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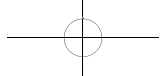
SYDNEY NSW 2000

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ISSN (ONLINE): 2208-3693

ISSN (PRINT): 2208-3685



## Journal of Clinical and Nursing Research

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# Exploration of the Value of Extract of Wuwei Xiaodu Drink on Rabbit Model of Spinal Infection

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**Abstract:** *Objective:* To study the therapeutic effect of the Extract of Wuwei Xiaodu Drink on spinal infection and provide the scientific basis for clinical application. *Methods:* By establishing a rabbit model of spinal infection, this paper observed and analyzed the changes in body mass before and after the intervention and the comparison of inflammation-related factors and blood leukocyte counts among the three groups. *Results:* There was a significant difference in the changes in body mass of rabbits before and after intervention in the experimental group, control group and blank group ( $P < 0.05$ ); there was no statistically significant difference in calcitoninogen, C-reactive protein and routine blood leukocyte counts between the experimental group and the control group ( $P > 0.05$ ), and there was a statistically significant difference in calcitoninogen, C-reactive protein and routine blood leukocyte counts between the experimental group and the blank group ( $P < 0.05$ ). *Conclusion:* The Extract of Wuwei Xiaodu Drink can play a protective role by regulating the level of inflammatory factors in blood routine leukocyte count and reducing the inflammatory reaction in the spinal cord injury area.

**Keywords:** Extract of Wuwei Xiaodu Drink; Spinal infection; Rabbit model

**Online publication:** March 6, 2025

## 1. Introduction

The spine, as the central axis structure of the human body, is mainly composed of vertebrae, intervertebral discs and ligaments. In daily life, various factors may lead to spinal infections, such as trauma and bacterial infections. If left untreated, it may cause nerve damage and even affect the patient's life. Therefore, it is of great significance to study the prevention and treatment effects of spinal infections. In recent years, with the deepening of medical research, traditional Chinese medicine (TCM) has shown good therapeutic prospects in the prevention and treatment of spinal infections. Chinese medicine has multi-target and multi-pathway action characteristics and can play an immunomodulatory role by inhibiting the expression of inflammatory cytokines<sup>[1]</sup>. Extract of Wuwei Xiaodu Drink is a recipe archived in "Pharmacopoeia of the People's Republic of China (2015 edition)." The main ingredients are honeysuckle, wild chrysanthemum, dandelion, *Viola philippica*, *Begonia fimbripetala*, etc., which

has the efficacy of clearing away heat and detoxicating, dispelling dampness and relieving pain, improving the “Qi” and strengthening the spleen, with astringent effect <sup>[2]</sup>. This study conducted a preliminary study on Wuwei Xiaodu Drink in the previous period and found that the formula could effectively reduce the peripheral blood leukocyte count, abdominal macrophage phagocytic index, and serum total protein concentration of rabbits and reduce the peripheral inflammatory response, besides improving the liver index and increase the spleen index of rabbits, and exerted a better anti-inflammatory effect. In this study, the rabbit was used as an animal model, and a spinal infection model was established. By observing and analyzing the changes in body mass before and after the intervention of the three groups and the post-intervention inflammation-related factors and blood leukocyte counts, this study explored the interventional effects of the Extract of Wuwei Xiaodu Drink on spinal infection and its mechanism, to provide the scientific basis for the clinical application.

## **2. Materials and methods**

### **2.1. General materials**

#### **2.1.1. Drugs and reagents**

Ninety wild-grade SD rabbits, 8 weeks old, were selected. They were kept in an SPF animal house with free feeding and drinking water, and the room temperature was  $25.00 \pm 0.33$  °C. Extract of Wuwei Xiaodu Drink was prepared by the School of Pharmaceutical Engineering of Traditional Chinese Medicine, Anhui University of Traditional Chinese Medicine, after water extraction and alcohol precipitation, and then vacuum freeze-dried, which contained baicalin and emodin, etc. LPS (Beijing Solepol Science and Technology Co., Ltd., purity  $\geq 99\%$ ); FBS (Beijing Biyuntian Biotechnology Institute); DMEM/F12 medium (Corning, USA); PBS buffer (Beijing Biosun Biotechnology Co., Ltd.); fluorescently labeled TNF- $\alpha$  (Suzhou Desai Biotechnology Co., Ltd.); and albumin (Shanghai Aladdin Biochemical Technology Co., Ltd.).

#### **2.1.2. Materials and instrument**

Microscope (Nikon E600i), enzyme labeler (Thermo Scientific, USA), bench-top high-speed cryo-centrifuge (Sartorius AG, Switzerland), automatic biochemical analyzer (Beckman Coulter Inc., USA), and fluorescence quantitative PCR instrument (Bio-Rad Laboratories, USA).

#### **2.1.3. Animal grouping and treatment**

In this study, the experimental rabbits were divided into a control group, a blank group, and a test group (Wuwei Xiaodu Drink group) by random number table method, with 30 animals in each group.

## **2.2. Methods**

The experimental group (Wuwei Xiaodu Drink group), blank group and control group were given an extract of Wuwei Xiaodu Drink orally, saline and amoxicillin (State Drug Permit H13021516 Shenwei Pharmaceutical Group Co., Ltd.) 20 mg/kg, dissolved in saline and then orally, respectively. The rabbits were weighed on the day of modeling and 12 weeks after modeling and the related evaluation indexes were measured. Extract of Wuwei Xiaodu Drink is composed of five traditional Chinese medicines: 15 g of honeysuckle, 6 g of wild chrysanthemum, 6 g of dandelion, 6 g of *Viola philippica*, 6 g of *Begonia fimbristipula* and so on. After the extraction and processing, the extract of Wuwei Xiaodu Drink can better retain the medicinal components and facilitate oral administration.

## 2.3. Observation indicators

Observe and analyze the changes in body mass before and after intervention, post-intervention inflammation-related factors and blood leukocyte count comparisons in the three groups.

## 2.4. Statistical methods

SPSS 21.0 statistical software was used to process the data. Measurement data were expressed as mean  $\pm$  standard deviation (SD), and a  $t$ -test was used, and count data were expressed as a percentage (%), an  $\chi^2$  test was used, and the difference was considered statistically significant at  $P < 0.05$ .

## 3. Results

### 3.1. Changes in body mass before and after intervention in three groups of rabbits

The changes in body mass of rabbits before and after intervention in the test group, control group and blank group were significantly different ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Changes in body mass before and after intervention in three groups of rats

Group	Number of SD rabbits	Pre-intervention (g)	Post-intervention (g)	$t$	$P$
Test group	30	236.62 $\pm$ 13.31	311.32 $\pm$ 10.84	23.835	0.000
Control group	30	247.12 $\pm$ 13.41	312.19 $\pm$ 10.32	21.062	0.000
Blank group	30	243.54 $\pm$ 13.32	223.28 $\pm$ 9.51	6.780	0.000

Note: There was no statistical significance in the two-by-two comparison of the experimental group, control group and blank group before intervention ( $P > 0.05$ ); after intervention, there was no statistical difference between the experimental group and the control group ( $P > 0.05$ ); there was a statistical difference between the experimental group and the blank group ( $P < 0.05$ ).

### 3.2. Inflammation-related factors and blood leukocyte counts in the three groups of rabbits after intervention

There were no statistical differences in calcitoninogen, C-reactive protein, and routine blood leukocyte counts between the test group and the control group ( $P > 0.05$ ), and there were statistical differences in calcitoninogen, C-reactive protein, and routine blood leukocyte counts between the test group and the blank group ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Inflammation-related factors and routine blood leukocyte counts in three groups of rabbits after intervention

Group	Number of SD rabbits	Calcitoninogen (ng/mL)	C-reactive protein (ng/mL)	Routine blood white blood cell count ( $\times 10^9$ )
Test group	30	0.32 $\pm$ 0.11	8.19 $\pm$ 0.23	8.21 $\pm$ 0.31
Control group	30	0.33 $\pm$ 0.21	8.08 $\pm$ 0.30	8.10 $\pm$ 0.32
Blank group	30	1.74 $\pm$ 0.22	14.31 $\pm$ 1.48	15.23 $\pm$ 1.17
$t_1$		0.231	1.594	1.352
$p_1$		$> 0.05$	$> 0.05$	$> 0.05$
$t_2$		31.621	22.380	31.767
$p_2$		0.000	0.000	0.000

Note:  $t_1$  and  $p_1$  indicate the comparison results between the test group and the control group;  $t_2$  and  $p_2$  indicate the comparison results between the test group and the blank group.



## 4. Discussion

Spinal infections are infectious diseases of the bones and soft tissues of the spine caused by bacteria, fungi or other microorganisms. This infection is usually caused by the invasion of various pathogenic microorganisms such as *Staphylococcus aureus*, *Streptococcus sp.*, etc. into the spinal column, and these microorganisms enter into the vertebral canal through the blood circulation or direct invasion, causing inflammation, necrosis, and abscess formation of the soft tissues and bones. Spinal infections can be triggered by a variety of causes, including, but not limited to, bacterial infections, foreign bodies in the spinal canal, trauma, immunocompromise, and medical infections. Bacterial infections are purulent infections caused by bacteria invading the spinal canal, with common causative organisms being *Staphylococcus aureus* and *Staphylococcus albicans*. Foreign bodies in the spinal canal may cause infection due to compression of the spinal cord, nerve roots, discs and other areas. In addition, trauma to the spine may cause localized blood vessel rupture, which in turn can lead to infection. Immunocompromised and medical infections are also potential causes of spinal infections. Clinical symptoms of spinal infections are varied and typically include back pain, fever, chills, general malaise, and limited mobility. In addition, patients may also experience localized skin erythema, edema and increased skin temperature. In severe cases, the infection may invade the nervous system, leading to symptoms such as numbness and weakness in the limbs and even affecting normal activities. Measures to treat spinal infections mainly include antibiotic therapy and surgical intervention. Depending on the severity of the infection and the type of pathogen, doctors will choose the appropriate antibiotic for treatment. Surgical treatment may be required if the infection is severe and the localized lesion is large. Meanwhile, physiotherapy such as massage, hot packs and hot baths can also be used as an adjunctive treatment to promote blood circulation in the spine area and relieve muscle tension. Spinal infection refers to the exogenous invasion of bacteria, viruses and other pathogens into the human body, disrupting the balance of the body's internal environment and the emergence of local or systemic infection<sup>[3]</sup>. Its pathogenesis is related to host immune dysfunction, which activates neutrophils, monocytes and macrophages under the action of multiple factors, which in turn releases a large number of inflammatory mediators and triggers an inflammatory response in the body.

Firstly, the treatment of spinal infections, as a serious clinical problem, often involves the use of antibiotics, but the long-term use or abuse of antibiotics may lead to the development of drug resistance. Wuwei Xiaodu Drink, as a natural drug, with its broad-spectrum antimicrobial effect may provide a new option for the treatment of spinal infections, especially for drug-resistant strains of bacteria, and it may be of therapeutic efficacy<sup>[4]</sup>. Secondly, the efficacy of Wuwei Xiaodu Drink in clearing heat removing toxins and dissipating boils may help to alleviate the local inflammatory response caused by spinal infections and reduce the pain and discomfort of patients. By regulating the body's immune response, Wuwei Xiaodu Drink may help control the progression of infection and promote the subsidence of inflammation and tissue repair. In addition, Wuwei Xiaodu Drink may also play a role in the prevention of spinal infections<sup>[5]</sup>. By improving the body's resistance, it reduces the invasion and multiplication of pathogenic microorganisms, thus reducing the risk of spinal infection. However, it is worth noting that although Wuwei Xiaodu Drink may have some value in the spinal infection rabbit model, its specific mechanism of action, dose-effect relationship, and the safety of long-term use still need to be further researched and verified. In addition, due to the differences between animal models and humans, the efficacy and safety of Wuwei Xiaodu Drink in humans also need to be confirmed by more clinical trials.

Studies have shown that Wuwei Xiaodu Drink has good antibacterial effects against gram-negative bacilli such as *Staphylococcus aureus*, *Haemophilus influenzae* type A, and *Klebsiella pneumoniae*<sup>[6]</sup>. In this experiment, the tissue sections of the thoracic and lumbar spine of rabbits in the test group showed obvious inflammatory

infiltration, severe vacuolization of nucleus pulposus cells, edema, degeneration and necrosis of neuronal cells, and proliferation of astrocytes. At the same time, there was a statistical difference in calcitoninogen, C-reactive protein, and blood routine leukocyte count between the experimental group and the blank group ( $P < 0.05$ ), and Extract of Wuwei Xiaodu Drink could significantly reduce the number of leukocytes in the serum after the infection, reduce the content of inflammatory markers blood routine leukocyte count, increase the splenic index, and improve the structure of the nucleus pulposus area after the infection. This may be closely related to the molecular mechanism of TCM for spinal infections.

Therefore, the research and development of drugs for spinal infections should focus on their effects on the host immune system and the interactions between different components, to obtain new drugs with higher efficacy. Wuwei Xiaodu Drink has a good bacteriostatic effect and inhibits the expression of LPS-induced inflammatory cytokines blood routine leukocytometer, C-reactive protein and calcitoninogen<sup>[7]</sup>. Studies have shown that there are interactions and synergistic effects between multiple components of traditional Chinese medicines, and their mechanisms of action in treating diseases are complex<sup>[8]</sup>. Honeysuckle is sweet and cold in nature, can clear heat and detoxify, with its light and clear evacuation, is one of the main herbs in Wuwei Xiaodu Drink, and its dosage is relatively large, which can play the effect of clearing heat and detoxification more effectively; wild chrysanthemum has the effect of dispersing wind and heat, detoxifying and eliminating oedema, and its dosage is moderate so that it can have a synergistic effect with honeysuckle without being too strong; dandelion clears heat and detoxifies, diuretic and diuretic, and its dosage is similar to that of wild chrysanthemum. Dandelion clears heat and removes toxins, induces diuresis and lymphatic drainage, and its dosage is the same as that of wild chrysanthemum, which jointly assists honeysuckle and strengthens the power of clearing heat and removing toxins<sup>[9-10]</sup>. This study confirmed the protective effect of Extract of Wuwei Xiaodu Drink on rabbits with spinal cord injury and preliminarily investigated that Extract of Wuwei Xiaodu Drink alleviated spinal cord nerve injury by down-regulating the expression of inflammatory cytokine calcitoninogen, reducing the release of inflammatory mediators, and decreasing the degree of tissue damage.

## 5. Conclusion

In conclusion, the Extract of Wuwei Xiaodu Drink can effectively alleviate pathological injury after spinal infection in rabbits and regulate the host immune response to play a role in protecting the organism, and its main mechanism of action may be:

- (1) Inhibit the expression of inflammatory cytokines calcitoninogen and C-reactive protein;
- (2) Enhance the proliferation ability of peripheral blood lymphocytes;
- (3) Promote the activity of spleen phagocytes;
- (4) Activate the expression of immune factors in spleen nucleoli;
- (5) Repair damaged spinal cord tissues.

However, it is worth noting that this study failed to exclude the possibility of other interfering factors, such as the animal's factors, feeding conditions, experimental methods, etc. It is necessary to expand the sample size further and repeat the verification.



## Funding

Shandong Province Traditional Chinese Medicine Science and Technology Project Task Book Number (Project No.: M-2022178); 2024 Shandong Provincial Traditional Chinese Medicine Science and Technology Project (Project No.: Z20242407)

## Disclosure statement

The author declares no conflict of interest.

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### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# The Application of Formative Evaluation System in Clinical Laboratory Teaching

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**Abstract:** Theoretical education and practical education are very important in clinical laboratory teaching. The teaching evaluation system is one of the important means to test the quality of course teaching. The traditional summative evaluation needs to be improved in terms of scientificity and impartiality, and its guiding effect on teaching reform is limited. Therefore, this paper proposes to apply formative evaluation to clinical laboratory teaching to remobilize students' learning enthusiasm and provide valuable guidance for the subsequent teaching reform, hoping to achieve the purpose of improving the quality of laboratory teaching.

**Keywords:** Formative evaluation; Clinical test; Application path; Application effect

**Online publication:** March 6, 2025

## 1. Introduction

The key to the talent quality evaluation mechanism is whether the teaching goal can be achieved, which depends on the completion of the teaching results every day. Therefore, teachers should have a proper criterion for judging whether students' learning achievements have reached or what degree they have reached, that is process evaluation criteria. As an important index to measure students' learning outcomes and teachers' teaching quality, scientific evaluation standards are not only conducive to the scientific evaluation of students but also conducive to students finding their learning methods. Ways to build a scientific and fair teaching evaluation system have always been a key topic of exploration in the field of education <sup>[1]</sup>. However, the construction of a teaching evaluation system for clinical laboratory disciplines is more difficult. Because theory teaching is only one part of clinical laboratory teaching, the proportion of clinical laboratory practice in teaching is higher. However, the traditional summative evaluation method is not suitable for clinical laboratory teaching because of its more content, longer time, and students' comprehensive quality. Formative evaluation has been an upsurge in the education sector in recent years and has played a significant role in the evaluation of practical teaching <sup>[2]</sup>. Based on the teaching needs of clinical examination, this paper analyzes the specific application strategies of formative evaluation.

## **2. The concept of “formative assessment”**

Formative evaluation refers to the evaluation of the whole process of teaching activities, not just the evaluation of teaching results. Its main goal is to find out the problems in teaching by analyzing the attitude and achievement of students in the teaching process to promote the continuous in-depth development of teaching reform. Therefore, the study can also say that the goal of formative evaluation is not only to evaluate students' academic performance but also to give timely feedback on the problems in the teaching process to improve teaching.

Formative evaluation according to different professional courses and teaching activities to formulate the evaluation content, evaluation methods and standards. As far as a course is concerned, the normal teaching activities mainly include: classroom teaching, classroom homework, practical training (experiment), course design and so on. Formative evaluation focuses on classroom work, experimental (training) learning results, and students' activeness in class. In addition, while emphasizing the process evaluation, formative evaluation should not only emphasize students' learning results and academic achievements but also strengthen the cultivation of students' innovative thinking and core qualities to give full play to the advantages of the talent training evaluation mechanism<sup>[3]</sup>.

As the teaching content of the clinical examination is rich and the design scope is wide, the summative examination only reflects the students' learning results through the final examination, and cannot cover all the learning content. On the other hand, for the problems existing in the teaching process, the summative evaluation is also difficult to find, it can only get the result, and it is difficult to find the crux through the result. Formative evaluation, on the other hand, pays close attention to teaching activities, finds problems, and gives feedback in time.

## **3. The concrete application of formative assessment method in inspection teaching**

### **3.1. Clarify the course assessment method**

At the beginning of teaching, a clear evaluation system should be established to let students understand the evaluation system. The assessment methods of this course are: class participation 10%, periodic test 20%, clinical case discussion and operation skills 20%, learning attitude 10%, and final test 40%. By clarifying the evaluation method of the course, students can better adapt to the teaching work to complete the examination efficiently. This evaluation method emphasizes the importance of ordinary scores and summary scores, thus stimulating students' enthusiasm for learning<sup>[4]</sup>.

### **3.2. Strengthen the implementation of formative evaluation in the teaching process**

The formative evaluation consists of three steps: evaluation, feedback, and correction. According to the synchronization of evaluation, formative evaluation can be divided into pre-evaluation, synchronous evaluation and lagging evaluation<sup>[5]</sup>. All these steps are intended to provide direction for teaching reform and effectively achieve teaching objectives.

#### **3.2.1. Preliminary evaluation**

The pre-evaluation is to design the teaching reform plan in advance according to the problems found in the previous evaluation and emphasize the important and difficult points and error-prone contents to avoid the same mistakes. For example, in clinical examination, samples of cerebrospinal fluid and subserosal fluid are often

confused in the process of fluid extraction. Therefore, in the teaching process, it is necessary to focus on explaining this content, and then strengthen students' memory by asking questions <sup>[6]</sup>.

### **3.2.2. Evaluation of synchronicity**

In the teaching process, evaluation is accompanied by teaching and it can get feedback from different sources and adjust it. Synchronous evaluation is also an important link in the evaluation process <sup>[7]</sup>.

#### **(1) Emphasizing review before class**

Pay attention to review before class, ask questions about the knowledge points of the last class ten minutes before class, understand students' mastery of the previous knowledge points, and comment on students' answers in time to quantify the learning effect of the previous class.

#### **(2) Emphasizing questions and observing students' status during class**

First, asking questions in class is an important means to test students' understanding of current knowledge points. By asking questions, teachers can learn about students' grasp of knowledge points in time, and adjust teaching strategies according to students' answers. At the same time, observing the state of students is also an important part of evaluating the teaching effect <sup>[8]</sup>. By observing students' expressions, movements and other details, teachers can judge students' interest in and acceptance of the teaching content to further adjust the teaching method and rhythm. For example, when explaining complex technology in clinical examination, teachers can test whether students understand it by asking questions and observing their reactions. If students show confusion or incomprehension, teachers can timely add explanations or adopt more intuitive teaching methods to help students better understand and master knowledge points <sup>[9]</sup>.

Second, observe students' learning state, expression and action in class. The students' emotions are high, indicating that the teaching activities are going smoothly, and the teachers can continue to teach with the same teaching method; If the students frown, sigh, or even wander off, it indicates that the knowledge point is difficult. The teacher should adjust the teaching progress and teaching methods in time to lead the students to understand the knowledge point. For example, when the clinical significance of eosinophil detection is applied in the evaluation of adrenal cortex function, students can't keep up with the teacher's thinking and are relatively silent in class <sup>[10]</sup>. To this end, teachers can lead students to consolidate the relevant knowledge of the "pituitary-adrenal cortex axis" in physiology, and further understand the relevant knowledge of eosinophilia detection in combination with the illustrations until the students become suddenly clear.

#### **(3) Training of experimental skills**

Experimental skills training is an important part of clinical laboratory teaching, requiring students to complete relevant operations in a standardized manner and complete each experimental project independently. In the evaluation of experimental skill training, on the one hand, it is necessary to observe whether the students' operation has been standardized. On the other hand, it is necessary to ask the key notes of the operation, experimental principle and result analysis, etc., and score the students' operation and answers <sup>[11]</sup>.

## **3.3. Hysteresis evaluation**

### **3.3.1. Phased test**

According to the unit, module, and other stages of the test, mainly the key content of the course, through the test paper detection, question types including experimental analysis, noun interpretation, short answer, and so on. For example, in the "hematology general examination" as a module, after explaining the knowledge points of the

module, stage test is carried out, including the test content of red blood cells, white blood cells and platelets quality control and clinical significance. Phased tests can provide timely feedback to students, let them understand their learning situation at this stage, adjust their learning status and learning methods in time, and check and fill in the gaps to help students improve their abilities<sup>[12]</sup>. At the same time, with the help of phased testing, teachers can also find out the problems in teaching and correct the problems.

### 3.3.2. Comprehensive trial clinical test based on clinical case discussion

The teaching evaluation of comprehensive experiments is very important, and clinical case discussion should also rely on comprehensive experiments. For example, in “Laboratory Diagnosis of Neonatal Hemolytic Disease,” teachers provide case data, students form a group to carry out clinical case discussion and propose a feasible experimental diagnosis plan, and then the group conducts experiments to complete the diagnosis work. The comprehensive experiment is the content closest to clinical practice. In the evaluation of a comprehensive experiment, attention should be paid to the accuracy of diagnostic results, students’ ability to apply theory to practical problems, and the cultivation of students’ teamwork ability<sup>[13]</sup>.

## 4. Initial practical results

After the course, teaching and evaluation work, design a questionnaire to understand the feedback of students on formative evaluation. The number of respondents was 41, and 41 valid questionnaires were collected, and the results were analyzed. The results show that students generally recognize the role of formative assessment, and believe that it plays a positive role in helping them to find learning problems, improve their comprehensive literacy, and enhance their problem-solving ability (**Table 1**).

**Table 1.** Results of the formative assessment questionnaire [ $n(\%)$ ,  $n = 41$ ]

Evaluation content	Good	Average	Poor
Strengthen basic theoretical knowledge learning	40 (97.6)	1 (2.4)	0 (0.0)
Cultivate self-study and innovation	37 (90.2)	2 (4.9)	2 (4.9)
Improve analytical and problem-solving skills	40 (97.6)	1 (2.4)	0 (0.0)
Develop a team spirit	40 (97.6)	(2.4)	(0.0)
Arouse interest in learning	38 (92.7)	2 (4.9)	1 (2.4)
Improve learning efficiency	40 (97.6)	1 (2.4)	0 (0.0)

## 5. Advantages and problems of formative evaluation

### 5.1. The advantages of formative evaluation

#### 5.1.1 It is helpful to evaluate students’ learning effect

- (1) From the perspective of teachers, formative evaluation helps them to grasp students’ learning situation in time and find ways to adjust teaching plans, which has positive significance for teachers to control the whole teaching progress and teaching process.
- (2) From the perspective of students, in the formative assessment system, through regular periodic tests, students can form a more comprehensive and objective understanding of their learning, find their



weaknesses in learning, and actively adjust their learning behaviors to effectively improve learning efficiency. Formative evaluation always pays attention to the growth of students in the classroom, regards students as the subject of the class, and students are encouraged and driven to fully learn, think, analyze and solve problems, and effectively improve the learning effect. In this process, the student-centered teaching concept has been fully reflected <sup>[14]</sup>.

### **5.1.2. It is helpful to the improvement of teachers' teaching ability**

In various daily formative evaluations, teachers can sort out the feedback data of students on the whole teaching process to make corresponding adjustments to the teaching process and teaching methods, so that the teaching content and methods of teachers can adapt to the actual situation of students, thus forming a virtuous circle of evaluation-feedback-improvement.

### **5.1.3. It is helpful to develop students' good learning habits**

Compared with the final assessment, the formative assessment system focuses more on the learning process. It uses multiple aspects of evaluation and supervision to guide students to correct learning. This can prevent students from attending classes to cope with attendance, which may lead to a lack of solid understanding of knowledge. Only by cramming before the exam can they get good grades and develop a habit of practical learning over time <sup>[15]</sup>.

## **5.2. Problems in formative evaluation**

Because formative evaluation focuses on the teaching process, the evaluation work is more complicated, and compared with the traditional evaluation mode, it also adds two links of feedback and correction, so it is more difficult to carry out. At present, there is still little research on formative assessment, and no unified guiding standards have been formed. As a result, when teachers apply formative assessment, the evaluation system is not comprehensive, the evaluation indicators are relatively few, and some teaching links are not accurate in the application of evaluation methods, and finally they cannot give correct teaching feedback.

## **6. Conclusion**

To sum up, formative evaluation plays a positive role in promoting clinical laboratory teaching. It makes up for the shortcomings of the traditional summative evaluation, which is one-sided and static, pays attention to the teaching process, and provides positive guidance for teaching reform through feedback and revision. It can be said that formative evaluation enriches and improves the evaluation system of basic clinical laboratory courses and guarantees the teaching quality of clinical laboratory courses. In future teaching work, formative evaluation will continue to play a role and will continue to improve with the development of teaching and achieve teaching goals more efficiently.

## **Disclosure statement**

The authors declare no conflict of interest.

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### Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# The Molecular Mechanism of Weilingxian and Guizhi in the Treatment of Gout was Studied Based on Network Pharmacology

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**Abstract:** *Objective:* To explore the mechanism of action of “Weilingxian-Guizhi” two drugs in the treatment of gout. *Method:* First obtain the 15 chemical components contained in the “Weilingxian-Guizhi” drug, predict its target points through the database, and then construct the gout-related protein-protein interaction network (PPI), and then construct the “Weiling,” the “Xian, Guizhi” drug pair “active ingredient-predicted target” network, the construction of the gout-related “Weilingxian-Guizhi” drug pair “active ingredient-potential target” network, based on the Kyoto Encyclopedia of Genes and Genomes (KEGG) biological pathway enrichment analysis and gene ontology (GO) functional enrichment analysis, to study the mechanism of action of the two drugs “Weilingxian-Guizhi” in the treatment of gout. *Results:* The gout-related “Weilingxian-Guizhi” drug pair “active ingredient-potential target” network contains 14 targets. KEGG pathway enrichment analysis yields 32 pathways, and GO functional enrichment analysis yields 517 GO entries. Among them, there are 468 items related to biological processes, 21 items related to molecular functions, and 28 items related to cell composition. *Conclusion:* The results of this study initially verified and predicted the mechanism of the “Weilingxian-Cinnamon Stick” medicine on the treatment of gout, and laid a good foundation for further revealing its mechanism of action.

**Keywords:** Weilingxian; Guizhi; Gout; Network pharmacology; Target; Signal pathway

**Online publication:** March 10, 2025

## 1. Introduction

If a doctor does not understand a disease, it is like a general not knowing his troops. To treat a disease, one must first understand it. The term “gout” in traditional Chinese medicine includes conditions such as gout, bi syndrome (a type of rheumatic disease), and Li Jie (a condition characterized by painful joints). These disease names have existed since ancient times, tracing back to the “Yellow Emperor’s Inner Canon of Medicine.” In the “Plain



Questions: Discussion on Bi Syndrome” chapter, it is stated, “When wind, cold, and dampness combine, they form bi syndrome”<sup>[1]</sup>. Clematis Root (Weilingxian) has a pungent and salty taste, warm properties, and slight toxicity. It is effective in dispelling wind and dampness, promoting the flow of Qi and blood, and softening bones. It is a commonly used herb in the clinical practice of traditional Chinese medicine<sup>[2]</sup>. Guizhi (Cassia Twig) has a pungent and sweet taste, and warm properties, and is effective in inducing sweating to relieve muscle tension, warming and unblocking meridians, assisting Yang to transform Qi, and calming the rebellion of Qi. Guizhi is often used in combination with other herbs to treat various diseases<sup>[3]</sup>. Weilingxian and Guizhi are frequently used in the treatment of gout and bi syndrome, and a typical example is Guizhi Shaoyao Zhimu Decoction<sup>[4]</sup>. This formula was devised by Zhang Zhongjing, and in the “Synopsis of Golden Chamber: Stroke and Li Jie” chapter, it is stated, “For pain in all limbs and joints, emaciation of the body, swelling of the feet as if they were about to fall off, dizziness, shortness of breath, and a feeling of warmth and nausea, Guizhi Shaoyao Zhimu Decoction is prescribed.”

So far, countless doctors have used Weilingxian and Guizhi, with adjustments, to treat bi syndrome. Studies have also shown that Weilingxian and Guizhi have significant anti-gout effects<sup>[5]</sup>. With the modernization of traditional Chinese medicine, research on the mechanism of action of these two herbs in treating gout has gradually deepened, entering the stage of molecular biology. However, from a general perspective, there are few examples of using network pharmacology methods to reveal their mechanism of action. Unlike chemical drugs, which typically have a single component and target<sup>[6]</sup>, traditional Chinese medicines are characterized by multiple components, targets, and pathways that work synergistically. Because of this, traditional pharmacological research has difficulty elucidating the material basis and related mechanisms of action of traditional Chinese medicines. Network pharmacology has emerged to fill this gap in traditional Chinese medicine research.

