to once every 1–2 days. Defecation is smooth and unobstructed, and the stool is normal and soft. Symptoms such as abdominal distension and abdominal pain related to post-stroke constipation have completely disappeared.
- (2) Markedly effective: Patients can defecate independently, with a defecation frequency maintained at approximately once every 2 days. The defecation process is relatively smooth, stool consistency has softened, and major symptoms such as abdominal distension and abdominal pain related to post-stroke constipation have been significantly alleviated.
- (3) Effective: Patients can defecate independently, with improved defecation frequency compared to before treatment, reaching once every 3 days. The defecation process is relatively smooth, stool has gradually softened from being dry and hard, and symptoms such as abdominal distension and abdominal pain related to post-stroke constipation have been reduced to varying degrees.
- (4) Ineffective: Patients are still unable to achieve independent defecation, or there is no significant improvement in defecation frequency, smoothness, stool consistency, and related symptoms compared to before treatment, or even worsening. Total effective rate = (number of cured cases + number of markedly effective cases + number of effective cases) / total number of cases × 100%.

### **2.4.2. Quality of life**

Observe and compare the quality of life of patients in both groups before and after treatment, using the Patient Assessment of Constipation Quality of Life (PAC-QOL) questionnaire. This questionnaire covers four dimensions: physical discomfort, psychosocial discomfort, satisfaction with treatment, and concerns/worries. It contains a total of 28 items, with each item rated on a Likert scale of 5 points (from 0 to 4). The total score ranges from 0 to 112, with higher scores indicating a more severe negative impact of constipation on the patient’s quality of life, i.e., poorer quality of life.

### **2.4.3. Laboratory indicators**



Observe and compare the laboratory indicators of patients in both groups before and after treatment. Use Enzyme-Linked Immunosorbent Assay (ELISA) to strictly follow the kit instructions and measure the concentration levels of serum Substance P (SP) and Vasoactive Intestinal Peptide (VIP). Implement a double-blind principle during the detection process and set up standard controls to ensure the accuracy of the results.

## 2.5. Statistical methods

Statistical analysis was performed using SPSS 21.0 software package. Measurement data were expressed as mean  $\pm$  standard deviation (SD) if they followed a normal distribution. Comparisons between groups were made using the t-test for continuous variables and the chi-square test ( $\chi^2$ ) for categorical variables. A *P*-value less than 0.05 was considered statistically significant.

## 3. Results

### 3.1. Comparison of therapeutic effects between the two groups

The observation group's therapeutic effect was superior to the control group ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of therapeutic effects between the two groups [n(%)]

Group	Sample Size (n)	Cured n (%)	Markedly Effective n (%)	Effective n (%)	Ineffective n (%)	Total Effective n (%)
Observation group	25	13 (52.00)	6 (24.00)	5 (20.00)	1 (4.00)	24 (96.00)
Control group	25	3 (12.00)	8 (32.00)	7 (28.00)	7 (28.00)	18 (72.00)
$\chi^2$	-	-	-	-	-	5.357
<i>p</i> -value	-	-	-	-	-	0.021

### 3.2. Comparison of quality of life between the two groups

There was no difference in the quality of life between the two groups before intervention ( $P > 0.05$ ). After treatment, their PAC-QOL scores decreased significantly, and the decrease in the observation group was greater than that in the control group ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of quality of life before and after treatment between the two groups ( $\bar{x} \pm s$ )

Group	Sample size (n)	Before treatment	After treatment
Observation group	25	84.15 $\pm$ 10.25	36.15 $\pm$ 7.15*
Control group	25	83.91 $\pm$ 9.18	45.15 $\pm$ 8.44*
<i>t</i> -value	-	0.087	4.068
<i>p</i> -value	-	0.931	< 0.001

Note: Compared with the same group before treatment, \* $P < 0.05$

### 3.3. Comparison of laboratory indices levels between the two groups

There was no significant difference in baseline laboratory indices ( $P > 0.05$ ). After intervention, VIP values decreased significantly in both groups, while SP values increased significantly. The changes in these two indices were more pronounced in the observation group ( $P < 0.05$ ), as shown in **Table 4**.

**Table 4.** Comparison of laboratory indices levels before and after treatment between the two groups ( $\bar{x} \pm s$ , pg/mL)

Group	Number of cases (n)	SP		VIP	
		Before treatment	After treatment	Before treatment	After treatment
Observation group	25	29.94 ± 3.16	52.15 ± 8.41*	171.54 ± 5.08	137.15 ± 9.48*
Control group	25	30.22 ± 2.94	40.11 ± 9.08*	170.91 ± 5.15	159.48 ± 11.25*
<i>t</i>	-	0.324	4.864	0.435	7.589
<i>P</i>	-	0.747	< 0.001	0.665	< 0.001

Note: Compared with the same group before treatment, \* $P < 0.05$

## 4. Discussion

Stroke, as a cerebrovascular disease with high disability, significantly increases the incidence of constipation among survivors. This complication not only causes physical pain such as abdominal distension and difficulty in defecation, but also may induce secondary stroke events through forced defecation, seriously affecting the recovery process and quality of life [6]. From a pathological mechanism perspective, central nervous system damage after a stroke can interfere with gut-brain axis signaling, leading to weakened intestinal motility and delayed transmission; meanwhile, factors such as limited patient mobility and changes in diet further exacerbate the retention of intestinal contents, creating a vicious cycle. Therefore, there is a clear clinical need to find safe and effective intervention methods [7].

Currently, osmotic laxative lactulose is often chosen as a basic treatment in clinical practice. It promotes water retention and softens feces by increasing intestinal osmotic pressure, providing short-term symptom relief. However, in this study, the limited effectiveness of lactulose alone in the control group reflects the limitations of drug treatment: on one hand, lactulose cannot repair damaged enteric nervous system function and only symptomatically treats feces properties; on the other hand, long-term use may lead to electrolyte imbalance and drug dependence, which is consistent with the adverse reactions described in the literature [8].

Addressing the limitations of pharmacological therapy, this study introduced lamp-fire moxibustion as a combined intervention. Tianshu acupoint was selected as the core target for moxibustion due to its traditional association with the regulation of intestinal functions as the front-mu point of the large intestine. During the procedure, the burning of rush dipped in vegetable oil produced a double effect: firstly, instantaneous thermal stimulation activated local nerve endings, enhancing the contraction of intestinal smooth muscles through axonal reflex; secondly, bioactive components released during the burning of rush (such as phenanthrene compounds) could be absorbed through the skin, which modern pharmacology has confirmed to have anti-inflammatory and neurotransmitter regulatory effects [9].

The study data showed that lamp-fire moxibustion combined with lactulose significantly optimized clinical outcomes. The total effective rate was improved in the observation group; among laboratory indicators, vasoactive intestinal peptide (VIP) was significantly lower in the observation group than in the control group ( $P < 0.001$ ). As an inhibitory neurotransmitter, the decrease in VIP levels could relieve the inhibition of intestinal smooth muscle relaxation; meanwhile, serum substance P (SP) was higher in the observation group than in the control group ( $P < 0.001$ ). As an excitatory neuropeptide, the increase in SP directly promoted intestinal motility and secretion. This bidirectional regulatory effect overcame the limitation of single drugs that only improve the physical properties of feces, restoring the autonomic regulatory function of the intestine at the neuro-humoral level [10].

The assessment of quality of life further supports the advantages of combination therapy. The reduction in PAC-QOL scores in the observation group was significantly greater than that in the control group. This result covers improvements in multiple dimensions such as physical discomfort, psychological distress, and treatment satisfaction, reflecting that fire moxibustion indirectly reduces patients' anxiety and concerns about complications by alleviating core symptoms (such as abdominal distension and difficulty in defecation), forming a physiologically and psychologically beneficial cycle.

## 5. Conclusion

In summary, fire moxibustion can synergistically enhance the efficacy of lactulose by regulating intestinal neuropeptide levels, and it is an effective treatment for post-stroke constipation.

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## Disclosure statement

The author declares no conflict of interest.

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# Analysis of the Effect of PDCA Cycle Combined with Information Technology on the Treatment Intervention of Chinese Herbal Medicines

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**Abstract:** *Objective:* To explore the effect of the PDCA cycle combined with information technology on the treatment intervention of Chinese herbal medicines. *Methods:* Traditional medication intervention was implemented from July 2022 to June 2023, and 57 patients who received Chinese herbal medicine treatment during this period were selected as the control group. The PDCA cycle combined with information technology was implemented from July 2023 to June 2024, and 56 patients who received Chinese herbal medicine treatment during this period were selected as the experimental group. Various indicators were compared between the two groups. *Results:* The total effective rate of the experimental group was higher, and the incidence of unreasonable prescriptions and adverse reactions was significantly lower than that of the control group. *Conclusion:* The combination of the PDCA cycle and information technology can improve the overall efficacy of Chinese herbal medicines, reduce the incidence of unreasonable prescriptions and adverse reactions, and ensure the safe use of Chinese herbal medicines. It is worthy of promotion and application.

**Keywords:** PDCA cycle; Information technology; Chinese herbal medicines; Safety Chinese library

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## 1. Introduction

Chinese herbal medicines have significant advantages such as efficacy, safety, and low cost, and have shown good results in the treatment of various diseases. However, with the expansion of the clinical application scope of Chinese herbal medicines, issues such as unindicated medication use, species confusion, and unreasonable compatibility have become increasingly prominent. Methods to ensure the safety and effectiveness of Chinese herbal medicine use are a key issue that needs to be addressed in medical institutions<sup>[1]</sup>. The PDCA cycle is a systematic, standardized, and professional evaluation measure developed for the treatment process of Chinese herbal medicines. It can timely identify and correct problems in medication regimens, thereby ensuring medication safety<sup>[2]</sup>. The PDCA cycle is a high-quality and comprehensive intervention method that covers four stages,



including planning and execution, and can continuously improve the quality of intervention to achieve established goals to the maximum extent. It has a wide range of applications and is considered a new method for the treatment intervention of Chinese herbal medicines. The Hospital Information System (HIS) is a relatively intelligent and efficient work system that can provide refined and targeted interventions for medication regimens of Chinese herbal medicines, thereby enhancing the safety of the treatment process and effectively promoting the service level of treatment intervention for Chinese herbal medicines. In this study, 113 patient samples receiving Chinese herbal medicine treatment in the hospital were selected to explore the implementation effect of the PDCA cycle combined with information technology.

## 2. Materials and methods

### 2.1. General information

This study explores the practical effects of combining the PDCA cycle method with information technology through a phased research approach. During the period from July 2022 to June 2023, when traditional medication intervention was implemented, 57 patients were selected as the control group. In the subsequent year when the PDCA cycle method was combined with information technology, 56 patients were chosen as the experimental group. The selected patient samples had clear disease diagnosis conclusions, were able to cooperate with the study, and the data content is shown in **Table 1**.

**Table 1.** Specific clinical data of two groups of patients

Group	Gender ratio (M:F)	Age range (years)	Mean age $\pm$ SD (years)
Test group (n=56)	31:25	33–65	50.08 $\pm$ 4.88
Control group (n=57)	30:27	34–68	50.14 $\pm$ 4.75
<i>p</i> -value	<i>P</i> > 0.05	<i>P</i> > 0.05	<i>P</i> > 0.05

### 2.2. Methods

The control group received traditional medication intervention: The pharmacist in the Chinese medicine dispensary only dispensed Chinese herbal medicine according to the medication plan, briefly informed patients about the mechanism and usage of each Chinese herbal medicine, informed them about common adverse reactions during medication and how to deal with them, and answered patients' questions. The experimental group implemented the PDCA cycle method combined with information technology:

#### 2.2.1. PDCA cycle method

##### (1) Planning

The department head serves as the team leader, whose responsibility is to summarize intervention issues, deeply analyze the causes of the problems, and systematically formulate intervention strategies. Doctors and pharmacists are team members, responsible for summarizing patients' basic information, fully evaluating their treatment intervention needs, regularly providing feedback on patients' opinions, incorporating their correct views, and then reasonably optimizing the intervention content. Comprehensively evaluate common problems with Chinese herbal medicine treatment interventions, such as patients' insufficient understanding of the performance of Chinese herbal medicines, limited

awareness of medication plans, low cooperation in treatment with Chinese herbal medicines, and lack of understanding of standardized medication methods. Led by the team leader, all team members are organized to participate in a collective meeting, review the literature from the past five years, sort out typical cases within the department, list relevant points of Chinese herbal medicine treatment intervention in tabular form, and provide an intervention plan.

(2) Execution

The team leader carries out knowledge training activities, explains the key points of the rational use of Chinese herbal medicines, screens relevant procedures for Chinese herbal medicine treatment interventions, and strictly implements intervention work. Strengthen communication between doctors and pharmacists, jointly discuss issues related to Chinese herbal medicine treatment interventions, and formulate corrective measures. The team leader periodically evaluates the implementation of relevant measures and addresses any unreasonable aspects to ensure medication safety.

(3) Inspection

Following relevant procedures, the team leader regularly inspects the current status of interventions, focusing on evaluating whether the medication methods and dosages are correct. After summarizing any incorrect situations, they will be made public, relevant responsible persons will be identified, and material and spiritual punishments will be imposed. Those who perform well will be rewarded.

(4) Handling

When patients encounter medication problems, doctors and pharmacists will conduct group discussions to evaluate the underlying causes of the problems and provide solutions. Continuous improvement of the medication plan will be carried out, and deficiencies in intervention measures will be summarized weekly. The current problems will be included in the intervention targets of the next cycle to continuously improve the standardization of medication.

### 2.2.2. Information technology

- (1) Regular assessment: According to relevant documents, regularly evaluate the current status of treatment with Chinese herbal decoction pieces at fixed times and locations each month. Evaluate information such as the drug name, drug dosage, rationality of use, dialectical medication, compatibility contraindications, and administration time of the medication plan. The evaluation content should be recorded in detail and comprehensively, and made public collectively within the department. The assessment results will be linked to the performance of the department staff.
- (2) Classified monitoring: Under the guidance of the HIS system, pharmacists are responsible for monitoring the treatment costs and dosages of Chinese herbal decoction pieces, and screening for abnormalities. At the same time, evaluate the usage of expensive and fine decoction pieces as well as toxic decoction pieces, implement a real-time abnormal warning mechanism, and conduct dynamic monitoring of medication plans. If there is abnormal usage, it will be immediately stopped. Focus on evaluating the independent packaging status of high-value Chinese herbal decoction pieces to ensure their standardized use.
- (3) Double-limit intervention: Multiple departments, such as the outpatient department, hospital clinic, and medical insurance office, will combine assessment results and the usage of Chinese herbal decoction pieces to establish control indicators for the average cost per visit for each department. Simultaneously, determine control indicators for the cost of Chinese herbs and the number of medicinal herbs used in

single-dose decoction pieces to carry out double-limit intervention. This aims to minimize the use of expensive decoction pieces and reduce the number of large prescriptions.

- (4) Optimizing the system interface: Doctors and pharmacists log into their personal accounts in the HIS system and enter the relevant interface to inquire about the monthly medication plan for Chinese herbal decoction pieces. This allows them to grasp the pending medication plans and evaluate patient information, medication amounts, diagnosis results, and lists of Chinese herbal decoction pieces. The list of Chinese herbal decoction pieces includes information such as the course of treatment, the name of the decoction piece, usage dosage, method of administration, and type of decoction piece. The system enables team members to identify unreasonable situations based on evaluation results and provides reminders through pop-up windows. The pop-up window information includes the patient's age, name, visiting department, and diagnosis. If doctors have doubts about the medication plan, they can directly appeal on the system, point out reasonable reasons, and provide direct feedback to the team leader for a final decision.

## 2.3. Evaluation criteria

Compare the total effective rate (Marked effectiveness: symptoms disappear, no discomfort such as nausea and vomiting; Effectiveness: symptoms are relieved, mild discomfort such as nausea and vomiting; Ineffectiveness: no change in symptoms, severe discomfort), incidence of irrational drug use, and incidence of adverse reactions between the two groups.

## 2.4. Statistical method

SPSS 23.0 software was used to analyze the research data. Measurement data ( $\pm s$ ) were tested using t-test, and count data (%) were tested using  $\chi^2$  test.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of total effective rate data between the two groups

As shown in **Table 2**, the total effective rate of the experimental group was higher, with  $P < 0.05$  between groups.

**Table 2.** Comparison of total effective rate between the two groups (n/%)

Group	Markedly effective	Effective	Ineffective	Total effective
Test group (n=56)	35	20	1	55 (98.21)
Control group (n=57)	30	20	7	50 (87.72)
$\chi^2$				4.730
<i>p</i> -value				0.030

### 3.2. Comparison of irrational drug use incidence data between the two groups

As shown in **Table 3**, the incidence of irrational drug use in the experimental group was significantly lower than that in the control group ( $P < 0.05$ ).

**Table 3.** Comparison of the incidence of irrational drug use between the two groups (n/%)

Group	Non-standard writing	Incompatibility	Inaccurate indication	Incorrect dosage	Unindicated use	Irrational medication rate
Test (n=56)	1	0	0	1	0	2 (3.6)
Control (n=57)	5	1	1	3	1	10 (17.5)
$\chi^2$						6.862
<i>p</i> -value						0.008

### 3.3. Comparison of adverse reaction incidence data between the two groups

As shown in **Table 4**, the incidence of adverse reactions in the experimental group was significantly lower than that in the control group ( $P < 0.05$ ).