Network pharmacology is a new method and model for drug design and development based on modern pharmacology. It analyzes the overall level of disease pathogenesis from a systems perspective and observes the complex network relationships between “drug-target-disease,” further guiding new drug development and research on pharmacological effects<sup>[7]</sup>. Network pharmacology upgrades the previous drug research model of “one component, one target” to a new model of “multiple targets, multiple components,” thus revealing the complex relationships between multiple components and targets of traditional Chinese medicines more deeply. Due to the complex mechanism of action of traditional Chinese medicines, further research has encountered significant obstacles. However, network pharmacology provides new ideas and entry points for the study of complex traditional Chinese medicine systems<sup>[8]</sup>. Network pharmacology can be used to discover active components in complex traditional Chinese medicines, identify targets, and predict indications<sup>[9]</sup>. This article analyzes the targets of the active components of Weilingxian and Guizhi in the treatment of gout based on network pharmacology, explores their mechanism of action and material basis, and hopes to provide references for further basic experimental research and clinical rational application of “Weilingxian and Guizhi” in the treatment of gout, as well as open up new ideas.

## **2. Materials and methods**

### **2.1. Collection of active ingredients and corresponding targets of the “Weilingxian and Guizhi” herbal pair**

Using the Traditional Chinese Medicine Systems Pharmacology Database and Analysis Platform (TCMSP) (<http://www.tcmsp.ac.cn/>)

lsp.nwu.edu.cn/tcmsp.php)<sup>[10]</sup>, this study searched for “Weilingxian” and “Guizhi” to identify active ingredients. The study screened for a subset of highly relevant ingredients based on an OB greater than 30% and a DL greater than 0.18. The corresponding targets for these active ingredients were then obtained through TCMSP and verified using the UniProt database to determine the abbreviated human gene names for each target, ultimately acquiring the target proteins.

## 2.2. Prediction of gout disease-related targets

Using “gout” as the keyword, the study searched the GeneCards database (<http://www.genecards.org/>) and the Online Mendelian Inheritance in Man (OMIM) database (<http://www.omim.org/>) to obtain gout-related targets. After removing duplicate gene targets, the final set of targets was determined.

## 2.3. Intersection of drug targets and disease targets

The study created a Venn diagram online using the website (<http://bioinformatics.psb.ugent.be/webtools/Venn/>) to identify the intersection of target proteins and potential targets obtained from steps 2.1 and 1.2. This allowed us to acquire the targets related to both “Weilingxian, Guizhi” and gout.

## 2.4. Construction of Protein-protein Interaction Network (PPI)

The common targets obtained from step 2.3 were imported into the STRING website (<https://string-db.org/>), selecting “*homo sapiens*” as the organism type to generate a protein-protein interaction information graph.

## 2.5. GO functional enrichment analysis and KEGG pathway enrichment analysis

DAVID website (<https://david.ncifcrf.gov/gene2gene.jsp>) was logged in and DAVID 6.8 (Functional Annotation Clustering) was used to perform GO gene functional analysis of the target proteins related to the treatment of gout with “Weilingxian and Guizhi.” This analysis covered three aspects: Molecular Function (MF), Cellular Component (CC), and Biological Process (BP). To elucidate the role of these therapeutic targets in signaling pathways, the study conducted a KEGG pathway enrichment analysis. The study selected GO functional terms and KEGG pathway terms as the main gene functional biological processes and signaling pathways involved in gout treatment, predicting the mechanism of action of the two herbs in treating gout.

# 3. Results

## 3.1. Screening of active ingredients from “Weilingxian and Guizhi”

Using the keywords “Weilingxian” and “Guizhi” in the TCMSP database, a total of 277 known active ingredients were obtained, among which 13 met the criteria (OB > 30%, DL > 0.18). See **Table 1**.

**Table 1.** Active ingredients of “Weilingxian and Guizhi”

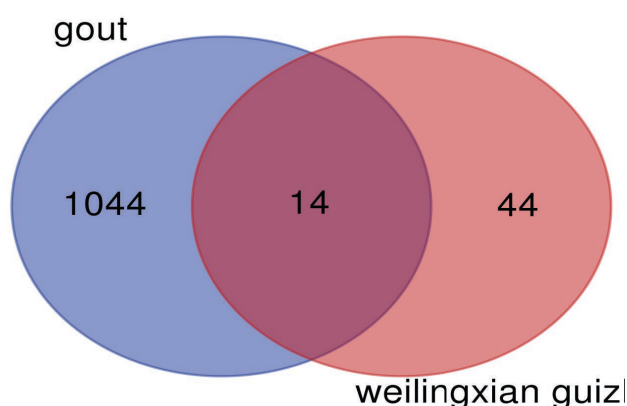
Serial Number	Mol ID	Compound	OB value	DL value
1	MOL001736	(-)-taxifolin	60.51	0.27
2	MOL000358	beta-sitosterol	36.91	0.75
3	MOL000359	sitosterol	36.91	0.75
4	MOL000492	(+)-catechin	54.83	0.24

**Table 1 (Continued)**

Serial Number	Mol ID	Compound	OB value	DL value
5	MOL000073	ent-Epicatechin	48.96	0.24
6	MOL004576	Taxifolin	57.84	0.27
7	MOL011169	Peroxyergosterol	44.39	0.82
8	MOL001663	<u>(4aS,6aR,6aS,6bR,8aR,10R,12aR,14bS)-10-hydroxy-2,2,6a,6b,9,9,12a-heptamethyl-1,3,4,5,6,6a,7,8,8a,10,11,12,13,14b-Tetradecahydronicene-4a-carboxylic acid</u>	32.03	0.76
9	MOL002372	<u>(6Z,10E,14E,18E)-2,6,10,15,19,23-hexamethyltetracos-2,6,10,14,18,22-hexaene</u>	33.55	0.42
10	MOL000449	<u>Stigmasterol</u>	43.83	0.76
11	MOL005594	<u>ClematosideA' qt</u>	37.51	0.76
12	MOL005598	<u>Embinin</u>	33.91	0.73
13	MOL005603	<u>Heptyl phthalate</u>	42.26	0.31

### 3.2. Prediction of targets for “Weilingxian and Guizhi” drugs and gout disease

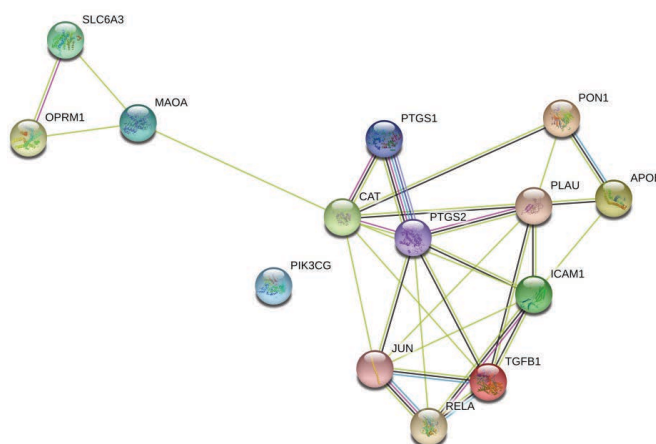
Using the target prediction function in TCMSP, target prediction was performed on the 13 active ingredients identified in 3.1. This resulted in 71 target proteins for “Weilingxian” and 51 target proteins for “Guizhi.” After removing duplicates, 64 target proteins remained. Using “GOUT” as the keyword, a total of 1062 targets related to gout were identified in the OMIM and GeneCards databases. After removing duplicates, 1057 targets were obtained. By creating a venn diagram to find the intersection, 14 targets associated with gout in “Weilingxian and Guizhi” were identified. See **Figure 1**. The venn diagram was created using the online tool at (<http://bioinformatics.psb.ugent.be/webtools/Venn/>).



**Figure 1.** Venn diagram of drug targets and predicted disease targets.

### 3.3. PPI network of “Weilingxian and Guizhi” targets for gout treatment

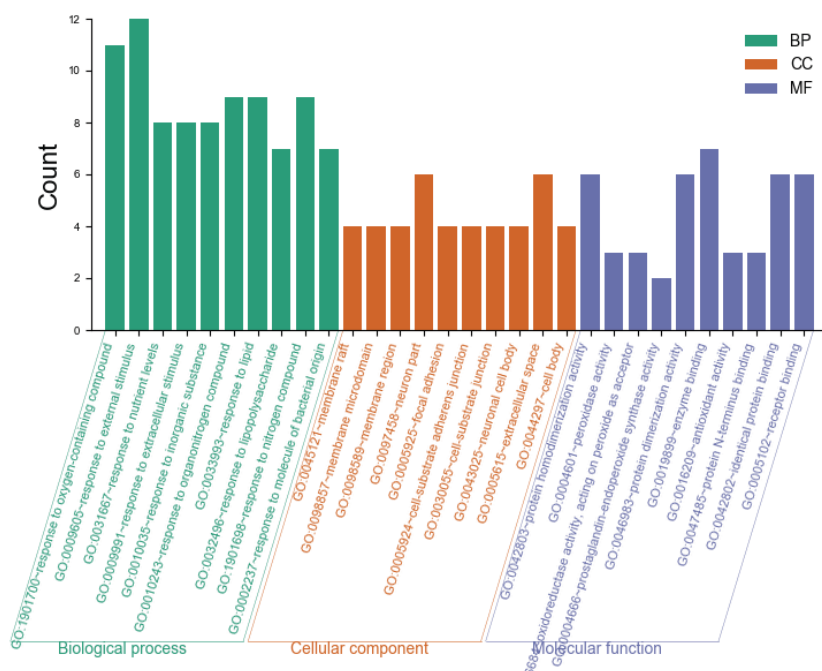
The 14 targets of “Weilingxian and Guizhi” for gout treatment were input into the STRING database (<https://string-db.org>). Based on preset conditions, a PPI network diagram was constructed, as shown in **Figure 2**. It can be observed that PTGS2 has the most connections with other targets, followed by TGFB1, ICAM1, PLA2, and JUN.



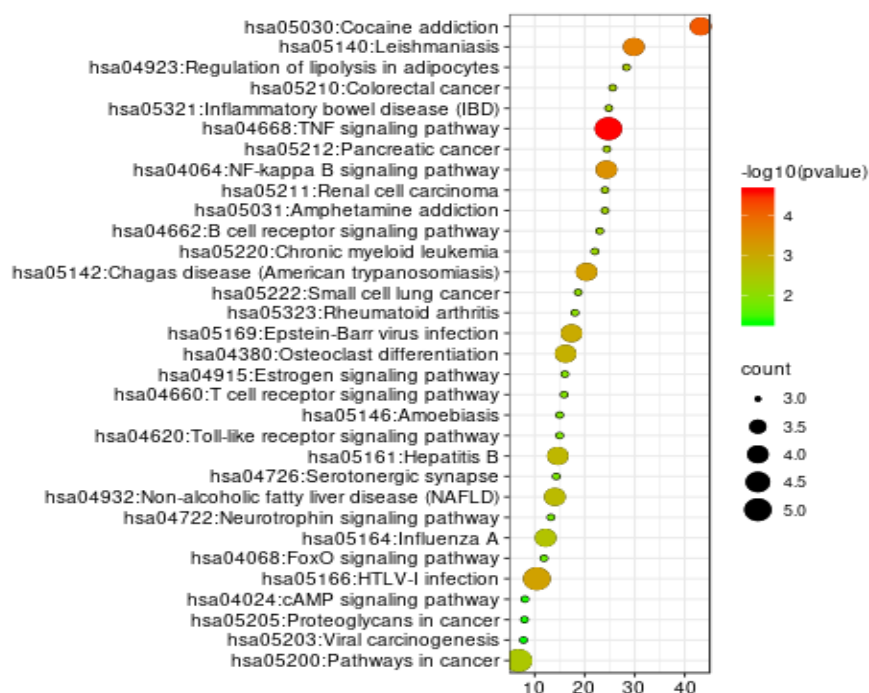
**Figure 2.** PPI network diagram of “Weilingxian and Guizhi” targets for gout treatment.

### 3.4. GO functional analysis and KEGG pathway enrichment analysis

GO functional enrichment analysis was performed using the DAVID platform (<https://david.ncifcrf.gov/gene2gene.jsp>). The 14 targets obtained in 3.2 were input, resulting in 517 GO terms. Based on the *P*-value, these terms were arranged in ascending order, and the top ten terms from each category (Biological Process, Molecular Function, and Cellular Component) were selected, totaling 30 terms (**Figure 3**). Among them, there were 468 terms related to Biological Process (BP), 21 terms related to Molecular Function (MF), and 28 terms related to Cellular Component (CC). Furthermore, using the KEGG pathway enrichment analysis function of the DAVID platform, the roles of the 14 proteins in the signal pathways of the “Weilingxian and Guizhi” active ingredient-potential target network related to gout were marked. This resulted in 37 signaling pathways, and 32 were selected based on  $P < 0.05$  (**Figure 4**).



**Figure 3.** GO functional enrichment analysis of potential target effects.



**Figure 4.** KEGG pathway enrichment analysis of potential target effects.

## 4. Discussion

Gout has been known by many names in ancient times, such as “Bi syndrome” and “Li Jie”<sup>[11]</sup>. Weilingxian and Guizhi are commonly used clinical medications for the treatment of gout, with significant effects<sup>[12]</sup>. With the development of society and the continuous improvement of people’s living standards, the incidence of gout has shown a continuously increasing trend. In China, it is about 0.34–2.84%, and the average age of the affected population is getting younger<sup>[13]</sup>. Modern pathophysiological studies have found that gouty arthritis can be divided into primary and secondary gouty arthritis, which is related to the phagocytosis of autoimmune cells in the body’s immune system and the negative regulation of inflammatory mediators such as NLRP3 inflammatory corpuscles and interleukin<sup>[14]</sup>.

This study found that the main active ingredients of Weilingxian and Guizhi for the treatment of gout include dihydroquercetin,  $\beta$ -sitosterol, catechin, epicatechin, ergosterol peroxide, taxifolin, and stigmasterol. Studies have confirmed that dihydroquercetin and  $\beta$ -sitosterol have the effect of inhibiting inflammatory responses<sup>[15,16]</sup>. Gabay *et al.* found that stigmasterol also has a certain inhibitory effect on inflammatory responses, possibly by blocking the NF- $\kappa$ B pathway activated by IL-1 $\beta$ <sup>[17]</sup>. However, catechin is currently mainly used for anti-radiation<sup>[18]</sup>, and whether it has an anti-inflammatory effect and whether it promotes the treatment of gout requires further research and confirmation.

The pathogenesis of gout is related to immune regulation and inflammatory responses. Uric acid sodium, which is recognized by immune cells and inflammatory factors, activates the NF- $\kappa$ B transcription factor pathway, releasing inflammatory mediators such as TNF and IL-1 $\beta$ . These inflammatory mediators cascade to produce inflammatory responses, joint spasms, swelling, fever, and pain<sup>[19,20]</sup>. The results of the KEGG pathway enrichment analysis in this study showed that the pathways regulated by Weilingxian and Guizhi, which are related



to immune regulation and inflammation, mainly include the tumor necrosis factor signaling pathway, nuclear transcription factor-kB signaling pathway, B-cell receptor signaling pathway, and cAMP signaling pathway. At the same time, some disease pathways are also enriched, such as rheumatoid arthritis, hepatitis B, small cell lung cancer, and colorectal cancer. Studies have shown that these diseases are closely related to inflammatory pathways, and Weilingxian and Guizhi have good therapeutic effects on them <sup>[21–23]</sup>. It can be inferred that the most critical pathway for the treatment of gout with Weilingxian and Guizhi is the inflammatory signaling pathway.

## 5. Conclusion

Network pharmacology is a new discipline that has emerged in recent years. Based on the theory of systems biology, it analyzes biological systems networks and selects specific signal nodes (Nodes) for multi-target drug molecule design. Network pharmacology emphasizes multi-pathway regulation of signaling pathways to improve the therapeutic effect of drugs, and reduce toxic and side effects, thereby increasing the success rate of clinical trials of new drugs and saving drug development costs <sup>[24]</sup>. The “single drug-single gene-single disease” approach has been the long-standing method for developing new drugs and is one of the important reasons for the failure of 70% of new drugs in clinical trials. In fact, many chronic diseases in clinical practice, such as tumors, cardiovascular and cerebrovascular diseases, and diabetes, are multi-gene and multi-factor diseases. It is difficult to achieve a good therapeutic effect by relying on a single target <sup>[25]</sup>. Of course, network pharmacology also has its limitations. For example, the efficacy of the macromolecular substance Polysaccharide from Clematis root (Weilingxian polysaccharide) has been confirmed, but it is not included in TCMSP, BATMAN, etc. Another example is that the KEGG pathway analysis results show a correlation with HTLV-I infection, EB virus infection, and amoebiasis pathways, but there is not enough evidence to confirm this, and further investigation is needed.

## Disclosure statement

The authors declare no conflict of interest.

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# The Application of Appropriate Traditional Chinese Medicine Techniques in the Rehabilitation Nursing of Neurogenic Bladder

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**Abstract:** The purpose of this study was to explore the application of TCM-appropriate technology in neurogenic bladder rehabilitation nursing. Firstly, the background and contents of the study were introduced. Then, it summarizes the definition and development of TCM-appropriate technology and expounds the main therapy and application of TCM-appropriate technology in the rehabilitation nursing field. Besides, the pathophysiological characteristics, rehabilitation nursing measures, and rehabilitation difficulties of the neurogenic bladder are described. Then, the application method, effect and prospect of TCM-suitable technology in rehabilitation nursing of neurogenic bladder are described. In addition, the object, method, result analysis, and conclusion of the experimental study are introduced, the main results of this study are summarized, and the future research direction is prospected. In summary, this study aims to provide effective TCM-appropriate technology for neurogenic bladder rehabilitation nursing and provide a reference for clinical practice and theoretical research in related fields.

**Keywords:** Appropriate techniques of traditional Chinese medicine; Neurogenic bladder rehabilitation nursing; Application

**Online publication:** March 6, 2025

## 1. Introduction

Neurogenic bladder is a dysfunction of the bladder due to damage or lesions of the nervous system. Planned drinking water, intermittent catheterization, and bladder function training are common interventions in rehabilitation care for neurogenic bladder after stroke or spinal cord injury. The TCM-appropriate technique is a treatment method that integrates TCM theories and techniques to promote the body's self-repair and recovery of functions. In the field of neurogenic bladder rehabilitation nursing, TCM-appropriate technology has been gradually considered and applied for its unique advantages and curative effects, including moxibustion treatment, acupuncture treatment, manual treatment and so on. The current research results show that TCM comprehensive



rehabilitation nursing can regulate and balance the movement of qi and blood in the body, promote the recovery and regulation of the nervous system, improve the function of the bladder, and play an important role in the establishment of bladder balance state, but there is still a lack of high-quality evidence-based medical evidence. This study evaluated the clinical efficacy of TCM-appropriate technology in the treatment of patients with neurogenic bladder through a controlled trial, to provide a reference for the clinical promotion of TCM-appropriate technology and the clinical practice and theoretical research in related fields.

## **2. Materials and methods**

### **2.1. General information**

In this study, 31 patients diagnosed with neurogenic bladder dysfunction after spinal cord injury and stroke who were admitted to the rehabilitation department of the hospital from July 2021 to December 2023 were selected and randomly grouped according to the order of admission, with the odd number as the observation group (16 cases) and the even number as the control group (15 cases). In the observation group, there were 10 males and 6 females; 30 to 68 years old, a mean ( $50 \pm 1.2$ ) years old; The duration of the disease was 3 to 10 months, with an average of ( $4.25 \pm 1.03$ ) months. In the control group, there were 11 males and 4 females; 32 to 70 years old, mean ( $48.26 \pm 4.15$ ) years old; The duration of disease was ( $5.32 \pm 1.25$ ) months from 4 to 12 months. There was no significant difference in the general data between the two groups ( $P > 0.05$ ), indicating comparability.

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

Inclusion criteria: (1) Patients diagnosed with stroke or spinal cord injury with neurogenic bladder-related symptoms; (2) Had survived spinal shock <sup>[1]</sup>; (3) The catheter was removed; (4) Course of disease  $> 3$  months  $< 1$  year; (5) Adults; (6) Patients know and consent to participate in the study.

Exclusion criteria: (1) Abnormal structural anatomy of the urinary system; (2) Organic lesions of the bladder; (3) Serious diseases of vital organs such as the heart, brain and kidney; (4) Cognitive dysfunction or mental illness; (5) Patients with severe urinary tract infections.

### **2.3. Methods**

#### **2.3.1. Control group**

The control group was given routine nursing, drinking water schedule, regular urination, intermittent catheterization, bladder function exercise, etc.

#### **2.3.2. Observation group**

The observation group was given the appropriate technical intervention of traditional Chinese medicine based on the control group for 20 days, specifically as follows:

- (1) Acupuncture therapy is a traditional Chinese medicine technology, through stimulating acupuncture points, regulating meridians, balancing Yin and Yang, improve the function of the bladder to achieve the purpose of treatment, and the efficacy is better than simple intermittent catheterization and bladder function training <sup>[2]</sup>. 25 minutes each time, once a day, take Zhongji, Guanyuan, Shenshu, Zhaohai, Taixi and other points <sup>[3]</sup>;
- (2) The dragon pot treatment integrates the characteristics of moxibustion, cupping and Guasha and other

traditional Chinese medicine techniques, by stimulating the meridians and points related to the urinary system, such as Sanyinjiao, middle pole, etc., its warm stimulation and negative pressure effect <sup>[4]</sup>, can promote the local Qi and blood operation, enhance the blood circulation of the bladder and its surrounding tissues, help regulate the meridians of the kidney and bladder, enhance the restraint ability of the bladder, improve the bladder work-energy. 20 minutes once a day;

(3) Acupressure patients lie flat on the bed after emptying the bladder for acupressure <sup>[5]</sup>, the use of the index finger, middle finger, ring finger abdominal pressure Guanyuan, Qi Hai, waterway, Yin Ling Quan, Qu bone, middle pole, Mingmen, Waiyanguan, Zusanli, Sanyinjiao and other acupoints, from light to heavy, press 3–5 minutes each time, 3 times a day;

(4) Wrist ankle needle to double down 1, 2 areas, 1 times a day, leave the needle for 30 minutes to 1 hour.

## **2.4. Observe the indicators**

### **2.4.1. Bladder volume measurement [6]**

Before and after treatment, musculoskeletal ultrasound technology and simple bladder volume pressure measurements were used to calculate the safe bladder volume <sup>[7]</sup>, residual urine volume, bladder pressure and bladder compliance of the two groups of patients.

### **2.4.2. Urination conditions**

During the observation period, water intake, frequency of urination, 24-hour urination volume, frequency of urination, urgency of urination and incontinence of patients in both groups were measured and recorded before and after treatment.

### **2.4.3. Therapeutic effect**

The therapeutic effect was divided into effective, ineffective and obvious effects. The obvious effect, after treatment can urinate by itself, and the residual urine volume is less than 60 mL, can better control the urination process, no frequent urination, urgent urination, incontinence, dysuria and other phenomena. For effective, after treatment, the number of spontaneous urination increased, and the residual urine volume was 100-150ml, no obvious frequency of urination, urgency of urination, dysuria, and occasionally stress incontinence. After the ineffective treatment, patients could not urinate by themselves or the residual urine volume after urination exceeded 200 mL.

Total effective rate = significant effective rate + effective rate

### **2.4.4. Nursing satisfaction**

According to the nursing situation and patient experience, it is divided into satisfaction, general satisfaction, and dissatisfaction.

## **2.5. Statistical analysis**

Statistical analysis was performed by SPSS 22.0. Statistical data were expressed as rates and  $\chi^2$  test was used. Residual urine volume and time to return to autonomous urination were expressed as mean  $\pm$  standard deviation (SD) by *t*-test, and *P* < 0.05 was considered as significant difference.

### 3. Results

The comparison of clinical effects between the two groups is shown in **Table 1**. The effective rate of the observation group is 93.7%, and the effective rate of the control group is 73.3%, the difference between the two groups is statistically significant ( $P < 0.05$ ).

**Table 1.** Comparison of clinical effects between the two groups

Group classification	<i>n</i>	Show effect	Effective	No effect	Total valid [ex. (%)]
Observation group	16	12	3	1	15 (93.7)
Control group	15	4	7	4	11 (73.3)

The recovery time and residual urine volume of the two groups were analyzed, and the residual urine volume was measured by ultrasonic scanner from three dimensions<sup>[8]</sup>. There was a significant difference between the two groups ( $P < 0.05$ ) (**Table 2**).

**Table 2.** Comparison of spontaneous urination recovery time and residual urine volume between the two groups

Group classification	Number of examples	Spontaneous urination Recovery time (d)	Residual urine volume (mL)
Observation group	16	$9.24 \pm 3.2$	$42.5 \pm 14.24$
Control group	15	$16.4 \pm 3.15$	$86.5 \pm 22.3$

The nursing satisfaction of the two groups was analyzed, and the difference between the two groups was significant ( $P < 0.05$ ) (**Table 3**).

**Table 3.** Comparison of nursing satisfaction between the two groups

Group classification	Satisfaction	Generally satisfied	Dissatisfied	Satisfaction rate (%)
Observation group	13	2	0	100
Control group	10	3	2	86.6

The study observed that in neurogenic bladder rehabilitation nursing with appropriate techniques of Chinese medicine, patients' symptoms were significantly relieved. By recording the changes in patients' symptoms such as frequency of urination, urgency of urination, and incontinence, the study found that these symptoms were reduced to varying degrees in the period after treatment. This indicates that the appropriate technology of Chinese medicine has a significant effect on neurogenic bladder rehabilitation nursing. The study carried out the urine flow mechanics examination and observed that the patient's urine flow velocity increased significantly after the treatment with the appropriate technique of traditional Chinese medicine. By comparing the urine flow velocity data before and after treatment, this study found that the urine flow velocity was significantly increased after treatment, which indicates that the appropriate technology of TCM has a positive impact on improving the parameters of urine flow mechanics in patients.

In addition, this also carried out the bladder-emptying examination, and the results showed that the bladder emptying function of the patient was significantly improved after treatment with appropriate techniques of TCM. After treatment, the bladder emptying time of patients was significantly shortened, and the bladder emptying rate

was significantly increased. This indicates that the appropriate technology of traditional Chinese medicine plays a positive role in improving the bladder-emptying function of patients.

The study also performed related physiological indicators, including musculoskeletal ultrasound and urine composition analysis. The results showed that the residual urine volume was within the normal range after the treatment with the appropriate technique of traditional Chinese medicine, and the relevant indexes in the urine composition analysis also changed significantly. This indicates that the appropriate technology of TCM has a significant effect on regulating the physiological indicators related to bladder function.

## 4. Discussion

Neurogenic bladder is a bladder dysfunction caused by injury or lesion of the nervous system, commonly seen in spinal cord injury, stroke, and other diseases. According to the different injury planes and injury degrees, it can lead to different types of lower urinary tract dysfunction, mainly including detrusor overactivity, detrusor muscle-bladder neck coordination disorder, clinical manifestations of frequent urination, urgent urination, urinary incontinence, dysuria, urine retention, etc., to the patient's life and psychological burden, effective nursing intervention plays an important role in its rehabilitation process. Routine indwelling urinary tube care, drinking water plan, intermittent catheterization, and other routine nursing measures have a certain effect<sup>[9]</sup>, but the need for rehabilitation time is longer, and long-term intermittent catheterization, prone to urethral injury and urinary tract infection and other problems, especially female patients, easy to insert the urinary tube into the vagina by mistake, causing cross-infection, the patient's ability to live a greater impact. Due to the complexity of nerve injury, the rehabilitation process needs to be considered by multiple factors. In the view of these characteristics, it is necessary to find an effective, simple and economical rehabilitation program to promote the recovery and regulation of the nervous system, improve bladder function, and improve the rehabilitation level and quality of life of patients are of great significance.

TCM-appropriate technology is a comprehensive treatment method, which is applied based on TCM theory and ADAPTS to the physiological and pathological characteristics of patients and the needs of rehabilitation nursing. The development of TCM-appropriate technology is inseparable from the in-depth study of traditional Chinese medicine theory and the application and innovation of modern medical technology. The key to the definition and development of TCM-appropriate technology lies in the full exploration and understanding of traditional Chinese medicine theory, combined with the application of modern scientific and technological means in rehabilitation nursing.

In the application of appropriate techniques of traditional Chinese medicine, acupuncture therapy is widely used in neurogenic bladder rehabilitation nursing<sup>[10]</sup>. Acupuncture therapy, as one of the traditional Chinese medicine therapies, regulates the function of the bladder and the balance of the nervous system by stimulating specific acupoints, thus improving the bladder urination function. Wrist and ankle needle is a unique acupuncture therapy, acupuncture through the skin → collaterals → channels → organs → viscera to stimulate the skin of the meridian qi, take the ankle point under the 1 area of the main bladder and kidney, can open the Ren pulse so that the bladder gasification function can be restored to normal, urination Tongli to achieve the therapeutic effect, improve the bladder function of rehabilitation effect<sup>[11]</sup>.

The massage technique is also one of the commonly used treatment methods of traditional Chinese medicine. By massaging the lumbosacral acupoints, the relevant parts are stimulated to promote local blood circulation,

relieve lumbar acid pain, and indirectly regulate the bladder function, improve the bladder nerve conduction function, enhance the bladder contraction performance, thereby improving the effect of bladder rehabilitation. Acupoint application of Chinese medicine can also be absorbed through the skin, directly acting on the local tissue, without gastrointestinal administration, no damage to the spleen and stomach and improve the function of bladder tissue.

TCM physical exercise is also an indispensable part of TCM rehabilitation treatment. For the rehabilitation of neurogenic bladder, proper sports can stimulate the contraction and relaxation of the bladder and pelvic floor muscles, improve the coordination and control of the pelvic muscle group to improve the symptoms of incontinence<sup>[12]</sup>, frequency of urination, urgency of urination and so on. For example, Baduanjin, pelvic floor muscle exercise, urination control exercises and other exercise therapy, all help to restore the normal function of the bladder.

Appropriate techniques of traditional Chinese medicine emphasize the comprehensive conditioning of the overall health of the human body. Traditional Chinese medicine theory holds that the health of the human body is maintained by the coordination and unified movement of various organs, tissues and systems. Therefore, TCM-appropriate techniques focus on repairing and restoring the normal function of the body by adjusting and balancing the Yin and Yang, Qi and blood within the body. This feature makes TCM-appropriate technology have unique advantages in neurogenic bladder rehabilitation nursing. By means of acupuncture, massage, Chinese medicine decoction, exercise therapy, etc., the nervous system, endocrine system and bladder-related muscles and tissues are regulated to promote the recovery and improvement of bladder function.

Appropriate techniques of traditional Chinese medicine advocate individualized and integrated treatment methods. According to the specific situation of the individual, the targeted treatment plan is adopted, and different treatment methods can be matched with each other to form an integrated treatment model. For example, in neurogenic bladder rehabilitation nursing, the appropriate technology of traditional Chinese medicine can be combined with acupuncture, dragon pot, acupoint massage application, wrist and ankle acupuncture, herbal fumigation and washing therapy and other methods to improve the efficacy of comprehensive treatment. Appropriate techniques of traditional Chinese medicine focus on prevention and rehabilitation. TCM emphasizes “treating no disease,” that is, taking corresponding measures when the disease does not occur to prevent further deterioration of the condition. Therefore, in neurogenic bladder rehabilitation nursing, you can prevent further damage to bladder function and promote rehabilitation through good living habits, diet conditioning and psychological counseling. As a comprehensive means of rehabilitation nursing, the appropriate technology of traditional Chinese medicine has important application value in neurogenic bladder rehabilitation nursing<sup>[13]</sup>.