**Table 4.** Comparison of the incidence of adverse reactions between the two groups (n/%)

Group	GI discomfort	Fever	Rash	ADR rate (%)
Test (n=56)	1	0	0	1 (1.8)
Control (n=57)	3	2	2	7 (12.3)
$\chi^2$				4.729
<i>p</i> -value				0.029

## 4. Discussion

With the gradual deepening of pharmaceutical research, the advantages of traditional Chinese medicine in the treatment of various diseases have become increasingly prominent, and the types, prescriptions, and formulations of Chinese medicinal decoction pieces have increased significantly. At the same time, the problem of irrational drug use of Chinese medicinal decoction pieces has become increasingly prominent. The PDCA cycle method and information technology are effective methods to intervene in irrational drug use behaviors under the guidance of professional pharmacists, ensuring the effectiveness and safety of Chinese medicinal decoction pieces<sup>[3]</sup>. Among them, the PDCA cycle method is a relatively new intervention method that can evaluate the rationality of drug use plans in a planned and purposeful manner. Information technology can use the HIS system to comprehensively understand the drug use plan, screen out irrationalities, and then optimize them appropriately. The combination of the two can provide closed-loop intervention for drug use plans to prevent erroneous drug use plans through real-time monitoring. Moreover, combined intervention can prevent the abuse of expensive or toxic decoction pieces and maximize the safety of drug use plans<sup>[4]</sup>. Joint double-limit intervention can effectively control the cost of medication plans, thereby reducing the treatment burden on patients. Adding continuous quality improvement can enable the PDCA cycle method to generate a long-term optimization mechanism driven by data, ultimately improving the scientific nature of Chinese medicinal decoction piece treatment.

The results of this study show that the incidence of unreasonable prescriptions in the experimental group was significantly lower than that in the control group. The reason for this is that the PDCA cycle method can fully identify and screen out the core issues of Chinese herbal medicine treatment interventions in the planning stage,

such as contraindications or limited patient awareness. Then, by integrating classic cases and literature books, comprehensive and standardized intervention measures can be formulated <sup>[5]</sup>. In the execution stage, training activities can be used to strengthen the collaboration between doctors and pharmacists, and then measures such as dialectical medication or dose adjustment can be used to improve the intervention process and avoid human error. In the inspection stage, dynamic verification and intervention can be implemented on the rationality of the medication plan, and medication problems can be publicized. Combining rewards and punishments can continuously enhance the sense of responsibility of doctors and pharmacists, driving them to continuously improve their skills under the pressure of quality improvement. In the processing stage, the current medication plan problems will be summarized and made into the next cycle goal. The medication plan will be iteratively processed every week to achieve continuous optimization of the medication plan. Information technology can automatically assess the rationality of the medication plan, including the dosage and contraindications of Chinese herbal medicines, ensuring that the evaluation results are linked to the performance of the assessment. Classified monitoring can use the HIS system to provide real-time warnings of abnormal use of Chinese herbal medicines and timely intercept higher-risk medication plans. The dual management of the number of Chinese herbal medicines and their costs can prevent the abuse of herbal medicines. The control indicators are feasible, so the intervention quality is high. Pop-up reminders can promptly point out the inadequacies of Chinese herbal medicines, allowing doctors to appeal online and optimizing communication efficiency.

Information technology has the advantage of real-time monitoring, breaking the delay of manual auditing, and enabling early detection and handling of medication risks. Making the assessment results public can achieve data transparency, comprehensively summarize medication data, and facilitate efficient communication and healthy competition among multiple departments. Furthermore, the HIS system aligns with dialectical medication plans. The combination of the two can use the inspection and processing stages of the PDCA cycle method to identify problems, then use the HIS warning function to evaluate medication risks, and quickly revise the medication plan. The combination of the PDCA cycle method and information technology can improve intervention efficiency. The HIS system can be used to automate data collection operations, reducing the time required for manual verification in the PDCA cycle method. Moreover, under the rules of informatization, the PDCA cycle method can strictly control the quality of medication, ensuring high scientific and standardization levels. However, it should be noted that before implementing the PDCA cycle method and information technology, it is necessary to dynamically understand the patient's disease situation, summarize their basic information and diagnosis results, and fully utilize the intelligent advantages of the HIS system. The team leader can organize doctors and pharmacists to learn HIS system operation skills uniformly, refine the intervention process of the PDCA cycle method, and ensure that all intervention measures are clearly understood and mastered. This lays the foundation for the smooth implementation of Chinese herbal medicine treatment interventions.

In this study, the experimental group demonstrated better medication safety. The main reason is that during the treatment intervention process, pharmacists utilize their professional skills to strengthen the review and supervision of prescription content. This allows them to discover and appropriately handle related prescription issues promptly, ensuring the safety of patient medication. With the assistance of information technology, the efficiency of auditing and reviewing has increased significantly. This saves pharmacists more time for medication education activities and improves the quality of pharmaceutical services. Pharmacists proactively provide pharmaceutical counseling services to patients, explaining the mechanism of action, usage, and dosage of the medication plan. They also inform patients about lifestyle and dietary precautions during medication and patiently and meticulously answer



various questions raised by patients. This can avoid adverse drug reactions caused by individual patient factors<sup>[6]</sup>.

## 5. Conclusion

In summary, the combination of the PDCA cycle method and information technology can reduce the incidence of unreasonable prescriptions and adverse reactions, ensuring the rational and safe use of Chinese herbal medicines. This approach is worthy of promotion and application. However, many aspects of this study are still incomplete, and further research is needed on the specific methods of the PDCA cycle and information technology.

## Disclosure statement

The author declares no conflict of interest.

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# Analysis and Reflection on a Case of Diagnosis and Identification of Occupational Noise-induced Deafness

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**Abstract:** *Objective:* Through retrospective analysis of a case of occupational noise-induced hearing loss (NIHL) diagnosis and two-grade appraisal, this study explores the causes of inconsistency between diagnosis and appraisal conclusions, aiming to improve occupational health management. *Methods:* Data including occupational history, workplace noise exposure levels, pure-tone audiometry (PTA), and objective audiological tests were collected and analyzed. *Results:* Both municipal and provincial appraisals contradicted the initial diagnostic conclusion of “moderate occupational NIHL”. *Conclusion:* The diagnosis of occupational NIHL requires multidisciplinary expertise and is influenced by subjective factors. Appraisal institutions should adopt evidence-based approaches, integrate objective tests with PTA results, and comprehensively evaluate occupational exposure history to ensure scientific and impartial conclusions.

**Keywords:** Occupational noise-induced hearing loss; Occupational disease diagnosis; Occupational disease appraisal; Evidence-based medicine

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## 1. Introduction

Occupational noise-induced deafness is the second most common occupational disease in China. Its diagnosis and appraisal involve multiple disciplines such as medicine and occupational health, and are susceptible to subjective factors. This article analyzes the underlying reasons for differences in conclusions through a controversial case of diagnosis and appraisal of a factory vehicle driver, aiming to provide a basis for standardizing the diagnostic process of occupational noise-induced deafness and improving the consistency of appraisal.

## 2. Case information

### 2.1. Occupational history

Male, 54 years old, worked as a factory vehicle driver from May 2008 to September 2021, with an average daily noise exposure of 7 hours (6 days per week). He wore earplugs during work.

## 2.2. Noise exposure level

The noise intensity in the workplace from 2018 to 2021 ranged from 78.6 to 91.1 dB(A) (L~ex, 8h~).

## 2.3. Hearing examination

### 2.3.1. In-service physical examination

In 2013, the speech frequency hearing threshold of the right ear was significantly abnormal (81 dB). In 2015, there was high-frequency hearing loss in the right ear, but the results from 2017 to 2020 were normal.

### 2.3.2. Examination during diagnosis (2021)

Multiple pure tone audiometry tests showed total deafness in the right ear and sensorineural hearing loss in the left ear, but the repeatability of the results was poor (**Table 1**).

**Table 1.** Summary of hearing examination results

Test date	Type	Left ear (dB HL)						Right ear (dB HL)					
		500 Hz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz	500 Hz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz
Aug 30, 2013	AC	32	32	30	27	43	42	82	82	80	77	88	77
Nov 9, 2015	AC	18	18	17	39	57	41	83	73	77	89	92	91
Jul 6, 2017	AC	18	23	22	19	17	16	18	18	17	14	12	11
Jul 8, 2019	AC	21	21	13	13	19	27	21	16	18	13	9	12
Sep 16, 2020	AC	21	21	18	13	9	7	21	16	13	13	9	7
Aug 31, 2021	AC	86	91	93	93	84	87	91	91	93	108	104	92
	BC	41	51	63	58	49	32	46	56	68	68	59	32
Oct 18, 2021	AC	46	46	28	58	64	52	96	101	83	108	104	92
	BC	26	46	53	53	54	32	36	61	63	68	59	32
Oct 22, 2021	AC	41	51	53	73	74	72	101	101	88	108	104	92
	BC	46	56	58	68	59	32	61	56	58	63	59	32
Oct 26, 2021	AC	56	51	48	68	79	77	111	106	93	108	104	92
	BC	61	61	63	68	59	22	61	71	73	68	59	32

Notes: The pure tone audiometric test results from the diagnostic institution were obtained on October 18, 22, and 26, 2021.

## 2.4. Objective examinations (November 1, 2021)

(1) Auditory brainstem response (ABR): No V wave was elicited in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL.

- (2) 40Hz auditory event-related potential: No V wave was elicited in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL.
- (3) Acoustic impedance: Both ears showed type A tympanograms.
- (4) Otoacoustic emissions: Both ears failed the DPOAE and TEOAE tests.

### **3. Occupational disease diagnosis**

The diagnostic team unanimously agreed that the worker had a clear history of exposure to occupational noise. The results of the three electro-audiometric tests after applying for diagnosis were relatively repeatable. The right ear showed air-bone conduction separation, indicating mixed hearing loss, but the bone conduction was consistent with the characteristics of occupational noise-induced deafness. After calculating the minimum threshold value for each frequency of the bone conduction results from the three tests and adjusting for age, the weighted hearing threshold for the right ear was 51 dB. The left ear showed sensorineural hearing loss, and after calculating the minimum threshold value for each frequency of the three test results, the weighted hearing threshold for the left ear was 41 dB. Objective hearing tests showed that the auditory brainstem response did not elicit a V wave in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL. The 40Hz auditory event-related potential also did not elicit a V wave in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL. Acoustic impedance tests showed type A tympanograms for both ears. Otoacoustic emissions tests (DPOAE and TEOAE) were not passed in both ears. The worker denied a family history of genetic deafness and also denied other causes of deafness, such as infection, trauma, or medication. Based on GBZ 49-2014 “Diagnosis of Occupational Noise-Induced Deafness,” the diagnosis on December 13, 2021, was “Occupational moderate noise-induced deafness.”

### **4. Occupational disease identification**

#### **4.1. Municipal-level identification**

The enterprise disagreed with the diagnosis of “occupational moderate noise-induced deafness” and requested an occupational disease identification on January 10, 2022.

##### **4.1.1. Consensus opinion**

Four identification experts believed that the worker had a history of occupational noise exposure. Abnormalities related to occupational hazard factors were found in occupational health checks in 2013 and 2015, while audiometric tests were normal in 2017 and 2019. However, in 2021, the audiometric test showed abnormalities. The expert group pointed out the poor repeatability of audiometric results and contradictions between subjective and objective tests. Additionally, the hearing loss did not conform to the progressive characteristics of noise-induced deafness. Based on the GBZ49-2014 “Diagnosis of Occupational Noise-Induced Deafness” standard, the identification conclusion was: no occupational noise-induced deafness.

##### **4.1.2. Dissenting opinion**

One identification expert believed that, based on interviews with the worker at the identification meeting, he self-reported hearing loss accompanied by tinnitus. Two other workers in the same job position were diagnosed with

“occupational noise-induced deafness.” The repeatability of the audiometric test results on October 18, 22, and 26, 2021, was acceptable. The right ear audiogram showed air-bone conduction separation, indicating mixed deafness, and the bone conduction matched the characteristics of occupational noise-induced deafness; the left ear showed sensorineural deafness. According to the GBZ49-2014 standard, when one ear has mixed deafness, and the bone conduction hearing threshold conforms to the characteristics of occupational noise-induced deafness, diagnosis and grading are based on the bone conduction hearing threshold of that ear. The worker’s average high-frequency bone conduction hearing threshold for both ears was 48.8 dB, and the weighted hearing threshold for the right ear was 51 dB. Therefore, the diagnosis was: occupational moderate noise-induced deafness.

Following the principle that the identification conclusion should be approved by more than half of the identification committee members, the final municipal-level identification conclusion was: no occupational noise-induced deafness.

## **4.2. Provincial appraisal**

The worker disagrees with the conclusion of the municipal appraisal and applies for a provincial appraisal to the Provincial Occupational Disease Diagnosis and Appraisal Committee. The expert group believes that the worker did not undergo pre-job occupational health checks and lacks pre-job baseline data. During employment, pure tone audiometry results were abnormal in 2013 and 2015, but normal from 2017 to 2020. However, the results were abnormal again in the post-employment occupational health check in 2021. Multiple pure tone audiometry tests from August 2021 to August 2022 showed total deafness in the right ear and sensorineural hearing loss in the left ear, but with poor reproducibility. On August 17, 2022, a 40Hz auditory evoked potential report from a hospital indicated specific hearing thresholds for both ears at different frequencies. No cases of occupational noise-induced deafness were found among employees of the same type of work. The worker has a history of occupational noise exposure. However, the inconsistent pure tone audiometry results during and after employment, as well as the poor reproducibility of subsequent tests, do not align with the characteristics of occupational noise-induced deafness. Therefore, the expert group concludes that the worker does not have occupational noise-induced deafness.

## **5. Discussion**

The occupational disease diagnosis and appraisal system is a quasi-arbitration system that implements the inversion of the burden of proof, with medical knowledge as the background, combined with occupational health-related knowledge, and aimed at protecting the health rights and interests of workers and resolving liability disputes <sup>[1]</sup>. In this case, the diagnosis conclusion made by the occupational disease diagnosis institution was ultimately overturned by municipal and provincial appraisal institutions, indicating that there are certain differences in the analysis of data and attribution inference during the diagnosis process among diagnosis institutions. The worker, a factory driver, has been exposed to noise for more than 13 years without undergoing a pre-employment examination. Abnormalities related to occupational hazard factors were found in occupational health checkups in 2013 and 2015, while audiometric tests in occupational health checkups in 2017, 2019, and 2020 were normal. However, the audiometric test in the 2021 occupational health checkup showed abnormalities. The poor reproducibility of consecutive audiometric tests after the occupational disease diagnosis weakened the credibility of the diagnostic basis, and the hearing loss detected by audiometric tests did not conform to the pathogenic characteristics of gradual hearing loss caused by noise-induced deafness. Finally, the appraisal



conclusion was “no occupational noise-induced deafness.”

Due to the varying understanding of diagnostic criteria among different diagnosing physicians during the diagnostic process, and the possibility that some diagnosing physicians may lack relevant clinical practice experience and are not familiar with subjective and objective examination methods such as pure tone audiometry, acoustic impedance, auditory brainstem response, 40Hz auditory evoked potential test, otoacoustic emissions, and multifrequency steady-state, inconsistencies in opinions may easily arise. This can lead to misdiagnosis or missed diagnosis of occupational noise-induced deafness during the diagnosis and identification process <sup>[2-4]</sup>. It is recommended that occupational disease diagnosing physicians have a strict understanding of the audiological characteristics of conductive, sensorineural, and mixed hearing loss. Audiometric testing has a certain subjectivity, and its results are correlated with the cooperation of the subject, comorbidities, and the examiner’s experience. Therefore, it is necessary to reasonably apply objective examination results in the diagnostic process and cross-validate them with pure tone audiometry results to improve differential diagnosis ability <sup>[3]</sup>. At the same time, comprehensive consideration should be given in combination with occupational exposure history. Whether the noise detection value in the occupational hazard factor detection report can truly reflect the actual noise exposure situation of workers, so the impact of noise levels < 85dB on noise-exposed workers cannot be ignored during the diagnosis process <sup>[5]</sup>.

The final diagnosis and appraisal conclusion of this case is “no occupational noise-induced deafness.” The employer bears certain faults: Firstly, the employer did not conduct pre-employment occupational health checkups on the patient according to law, and failed to promptly remove the worker from the noisy workplace and conduct further re-examination when abnormalities were found in the worker’s audiometric test results. Secondly, there was a lack of risk awareness and deficiencies in occupational health management, which led to difficulties in diagnosing this case. Therefore, as an employer, lessons should be learned, and pre-employment and on-the-job occupational health checkups should be standardized to facilitate early detection and early treatment, thereby better protecting workers’ occupational health.

The diagnosis of occupational noise-induced deafness requires consideration of both medical rigor and the correlation of occupational exposure. It is a highly specialized and subjective task that involves multiple disciplines and has high professional requirements for diagnostic physicians <sup>[6]</sup>. In this case, the phenomenon of two levels of appraisal overturning the diagnostic conclusion highlights the current deficiencies in standard implementation and multidisciplinary collaboration. In the future, efforts should be made to standardize the diagnostic process, strengthen objective evidence support, and urge employers to implement occupational health monitoring to achieve a balance between workers’ rights and corporate responsibilities.

## 6. Conclusion

The diagnosis of occupational noise-induced hearing loss (NIHL) should combine objective audiological tests with pure-tone audiometry (PTA) and a thorough assessment of occupational exposure history. A multidisciplinary, evidence-based approach is essential to minimize subjectivity and ensure scientifically sound, impartial conclusions.

## Disclosure statement

The author declares no conflict of interest.

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# Evaluation of Task-Oriented Training Combined with Lower Limb Rehabilitation Robot on Improvement of Motor Function and Ankle Joint Function in Stroke Patients with Hemiplegia

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**Abstract:** *Objective:* To evaluate the effect of task-oriented training combined with a lower limb rehabilitation robot on improving motor function and ankle joint function in stroke patients with hemiplegia. *Methods:* Sixty-three stroke patients with hemiplegia admitted to our hospital from January 2022 to June 2024 were randomly divided into observation group (32 cases) and control group (31 cases) using the envelope method. The control group received task-oriented training, while the observation group received additional lower limb rehabilitation robot training. The motor function (Fugl-Meyer Assessment of Lower Extremity, FMA-LE) and ankle joint function (Active Dorsiflexion Range of Motion, DF AROM) were compared between the two groups. *Results:* After treatment, the levels of FMA-LE and DF AROM in both groups increased significantly, and the improvement in each index in the observation group was better than that in the control group ( $P < 0.05$ ). *Conclusion:* The combination of task-oriented training and lower limb rehabilitation robot training can more effectively improve the overall motor function of the lower limbs and the active dorsiflexion ability of the ankle joint in stroke patients with hemiplegia.