## 5. Conclusion

The study confirms that Traditional Chinese Medicine (TCM)-appropriate technology significantly improves neurogenic bladder rehabilitation. Techniques like meridian conditioning, acupressure, and drug application effectively restore bladder function, with the experimental group showing greater improvement in bladder control and reduced urinary incontinence compared to the control group<sup>[14]</sup>.

Moreover, TCM techniques provide lasting benefits. Follow-up studies show that patients maintain stable bladder function without recurrence. Additionally, TCM methods support psychological well-being, reducing anxiety and depression through techniques such as massage and dragon pot treatment. TCM rehabilitation nursing



is valued for its simplicity, affordability, quick effects, and minimal side effects, making it widely accepted by patients. By integrating various TCM techniques, bladder rehabilitation outcomes and patient satisfaction can be enhanced.

Future research should expand the application of TCM in neurogenic bladder rehabilitation, further exploring its mechanisms and methods. This will not only advance TCM but also contribute to rehabilitation nursing and improve patient care<sup>[15]</sup>.

## Disclosure statement

The authors declare no conflict of interest.

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# Research on the Development of the Big Health Industry in the Context of Digitalization

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**Abstract:** This paper makes an in-depth study of the status quo and trend of the development of the big health industry under the background of digitalization, aiming to explore ways to promote the transformation, upgrading and sustainable development of the big health industry through technological innovation and policy guidance, and provide valuable references for the government, enterprises and universities and other stakeholders to promote the high-quality development of the big health industry in the digital era.

**Keywords:** Digitization; Big health industry; Development research

**Online publication:** March 6, 2025

## 1. Introduction

In the opinions of The State Council on implementing the Healthy China Action, it is pointed out that to give priority to prevention, place prevention in a more prominent position, and effectively deal with the current prominent health problems, it is important to take effective intervention measures and detail the implementation of the Outline of the Healthy China 2030 Plan on popularizing a healthy life, optimizing health services, and building a healthy environment. Focusing on the major diseases and major problems affecting people's health at present and in the coming period, we will carry out medium- and long-term actions for disease prevention and health promotion, improve the system that puts prevention first in the whole society, and make unremitting efforts to promote it, so that people will not get sick, get sick less, and improve their quality of life. It can be seen that the state exerts great importance on healthy development, and colleges and universities should also take the road in line with the development of the country to promote the development of the health industry.



## **2. The significance of research on the development of large health industry under the background of digitalization**

### **2.1. Leading the innovation of medical and health service models and creating a new era of wisdom and health**

With the continuous development of advanced technologies such as big data, cloud computing, and artificial intelligence, intelligent and personalized precision services have been realized in all aspects of improving the efficiency and quality of medical technical services, prevention, diagnosis, treatment and rehabilitation. Patients can also enjoy more convenient and efficient medical services through electronic medical records, telemedicine and intelligent diagnosis systems, and doctors can make more scientific diagnoses and treatment decisions according to the consultation and participation of patients, so as to make the big health industry develop in the direction of intelligence, create a new era of intelligent health, and provide the foundation for the development of the big health industry <sup>[1]</sup>.

### **2.2. Promoting the optimization and upgrading of industrial structure and promoting high-quality economic development**

As an emerging strategic pillar industry, the major health industry covers a wide range of fields <sup>[2]</sup>, including medical devices, healthcare products, and health management services. The big health industry not only drives the development of the industry, but also the collection of information technology, giving birth to the development of online diagnosis and treatment, medical data analysis, medical e-commerce, and other forms of business, which not only brings a huge market development space for the big health industry but also makes the big health put its development vision in other fields. According to the development of Great Health, the government can provide certain policies to encourage the development of Great Health in many ways, so that Great Health can develop further and deeper so that health care can better serve the people.

### **2.3. Strengthening international cooperation and exchanges to enhance national health competitiveness**

The wide application of digital technology not only breaks the geographical restrictions, enables the efficient integration and sharing of global health resources, provides a broad stage for international health science and technology innovation and industrial cooperation, further strengthens transnational research and development cooperation, promotes health service trade, and enables China's major health industry to not only develop itself, It can also develop based on drawing on international advanced experience and technological achievements, to better enhance the ability of independent innovation, improve its position in the international market, and enhance the soft power of national culture <sup>[3]</sup>.

## **3. Strategies for the development of a large health industry**

### **3.1. Data security practice: Teaching exploration of building a comprehensive privacy protection system**

The university actively responded to the call of national data security and privacy maintenance. It cooperated with a comprehensive health management company to build a safe and efficient data management system <sup>[4]</sup>. Colleges and universities can be led by teachers to participate in the project. When participating in the analysis of users'

health status, they can directly replace the identity information (such as name and ID number) with a randomly generated unique identifier to ensure that the original data is analyzed and utilized without being identified. Also, the participation of students and teachers to establish a strict data access rights management mechanism, so that teachers and students feel that this is based on the role and attributes of the allocation of access rights, only through strict identity verification of medical professionals and researchers can access the corresponding sensitive data. There will also be a health data inspection module, which not only oversees the collection, storage, sharing and use of data but also conducts regular security audits of the system (checking the effectiveness of data encryption measures, the integrity of access logs and the implementation of emergency response plans). In addition to the above, university faculty and students also participate in regular data ethics training activities, so that the smooth implementation of the project and staff awareness of the importance of data privacy must be sufficient. The teachers asked the students to write an experimental harvest report according to the project they participated in. Some students wrote in the process of implementation of the project, deeply experiencing the risk of data leakage, data access should be carried out in a safe and controllable environment, raw data should be processed based on law, and any form of abuse and improper handling should be resisted. The teacher led the students to participate in the data desensitization technology, strict access control, independent data supervision, data ethics education and other measures in the project so that the students could more clearly understand the importance of building a comprehensive and multi-level data security and privacy protection system, which can not only ensure the personal health information security of login users, but also set a model for the development of the health industry <sup>[5]</sup>.

### **3.2. School-enterprise cooperation to build a healthy ecosystem: Practical exploration of user participation**

Colleges and universities can cooperate with enterprises to establish a simulation base so that the person in charge of the project in the enterprise can come to the university to teach. The staff of the enterprise chose a health ecosystem that combines user participation and feedback mechanism so that students can understand that the digital health services provided should not only be close to the actual needs of users but also improve the user experience <sup>[6]</sup>. First of all, the project leader divided the students into different groups, each group of 4–5 people, asked the students to investigate and collect users' opinions and suggestions on the existing digital health services through online searches and visits, and summarized them. There are questions about personal information protection measures raised by users and detailed records of students' answers. The system uses data encryption technology, an anonymisation process and strict data access control, and these are in line with the requirements of laws and regulations <sup>[7]</sup>. Secondly, to deepen users' understanding of digital health services, the project leader also asked the students to tell the interviewees during the survey that they would set up a live lecture, which would explain the basic knowledge of health services, use skills and how to manage personal health through digital tools so that users can have a better use of health management system and learn to make an appointment with a doctor by themselves. To deepen their understanding of digital health services <sup>[8]</sup>. Finally, enterprises can also let students learn basic computer operation, smartphone applications, network security awareness and other aspects, so that students first have a good understanding of it, and then spread it, which can stimulate their interest and confidence in digital technology so that they can become ambassadors for promotion. In building a comprehensive user participation and feedback mechanism, and carrying out a variety of educational activities, users' satisfaction and participation in digital health services can be better enhanced, and the popularization of digital skills can be accelerated <sup>[9]</sup>.

### **3.3. Government-led development of digital health industry: Policies and regulations and strategies for collaborative innovation**

Today, with the continuous development of digitalization, the big health industry has also ushered in unprecedented changes. To ensure its healthy development, the government should adopt a series of forward-looking policies and regulations to better promote the development of big health <sup>[10]</sup>. The government can set up an inter-departmental working group composed of experts from the health sector, science and technology sector, economic sector and law sector to study and draft policies and regulations for the digital health industry. While deeply analyzing the current development trend of digital health services, it also needs to listen to the opinions of industry experts, scientific and technological innovation enterprises, medical institutions and the public to ensure the scientific and democratic nature of policy-making <sup>[11]</sup>. For example, in the AI-assisted diagnosis system, the policy stipulates the accuracy standard of the system function, the principles of data use and protection, and the responsibility traceability mechanism to ensure the accuracy and safety of the technology application. For telemedicine services, the policy can clarify the qualification requirements of service providers, service processes, and the protection of patients' rights and interests. It can also cooperate with the science and technology industry to establish a digital health industry innovation research center to explore policy innovation and scientific and technological innovation of the digital health industry. It can also provide tax incentives, financial support, talent introduction and other aspects for digital health service enterprises to stimulate the innovation vitality of enterprises and accelerate the popularization and optimization of digital health services. Moreover, it can strengthen exchanges and cooperation with the international community, learn from advanced international experience, and constantly improve the international competitiveness of the digital health industry in China. In the research on the development of the large health industry under the digital background, the government provides a solid policy guarantee for the steady development of digital health services and the development of school talents by formulating forward-looking policies and regulations <sup>[12]</sup>, establishing cross-departmental cooperation mechanisms, and encouraging the collaborative innovation of policies and technologies.

### **3.4. Colleges and universities should build a digital talent training system for the big health industry**

Colleges and universities can add the major of “Health Information Management and Information System” according to the needs of the society for health. In the course design, the knowledge system of multiple disciplines such as basic medicine, public health, information technology, data analysis and project management can be integrated by combining theory and practice, so that students can master the collection, processing, analysis and application ability of health data in a comprehensive way to lay a solid foundation for the digital development and telemedicine of their profession. In addition, an “Advanced Training Course on Digital Transformation of Big Health Industry” can be set up for employees. The training course is to invite industry experts, enterprise executives and technology pioneers as lecturers to teach cutting-edge topics such as the application of big data in the medical and health field, artificial intelligence-assisted diagnosis technology, cloud computing platform construction and operation and maintenance, and business model innovation of digital health services. The participants can broaden their horizons through group discussion and apply what they have learned to practical work. Colleges and universities can also create digital scholarships to recognize outstanding students and provide them with financial support and academic guidance so that more students can join the health industry. By setting up relevant professional courses, providing diversified training opportunities, implementing incentive measures

and strengthening international cooperation, colleges and universities can not only build a digital talent training system for the major health industry, but also provide a large number of high-quality professionals for the industry, and promote the process of digital transformation of China's major health industry <sup>[13]</sup>.

### **3.5. Industry-university-research cooperation promotes the cultivation and innovative development of talents**

Colleges and universities can set up a special industry-university-research cooperation office, which is responsible for connecting internal and external resources and establishing stable cooperative relations with many well-known enterprises, medical institutions, scientific research institutions and investment institutions at home and abroad. Online industry-university-research projects are held regularly to provide direct communication between the two sides, learn about the latest scientific research results, and provide an in-depth understanding of industry trends for the auditing students and teachers. To grasp the opportunities of cutting-edge technology <sup>[14]</sup>. Colleges and universities can also create a learning mechanism:

- (1) Multiple courses related to emerging digital technologies, artificial intelligence, big data and other frontier fields can be set up so that students can better access front-end skills;
- (2) The university can also establish an online learning platform and integrate rich online course resources such as open courses, industry lectures and technical seminars from top universities at home and abroad so that students can learn anytime and anywhere and keep up with the development trend of technology.

After learning the basic knowledge, students and teachers can take part in the examination and obtain the corresponding certificate to prove their learning results. After students and teachers have obtained the corresponding certificates (proving a solid grasp of basic knowledge), colleges and universities can also assign teachers to participate in the implementation of projects in enterprises, and introduce the advanced theoretical knowledge learned to students as cases. Meanwhile, a report will be drafted to make certain suggestions on the arrangement of textbooks. The teaching materials compilation team can combine the latest big health data to compile teaching materials so that students are exposed to the latest big health knowledge. Through the way teachers and students learn together, colleges and universities can not only make both sides grow together, but also make a reputation, so that more students come to the school in this major, to make a certain contribution to the development of big health, but also enable online students to better participate in the work, through their practical activities, to promote the rapid development of big health industry <sup>[15]</sup>.

## **4. Conclusion**

It can be seen in the technological innovation and mode reform of colleges and universities that these strategies can not only improve the efficiency and quality of medical services but also optimize the health management process to meet the growing diversified health needs of the people.

## **Disclosure statement**

The author declares no conflict of interest.



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# The Role of Central Inflammation in Postoperative Cognitive Dysfunction

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**Abstract:** Postoperative cognitive dysfunction is a typical complication, which can be referred to as POCD. This complication is common in elderly patients. Among them, POCD is mainly manifested in the function of patients with attention deficit and memory reduction after surgery, among which serious patients are prone to personality change, which affects their social behavior ability. In the context of the current era, the cause of POCD is not clear, combined with the results of most studies, it is found that central nervous inflammation, is a key factor affecting POCD. From the perspective of central inflammation, this paper analyzes the relationship between central inflammation and POCD, and discusses the mechanism of action, aiming at effectively preventing and treating POCD and providing a reference for subsequent research in related fields.

**Keywords:** Central inflammation; Postoperative cognitive dysfunction; Effects

**Online publication:** March 6, 2025

## 1. Introduction

In 1955, Bedford found that patients with postoperative cognitive dysfunction occurred, until 1998 Moller of this phenomenon, namely the postoperative cognitive dysfunction (POCD). POCD patients mainly manifested mental disorders and social ability decline, and even some serious patients lost the ability to take care of themselves, and the postoperative recovery effect was poor. Previous studies have found that POCD usually appears after major surgery, such as coronary artery bypass, and has a high postoperative incidence. However, the pathogenesis of POCD has not been clarified, and the incidence of POCD is higher in the postoperative group of elderly patients. According to recent research results, there is a close relationship between inflammation induced by the use of narcotic drugs and POCD. Based on this, the role of central inflammation in POCD is discussed.

## **2. Central inflammation and postoperative cognitive dysfunction**

### **2.1. Central inflammatory response**

In the human body, the central nervous system (CNS) can accept all kinds of information, integrate and process the information, transmit the coordinated movement output, or store it well to facilitate the human body to carry out learning and memory <sup>[1]</sup>. The central nervous system is one of the special parts of the human immune system. If it is not subjected to inflammation and injury, the circulating immune cells contained in the human body cannot penetrate the central nervous system through the blood-brain barrier. Under normal circumstances, the human body does not contain special antigen-transfer cells. The central nervous system of the human body, containing microglia, T cells, etc., can secrete many cytokines after activation, deepening the neuroinflammatory response of patients after surgery. The emergence of neuroinflammation, easily leads to the emergence of neurodegenerative diseases in the human body, in which inflammatory mediators can effectively play a role in the central nervous system in the following ways:

- (1) Cytokines such as interleukin, can penetrate into the area around the ventricle, or through the form of transport, effectively break through the blood-brain barrier <sup>[2]</sup>.
- (2) Human cytokines and BBB endothelial cell receptors fusion, easy to affect the central nervous system, and then secrete a large number of inflammatory factors.
- (3) In the human CNS, when the vagus nerve and afferent nerve are affected by surrounding immune factors, they are easy to activate the central inflammatory pathway. The microglia of the central nervous system can effectively recognize signals and transmit them through stimulant mediators, which have an effect on astrocytes and bring about a more serious second reaction.

### **2.2. Central inflammation and POCD**

The key influencing factors of POCD after surgery include neuroinflammation, microglial cell activation, etc. Central inflammation is usually indirectly caused by glial cell activity, so inflammation can be appropriately regulated by regulating glial cell activity <sup>[3]</sup>. In the composition of human nerve cells, microglia and astrocytes are usually included, and astrocytes occupy the majority and play an important role, while microglia belong to the immune cells of the central nervous system, and their lineage is similar to that of surrounding macrophages. Through the activation of microglia, many cytokines can be produced, and then a large number of inflammatory factors appear in the field of the central nervous system, such as TNF- $\alpha$ , IL-6, etc. Through the excessive release of pro-inflammatory factors, the phosphorylation of tau protein can be accelerated, and amyloid protein accumulation can be caused <sup>[4]</sup>. In addition, if the microglia in the human body are over-activated, the release of neurotoxins will increase significantly, thus changing the mode of neurotransmitter transmission and affecting the plasticity of synapses, resulting in postoperative cognitive dysfunction. The excessive activation of microglia in the hippocampus of the brain leads to high levels of IL-1 and inflammatory mediators, which will destroy learning and memory. Older brains, with an increase in microglia, exhibit inflammatory features, synaptic plasticity, and cognitive deficits <sup>[5]</sup>. With the increase of human age, the activation of microglia is easy to causes the intensification of the role of stressors, which further affects central nervous inflammation and has adverse effects on the cognitive function of the human body.

Through the clinical trial activities carried out on the animal model and the analysis of the test data, it is not difficult to find that there is a relationship between the activation of the immune system and the cognitive ability of the animals after the operation, and the operation is easy to cause hippocampal-dependent memory impairment

and promote the increase of plasma cytokines<sup>[6]</sup>. Some medical studies have found that the lipopolysaccharides (LPS) in mice can induce the brain of mice, resulting in an increase in microglia in the brain, cell morphology will also change, showing obvious activation form, bringing more serious neuroinflammatory response. Among them, the out-of-control phenomenon of inflammation will cause cognitive decline in mice, and then bring a series of complications. Neuroinflammation induced by microglia activation caused by surgical trauma is accompanied by cognitive dysfunction, and the pro-inflammatory factors in glia are dependent, which can easily induce hippocampal inflammation<sup>[7]</sup>. Studies have shown that surgical injury can easily lead to hippocampal-dependent cognitive impairment. There is a correlation between hippocampal interleukin and cognitive function in the brain of mice, that is, increased expression of interleukin and decreased cognitive function. IL-6 can activate NF- $\kappa$ B signal, causing neuroinflammation in elderly mice, and thus forming postoperative cognitive dysfunction. Some clinical studies have shown a link between peripheral inflammatory markers and POCD, including an association between inflammatory cytokines and neurocognitive decline in patients undergoing surgery<sup>[8]</sup>. Hudetz found that postoperative peripheral serum IL-6 was closely associated with elevated CRP levels. After the above research and discussion, it can be found that surgery can activate the homeostasis response, effectively release inflammatory mediators, cause an inflammatory cascade reaction, and finally cause POCD.

### **3. The possible mechanism of central inflammation in postoperative cognitive dysfunction**

Through research activities, Kiecolt-Glaser found that in animal and clinical experiments, postoperative cognitive dysfunction is closely related to central nervous inflammation, in which the expression of inflammatory factors is up-regulated and the release is increased, such as IL-1 $\beta$ , IL-6 and so on. Due to the excessive release of pro-inflammatory factors, the tau protein phosphorylation problem is brought about, resulting in excessive activation of microglia<sup>[9]</sup>. Among them, the play of neurotoxic substances can bring about the transformation of neurotransmitter transmission, affect the plasticity of synapses, and then lead to postoperative cognitive dysfunction in patients. At the same time, there is a decrease in anti-inflammatory substances in the body, which causes inflammatory factors in the brain, leading to cognitive impairment<sup>[10]</sup>. This study focuses on the activation of microglia and analyzes the role of central inflammation in POCD.

In the central system of the human body, microglia are mononuclear phagocytes, which belong to the first line of defense of the human brain. They can play a neuroprotective role, make the brain free from the influence of external factors, effectively reduce the damage caused by pathogens, clean up the cell debris, truly protect the stability of the human brain, and play a leading role in the inflammatory response. Microglia can be divided into two forms, which are resting and activated. Under normal conditions, microglia are in a resting state, and only after being stimulated by exogenous antigens, they will be rapidly activated, gradually form small cells, slender branch pseudopodia appearance transformation, forming amoeba shape, effectively play its phagocytic role, and eliminate the possible existence of neurotoxins in the human body, cell debris, which results in better protection<sup>[11]</sup>. In this regard, in the course of specific experiments, the average volume of microglia can be understood according to the overall volume, and the activated number of microglia can be effectively judged. According to the previous literature, taking mice as experimental objects, it can be found that the operation tends to cause a significant increase in microglia activation in young mice within a week after the operation, and it is easy to bring about inflammation in the hippocampus, resulting in a decrease in the cognitive function of the mice. After a week, all

indexes of the mice gradually returned to normal, according to the experimental results. It can be concluded that the operation brought about the activation of microglia, and then caused the decline of cognitive function in mice <sup>[12]</sup>. Through the study of elderly mice, it was found that aging will promote the increase of microglia activation, and its characteristics have a high similarity with chronic degenerative diseases. Combined with the condition of healthy old mice, the activation of microglia appeared in the body, which mainly showed a significant increase in MHC-ii. From the perspective of the surgical model of elderly mice, the activation of microglia in the hippocampus is usually maintained for more than two weeks, and the increase in the activation ratio leads to the reduction of memory in mice <sup>[13]</sup>. Based on this, it is reasonable to infer that microglia activity is the key factor causing POCD problems. According to the results of the study, it can be found that the emergence of peripheral inflammation, will affect the central nervous system, from the human level, the path of activation of microglia includes the following:

- (1) The human internal and external neuroinflammation will release a large number of inflammatory factors, and then stimulate the liver, and with the vagus nerve transmission, bring serious inflammation;
- (2) Increased permeability of the blood and cerebrospinal fluid barriers in the human body can transmit peripheral inflammatory factors into the central nervous system <sup>[14]</sup>;
- (3) In the internal and external inflammatory factors of the human body, they can play the role of the barrier carrier of blood and cerebrospinal fluid, and use their dependence to achieve protein transport and smooth integration into the central nervous system;
- (4) The blood circulation in the human body will bring inflammatory factors to bind to the barrier of blood and cerebrospinal fluid, fuse endothelial cells, and make immune molecules enter the brain <sup>[15]</sup>.

Under the pathway, which cannot be found, the human central system's neuroimmunity is usually transmitted by the vagus nerve. Under the third path, the brain in the human body contains an increase in inflammatory factors, the main reason refers to peripheral circulation stimulation, easy to drive behavior change. But no matter what path, the result is the inflammatory response of the central nervous system, and the activation of microglia can release inflammatory factors and strengthen the connection with the brain, leading to neurodegenerative diseases in patients.

## 4. Conclusion

To sum up, in the context of the current era, although the mechanism of action of POCD has not been clearly defined, experimental studies by many scholars have proposed that central inflammation is the main cause of POCD. Starting from the pathogenesis of POCD, the key influence of central inflammation cannot be found. In this regard, a series of measures should be taken to inhibit central inflammation in the human body. Continuously improve the medical effect, to avoid affecting the postoperative cognitive ability of patients. In the current medical field, a series of studies have been carried out on POCD, but the exact mechanism has not been clarified, so it is necessary to carry out in-depth research. By carrying out a series of treatments of central inflammation, good results can be achieved, and the prevention and treatment of POCD can be explored, providing reference for the follow-up to find appropriate treatment methods, and effectively reducing the incidence of POCD.

## Funding

Jiangsu University Student Innovation and Entrepreneurship Project, "Study on the Mechanism of TLR4-mediated Central Inflammation Induced by Glial Cell Activation to POCD" (Project No.: 202313980027Y)

## Disclosure statement

The authors declare no conflict of interest.

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# A Case of Head Posture Control Training Combined with Breathing Training in the Treatment of Dysarthria Brainstem Infarction Patient

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**Abstract:** This paper reports a case of cerebral stem infarction with quadriplegia and complete dependence on daily life. The course of the disease lasted more than 7 months. Frenchay's improved articulation Disorder Assessment Form has been assessed as severe articulation disorder. The patient has significantly improved his speech function and quality of life after systematic head control training, respiratory function training, articulation motor training, and articulation training. In the course of treatment, emphasis was placed on head postural control training and respiratory function training, and emphasis was placed on the strength and coordination training of articulatory organs, and the results were remarkable. After the patient was discharged from the hospital, the follow-up of basic daily life communication was not limited.

**Keywords:** Brainstem infarction; Articulation disorder; Breathing training; Head posture control training

**Online publication:** March 7, 2025

## 1. Introduction

With the development of population aging, stroke has become the first cause of death and disability of adult residents in China<sup>[1]</sup>. Dysarthria is one of the common complications after stroke. Its main manifestations include complete inability to speak, abnormal articulation, and slurred speech<sup>[2,3]</sup>. As it seriously affects the expression ability of patients, rehabilitation treatment of dysarthria is of great importance to the improvement of patients' subsequent daily living ability and quality of life.

## 2. Case data

### 2.1. General information

The patient was a 63-year-old male. He was admitted to hospital for "poor movement of limbs with speech

disorder for more than 7 months.” History of present disease: On April 28, 2023, the patient suddenly suffered from impaired speech with impaired movement of limbs, and was sent to other hospitals for brain stem infarction shown by head MRI. At the same time, the patient developed shallow and slow breathing and was treated with tracheotomy, thrombolysis, circulation improvement, phlegm reduction, electrolyte disturbance correction, etc. After his condition improved, the patient received rehabilitation treatment in several hospitals. Now, the patient still has impaired movement of limbs with impaired speech. For further diagnosis and treatment, the patient was admitted to the hospital. Since the onset of the disease, the patient has had poor spirit, poor sleep, normal appetite, normal stool, normal urine, and no significant change in weight. She was healthy in the past and had a history of open reduction and internal fixation for femoral fracture 15 years ago. Physical examination: conscious, weak breathing, unable to sound, quadriplegia, increased muscle tone in all extremities, bilateral Pap sign (+). Auxiliary examination: Head MRI on May 7, 2023, showed cerebral stem infarction. Preliminary diagnosis: sequelae of cerebral infarction, quadriplegia, dysarthria.

## 2.2. Rehabilitation assessment and treatment

For patients with normal consciousness, the result of aphasia screening and Loeston cognitive ability assessment and the modified Frenchay dysarthria assessment (FDA) is as follows <sup>[4]</sup>:

- (1) The evaluation content is divided into 8 items, including reflexes, breathing, lip movement, jaw position, soft palate movement, laryngeal movement, tongue movement, and speech intelligibility (29 items in total).
- (2) The evaluation results are divided into five levels: A, B, C, D, and E, with A indicating no abnormality and E indicating serious functional impairment <sup>[5]</sup>. For the convenience of statistics, Grade A corresponds to 5 points, Grade B corresponds to 4 points, Grade C corresponds to 3 points, Grade D corresponds to 2 points, and Grade E corresponds to 1 point. The evaluation results of admission and delivery of this patient are shown in **Figure 1**.
- (3) Evaluation of maximum phonation time (MPT): The patient is asked to pronounce “ah” as long as possible after deep inhalation and record the time, requiring proper volume and even breath, which can reflect the longest pronunciation level of the patient <sup>[6]</sup>. The evaluation result of the patient’s admission was 0 seconds.
- (4) Maximum counting ability (MCA) assessment: Patients were asked to count “1” as many times as possible after deep inspiration, requiring uniform speech speed and symmetrical changes in tone and volume, which can reflect the coordination between vocalization and breathing <sup>[7]</sup>. The evaluation result of the patient’s admission was 0 seconds. Berg’s balance function score was 0, and the head maintained a neutral position for 10 minutes, accompanied by frequent involuntary nodding movements.
- (5) Problems with speech rehabilitation: Dysarthria (voicelessness), poor head postural control, quadriplegia, complete dependence on daily living.

## 2.3. Rehabilitation goals

Specific treatment measures include the following:

- (1) Head postural control training  
Anti-resistance extension, flexion, rotation and lateral flexion of the neck under the sitting position.  
Neutral head position training includes blow paper training under different rotation angles of the cervical

vertebra under a sitting position.

(2) Respiratory function training

- (a) Abdominal breathing establishment: Give appropriate resistance to the abdomen under the seated position, ask the patient to inhale deeply, make the abdomen rise as much as possible, hold the breath for 3 seconds after the end of the inhalation, and then exhale slowly as possible, the ratio of inhaling and exhaling time is 1:2, and put pressure on the abdomen at the end of the exhalation phase to promote the reduction of residual volume <sup>[8]</sup>;
- (b) Chest breathing training: The upper limbs and head were passively moved to relax the muscles related to breathing, the thorax was restrained with a wide restraint band, and the patient was asked to inhale and resist the enlargement of the thorax through the restraint band;
- (c) Paper blowing training: Ask the patient to inhale deeply through the nose and then blow the paper through the mouth to extend the floating time of the paper as long as possible;
- (d) Breath-holding training: The longest exhalation time training.

(3) Articulation organ movement training

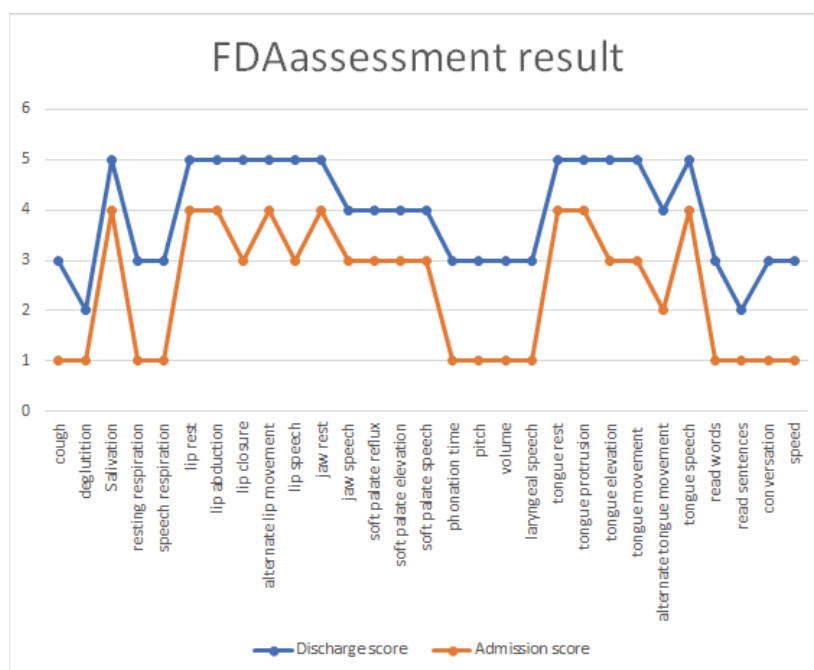
- (a) Lip movement: Pout, grin, lips, cheek.
  - (b) Tongue movement: Tongue resistance to forward extension, resistance to swinging from side to side, resistance to up and down movement, flicking tongue movement.
  - (c) After deep inspiration, make “a” sound, observe the soft palate lift up, give real-time feedback to the patient about the soft palate movement, and pay attention to correct the nasal sound during the process.
- (4) Voice training: As long as possible pronounce the “a” sound, repeat the “ba, ta, la, click” sound, and count training.
- (5) Articulation similar movement training and rehearsal training

Teaching patients the articulation similar movement of consonants, mainly in the form of therapist demonstration, patient observation and imitation; Ask the patient to breathe deeply and repeat the monosyllabic word, at the same time in the patient’s voice, apply appropriate pressure in the patient’s abdomen to increase the hypoglottic pressure, promote vocal cord vibration, and then gradually reduce the assistance until the removal of the retelling content from vowel, bilabial sound, gradually transition to complex pronunciation, and then transition to double syllable overlapping words, double syllable general words, polysyllabic words <sup>[9]</sup>.

- (6) Teach the patient’s family members to carry out simple articulation organ movement training, head posture control training, breathing training, and continuous rehabilitation treatment.

### 3. Treatment results

Discharge evaluation: FDA evaluation results are shown in **Figure 1**, MPT evaluation results are 4 seconds, MCA evaluation results are 4 seconds, and the neutral head position time is 30 minutes.