**Keywords:** Stroke; Hemiplegia; Task-oriented training; Lower limb rehabilitation robot; Motor function; Ankle joint function

**Online publication:** September 8, 2025

## 1. Introduction

Stroke is one of the leading causes of long-term disability among adults, and its high incidence, disability rate, and fatality rate impose a heavy burden globally <sup>[1]</sup>. In China, as the population ages, the number of patients with hemiplegia after a stroke continues to rise, significantly affecting patients' daily living skills and quality of life, and increasing the pressure on family and social care <sup>[2]</sup>. Hemiplegic patients often suffer from significant lower limb motor dysfunction, especially ankle joint control disorders, which severely limit walking ability <sup>[3]</sup>.

Although traditional rehabilitation training can improve patients' motor function, it often fails to meet the need for efficient rehabilitation due to issues such as insufficient intensity and imprecise movements. Task-oriented training focuses on targeted functions and encourages patients to actively participate through daily functional tasks. It is increasingly valued in the field of neuro-rehabilitation and can effectively promote the reconstruction of motor functions. Meanwhile, lower limb rehabilitation robots, with their advantages of high-intensity, high-repetition, standardized gait training, and precise control of trajectory and mechanical parameters, offer new possibilities for improving training efficiency<sup>[4, 5]</sup>. This study intends to combine task-oriented training with lower limb rehabilitation robot training to evaluate its effectiveness in improving the overall lower limb motor function and active ankle joint mobility in stroke patients with hemiplegia. The goal is to provide practical evidence for optimizing clinical rehabilitation strategies. The report is as follows:

## 2. Materials

### 2.1. General information

Sixty-three patients with hemiplegia due to stroke, admitted to our hospital from January 2022 to June 2024, were selected. They were randomly divided into observation and control groups using the envelope method, with 32 and 31 patients, respectively. There was no statistically significant difference in basic data between the two groups ( $P > 0.05$ ), as shown in **Table 1**. This study was approved by the hospital ethics committee and complied with the relevant ethical principles of the Helsinki Declaration.

**Table 1.** Comparison of general information between the two groups ( $\bar{x} \pm s/n$ )

Characteristics	Observation group (n=32)	Control group (n=31)	$t/\chi^2$	<i>P</i> -value
Male/Female	18/14	19/12	0.165	0.685
Age (years)	40-65	43-64	0.053	0.958
	$51.15 \pm 5.11$	$51.08 \pm 5.41$		
Disease Duration (months)	1-6	1-7	1.390	0.170
	$2.91 \pm 0.46$	$3.08 \pm 0.51$		

### 2.2. Inclusion and exclusion criteria

#### 2.2.1. Inclusion criteria

- (1) Aged between 18 and 65.
- (2) Meeting the diagnostic criteria for stroke in the Guidelines for the Prevention and Treatment of Cerebrovascular Diseases in China, and confirmed by cranial CT or MRI.
- (3) Having clear lower limb motor dysfunction.
- (4) In the recovery phase, with a disease duration of 1 to 7 months after onset.
- (5) Able to understand and cooperate with simple instructions from the rehabilitation therapist.
- (6) The patient or their legal guardian voluntarily participates in this study and signs a written informed consent form.

#### 2.2.2. Exclusion criteria

- (1) Severe heart, lung, liver, or kidney failure.

- (2) Contraindications for the use of lower limb rehabilitation robots.
- (3) Severe contractures, deformities, or unhealed fractures in the affected lower limb joints that significantly affect gait or hinder the wearing of the robot.
- (4) Comorbidities such as Parkinson's disease, spinal cord injury, multiple sclerosis, or other central or peripheral nervous system diseases that may cause gait abnormalities.

### **3. Methods**

#### **3.1. Control group**

Received a structured, task-oriented training program designed by professional rehabilitation therapists, including:

##### **3.1.1. Muscle strength and joint range of motion training**

- (1) Bridge exercise in a supine position: Patients were instructed to lie on their back, bend their knees, and place their feet flat on the bed surface. They were then asked to place their hands 5–15cm above their abdomen as a target point. They actively lifted their pelvis off the bed until it touched their hands, maintained this position for 3–5 seconds, and then slowly lowered it. This exercise was repeated 10–15 times per set.
- (2) Straight leg raise exercise for the affected lower limb: Patients were instructed to keep their knee straight and lift their lower limb 15cm off the bed surface, maintain this position for 3–5 seconds, and then slowly lower it. This exercise was repeated 10–15 times per set.
- (3) Adduction, abduction, and knee flexion control training for the affected lower limb: Patients performed active movements in various directions within a painless range, repeating each direction 10–15 times.

##### **3.1.2. Core control and trunk stability training**

- (1) Supine position with hands behind the head: Patients simultaneously or alternately lifted their head, shoulders, and lower limbs off the bed surface to strengthen their abdominal and back muscles. They maintained the lifted position for 5–10 seconds and repeated this exercise 5–10 times.
- (2) Sitting forward lean and side picking practice: Patients sat on a stable chair while the therapist placed light objects at different distances in front, behind, and on the sides. Patients were instructed to lean forward or laterally to pick up the objects and return them to their original positions, repeating each direction 10 times. This exercise focused on training dynamic trunk balance and control.

##### **3.1.3. Balance and postural transfer training**

- (1) Sit-to-stand transfer training: Gradually transition from using armrests for support to independently standing up and sitting down without assistance, completing 10–15 transfers each time.
- (2) Standing balance training: The patient stands with feet apart, and the therapist guides them to shift their center of gravity forward, backward, left, and right, maintaining each direction for 5–10 seconds. Gradually reduce the support area of both feet, including standing with feet together and assisted single-leg standing.
- (3) Perform combined exercises of stepping and shifting the center of gravity in different directions while standing.



### **3.1.4. Functional gait training**

- (1) Flat ground walking training: Set a fixed distance, initially using a walking aid or therapist assistance, gradually increasing step length, decreasing step width, and increasing walking speed until achieving independent, symmetrical, and stable walking.
- (2) Simulation training for ascending and descending stairs: Use training steps to practice weight-bearing and controlled descent with the affected lower limb.
- (3) Integration of daily life tasks: Simulate stepping over low obstacles, walking on different surfaces, walking while carrying items, etc. All training actions require the patient's active and focused participation. The therapist closely observes the quality of movements, level of fatigue, and safety, and dynamically adjusts the difficulty of tasks based on the patient's weekly performance. The training frequency is set to 30 minutes per session, twice a day, 5 days a week, with continuous intervention for 12 weeks.

## **3.2. Observation group**

Patients in this group underwent additional lower extremity rehabilitation robot (Lokomat system) assisted training based on the completion of the same personalized task-oriented rehabilitation training program as the control group. Before training, professionally certified therapists performed individualized fitting for patients, measured and adjusted equipment parameters to match patients' lower extremity length, circumference, and joint mobility. Soft cushions or foot drop correction belts were used to ensure comfort and safety when necessary. During training, the robot's weight support system (initially set to approximately 50% of body weight, gradually reduced based on tolerance and performance, but maintained above 20%) was utilized to reduce weight-bearing. Programmed control of the driving device provided gait guidance force and speed regulation (starting speed of approximately 1.2–1.4 km/h, adjustable). Therapists set walking training task modules appropriate to the patient's functional level. With precise mechanical support and movement trajectory guidance provided by the robot, the focus was on strengthening coordinated movement patterns of the lower extremities, gait symmetry, perception of weight-bearing on the affected side, and active participation. Patients were particularly encouraged to attempt active extension of the affected calf during robot-assisted walking to complete specific tasks such as touching target objects with their toes, to promote dissociated movement. Robot training was set to 30 minutes per session, twice a day, five days a week, for 12 weeks.

## **3.3. Observation indicators**

### **3.3.1. Motor function**

The lower extremity motor function of the two groups of patients before and after treatment was evaluated using the FMA-LE. This scale contains 17 items that evaluate lower extremity reflexes, flexor/extensor synergies, selective motor control, coordination, and speed, involving multi-joint movements such as hip, knee, and ankle. Each item is scored on a scale of 0 (cannot perform), 1 (partial), or 2 (full), with a total score ranging from 0–34. A higher score indicates better motor function, fewer abnormal movement patterns, and stronger selective motor control.

### **3.3.2. Ankle joint function**

The active dorsiflexion range of motion (DF AROM) of the ankle joint was measured using a universal

goniometer. The standard position was supine with the knee extended. The stationary arm was aligned with the long axis of the fibula, and the axis was positioned slightly anterior to the lateral malleolus. The moving arm was parallel to the fifth metatarsal. The patient actively dorsiflexed their toes to the maximum angle (avoiding compensation), and the degree between the moving arm and the stationary arm was recorded.

### 3.4. Statistical methods

Statistical analysis was performed using SPSS 21.0 software package in our hospital. Measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ) and followed a normal distribution. The t-test was used for comparisons between groups. Count data were expressed as relative numbers, and the chi-square test ( $\chi^2$  test) was used for comparisons between groups. The rank sum test was used to compare clinical efficacy. A  $P$ -value  $< 0.05$  was considered statistically significant.

## 4. Results

### 4.1. Comparison of motor function between the two groups

Before treatment, there was no significant difference in FMA-LE levels between the two groups ( $P > 0.05$ ). After treatment, FMA-LE levels in both groups increased significantly, and the improvement in various indicators in the observation group was better than that in the control group ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of motor function between the two groups before and after treatment ( $\bar{x} \pm s$ )

Group	Cases (n)	Before treatment	After treatment
Observation group	32	15.24 $\pm$ 3.11	25.11 $\pm$ 2.94*
Control group	31	15.18 $\pm$ 3.08	22.69 $\pm$ 3.01*
<i>t</i> -value	-	0.077	3.228
<i>p</i> -value	-	0.939	0.002

Note: Compared with the same group before treatment, \* $P < 0.05$

### 4.2. Comparison of ankle joint function between the two groups

Before treatment, there was no significant difference in DF AROM levels between the two groups ( $P > 0.05$ ). After treatment, the DF AROM levels of both groups increased significantly, and the improvement of each index level in the observation group was better than that in the control group ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of ankle joint function levels between the two groups before and after treatment ( $\bar{x} \pm s$ , °)

Group	Sample size (n)	Before treatment	After treatment
Observation group	32	10.08 $\pm$ 1.41	15.41 $\pm$ 1.52*
Control group	31	10.11 $\pm$ 1.39	13.08 $\pm$ 1.61*
<i>t</i> -statistic	-	0.085	5.908
<i>p</i> -value	-	0.933	$< 0.001$

Note: Compared with the same group before treatment, \* $P < 0.05$

## 5. Discussion

Stroke leads to damage in the brain's motor control areas, particularly affecting the corticospinal tract, which causes typical lower limb movement disorders and difficulties in ankle dorsiflexion for hemiplegic patients<sup>[6]</sup>. In this study, the control group underwent task-oriented training, which focuses on designing functional tasks close to daily life, such as bridging exercises, sit-to-stand transfers, center of gravity shifts, and walking training. This approach encourages patients to actively participate and repeat exercises, utilizing the principle of neurological reorganization to promote compensation in areas surrounding or contralateral to the damaged brain regions, gradually rebuilding normal motor control patterns<sup>[7]</sup>. However, task-oriented training heavily relies on patient initiative and therapist guidance accuracy. In practice, patients often struggle to maintain standard movements and sufficient training intensity due to muscle weakness, fatigue, or incorrect compensatory patterns, especially during ankle dorsiflexion, which requires precise control. This may limit further improvement in its effectiveness<sup>[8]</sup>. Although the data from the control group in this study showed some improvement in FMA-LE and DFAROM, the magnitude of improvement was relatively limited.

The observation group integrated lower limb rehabilitation robot training into task-oriented training to address its limitations. The robot system provides patients with a stable movement guidance framework through precise mechanical support and preset physiological gait trajectories<sup>[9]</sup>. Its weight-reducing support function allows patients to perform near-normal walking posture training in the early stages of muscle weakness, significantly reducing abnormal compensations and posture errors caused by fear of weight-bearing or insufficient strength. More importantly, the robot can enforce precise joint movement trajectories, continuously providing correct proprioceptive input, especially during the gait swing phase and ankle dorsiflexion movements. This high-intensity, highly repetitive, and highly standardized training can more effectively stimulate the sensorimotor cortex and spinal motor circuits, promoting the encoding and consolidation of correct movement patterns in the brain and accelerating the process of neurological reorganization<sup>[10]</sup>. This may be the key reason for the more significant improvement in FMA-LE scores in the observation group.

Improvements in ankle function, especially the increase in active dorsiflexion range of motion (DFAROM), were also observed to be more advantageous in the observation group in this study. Ankle dorsiflexion control is crucial for ground clearance and heel contact during the gait cycle. Robot training accurately guides ankle dorsiflexion movements throughout the gait cycle, especially at the end of the swing phase. This not only directly stretches the contracted plantar flexor muscle groups but also strengthens the active contraction ability of dorsiflexor muscle groups, such as the tibialis anterior muscle, under correct movement patterns. The real-time and consistent mechanical feedback provided by the robot helps patients perceive and control ankle position and movement more clearly, optimizing the afferent proprioceptive information and thereby more effectively rebuilding the central nervous pathway for active ankle control.

## 6. Conclusion

In summary, the combined application of lower limb rehabilitation robot training based on conventional task-oriented training can more effectively improve the overall lower limb motor function and active ankle dorsiflexion ability of stroke patients with hemiplegia.

## Disclosure statement

The author declares no conflict of interest.

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# Influence of Parenting Care Guidance Combined with Preventive Healthcare on the Effectiveness of Child Family Parenting

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**Abstract:** *Objective:* To explore the impact of parenting care guidance combined with preventive healthcare on child family parenting. *Methods:* Ninety-two child families were included as research subjects and randomly divided into a control group and an observation group, with 46 cases in each group. The former implemented basic preventive healthcare, while the latter simultaneously carried out parenting care guidance combined with preventive healthcare. The intervention results of the two groups were compared. *Results:* The observation group had a higher awareness rate of family parenting knowledge and a higher formation rate of healthy behaviors,  $P < 0.05$ . At the same time, parents' parenting anxiety scores were lower, and family health management ability scores were higher,  $P < 0.05$ . Moreover, the observation group showed higher scores in children's social skills,  $P < 0.05$ . *Conclusion:* Parenting care guidance combined with preventive healthcare can effectively improve the status of child family parenting, and it is worthy of promotion and application.

**Keywords:** Child family parenting; Parenting care guidance; Preventive healthcare; Impact effectiveness

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## 1. Introduction

Family upbringing plays a crucial role in children's growth, and its quality has a long-term impact on children's physical and mental health as well as their future development<sup>[1]</sup>. However, many parents lack systematic health knowledge and preventive health care concepts when raising their children, which may expose children to various health risks during their growth stage. Integrating parenting guidance with preventive health care provides new ideas and approaches for family upbringing<sup>[2]</sup>. Parenting guidance can help parents establish correct health cognition, grasp the physiological and psychological characteristics of children in different growth stages in detail, and thus more effectively meet children's health needs. Preventive health care focuses on preventing health problems from the root, which can not only reduce the possibility of children getting sick but also alleviate the economic pressure and psychological burden caused by diseases. Combining parenting guidance with preventive health care can not only enhance parents' parenting skills but also create a healthier and safer growth space for children<sup>[3]</sup>. In this study,



ninety-two children's families were selected for group research to explore the practical effectiveness of parenting guidance combined with preventive health care measures in children's family upbringing.

## **2. Materials and methods**

### **2.1. General information**

A total of 92 children's families were included in the study, with an enrollment period from January 2023 to December 2024. Using random sampling, the families were divided into intervention groups, with 46 cases in each group. In the control group, there were 22 males and 24 females, with a mean age of  $(2.5 \pm 0.2)$  years. In the observation group, there were 21 males and 25 females, with a mean age of  $(2.6 \pm 0.3)$  years. There was a high consistency in general information between the two groups of children ( $P > 0.05$ ). Information on primary caregivers and family situations was compared.

#### **2.1.1. Inclusion criteria**

- (1) Children aged 3–6 years
- (2) Primary caregivers have basic communication skills
- (3) Families are aware of and agree to the study content.

#### **2.1.2. Exclusion criteria**

- (1) Children with severe congenital diseases
- (2) Families with cognitive impairments
- (3) Incomplete clinical data.

### **2.2. Methods**

The control group received routine child health care, including regular physical examinations, monitoring of children's growth and development, answering parents' questions and addressing their concerns, and distributing health promotion materials and other basic health care services.

The observation group, on the basis of routine health care, received comprehensive intervention measures for parenting guidance and preventive health care, as follows:

- (1) Parenting guidance measures: Monthly lectures on child-rearing knowledge were organized and conducted through various forms such as PPT, videos, and case analyses to enhance parents' enthusiasm for participation and make the transmission of health knowledge more intuitive and easier to understand. At the same time, a WeChat group was established to achieve the goals of normalization and instant health guidance. One to two articles related to healthy child-rearing were pushed every week, and various questions encountered in daily parenting were answered promptly, thus building a three-dimensional knowledge transmission mode of "offline centralized teaching combined with online continuous interaction", which facilitated parents to obtain professional support at any time and solve problems encountered in the actual process of raising children <sup>[4]</sup>.
- (2) Preventive health measures: Personalized preventive health plans were developed based on the developmental characteristics of children at different ages and problems identified during health checkups, taking into account children's family habits and rearing environments. Targeted individualized guidance measures were formulated, including parenting guidance, family education, parent-child interaction, oral

health care, eye health care, and other aspects. A good early education environment was created to guide children's active movement and increase language communication, allowing children to "learn through play" and parents to "learn through parenting". At the same time, the concept of health was continuously strengthened, and the cultivation of health awareness was extended to children themselves, enabling them to gradually establish health cognition through practical activities and improve the level of cooperation between parents and children in developing healthy habits <sup>[5]</sup>.