**Figure 1.** FDA evaluation results.

## 4. Discussion

After treatment, the patient's speech function was significantly improved compared with the admission, and FDA, MPT and MCA were significantly improved. In the course of the treatment of this patient, emphasis was placed on head postural control training and respiratory function training.

The respiratory system includes the lungs, diaphragm, trachea, ribs and respiratory muscles. Breathing is the dynamic basis of pronunciation and can regulate loudness, prosody, stress and the special tones in Chinese. Only with good coordination of respiratory muscles can the subglottic pressure be controlled in an appropriate range to complete the speech process and ensure the articulation of speech <sup>[10]</sup>. In the treatment of this patient, the emphasis was placed on the training of respiratory function, emphasizing the dominant role of the diaphragm in the breathing movement, and holding the breath after inspiration to create sufficient conditions for lung ventilation and improve the patient's physical strength. The completion of a long sentence requires about 12–16 seconds of respiratory maintenance <sup>[11]</sup>. During breathing training, attention is paid to the extension of the expiratory phase, which is an active control process that requires the participation of the expiratory muscle. After a period of training, patients can significantly increase MPT. Abdominal breathing is important, but efficient speech should be the result of complementary chest and abdominal breathing. Therefore, in the breathing training of patients with dysarthria, it is also necessary to emphasize chest breathing and relax the neck muscle group and upper limb before chest breathing to improve thoracic compliance. For patients with dysarthria, simple breathing training is far from enough, the speech must be well coordinated between the relationship between vocalization and pronunciation, so the breathing training should be carried out at the same time as the movement of the articulation organ training. The range of motion of the articulation organs of the patient has no issue, but the coordination and strength are insufficient, so the emphasis is on the strength and coordination training of the articulation organs, and the articulation similar movement training, which requires the coordination and cooperation between the articulation

organs to complete. Articulation training is a comprehensive training method that integrates the movement of respiration and articulation organs. When making the “l” sound, the vocal cords are required to be closed well and there is enough airflow to impact the vocal cords to ensure the loudness of the sound. When the vocal cords are stopped, the tension of the vocal cords is reduced. If the patient can coordinate breathing and pronunciation, the speed of “l” can be uniform <sup>[12]</sup>. After treatment, the MCA value of the patient increased, indicating that the coordination of voice and breath was improved.

The lesion was located in the brain stem, resulting in poor head postural control. The neutral head position was only maintained for 30 seconds on admission with involuntary nodding. Therefore, targeted head postural control training was adopted. First of all, the active and passive movements of the head in all directions were carried out, and then the patient was asked to turn the head to blow paper through the comprehensive training method. The process can be divided into head movement training, separate breathing training and air pumping training. Better head posture control and movement coordination are the basis for the completion of this movement. Patients can improve their breathing control ability through deep nasal inhalation and oral exhalation. Oral blowing is the premise of clear pronunciation of aspirated sounds <sup>[13]</sup>. When the head posture remains stable, the internal laryngeal muscle may be well in a state of contraction or relaxation, and the vocal cords can have the tension that should be produced when sounding. Limb muscle tension can affect the tension of the throat muscles <sup>[12]</sup>. It can be seen that the stability of head posture is an important guarantee of speech quality.

Studies have confirmed that the treatment of dysarthria patients must accumulate enough amount of treatment <sup>[14]</sup>, prolong the treatment time, or increase the frequency of treatment, to show satisfactory therapeutic effect. Given this, the family members of patients are taught to carry out simple speech rehabilitation therapy and carry out continuous rehabilitation therapy after treatment. Mackenzie C *et al.* also confirmed that the continuous rehabilitation treatment of family members or companions can improve the rehabilitation effect of patients with dysarthria <sup>[15]</sup>.

With the rapid development of modern rehabilitation technology, most patients with dysarthria can recover their daily communication ability after systematic rehabilitation treatment, and their quality of life will be greatly improved. At present, the treatment methods for dysarthria include behavioral therapy, physical therapy, traditional Chinese medicine therapy, music therapy, psychotherapy and rehabilitation education. The therapeutic effect of a single method is often limited, and a comprehensive treatment method should be adopted. In this case, head control training and breathing training are emphasized in the treatment of dysarthria. As this is merely a case report, the effectiveness of the treatment needs further study.

## **Funding**

Teaching and Research Project of Anhui Urban Management Vocational College (Project No.: 2024kfk001)

## **Author contribution**

Jingyi Li – Data collection, manuscript writing

Chen Kai – Manuscript review, guidance

## **Disclosure statement**

The authors declare no conflict of interest.



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# A Study on the Impact of Filial Piety Values of Caregivers of Patients with Chronic Heart Failure on Their Caregiving Burden

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**Abstract:** *Objective:* To analyze the burden of caregivers of CHF patients in the current environment, to explore the related burden and influencing factors of caring for patients with chronic heart failure, and to explore the impact of filial piety values on the burden of caring for patients. *Methods:* 192 caregivers of CHF patients in the hospital were selected as the main objects of this study. The main method was convenient sampling. Through a questionnaire survey of 192 CHF patients' caregivers, a unified investigation was conducted from the aspects of patient's general condition, objective burden, anxiety and depression degree and relationship quality, etc. The structural equation model was constructed and adjusted by analyzing data entry and variable correlation. Finally, path analysis was used to conduct inferential research on the direct and indirect influencing factors of control burden. *Results:* More than half of the patients' caregivers had a caregiving burden, and the practical caregiving dimension had the highest score. The total effect values of patient-related factors, including anxiety degree, number of concomitant diseases and half-year readmission rate, were 0.36, 0.31 and 0.20, respectively ( $P < 0.05$ ). The total effect values of filial piety, anxiety degree, average care time and understanding degree of disease directly derived from the caregivers themselves were -0.38, 0.29, 0.29 and -0.23, respectively ( $P < 0.05$ ). In addition, the influence of filial piety values on the caregiver burden was more obvious, and the direct effect value of the value was -0.41 ( $P < 0.001$ ). *Conclusion:* Most caregivers of CHF patients have a certain objective burden of care, and there are many factors that affect it, among which the degree of filial piety value is the most important. This finding provides a clear goal for caregivers to develop measures to improve the caregiver burden.

**Keywords:** Chronic heart failure; Values of filial piety; Caring burden; Influencing factors

**Online publication:** March 10, 2025

## 1. Introduction

Some elderly people and people with coronary heart disease and heart problems are vulnerable to disease intrusion, and a group of clinical syndromes caused by organic or functional heart diseases affecting ventricular

filling and ejection ability is heart failure. The symptoms of this disease are also the final form of most cardiovascular diseases, which pose a strong threat to the life and health of the affected people. Once the occurrence of heart failure will fall into the irreversible disease response, which is also the main cause of death of patients <sup>[1]</sup>. Therefore, the care process for patients with chronic heart failure (CHF) is very important. Generally speaking, patients need to be given long-term and continuous care, which is easy to increase the burden of psychological and socioeconomic aspects of the caregiver. On the contrary, a caregiver who is in a state of stress and anxiety for a long time will have a much higher mortality rate than a caregiver who does not have the burden of care, and the quality of all aspects of their life will be significantly reduced <sup>[2]</sup>. In addition, with the development and influence of the value of filial piety in recent years, the influence of this concept on caregivers of patients with chronic heart failure has become increasingly strong. On the one hand, the value of filial piety has made requirements for children and has made more and more detailed provisions in the aspect of supporting parents and regulating the attitude of children. On the other hand, the value of filial piety can also play a regulating role <sup>[3]</sup>. It can influence the burden of caregivers directly or indirectly, to positively regulate the willingness of caregivers, which has a good guiding role in reducing the psychological burden of caregivers and ensuring the follow-up maintenance status of patients.

## **2. General information selection**

### **2.1. General data selection**

In this study, 192 caregivers of CHF patients admitted to hospitals were selected as the main objects of this study by convenient sampling method. Among the 192 CHF patients, nearly 73% of the caregivers lived with the patients, and the average caring time was 11 hours per day, and the proportion of men and women was the same. The spouse relationship of the main caregivers accounted for 41.1%, and the child relationship accounted for 52.6%. Meanwhile, 46.9% of the caregivers were optimistic about the patient's disease. Only 2.6% of the caregivers were not familiar with the patient's disease.

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

Inclusion criteria: (1) All patients' clinical manifestation records and medical records must be complete, which is convenient for later analysis and accurate report data; (2) Informed consent must be signed by the patient and the caregiver in person, agreeing to participate in the study and accept related examinations and treatments; (3) Caregivers of confirmed patients whose clinical symptoms meet the diagnostic criteria for heart failure; (4) The average weekly care time was more than 8 hours per week. Exclusion criteria: (1) patients with serious complications; (2) patients with missing clinical data; (3) patients with vital organ lesions.

## **3. Methods**

### **3.1. Research indicators and tools**

The general situation questionnaire, Chinese version of Filial Values Index (FVI) scale and objective burden scale for caregivers of chronic heart failure patients were adopted by this research group.

### **3.2. Data analysis**

(1) Descriptive statistics was used to analyze the demographic data, filial piety scores and caregiver burden of

CHF patients and their caregivers. The measurement data were represented by mean  $\pm$  standard deviation (SD), the number of cases and percentage of measurement data, and the median M (interquartile interval P25, P75) for non-normal distribution. Descriptive statistics were carried out.

- (2) Univariate analysis: Pearson/Spearman correlation coefficient was used to analyze the correlation between variables, filial piety values, relationship quality, anxiety and depression scores and DOBI scores in patients and caregivers.
- (3) AMOS 22.0 was used to build and debug the structural equation model. Based on the literature review and Pearson/Spearman correlation coefficient analysis results, the initial path analysis model was built and debuted with the univariate observation variables correlated with the burden of care ( $P < 0.05$ ).
- (4) Inferential statistical analysis was performed on the direct and indirect influencing factors of caregiver burden. The results include a standardized path model graph and effect value, the number between the foreign and foreign dependent variables in the path model graph is the product difference correlation coefficient between the two variables, and the number on the single arrow symbol is the path coefficient of the external variable and the internal dependent variable (standardized regression coefficient), the path coefficient is positive, indicating that the influence of the internal variable is positive, and the reverse is negative. If the absolute value of the correlation coefficient is greater than 1, it indicates that the model has unreasonable parameters. The single arrow path coefficient is also a direct effect value, the standardized direct effect value is the size of the influence of external variables directly on internal variables, the standardized indirect effect value is equal to the multiplication of path coefficients, the standardized total effect value is equal to the sum of the standardized direct effect value and the standardized indirect effect value, the greater the absolute value of the standardized effect value, the greater the influence of external variables on internal variables.
- (5) The fitting indicators of path analysis model include <sup>[4]</sup>: absolute fitting statistic Chi-square degree of freedom ratio (CMIN/DF), asymptotic residual Mean Square Error of Approximation (RMSEA); Incremental Fit statistical gauge Normed Fit Index (NFI), Incremental Fit Index (IFI), Tacker-Lewis Index, TLI) and Comparative Fit Index (CFI); The reduced fit statistic Akaike Information Criteria (AIC), the Expected Cross-Validation Index (EVCI) and the minimum difference value function (FMIN). Test level: bilateral  $\alpha < 0.05$ , with statistical significance.

## 4. Observation index

### 4.1.1 Statistical analysis

In this study, SPSS 18.0 software was used to establish a database and carry out statistical analysis.

## 4.2. Results

### 4.2.1. Status quo of caregivers' caregiving burden

The total caregiver burden score of this study was ( $10.97 \pm 13.78$ ), and the detailed types of burdens are shown in Table 1.

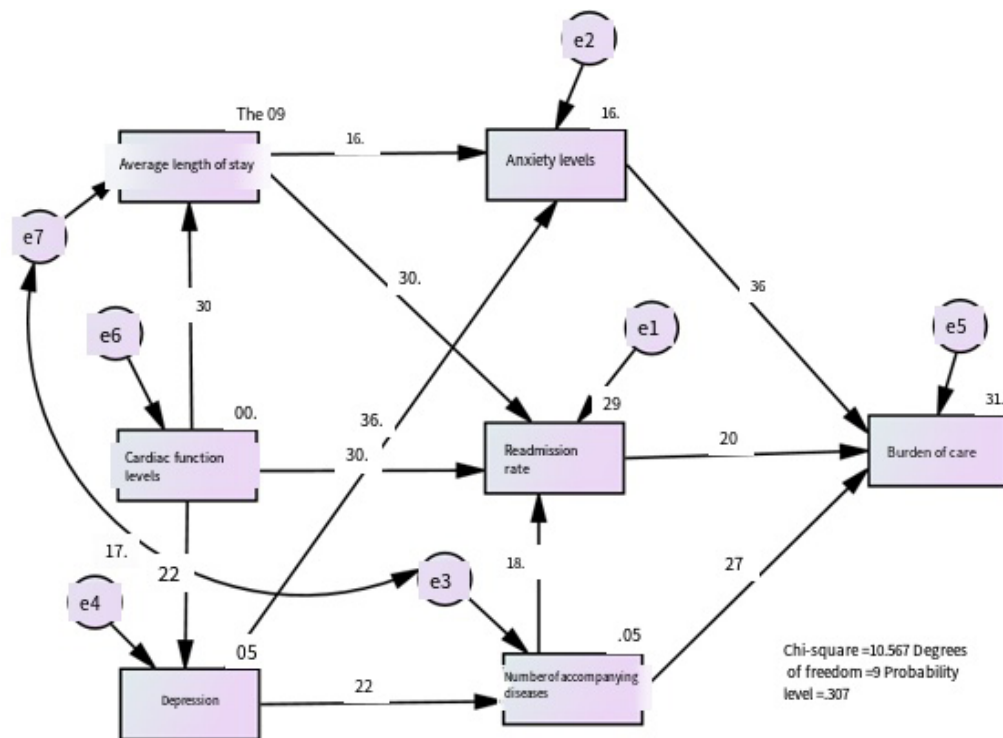
**Table 1.** Scores of each dimension of the caregiver burden

Item	Mean $\pm$ SD	M (P25,P75)
Total burden	10.97 $\pm$ 13.78	4 (0, 18.75)
Personal care dimension	3.19 $\pm$ 4.27	1 (0,6)
Practical care dimension	3.30 $\pm$ 4.13	1 (0,6)
Incentive support dimension	2.73 $\pm$ 3.83	0 (0,6)
Affective support dimension	1.84 $\pm$ 2.49	0 (0,4)

#### 4.2.2. Influencing factors of caregiving burden

##### (1) The influence of CHF patients on caring burden

The standardized path coefficients all reached significant levels ( $P < 0.05$ ), as shown in **Figure 1**. The level of cardiac function, depression and anxiety had indirect effects on the burden of care, and the indirect effect values were 0.14, 0.20 and 0.36, respectively, as shown in **Table 2**. The structural equation model showed good fit indicators. The values of preset models such as AIC/BCC/EVCI are smaller than those of independent models, and the specific evaluation indicators are shown in **Table 5**.



**Figure 1.** Structural equation model of CHF patient side influencing factors on caregiving burden.

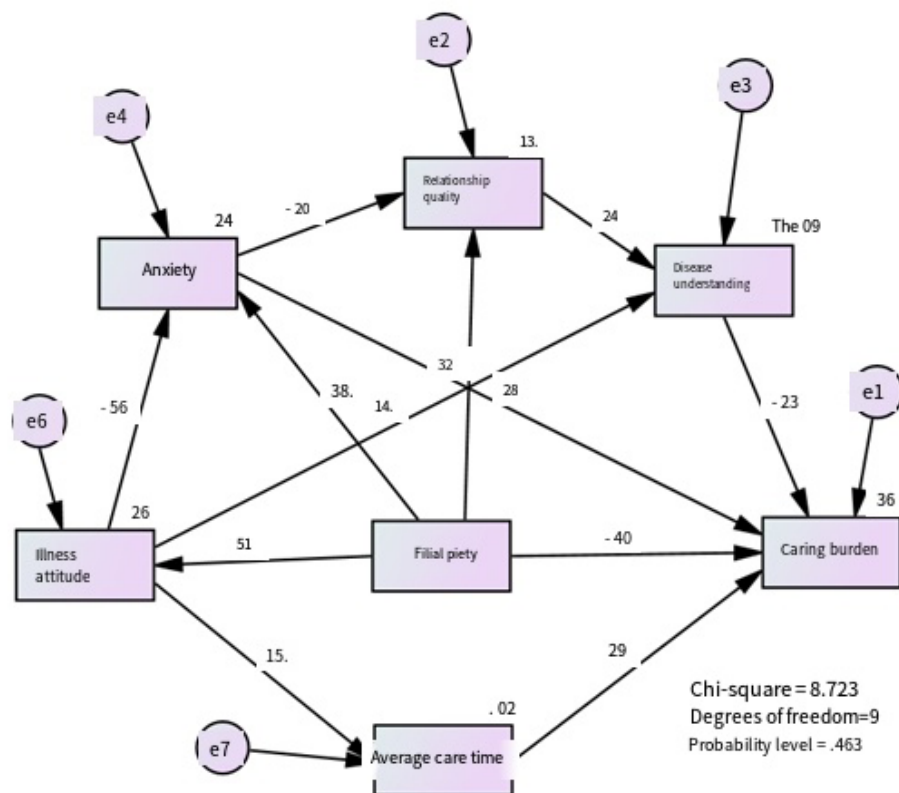


**Table 2.** Influence of patient-side variables on caregiving burden

Observed variable	Caring burden		
	Direct effect	Indirect effect	Total effect
Cardiac function level	0	0.14	0.14
Depressed	0	0.20	0.20
Mean length of stay	0	0.12	0.12
Number of accompanying diseases	0.27	0.04	0.31
Half-year readmission rate	0.2	0	0.20
Anxiety level	0.36	0	0.36

(2) The influence of caregivers on the burden of care

The final model and path coefficient were obtained through continuous modification of the revised index, parameter test and other models, and the relevant standardized path coefficient ( $P < 0.05$ ) is shown in **Figure 2**. The value of filial piety had the greatest impact on the caregiver burden of CHF patients and was correlated with other influencing factors (**Table 3**).



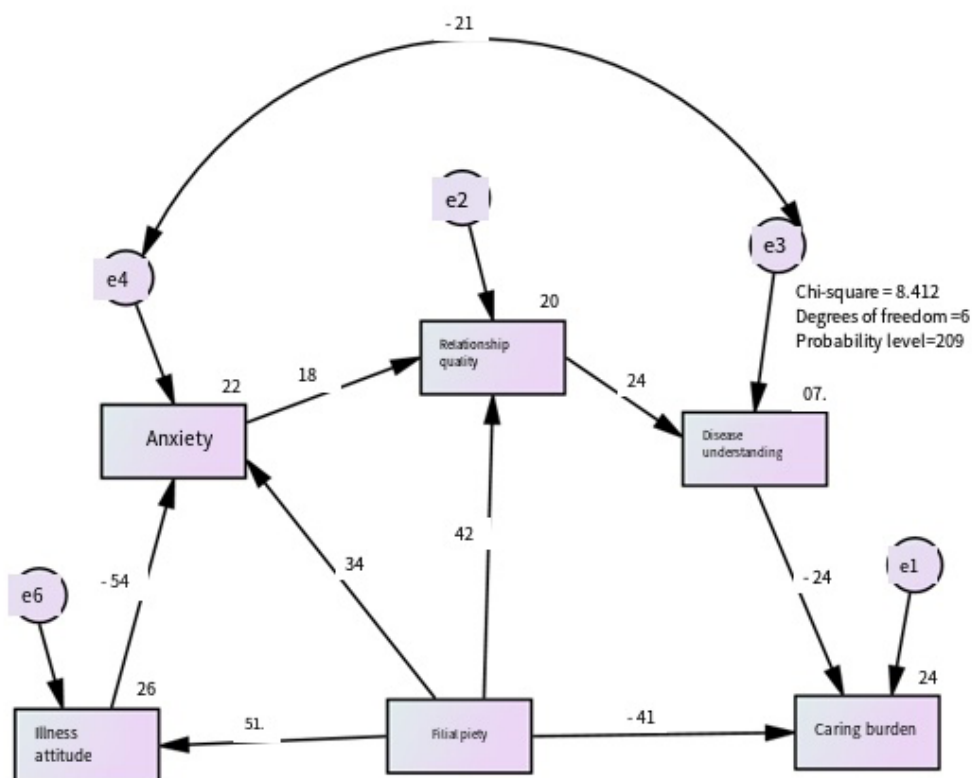
**Figure 2.** Structural equation model of influencing factors on caregiver burden from a caregiver perspective.

**Table 3.** Influence of caregiver variables on caregiving burden

Observed variable	Caring burden		
	Direct effect	Indirect effect	Total effect
Filial piety	-0.40	0.02	-0.38
Attitude to illness	0	-0.15	-0.15
Anxiety	0.28	0.01	0.29
Relationship quality	0	-0.06	-0.06
Average care time	0.29	0	0.29
Disease understanding	-0.23	0	-0.23

### 4.3. Influence of filial values on the caregiving burden of children

Through testing and revising the index, the relevant data of child caregivers are improved, and the relevant model and path coefficient of corresponding influencing factors are obtained. The final results show that the structural equation model has a good fit index, and the corresponding standardized path coefficient ( $P < 0.05$ ) is shown in **Figure 3**. However, the influence of filial piety on caregivers' caring burden is still the main one, as shown in **Table 4**.



**Figure 3.** Structural equation model of the influence factors of filial piety values on caregivers' caring burden.

**Table 4.** Influence of filial piety values on caregiving burden

Observed variable	Caring burden		
	Direct effect	Indirect effect	Total effect
Total score of filial piety	-0.41	-0.02	-0.43
Attitude to illness	0	-0.01	-0.01
Anxiety	0	0.01	0.01
Relationship quality	0	-0.06	-0.06
Disease understanding	-0.24	0	-0.24

**Table 5.** Structural equation model fit indicators

Evaluation index	Patients	Caregiver	Child caregiver
CMIN/DF	1.174	0.969	1.402
TLI	0.974	1.005	0.945
CFI	0.992	1.000	0.978
FMIN	0.055	0.046	0.084
RMSEA	0.030	< 0.001	0.063

## 5. Discussion

Through this study, it can be seen that the main group prone to chronic heart failure is the elderly with a long course of disease, and some groups with poor heart function are also prone to such diseases. Meanwhile, most of these patients will be admitted to the hospital for the second time after half a year's recovery period, sometimes accompanied by other diseases, which indicates that patients' self-care ability is weak. To some extent, caregivers must follow up with family nursing for a long time and accompany patients after admission, which is also the main source of objective care burden faced by caregivers <sup>[5]</sup>. The research results show that more than half of the caregivers have different degrees of care burden, and most of the caregivers' stress levels are concentrated in the medium and low levels. When analyzing the score of the objective burden dimension of caregivers, the score of the basic care burden dimension such as objective care and personal care is relatively high. Indicating that the caregiver can complete the behavior in taking care of the patient's daily life and housework activities, but the frequency of the fact may vary according to different personal circumstances <sup>[6]</sup>. In terms of compliance with doctor's orders and health promotion behaviors, caregivers showed a heavier burden, with the incentive support dimension accounting for one-third of the total burden. This situation may be related to patients' treatment cooperation, and their treatment compliance is closely related to compliance with doctor's orders and other aspects requiring patients' cooperation, which can easily lead to increased burden of caregivers. In addition, the high scores of the values of filial piety of the caregivers in this study indicate that they have a good understanding of filial piety and the implementation of the obligation to support their parents, which may be related to the traditional virtue of "filial piety first" in the country <sup>[7]</sup>.

By screening the factors associated with the caregiving burden and combining the theory of literature review, this study generated an initial model of the relevant factors affecting caregivers and determined the final structural equation of the influencing factors of caregiving burden through index modification, parameter testing

and structural adjustment. The results showed that the value of filial piety was a direct factor influencing caregiver burden in CHF patients, and had the most obvious effect compared with other factors (direct effect -0.4). At the same time, the value of filial piety could also mediate the degree of caregiver anxiety, the attitude toward the disease and the quality of the relationship with the patient and indirectly regulate the caregiver burden, which was the most important factor influencing the caregiver burden <sup>[8]</sup>. The higher the filial piety score, the lower the caregiver burden. This result is the same as the results of many domestic and foreign studies, which further verifies the importance of filial piety values in the caregiver burden. Caregivers with a high filial piety score will have a higher sense of responsibility when carrying out nursing work, they will be more clear about their moral obligations, they will be willing to undertake the obligation of caring for patients in an all-round way, and they will be better able to cope with various challenges encountered in the care process <sup>[9]</sup>. In addition, the value of filial piety can further reduce the burden through indirect ways such as improving the caregiver's psychological state, adjusting the attitude toward the disease and improving the quality of the relationship with the patient. Those with high filial piety adopt positive psychological adjustment to reduce anxiety, enhance family cohesion, and form a supportive care environment <sup>[10]</sup>. Although most current studies focus on the direct effect, the indirect influence mechanism of different dimensions of filial piety, such as respect, obedience and support, is worthy of further exploration. Future studies should refine these dimensions to fully reveal the complex role of filial piety values on caregiver burden to provide a scientific basis for formulating targeted intervention measures to reduce caregiver burden <sup>[11]</sup>.

In addition to the values of filial piety, the influencing factors of the caregiver burden of CHF patients also include the influencing factors of the patient and the caregiver. Among them are the patient's anxiety level, the number of accompanying diseases, and the readmissions in six months, etc. The patient's mood, complications, and readmission rate are easy to generate emotional and financial pressure for the caregivers, thus increasing the caregiver's burden <sup>[12]</sup>. In terms of caregivers, factors such as the degree of anxiety, the degree of understanding of the disease and the average time of care will also have a direct impact on the caregiver burden. Caregivers' anxiety will further aggravate their burden, and their understanding of patients' disease development is also related to their ability to provide more accurate and perfect care and support. Although the average caregiving time was not a direct factor affecting the caregiving burden in this study, longer caregiving time may harm the physical and psychological state of caregivers, thereby indirectly increasing their burden <sup>[13]</sup>. In these cases, medical staff should pay attention to the patient's condition, but also pay attention to the patient's mental state and the caregiver's mental state and disease management ability, and provide necessary support and help to reduce the caregiver's burden.

In the care of patients with chronic heart failure in the future, clinicians can promote the culture of filial piety through publicity and education, community activities, peer support and other ways to improve the social sense of identity and respect for the values of filial piety, so as to stimulate the sense of moral obligation and responsibility of care of caregivers <sup>[14]</sup>. At the same time, it can combine health education, nursing guidance courses, cognitive behavioral therapy, psychological counseling and other ways to improve patients' and caregivers' disease cognition, disease management ability, and strengthen the intervention of patients or caregivers' anxiety, so as to reduce the number of readmissions and the incidence of accompanying diseases, reduce the burden of caregivers <sup>[15]</sup>. At the same time, the health promotion activities of filial piety values can also promote the formation of multi-party cooperation mechanisms including medical institutions, communities and families, and encourage all parties in society to jointly provide a full range of support and services for CHF

patients and their caregivers, forming a joint force to reduce the burden faced by caregivers to the greatest extent, so as to lay the foundation for their follow-up health work <sup>[15]</sup>.

## Disclosure statement

The authors declare no conflict of interest.

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# Prevention and Nursing Experience of Complications in Advanced Lung Cancer

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**Abstract:** *Objective:* To study the measures and effects of advanced lung cancer patients in terms of complication prevention and care. *Methods:* 50 cases of advanced lung cancer patients were selected for data study during January–December 2023, where the patients were divided into two groups. The study group used complication prevention and nursing care, while the control group used conventional care. The differences between the groups were compared. *Results:* Compared with the control group, the study group had significantly fewer complications, significantly lower psychological state scores, significantly higher quality of life scores, and significantly lower pain scores ( $P < 0.05$ ). Comparing the psychological state scores, quality of life scores, and pain scores before care, both groups showed insignificant differences ( $P > 0.05$ ). *Conclusion:* The results of patients with advanced lung cancer are ideal after the application of measures in the area of complication prevention and care.

**Keywords:** Advanced lung cancer; Complications; Prevention; Nursing care

**Online publication:** March 10, 2025

## 1. Introduction

Patients with advanced lung cancer are common in the clinic. Due to its high morbidity, chemotherapy is generally carried out in the process of patient treatment. However, prolonged use of drugs leads to toxic side effects<sup>[1]</sup>, and advanced lung cancer patients are also prone to complications, thereby affecting the therapeutic effect of patients and aggravating pain and discomfort. Hence, it is essential to implement complication prevention and care<sup>[2]</sup>. In this paper, 50 patients were selected to explore the measures and effects of complication prevention and care in advanced lung cancer patients.

## 2. Materials and methods

### 2.1. General information

Fifty cases of advanced lung cancer patients were selected for data study, the selection time was January–December 2023, and the random number table method was divided into two groups, each group of 25 cases. In the study group, there were 15 males and 10 females, aged 54–78 ( $62.66 \pm 3.66$ ) years old, while in the control group, there were 14 males and 11 females, aged 55–77 ( $62.61 \pm 3.61$ ) years old. The result of the comparative data was that there was no statistical significance ( $P > 0.05$ ).

### 2.2. Methods

The control group used conventional nursing care, distributed health manuals for patients, monitored patients' signs, provided conventional health education to patients, channeled patients' negative emotions, and provided nursing guidance for patients' diets and medications in the nursing process. The study group used complication prevention and care, specifically:

#### (1) Nursing care for radiation esophagitis

This disease is prone to occur when patients are treated for 14 days, so nursing staff should instruct patients to rinse their mouths promptly after eating, to avoid long-term retention of food residues in the patient's mouth, and advise patients not to eat oily food. For patients who have developed radiation esophagitis, solutions can be administered orally, including vitamin B, dexamethasone, lidocaine, and gentamicin, to promote successful feeding. Mix 1/3 bag of montelukast and 10 mL of Rehabilitation New Solution, and take it before bedtime and before and after radiotherapy to effectively protect the patient's esophageal mucosa.

#### (2) Nursing care in radiation pneumonitis

Nursing staff should ensure that the temperature of the ward the patient is in is appropriate and the humidity is appropriate, at 20–22°C and 40–60%. Nursing staff should strengthen the management of the environment of the ward where the patient is located, do a good job of disinfection, tell the patient not to stay in the same position for a long time while lying in bed, regularly turn over for the patient to promote effective coughing, help the patient to effectively discharge phlegm.

#### (3) Nursing care for myelosuppression

In the process of radiotherapy and chemotherapy, promote patients to have regular rest, tell patients to eat iron food, take vitamin B4 orally, use drugs such as Diyu Zhenbai tablets, and carry out regular checks on patients' liver and kidney functions as well as blood counts, thereby avoiding the occurrence of such complications in patients.

#### (4) Gastrointestinal reaction care

Nursing staff should take into account the patient's dietary preferences and habits, implement dietary care for the patient, urge the patient to eat light food, and guide the patient to eat more fresh fruits and vegetables, to effectively supplement the patient's body vitamins.

#### (5) Infection care

Nursing staff should strengthen the patient's protection and isolation, control the visitation, use antibiotics according to the doctor's orders, implement deep breathing guidance for patients, and help patients master effective coughing methods, to effectively prevent infection.

#### (6) Other care

For patient care, it is also necessary to give patients to implement health education, focusing on the prevention of complications and care, to promote patients to master the relevant knowledge, strictly comply with the doctor's

orders, cooperate with the care, but also need to give patients to implement the targeted psychological guidance, to promote the patient's bad mood can be significantly improved, and to promote the patient's confidence in the treatment of significantly improved. For patient pain care, timely assess the patient's pain situation, then carry out targeted verbal communication. If the patient has serious pain, follow the doctor's orders for patients to implement analgesic drug therapy, thereby reducing the patient's pain significantly.