## 2.3. Observation indicators

- (1) Compare the situation of children's family upbringing, including the awareness rate of family upbringing knowledge. Conduct a self-made 100-point questionnaire survey to calculate the proportion of those who score  $\geq 80$  points. The formation rate of healthy behaviors. Evaluate with a self-made child family health behavior assessment scale (reasonable diet, regular work and rest, personal hygiene habits, outdoor activities, and disease prevention behaviors). If each behavior meets the standard for  $\geq 5$  days per week, it is judged as "formed". The formation rate of healthy behaviors refers to the proportion of families that meet the "formed" criteria.
- (2) Compare parental indicators; the former uses the Self-Rating Anxiety Scale (SAS) score, where  $\geq 50$  points suggest the presence of anxiety, and the higher the score, the more severe the anxiety <sup>[6]</sup>; the latter uses a self-designed family health management ability assessment scale with a total score of 100. The higher the score, the stronger the management ability.
- (3) Compare children's social skills scores using the Children's Social Skills Assessment Scale (Simplified Version), which assesses five dimensions: Interaction with peers, cooperation and sharing, emotional expression, social rules, and social confidence. Each dimension is scored out of 10, with a total score of 50. A higher score indicates better social skills <sup>[7]</sup>.

## 2.4. Statistical methods

The count data and measurement data involved in the study were entered into SPSS 23.0 software. The former was subjected to chi-square ( $\chi^2$ ) testing and expressed as (n, %). The latter underwent t-testing, assuming a normal distribution, and was expressed as ( $\bar{x} \pm s$ ). If  $P < 0.05$ , the comparison was considered statistically significant.

# 3. Results

## 3.1. Comparison of primary caregivers and family background

There was no significant difference between the groups in terms of primary caregivers and family backgrounds, with  $P > 0.05$ , as shown in **Table 1**.

**Table 1.** Comparison of primary caregivers and family backgrounds between groups [ $(\bar{x} \pm s)$ , n(%)]

Group	n	Primary caregiver age (years)	Family structure (Nuclear/3-Generation/ Other)	Caregiver education ( $\leq$ Middle school/ high School-college/ $\geq$ Undergraduate)	Income level (Low/ Medium/High)
Study	46	32.6 $\pm$ 4.2	22/14/10	10/15/21	14/22/10
Control	46	32.7 $\pm$ 4.4	23/13/10	11/15/20	14/23/9
t/ $\chi^2$	-	0.112	0.059	0.072	0.075

Group	n	Primary caregiver age (years)	Family structure (Nuclear/3-Generation/ Other)	Caregiver education ( $\leq$ Middle school/ high School-college/ $\geq$ Undergraduate)	Income level (Low/ Medium/High)
<i>P</i> -value	-	0.911	0.971	0.965	0.963

### 3.2. Comparison of family child-rearing situations

The observation group showed higher awareness of family parenting knowledge and a higher rate of healthy behavior formation, with  $P < 0.05$ , as shown in **Table 2**.

**Table 2.** Comparison of family child-rearing situations between groups [n(%)]

Group	n	Family parenting knowledge awareness rate (%)	Healthy behavior formation rate (%)
Study	46	45 (97.83)	46 (100.00)
control	46	39 (84.78)	42 (91.30)
$\chi^2$	-	4.929	4.235
<i>P</i> -value	-	0.026	0.039

### 3.3. Parental anxiety scores and family health management ability scores

The observation group exhibited lower parental anxiety scores and higher family health management ability scores, with  $P < 0.05$ , as shown in **Table 3**.

**Table 3.** Comparison of parental anxiety scores and family health management ability scores between groups [ $\bar{x} \pm s$  /score]

Group	n	Parenting anxiety score (mean $\pm$ SD)	Family health management score (mean $\pm$ SD)
Study	46	32.34 $\pm$ 2.18	87.66 $\pm$ 4.22
Control	46	48.78 $\pm$ 2.16	78.67 $\pm$ 4.28
<i>t</i> -value	-	36.333	10.144
<i>P</i> -value	-	0.001	0.001

### 3.4. Comparison of children's social skills scores

The observation group demonstrated higher scores in children's social skills, with  $P < 0.05$ , as shown in **Table 4**.

**Table 4.** Comparison of children's social skills scores between groups [ $\bar{x} \pm s$ /score]

Group	n	Peer interaction	Cooperation/ Sharing	Emotional expression	Social rules	Social confidence
Study	46	8.56 $\pm$ 1.34	8.23 $\pm$ 1.22	8.78 $\pm$ 1.34	8.49 $\pm$ 1.48	8.78 $\pm$ 1.37
Control	46	7.67 $\pm$ 1.26	7.56 $\pm$ 1.24	7.76 $\pm$ 1.56	7.78 $\pm$ 1.44	7.45 $\pm$ 1.45
<i>t</i> -value	-	3.282	2.612	3.364	2.332	4.522
<i>P</i> -value	-	0.001	0.011	0.001	0.022	0.001

## 4. Discussion

The healthy growth of children is a crucial foundation for family happiness and social development. Family upbringing is a central aspect of children's development, and the level of family parenting directly impacts children's lifestyle habits, physiological development, psychological state, and social skills development<sup>[8]</sup>. In the current rapidly changing social information environment, many parents have recognized the importance of scientific parenting and have accessed parenting knowledge and precautions through information sources such as official accounts and short videos. However, due to a lack of systematic understanding, parenting skills support, and effective health management tools, there are still many confusions and challenges in the process of raising children. Parents often find it difficult to achieve a successful parenting experience, which may lead to excessive anxiety in some parents in the long run<sup>[9]</sup>. Therefore, providing specific guidance on family parenting to assist parents in arranging specific parenting activities has important practical value. This study conducted research on 92 children's families to analyze the impact of combined parenting care guidance and preventive health care on family parenting. The results obtained from the study indicate that this intervention model provides significant assistance to parents.

The results of this study showed that the observation group had higher levels of knowledge about family parenting and a higher rate of developing healthy behaviors compared to the control group ( $P < 0.05$ ). This suggests that parenting care guidance can significantly guide parents' parenting behaviors. Through regular parenting care guidance activities, parents gained a clearer understanding of the physiological and neurological developmental needs of children at different growth stages and learned to prepare reasonable diets for their children<sup>[10]</sup>. Parents also became more familiar with common disease prevention knowledge and early disease identification methods for children, enabling them to more effectively address common health issues in children. Task-based parenting guidance helped parents translate the knowledge they learned into practical actions, which played a crucial role in the healthy growth of children<sup>[11]</sup>. Furthermore, data comparison revealed that parents in the observation group had lower scores for parenting anxiety and higher scores for family health management ability ( $P < 0.05$ ). This indicates an improvement in family health management ability, meaning that parents can more effectively plan and implement health management programs for their children, creating a healthy and harmonious growth environment<sup>[12]</sup>. Additionally, children in the observation group had higher scores for social skills ( $P < 0.05$ ), suggesting that this approach can enhance parent-child interaction and communication, contribute to the sustained healthy psychological development of children, and assist in their future social life.

## 5. Conclusion

Overall, the combination of parenting care guidance and preventive healthcare significantly optimizes the current state of family parenting for children. This positive change lays a solid foundation for children's comprehensive healthy growth and the benign development of their social skills, creating a more favorable environment for their growth.

## Disclosure statement

The author declares no conflict of interest.

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# Research on the Application Effect of Rapid Rehabilitation Surgery Concept in Patients Undergoing Gynecological Laparoscopic Surgery

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**Abstract:** *Objective:* To investigate the application effect of the concept of rapid rehabilitation surgery in patients undergoing gynecological laparoscopic surgery. *Method:* Seventy laparoscopic surgery patients treated in our gynecology department from May 2023 to May 2024 were selected and divided into two groups using a random number table method, with 35 patients in each group. The control group received routine nursing care, while the observation group received rapid recovery surgery on the basis of the control group. Record and compare the incidence of incision infection, urinary retention, lung infection and other related complications between the two groups of patients with different nursing modes; Record and compare perioperative indicators such as surgical time, intraoperative blood loss, first exhaust time, first time out of bed, and hospital stay between two groups of patients using different nursing modes. *Result:* There were significant differences in perioperative indicators such as the incidence of complications, surgical time, intraoperative bleeding volume, first exhaust time, first time out of bed, and hospital stay between the two groups under different nursing modes. The data scores of the observation group were better than those of the control group, and the difference was statistically significant ( $P < 0.05$ ). *Conclusion:* The application of the concept of rapid recovery surgery in perioperative nursing of gynecological laparoscopic surgery patients has significant effects, which can effectively promote postoperative recovery, reduce the incidence of complications, and improve nursing satisfaction. This model has scientific validity, feasibility, and promotional value, and can provide new ideas and methods for perioperative management of gynecological laparoscopic surgery.

**Keywords:** Rapid rehabilitation surgery; Gynecological laparoscopy; Postoperative recovery; Incidence of complications

**Online publication:** September 8, 2025

## 1. Introduction

With the rapid development of minimally invasive technology, gynecological laparoscopic surgery has become

the preferred surgical procedure for benign gynecological diseases (such as uterine fibroids, ovarian cysts, endometriosis, etc.) and early malignant tumors due to its advantages of small trauma, fast recovery, and few complications <sup>[1]</sup>. However, the traditional perioperative nursing model still has many limitations, such as prolonged fasting and water deprivation before surgery, delayed eating and activity after surgery, excessive dependence on opioid analgesics, etc., which may lead to increased stress response, delayed gastrointestinal function recovery, prolonged hospitalization time, and increased risk of complications in patients. How to further optimize perioperative management and promote rapid postoperative recovery of patients while ensuring surgical safety has become a hot topic of clinical concern <sup>[2]</sup>.

Enhanced Recovery After Surgery (ERAS) has been widely applied and achieved significant results in various fields such as general surgery, orthopedics, and thoracic surgery. Its core is to optimize perioperative management measures based on evidence-based medicine through multidisciplinary collaboration, including preoperative education, nutritional support, intraoperative insulation, fluid management, etc., aiming to reduce surgical stress response, maintain body function, shorten hospitalization time, and reduce medical costs. In recent years, the application of ERAS concept in the field of gynecology has gradually received attention, but related research has mostly focused on open surgery or specific diseases (such as gynecological malignant tumors). Systematic research on gynecological laparoscopic surgery patients still needs to be further deepened <sup>[3]</sup>. Gynecological laparoscopic surgery patients are mainly middle-aged and young women. Rapid postoperative recovery is not only related to their physiological function recovery, but also involves psychological adaptation, social role return, and quality of life improvement. Therefore, introducing the ERAS concept into the perioperative management of gynecological laparoscopic surgery is expected to provide patients with more efficient and humane medical services by optimizing nursing processes, reducing complications, and shortening hospital stays. A study and analysis are conducted on the nursing situation of 70 laparoscopic surgery patients treated in the gynecology department from May 2023 to May 2024 under the concepts of routine nursing and rapid recovery surgery.

## **2. Data and methods**

### **2.1. General information**

Seventy laparoscopic surgery patients admitted to the gynecology department from May 2023 to May 2024 were randomly divided into two groups using a random number table method, with 35 patients in each group. There were no significant differences in age, education, economic status, or past physical fitness between the two groups ( $P > 0.05$ ). The control group received routine nursing procedures for gynecological laparoscopic surgery, while the observation group received guidance on the concept of rapid recovery surgery on the basis of the control group.

#### **2.1.1. Inclusion criteria**

- (1) Age range of 20–60 years old
- (2) Laparoscopic surgery for uterine fibroids/ovarian cysts
- (3) Family members sign informed consent forms
- (4) Individuals with a body mass index (BMI) of 18–28 kg/m<sup>2</sup>
- (5) Patients with surgery time less than 4 hours

#### **2.1.2. Exclusion criteria**

- (1) Malignant tumors
- (2) Having mental illness or cognitive impairment
- (3) Cases of conversion to open surgery
- (4) Patients who have also participated in other research projects
- (5) Patients with other major organ dysfunction combined.

## **2.2. Nursing methods**

### **2.2.1. Routine nursing**

Adopting routine perioperative management includes: Fasting for 12 hours before surgery and abstaining from drinking for 6 hours; Routine intraoperative infusion (2000–2500ml); Postoperative pain relief as needed (intramuscular injection of pethidine), eating after anal emptying, and guiding to get out of bed and move around 24 hours later. No systematic psychological intervention or targeted rehabilitation training was conducted, and the monitoring of complications was the same as routine nursing.

### **2.2.2. Observation group: Rapid recovery surgery concept**

- (1) Preoperative nursing process
  - (a) Multidisciplinary joint assessment and education: A multidisciplinary team consisting of gynecologists, anesthesiologists, ward nurses, and nutritionists will conduct a comprehensive preoperative assessment of patients, including cardiopulmonary function, nutritional status, psychological status, and thrombus risk.
  - (b) Health education: Provide detailed explanations of ERAS concepts, surgical procedures, expected recovery time, and postoperative precautions to patients and their families to alleviate preoperative anxiety. Preoperative preparation optimization: Dietary management: One day before surgery, a low-residue diet is given. On the day of surgery, fasting is done for 6 hours before surgery. Two hours before surgery, 300ml of 5% glucose water is taken orally to reduce preoperative hunger stress.
  - (c) Intestinal preparation: Take polyethylene glycol electrolyte powder orally for laxative treatment before surgery, avoid mechanical enema, and reduce intestinal irritation.
  - (d) Vaginal preparation: Perform vaginal flushing on the evening before surgery and in the morning on the day of surgery to reduce the risk of postoperative infection. Skin preparation: Preoperative skin preparation covers from the xiphoid process to the upper one-third of the thigh, from both sides to the midline of the axilla, with a focus on cleaning the navel.
  - (e) Pre-rehabilitation measures: Guide patients to engage in preoperative physical exercise, including respiratory training (such as balloon blowing) and lower limb activities, to enhance cardiorespiratory reserve.
  - (f) Nutritional support: Provide enteral or parenteral nutritional support to malnourished patients to improve preoperative nutritional status, enhance immunity, and improve nutritional reserves.
  - (g) Psychological intervention: Use the Anxiety and Depression Scale (HADS) to assess psychological status, encourage patients with positive language, and use successful cases to enhance their confidence. If necessary, provide psychological counseling or medication intervention.
- (2) Intraoperative nursing process
  - (a) Anesthesia and fluid management: Anesthesiologists use the most suitable short-acting anesthetic

drugs for patients based on preoperative evaluation results, reducing the use of opioid drugs and lowering the risk of postoperative nausea and vomiting.

- (b) Goal-oriented liquid therapy: Dynamically adjust the infusion speed and volume based on the patient's weight, surgical time, and bleeding volume to avoid volume overload.
  - (c) Body temperature management: During surgery, warm blankets, heated infusion devices, etc., are used to protect the patient's body temperature, maintain a core body temperature of  $\geq 36^{\circ}\text{C}$ , and reduce complications related to hypothermia.
  - (d) Minimally invasive operation and incision management: Skilled surgeons use laparoscopic techniques and incision protective covers to reduce the risk of abdominal contents exposure and infection. During the operation, the patient's skin condition and body surface area are accurately evaluated to minimize tissue trauma and postoperative pain <sup>[4]</sup>.
- (3) Postoperative nursing process
- (a) Pain management: Based on pain pattern management, multimodal analgesia management is now advocated, such as continuous administration of pain pumps 24–48 hours after surgery, and switching to oral nonsteroidal anti-inflammatory drugs (NSAIDs) or weak opioid drugs after 48 hours to reduce opioid dependence.
  - (b) Non-pharmacological analgesia: After anesthesia, patients can play soothing light music, short videos, and cross-talk skits to divert their attention. Can assist patients in moving their upper and lower limbs to a comfortable position, reducing abdominal pain.
  - (c) Early eating and nutritional support: Encourage patients to chew gum and engage in early activities to promote gastrointestinal function recovery. After postoperative anesthesia and awakening, a small amount of water can be consumed. The daily cumulative intake before defecation should not exceed 300ml. After no coughing, sugar-free and milk-free liquid food should be given. After anal defecation, the diet should be switched to a semi-liquid diet and gradually transitioned to regular food.
  - (d) Nutritional guidance: After resuming a regular diet, encourage patients to consume more high-protein and high-vitamin foods, such as fish, eggs, lean meat, and fresh fruits and vegetables, to promote wound healing.
  - (e) Early activity and rehabilitation: Develop personalized activity plans based on the patient's surgical approach and condition. Assist the patient in taking a semi-recumbent position 6 hours after surgery, encourage bed turning and limb movement. On the first day after surgery, bed activity was gradually increased to at least 6 hours per day.
  - (f) Preventing thrombosis: The occurrence of deep vein thrombosis has a serious impact on the recovery time, treatment costs, and psychological state of hospitalized surgical patients. Therefore, preventing the formation of thrombosis is of utmost importance. Dual lower limb pressure therapy devices or subcutaneous injection of low molecular weight heparin sodium can be used, combined with early activity, to reduce the risk of deep vein thrombosis.
  - (g) Drainage tube and urinary catheter management: Drainage tube removal: Within 24 hours after surgery, depending on the drainage volume and nature, the abdominal drainage tube may be removed as appropriate. Remove the urinary catheter within 24 hours after surgery, encourage patients to drink more water and urinate more to promote bladder function recovery, and reduce the occurrence of urinary system infections.

- (4) Wound care and observation.
  - (a) Wound observation: Keep the wound clean and dry, change the dressing 24–48 hours after surgery, and observe for signs of infection such as redness, swelling, and exudation.
  - (b) Discharge guidance: 5–7 days after the wound heals, instruct the patient to avoid rubbing the wound vigorously while showering, and prohibit taking baths or soaking.
- (5) Follow-up and rehabilitation guidance after discharge
  - (a) Diet and activities: Continue regular meals and avoid spicy and greasy foods; Avoid lifting heavy objects and vigorous exercise within one month.
  - (b) Wound care: Keep the wound dry, and seek medical attention promptly if redness, swelling, or exudation occur<sup>[5]</sup>.
  - (c) Sexual activity and bathing: Sexual activity and bathing are prohibited within one month after surgery, and the specific time should follow the doctor's advice.
  - (d) Follow-up plan: Postoperative follow-up: Outpatient follow-up at 1 week, 1 month, and 3 months after surgery to evaluate wound healing, gastrointestinal function, and psychological status.
  - (e) Complications monitoring: Pay attention to whether the patient has symptoms such as fever, abdominal pain, and abnormal vaginal bleeding, and handle them in a timely manner.