### 2.3. Observation indicators

Comparison of complications, psychological state scores (using the Hamilton Anxiety Scale, HAMA, and Hamilton Depression Scale, HAMD), quality of life scores (using the Health Survey Short Form), and pain scores (using the Self-Statement Scale) between the two groups.

### 2.4. Statistical analysis

SPSS 25.0 software was used for statistical analysis, data were expressed as either [*n* (%)] or mean  $\pm$  standard deviation (SD), with either the  $\chi^2$  test or the *t*-test implemented, and  $P < 0.05$  indicating statistically significant differences.

## 3. Results

Compared with the control group, the study group had significantly fewer complications, significantly lower psychological state scores, significantly higher quality of life scores, and significantly lower pain scores ( $P < 0.05$ ) after nursing care. The psychological state scores, quality of life scores, and pain scores of the two groups before nursing care yielded  $P > 0.05$ , showing insignificant differences between the two groups. Details are shown in **Table 1–3**.

**Table 1.** Comparison of complications between the two groups [*n* (%)]

Group	<i>n</i>	Pressure ulcers	Oral ulcers	Venous thrombosis	Gastrointestinal reaction	Total
Study group	25	0	1	0	1	2 (8.00)
Control group	25	1	3	1	4	9 (36.00)
$\chi^2$ value						5.7110
<i>P</i> value						< 0.05

**Table 2.** Comparison of psychological state scores and pain scores (points) between the two groups (mean  $\pm$  SD)

Group	<i>n</i>	HAMA		HAMD		Pain score	
		Before care	After care	Before care	After care	Before care	After care
Study group	25	22.2 $\pm$ 3.2	5.2 $\pm$ 0.6	21.5 $\pm$ 2.4	5.1 $\pm$ 0.5	8.2 $\pm$ 0.7	4.1 $\pm$ 0.2
Control group	25	22.4 $\pm$ 3.3	13.1 $\pm$ 1.2	21.4 $\pm$ 2.5	13.5 $\pm$ 1.2	8.1 $\pm$ 0.8	6.6 $\pm$ 0.9
<i>t</i> value		0.2175	29.4416	0.1443	32.3077	0.4704	13.5582
<i>P</i> value		> 0.05	< 0.05	> 0.05	< 0.05	> 0.05	< 0.05

**Table 3.** Comparison of quality of life scores of the two groups (mean  $\pm$  SD)

Index		Study group ( <i>n</i> = 25)	Control group ( <i>n</i> = 25)	<i>t</i> value	<i>P</i> value
Physiological functions	Before care	22.62 $\pm$ 3.04	22.51 $\pm$ 2.02	0.1507	> 0.05
	After care	33.22 $\pm$ 2.25	29.11 $\pm$ 2.34	6.3304	< 0.05
Physiological responsibilities	Before care	24.44 $\pm$ 2.52	24.35 $\pm$ 3.62	0.1020	> 0.05
	After care	33.85 $\pm$ 2.65	28.11 $\pm$ 4.32	5.6630	< 0.05
Vitality	Before care	24.42 $\pm$ 3.07	24.36 $\pm$ 3.05	0.0693	> 0.05
	After care	33.96 $\pm$ 2.75	27.11 $\pm$ 4.32	6.6881	< 0.05
Social functions	Before care	23.82 $\pm$ 3.33	23.85 $\pm$ 3.32	0.0319	> 0.05
	After care	33.11 $\pm$ 4.15	26.85 $\pm$ 4.61	5.0461	< 0.05
Role functions	Before care	24.92 $\pm$ 3.02	25.05 $\pm$ 2.62	0.1626	> 0.05
	After care	27.12 $\pm$ 2.11	33.44 $\pm$ 3.61	7.5573	< 0.05
Cognitive functioning	Before care	23.12 $\pm$ 3.11	23.68 $\pm$ 2.42	0.7105	> 0.05
	After care	28.66 $\pm$ 4.21	33.52 $\pm$ 3.27	4.5584	< 0.05
Mental health	Before care	22.56 $\pm$ 2.14	22.65 $\pm$ 2.11	0.1497	> 0.05
	After care	27.88 $\pm$ 4.56	33.65 $\pm$ 4.06	4.7252	< 0.05
Total score	Before care	26.88 $\pm$ 2.44	26.82 $\pm$ 3.41	0.0715	> 0.05
	After care	36.32 $\pm$ 5.98	40.26 $\pm$ 2.33	3.0695	< 0.05

## 4. Discussion

Patients with advanced lung cancer need to pay attention to complication prevention and care in nursing<sup>[3,4]</sup>. These complications include pressure ulcers, oral ulcers, venous thrombosis, and gastrointestinal reactions. Clinical analysis has concluded that implementing measures to prevent and care for complications in advanced lung cancer patients is of great significance and has high clinical value<sup>[5]</sup>.

The experiments in this study showed that, compared to the control group, the study group had significantly fewer complications, lower psychological state scores, higher quality of life scores, and lower pain scores ( $P < 0.05$ ). Comparing the psychological state score, quality of life score, and pain score before nursing between the two groups yielded  $P > 0.05$ . Analyzing these results, it was concluded that the measures applied for the prevention and care of complications in patients with advanced lung cancer are highly feasible.

In patient care, all changes in patients' signs are closely observed<sup>[6–12]</sup>, and oral cleaning and care are strengthened to avoid oral ulcers effectively. Patients receive regular limb massages and are instructed on proper body positioning. During the nursing period, the prevention of complications, appropriate care, and other nursing measures such as health education, psychological intervention, and pain care, significantly improve the patient's condition. These measures reduce pain, alleviate negative psychological states, and significantly reduce complications. Overall, these interventions promote the patient's physical and mental health, significantly improving their quality of life<sup>[13–15]</sup>.



## 5. Conclusion

In conclusion, the application of these measures in the prevention of complications and nursing care for patients with advanced lung cancer is highly effective. Patients show significant improvement in complications, psychological state, quality of life, and pain, making these measures worthy of clinical promotion.

## Disclosure statement

The authors declare no conflict of interest.

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**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Work Stressor and Turnover Intentions Among Chinese Obstetrical Nurses

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**Abstract:** This study focuses on the relationship between job stress and intention to leave among obstetric (OB) nurses in the context of China's birth policy adjustment, and provides a scientific basis for policymakers and healthcare administrators. This study used a non-experimental descriptive correlation design with a purposive sampling of 230 OB nurses from three tertiary hospitals in Jinan, Shandong Province. Participants were surveyed using three questionnaires and descriptive analysis; ANOVA and correlation analyses were used to analyze the relationship between participants' stressor levels and turnover intention. Pearson's correlation coefficient analysis showed that there was a positive correlation between nurses' work stressors and turnover intention, with a correlation coefficient of  $r = 0.53$ , a moderate positive correlation ( $P < 0.001$ ). Based on the survey data from three tertiary hospitals in Shandong Province, the obstetric nurses group has a medium level of work stressors, but a high turnover intention, highlighting the professional identity crisis.

**Keywords:** Work stressor; Turnover intentions; Obstetric nurses

**Online publication:** March 6, 2025

## 1. Introduction

Over the past few years, China's healthcare industry, particularly in the field of obstetrics, has undergone significant growth and transformation. With the adjustment of China's population policies, including the universal two-child policy and the more recent three-child policy, the demand for obstetric services has experienced explosive growth<sup>[1]</sup>. The implementation of these policies has not only brought about a baby boom but has also significantly increased the proportion of high-risk pregnant women, leading to a continuous rise in the incidence of maternal and neonatal complications and adverse pregnancy outcomes<sup>[2]</sup>. In the face of this new situation, obstetric nursing work is confronted with unprecedented challenges.

In this wave of changes in fertility policies, obstetric nurses have become the most direct "pressure bearers." They not only have to cope with the increasing workload of nursing care but also bear the significant responsibility of

ensuring the safety of mothers and infants<sup>[3]</sup>. Data shows that with the continuous rise in the birth rates of second and third children, the workload of obstetric nurses has grown exponentially<sup>[4]</sup>. However, in stark contrast to the surge in workload, the number of medical staff has not been correspondingly supplemented, leading to a continuous increase in workload per capita<sup>[3]</sup>. This dilemma of “fewer people and more tasks” keeps obstetric nurses under prolonged high pressure, requiring them not only to complete heavy nursing tasks but also to remain highly vigilant to respond to potential emergencies<sup>[3]</sup>. The impact of this high-pressure work environment is multifaceted.

Firstly, obstetric nurses face both physiological and psychological pressures. Long hours of irregular schedules, high-intensity work rhythms, and the high responsibility for the safety of mothers and infants make them prone to emotional exhaustion and job burnout. Secondly, the disproportionate compensation compared to the work stressor further exacerbates dissatisfaction among the nursing staff<sup>[5]</sup>. International research also confirms this phenomenon; Edmonds (2023) found in the study of nurses that job dissatisfaction is highly correlated with turnover intentions, with understaffing and emotional exhaustion being the main reasons for leaving<sup>[6]</sup>.

In China, this phenomenon is particularly prominent. A survey of nurses in tertiary public hospitals showed that the proportion of turnover intentions among obstetric nurses is significantly higher than in other departments<sup>[7]</sup>. This high turnover intentions not only stems from work stressor but is also closely related to limited career development space and low social recognition<sup>[8]</sup>. It is noteworthy that the departure of obstetric nurses not only leads to the loss of human resources but may also affect the quality and safety of the entire obstetric medical service<sup>[9]</sup>. Faced with this severe situation, it is particularly important to delve into the specific work stressors faced by obstetric nurses and their impact on turnover intentions<sup>[10]</sup>.

This study aims to systematically analyze and identify key factors affecting the occupational stability of obstetric nurses, providing scientific evidence for policymakers and healthcare administrators. By formulating effective intervention measures to improve job satisfaction and retention rates among obstetric nurses not only concerns the career development of the nursing group but is also an important measure to ensure the safety of mothers and infants and maintain the stability of the medical system.

This study fills the gap in research on the relationship between work stressors and turnover intentions, providing a new perspective for improving the occupational health status of obstetric nurses. Future research needs to further explore precise and effective intervention strategies to reduce work stressor among obstetric nurses, lower turnover rates, and ensure the stability and development of this critical team in China's medical system. Only by establishing a comprehensive occupational support system can obstetric nurses protect their career ideals and life values while guarding new lives.

## **2. Materials and methods**

This study utilized a non-experimental descriptive correlational research design to examine the work status of obstetric nurses and their turnover intentions. The purpose of the study was to collect authentic real-world data without any intervention or manipulation of the participants, ensuring that the results reflect the true characteristics of the nurses. In this study, the researcher would like to determine the relationship between work stress and the turnover intention of obstetric nurses.

### **2.1. Population and sample**

This study, based on in-depth knowledge of the working environment of obstetric nurses in three hospitals, used

purposive sampling to select samples according to the study's purpose and research questions. Samples were chosen from the obstetrics wards of these three representative hospitals, considering personal characteristics of nurses like age, work experience, and their roles in the wards. Thorough communication with hospital administrators was done before sampling and nurses were fully informed. While purposive sampling ensures sample diversity and representativeness, it may cause data bias due to subjective judgment, potential omission of variables and groups, and insufficient sample size. The calculated sample size was 230 when the number of nurses in all obstetrics departments of the three hospitals was 570, with a 5% margin of error, 95% confidence level, and 50% response distribution.

## **2.2. Research instrument**

### **2.2.1. Demographic profile questionnaire**

This questionnaire focused on collecting essential background information of nurses, such as age, nursing rank, work experience, and education level. It aimed to comprehensively understand the current situation of obstetric nurses in China, laying a data foundation for further research.

### **2.2.2. Chinese Nurse Work Stressors Scale (CNWSS)**

Based on Grey-Toft *et al.* scales and adapted to the Chinese nursing context with input from international and Chinese experts, this 35-item scale has five dimensions <sup>[11]</sup>. It uses a 1–4 Likert scale, with scores from 35–140 divided into mild, moderate, and severe stress levels. The high reliability (Cronbach's alpha 0.972) and excellent content validity prove its effectiveness in assessing nurse work stress.

### **2.2.3. Turnover Intention Scale**

Translated and revised by Lee from Taiwan, this scale has six questions across three dimensions <sup>[12]</sup>. It assesses an individual's intention to leave work, with an internal consistency coefficient of 0.83. Scored from 4–1, the overall mean indicates turnover intention levels, serving as a reference for research and human resource management.

## **2.3. Data analysis**

The data collected was systematically recorded and analyzed using SPSS statistical methods. To ensure data security, all information was stored on a computer with strict confidentiality measures and used exclusively for this study.

- (1) Descriptive analysis: frequency counts, composition ratios (%) for categorical variables, mean scores (Mean  $\pm$  SD) for data with normal distribution to show concentration trend and standard deviation (sd) to measure data dispersion.
- (2) Analysis of variance (ANOVA): To explore significant differences between groups in terms of stressors and intention to leave, along with t-tests for in-depth comparisons.
- (3) Correlation analysis: Pearson correlation coefficient (*r*) analysis to assess the strength and direction of the linear relationship between job stressors and intention to leave.

## **3. Results**

**Table 1** shows that 230 obstetric nurses showed that the age distribution was concentrated in the 31–40 age range



(50.00%), with a standard deviation of 5.61. Most nurses (97.40%) had college or undergraduate degrees. Among professional titles, around 53.48% held primary titles and 45.65% held medium-grade titles. Work experience was balanced among 2–5 years (22.6%), 5–10 years (39.6%), and  $\geq 10$  years (37.8%). Among them, around 61.74% were married. Regarding employment form, 70.43% were contract nurses, 25.22% were regular staff, and 4.35% were agency - employed. These factors, such as age, education, title, experience, marital status, and employment form, all impact nurses' work, like job stress and turnover intentions.

**Table 1.** General demographic information of 230 obstetrical nurses ( $n = 230$ )

Profiles	Frequency ( $n$ )	Percentage (%)
Age group		
22–30 years old	98	42.60
31–40 years old	115	50.00
41–45 years old	17	7.40
Educational background		
College/Undergraduate	224	97.40
Postgraduate	6	2.60
Professional title		
Primary	123	53.48
Medium-grade	105	45.65
Supervisor nurse	2	0.87
Years of work		
$2 \leq$ years of work $< 5$	52	22.61
$5 \leq$ years of work $< 10$	91	39.57
years of work $\geq 10$	87	37.82
Marital status		
Married	142	61.74
Unmarried	82	35.65
Divorced	6	2.61
Employment mode		
Regular staff	58	25.22
Personnel Agency	10	4.35
Contract	162	70.43
Total	230	100

**Table 2** shows that obstetric nurses' perceived stress dimensions shows their total work stress score is  $68.10 \pm 19.41$ , indicating mild stress. The “patient care” dimension scored highest ( $21.74 \pm 6.82$ ), followed by others, with “working environment and equipment” scoring lowest ( $5.30 \pm 2.22$ ). The overall stress aligns with previous studies on high-risk department nurses. High stress in patient care reflects nurses' responsibility for maternal and infant safety, while moderate time and workload stress implies room for resource optimization. The low work

environment stress validates the positive effect of facility improvements. Differences in stress from the nursing profession and management compared to other studies offer new research directions. These analyses can help formulate intervention strategies to reduce nurses' stress, improving workforce stability and service quality.

**Table 2.** The level of work stressor of the respondents

Dimensions	Scores	Interpretation
Nursing profession and work aspects	15.27 ± 4.76	Mild
Time allocation and workload	11.01 ± 3.83	Mild
Working environment and equipment	5.30 ± 2.22	Low
Patient care	21.74 ± 6.82	Low
Management and interpersonal relationships	14.78 ± 5.77	Low
Total score of work stressors	68.10 ± 19.41	Mild level

**Table 3** shows that obstetric nurses' total perceived Work Stressor score was 68.10 ± 19.41, indicating mild stress. The "patient care" dimension scored highest (21.74 ± 6.82), showing their heavy responsibility for maternal and neonatal care, while "working environment and equipment" scored lowest (5.30 ± 2.22) due to good hospital facilities. Other dimensions like "nursing profession and work aspects" (15.27 ± 4.76), "time allocation and workload" (11.01 ± 3.83), and "management and interpersonal relationships" (14.78 ± 5.77) were at mild to moderate stress levels. The high "patient care" score reflects the high-risk nature of the job, the moderate "time allocation and workload" score indicates work-life balance challenges, and the "management and interpersonal relationships" score shows communication improvement potential. These results align with previous research on the high-stress nature of obstetric nursing, workload-related stress, and the stress-reducing role of the work environment but there are differences in management-related stress findings.

**Table 3.** The level of the turnover intention

Obstetric nurses' turnover intention score (points, <i>n</i> = 230, Mean ± SD)			
Dimension		Average score for each entry	Interpretation
Turnover intention leave I	Quit your job	3.27 ± 0.77	High
	Find another job of the same nature		
Turnover intention leave II	Looking for a different job	3.43 ± 0.77	High
	Possibility of finding a suitable position		
Turnover intention leave III	What is the likelihood of getting a job	3.32 ± 0.76	High
	Whether you will quit your job		
Total score		3.34 ± 0.70	High

**Table 4** shows that the impact of various factors on the turnover intentions of obstetric nurses. No significant differences were found in turnover intentions among different age groups ( $P = 0.65$ ) and professional titles ( $P = 0.12$ ), contrary to some previous studies. However, significant differences were identified based on years of work experience ( $P = 0.04$ ), with 6–10 years of experience nurses having the highest turnover intentions. There was

no significant difference between undergraduate and postgraduate nurses ( $P = 0.12$ ), though postgraduate nurses had a slightly higher score. Marital status ( $P < 0.05$ ) and employment form ( $P = 0.03$ ) also significantly affected turnover intentions. Married nurses and contractual nurses showed higher turnover intentions, likely due to work-family conflict and job insecurity respectively. These results, consistent with some prior research, suggest that work experience, marital status, and employment form are important factors in turnover intentions, while age and professional title may not be as significant in this study.

**Table 4.** Comparison of differences in turnover intention of OB nurses with different demographic characteristics

	Grouping variables	Frequency (n)	Percentage (%)	<i>P</i> -value	Interpretation	Decision H01
Age	22–30 years old	98	42.60	0.65	No significant	Failure to Reject H01
	31–40 years old	115	50.00			
	41–45 years old	17	7.40			
Professional title	Primary	123	53.48	0.12	No significant	Failure to Reject H01
	Medium-grade	105	45.65			
	Supervisor nurse	2	0.87			
Years of work	$2 \leq$ years of work $< 5$	52	22.61	0.04*	Significant	Reject H01
	$5 \leq$ years of work $< 10$	91	39.57			
	years of work $\geq 10$	87	37.82			
Educational background	College/Undergraduate	224	97.40	0.12	No significant	Failure to Reject H01
	Postgraduate	6	2.60			
Marital status	Married	142	61.74	0.01*	Significant	Reject H01
	Unmarried	82	35.65			
	Divorced	6	2.61			
Employment Mode	Regular staff	58	25.22	0.03*	Significant	Reject H01
	Personnel Agency	10	4.35			
	Contract	162	70.43			

Note: The correlation is significant at the 0.05 level (double tailed), and the correlation is significant at the 0.01 level (double tailed).

**Table 5** found a positive correlation ( $r = 0.53$ ,  $P < 0.05$ ) between obstetric nurses' perceived stress and turnover intention total score, consistent with previous research indicating job stress as a key factor in nurses' leaving intentions. The nurses' perceived stress was mild, yet their intention to leave was high. Although age, title, and education level showed no significant impact on turnover intention, years of employment, marital status, and employment form did. Even mild stress levels may trigger the intention to leave and there could be other unassessed factors like career development, compensation, and work environment affecting it. This emphasizes the need for a comprehensive approach to reducing turnover by considering multiple factors beyond just stress when formulating employee retention strategies.

**Table 5.** The relationship between work stressor and turnover intention

Variables	Mean $\pm$ SD	Pearson correlation coefficient ( <i>r</i> )	Relationship	<i>P</i> -value	Interpretation	Decision H02
Work stressor	68.10 $\pm$ 19.41	0.53	Moderate positive correlation	<i>P</i> < 0.05	Significant	Reject H02
Turnover intention	3.34 $\pm$ 0.70					

Note: The correlation is significant at the 0.05 level (double tailed), and the correlation is significant at the 0.01 level (double tailed). \*Significance level at 0.05 using Pearson correlation coefficient (*r*)

## 4. Discussion

The study on 230 obstetric nurses showed a relatively young age distribution, with most in the 31–40 age range. High proportions held college or undergraduate degrees, had primary or medium-grade professional titles. Work experience was well-distributed. Marital status was mainly married and contract employment was dominant. These characteristics align with the literature, indicating the nature of the obstetric nursing workforce. However, they may also influence work-related aspects such as stress and turnover intentions.

The total work stress score of obstetric nurses was in the mild range (68.10  $\pm$  19.41). The “patient care” dimension had the highest score, highlighting the high-risk nature of the job, while “working environment and equipment” had the lowest, likely due to good hospital infrastructure. Moderate scores in other dimensions suggest areas like time management and interpersonal relationships need improvement. This is consistent with some previous research<sup>[13,14]</sup>, but also shows differences in stress contributions from professional and management factors, providing new research directions.

The mild stress level overall, along with the distribution of stress scores across dimensions, is in line with some prior studies on high-risk department nurses. The high score in “patient care” and low score in “working environment and equipment” support previous findings. However, the “management and interpersonal relationships” score shows differences compared to some studies, possibly due to institutional differences, emphasizing the complexity of stress factors.

Age and professional title did not significantly affect turnover intentions, contrary to some previous research. However, work experience, marital status, and employment form did. Nurses with 6–10 years of experience had the highest turnover intentions, married nurses faced work-family conflict leading to higher turnover, and contractual nurses had high turnover due to job insecurity. These findings suggest that various factors play different roles in turnover intentions, and more research considering different contexts is needed.

Perceived stress was positively correlated with turnover intention ( $r = 0.53$ ,  $p < 0.05$ ), consistent with previous studies indicating job stress as a key factor in nurses’ leaving intentions. Despite the mild overall stress level, the high intention to leave implies that other unassessed factors may also contribute. This highlights the need for a comprehensive approach to reducing turnover, considering both stress and other factors like career development and work-life balance.

## 5. Conclusion

This study found that social factors are challenging the professional identity of obstetric nurses, with job stressors significantly influencing the intention to leave. A survey conducted among obstetric nurses in three tertiary hospitals in Shandong revealed moderate levels of job stress and high turnover intentions. The study also found that factors such as education, employment type, years of experience, and marital status all influenced the nurses’ job stress and turnover intentions. Enhancing the positive psychological level of nurses is the key and hospitals

should strengthen relevant psychological training and vocational education to reduce the intention to leave and enhance the sense of professional belonging.

## Disclosure statement

The authors declare no conflict of interest.

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# The Value of Chinese Medicine Humanistic Nursing in Healthcare Integration

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**Abstract:** With the rapid development of medical and nursing combinations, the application of humanistic care in medical and nursing combination institutions is getting more attention. Elderly institutions are the main carrier of elderly services in China, and the demand for humanistic care among the elderly in elderly institutions is also getting higher and higher, but at present, the humanistic care ability of the nursing staff in China's medical and nursing combined institutions is low. In recent years, the state vigorously promoted the development of traditional Chinese medicine, traditional Chinese medicine nursing contains a wealth of humanistic ideas, which can provide another solution for the lack of humanistic care in healthcare institutions. This paper discusses the ideological value, practical value and talent cultivation value of TCM humanistic nursing in medical care combination, aiming to provide a reference basis for improving the quality of humanistic nursing in medical care combination organizations.

**Keywords:** Healthcare integration; Healthcare institutions; Chinese medicine care; Humanistic care

**Online publication:** March 10, 2025

## 1. Introduction

The results of the seventh national population census show that China's population aged 60 years and above is 264.02 million, accounting for 18.70%, of which, the population aged 65 years and above is 190.64 million, accounting for 13.50%<sup>[1]</sup>. The aging of the population is becoming serious. The demand for elderly care and medical rehabilitation services for the elderly is increasing, but at present, elderly care and medical care in most areas of China are in a state of separation, and the level of medical and nursing integration is limited<sup>[2]</sup>. In the face of this problem, the 14th Five-Year National Health Plan states that the development level of medical and nursing integration should be improved. The improvement of the cooperation mechanism between medical and health institutions and elderly service organizations provides the elderly with integrated services of hospitalization during the treatment period, nursing care during the rehabilitation period, life care during the stabilization period,

and hospice care<sup>[3]</sup>. The combination of medical and nursing care is a continuous social pension model that effectively integrates medicine, nursing, and recreation, which can better promote the allocation between the supply of medical resources and the demand for senior care services, and is a positive response to the aging of the healthy population<sup>[4]</sup>. Elderly people are a special group of people, and most of them are accompanied by chronic diseases, which require prolonged medical and nursing care services. Elderly people hope to receive humanistic care from caregivers in addition to better medical care services. However, in most of the current medical and nursing care institutions, due to the shortage of manpower, professional technology is not hard enough and other shortcomings, result in the lack of humanistic care perceived by the elderly in the institutions<sup>[5]</sup>. Humanistic care is a specific expression of humanism. Humanism is an important ideological foundation of TCM nursing, where it contains a rich humanistic spirit. In recent years, the state vigorously developed the application of traditional Chinese medicine in combination with medical care, and the development of TCM nursing in combination with medical care will become more extensive. It is of great significance to explore and discover the value of Chinese medicine humanistic nursing in the combination of healthcare and nursing, so that Chinese medicine humanistic nursing can be better integrated into the practice of a combination of healthcare and nursing so that the elderly can have medical treatment and nursing care for the elderly, which is of great significance to the promotion of the development of the combination of healthcare and nursing. This paper discusses the value of TCM humanistic nursing in the combination of healthcare and nursing.

## **2. The ideological value of Chinese medicine humanistic nursing in the integration of healthcare**

### **2.1. The idea of the holistic view of humanistic nursing in Chinese medicine**

Chinese medicine humanistic nursing has the idea of a holistic view, always observing and caring for humans and nature as a whole, believing that human health should include the health of physiological, psychological and social factors, rather than just looking at the disease from the focus of the disease<sup>[6]</sup>. The holistic view of TCM humanistic nursing is in line with the current development goal of healthcare integration: to promote a better combination of medical care and elderly care services and to improve the quality of life and vitality of the elderly in all aspects, including their physiology, psychology and social environment<sup>[7]</sup>. In the institution of medical and nursing integration, based on the idea of the holistic view of Chinese medicine and humanistic care, man and nature are a unified whole, and human spirit and society are a unified whole. It is important to focus on cleanliness, tidiness, and quietness in the environment to create a warm and harmonious home environment, and also hang Chinese medicine-related humanistic paintings and calligraphy in the corridors and wards to create a strong Chinese medicine Humanistic atmosphere. In terms of the social interaction of the elderly, the spiritual needs of the elderly can be met by organizing colorful recreational activities, such as singing, listening to music, watching movies, etc. Collective activities can also be used to enhance emotional exchanges among the elderly, and good interpersonal relationships can enable the elderly to care for each other and feel warmth. In terms of the spiritual needs of the elderly, caregivers are the group of people who usually have the most contact with the elderly. In addition to daily care services and routine care services, caregivers should also pay attention to the spiritual needs of the elderly, such as paying attention to the protection of the privacy of the elderly, respecting the wishes of the elderly and interacting with the elderly more emotionally.

## **2.2. TCM humanistic nursing's idea of treating future diseases**

Chinese medicine humanistic nursing has the idea of treating future disease, which includes the three aspects of preventing the disease before it occurs, preventing the change of the existing disease, and preventing the recurrence of the disease after it occurs<sup>[8]</sup>. The idea of treating the disease before it occurs takes human health as the starting point, emphasizes the prevention of disease, reduces the occurrence of disease, and cares for human life; when the disease occurs, it advocates the adoption of active nursing measures to intervene and prevent the further development of the disease; after the prognosis, it also emphasizes the development of human beings, and guides them to improve the quality of life through the health maintenance and adjustment of nursing care, which can be seen that the idea of treating the disease before it occurs is rich in the spirit of humanism. Taking elderly hypertensive patients as an example<sup>[9]</sup>, preventing the disease before it develops is to take measures before the onset of the disease, such as nursing staff instructing patients to adjust their lifestyles to maintain the kidney Qi, and traditional Chinese medicine adjusting and tonifying the kidney Qi to stabilize the blood pressure. Pre-existing disease prevention is in the initial stage of hypertension, early diagnosis, early treatment, the use of Chinese medicine nursing technology for elderly patients with hypertension to intervene to improve their clinical symptoms, improve the quality of life, block the disease transmission pathway, and protect the target organ function. Prevention of recurrence after disease recovery, at the beginning of disease recovery, adopting Chinese medicine and appropriate technology such as acupuncture, Tuina and acupoint plastering to improve the resistance of the elderly and prevent the recurrence of the disease. Hospitals can also use health education with Chinese medicine nursing characteristics to guide patients to avoid damage to the organism caused by the six external evils and internal injuries in their daily life. The diet should be reasonable, with light as the main avoidance of fat, sweet and thick flavors, and according to the different types of evidence to the Chinese medicine dietary care. Exercise should pay attention to the combination of static and dynamic, and moderation of work and rest, and hospitals can guide elderly hypertension patients to practice Taijiquan and Ba Duanquan, which have good control of the blood pressure and have the appropriate intensity. At the same time, it is also necessary to carry out emotional care for elderly hypertensive patients, strengthen psychological guidance for patients with bad emotions, help them reasonably vent their emotions, relieve the pressure and tension produced by the disease, and establish confidence in long-term treatment by sharing cases of good blood pressure control. Elderly chronic diseases are characterized by the long duration of illness, high demand for services and costs, and health management based on the combination of the idea of treating the future disease and modern health education has a good therapeutic effect in chronic diseases and geriatric diseases such as hypertension, diabetes mellitus and osteoarthritis of the knee joints, which are common to the elderly<sup>[10]</sup>, and it can prevent or regulate the chronic diseases to improve the quality of life of the elderly.

## **3. The practical value of Chinese medicine humanistic nursing in healthcare integration**

### **3.1. Evidence-based care can provide personalized care for seniors**

The most distinctive feature of TCM humanistic nursing in the practice of healthcare integration is its evidence-based nursing care, based on humanistic philosophical thinking, emphasizing that nursing care should be different for the same disease and different diseases, so as to achieve personalized nursing care, thus achieving the purpose of “people-oriented.” Different care for the same disease refers to the same disease in different times and places

or stages of development, the performance of different symptoms, and nursing measures are also different, such as hypertension in the elderly population based on different types of evidence to care<sup>[11]</sup>, kidney Qi deficiency, with moxibustion, auricular pressure beans and other treatments. Phlegm and blood stasis mutual conjugation of evidence of the accompaniment of chest tightness and other symptoms such as oxygen, electrocardiographic monitoring, etc. Liver Yang hyperactivity is evidence of sweaty and this can strengthen the skin care and ask the patient to maintain. If the patient has excessive sweating, strengthen the skin care and ask the patient to keep the emotion relaxed, and rest in bed if necessary. Different diseases with the same care refer to different diseases in the process of development of the same certificate, can use the same nursing measures, such as the elderly will due to acute and chronic glomerulonephritis edema, nursing will limit the patient's salt intake, and asked the patient to bed rest, appropriate activities, routine, and pay attention to keep warm. Medical and nursing institutions nurse staff of elderly patients for evidence-based care is not only the combination of medical and nursing "medical" requirements but also the performance of the humanistic spirit of Chinese medicine nursing, the value of providing personalized care to patients.