## 2.3. Observation indicators

- (1) Compare the incidence of postoperative complications in the two groups: incision infection, urinary retention, and pulmonary infection.
- (2) Compare perioperative indicators between two groups of patients: surgical time, bleeding volume, first exhaust time, first time out of bed, and length of hospital stay.

## 2.4. Statistical methods

Statistical analysis was performed using SPSS 22.0 software, with count data expressed as n (%) and subjected to a chi-square test; The measurement data is expressed as  $\bar{x} \pm s$ , and t-test is performed. When  $P < 0.05$ , the difference is statistically significant<sup>[6]</sup>.

## 3. Results

### 3.1. Comparison of the incidence of related complications between two groups of patients

**Table 1** shows after intervention, the total incidence of incision infection, urinary retention, pulmonary infection and complications in the observation group was significantly lower than that in the control group ( $p < 0.05$ ).

**Table 1.** Comparison of incidence of related complications between two groups of patients [n, (%)]

Types of complications	Observers (n=35)	Control group(n=35)	X <sup>2</sup>	P
Incision infection	1(2.9%)	0(22.9%)	1.242	< 0.001
Urinary retention	0(0.0%)	3(8.6%)	2.143	< 0.001
Pulmonary infection	0(0.0%)	2(5.7%)	1.071	< 0.001
Total incidence rate	1(2.9%)	5(14.3%)	4.593	< 0.001



### 3.2. Comparison of perioperative indicators between two groups of patients

**Table 2** illustrates after intervention, the observation group had significantly lower surgical time, first exhaust time, first time getting out of bed, and hospitalization time than the observation group ( $p < 0.05$ ), and the difference was statistically significant; After intervention, the observation group had significantly less intraoperative bleeding than the control group ( $p < 0.05$ ), and the difference was statistically significant.

**Table 2.** Comparison of perioperative indicators between two groups of patients  $[(\pm S)]$

Index	Observers (n=35)	Control group (n=35)	<i>t</i>	<i>P</i>
Operative time(min, $\bar{x} \pm s$ )	85.2 $\pm$ 12.4	87.6 $\pm$ 15.3	0.732	< 0.001
Intraoperative bleeding volume(ml, $\bar{x} \pm s$ )	50.3 $\pm$ 15.7	55.8 $\pm$ 18.2	1.402	< 0.001
First exhaust time(h, $\bar{x} \pm s$ )	16.3 $\pm$ 3.2	28.7 $\pm$ 5.1	12.654	< 0.001
First time getting out of bed(h, $\bar{x} \pm s$ )	6.5 $\pm$ 1.8	18.2 $\pm$ 4.3	15.219	< 0.001
Hospital stay(d, $\bar{x} \pm s$ )	3.1 $\pm$ 0.8	5.4 $\pm$ 1.2	9.872	< 0.001

## 4. Discussions

The successful implementation of the Rapid Recovery Surgery (ERAS) model relies on the close collaboration of multidisciplinary teams such as gynecology, anesthesia, nursing, and nutrition. By developing individualized nursing plans, patients are ensured to receive comprehensive and continuous nursing services during the perioperative period <sup>[7]</sup>. The traditional nursing model has problems such as prolonged preoperative fasting and delayed postoperative activities, which may lead to increased stress response and delayed recovery of gastrointestinal function in patients. The ERAS model significantly improves patient prognosis by optimizing perioperative management measures, and has significant advantages in perioperative management of gynecological laparoscopic surgery patients. The following analysis is conducted from multiple dimensions:

- (1) Reducing the incidence of complications: ERAS optimizes perioperative management through multidisciplinary collaboration, which can systematically address the risk of complications.
- (2) Shortening recovery time: The ERAS concept promotes gastrointestinal function recovery and reduces muscle atrophy and the risk of blood clots by shortening fasting time before surgery, early eating, and activity after surgery.
- (3) Improving nursing satisfaction: The ERAS model emphasizes patient participation and multidisciplinary collaboration to enhance patient trust and satisfaction with nursing services.

In summary, the application effect of ERAS concept in perioperative nursing of gynecological laparoscopic surgery patients is significant, which can effectively shorten postoperative recovery time, reduce the incidence of complications, and improve nursing satisfaction. This model has scientific validity, feasibility, and promotional value, and can provide new ideas and methods for perioperative management of gynecological laparoscopic surgery.

## 5. Conclusion

The application of enhanced recovery after surgery (ERAS) concepts in perioperative nursing for gynecological

laparoscopic patients demonstrates significant benefits, including accelerated postoperative recovery, reduced complication rates, and improved patient satisfaction. This approach is scientifically valid, clinically feasible, and worthy of widespread adoption, offering a valuable reference for optimizing perioperative management in gynecological laparoscopic surgery.

## Disclosure statement

The authors declare no conflict of interest.

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# Yiqi Huoxue Method for Treating Benign Prostatic Hyperplasia in Elderly Patients

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**Abstract:** Benign prostatic hyperplasia (BPH) is a common condition affecting the quality of life and health status of elderly men. Its incidence increases with age and is often accompanied by symptoms such as urinary frequency, urgency, nocturia, difficulty voiding, and even urinary retention. While conventional Western medicine can alleviate symptoms, it frequently carries risks of side effects and disease recurrence. Traditional Chinese Medicine approaches this condition based on the characteristic patterns observed in the elderly population: predominantly deficiency and blood stasis, with chronic conditions leading to blood stasis. The Yiqi Huoxue method—aimed at tonifying Qi and activating blood circulation—has been shown to improve urinary symptoms, enhance quality of life, and promote overall health in elderly BPH patients. This article explores the application of the Yiqi Huoxue therapeutic principle in managing benign prostatic hyperplasia.

**Keywords:** Lower urinary tract symptoms; Benign prostatic hyperplasia; Kidney deficiency with blood stasis; Tonifying Qi and activating blood

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## 1. Introduction

According to the data from China's seventh national census, there are approximately 267 million people aged 60 and above, accounting for 18.9% of the total population. China has entered an aging society <sup>[1]</sup>. Lower urinary tract symptoms (LUTS) are common symptoms among elderly men and the main reason for their hospital visits. They seriously affect the quality of life of patients. The incidence of LUTS increases with age, and more elderly people will be troubled by LUTS. Benign prostatic hyperplasia (BPH) is the most common cause of LUTS in men. Histologically, it shows the hyperplasia of the prostate stroma and glands, and anatomically, the volume of the prostate increases. Common symptoms include frequent urination, frequent nocturia, urgent urination, difficulty in urination, and even inability to excrete urine. The onset of the disease usually begins around the age of 50. The incidence rate is over 50% for those aged 60 and as high as 83% for those aged 80. It seriously affects the quality of life of elderly patients and imposes a heavy economic burden on individuals and society <sup>[2-4]</sup>.

## 2. Understanding of benign prostatic hyperplasia in traditional Chinese medicine

Although ancient Chinese medical books do not have a direct corresponding disease name for benign prostatic hyperplasia, based on its clinical manifestations such as difficulty in urination, frequent urination, urgent urination, and increased nocturia, it can be classified into categories such as “retention of urine”, “seminal urinary tract”, or “urinary tract syndrome”. Among them, difficulty in urination with short and scarce drops is “urinary tract”, and urinary tract obstruction with no drops at all is “urinary tract closure”, which is relatively consistent with the urinary tract symptoms of BPH. The “Jin Jian of Medical Canon: Retention of urine Theory” states, “In men, retention of urine is often caused by deficiency of kidney Qi and damp-heat in the bladder.” The “Suwen: Xuanming Wuqi” states, “If the bladder is not functioning well, it is considered as urinary retention; if not, it is associated with enuresis.” This indicates that the abnormal Qi transformation function of the bladder leads to difficulty in urination, and it also suggests that the location of the disease lies in the bladder. The Medical Practice of retention of urine states: “The diseases of retention of urine are often caused by deficiency of the kidney meridian, failure of Qi transformation, and internal retention of water and dampness.” Or due to damp-heat in the bladder, the waterways are not in good condition; Or due to liver depression and qi stagnation, the waterways are blocked. In the “Medical Record of Integrating Chinese and Western Medicine - Difficulty in Urination”, it is stated that “it may be due to internal obstruction of blood stasis, resulting in blocked waterways.” Therefore, traditional Chinese medicine holds that bladder dysfunction, kidney deficiency, blood stasis and damp-heat are the main causes of BPH <sup>[5, 6]</sup>.

In “Suwen: The Ancient Theory of Innocence”, it is mentioned: “Husband...” On the fifth day of the fifth lunar month, when kidney Qi declines, hair becomes sagging and teeth become dull. On the sixth and eighth lines, when the Yang energy is exhausted from the upper body, the face becomes flushed, and the temples turn grey. At the seventh or eighth point, the liver Qi declines, the tendons cannot move, the heavenly essence is exhausted, the essence is scarce, the kidneys are weak, and the body is extremely weak. “Eighty-eight, then the teeth spread out.” As people age, the deficiency of kidney qi and kidney essence in elderly men is a normal physiological process. In the “Suwen; Linglan’s Secret Treatise”, it is mentioned: “The bladder is the official of the state capital. When the body fluids are stored there and transformed, they can be discharged.” Although the bladder is the official of the state capital and is responsible for the function of Qi transformation and opening and closing, this function of Qi transformation and opening and closing is accomplished through the Qi transformation of the kidneys. The elderly often suffer from kidney deficiency with weak qi transformation, poor circulation of Qi and blood, and obstructed distribution of body fluids. At the same time, it is often accompanied by blood stasis, damp-heat, and other factors, leading to the onset of the disease. This results in the interweaving of kidney deficiency, blood stasis, and damp-turbidity, which are mutually causal <sup>[7]</sup>.

## 3. Contemporary medical experts’ understanding of benign prostatic hyperplasia

Academician Wang Qi of the Chinese Academy of Engineering and a master of traditional Chinese medicine believes that the basic pathogenesis of benign prostatic hyperplasia is “deficiency at the root and excess at the symptoms”. Deficiency at the root refers to the decline of the functions of the kidneys, spleen, liver, and other organs, with insufficiency of kidney Qi being the core. In fact, the key issue is internal obstruction of blood stasis, accompanied by Qi stagnation, damp-heat, and phlegm turbidity. Aging and physical decline lead to kidney deficiency and weak qi transformation, resulting in poor blood circulation and blood stasis. Blood stasis is not only

a cause of hyperplasia but also a pathological product that compresses the urethra and hinders microcirculation after hyperplasia, forming a vicious cycle of “stasis–deficiency–stasis”. In treatment, emphasis is placed on both strengthening the body’s fundamental constitution and promoting blood circulation to remove blood stasis, supplemented by clearing heat, promoting diuresis, resolving phlegm, and dispersing nodules<sup>[8]</sup>.

Professor Li Haisong from Dongzhimen Hospital of Beijing University of Chinese Medicine holds that the pathogenesis of benign prostatic hyperplasia is centered on kidney deficiency with poor Qi transformation and internal obstruction of blood stasis. He believes that “deficiency” is the fundamental pathogenesis and the prerequisite for the onset of the disease, while “blood stasis” is the core pathogenesis and an important pathological product. The two are interrelated as cause and effect. Kidney deficiency leads to the loss of Qi transformation in the bladder, and poor blood circulation results in blood stasis. Blood stasis obstructs the lower part of the body, aggravating difficulty in urination. This forms a vicious cycle of “mutual accumulation of deficiency and blood stasis”. The treatment advocates tonifying the kidney and benefiting Qi to restore the function of Qi transformation, and promoting blood circulation and removing blood stasis to unblock the waterways<sup>[9]</sup>.

Professor Li Yueqing from Dongzhimen Hospital of Beijing University of Chinese Medicine proposed that the core pathogenesis of benign prostatic hyperplasia is kidney deficiency and blood stasis, with the principle that “kidney deficiency in old age is the root cause, and the internal formation of blood stasis is the symptom.” Deficiency of kidney Qi leads to weak Qi transformation and poor blood circulation, resulting in blood stasis. Blood stasis blocks the lower jiao waterways and compresses the urethra, causing difficulty in urination. This creates a vicious cycle of “kidney deficiency generating blood stasis and blood stasis damaging kidney Qi”. The treatment emphasizes tonifying the kidney and replenishing essence to consolidate the root cause, promoting blood circulation, and resolving nodules to eliminate symptoms<sup>[10]</sup>.

Professor Zeng Qingqi, a renowned traditional Chinese medicine doctor in Jiangsu Province, believes that blood stasis obstruction is the core pathogenesis of benign prostatic hyperplasia. Elderly people with kidney deficiency or long-term accumulation of damp-heat can lead to poor circulation of Qi and blood, causing blood stasis to accumulate in the lower part of the body, directly blocking the urethra and the meridians of the prostate, resulting in glandular hyperplasia, urethral compression, and difficulty in urination. Blood stasis is not only a pathological product but also further hinders Qi transformation and blood circulation, forming a vicious cycle of “blood–hyperplasia–blood stasis”. The treatment mainly focuses on promoting blood circulation, removing blood stasis, and unblocking meridians, supplemented by tonifying the kidney and benefiting Qi or clearing heat and promoting diuresis<sup>[11]</sup>.

Professor Men Chengfu, a renowned national traditional Chinese medicine expert, believes that although the onset of benign prostatic hyperplasia can be attributed to pathological factors such as Qi deficiency, Qi stagnation, damp-heat, and blood stasis, the key to its pathological mechanism lies in blood stasis. The occurrence, development, evolution, and outcome of this disease are all closely related to blood stasis. Blood stasis is not only a pathogenic factor of this disease but also a pathological product, running through the entire course of the disease. It is also the main reason for the recurrence and persistence of benign prostatic hyperplasia<sup>[12]</sup>.

Professor Zhao Fan believes that in elderly patients, kidney deficiency leads to weak propulsion, and the bladder’s Qi transformation function declines. Qi deficiency causes blood stasis, which accumulates in the lower part of the body and forms accumulations that obstruct the urethra<sup>[13]</sup>. In the “Guidelines for the Management of Chronic Diseases of Benign Prostatic Hyperplasia in the Elderly”, it is mentioned that in the early stage, the disease is mainly characterized by a mixture of deficiency and excess, while in the later stage, it is mainly based on



fundamental deficiency. It emphasizes that “treating both the symptoms and root causes”, “combining attack and tonification”, and “regulating Yin and Yang” are the main therapeutic principles, and has determined therapeutic methods such as “clearing heat and promoting diuresis”, “promoting blood circulation and removing blood stasis”, “warming and tonifying kidney Yang”, “nourishing kidney Yin”, and “tonifying the middle and benefiting qi”.

#### **4. Analysis of the syndrome types of benign prostatic hyperplasia**

The PH lesion sites mostly involve the spleen, kidney, lung, bladder, and the three jiao. The pathogenic factors include Qi deficiency, Yang deficiency, damp-heat, and blood stasis, among which “kidney deficiency, damp-heat, and blood stasis” are particularly important in the progression of the disease <sup>[14]</sup>. Han *et al.* conducted a study on the distribution pattern of TCM syndrome types in 1052 patients with BPH and found that kidney qi deficiency syndrome was the most common, accounting for 43.2%, while blood stasis and turbidity obstruction syndrome accounted for approximately 20.7% <sup>[15]</sup>. It can be concluded that kidney Qi deficiency and blood stasis, and turbidity obstruction syndrome are the most frequently witnessed types. Xu *et al.* identified the TCM constitutions of patients with benign prostatic hyperplasia and found that they were mainly characterized by Yang deficiency and Qi deficiency <sup>[16]</sup>. Professor Guo Jun found in clinical practice that BPH of kidney deficiency and blood stasis type is the most common <sup>[17]</sup>. The treatment involves tonifying the kidney and benefiting Qi, promoting blood circulation, and removing blood stasis. Pan *et al.* analyzed the data of 506 patients with BPH collected and found that among all the cases, the proportion of kidney Yang deficiency type was the highest, followed by spleen and kidney qi deficiency type, qi stagnation and blood stasis type, and then kidney Yin deficiency type and damp-heat descending type in sequence <sup>[18]</sup>. Chen *et al.* analyzed and summarized the frequency of the collected literature on the treatment of BPH with traditional Chinese medicine to explore the rules of syndrome differentiation and treatment <sup>[19]</sup>. The top four frequently witnessed types, accounting for 53.58%, were: kidney deficiency and blood stasis type, kidney Yang deficiency type, middle Qi sinking type, and lung heat congestion type.

#### **5. The method of tonifying Qi and promoting blood circulation for the treatment of benign prostatic hyperplasia**

As a distinctive therapy in traditional Chinese medicine, the method of tonifying Qi and promoting blood circulation regulates the balance of Qi and blood in the human body and improves local microcirculation to achieve the purpose of treating benign prostatic hyperplasia. The key to the pathogenesis of BPH lies in Qi deficiency and blood stasis. Tonifying Qi and promoting blood circulation will run through the entire course of the disease. The mechanism of action of the method of tonifying Qi and promoting blood circulation in the treatment of benign prostatic hyperplasia may involve multiple aspects. First of all, Qi-tonifying drugs can enhance the circulation of Qi and blood in the body. Secondly, blood-activating and stasis-resolving drugs can improve local microcirculation disorders, alleviate the congestion, edema, and inflammatory response of the prostate tissue.

In addition, the method of tonifying Qi and promoting blood circulation may also exert therapeutic effects by regulating the endocrine system, immune system, and other pathways. In the specific drug application of the method of tonifying Qi and promoting blood circulation for the treatment of benign prostatic hyperplasia, traditional Chinese medicinal materials such as *Astragalus membranaceus*, *Angelica sinensis*, *Salvia miltiorrhiza*, and *Panax notoginseng* are widely used. These traditional Chinese medicinal materials have the effects of

tonifying Qi and nourishing blood, as well as promoting blood circulation and removing blood stasis. On the basis of tonifying Qi and promoting blood circulation, the drugs are adjusted according to the patient's symptoms, such as damp-heat, Yang deficiency, and Yin deficiency. Professor He Juqiao plans to use a formula for tonifying Qi, promoting blood circulation, and eliminating symptoms for treatment. The entire formula consists of *Astragalus membranaceus*, *Atractylodes macrocephala*, Pangolin, *Trichosanthes*, *Phellodendron amurense*, Wulingzhi, *Fructus aurantii*, and Turtle shell, etc. <sup>[20]</sup>. The *Astragalus membranaceus* and *Atractylodes macrocephala* in the formula exert the effects of tonifying Qi and promoting diuresis. Pu Huang and Wu Ling Zhi have the effects of promoting blood circulation, removing blood stasis, and relieving pain. Pangolin, tricolor, *Fructus aurantii*, and turtle shell have the effects of breaking Qi, eliminating accumulation, softening hardness, dispersing nodules, and relieving symptoms. When used in combination, these herbs work together to achieve the effects of tonifying Qi, promoting diuresis, activating blood circulation, and eliminating symptoms.