### **3.2. Emotional care can provide pampering for the spiritual world of older adults**

Chinese medicine humanistic nursing is not only concerned with the care of human diseases but also emphasizes the care of human emotions. Chinese medicine believes that joy hurts the heart, anger hurts the liver, worry hurts the lungs, thought hurts the spleen, and fear hurts the kidneys. Elderly people are prone to chronic diseases such as cardiovascular and cerebrovascular diseases, and due to the long-term and recurring nature of the disease, it is inevitable that they will have a heavy psychological burden, and if they do not receive timely counseling, the probability of mental health problems will increase dramatically. This requires caregivers to provide timely emotional care for the elderly. According to the personality characteristics of the elderly, Chinese medicine constitution customized with personalized negative emotion channeling program as well as methods to maintain emotional peace, such as following the principle of the five elements of the phases of life, the use of emotion to overcome the emotion method, interference and transfer of unfavorable feelings of the organism, in order to regulate the emotion. The use of empathy and ease of nature method, with sports, chess and card recreation and watching the theater and other methods to transfer the patient's attention, so as to get rid of the distress of the bad mood. The use of reasoning and enlightenment methods to persuade and persuade the patients, and get rid of the distress of bad emotions. The use of Reasoning and Enlightenment methods, mainly persuasion and enlightenment, so that the elderly correct the negative attitude of looking at things or change their angle and position to think about the problem. The use of the moderation method, appropriate catharsis of bad emotions, so that the emotions achieve mental equilibrium, but pay attention to prevent over-excitement of emotions, to avoid damage to the physical and mental health<sup>[12]</sup>. It can also use the five elements of music to personalize and identify the selection of music to improve the negative emotions of depression, anxiety, paranoia and other negative emotions of the elderly<sup>[13]</sup>. Thus, it can be seen that affective nursing starts from the human whole, focuses on and meets the needs of the elderly in terms of affective aspects that are often easily neglected by caregivers, reflecting the humanistic spirit of TCM nursing and the value of caring for the affective aspects of the elderly.

### **3.3. Appropriate Chinese medicine techniques can improve the quality of life of the elderly**

Appropriate technology in Chinese medicine is a concrete manifestation of humanistic care in Chinese medicine. Due to the aging and degeneration of the body function, the function of internal organs gradually declines, and



the positive Qi gradually declines, the elderly are prone to chronic diseases such as hypertension, diabetes, cardiovascular diseases, and geriatric diseases such as Alzheimer's disease, geriatric psychosis, and strokes<sup>[14]</sup>, and the appropriate Chinese medicine technology has the unique advantages and characteristics of easy operation, significant effect, wide range of use, little trauma and no pain in preventing and controlling the chronic diseases and geriatric diseases<sup>[15]</sup>. The Chinese medicine nursing techniques such as moxibustion, Guasha, and acupuncture are easy to operate, easy to take materials, and have better effects in treating diseases and healthcare. The elderly and their caregivers would like to master and apply the relevant nursing techniques by themselves through explanations<sup>[16]</sup>. The scope of application of each of the TCM-appropriate techniques is wide, such as the ear-point application being applicable to the control of blood pressure, the improvement of insomnia, the alleviation of pain, and the improvement of constipation, and so on. It can be seen that TCM-appropriate technology highlights the glory of humanism and is more suitable for use in the conditioning of the elderly population. Some research surveys show that there is a great demand for relevant TCM-appropriate technology among the elderly<sup>[17]</sup>, which reflects the recognition of TCM-appropriate technology among the elderly from the side, therefore, while carrying out high-quality TCM-appropriate technology operation, nursing staff of healthcare institutions should explain the knowledge of TCM appropriate technology and guide the elderly and their caregivers to learn and carry out the operation of TCM appropriate technology on themselves has the value of improving the diseases of the elderly and improving the quality of life of the elderly. Therefore, it is valuable for nursing staff of medical and nursing institutions to carry out high-quality TCM-appropriate technology operations, explain TCM-appropriate technology knowledge, and guide the elderly and their caregivers to learn and carry out TCM-appropriate technology operations by themselves.

### **3.4. Traditional Chinese Medicine can keep older people healthy and promote longevity**

Humanism is concerned with human development, and Chinese medicine humanistic nursing of Chinese medicine and healthcare is based on human development, reflecting the pursuit of a long and healthy life. Chinese medicine and healthcare are based on the holistic concept of "unity of heaven and man" in Chinese medicine and nursing, with the principle of following the time of the day and nature. People should follow the changes of the four seasons, spring and summer seasons should focus on Yang, under the premise of ensuring the quality of sleep should be late to bed and early to get up, as far as possible to delay the removal of winter clothing in spring, to keep warm to prevent the invasion of foreign evils, and in summer should not be greedy for cold food. Fall and winter seasons focus on the maintenance of yin, autumn and early to bed and get up early in winter, early to bed and late to get up and pay attention to warmth, especially in the elderly should pay attention to the head, neck, back and feet of the warmth of the<sup>[18]</sup>. The meaning of conforming to nature is not only conforming to the natural environment but also conforming to the laws of natural development of the human body. The elderly should comply with the law of the body's decline, diet, small meals, eating more fresh vegetables and fruits; living and resting regularly, and not sitting for a long time lying down<sup>[19]</sup>. Besides, exercise must be gradual, do not overwork and injure to the muscles and bones, traditional Chinese medicine exercises such as the five bird play, Taijiquan, eight brocade, etc. are low-intensity exercises, have a very good effect on strengthening the body and fitness for older people exercise, can be based on their own interests and physical load, the elderly. Elderly people can choose on their own according to their interests and the degree of physical load<sup>[20]</sup>, focusing on nourishing nature, and avoiding excessive exhaustion of the mind and spirit, so as to make the form and spirit maintain a natural and peaceful state. Therefore, it is valuable to promote the longevity of the elderly by providing TCM health guidance



to the elderly by the nursing staff of healthcare institutions.

## **4. The value of Chinese medicine humanistic nursing in the cultivation of Chinese medicine healthcare integrated nursing talents**

### **4.1. Chinese medicine humanistic nursing is a realistic need**

Nursing staff of medical and nursing institutions have to deal with the elderly for a long time, and the health needs of the elderly and the needs for Chinese medicine treatment are rigid needs, but the psychological needs are also very urgent<sup>[21]</sup>. However, at present, there is a general lack of humanistic care among the staff of medical and nursing institutions in China, and the overall humanistic quality of the geriatric nursing team is low<sup>[22]</sup>. In the cultivation of Chinese medicine nursing personnel, there is also the problem of humanistic quality education is not in place, a study investigation of Chinese medicine colleges and universities found that there is a weak cognitive knowledge of the basic knowledge of humanistic quality education of the students, the curriculum of humanistic courses accounted for a small percentage of the curriculum and a single way of teaching to indoctrinate the main, in the clinical practice of the technical operation and light humanities and other issues<sup>[23]</sup>. In recent years, the state has issued several policies to encourage the combination of traditional Chinese medicine and elderly services, and the combination of traditional Chinese medicine medical care model is also accelerating the development, but in the face of the increasing number of elderly people, the shortage of traditional Chinese medicine nursing personnel is still expanding<sup>[24]</sup>. Ways to meet the multifaceted and multilevel needs of the elderly for nursing care puts forward higher requirements for the training of TCM nursing talents, in addition to the teaching of basic professional knowledge and skills training, there is also an urgent need for the cultivation and shaping of TCM humanistic spirit of TCM nursing talents.

### **4.2. Chinese medicine humanistic nursing can improve the comprehensive quality of Chinese medicine nursing personnel**

Chinese medicine nursing contains rich humanistic thoughts, human-oriented, emphasizing the correspondence between heaven and man, individual differences and holistic care, etc., which can make the spiritual world and inner emotions of Chinese medicine nursing talents richer and cultivate noble moral sentiments. By reading a large number of TCM medical texts, not only can they receive the inculcation of TCM humanistic thoughts, but also feel the wisdom of the ancients, broaden their horizons, internalize the traditional cultural achievements they have learned continuously, and improve their cultural literacy<sup>[25]</sup>. By practicing in healthcare institutions, TCM humanistic nursing can help TCM nursing talents to think comprehensively about the nursing needs of the elderly, seek interdisciplinary cooperation and communication when encountering difficulties, improve teamwork ability at the same time, but also deepen the knowledge of TCM nursing, to apply it flexibly in clinical practice, to cope with the needs of the elderly, and to make the elderly feel humanistic care.

## **5. Conclusion**

Humanistic care is an essential requirement of the nursing discipline, and the precipitation and condensation of the humanistic spirit reflects the development of the nursing discipline<sup>[26]</sup>. China's healthcare integration model started late, and there is an obvious gap with Western developed countries<sup>[27]</sup>. In particular, humanistic care is

generally missing in China's healthcare integration institutions<sup>[22]</sup>, and the improvement of humanistic qualities of nursing staff, humanistic care for the elderly, and the popularization of humanistic care in healthcare integration institutions cannot be accomplished overnight, but requires time to precipitate. Humanism is the inner soul of the medical care combination<sup>[28]</sup>, to develop a good medical care combination and good humanistic care. The country vigorously developed the cause of traditional Chinese medicine today, traditional Chinese medicine has a broad social base, in the prevention and treatment of chronic diseases and geriatrics and other aspects of the advantages<sup>[29]</sup>, and healthcare integration of the depth of the integration of the trend is also where the humanities contained in traditional Chinese medicine has gradually been emphasized. Chinese medicine is the treasure of Chinese civilization, is a huge treasure trove, gives full play to the advantages of Chinese medicine in elderly healthcare, the development of Chinese medicine and healthcare integration mode, out of the Chinese characteristics of Chinese medicine healthcare integration development road, cannot be separated from the excavation of traditional Chinese medicine and modernization of the application. Thus, facing the problem of lack of humanistic care, TCM humanistic nursing is another solution. Chinese medicine nursing contains rich humanistic thoughts, and Chinese medicine humanistic nursing is the inner thrust to promote the good development of medical-care integration. Only by fully recognizing the value of Chinese medicine humanistic nursing, continuously digging out the value of Chinese medicine humanistic nursing in the field of medical-care integration and applying it, and giving full play to the characteristics and advantages of Chinese medicine humanistic nursing can hospitals better meet the needs of humanistic care of the elderly groups, and push forward the development of the cause of combining traditional Chinese medicine and medical care in a better way. The only way to better meet the needs of humanistic care for the elderly and promote the better development of Chinese medicine and healthcare integration.

## Funding

Shaanxi Provincial Key R&D Program (Project No.: 2021SF-351)

## Disclosure statement

The authors declare no conflict of interest.

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# Research Progress on the Mechanism of GSDMD-Induced Pyroptosis in Macrophages

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**Abstract:** Pyroptosis is a form of programmed cell death. Excessive or uncontrolled pyroptosis and the production of pro-inflammatory cytokines can lead to organ damage, circulatory failure, and even death. Gasdermin D (GSDMD) is the primary executor of pyroptosis in macrophages. Upon cleavage, the N-terminal domain of GSDMD (GSDMD-N) is activated and oligomerizes to form pore-like structures in the plasma membrane, triggering pyroptosis and resulting in the release of pro-inflammatory cytokines such as interleukin-1 $\beta$  (IL-1 $\beta$ ). As a key executioner molecule of pyroptosis, Gasdermin D plays a crucial role in pathogen-induced pyroptosis in macrophages. With in-depth research on the function and regulatory mechanisms of GSDMD, its role in pathogen-induced macrophage pyroptosis has gradually been revealed. This article elaborates on the mechanism of GSDMD in pathogen-induced macrophage pyroptosis, providing insights for exploring pyroptosis in the prevention and control of bacterial diseases, and identifying new therapeutic targets for bacterial infections.

**Keywords:** GSDMD; Pyroptosis; Macrophages

**Online publication:** March 10, 2025

## 1. Introduction

Pyroptosis is a form of programmed cell death triggered by inflammasome activation, closely associated with host innate immunity and tumor immunotherapy <sup>[1]</sup>. Gasdermin D (GSDMD) is the key executioner molecule of pyroptosis. Upon inflammasome activation, GSDMD is cleaved into its N-terminal fragment (GSDMD-N), which possesses membrane pore-forming activity. This fragment oligomerizes to form pores in the cell membrane, leading to the release of cellular contents and inflammatory factors. During pathogen infection, macrophages, as a critical component of the immune system, recognize pathogen-associated molecular patterns (PAMPs) to activate inflammasomes, thereby inducing pyroptosis. Recent studies have confirmed the propagation of pyroptosis between cells. Pyroptotic cells secrete extracellular vesicles (EVs) carrying GSDMD pores, which are transferred



to bystander cells, resulting in pyroptosis of these bystander cells <sup>[2]</sup>.

## 2. Pyroptosis

Pyroptosis is characterized by cell swelling, plasma membrane rupture, and the release of pro-inflammatory cytokines, damage-associated molecular patterns (DAMPs), and PAMPs <sup>[3]</sup>. As a crucial innate immune response, pyroptosis plays a significant role in defending against infections and endogenous danger signals. Its molecular mechanisms include the canonical pathway, non-canonical pathway, Caspase-3/8-mediated pathway, and granzyme-mediated pathway <sup>[4]</sup>. Pyroptosis eliminates damaged cells, thereby removing protective niches for pathogens, while simultaneously triggering inflammatory responses to combat intracellular infections. It is widely involved in the pathogenesis of infectious diseases, neurological disorders, and atherosclerosis. However, excessive pyroptosis can amplify inflammatory responses and cause harm to the organism. During pathogen infection, macrophages, as a critical component of the immune system, recognize PAMPs to activate inflammasomes, thereby inducing pyroptosis. GSDMD plays a central role in this process, as its activation and pore formation in the membrane are key steps in the occurrence of pyroptosis.

## 3. Macrophage pyroptosis

Cell death is a critical process in modulating host-pathogen interactions. Pathogen-triggered macrophage death manifests in various forms, including apoptosis, pyroptosis, necroptosis, and autophagic cell death <sup>[5]</sup>. Macrophage pyroptosis is an inflammatory form of cell death driven by the GSDMD protein family. During pyroptosis, inflammasomes are activated, leading to the cleavage of GSDMD and the release of its GSDMD-NT. These fragments form pores in the cell membrane, resulting in membrane rupture, cell death, and the release of large amounts of inflammatory cytokines and DAMPs, triggering a robust inflammatory response.

Studies have shown a close relationship between bacterial infections and pyroptosis. For example, *Streptococcus pneumoniae* can induce macrophage pyroptosis, while its expression of IL-6 can inhibit pyroptosis and alleviate associated inflammatory damage <sup>[6]</sup>; Macrophage pyroptosis can also mitigate infections by clearing *Mycobacterium tuberculosis* <sup>[7]</sup>; *Salmonella* infection induces inflammasome activation and macrophage pyroptosis, leading to inflammation and lethality <sup>[8]</sup>. It has been reported that secretions from pyroptotic macrophages upregulate gene signatures related to migration, cell proliferation, and wound healing, promoting wound closure and tissue repair in vivo <sup>[9]</sup>. The transcriptional regulation of GSDME (Gasdermin E) in macrophages and the role of GSDME-mediated pyroptosis in atherosclerosis provide new potential therapeutic targets for this condition <sup>[10]</sup>.

With advancing research on pyroptosis, the molecular characteristics and regulatory mechanisms of the GSDMD family are gradually being elucidated, offering increasing insights into the treatment of host diseases and anti-pathogen infections.

## 4. The role of GSDMD in pathogen-induced pyroptosis

### 4.1. Overview of GSDMD protein

GSDMD is a mediator of inflammatory cell death triggered by the sensing of invasive infections and danger signals in the cytoplasm. Upon activation, GSDMD forms pores in the cell membrane, releasing pro-inflammatory

cytokines and disrupting membrane integrity, thereby inducing inflammatory cell death. The human GSDM family comprises six members: GSDMA, GSDMB, GSDMC, GSDMD, GSDME, and DFNB59. Among these, GSDMD is the key effector molecule of pyroptosis.

GSDMD is encoded by the GSDMD gene located on chromosome 8q24.3 and serves as the primary executor of inflammasome-driven pyroptosis <sup>[11]</sup>. The GSDMD protein features two characteristic domains: the pore-forming GSDMD-N domain and the inhibitory C-terminal domain (GSDMD-C). In resting cells, GSDMD-N interacts intramolecularly with GSDMD-C, resulting in autoinhibition of full-length GSDMD. Cleavage of GSDMD is typically mediated by inflammasome-activated Caspase-1 or LPS-stimulated Caspase-4/5/11, leading to the release of GSDMD-N <sup>[12]</sup>. In addition to activating GSDMD, Caspase-1, a canonical member of the Caspase family, also cleaves pro-IL-1 $\beta$  and pro-IL-18 into their active forms, promoting their maturation and secretion. In highly activated cells that do not undergo pyroptosis, the inner diameter of GSDMD transmembrane pores determines the release of intracellular proteins, facilitating the secretion of inflammatory cytokines such as IL-1 $\beta$  and IL-18, while filtering larger proteins like high-mobility group box 1 (HMGB1, 150 kDa) and lactate dehydrogenase (LDH, 140 kDa) <sup>[13]</sup>. Therefore, the release of LDH is considered a hallmark event of pyroptosis.

## 4.2. GSDMD and bacterial infection

Bacterial infections can induce pyroptosis, and GSDMD plays a critical role in controlling microbial infections by regulating cytokine release and cell death. Studies have found that when intracellular infections are triggered by pathogens such as bacteria or viruses, the inflammasome signaling pathway is activated, ultimately leading to the cleavage and activation of the pore-forming protein GSDMD, releasing its N-terminal domain with pore-forming activity. The GSDMD-N oligomerizes to form pores in the cell membrane, causing cell rupture, pyroptosis, and the release of cytoplasmic contents, thereby inducing a strong inflammatory response to eliminate pathogens or clear endogenous harmful factors <sup>[1]</sup>.

Subsequently, the involvement of other GSDM family proteins (GSDMA-E) in mediating pyroptosis has been discovered. Since the activation of GSDM proteins is not solely dependent on inflammatory caspases, pyroptosis has been redefined as a regulated cell death mediated by GSDM proteins <sup>[14, 15]</sup>. Research indicates that GSDMD is central to controlling infections caused by *Rotavirus* and *Salmonella*, GSDMD is also essential for inhibiting infections by *Brucella* <sup>[16]</sup>, *Legionella pneumophila* <sup>[17]</sup>, *Burkholderia thailandensis* <sup>[18]</sup> and *Francisella* <sup>[19]</sup>.

Additionally, the direct antibacterial effect of GSDMD on bacterial membranes expands the mechanisms for restricting microbial growth and dissemination. However, the activation of GSDMD is a double-edged sword. For instance, the absence of Caspase-11 or GSDMD protects mice from septic shock in sepsis models <sup>[20]</sup>. Excessive activation of pyroptosis can lead to increased release of DAMPs or danger signals.

## 4.3. GSDMD and pyroptosis

GSDMD is a key effector of pyroptosis. In the context of bacterial infections, GSDMD-mediated pyroptosis can be driven by various molecular signaling pathways. Bacteria can activate both canonical (NLRs) and non-canonical (Caspase-11/4/5) inflammasomes through multiple mechanisms, processing GSDMD into its bioactive N-terminal fragment. The GSDMD-N fragment oligomerizes and forms pores in the host cell membrane, leading to pyroptosis <sup>[21]</sup>.

Most studies suggest that pyroptosis is beneficial for host defense. For instance, during intracellular bacterial infections, the formation of GSDMD pores and subsequent cell lysis effectively disrupt the niche of invading

pathogens, reducing pathogen replication and evasion of the immune system. Additionally, the formation of GSDMD pores downstream of inflammasome signaling during pyroptosis releases cellular contents, including processed pro-inflammatory cytokines, LDH, nuclear DNA, and mitochondrial components. These molecules can act as DAMPs for the immune system, effectively enhancing inflammation and recruiting various immune cells to induce a localized antibacterial response <sup>[22]</sup>.

#### **4.4. GSDMD and disease pathogenesis**

GSDMD-induced pyroptosis plays a crucial role in defending against pathogen infections and DAMPs by promoting the clearance of infected or damaged cells. However, sustained GSDMD-mediated pyroptosis can lead to ion flux dysregulation, organelle dysfunction, and excessive inflammatory responses, contributing to the onset and progression of various inflammatory diseases. These include, but are not limited to, diabetes, liver diseases, cardiovascular diseases, neurodegenerative disorders, intestinal diseases, and bloodstream infections. Pathophysiologically, GSDMD-mediated pyroptosis exacerbates the development of different inflammatory diseases <sup>[23]</sup>. Clinical studies have identified GSDMD as a potential diagnostic and prognostic marker for various diseases. Additionally, certain preclinical studies have discovered potential GSDMD inhibitors and other therapeutic agents to counteract GSDMD-mediated suppuration and inflammation.

### **5. Summary and perspectives**

With in-depth research on the functions and regulatory mechanisms of GSDMD, its role in inflammatory responses has gradually been revealed. GSDMD-mediated pyroptosis has been shown to protect the host against bacterial infections. However, excessive GSDMD-mediated pyroptosis can lead to organelle dysfunction, cytokine storms, and harmful inflammation, contributing to the development and progression of various diseases. Inhibition or knockout of GSDMD has demonstrated protective effects in animal models of multiple inflammatory diseases, such as sepsis and other inflammatory disorders. Although significant progress has been made in understanding GSDMD-mediated pyroptosis, the specific mechanisms of GSDMD in different pathogen infections require further investigation.

Additionally, the specific roles of other members of the GSDM family in pyroptosis, pathogen evasion strategies targeting GSDM proteins, and how to leverage these findings to develop novel therapeutic strategies remain areas for further research. In summary, research on GSDMD highlights its critical role in bacterial infection-induced pyroptosis, with significant physiological and pathological implications. GSDMD may serve as an important therapeutic target for related diseases. The mechanisms of host inflammatory responses and tissue damage, as well as the intercellular transmission mechanisms of GSDMD and its role in diseases, provide new insights for future treatments.

### **Funding**

Foshan High-Level Talent and Lingnan Scholar Research Initiation Project(Project No.: CGZ07001); Foshan Science and Technology Innovation Project (Project No.: 2420001004253); Foshan Self-Funded Science and Technology Innovation Project (Project No.: 2420001004253)

## Disclosure statement

The authors declare no conflict of interest.

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# Research Progress in Rehabilitation Nursing for Limb Dysfunction after Stroke

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**Abstract:** Stroke, as a highly prevalent cerebrovascular disease, often leads to limb dysfunction in patients, severely affecting their quality of life. Seeking effective rehabilitation nursing methods is of great significance for patient recovery. This article deeply analyzes various aspects such as intelligent rehabilitation technology, traditional Chinese medical therapies, Western medical therapies, and rehabilitation training methods. It explores the characteristics, effectiveness, and application prospects of various rehabilitation nursing approaches, providing a reference for clinical rehabilitation nursing of limb dysfunction after stroke, and helping to improve the quality of patient recovery and enhance their self-care ability and quality of life.

**Keywords:** Stroke; Limb dysfunction; Rehabilitation nursing

**Online publication:** March 6, 2025

## 1. Introduction

Stroke, as an acute cerebrovascular disease that seriously threatens human health, is characterized by high incidence, high disability rate, and high mortality rate. According to statistics, there are over 13 million new cases globally each year <sup>[1]</sup>. Due to China's large population base, unhealthy lifestyles, and aging population, it has become the country with the highest number of stroke cases in the world <sup>[2]</sup>. Motor dysfunction is the most common complication of stroke, with about 80% of patients experiencing hemiplegia or unilateral paralysis and half of these symptoms may persist for the rest of the patients' lives <sup>[3]</sup>. This not only causes great physical and psychological pain to the patients, severely limiting their self-care ability and significantly reducing their quality of life, but also imposes a heavy burden on families and society. Rehabilitation training plays a crucial role in the treatment of stroke patients, as it can effectively reduce functional disability, improve patient satisfaction with their own recovery, and accelerate the process of stroke rehabilitation <sup>[4]</sup>. With the continuous development of medical science and technology and the deepening of research on stroke rehabilitation nursing, various rehabilitation nursing methods have emerged, bringing new hope to patients with limb dysfunction after stroke.

## **2. Rehabilitation technology**

### **2.1. Intelligent rehabilitation technology**

#### **2.1.1. Wearable devices**

Wearable devices, with their portability and real-time monitoring capabilities, are gradually emerging in stroke rehabilitation nursing. These devices typically integrate multiple sensors, such as accelerometers and gyroscopes, which can accurately capture the movement information of patients' limbs, including the amplitude, speed, and frequency of movement. By analyzing these data, wearable devices serve a dual purpose. Firstly, they provide an objective assessment framework for rehabilitation therapists, enabling them to accurately track a patient's recovery progress and make timely adjustments to the rehabilitation plan.

Secondly, they offer real-time feedback to patients, enhancing their engagement and motivation during the rehabilitation process. For example, when the patient's limb movement reaches a preset goal, the device will emit a sound or vibration to give positive incentives to the patient, enhancing their enthusiasm and initiative in rehabilitation training. Wang *et al.* explored the guiding and monitoring role of the wearable device uCare in the rehabilitation of stroke patients<sup>[5]</sup>. The results showed that patients using this device had significant improvement in their ICF general set, dysfunction set, and brief core set for stroke compared to when they were enrolled. In the study by Si *et al.*, a wristband wearable device was used to monitor the number of target movements completed by stroke patients during daily activities<sup>[6]</sup>.

#### **2.1.2. Brain-computer interface technology based on motor imagery**

Brain-computer interface technology based on motor imagery is an emerging rehabilitation technique that utilizes specific brain signals generated by patients when they imagine limb movements. These signals are converted into control commands through computer algorithms, which then drive external devices to assist patients in performing limb movements. This technology not only stimulates the plasticity of the patient's brain and promotes the reconstruction of neurological functions but also provides a new rehabilitation pathway for patients who are unable to perform active movements due to limb movement disorders. Studies have indicated that providing patients with multimodal feedback, which integrates sensory information such as vision, hearing, and touch, may be more effective in improving motor function<sup>[7]</sup>. Sieghartsleitner *et al.* conducted 25 sessions of brain-computer interface training on 19 stroke patients, providing visual and proprioceptive feedback during signal matching. The results showed improvement in patients' motor dysfunction<sup>[8]</sup>.

#### **2.1.3. Virtual reality (VR)**

Virtual reality technology creates highly realistic virtual environments, providing patients with an immersive rehabilitation training experience. In VR rehabilitation training, patients can be placed in various virtual scenes, such as simulated daily life scenes (e.g., shopping, doing housework) and game scenes (e.g., ball games, flight games). By interacting with objects in the virtual environment, patients can complete various limb movement tasks. This training method is advantageous due to its strong interest and customizable tasks, effectively enhancing patients' training enthusiasm and participation. Additionally, the VR system can monitor patients' movement trajectories and task completions in real-time, providing detailed data feedback to rehabilitation therapists for adjusting training difficulty and programs. According to Karamians *et al.*, virtual reality-based games are more effective than traditional rehabilitation methods for upper limb recovery after stroke<sup>[9]</sup>. Other studies have pointed out that this technology significantly improves muscle strength, coordination, and flexibility when used for upper

limb rehabilitation<sup>[10]</sup>. Wu *et al.* also confirmed its remarkable effectiveness in improving upper limb function<sup>[11]</sup>. Evidently, virtual reality technology can serve as a method for rehabilitation simulation training.

#### **2.1.4. Rehabilitation robot-assisted therapy**

A rehabilitation robot is a device that can simulate human movements and provide precise movement training for patients. It can accurately control the intensity, speed, and mode of movements based on the patient's specific conditions, such as limb strength and range of motion, offering personalized rehabilitation training. Rehabilitation robot-assisted therapy has advantages such as high repeatability, precise movement accuracy, and good safety. It can effectively reduce the workload of rehabilitation therapists while ensuring the quality and effectiveness of training. Gu *et al.* selected 46 stroke patients with unilateral neglect within three months of onset<sup>[12]</sup>. All patients received conventional rehabilitation therapy, and on this basis, they underwent a nine-week upper limb rehabilitation robot training program. The results showed that upper limb rehabilitation robot-assisted therapy could effectively improve patients' unilateral neglect, upper limb motor function, and activities of daily living abilities.

### **3. Traditional chinese medicine therapies**

#### **3.1. Herbal medicine therapy**

Herbal medicine has a long history and rich experience in the rehabilitation treatment of limb dysfunction after stroke. According to Chinese medicine theory, limb dysfunction after stroke is often associated with factors such as Qi and blood deficiency, blood stasis, and meridian obstruction. Therefore, herbal medicine treatment often focuses on nourishing Qi and promoting blood circulation, clearing meridians, and resolving stasis.

Some classic herbal formulas, such as Buyang Huanwu Decoction, emphasize the use of Huangqi(Astragalus root) to tonify the Qi of the spleen and stomach, promote blood circulation, and eliminate stasis without injuring the healthy Qi. It is combined with Dangguiwei(Angelica root tail) to promote blood circulation and dredge meridians without injuring the blood. Chuanxiong(*Ligusticum chuanxiong*), Chishao(Red peony root), Taoren(Peach kernel), and Honghua(Safflower) work together with Dangguiwei to promote blood circulation and eliminate stasis, while Dilong(Earthworm) is used to dredge meridians and facilitate the circulation of medicinal effects throughout the body.

Studies by Wu *et al.* have shown that the modified Buyang Huanwu Decoction combined with acupuncture has a definite effect on patients with post-stroke limb dysfunction, reducing inflammation, promoting neurological recovery, and improving quality of life<sup>[13]</sup>. Zou Na *et al.* studied 60 patients with high muscle tension on the paralyzed side during stroke recovery and found that the combination of exercise therapy and herbal steaming significantly reduced muscle spasms and effectively improved upper limb joint function<sup>[14]</sup>.

#### **3.2. Acupuncture therapy**

Acupuncture is one of the important means of rehabilitation treatment in Chinese medicine. By stimulating specific acupoints, it activates the circulation of Qi and blood in the meridians, regulates organ functions, and thereby improves limb dysfunction. In stroke rehabilitation, commonly used acupoints include head acupoints(such as Baihui and Shenting) and limb acupoints(such as Jianyu, Quchi, Hegu, Huanqiao, Yanglingquan, and Zusanli). Acupuncture on head acupoints can regulate the function of the cerebral cortex and promote the recovery of

neurological function, while acupuncture on limb acupoints can dredge meridians, harmonize Qi and blood, and improve limb motor function. Different acupuncture techniques, such as lifting and thrusting, twisting and rotating, also have certain influences on the rehabilitation effect. Chen *et al.* studied 64 patients with post-stroke spastic paralysis and found that the combination of acupuncture and rehabilitation training, focusing on stimulating the motor and sensory areas of the head as well as the Yangming meridians of the affected hand and foot, significantly reduced muscle tension and improved rehabilitation outcomes compared to a single treatment approach <sup>[15]</sup>.

## **4. Western medicine therapies**

### **4.1. Drug therapy**

Drug therapy plays an important auxiliary role in the rehabilitation of limb dysfunction after stroke. Commonly used drugs include neurotrophic drugs and drugs that improve cerebral circulation. Neurotrophic drugs, such as Mecobalamin, participate in methyl conversion within nerve tissue and nucleic acid, protein, and lipid metabolism, promoting axonal transport function and regeneration, and repairing damaged nerve tissue, which can help improve limb dysfunction. Drugs that improve cerebral circulation, such as Butylphthalide, can improve microcirculation and blood flow in ischemic areas of the brain, increase the number of capillaries in ischemic areas, promote the establishment of collateral circulation, improve neurological deficit symptoms, and enhance patients' limb motor function and activities of daily living.

### **4.2. Exercise therapy**

Exercise therapy is one of the core components of stroke rehabilitation, mainly including Bobath technique, Brunnstrom technique, Rood technique, and PNF technique. The Bobath technique emphasizes the promotion of normal movement patterns by inhibiting abnormal movement patterns to improve limb function. The Brunnstrom technique, on the other hand, utilizes abnormal movement patterns such as associated reactions and common movements to guide patients to gradually restore normal movement based on different stages of motor function recovery after stroke. Pu divided 90 patients with post-stroke upper limb motor dysfunction into three groups: control group A received ordinary acupuncture, control group B received Brunnstrom graded acupuncture combined with exercise therapy, and the observation group received a combination of all these treatments plus transcranial magnetic stimulation for 4 weeks <sup>[16]</sup>. The results showed that the combined treatment had the best effect, significantly improving patients' motor and daily living abilities. The Rood technique stimulates receptors such as skin and muscles to induce or inhibit muscle contraction and promote the recovery of motor function. The PNF technique emphasizes the use of spiral diagonal movement patterns, stimulating the limbs through stretching and squeezing to enhance muscle strength and coordination.

### **4.3. Physical therapy**

Physical therapy includes various methods such as electrotherapy, phototherapy, magnetic therapy, and ultrasound therapy. Low-frequency electrical stimulation in electrotherapy can stimulate neuromuscular activity, causing muscle contraction, enhancing muscle strength, and improving limb motor function. Functional electrical stimulation (FES) can provide timely electrical stimulation to the corresponding muscles during limb movements, helping patients complete normal motor actions and promoting the recovery of neuromuscular function. Studies have shown that clinicians can provide functional electrical stimulation (FES) therapy for patients with reduced



lower limb motor function caused by acute or chronic hemiplegia after stroke, which can effectively optimize gait, increase walking speed, and enhance dynamic balance and other activities <sup>[17]</sup>.

#### **4.4. Psychotherapy**

Stroke patients often experience psychological issues such as anxiety and depression due to physical dysfunction, which can severely affect their rehabilitation enthusiasm and effectiveness. Therefore, psychotherapy plays a significant role in stroke rehabilitation nursing. Psychotherapy includes cognitive behavioral therapy, supportive psychotherapy, and relaxation training. Cognitive behavioral therapy helps patients identify and change unhealthy cognitive patterns and behavioral habits, enhances their understanding and coping abilities regarding the disease, and boosts their confidence in recovery. Zhang conducted a study on 110 stroke patients with cognitive dysfunction <sup>[18]</sup>. The results showed that the use of psychological and behavioral interventions not only significantly improved patients' cognitive function but also helped enhance their physical function. Additionally, supportive psychotherapy provides emotional support to patients through listening, comforting, and encouraging, alleviating their anxiety and depression. Relaxation training, such as deep breathing exercises and progressive muscle relaxation training, can help patients reduce physical tension and relieve psychological stress.

#### **4.5. Music therapy**

Music therapy is a treatment method that promotes patients' physical and mental recovery through listening to music and participating in music creation. In stroke rehabilitation nursing, music therapy can stimulate the brain's auditory center, activate neural pathways related to movement and emotion, and promote the recovery of neural function. Studies have explored motor abilities in music task training and the results showed that patients' speed, key pressure, and note accuracy improved rapidly during the first phase of training <sup>[19, 20]</sup>. By the end of the second phase of training, functional enhancement and defect recovery were more prominent. Simultaneously, music has the functions of regulating emotions, relieving pain, reducing anxiety and depression, and improves patients' rehabilitation enthusiasm and compliance. Xu divided 100 stroke patients with hemiplegia into two groups for treatment <sup>[21]</sup>. One group received conventional rehabilitation training, while the other group received additional music therapy. After one month of assessment, both groups showed improvement in upper and lower limbs and overall scores, but the group with music therapy showed more significant improvement. This therapy also positively impacted patients' emotions and sleep.

### **5. Rehabilitation training methods**

#### **5.1. Group circuit training method**

The Circuit Training Method (CCT) is a rehabilitation therapy based on activity design. It provides patients with targeted, concentrated, and high-intensity rehabilitation exercise practices through group gatherings <sup>[22]</sup>. The advantage of this training method lies in its ability to fully utilize rehabilitation resources and improve training efficiency. Additionally, the mutual communication and encouragement among patients within the group can enhance patients' confidence and enthusiasm for recovery. The research results of Huang *et al.* show that task-oriented circuit training has a positive effect on patients' recovery <sup>[23]</sup>.



## 5.2. Mirror therapy (MT)

Mirror therapy is based on the plasticity principle of the brain. It utilizes the principle of mirror reflection to project the movement-image of the healthy limb onto the affected side, creating an illusion that the affected limb is moving. This induces cortical remodeling and improves the motor function of the affected limb. In clinical applications, patients are typically seated in front of a mirror with their affected limb hidden behind it while their healthy limb performs various movements in front of the mirror. By observing the movement of their healthy limb in the mirror, patients imagine that their affected limb is performing the same movements. Liu *et al.*'s research indicates that compared to the control group, the mirror group showed more significant improvement in lower limb motor function and activities of daily living<sup>[24]</sup>. Lee *et al.* used MT combined with afferent electrical stimulation to treat chronic stroke patients and found that compared to the control group, the experimental group showed significant improvement in muscle strength, modified Ashworth scale, Berg balance scale (BSS), gait speed, and step length<sup>[25]</sup>.

## 6. Conclusion and outlook

Significant progress has been made in the research of rehabilitation nursing for post-stroke limb dysfunction and various rehabilitation techniques, therapies, and training methods have continuously emerged, providing strong support for improving patients' quality of recovery. However, there are still some problems, such as the optimal combination and application timing of different rehabilitation methods, which are not fully clear. Additionally, the standardization and normalization of rehabilitation nursing need to be improved. In the future, greater emphasis should be placed on strengthening multidisciplinary collaboration, conducting large-scale, high-quality clinical studies, and thoroughly investigating the mechanisms and effectiveness of various rehabilitation nursing approaches. Additionally, developing more scientific, personalized, and evidence-based rehabilitation plans will be essential to improving recovery outcomes for patients with post-stroke limb dysfunction.

## Disclosure statement

The authors declare no conflict of interest.

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# A Preliminary Study on the Background of the Formation of the Meng Yao Zheng Dian

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**Abstract:** Meng Yao Zheng Dian is one of the three classics of Mongolian medicine. It was written by Zhanbra Dorje, who was a famous Mongolian physician. The book was not only related to the author's origin, education and learning experience, but also closely related to the social development, cultural exchanges between Mongolian and Tibet, and people's demand for Mongolian medicine at that time. The book in four languages indicates the name of Mongolian medicinal herbs, Mongolian, Tibet, Chinese, Manchu medicine academic and cultural exchanges played a positive role in promoting the cultural exchanges, is a vivid embodiment of the cultural exchanges between Chinese nationalities and exchanges and mingling.

**Keyword:** Zhanbra Dorje; Meng Yao Zheng Dian; Background of the book

**Online publication:** March 10, 2025

## 1. Introduction

"Mongolian Medical Canon" is a specialized monograph on Mongolian medicine written by Jambaldorji, a Mongolian medical scientist in the 19th century (1792–1855). It is known as one of the three classic works of Mongolian medicine and holds an important academic position in the history of Mongolian medicine. The full title of "Mongolian Medical Canon" translates to "Medicinal Nectar for Healing Diseases: Accurate Identification and Skillful Insight Manifesting Marvelous Forms, Adorned with Beautiful Eyes." It is abbreviated as "Ugis Gulung Tudun Chimuge" in Mongolian and "Mdzes mtshar mig rgyan" in Tibetan, meaning "Beautiful Eye Ornament." There are numerous Chinese translations with titles such as "Accurate Mirror Dictionary," "Tibetan-Chinese Drug Name Comparison," "Mongolian Medical Chapter Illustrations," "Mongolian Medical Illustrations," "Accurate Mongolian Medical Identification," "Correct Drug Identification Illustrations," and "Revised Drug Identification Illustrations" <sup>[1]</sup>. Different titles used by people in various periods or regions reflect the academic influence of this book. Nowadays, it is commonly referred to as "Mongolian Medical Canon" <sup>[2]</sup>. In the 1960s, it was translated

into Mongolian by Gendunzalasen from the IHH (now Ordos City) Mongolian Medical Research Institute and circulated internally within the institute. It was translated into English and published in New Delhi, India, in 1971, and into Russian, published in Western Siberia, Russia, in 1985<sup>[3]</sup>. In July 1988, the Mongolian version, translated by Gendunzalasen, was officially published for the first time by the Inner Mongolia People's Publishing House under the title "Accurate Mongolian Medical Identification"<sup>[4]</sup>. Chinese translations edited by Liu Baiyila and translated and annotated by Luobusang and Xu Chang were published by the Ethnic Publishing House and the Inner Mongolia People's Publishing House in 2006<sup>[1,5]</sup>.

## **2. Main contents of "Mongolian Medical Canon"**

The main body of "Mongolian Medical Canon" consists of four parts: the first is the "Fundamental Medical Canon" represented through a tree metaphor; the second is an illustration of drugs and the shapes of instruments; the third is the measurement and vital points of the body; and the fourth is bloodletting, moxibustion, and acupuncture points. The "Fundamental Medical Canon" is the first part of the Tibetan medical classic "Four Medical Classics." It summarizes the content of the entire book. In Chapter 6, "Classification by Analogy," the content of the "Fundamental Medical Canon" is structured like a tree, with roots, trunks, branches, and leaves, divided into 3 roots, 9 trees, 47 branches, and 224 leaves, along with 2 flowers and 3 fruits. The first section of the "Mongolian Medical Canon" comprises 9 tree metaphor diagrams and related explanations. This is the first time in Mongolian medical literature that the content of the tree metaphor method has been visually represented through illustrations. The second section, which focuses on drug illustrations and the shapes of instruments, is the main content of the book. It is divided into nine chapters, covering treasure drugs, soil drugs, stone drugs, tree drugs, essence drugs, herbal drugs, plain drugs, animal drugs, water and fire drugs, and the shapes of instruments. The book records 879 types of Mongolian medicinal materials, comprehensively and systematically explaining the source, origin, growth environment, form, taste, function, primary treatment, medicinal parts, harvesting season, processing methods, usage, and identification methods of specific medicinal materials. It includes 579 drug illustrations, most of which are labeled in Chinese, Mongolian, Tibetan, and Manchu. The author intends to correct the confusion caused by misidentification or inconsistency in medicine names at that time. The third part deals with body measurements and vital points, divided into four sections: skull, neck, body cavity, and limbs. Graphics of the front and back of the entire body are plotted on a straight-line grid to determine the length, proportion of each body part, and vital areas. The fourth section focuses on bloodletting, moxibustion, and acupuncture points. Many exquisite medical instruments are illustrated, and two images of the front and back of the entire body indicate bloodletting acupuncture points, moxibustion acupuncture points, and puncture acupuncture points<sup>[6]</sup>.

"Mongolian Medical Canon" is a complete and systematic classic work on Mongolian medicine. It is also the most comprehensive, richest, and most distinctive classic among Mongolian medical ancient books on herbal medicine<sup>[7]</sup>.

## **3. Background of the compilation of "Mongolian Medical Classics"**

### **3.1. Social background**

The social background lays the foundation for the compilation of "Mongolian Medical Classics." Since the mid-16th century, with the strong support of ruling classes throughout history, Tibetan Buddhism Gelug Sect (Yellow



Hat Sect) has been widely spread in Mongolia. Emperor Qianlong directly stated the reason for promoting the Yellow Hat Sect: “Our dynasty maintains the Yellow Hat Sect because the Mongolians have always been devoted to it, showing respect and adapting to local customs”<sup>[8]</sup>. In Emperor Qianlong’s “Imperial Lama Doctrine,” a policy paper addressing Lamaism, he mentioned, “Promoting the Yellow Hat Sect is to appease the Mongolians. This is of great significance, so it is important to protect it, unlike the excessive flattery and worship of Tibetan monks during the Yuan Dynasty”<sup>[9]</sup>. Numerous historical records prove that the establishment of exchanges and interactions between the Mongolian and Tibetan nations was preceded by politics rather than religion. Since the Qing government began promoting the Yellow Hat Sect, temples have been widely built in Mongolia. In the mid-Qing Dynasty, there were about 1,500 Lamaist temples in Inner Mongolia, with around 200,000 lamas<sup>[10]</sup>. As the number and scale of temples continued to grow, many large temples established specialized institutions for medical education - the Manbazhacang. Most of these Manbazhacang were built during the Qianlong period, such as Chifeng Qingzhen North Temple (1739), Xilinhot’s Beizimiao (1743), Baotou Wudangzhao (1749), Alashan Guangzong Temple (1756), and Xilin Gol League’s Lamakule Temple (1781), which produced many famous Mongolian medical experts<sup>[10]</sup>. Initially, the Manbazhacang in Mongolia largely drew on the Tibetan medical model, both in terms of organizational structure and teaching content<sup>[11]</sup>. Many medical works, including “Mongolian Medical Classics”, were also written in Tibetan.

Tibetan and Mongolian medicine is set in the context of Buddhist culture. The founder of the Gelug Sect, Master Tsongkhapa, was proficient in medicine. Before establishing the sect, he promoted Buddhist thought among the people through medical practice, inspiring many later lamas to reach the masses through medicine for the purpose of missionary work<sup>[12]</sup>. Although the Qing Dynasty was established by ethnic minorities, its temporary prosperity during the “Kangxi-Qianlong Flourishing Age” was closely related to its tolerance, appreciation, and cultivation of Han culture. To further its interests, the ruling class of the Qing Dynasty, while maintaining the subjective consciousness of Manchu culture, strived to absorb the essence of Han, Mongolian, and Tibetan cultures through political advantages. By actively learning, referencing, and drawing on various ethnic cultures while maintaining its own identity, the Qing Dynasty facilitated deep communication and exchange between Manchu, Han, Tibetan, Mongolian, and Hui cultures in a relatively harmonious manner, ultimately playing a significant role in promoting the development of traditional Chinese culture.

Zhanbuladaorji, the author of “Mongolian Medical Canon,” was born in the 57th year of the Qianlong Emperor’s reign (1792) and passed away in the 5th year of the Xianfeng Emperor’s reign (1855). He lived through the reigns of four emperors: Qianlong, Jiaqing, Daoguang, and Xianfeng. At that time, the Qing government, which had just experienced the Kangxi-Qianlong period of prosperity, entered a stable period. Buddhist culture flourished in China, and Mongolian medicine also experienced its best development phase. Although Mongolian medicine and Tibetan medicine belonged to the same medical system and were difficult to distinguish, due to geographical relationships, Mongolian medical practitioners gradually increased their interactions with the Han Chinese regions. Luobusangquedan mentioned in his “Mongolian Customs Mirror” the scene of Mongolian doctors purchasing Chinese herbs at that time: “Mongolian doctors’ medical books are all in Tibetan, and they buy medicines from the Han people. The herbal medicines grown in Mongolia are not very effective in treating diseases. Therefore, well-trained Mongolian doctors need to familiarize themselves with the shapes of the medicines from books, and then go to Han medicine shops to buy them. Although they may not speak Chinese, they can still buy various medicines by comparing them with the illustrations (it is very difficult for a doctor who does not recognize medicines). This shows that Mongolian doctors often go to the city to buy medicines from

Chinese medicine shops or seek to purchase them from medicine dealers. For Mongolian doctors with low cultural levels or who are not proficient in Chinese, this is extremely difficult, and they can only rely on the illustrations of medicinal herbs in books to purchase medicines. Among them, there are also many who have been deceived. This is a social phenomenon that emerged in this special historical period. People gradually realized that there was an urgent need for a Mongolian medicinal herb dictionary with Tibetan-Chinese comparisons to solve this social problem. The first person to notice this issue was the famous Mongolian scholar Gunbuzhabu. Gunbuzhabu, a native of Xiwuzhumuqin Banner in Xilin Gol League, was the governor of the Tanggute Official School in Beijing at that time. He took advantage of his convenient conditions, widely collected data, and compiled the book “Tibetan and Chinese Medicinal Names,” which included 381 Mongolian medicinal herb names in a Tibetan-Chinese comparison format. The author expressed his intention to edit and publish in the postscript, broadly speaking, “for the benefit of all sentient beings through medicine in Mongolia,” and narrowly speaking, “so that buyers can avoid mistakenly purchasing or being deceived among the many varieties of medicinal herbs in large pharmacies.” To this end, he visited doctors of various sizes, collected literature both on and off campus, and conducted detailed research. “Although some medicines may differ in shape or color from Tibetan medicines, their functionality is not affected,” indicating that some different medicinal herbs are not replaced arbitrarily. This is the mistake mentioned in the “Mongolian Medical Canon” that needs to be corrected due to clerical errors made by people like Gunbuzhabu.

In 1988, when the Mongolian book “Mongolian Medical Classics” was published, it was named “The Accurate Identification of Mongolian Medicine.” From the title, “accurate” means without error, indicating the author’s intention to precisely identify Mongolian medicines, which is precisely the purpose of writing this book. In the book, the author mentioned: “Currently, even we who live in the border areas have not seen many interpretations, or there are many errors due to not inheriting the techniques of superior doctors. The main reason is the failure to correct material differences, or due to writing errors such as those made by Gunbujab and others.” At that time, there were many confusions and errors in the names of Mongolian medicines in Inner Mongolia. The author wrote in the preface: “Some people say that silver vermilion was mistakenly written as mercury, malachite was mistakenly written as ochre, yellow lead was mistakenly written as yuliang soil, fresh ginger was mistakenly written as galangal, shegan was mistakenly written as boling melon seeds, silver vermilion was mistakenly written as red powder, orpiment was mistakenly written as hollyhock root, celery seeds were mistakenly written as independent living seeds, leeches were mistakenly written as cantharides, and abalone shells were mistakenly written as pearls, coptis was mistakenly written as groundsel, etc. It also mentioned that modern doctors also adhere to their own knowledge of medicine, and there are differences among them. So, different understandings of medicine are also common. Some mistakenly write Fule as nutmeg, boling melon seeds as sow thistle, Guang Muxiang as Chuan Muxiang, Caowuye as Senba, Datangye Yunshi as gorgon fruit, dried ginger as galangal, and Huangqin as sweet basil, etc. In view of the spread of falsehoods, the author wants to correct the mistakes and combine the interpretation of medical books with the author’s experience, so this book was compiled.” Due to cultural differences, coupled with the fact that many drugs are produced in the south and are not available in Mongolia at all, coupled with the fact that Mongolian doctors often mispurchase or buy the wrong medicine due to language barriers, it is very common for many commonly used drugs to be replaced by other drugs, or even misidentified and misused. Jambuldorji was born in Mongolia and later took vows and became a disciple at the Tashilhunpo Monastery in Tibet. He was very familiar with the phenomenon of mispurchasing or buying the wrong items at that time. From this, we can see that the author’s motivation for writing is to correct mistakes and

ensure the efficacy of Mongolian medicine by correctly understanding it.

### 3. Academic background

The formation and development of Mongolian medicine have undergone a long period of time. However, due to the late creation of the Mongolian script, records of medical activities can only be found scattered in classics written in other ethnic languages. For example, the “Yellow Emperor’s Inner Canon” states, “The northern region is where heaven and earth conceal and store things. The land is high and inhabited by winds, cold, and ice. People enjoy living in the wilderness and eating dairy products. Diseases caused by cold accumulation are common, and the treatment should involve moxibustion. Therefore, moxibustion techniques also originate from the north”<sup>[15]</sup>. The “north” mentioned here includes the northern ethnic groups, including the Mongolians. These treatment methods, such as moxibustion, self-comfort by burning stones, lying on burned ground, and bleeding by cutting veins, were distinctive therapeutic approaches of the northern ethnic groups (including the Mongolians) at that time. With the development of primitive animal husbandry, such simple medical activities also became more frequent. By the 8th century AD, the moxibustion technique originating from the “north” was introduced into Tibet and was called “Mongolian Moxibustion” by Yutuo Yuandan Gongbu, who recorded it in the “Four Tantras”. The 13th century marked a peak period in the development of Mongolian medicine, with the emergence of famous physicians and works. For instance, Shatu Musu and his “Ruizhu Tang Experience Prescriptions,” as well as the court dietitian Husihui and his “Essentials of Diet and Therapeutics,” are representatives of this period. With the introduction of the Gelug sect of Tibetan Buddhism into Mongolia, many classic works of Tibetan medicine also arrived. In the 17th century, during the 1640s, after the Manchu rulers entered Shanhaiguan and established the Qing Dynasty, Mongolian medicine experienced unprecedented development, giving rise to a large number of Mongolian medical experts and works<sup>[16]</sup>. Starting from the 17th and 18th centuries, traditional Mongolian medicinal knowledge was further enriched, drawing from the pharmaceutical knowledge of Tibetan, Han, and other ethnic groups as well as Indian medicine, leading to significant progress in Mongolian pharmacology. During this period, a group of researchers emerged in the field of medicine and pharmacology, who authored numerous monographs on Mongolian pharmacology and prescriptions. For example, “Twenty-Five Formulas Collection” by Luobusangdanjinzalacang (1639–1704), known as the “First Outstanding Doctor of Mongolia,” is an early monograph on prescriptions. Subsequently, works such as “Identification of Medicinal Herbs: Bai Jing Jian” by Yixibalajier (1704–1788) and “Knowledge of Pharmacology” by Luobusengsulehemu (1740–1810) appeared, marking significant contributions to Mongolian pharmacology.

The emergence of “Mongolian Medical Canon” in the mid-19th century is considered a relatively complete classic work. This is because Jambaladorji referenced numerous predecessors’ works, compiled his practices based on extensive research, and integrated them into the book. Of course, the classic Tibetan pharmacology work “Jingzhu Bencao” had a significant influence on him. After mastering the theoretical knowledge of medicine from this work, Jambaladorji discovered severe confusion in the use of medications in Mongolian regions. To address this, he also referenced classic works such as “Ancestral Teachings,” “Golden Light Annotation Collection,” “Crystal Mirror,” and “Four Tantras.” His research scope not only encompassed classic works of Mongolian and Tibetan medicine, such as “Wu Gou Shui Jing Huan,” “Commentary on Medical Classics: Shan Lun Jin Shi,” “Blue Glazed Tile,” and “Subsequent Annotation on Medical Classics: Jin Gang Jie Zhu,” but also included many ancient Indian medical classics, such as “Eight Branches of Medical Scripture,” “Explanation of Eight Branches of Heart

and Marrow Medicine,” “Elucidation of Sentences from Eight Branches of Heart and Marrow by Moonlight,” “Hundred Prescriptions,” “Medicine Rituals of Apo,” “Essentials of Pharmaceutical Achievements,” and over 120 other related ancient books <sup>[17]</sup>.

“Mongolian Materia Medica” is known as the “Compendium of Materia Medica” in the field of Mongolian medicine. Its classification differs from that of the “Compendium of Materia Medica” and also differs from the referenced works such as “Jingzhu Bencao” and “Four Medical Classics” <sup>[18,19]</sup>. Taking the classification of herbal medicines as an example (**Table 1**), the classification method of roots, leaves, flowers, fruits, and stems in the “Mongolian Materia Medica” is more closely aligned with the retrieval table of modern botanical classification methods. The plant retrieval table is a tool for identifying plants. The method of compiling the retrieval table often involves using plant morphology comparison methods, selecting a pair of distinctly different characteristics according to the criteria and features for dividing families, genera, and species, and dividing plants into two categories, such as dicotyledons and monocotyledons. Then, relative characteristics are sought from each category to further distinguish them into two more categories. This process continues until the families, genera, and species are finally separated <sup>[20]</sup>. Thus, it can be seen that the classification method of the “Mongolian Materia Medica” is closer to modern scientific classification methods. “The study of Chinese medicine has deep roots in ancient times and has its unique efficacy and value. The use of medicine is half reliant on drugs, and plants account for the absolute majority of traditional Chinese medicine <sup>[21]</sup>. Although the “Mongolian Materia Medica” is ancient, it is highly academically valuable and is a revered classic among Mongolian medicine scholars throughout the ages. It is a local herbal medicine with great value and wide influence in the history of Mongolian medicine, and it is also a relatively complete and practical work among the regional herbal books of Mongolia and Tibet.

**Table 1.** Classification of herbal medicines

Four Medical Classics	Compendium of Materia Medica	Jingzhu Bencao	Mongolian Materia Medica
Directly divided into 108 types of herbal medicines based on specific properties	Herbal Medicine 1 (31 types of mountain herbs, upper part)	64 types of wetland herbs	25 types of root medicines
	Herbal Medicine 2 (39 types of mountain herbs, lower part)	Upland herbs: 20 types of root medicines	15 types of leaf medicines
	Herbal Medicine 3 (56 types of fragrant herbs)	Upland herbs: 16 types of leaf medicines	21 types of flower medicines
	Herbal Medicine 4 (53 types of marsh herbs, upper part)	Upland herbs: 21 types of flower medicines	24 types of fruit medicines
	Herbal Medicine 5 (73 types of marsh herbs, lower part)	Upland herbs: 20 types of fruit medicines	32 types of medicines using leaves, stems, flowers, and fruits together
	Herbal Medicine 6 (47 types of poisonous herbs)	Upland herbs: 25 types of whole-plant medicines	using roots, leaves, flowers, and fruits 20 types of medicines using roots, stems, leaves, flowers, and fruits together
	Herbal Medicine 8 (73 types of vine herbs)		23 types of crop medicines
	Herbal Medicine 9 (19 types of stone herbs)		
	Herbal Medicine 10 (16 types of mosses)		
	Herbal Medicine 11 (9 types of weeds)		



### 3.3. Family background

The reason why Jambaldorji, the author of “Mongolian Medical Classics,” was able to write this book is directly related to his upbringing, the education he received from a young age, and his life experiences. Jambaldorji was born into the aristocratic Balachuk family in Naiman Banner, the former Zhaowuda League in Inner Mongolia, and his father was the Zasag Noyan. According to the “Naiman Banner Chronicles,” the origin of Naiman Banner can be traced back to the Naiman tribe of the 13th century. In the 16th century, some Naiman people moved east to the western Liaoning region. They submitted to the Qing government in 1627, and in 1636, Taiji Guan Qige was ennobled as the Zasag Prince of Naiman Banner. In 1720, Jambaldorji’s great-grandfather, Asala, became the seventh Zasag King. His grandfather, Lawanglabutan, succeeded him as the Zasag King in 1757 and ruled Naiman Banner for 46 years, making him the longest-serving Zasag King of Naiman Banner. In 1803, Jambaldorji’s father, Balachuk, the second son of Lawanglabutan, succeeded him as the ninth Zasag Prince. Initially, to preserve the Manchu language and script, the Qing government established Eight Banner official schools and free schools, as well as schools specifically for the poor and servants’ children under the Ministry of Rites and hereditary official schools. Manchu language and literature were core courses in these schools. Jambaldorji was intelligent and eager to learn from a young age, starting to study Mongolian and Manchu at the age of 7. At 16, he became an official under the Naiman Banner commander. He began studying Tibetan at 23, learned Buddhist scriptures such as the “Bodhi Path Theory” under a teacher, became a devout Buddhist, and later received the layman’s precepts. At 27, he visited the Tashilhunpo Monastery in Tibet for the first time, became a disciple of Lazhiba Yixidansen, received the novice precepts, and officially became a monk. Later, he studied five classic philosophical works that are compulsory for Gelugpa Geshe at the Drepung Monastery in Lhasa: “Prajnaparamita,” “Middle Way Theory,” “Interpretation of Quantity Theory,” “Abhidharma Theory,” and “Precepts.” At 33, he returned to his hometown, practiced in solitude for a year, and then went to Mount Wutai to practice the Great Terror Vajra. After returning to Naiman Banner, he studied the Four Tantras of the Esoteric School under a teacher, received the empowerment, and wrote the “Ritual Orbit of the Four Tantras - Wish-fulfilling Pearl” in two volumes. After the age of 55, he lectured on scriptures and dharma among the Gelugpa apprentices at the Drepung Monastery and Gaden Monastery, imparting the “Annotation on the Path of Secret Mantras” and the “Thirteen Golden Sutras.” He passed away in Tibet at the age of 64 in 1855.

From the personal growth experience of Jambal Dorji, we can see that he was born into an official family and received a good education from childhood. He was open to learning, diligently seeking advice, and working hard to study. He was a devout Buddhist in his early years, and he persisted in practicing Buddhism in his middle age. For nearly 40 years, he studied scriptures extensively, learned from more than 150 masters, systematically studied Buddhist knowledge, and became proficient in the “Five Sciences,” making him one of the renowned scholars circulating in Mongolian society at that time. Moreover, he had profound medical knowledge, was proficient in Chinese, Mongolian, Manchu, and Tibetan languages, and could browse various documents, laying a solid foundation for his later work, “Pharmacopoeia of Mongolian Medicine.” Jambal Dorji’s personal knowledge, expertise, and abilities became the basic conditions for him to write and publish books.

## 4. Conclusion

“Pharmacopoeia of Mongolian Medicine” has been circulating for more than 170 years, and it has had a significant impact on the Mongolian medical community since its publication. Its creation is not only related to the



political, social, and cultural background of the Qing Dynasty and the level of medical and cultural development but is also closely related to the medical environment and development in Mongolian and Tibetan regions. The background of the book's creation is inseparable from the combined effects of social development, medical needs, and personal factors at that time. If the social background provides motivation and opportunities for writing this book, the academic background is the basic condition for writing it. Jambal Dorji's personal growth experience and knowledge abilities make this book a classic. "Pharmacopoeia of Mongolian Medicine" not only has high academic and practical value but also promotes the exchange and integration of medical cultures among various ethnic groups. Traditional medicine is an indispensable part of the traditional folk knowledge system and is a valuable intangible cultural heritage. As a traditional medicine, Mongolian medicine has distinct regional and cultural characteristics worthy of our time and effort to study.

## Funding

General project of the National Social Science Foundation, "Research on the History of Exchanges between Traditional Chinese Medicine and Mongolian Medicine from the Perspective of Strengthening the Consciousness of the Chinese Nation's Community" (Project No.: 21BMZ078)

## Disclosure statement

The authors declare no conflict of interest.