## 6. Case analysis

The patient is a 75-year-old male who sought medical attention due to symptoms such as difficulty in urination, frequent urination, urgent urination, and increased nocturia. Diagnosed with benign prostatic hyperplasia by Western medicine. The patient reported obvious symptoms such as easy fatigue, shortness of breath, and excessive sweating in daily life. The tongue is pale purple with a thin white coating, and the veins at the base of the tongue are tortuous. The pulse is fine and sluggish. It is diagnosed as benign prostatic hyperplasia of Qi deficiency and blood stasis type in traditional Chinese medicine. The treatment adopts the method of tonifying Qi and promoting blood circulation. A prescription is composed of Qi-tonifying drugs such as *Astragalus membranaceus*, *Codonopsis pilosula*, and *Atractylodes macrocephala*, as well as blood-activating and stasis-resolving drugs such as *Salvia miltiorrhiza*, Peach kernel, and safflower for treatment. Two weeks after the treatment, the patient's symptoms, such as difficulty in urination, frequent urination, and urgent urination, were significantly improved. Symptoms such as fatigue and shortness of breath have also been alleviated. After continuing the consolidation treatment for 4 weeks, the patient's symptoms basically disappeared, and the quality of life significantly improved.

## 7. Conclusion

The condition of patients with benign prostatic hyperplasia is complex and diverse. There are differences among different patients in terms of physical constitution, severity of the condition, and complications. Therefore, future treatments should place greater emphasis on individualization and precision. Through the treatment of syndrome differentiation in traditional Chinese medicine, combined with the specific condition and physical characteristics of the patient, personalized treatment plans for tonifying Qi and promoting blood circulation are formulated to improve the treatment effect and patient satisfaction. In the treatment of benign prostatic hyperplasia, the comprehensive treatment model combining traditional Chinese and Western medicine has broad application prospects. The method of tonifying Qi and promoting blood circulation can be combined with Western medical methods such as surgery and medication to complement each other's advantages and enhance the overall therapeutic effect.

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# Research Progress on Trimethoprim Cyclodextrin Inclusion Complexes

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**Abstract:** Trimethoprim (TMP), as a broad-spectrum bacteriostatic antibiotic, is widely used in clinical anti-infection therapy and livestock breeding. However, its low water solubility leads to insufficient bioavailability, which has become a key problem restricting its development. Cyclodextrins and their derivatives, with their unique cyclic structures, can form inclusion complexes with TMP to improve its properties. This article reviews the pharmacological characteristics of TMP, the types and properties of common cyclodextrins, focusing on introducing various preparation methods of trimethoprim cyclodextrin inclusion complexes and multiple characterization methods for identifying the inclusion complexes, aiming to provide a reference for further research and development of trimethoprim cyclodextrin inclusion complexes.

**Keywords:** Trimethoprim; Cyclodextrin; Inclusion technology; Characterization method; Research progress

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## 1. Introduction

Trimethoprim (TMP), as a broad-spectrum antibacterial synergist, selectively inhibits bacterial dihydrofolate reductase, blocks bacterial nucleic acid and protein synthesis, and is widely used in the treatment of bacterial infections in clinical and veterinary fields. However, TMP has extremely poor water solubility, only 0.4 mg/mL, and a bitter taste, which seriously limits its bioavailability and clinical efficacy. Although trimethoprim lactate has good water solubility, it has strong hygroscopicity and poor stability, and faces many formulation problems when compatible with alkaline drugs such as sulfonamides <sup>[1]</sup>. To improve the physicochemical properties and biological activity of TMP, researchers have turned their attention to cyclodextrins and their derivatives.

Cyclodextrins (CDs) are a class of cyclic oligosaccharides produced by the action of glucosyltransferases from *Bacillus* on amylose <sup>[2, 3]</sup>. Under the action of cyclodextrin glucosyltransferase, a series of cyclic oligosaccharides with 6-12 glucose units and molecules with 6, 7, and 8 glucose units of different degrees of polymerization are obtained, which are named  $\alpha$ -cyclodextrin,  $\beta$ -cyclodextrin, and  $\gamma$ -cyclodextrin, respectively <sup>[4]</sup>.



Their solubilities in water are 145 mg/mL, 18.5 mg/mL, and 232 mg/mL<sup>[5]</sup>. Specifically,  $\alpha$ -cyclodextrin has a small inner cavity and can only include small molecules, which has certain limitations<sup>[6]</sup>. It can regulate gastrointestinal reactions, improve constipation, reduce blood glucose concentration, help in weight loss, and can also be used as a pharmaceutical excipient<sup>[7]</sup>.  $\beta$ -cyclodextrin has an inner cavity diameter of 0.7–0.8 nm, low water solubility, low production cost, and can be used as an antioxidant<sup>[8, 9]</sup>.  $\gamma$ -cyclodextrin has a larger cavity and can include more substances, which can increase the water solubility, reactivity, stability, and volatility of drugs, but its production cost is high, and it cannot be produced in large quantities<sup>[10, 11]</sup>. Among them,  $\beta$ -CD is the most widely used, with a suitable cavity size, easy availability, reasonable price, and a retention rate higher than that of  $\alpha$  and  $\gamma$ -CD<sup>[12]</sup>. In recent years, to solve the problems of formulation design and safety and effectiveness caused by drugs' insufficient solubility, stability, and bioavailability, researchers at home and abroad have prepared drug delivery systems such as inclusion complexes, solid dispersions, and nanoparticles with cyclodextrins, which have expanded the application of cyclodextrins and their derivatives in pharmaceuticals<sup>[3]</sup>.

In recent years, significant progress has been made in the research on trimethoprim cyclodextrin inclusion complexes in terms of solubilization mechanisms and preparation technologies. This article systematically reviews the preparation methods and structural characterization of TMP cyclodextrin inclusion complexes, aiming to provide a reference for the research and development of new trimethoprim preparations and their clinical applications.

## 2. Preparation technologies of trimethoprim cyclodextrin inclusion complexes

Common preparation technologies for trimethoprim cyclodextrin inclusion complexes include saturated aqueous solution method, ultrasonic method, freeze-drying method, grinding method, etc. Different methods have different effects on the formation efficiency and physicochemical properties of inclusion complexes.

### 2.1. Saturated aqueous solution method

The saturated aqueous solution method has a simple process and does not require expensive equipment, making it one of the most commonly used methods for preparing inclusion complexes<sup>[13]</sup>. It is also one of the commonly used methods for preparing trimethoprim-cyclodextrin inclusion complexes<sup>[14]</sup>. In this method, the guest drug trimethoprim is added to an aqueous solution in which cyclodextrin is dissolved, and under appropriate conditions, such as temperature, molar ratio, rotation speed, and time, sufficient mixing and stirring are carried out to allow the inclusion of trimethoprim with cyclodextrin. After the reaction, the undissolved drug is removed by cooling crystallization and suction filtration, and the product is obtained after drying. Zou *et al.* used the saturated aqueous solution method with a host-guest molar ratio of 3:1, a reaction system pH of 7.5, an inclusion time of 4 hours, a rotation speed of 800 r/min, and vacuum drying and grinding at 60°C<sup>[15]</sup>. The solubility of the obtained inclusion complex was 26 times higher than that of the original drug. Li *et al.* adopted the solvent method (a derivative process of the saturated aqueous solution method), dissolving TMP in an aqueous solution containing 2% acetic acid, and reacting with  $\beta$ -cyclodextrin at a molar ratio of 1:1, which significantly improved the water solubility of TMP<sup>[16]</sup>. In addition, Hu prepared inclusion complexes of TMP with  $\beta$ -cyclodextrin and its derivatives by the aqueous solution method (with a molar ratio of 1:1 for all), and found that the hydrophobic cavity of  $\beta$ -cyclodextrin is more conducive to the embedding of TMP molecules, providing a reference for the process optimization of this method<sup>[17]</sup>.

## 2.2. Ultrasonic method

The ultrasonic method first prepares a mixed saturated solution of the guest substance and cyclodextrin, sets the ultrasonic power, ultrasonic time, and the on and off time of each pulse, then uses ultrasonic equipment to synthesize the inclusion complex, and finally obtains the powdery inclusion complex by drying methods (such as spray drying or freeze-drying)<sup>[18]</sup>. The ultrasonic method is suitable for the preparation of most inclusion complexes, resulting in a high inclusion rate, and the inclusion complex is not easy to disintegrate during the preparation process<sup>[19]</sup>. The cavitation effect, mechanical effect, and thermal effect of ultrasound are used to promote the inclusion reaction between trimethoprim and cyclodextrin. Sun *et al.* prepared inclusion complexes by the ultrasonic-microwave freeze-drying method, and optimized ultrasound was used in the preparation of TMP-sulfobutyl ether- $\beta$ -CD inclusion complexes<sup>[20]</sup>.

## 2.3. Freeze-drying method

Freeze-drying is the most widely used technology to improve the stability of compounds<sup>[21]</sup>. The freeze-drying method is suitable for the preparation of temperature-sensitive TMP-cyclodextrin inclusion complexes, which can avoid the impact of high temperature on drug activity. Macedo OFL prepared inclusion complex samples by the suspension method, adding TMP to HP- $\gamma$ -CD aqueous solution at a molar ratio of 1:1, stirring the suspension at a dark temperature for 8 hours. After the drug was included, the water was removed by vacuum drying and freeze-drying to obtain a loose powdery inclusion complex. This method is suitable for temperature-sensitive drugs<sup>[22]</sup>.

## 2.4. Grinding method

Cyclodextrin is dissolved in water to prepare a saturated solution, and a solvent containing an appropriate amount of the drug to be included is added. The mixture is ground into a paste under suitable conditions, such as grinding temperature, time, and type of solvent. After suction filtration, washing, and filtration, the filtrate is concentrated and dried to obtain the product. In the industry, colloid mills are mostly used for including drugs. The kneading method is a simplified process of the grinding method. Cyclodextrin and a small amount of pure water are mixed in a mortar at a specific molar ratio to form a paste. TMP is added and fully kneaded, and the product is obtained after solvent washing and drying. This method is simple, efficient, and scalable<sup>[23]</sup>. Figueiras A added  $\beta$ -CD to a ceramic mortar with deionized water until a paste was obtained, slowly added TMP, kneaded the slurry, and allowed the final product to equilibrate in the dark at room temperature and humidity for 72 hours to obtain the inclusion complex. This method has difficulties in controlling the grinding time and operation degree, resulting in poor drug inclusion rate and repeatability<sup>[24]</sup>.

## 3. Screening of cyclodextrin derivatives

Cyclodextrins themselves have the ability to recognize molecules and selectively include guest molecules<sup>[25]</sup>. Cyclodextrins are not easily decomposed in environments such as heat, acid, and alkali, and can improve the solubility, stability, safety, and bioavailability of drugs or achieve other purposes<sup>[26, 27]</sup>. Natural cyclodextrins have disadvantages such as low water solubility and difficulty in perfectly including drugs. To improve these problems, scientists have introduced groups such as sulfobutyl, hydroxypropyl, and methyl to form new cyclodextrin derivatives, thereby changing their own properties and expanding their application range<sup>[28]</sup>. Cyclodextrins

and their derivatives, with their unique cavity structures, physical and chemical properties, can form host-guest inclusion complexes with a variety of drugs. Cyclodextrin derivatives, with their unique cylindrical structure, moderately sized molecular weight, and hydrophilic exterior and hydrophobic interior characteristics, have become carriers for various drugs, and form inclusion complexes with many small molecule drugs to improve the solubility of poorly soluble drugs <sup>[29]</sup>. CD derivatives obtained by introducing substituent groups on CD have stronger solubility and solubilizing ability than the parent, and can improve water solubility when forming inclusion complexes with water-insoluble functional components <sup>[30]</sup>. The use of sulfobutyl ether, hydroxypropyl, and carboxymethyl  $\beta$ -CD can obtain better CD-guest complex performance <sup>[31]</sup>.

Drugs carried by cyclodextrins or their derivatives can significantly prolong the retention time of drugs in the body, enhance the targeting of drugs, improve bioavailability, and improve drug properties <sup>[32]</sup>. Among various cyclodextrins,  $\beta$ -cyclodextrin ( $\beta$ -CD) has become a new type of pharmaceutical excipient due to its special cavity structure, non-toxicity, safety, and easy formation of stable hydrates. It is mainly used to mask the irritating odor of drugs, increase drug stability, improve solubility and bioavailability, and also can play a sustained-release role <sup>[33]</sup>. Based on the advantages of  $\beta$ -cyclodextrin, the research on its derivatives has attracted much attention. At present, three ideal pharmaceutical excipients with good water solubility are considered: hydroxypropyl- $\beta$ -cyclodextrin (HP- $\beta$ -CD), methyl- $\beta$ -cyclodextrin (Me- $\beta$ -CD), and 2,6-dimethyl- $\beta$ -cyclodextrin (DM- $\beta$ -CD) <sup>[34]</sup>. Among them, methyl- $\beta$ -cyclodextrin (M- $\beta$ -CD), as the most effective solubilizer for insoluble substances among  $\beta$ -CD alkylated derivatives, can be used in oral preparations, suppositories, transdermal absorbents, nasal sprays, and other dosage forms at very low doses for poorly soluble and highly active drugs <sup>[35, 36]</sup>. In the research on trimethoprim (TMP),  $\beta$ -cyclodextrin and its derivatives, such as hydroxypropyl- $\beta$ -cyclodextrin and sulfobutyl ether- $\beta$ -cyclodextrin have become research hotspots due to the high matching degree between their cavity size and TMP molecules, and different cyclodextrin derivatives have significant differences in the solubilizing effect on TMP.

## 4. Characterization methods of trimethoprim cyclodextrin inclusion complexes

In modern preparations, inclusion complexes are mainly used to increase the dissolution rate of drugs and improve drug stability. During their formation, several physicochemical property changes occur, such as optical properties, thermodynamics, electrochemistry, and solubility, which are used to evaluate whether cyclodextrins and guest molecules form inclusion complexes. Sometimes the difference in a certain property is not obvious, so multiple methods need to be comprehensively used for determination <sup>[17]</sup>. For example, Li *et al.* studied the inclusion complex of TMP with  $\beta$ -cyclodextrin, used ultraviolet spectrophotometry and phase solubility method to determine the properties of the inclusion complex in aqueous solution to prove that TMP was included, and characterized the formation of solid inclusion complexes by differential scanning calorimetry (DSC) and powder X-ray diffraction (X-RD) <sup>[16, 17]</sup>.

### 4.1. Phase solubility method

The apparent inclusion constant ( $K_c$ ) of the inclusion complex is an important parameter determining the inclusion properties of cyclodextrins. The magnitude of  $K_c$  reflects the strength of the binding force when cyclodextrins and drug molecules form inclusion complexes, and the main determination method is the phase solubility method. The phase solubility method is an important method to study the formation and stability of inclusion complexes. By determining the solubility of TMP in cyclodextrin solutions of different concentrations and drawing a phase

solubility diagram, the formation and stability constant of the inclusion complex can be judged. The solubility of TMP increases with the increase of HP- $\beta$ -CD concentration, and also increases with the increase of temperature<sup>[37]</sup>. Zou *et al.* conducted a phase solubility study, and the phase solubility curve was a typical AL type, indicating that TMP and HP- $\beta$ -CD formed an inclusion complex within this concentration range<sup>[15]</sup>.

## 4.2. Differential scanning calorimetry

To accurately investigate the effect of temperature on volatile substances in the inclusion complex and verify the formation of the inclusion complex, auxiliary evidence can be obtained from the thermogravimetric analysis chart. The formation of the inclusion complex can be judged by studying the change of properties of different substances with temperature<sup>[38]</sup>. Differential scanning calorimetry (DSC) characterizes inclusion complexes by measuring the heat flow change of samples under programmed temperature control, which is a commonly used method for the characterization and analysis of cyclodextrin inclusion complexes. Lu *et al.* used Chem3D Ultra 8.0 and SYBYL software for molecular simulation and phase solubility method to explore the possibility of inclusion of trimethoprim by hydroxypropyl- $\beta$ -cyclodextrin, and both thin-layer chromatography and differential scanning calorimetry verified the formation of the inclusion complex<sup>[39]</sup>. The DSC spectra of TMP, Me- $\beta$ -CD, and their inclusion complexes show obvious differences<sup>[40]</sup>. The melting point of TMP is 199–203°C, and it has been reported in the literature that TMP has a sharp melting endothermic peak near 199°C, and Me- $\beta$ -CD has a dehydration endothermic peak at 80–120°C<sup>[41]</sup>. After the formation of the inclusion complex, the melting peak of TMP disappears or is significantly weakened, indicating that TMP molecules have entered the cavity of Me- $\beta$ -CD<sup>[42]</sup>.

## 4.3. Fourier transform infrared spectroscopy

Fourier transform infrared spectroscopy studies the inclusion effect by analyzing the changes in molecular vibration frequencies, and obtains information by observing the absorption peaks of substances in the infrared region<sup>[43]</sup>. FTIR can reveal the transition of intramolecular vibrational energy levels and judge whether the inclusion complex is formed by comparing the changes in infrared absorption of specific functional groups between physical mixtures and inclusion complexes<sup>[44]</sup>. The functional group bands related to the inclusion of drugs with cyclodextrins are studied by infrared spectroscopy to obtain more evidence for the formation of inclusion complexes<sup>[45]</sup>.

The interaction between CD and TMP molecules in solids can be evaluated by infrared spectroscopy. The shift of TMP absorption spectrum indicates the change in the hydrogen bond mode of polymorphic substances<sup>[46]</sup>. In the characterization of TMP-cyclodextrin inclusion complexes, by comparing the infrared spectra of TMP, cyclodextrin, physical mixtures, and inclusion complexes, it can be judged whether the inclusion complex is formed. If an inclusion complex is formed, the characteristic absorption peak of TMP may shift, change in intensity, or even disappear, and new absorption peaks may appear. When preparing TMP-sodium butyl ether- $\beta$ -cyclodextrin complexes, Sun *et al.* found a new peak at 1162.34 cm<sup>-1</sup> in the TMP-SDS- $\beta$ -cyclodextrin complexes. It was speculated that this peak might be caused by the C-O-C stretching vibration of the TMP being included, which preliminarily indicated that the complexes had been formed<sup>[20]</sup>.

## 4.4. Nuclear magnetic resonance spectroscopy

Proton nuclear magnetic resonance spectroscopy is used to record the hydrogen spectra of inclusion complexes



formed by TMP with different CDs. TMP interacts with protons on CD inside the cavity due to van der Waals forces. By comparing the chemical shift changes of specific hydrogen atoms after physical mixing and inclusion reaction, it can be judged from the spectrum whether TMP has entered the hydrophobic cavity of CD. If the drug accumulates in the cavity of the inclusion material, the hydrogen atoms in the cavity will be shielded by the drug molecules, resulting in a change in the chemical shift value, while the hydrogen atoms outside the cavity will not change<sup>[38]</sup>. Ma *et al.* judged the occurrence of the inclusion reaction based on the chemical shift of H in TMP in the region of 5.0–8.0<sup>[47]</sup>. In the physical mixture, the chemical shift of H in TMP molecules almost did not shift, while in the inclusion complex, they all changed, indicating that each CD cavity contained TMP molecules.

#### 4.5. Scanning electron microscope

Scanning electron microscope (SEM) excites various physical information through the interaction between the light beam and the substance, and collects, amplifies, and images this physical information, to achieve the purpose of characterizing the micro-morphology of the substance. By analyzing the signals generated by the interaction between the light beam and the sample, SEM can characterize the micro-morphological structure of the substance<sup>[48]</sup>. When the drug is included by cyclodextrin, its lattice arrangement will change, which can be observed under the electron microscope. The formation of the inclusion complex can be judged by comparing the three-dimensional structure differences between the inclusion complex and the original drug molecules<sup>[49]</sup>. Li *et al.* conducted spray gold coating experiments on TMP raw materials,  $\beta$ -cyclodextrin, and TMP- $\beta$ -cyclodextrin complexes, respectively<sup>[14]</sup>. Scanning electron microscopy observations revealed that the TMP- $\beta$ -cyclodextrin complex contained no crystalline form of TMP but instead formed dense polymer aggregates. This suggests that TMP molecules are dispersed within the  $\beta$ -cyclodextrin matrix, creating irregular agglomerates that enhance both solubility and dissolution profiles through increased specific surface area.

Cyclodextrins have unique molecular structures and can interact with guest molecules, but it is impossible to intuitively study the formation process of inclusion complexes only by experiments, so molecular simulation is widely used to explore cyclodextrin inclusion complexes<sup>[50]</sup>. Molecular simulation is a computer simulation method for simulating the properties of molecules or molecular systems, used to study the properties and three-dimensional structures of molecules. Molecular simulation methods such as molecular docking and molecular dynamics simulation can show the details of intermolecular interactions that cannot be captured by experiments, and better understand the structure and inclusion mechanism of cyclodextrin inclusion complexes<sup>[51]</sup>. However, the flexibility and asymmetric shape of cyclodextrins lead to a rather complex conformational space of the formed inclusion complexes. There seem to be multiple binding modes, but usually only one of them is dominant, and this main conformation can often be determined by molecular simulation<sup>[52]</sup>.

### 5. Summary

In conclusion, the research on the inclusion of trimethoprim with cyclodextrins provides an effective way to improve the physicochemical properties of TMP and enhance its bioavailability. This article systematically combs the preparation methods, experimental characterization methods of trimethoprim cyclodextrin inclusion complexes, and the synergistic role of molecular simulation technology in the structural verification and mechanism analysis of inclusion complexes. These studies not only deepen the understanding of the laws of host-guest interactions but also lay a theoretical and experimental foundation for the subsequent development of



trimethoprim and cyclodextrin inclusion complexes.

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## Disclosure statement

The authors declare no conflict of interest.

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# Construction of a Risk Prediction Model for Central Venous Catheter–Associated Thrombosis in Pediatric Patients with Severe Traumatic Brain Injury

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**Abstract:** *Objective:* To develop and validate a risk prediction model for catheter-related thrombosis (CRT) in pediatric patients with severe traumatic brain injury (sTBI). *Methods:* Using convenience sampling, 216 pediatric patients with sTBI admitted to the Surgical Intensive Care Unit of Kunming Children's Hospital between June 2022 and May 2025 were enrolled and randomly divided into a training set of 151 cases and a validation set of 65 cases. Influencing factors were identified through univariate analysis and logistic regression analysis to construct the prediction model. The model's discrimination and calibration were evaluated by the area under the receiver operating characteristic (ROC) curve (AUC) and the Hosmer–Lemeshow goodness-of-fit test. *Results:* Univariate analysis showed that admission GCS score, CVC insertion site, D-dimer level, and duration of mechanical ventilation were risk factors for CRT in children with sTBI ( $P < 0.05$ ). The logistic regression equation was constructed as follows:  $\text{Logit}(P) = 2.74 - 1.95 \times \text{GCS score} + 0.25 \times \text{D-dimer } (\mu\text{g/mL}) + 0.02 \times \text{duration of mechanical ventilation (h)}$ . Based on this model, the AUC was 0.87 in the training set and 0.88 in the validation set. The Hosmer–Lemeshow goodness-of-fit test indicated good agreement between the model's calibration curve and the ideal curve. *Conclusion:* The developed prediction model demonstrates good predictive performance and can serve as a reference for the early clinical identification of CRT risk in pediatric patients with sTBI.

**Keywords:** Severe traumatic brain injury; Central venous catheter-related thrombosis; Children; Prediction model; Influencing factors

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## 1. Introduction

The main causes of traumatic brain injury (TBI) in children are falls, traffic accidents, and blows, with a global incidence rate of approximately (47–280)/100,000. TBI is one of the leading causes of death and disability among

children worldwide <sup>[1, 2]</sup>. With the improvement of living standards and the development of urban transportation, the number of children with TBI has significantly increased, and the severity of trauma has been increasing <sup>[3]</sup>. Children with severe traumatic brain injury (sTBI) often face life-threatening issues such as hypovolemia and increased intracranial pressure, urgently requiring vasoactive drugs, blood transfusions, hypertonic solutions, and other treatments. Therefore, the central venous catheter (CVC) serves as a crucial lifesaving access route. However, research has shown that CVC is a significant risk factor for venous thromboembolism in pediatric patients <sup>[4]</sup>. Additionally, the incidence of central venous device-related thromboses (CRT) has been increasing in recent years <sup>[5]</sup>. Current studies indicate that the CRT incidence rate among hospitalized children is as high as 25.7%–43.53% <sup>[6–9]</sup>. Currently, there are no reports on CRT risk prediction models for children with sTBI. Therefore, this study aims to construct a CRT prediction model for children with sTBI to assist in the early identification of CRT patients.

## **2. Objects and methods**

### **2.1. Subjects**

Children with sTBI admitted to the surgical intensive care unit (SICU) of Kunming Children's Hospital from June 2022 to May 2025 were selected to construct the prediction model.

The sample size calculation in this study followed the clinical prediction model sample size calculation formula EPV (events per variable) <sup>[10]</sup>. Through literature review and expert panel meetings, it was determined that there were 5 predictive variables. Considering a 10% loss to follow-up rate, the total sample size was determined to be at least approximately 216 cases. Patients were randomly split into a training set (151 cases) and a validation set (65 cases) at a 7:3 ratio.

The children were divided into CRT and non-CRT groups. This study was approved by the Medical Ethics Committee of Kunming Children's Hospital (2023-03-264-K01).

#### **2.1.1. Inclusion criteria**

- (1) Children diagnosed with severe or extremely severe traumatic brain injury.
- (2) Children aged < 18 years.
- (3) Admission to the hospital within 24 hours of injury, with a hospital stay  $\geq 3$  days and CVC indwelling time  $\geq 72$  hours.
- (4) Doppler ultrasonography performed before catheterization to confirm no thrombosis in the catheterized vein.

#### **2.1.2. Exclusion criteria**

- (1) History of venous thromboembolism.
- (2) Coagulation dysfunction or thrombocytopenia before trauma.
- (3) Incomplete medical records.

#### **2.1.3. CRT diagnosis criteria**

- (1) Clinicians or nurses with 3 or more years of experience perform vascular ultrasound screening. Detection of thrombus in the blood vessels of the limb with the catheter indicates CRT.
- (2) During routine catheter maintenance by nurses, if there is no blood return when withdrawing the catheter,



infusion is not smooth, or tissue plasminogen activator is required, it indicates the occurrence of CRT.

## 2.2. Determination of predictive variables

The clinical data collected in this study was determined through expert consultation:

- (1) A risk factor item pool for CRT was formed through literature review and research group discussion.
- (2) Inclusion criteria for experts: having a professional title of associate professor or above; engaged in pediatric critical care or intravenous therapy nursing for more than 10 years; voluntarily participating in this consultation. Five experts were included in this study for consultation.
- (3) After two rounds of expert consultation, the items were revised to determine the predictive variables.

Finally, the clinical data of the patients included:

- (1) General information: age, gender, weight, whether surgery was performed, whether there were multiple injuries, and Glasgow Coma Scale (GCS) score at admission for sTBI patients.
- (2) Catheter factors: CVC model, CVC type, catheter insertion site.
- (3) Laboratory indicators 24 hours after CVC placement: activated partial thromboplastin time (APTT), prothrombin time (PT), D-dimer (D-d), fibrinogen concentration (FIB), white blood cell count, platelet count, C-reactive protein, cholesterol concentration, lactic acid level (Lac).
- (4) Treatment factors: duration of mechanical ventilation, whether blood products, vasoactive drugs, parenteral nutrition, hypertonic fluids, anticoagulants, two or more antibiotics, or early rehabilitation were used.

## 2.3. Data collection

Data was collected by a trained member of the research team and verified by another team member to ensure authenticity and accuracy. If any issues were found during the collection process, adjustments were made promptly after discussion within the research team.

## 2.4. Statistical methods

Statistical analysis was performed using SPSS 25.0 software and R 4.5.1. Qualitative data were described using frequency and proportion, and univariate analysis was conducted using the  $\chi^2$  test. Quantitative data conforming to a normal distribution were described using mean  $\pm$  standard deviation, and comparisons between groups were made using the t-test. Quantitative data not conforming to a normal distribution were described using median (quartiles) [M(P25, P75)], and comparisons between groups were made using the Mann-Whitney U test. Variables with statistical significance were included in Logistic regression analysis. A nomogram prediction model was established using R 4.5.1 software. The area under the receiver operating characteristic (ROC) curve (AUC) and the Hosmer-Lemeshow goodness-of-fit test were used to evaluate the model's discrimination and calibration, respectively. The model was internally validated using the Bootstrap method with 500 repetitions. Statistical significance was set at  $P < 0.05$ .

## 3. Results

### 3.1. General information of children with sTBI

Among the 151 children with sTBI in the training set, 38 developed CRT and 113 did not, resulting in an incidence rate of 25.17%. In the validation set of 65 children with sTBI, 17 developed CRT and 48 did not, yielding an incidence rate of 26.15%. None of the children in the CRT group exhibited clinical symptoms in this study.

### 3.2. Univariate analysis of CRT occurrence in children with sTBI

In the univariate analysis of CRT occurrence in children with severe traumatic brain injury (sTBI), significant differences were observed in GCS score, catheter insertion site, D-dimer concentration, and duration of mechanical ventilation, with statistical significance ( $P < 0.05$ ). No statistically significant differences were found in age, gender, weight, surgery, multiple trauma, CVC model, CVC type, APTT, PT, FIB, white blood cell count, platelet count, C-reactive protein concentration, cholesterol concentration, Lac level, use of blood products, use of vasoactive drugs, use of parenteral nutrition, use of hyperosmolar solution, use of anticoagulants, use of two or more antibiotics, and implementation of early rehabilitation ( $P > 0.05$ ), as shown in **Table 1**.

**Table 1.** Univariate analysis of CRT occurrence in children with sTBI

Variable	CRT group	Non-CRT group	Statistic	P-value
Age [months, M (Q1, Q3)]	57.5 (10.5, 75)	30 (18, 66)	-1.89	0.06
Gender				
Male	20	74	2.00	0.16
Female	18	39		
Weight [kg, M (Q1, Q3)]	18 (8.5, 19.75)	14 (10, 19)	-0.74	0.46
Surgery				
Yes	18	45	0.67	0.41
No	20	68		
Multiple trauma				
Yes	16	48	0.02	0.97
No	22	65		
GCS [score, M (Q1, Q3)]	3 (3, 4)	6 (5, 7)	-0.842	< 0.001
CVC Size				
18G	3	12	-1.67	0.10
20G	7	36		
4F	28	65		
CVC Type				
Single-lumen	12	47	1.20	0.27
Double-lumen	26	66		
Insertion site				
Jugular vein	14	79	13.15	< 0.001
Femoral vein	24	34		
APTT [s, M (Q1, Q3)]	37.2 (29, 40.9)	36.2 (34, 40.1)	-0.33	0.74
PT [s, M (Q1, Q3)]	14.7 (14, 15.93)	14.4 (13.6, 15.3)	-0.57	0.12
D-dimer [ $\mu\text{g/mL}$ , M (Q1, Q3)]	18 (15.25, 22)	7 (2.76, 9)	-8.66	< 0.001
FIB [g/L, M (Q1, Q3)]	2.99 (1.57, 3.26)	2.53 (1.65, 3.11)	-1.17	0.24

**Table 1 (Continued)**

Variable	CRT group	Non-CRT group	Statistic	P-value
WBC [ $\times 10^9/L$ , M (Q1, Q3)]	11.85 (9.54, 18.42)	10.77 (7.34, 13.9)	-1.84	0.07
Platelet [ $\times 10^9/L$ , M (Q1, Q3)]	254 (182, 315)	260 (213, 315)	-0.82	0.41
CRP [mg/L, M (Q1, Q3)]	11.18 (1.47, 49.73)	9.37 (1.49, 31.98)	-0.40	0.69
Cholesterol [mg/dL, M (Q1, Q3)]	3.46 (2.6, 4.46)	3.31 (3.01, 4)	-0.10	0.92
Lac [mmol/L, M (Q1, Q3)]	1.59 (1.4, 2)	1.3 (0.6, 2.2)	-1.76	0.08
MV Duration [h, M (Q1, Q3)]	96 (60, 148.5)	24 (1, 60)	-6.04	< 0.001
Blood product use				
Yes	31	94	0.52	0.82
No	7	19		
Vasoactive drug use				
Yes	31	90	0.67	0.80
No	7	23		
Parenteral nutrition use				
Yes	4	8	0.11	0.74
No	34	105		
Hypertonic fluid use				
Yes	24	56	2.11	0.15
No	14	57		
Anticoagulant use				
Yes	9	18	1.17	0.28
No	29	95		
$\geq 2$ Antibiotic use				
Yes	10	20	1.33	0.25
No	28	93		
Early rehabilitation				
Yes	13	44	0.27	0.60
No	25	69		

### 3.3. Logistic regression analysis of CRT occurrence in children with sTBI

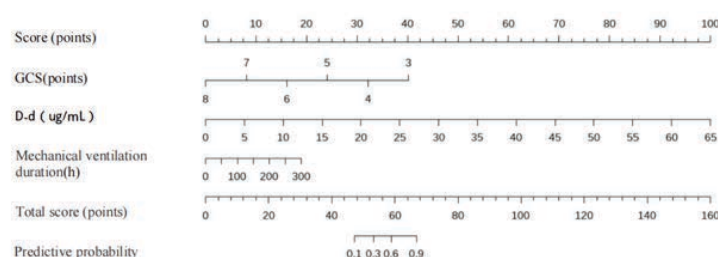
Variables with statistical significance in the univariate analysis were included as independent variables in the logistic regression analysis. Whether CRT occurs was set as the dependent variable (yes=1, no=0). The independent variables were assigned as follows: catheter insertion site (femoral vein=1, jugular vein=0), GCS score, D-dimer concentration, and duration of mechanical ventilation were entered as original values. The results showed that GCS score, D-dimer concentration, and duration of mechanical ventilation were influencing factors for CRT occurrence in children with sTBI ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Logistic regression analysis of CRT occurrence in children with sTBI

	Regression coefficient	Standard error	Wald $\chi^2$ value	Degrees of freedom	P-value	OR	95% CI
GCS score	-1.95	0.55	12.40	1	< 0.001	0.14	[0.05, 0.42]
Catheter insertion site	2.85	1.57	3.28	1	0.07	7.17	[0.79, 11.25]
D-dimer level	0.25	0.11	5.50	1	0.02	1.28	[1.04, 1.57]
Mechanical ventilation duration	0.02	0.01	4.18	1	0.04	1.02	[1.00, 1.04]

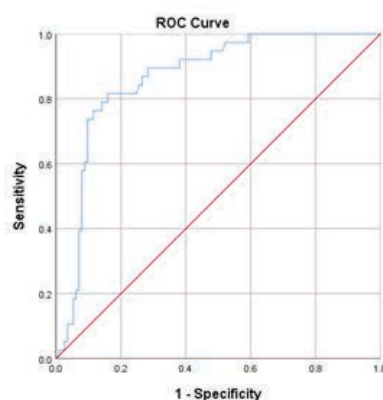
### 3.4. Construction of a prediction model for CRT occurrence in children with sTBI

Based on the results of the logistic regression analysis, a prediction model was constructed. The logistic regression equation is:  $\text{Logit}(P) = 2.74 - 1.95 \times \text{GCS score} + 0.25 \times \text{D-dimer (ug/mL)} + 0.02 \times \text{duration of mechanical ventilation (h)}$ . A nomogram was created based on this equation, as shown in **Figure 1**.

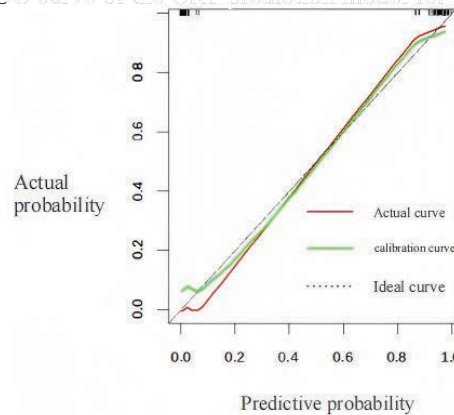
**Figure 1.** Nomogram for predicting CRT in children with sTBI

### 3.5. Evaluation and validation of the prediction model for CRT in children with sTBI

The AUC of the ROC curve for the constructed model was 0.87 [95% CI (0.80, 0.93)], as shown in **Figure 2**. The sensitivity was 81.6%, the specificity was 84.1%, the maximum Youden index was 0.66, and the corresponding cut-off value was -0.58. Internal validation was performed using the Bootstrap method repeated 500 times to evaluate the discrimination and calibration of the model. The AUC of the ROC curve was 0.86 [95% CI (0.81, 0.92)], the sensitivity was 82.5%, and the specificity was 79.2%. The calibration curve showed good agreement with the prediction curve, as seen in **Figure 3**. The Hosmer-Lemeshow goodness-of-fit test showed  $\chi^2=4.79$ ,  $P = 0.78$ . Validation was performed using a validation set of 65 children with sTBI, where the AUC of the ROC curve was 0.88 [95% CI (0.80, 0.94)], the sensitivity was 88.2%, and the specificity was 79.2%.



**Figure 2.** ROC curve of the CRT prediction model for children with sTBI



**Figure 3.** Calibration curve of the CRT prediction model for children with sTBI

## 4. Discussion

### 4.1. High incidence of CRT in children with sTBI

Critically ill children have potential life-threatening factors, and the placement of CVCs further increases the incidence of CRT during treatment. In this study, the incidence of CRT in children with sTBI was 25.17%, which is higher than the 9.85% incidence of CRT in general critically ill children reported by Li *et al.* <sup>[12]</sup>. Severe brain injury leads to post-traumatic hypercoagulability of the blood, which is already a strong inducer of thrombosis. Guidelines indicate that the treatment of sTBI includes surgical procedures, the use of mechanical ventilation, blood products, vasoactive agents, and intravenous infusion of high-concentration electrolyte solutions <sup>[13]</sup>. Studies have shown that these treatment factors increase the risk of venous thromboembolism <sup>[4]</sup>. CVC catheters are widely recognized as important risk factors for venous thromboembolism in pediatric trauma patients, and each additional risk factor triples the chance of thrombosis <sup>[14, 15]</sup>. Therefore, early identification of CRT risk and prevention are particularly important in children with sTBI.

### 4.2. GCS is an important predictor of CRT in children with sTBI

A GCS score of  $\leq 8$  in children with traumatic brain injury is considered sTBI. These children often experience the most severe condition within 24-72 hours after injury, which can lead to diffuse brain swelling. The resulting increase in intracranial pressure can further damage cerebral perfusion, causing more cerebral ischemia, swelling, cerebral hernia, and death <sup>[16]</sup>. Multiple studies have reported a significant correlation between a GCS score of  $\leq 8$  and increased risk of thrombosis, with lower GCS scores associated with higher thrombotic risk <sup>[17, 18]</sup>. This is consistent with the findings of this study. Therefore, timely assessment of GCS scores is crucial during condition observation.

### 4.3. D-dimer is an important predictor of CRT in children with sTBI

D-dimer is the terminal product of cross-linked fibrin. Elevated concentrations represent coagulation activation and secondary fibrinolysis in the body, reflecting a hypercoagulable state. D-dimer has high sensitivity but low specificity <sup>[19]</sup>. The results of this study show that D-dimer is a risk factor for CRT in children with sTBI, and higher concentrations are more likely to lead to CRT, consistent with previous studies on thrombotic risk <sup>[20]</sup>. Therefore, medical staff should routinely screen children's coagulation function after admission. For children with



high or continuously rising D-dimer concentrations, they should be alert to the occurrence of CRT.

#### **4.4. Duration of mechanical ventilation is an important predictor of CRT in children with sTBI**

The duration of mechanical ventilation itself does not directly cause thrombosis. However, due to consciousness disorders, respiratory abnormalities, surgery, and other reasons after sTBI, mechanical ventilation is often required. Factors such as long-term sedation therapy, restraint, or immobilization during mechanical ventilation can significantly slow down blood flow in the body. The longer the duration of mechanical ventilation, the longer the blood stasis time, and the higher the risk of CRT. In previous studies, mechanical ventilation has also been identified as one of the influencing factors for thrombosis in children with moderate to severe TBI<sup>[21]</sup>.

The AUC for the training set in this study was 0.87, and the AUC for the validation set was 0.88, indicating good discrimination in predicting CRT. The calibration curve of the model demonstrated good fit, and the decision curve showed a good benefit rate. Therefore, the model has high efficacy and certain clinical practical value. However, there are some limitations in this study. Firstly, the sample size is limited, and multi-center studies are needed. Secondly, the study tracked whether CRT occurred during the children's stay in the ICU, but failed to continue tracking some children who were transferred to general wards with CVC, which may lead to missed cases.

### **5. Conclusion**

In summary, this study explored the risk factors for CRT in children with sTBI, including GCS score at admission, catheter location, D-dimer concentration 24 hours after CVC placement, and duration of mechanical ventilation. Additionally, a clinical prediction model for CRT in children with sTBI was constructed using GCS score, D-dimer concentration, and duration of mechanical ventilation, and the reliability of the model was verified. This model can guide clinical healthcare professionals in early identification of CRT risk in children with sTBI and further improve the quality management of central venous access.

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### **Disclosure statement**

The authors declare no conflict of interest.

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# Analysis on the Influence of Programmed Harmonized Nursing Combined with Hierarchical Management on Nursing Quality and Nursing Satisfaction in Health Management Center

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**Abstract:** *Objective:* To investigate the impact of programmed harmonious nursing combined with hierarchical management on nursing quality and satisfaction in a health management center. *Methods:* A total of 100 patients who received care at this health management center from January 2024 to January 2025 were selected as subjects. Using a random number table method, they were divided into an observation group (n=50) and a control group (n=50). The control group followed traditional methods, while the observation group integrated programmed harmonious nursing with hierarchical management. Comparative analysis was conducted on nursing quality scores, adverse event occurrence rates, and patient satisfaction between the two groups. *Results:* The observation group showed significantly improved nursing quality scores ( $P < 0.05$ ) and markedly reduced incidence of adverse events ( $P < 0.05$ ), with statistically significant differences compared to pre-treatment conditions ( $P < 0.05$ ). *Conclusion:* The combination of hierarchical management and programmed harmonious nursing demonstrates effectiveness in enhancing medical service quality, reducing adverse reactions, and improving patient satisfaction—a method worthy of promotion.

**Keywords:** Programmed harmonious nursing; Hierarchical management; Health management center; Nursing quality; Nursing satisfaction

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## 1. Introduction

Health service institutions have played an increasingly vital role in disease prevention, health promotion, and chronic disease management. Beyond providing health screenings, these organizations deliver comprehensive services including health risk assessments, lifestyle interventions, and follow-up care. The quality of their medical services directly impacts patient satisfaction and the effectiveness of health management programs. However, issues such as non-standardized procedures, unclear accountability, and inefficient staffing have resulted in subpar service quality, severe complications, and diminished patient satisfaction. To elevate overall hospital service

standards, developing a scientifically validated nursing management approach has become imperative. Currently, the “harmonious coordination” and “tiered” nursing models have emerged as key research focuses in clinical practice.

Project-coordinated nursing emphasizes patient-centered care through standardized protocols that ensure seamless workflow execution, thereby enhancing service quality and efficiency. The core philosophy of “harmony” advocates for nurse-patient communication and trust-building, reflecting humanistic care. Tiered management leverages nurses’ expertise by assigning roles to different competency levels, maximizing their professional impact. Research demonstrates that this model reduces operational chaos, strengthens nurses’ professional identity, and boosts work motivation <sup>[1]</sup>. Moreover, with China’s healthcare system evolving, patients now demand not only treatment but also holistic, personalized health management throughout their entire life cycle. Health management institutions serve as the primary platform for hospital healthcare administration, where their operational effectiveness significantly impacts patient care.

Traditional medical management approaches, characterized by fragmentation and lack of standardization, have resulted in fragmented service delivery that fails to meet patients’ diverse needs. The question of how to effectively enhance patient satisfaction remains a crucial subject worthy of research and discussion. This study selected 100 patients who received nursing services at our health management center from January 2024 to January 2025 as subjects, comparing the efficacy of stratified management with traditional nursing practices. The findings provide valuable insights for health service centers to develop rational nursing service plans and offer reference value for quality improvement in similar hospitals <sup>[2]</sup>.

2. General data and methods

2.1. General information

This study enrolled 100 patients who received care at the health management center from January 2024 to January 2025 as subjects (Table 1). The inclusion criteria were: (1) Age ≥ 18 years; (2) Consciousness and ability to communicate with nurses and complete questionnaires; (3) Willingness to participate and signed consent forms.

Meanwhile, the exclusion criteria included: (1) Significant psychological/cognitive impairment; (2) Severe organ damage (heart, liver, kidneys); (3) Withdrawal or incomplete follow-up during trial. Patients were randomly divided into two groups of 50 each for comparison. No significant differences were observed in basic data such as age, gender, and disease type between the groups ( $P > 0.05$ ) <sup>[3]</sup>.

Table 1. Comparison of baseline data between the two groups

Metric	Age (years)	Gender (male/female)	Hypertension (example)	Diabetes mellitus (cases)	Hyperlipidemia (cases)	Other chronic conditions (cases)
Observation group (n = 50)	42.3 ± 10.5	26/24	12	10	15	13
Control group (n = 50)	41.8 ± 11.2	25/25	11	9	16	14
$t/\chi^2$ price	0.23	0.04	0.1	0.11	0.06	0.07
$P$ price	0.82	0.84	0.75	0.74	0.81	0.79

2.2. Methodology

The control group adopted a standard nursing model without hierarchical divisions, operating under traditional

shift scheduling. Key nursing measures included: (1) Basic care services such as vital sign monitoring and physical examinations; (2) Health education programs covering disease prevention, treatment, and lifestyle guidance; (3) Postoperative follow-up through regular phone calls and WeChat updates to track patients' health status. This management approach exhibited issues including non-standardized procedures, ambiguous role assignments, overlapping responsibilities, and missed diagnostic evaluations <sup>[4]</sup>.

The observation group implemented a structured harmonious nursing approach with hierarchical management while maintaining standard care protocols. Establishing standardized nursing procedures to ensure procedural continuity and standardization is crucial for achieving this harmonious nursing model. First, during hospitalization, designated nurses conduct physical examinations and assess patients' health status. Second, nurses strictly follow protocols when performing health checks, including blood pressure measurement, blood sampling, and electrocardiogram (ECG) tests to ensure accurate results. Additionally, nurses actively communicate with patients to understand their needs and concerns, providing tailored healthcare guidance. For example, hypertension patients receive detailed instructions on proper diet and exercise regimens, while diabetic patients receive focused attention on blood sugar monitoring and medication adherence. After completing physical examinations, nurses implement planned follow-ups using mobile devices or online platforms to evaluate patients' conditions and propose corresponding strategies <sup>[5]</sup>.

## 2.3. Observation indicators

- (1) Nursing quality score.
- (2) Incidence of adverse nursing events.
- (3) Nursing satisfaction.

## 2.4. Statistical methods

The results were analyzed by SPSS26.0 statistical software. The count data were expressed as  $x \pm s$  and tested by *t*-test, while the measurement data were expressed as  $n$  (%) and tested by chi-square test.  $P < 0.05$  indicated that there was a significant difference <sup>[6]</sup>.

# 3. Results

## 3.1. Nursing quality score

The observation group was significantly higher than the control group in all dimensions and the total score ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of nursing quality scores between the two groups

Dimension	Standard nursing practice	Communication skills	Emergency response capacity	Effect of health education	Patient feedback	Total points
Observation group (n = 50)	28.5 ± 1.2	19.2 ± 0.8	18.8 ± 0.9	19.0 ± 0.7	9.5 ± 0.5	94.0 ± 3.5
Control group (n = 50)	25.1 ± 2.1	16.3 ± 1.5	15.7 ± 1.8	16.5 ± 1.3	8.2 ± 0.9	81.8 ± 5.2
<i>t</i> price	9.87	11.23	10.56	12.14	8.91	14.2
<i>P</i> price	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05



### 3.2. Incidence of adverse nursing events

The overall incidence of adverse events in the observation group was significantly lower than that in the control group, as shown in **Table 3**.

**Table 3.** Comparison of the incidence of nursing adverse events between the two groups

Type of adverse event	Operate miss	Specimen confusion	Patient complaint	Falling incident	Overall incidence
Observation group (n = 50)	0(0%)	0(0%)	1(2%)	0(0%)	1(2%)
Control group (n = 50)	3(6%)	2(4%)	4(8%)	1(2%)	10(20%)
$\chi^2$ price	3.13	2.04	2.38	1.01	8.27
<i>P</i> price	0.077	0.153	0.123	0.315	0.004

### 3.3. Nursing satisfaction score

The observation group was significantly better than the control group in all satisfaction scores and total scores ( $P < 0.05$ ), as shown in **Table 4**.

**Table 4.** Comparison of nursing satisfaction scores between the two groups

Metric	Attitude towards care	Service efficiency	Effect of health education	Environmental comfort	Overall satisfaction	Total points
Observation group (n = 50)	23.8 ± 1.1	22.6 ± 0.9	23.5 ± 1.0	12.1 ± 0.6	12.6 ± 0.5	94.6 ± 3.8
Control group (n = 50)	20.5 ± 1.8	19.3 ± 1.6	20.0 ± 1.7	10.8 ± 1.0	10.6 ± 1.2	81.2 ± 5.6
<i>t</i> price	10.89	12.34	12.78	8.21	10.45	14.87
<i>P</i> price	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

### 3.4. Distribution of patient satisfaction levels

The proportion of “very satisfied” in the observation group was significantly higher than that in the control group, as shown in **Table 5**.

**Table 5.** Comparison of satisfaction level distribution between the two groups

Level of satisfaction	Very satisfied (≥ 90 points)	Satisfied (80–89)	Average (70–79)	Not satisfied (< 70 points)
Observation group (n = 50)	38(76%)	10(20%)	2(4%)	0(0%)
Control group (n = 50)	15(30%)	20(40%)	10(20%)	5(10%)
$\chi^2$ price	21.33	4.76	6.06	5.26
<i>P</i> price	< 0.05	0.029	0.014	0.022

## 4. Discussion

The results of this study show that the combination of programmed harmonious nursing and hierarchical management can significantly improve the nursing quality of health management centers, reduce the incidence of adverse nursing events, and improve patient satisfaction. The advantages of this model are mainly reflected in the following aspects.

First, standardized work procedures have reduced nurses' discretionary actions in their duties, enhancing both the standardization and effectiveness of nursing practices. In health management centers, nurses' responsibilities encompass pre-examination guidance, clinical collaboration during assessments, and post-examination follow-ups. Through systematic procedural management, every step is meticulously executed without gaps or errors. Before conducting physical examinations, nurses provide detailed patient instructions to prevent psychological preparation deficiencies that might compromise test results. During examinations, strict adherence to established protocols ensures measurement accuracy. Comprehensive post-examination tracking enables timely diagnosis and treatment. This holistic, standardized nursing management approach not only boosts operational efficiency but also strengthens professional consistency and scientific rigor. The implementation of a tiered management model maximizes workforce efficiency across different nursing levels. In China, traditional nurse management methods often resulted in ambiguous role definitions, leading to uneven workload distribution and resource waste. The new hierarchical system clarifies responsibilities among three nursing tiers: junior nurses handle basic care, mid-level nurses manage challenging health education programs, while senior nurses focus on quality control and team development. This stratified management approach effectively enhances both nursing productivity and professional growth. For N0-level nursing staff, after training and evaluation, they can gradually advance to N1 level to assume greater responsibilities. Meanwhile, N2-level nurses can enhance their leadership skills and professional competence through quality control training. This career development pathway effectively motivates nurses' enthusiasm while reducing occupational burnout <sup>[7]</sup>.

Currently, China's healthcare management institutions primarily serve "healthy individuals" and "sub-healthy populations," who demand higher medical quality. During surgical procedures, errors or improper patient communication can lead to dissatisfaction. Process control helps reduce human errors—standardizing blood collection processes minimizes sample contamination risks, for instance. Implementing a hierarchical system significantly enhances nurses' vigilance: N2-level nurses regularly review patient records to identify and correct potential issues. Effective communication during care also helps prevent conflicts caused by misunderstandings or information asymmetry. Patient satisfaction depends not only on the doctors' skills but also on the nurses' attitudes and service details.

## 5. Conclusion

In conclusion, the integration of programmatic harmonious nursing with hierarchical management can significantly enhance medical service quality, reduce medical accidents, and improve patient satisfaction. This model has demonstrated effective implementation in practice, making it a method worthy of vigorous promotion in primary care hospitals. Subsequent research could also focus on other cases to further optimize the efficiency of the entire nursing system.

## Disclosure statement

The author declares no conflict of interest.

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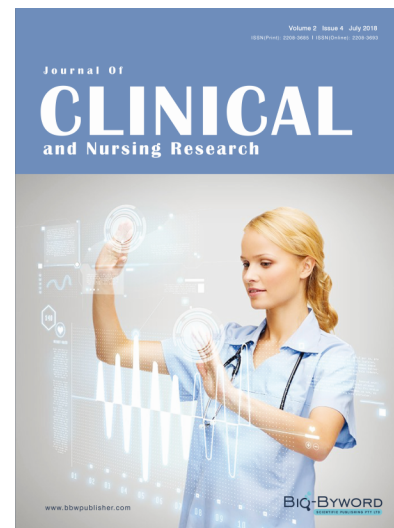
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