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# Clinical Study on Treating Diarrhea-Predominant IBS with Liver Depression and Spleen Deficiency Using Shu Gan Jian Pi Yi Qi Prescription and Grain-Sized Moxibustion

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**Abstract:** *Objective:* To evaluate the therapeutic effect of Shu Gan Jian Pi Yi Qi prescription combined with grain-sized moxibustion on diarrhea-predominant irritable bowel syndrome (IBS-D) with liver depression and spleen deficiency syndrome. *Methods:* 60 patients with IBS-D (liver depression and spleen deficiency syndrome) treated in the outpatient clinic from January 2021 to December 2023 were selected and randomly divided into two groups using a random number table. The combined group was treated with Shu Gan Jian Pi Yi Qi prescription and grain-sized moxibustion, while the reference group was treated with western medication. The total effective rate, IBS symptom severity score (IBS-SSS), Bristol stool scale score, and IBS-specific quality of life questionnaire (IBSQOL) were compared between the two groups. *Results:* The total effective rate of the combined group was higher than that of the reference group ( $P < 0.05$ ). Before treatment, there were no differences in IBS-SSS score, Bristol stool scale score, and IBSQOL score between the two groups ( $P > 0.05$ ). After treatment, the IBS-SSS score and Bristol stool scale score of the combined group were lower than those of the reference group, while the IBSQOL score was higher ( $P < 0.05$ ). *Conclusion:* Shu Gan Jian Pi Yi Qi prescription combined with grain-sized moxibustion can improve the symptoms of IBS-D patients, including stool characteristics, and enhance their quality of life.

**Keywords:** Shu Gan Jian Pi Yi Qi prescription; Grain-sized moxibustion; Diarrhea-predominant irritable bowel syndrome; Liver depression and spleen deficiency syndrome

**Online publication:** March 6, 2025

## 1. Introduction

Irritable Bowel Syndrome (IBS) is a gastrointestinal disease with a high incidence rate, characterized by intermittent or persistent diarrhea and abdominal pain. It mostly occurs in young and middle-aged populations,

with a predominance of female patients. IBS-D is a common type of IBS, which often has a long course and is accompanied by symptoms such as depression and sleep disorders <sup>[1]</sup>. In traditional Chinese medicine, IBS-D belongs to the category of “diarrhea” and is mainly caused by liver depression and spleen deficiency syndrome. The treatment principles include soothing the liver, strengthening the spleen, and nourishing Qi. Shu Gan Jian Pi Yi Qi prescription is often selected for this purpose. Simultaneously, combining grain-sized moxibustion can regulate Qi and blood, dredge meridians, and improve symptoms such as diarrhea. Furthermore, the combined use of these two traditional Chinese medicine therapies can fully utilize the pharmacological effects of Chinese herbal medicines through thermal action, thereby enhancing clinical efficacy. Based on this, the present study selected 60 patients with IBS-D (liver depression and spleen deficiency syndrome) to evaluate the therapeutic efficacy of Shu Gan Jian Pi Yi Qi prescription combined with grain-sized moxibustion.

## 2. Materials and methods

### 2.1. General information

Sixty patients with IBS-D (liver depression and spleen deficiency syndrome) treated from January 2021 to December 2023 were selected and randomly divided into two groups using a random number table. The combined group consisted of 30 patients, including 19 males and 11 females, with ages ranging from 24 to 75 years (mean age:  $54.86 \pm 4.18$  years old) and a disease duration of 7 months to 9 years (mean duration:  $5.18 \pm 1.37$  years). The reference group consisted of 30 patients, including 18 males and 12 females, with ages ranging from 23 to 77 years (mean age:  $54.94 \pm 4.27$  years old) and a disease duration of 8 months to 10 years (mean duration:  $5.33 \pm 1.42$  years). There were no significant differences in general information between the two groups ( $P > 0.05$ ).

Inclusion criteria: Patients who met the diagnostic criteria of Rome IV, were diagnosed with liver depression and spleen deficiency syndrome, were less than 80 years old, had complete clinical data, and were informed and consented to the study. Exclusion criteria: Patients who received Chinese and Western medicine treatment in the past month, had a history of intestinal surgery, had other types of intestinal diseases, were in lactation or pregnancy, had insufficient liver and kidney function, or suffered from mental illnesses.

### 2.2. Methods

The combined group was treated with Shu Gan Jian Pi Yi Qi prescription and grain-sized moxibustion. The self-made Shu Gan Jian Pi Yi Qi prescription consisted of the following herbs: Huangqi (10 g), Chuanxiong (6 g), Baizhu (15 g), Xiangfu (6 g), Sharen (6 g), Lianzirou (15 g), Dangshen (10 g), Shanyao (6 g), Yinyiren (15 g), Chenpi (6 g), Chaihu (10 g), Baibiandou (10 g), Fuling (6 g), Baishao (6 g), and Zhigancao (6 g). These herbs were made into granules and dissolved in 60 °C water to a volume of 150 mL. One dose was taken twice a day after meals. Additionally, grain-sized moxibustion was applied to Guanyuan, Zusanli, Dachangshu, Zhongwan, Taichong, Tianshu, Pishu, and Baihui acupoints. A suitable amount of mugwort floss was made into grain-sized conical moxa cones. A small amount of water was sprinkled on the acupoints, and then the moxa cones were adhered and ignited with incense. Seven moxa cones were ignited on each acupoint. After treatment, patients were instructed not to burst the moxibustion blisters to allow for full absorption. The treatment was performed three times a week.

The reference group was treated with Western medication. They were given Pinaverium Bromide tablets orally, with a dose of 50 mg each time, three times a day, taken with meals and swallowed whole. Both groups

underwent a treatment course of 4 weeks, which was repeated for 3 courses.

### 2.3. Observation indicators

- (1) IBS-SSS Score: The score includes indicators such as abdominal pain frequency, abdominal pain symptoms, bowel satisfaction, abdominal distension, and impact on quality of life. Each item is rated on a scale from asymptomatic (20 points), not very severe (40 points), slightly severe (60 points), severe (80 points), to very severe (100 points) based on severity.
- (2) Bristol Score: 1 point for hard, lumpy stools; 2 points for sausage-shaped stools; 3 points for dry, cracked sausage-shaped stools; 4 points for soft, sausage-shaped stools; 5 points for soft blobs; 6 points for muddy stools; and 7 points for watery diarrhea.
- (3) IBSQOL Score: It includes 8 items such as conflict behavior, health concerns, restlessness, and dietary restrictions. The total score for each dimension is converted to a percentage system, with a positive score for quality of life.

### 2.4. Criteria for evaluating therapeutic effect

Complete recovery indicates normal gastrointestinal function with no related symptoms. Significant efficacy indicates normal stool characteristics, reduced frequency, and significant symptom relief. Initial efficacy indicates improvement in stool characteristics, reduced frequency, and some symptom relief; no efficacy indicates no change in stool characteristics or frequency, and no symptom relief.

### 2.5. Statistical analysis

Data were processed using SPSS 28.0 software. Measurement data were expressed as mean  $\pm$  standard deviation (mean  $\pm$  SD) and compared using the *t*-test. Count data were expressed as numbers and percentages (*n*/% ) and compared using the chi-square ( $\chi^2$ ) test. Statistical significance was set at  $P < 0.05$ .

## 3. Results

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

The total effective rate of the combined group was higher than that of the reference group ( $P < 0.05$ ) (Table 1).

**Table 1.** Comparison of total effective rate between two groups (*n*/%)

Grouping	<i>n</i>	Complete recovery	Significant efficacy	Initial efficacy	No efficacy	Total effective rate
Combined group	30	13	10	6	1	96.67% (29/30)
Reference group	30	10	8	5	7	76.67% (23/30)
$\chi^2$	-	-	-	-	-	5.192
<i>P</i>	-	-	-	-	-	0.023

### 3.2. Comparison of IBS-SSS scores between two groups

Before treatment, there was no difference in IBS-SSS scores between the two groups ( $P > 0.05$ ). After treatment, the IBS-SSS score of the combined group was lower than that of the reference group ( $P < 0.05$ ) (Table 2).



**Table 2.** Comparison of IBS-SSS scores between two groups (mean  $\pm$  SD /score)

Grouping	<i>n</i>	Before treatment	After treatment
Combined group	30	371.31 $\pm$ 48.61	182.44 $\pm$ 21.61
Reference group	30	370.98 $\pm$ 50.81	207.63 $\pm$ 22.73
<i>t</i>	-	0.026	4.399
<i>P</i>	-	0.980	0.000

### 3.3. Comparison of Bristol scores between two groups of patients

Before treatment, there was no difference in Bristol scores between the two groups ( $P > 0.05$ ). After treatment, the Bristol score of the combined group was lower than that of the reference group ( $P < 0.05$ ) (Table 3).

**Table 3.** Comparison of Bristol scores between two groups of patients (mean  $\pm$  SD /score)

Grouping	<i>n</i>	Before treatment	After treatment
Combined group	30	5.89 $\pm$ 1.34	3.87 $\pm$ 0.71
Reference group	30	5.91 $\pm$ 1.36	4.76 $\pm$ 0.82
<i>t</i>	-	0.057	4.494
<i>P</i>	-	0.954	0.000

### 3.4. Comparison of IBSQOL scores between two groups of patients

Before treatment, there was no significant difference in IBSQOL scores between the two groups ( $P > 0.05$ ). After treatment, the IBSQOL score of the combined group was higher than that of the reference group ( $P < 0.05$ ) (Table 4).

**Table 4.** Comparison of IBSQOL scores between two groups of patients (mean  $\pm$  SD /score)

Grouping	<i>n</i>	Before treatment	After treatment
Combined group	30	75.29 $\pm$ 4.91	89.35 $\pm$ 6.10
Reference group	30	75.18 $\pm$ 4.86	84.12 $\pm$ 6.02
<i>t</i>	-	0.087	3.342
<i>P</i>	-	0.931	0.001

## 4. Discussion

IBS-D (syndrome of liver stagnation and spleen deficiency) falls under the category of “diarrhea” in traditional Chinese medicine. The causes are related to dietary indiscretion harming the spleen and stomach, constitutional weakness affecting the spleen, and its pathogenesis associated with factors such as liver Qi stagnation, emotional imbalance, and water-dampness retention<sup>[2]</sup>. The disease locus lies in the kidneys, intestines, and spleen, requiring symptomatic treatments like meridian dredging, warming the kidneys and strengthening the spleen, stopping diarrhea, and dispelling cold.

The self-prescribed formula for soothing the liver, strengthening the spleen, and nourishing Qi is a commonly used traditional Chinese medicine prescription for this disease. It can be administered orally to soothe the liver, regulate Qi, and relieve pain. This prescription is based on Shenling Baizhu Powder combined with methods to

soothe the liver and relieve depression, with the therapeutic goal of nourishing qi and strengthening the spleen [3]. In this formula, Baizhu, Dangshen, and Fuling are the principal herbs, capable of strengthening the spleen, stimulating appetite, promoting urination and dampness dispersion, and nourishing Qi and generating fluids. Yiyiren and Baibian dou are the minister herbs, which can play a role in strengthening the spleen and dispersing dampness. Other herbs serve as assistants, where Chuanxiong and Xiangfu can soothe the liver, regulate Qi, relieve pain, and promote blood circulation. Chaihu has effects such as removing blood stagnation, relieving depression, and promoting Qi and blood circulation. Next, Chenpi has effects like promoting Qi circulation and regulating Qi stagnation. In addition, Huangqi and Gancao can nourish Qi and neutralize its medicinal properties. Baishao has the function of softening the liver and nourishing blood [4]. The combination of these herbs can promote Qi circulation, nourish Qi, and strengthen the spleen, nourishing the liver and stomach while soothing the liver, thereby restoring gastrointestinal function.

Grain-sized moxibustion is one of the classic moxibustion methods, and its effect is to regulate Qi and blood and warm the meridians. Among the selected acupoints, Guanyuan and Pishu are commonly used acupoints for treating diarrhea. Moxibustion on these acupoints has effects such as strengthening the spleen and stopping diarrhea. The combination of Guanyuan and Zusanli is considered a strengthening acupoint, which can play a role in consolidating the foundation and cultivating the original Qi, and enhancing physical fitness [5]. Dachangshu belongs to the large intestine meridian, and Tianshu belongs to the Back-shu point. The combination of the two can improve the physiological functions of the internal organs. Zhongwan is a stomach meridian point of the Ren meridian, which can improve gastrointestinal and nervous system functions. Taichong belongs to the liver meridian, and moxibustion on this acupoint can regulate qi and blood and soothe the liver to relieve depression [6]. Baihui can reach the Yin and Yang meridians, and moxibustion on this acupoint has a calming effect. Combining traditional Chinese medicine prescriptions with grain-sized moxibustion can soothe the liver, stop diarrhea, nourish Qi, and strengthen the spleen [7].

The results showed that the total effective rate of the combined group was higher than that of the reference group ( $P < 0.05$ ). This is basically consistent with the research results of Wu (2024) [8]. After treatment, the IBS-SSS score and Bristol score of the combined group were lower than those of the reference group, and the IBSQOL score was higher than that of the reference group ( $P < 0.05$ ). The reason is that the formula for soothing the liver, strengthening the spleen, and nourishing Qi has an anti-inflammatory mechanism, can enhance spleen and stomach function, improve the digestive and absorptive capacity of the gastrointestinal tract, and thereby relieve symptoms such as abdominal distension and diarrhea. Moreover, the formula can exert antioxidant and antibacterial effects, exerting multiple therapeutic mechanisms [9,10]. Combining grain-sized moxibustion can achieve both internal and external treatment, treating the disease in a coordinated manner with a holistic view and local treatment, which can significantly improve patients' disease symptoms and maximize their quality of life.

In summary, the combination of the formula for soothing the liver, strengthening the spleen, and nourishing Qi with grain-sized moxibustion can improve the disease symptoms of patients with IBS-D (syndrome of liver stagnation and spleen deficiency), increase the total effective rate, and benefit the improvement of quality of life, possessing high therapeutic value.

## Funding

Inner Mongolia Autonomous Region Education Science 14th Five-Year Planning Project (Project No.:

## Disclosure statement

The authors declare no conflict of interest.

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Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Study on the Clinical Effect of Percutaneous Vertebroplasty in the Treatment of Old Unstable Osteoporotic Spinal Fractures

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**Abstract:** *Objective:* To evaluate and analyze the actual efficacy of percutaneous vertebroplasty in the treatment of old unstable osteoporotic spinal fractures. *Methods:* From March 2023 to March 2024, 46 patients with old unstable osteoporotic spinal fractures in our hospital were included in this study. They were divided into the conventional group and the observation group based on treatment differences, with 23 patients in each group. The conventional group received conservative drug therapy, while the observation group underwent percutaneous vertebroplasty. The following indicators were compared and analyzed between the two groups: clinical treatment effect and improvement in physical function indicators. *Results:* The treatment efficiency of the observation group was 95.65% (22/23), while that of the conventional group was 69.57% (16/23). There was a significant difference between the groups, and the treatment effect of the observation group was significantly better ( $P < 0.05$ ). After treatment, the scores of physical status, daily living ability, functional independence, and life obstacles in the observation group were  $(89.33 \pm 4.08)$ ,  $(88.72 \pm 4.08)$ ,  $(90.41 \pm 2.89)$ ,  $(72.35 \pm 3.22)$ , respectively, while those in the conventional group were  $(68.54 \pm 4.21)$ ,  $(67.42 \pm 4.11)$ ,  $(73.48 \pm 2.75)$ ,  $(72.35 \pm 3.22)$ . There was a significant difference between the groups, and the improvement in physical function indicators in the observation group was more pronounced ( $P < 0.05$ ). *Conclusion:* For patients with old unstable osteoporotic spinal fractures, the basic value of percutaneous vertebroplasty is significant. It can not only improve clinical efficacy and safety but also promote the gradual recovery of patients' physical function indicators. It is recommended for clinical reference and practical application.

**Keywords:** Old unstable osteoporotic spinal fractures; Percutaneous vertebroplasty; Treatment effect

**Online publication:** March 6, 2025

## 1. Introduction

For most middle-aged and elderly people, there is a higher probability of developing old and unstable osteoporotic vertebral fractures<sup>[1,2]</sup>. Patients with this disease often experience age-related calcium loss, leading to osteoporosis.

Unexpected violent impacts can result in spinal fractures. Since the affected site is the spinal column, it can directly impact the patient's upper limb motor function to a certain extent, disrupting the stability of the spinal structure. This, in turn, leads to severe local pain and limited physical movement. Surgical intervention can help adjust the structure and morphology of the fractured spine, which is practically significant for the patient's postoperative recovery<sup>[3,4]</sup>. Conservative treatment methods may not yield significant results. Following such treatments, patients may develop kyphosis, compromising spinal stability. The use of minimally invasive percutaneous vertebroplasty can achieve remarkable treatment effects and avoid various postoperative adverse reactions. In this study, patients in the conventional group received conservative drug treatment, while patients in the observation group underwent percutaneous vertebroplasty. A comparative analysis was conducted on the following indicators between the two groups: clinical treatment effect and improvement in physical function indicators. The specific details are elaborated below.

## **2. Materials and methods**

### **2.1. General information**

This study included 46 patients with old unstable osteoporotic spinal fractures treated in the hospital between March 2023 and March 2024. The patients were divided into a conventional group and an observation group based on differences in treatment methods, with 23 patients in each group. The conventional group consisted of 15 males and 8 females, aged between 58 and 78 years, with an average age of  $(66.52 \pm 2.09)$  years old. The observation group included 14 males and 9 females, aged between 57 and 78 years old, with an average age of  $(66.71 \pm 2.46)$  years old. There was no significant difference in baseline data between the two groups, making them comparable ( $P > 0.05$ ).

### **2.2. Inclusion criteria**

Patients diagnosed with old unstable osteoporotic spinal fractures; patients with stable vital signs; patients with complete medical records and high cooperation between patients and their families.

### **2.3. Exclusion criteria**

Patients with malignant tumors; patients with open traumatic injuries; patients with severe consciousness disorders and unable to communicate normally; patients in the acute infection phase; patients with severe coagulation disorders; and patients who withdrew from the study midway.

### **2.4. Methods**

The conventional group received conservative drug therapy intervention: patients maintained bed rest, and after significant relief of low back pain, they engaged in moderate-intensity functional exercise activities for the lower back muscles. The most appropriate time for getting out of bed was determined based on the patient's basic recovery status. Patients were given oral Alfacalcidol tablets at a dose of  $0.5 \mu\text{g}$  twice daily, Calcium carbonate D3 tablets at 600 mg once daily, and during hospitalization, they were treated with salmon calcitonin at 100 mg once daily for 7–9 days via subcutaneous injection. After discharge, patients were treated with Alendronate Sodium tablets at 70 mg once weekly.

Patients in the observation group were treated with percutaneous vertebroplasty: patients maintained a prone position with lumbar overextension, and the location of the affected vertebra was accurately positioned using X-ray examination. Local infiltration anesthesia was performed using 1% lidocaine from the skin to the periosteum. Lumbar traction and overextension interventions were performed during the surgery to reduce the fracture site.



Using fluoroscopy, a puncture needle was used to puncture the pedicle of the affected vertebra to the 1/3 position of the vertebral body. After tapping on the front of the vertebra, the needle was smoothly replaced with an injection cannula for bone cement injection. The injection pressure was accurately controlled to avoid the risk of leakage. If leakage occurred, the injection was immediately stopped. During the treatment, it was ensured that the bone cement was evenly distributed within the vertebral body. After the bone cement hardened, the working cannula was smoothly removed, and the surgery was completed by suturing.

## 2.5. Observation indicators

### (1) Observe and study the treatment efficacy of the two groups of patients

If the patient's vertebral body anterior edge height recovers or approaches the normal range, there is no obvious lumbar soreness and backache, and the ability to daily living improves significantly, the actual evaluation criterion is very effective <sup>[5]</sup>. If the patient's vertebral body anterior edge height increases compared to before treatment, occasionally experiences lumbar soreness and backache, and the ability to daily living recovers somewhat, the actual evaluation criterion is effective. If the above criteria are not met, it is indicated as ineffective.

### (2) Observe and study the improvement of physical function indicators in the two groups of patients

Based on the Barthel Activity of Daily Living Scale, Life Obstacle Rating Scale, and Functional Independence Measure, the actual items selected include physical status, ability of daily living, functional independence, and life obstacles <sup>[6]</sup>. Each item is scored from 0–100, with scores closer to 0 indicating poorer improvement in the patient's physical function indicators.

## 2.6. Statistical analysis

SPSS 26.0 software was used for data processing. Measurement data were expressed as “( )”, and tested using the *t*-test; count data were expressed as “*n*/” and tested using the  $\chi^2$  test. A *P*-value < 0.05 was considered statistically significant.

## 3. Results

### 3.1. Observation of treatment efficacy in two groups of patients

The effective treatment rate in the observation group was 95.65% (22/23), while the effective treatment rate in the conventional group was 69.57% (16/23). There was a significant difference between the two groups, with the observation group showing more prominent treatment efficacy (*P* < 0.05). The specific data are shown in **Table 1**.

**Table 1.** Comparison of treatment efficacy between the conventional group and the observation group

Group	Very Effective		Effective		Ineffective		Total Effectiveness	
	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)
Observation Group ( <i>n</i> = 23)	14	60.87	8	34.78	1	4.35	22	95.65
Conventional Group ( <i>n</i> = 23)	10	43.48	6	26.09	7	30.43	16	69.57
$\chi^2$ value	-	-	-	-	-	-	-	5.447
<i>P</i> value	-	-	-	-	-	-	-	0.020

### 3.2. Observation study on the improvement of physical function indicators in two groups of patients

After treatment, the scores for indicators such as physical status, daily living skills, functional independence, and life obstacles in the observation group were  $(89.33 \pm 4.08)$ ,  $(88.72 \pm 4.08)$ ,  $(90.41 \pm 2.89)$ ,  $(72.35 \pm 3.22)$  respectively; while those in the conventional group were  $(68.54 \pm 4.21)$ ,  $(67.42 \pm 4.11)$ ,  $(73.48 \pm 2.75)$ ,  $(72.35 \pm 3.22)$ . There were significant differences in the data comparison between the two groups, with the observation group showing more pronounced improvement in physical function indicators ( $P < 0.05$ ). Specific data is shown in Table 2.

**Table 2.** Comparison of improvement in physical function indicators between the conventional group and the observation group (Scores, mean  $\pm$  SD)

Group	Physical Status		Daily Living Skills	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Observation Group ( $n = 23$ )	$56.89 \pm 3.32$	$89.33 \pm 4.08$	$61.33 \pm 3.68$	$88.72 \pm 4.09$
Conventional Group ( $n = 23$ )	$56.71 \pm 3.65$	$68.54 \pm 4.21$	$61.85 \pm 3.25$	$67.42 \pm 4.11$
<i>T</i> value	0.175	17.007	0.508	17.617
<i>P</i> value	0.862	0.000	0.614	0.000

Group	Functional Independence		Life Obstacles	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Observation Group ( $n = 23$ )	$66.52 \pm 3.89$	$90.41 \pm 2.89$	$63.38 \pm 3.02$	$91.48 \pm 3.05$
Conventional Group ( $n = 23$ )	$66.49 \pm 3.71$	$73.48 \pm 2.75$	$63.52 \pm 3.66$	$72.35 \pm 3.22$
<i>T</i> value	0.027	20.353	0.141	20.686
<i>P</i> value	0.979	0.000	0.888	0.000

## 4. Discussion

Patients with old unstable osteoporotic vertebral fractures often face high incidence, complex etiology, and difficulty in complete eradication of the disease. Without early targeted treatment, the condition may progress to bone deformation, leading to fractures and healing difficulties<sup>[7,8]</sup>. In the clinical treatment of patients with old unstable osteoporotic spinal fractures, the effect of conservative treatment is not significant. Long-term bedridden patients have poor comfort and may also experience bone loss. The use of percutaneous vertebroplasty to inject cement can reduce pain sensitivity and ensure vertebral stability. Percutaneous vertebroplasty takes advantage of minimally invasive surgery, employing puncture methods to insert cannulas and trocars, and utilizes materials and medical equipment for intervention to reasonably adjust the structure and morphology of the vertebrae<sup>[9,10]</sup>. This surgical approach does not require expanding the incision range, ensures sufficient operating space, can directly target the affected area without damaging surrounding tissues, and offers relatively prominent operational timeliness. Based on the actual characteristics of the patient, preoperative understanding of the patient's condition and disease progression allows for reasonable planning of needle depth and angle. A high-pressure injector is used to smoothly inject bone cement into the patient's vertebrae. After the bone cement solidifies, the actual stability of the structure and the basic shape of the spine are scientifically adjusted. This not only aids in the recovery of spinal

function but also improves the practical operability of the surgery, reduces trauma, and enhances treatment safety. The results of this study showed that after treatment, the observation group's scores for physical status, daily living ability, functional independence, and life obstacles were  $(89.33 \pm 4.08)$ ,  $(88.72 \pm 4.08)$ ,  $(90.41 \pm 2.89)$ , and  $(72.35 \pm 3.22)$ , respectively, while the conventional group's scores were  $(68.54 \pm 4.21)$ ,  $(67.42 \pm 4.11)$ ,  $(73.48 \pm 2.75)$ , and  $(72.35 \pm 3.22)$ . There were significant differences between the groups, and the improvement of physical function indicators in the observation group was more pronounced ( $P < 0.05$ ). From the above data analysis results, it is not difficult to understand that the application of percutaneous vertebroplasty in a minimally invasive surgical form not only reduces pain levels but also promotes significant recovery of spinal dysfunction, increases vertebral height, and facilitates fracture site recovery. Compared with conservative treatment, minimally invasive surgery has significant advantages. injecting bone cement into the diseased vertebra can reduce lateral bending compliance can effectively repair the diseased bone tissue, and lay a solid foundation for subsequent treatment [11,12]. Using a transpedicular approach to inject bone cement into the patient's vertebrae can significantly enhance vertebral stability and gradually increase strength. Injecting bone cement not only avoids damage to the patient's vertebral height but also reduces the likelihood of vertebral collapse, effectively relieving and improving pain symptoms, and enhancing physical function and quality of life.

## 5. Conclusion

In summary, for the treatment of patients with old unstable osteoporotic spinal fractures, the value of choosing percutaneous vertebroplasty as a minimally invasive surgery is prominent. It not only improves clinical efficacy and safety but also promotes the gradual recovery of patients' physical function indicators. It is recommended for clinical reference and practical promotion.

## Disclosure statement

The authors declare no conflict of interest.

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# Visual Analysis of Nursing Research on Children with Kawasaki Disease based on CiteSpace

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**Abstract:** *Objective:* This study aims to analyze the research hotspots and trends in nursing care for children with Kawasaki disease. *Methods:* The study utilized the CiteSpace 6.1.R6 software to visualize nursing-related research on Kawasaki disease in children, drawing from articles published in the CNKI and Web of Science core collection databases from January 1, 2014, to January 1, 2024. Key analysis components included authors, institutions, and keywords, supported by the creation of a corresponding knowledge map. *Results:* Literature Publications: Over the past decade, the analysis encompassed a total of 309 Chinese articles on nursing care for children with Kawasaki disease, with an average annual publication rate of 30.9 articles. Additionally, 251 foreign language articles were scrutinized, exhibiting an average annual publication rate of 25.1 articles. Author and Institution Analysis: In Chinese literature, the notable figure of Huang Rimei emerged as a prolific author, with the Children's Hospital Affiliated with Zhengzhou University standing out as a high-yielding institution. Conversely, in English literature, the prolific authors Burns and Jane C were prominent, alongside the University of California, San Diego, which emerged as a high-yielding institution. Keyword and Research Hotspots Analysis: The focal points of research in Chinese literature revolved around continuous nursing, cardiovascular complications, clinical nursing pathways, rehabilitation effects, holistic nursing, and gamma globulin. Conversely, English literature emphasized research hotspots such as cardiovascular complications, treatment modalities, diagnostic approaches, long-term management strategies, gamma globulin therapy, steroid pulse therapy, and pediatric multisystem inflammatory syndrome. *Conclusions:* The quantity of Chinese literature concerning nursing care for children with Kawasaki disease appears comparatively scant, underscored by an uneven distribution of issuing institutions and a lack of influence. To address this, future endeavors should prioritize bolstering collaboration across diverse regions and institutions, conducting multi-center, cross-regional research, implementing clinical nursing pathways, and augmenting the continuity of care. Conversely, the upsurge in English literature publications regarding nursing care for children with Kawasaki disease signals a burgeoning interest, primarily concentrated on treatment modalities. This trend advocates for the integration of medical and nursing care and emphasizes the importance of remaining abreast of advancements in managing Kawasaki disease in children.

**Keywords:** Children Kawasaki disease; Bibliometrics; Visualized analysis; CiteSpace; Nursing care

**Online publication:** March 6, 2025



# 1. Introduction

Kawasaki disease (KD) is a common acute systemic vasculitis in children under the age of 5 years old. Systemic inflammatory response can lead to multiple organ dysfunction, and serious complications such as cardiovascular damage, shock syndrome and macrophage activation syndrome may occur <sup>[1]</sup>. The incidence of pediatric KD is increasing year by year worldwide, especially in Asia <sup>[2]</sup>. In Japan, the incidence rate is the highest, and the latest statistics show that the incidence rate of children aged 0–4 years old is 359/100,000. In some regions of China, the incidence rate of children aged 0–4 years old is (69–110)/100,000 <sup>[1]</sup>. KD is more common in male children and the high incidence season is spring and summer, with April–June being the most common <sup>[3]</sup>. KD causes immense suffering and burden to children and their families, including but not limited to persistent fever, generalized rash, eye redness, changes in oral mucosa, and heart inflammation. These symptoms severely impact the quality of life for children and also bring psychological and economic pressures to their families. Early identification of KD by healthcare providers, along with appropriate treatment and care, is crucial for the long-term prognosis of children <sup>[4]</sup>. Medical staff should focus on research in areas such as the determination and optimization of early identification diagnostic criteria, comparison and effectiveness analysis of different treatment options, prevention of complications, and influencing factors. This will enhance the quality of care for patients, improve recovery rates, reduce the occurrence of complications, and improve the quality of life for both children and their families. Currently, scholars like Cui (2023) have already made contributions <sup>[5]</sup>. Che (2022) made a quantitative analysis of foreign literature on KD research, and the current status and hot spots of KD research were reviewed <sup>[6]</sup>. In the past 10 years, KD research showed an upward trend, especially since the outbreak of COVID-19 in 2019, children infected with the novel coronavirus showed multiple system inflammatory syndrome, which exhibited clinical symptoms similar to KD <sup>[7]</sup>. It has attracted widespread attention from researchers. Moreover, it is worth noting that there has been a lack of systematic analysis and visualization studies on relevant literature in the field of pediatric KD care. Therefore, this study plans to use CiteSpace software for the visual analysis of research related to pediatric Kawasaki disease care. Conducting such research can help summarize previous findings, identify weak points in studies, analyze development trends and research hotspots in this area, and provide guidance and basis for further in-depth research.

## 2. Data and methods

### 2.1. Literature search and screening

Chinese Search: The search database is CNKI, the search field is “Subject” (precise), the search formula is (“Kawasaki disease” + “KD”) AND “nursing,” the search time is from January 1, 2014, to January 1, 2024, and the literature type is limited to published journal articles in Chinese. A total of 323 articles were retrieved. The screening of these articles was independently conducted by two researchers with relevant background knowledge and experience within the research team. They read the abstracts and full texts of the articles and screened them according to pre-set inclusion and exclusion criteria. The inclusion criteria include articles discussing pediatric Kawasaki disease nursing; content involving “Kawasaki disease (KD)” and “nursing” related topics. The exclusion criteria include articles not focusing on full texts of Kawasaki disease nursing; and content not discussing nursing methods or measures. Unrelated articles such as conference papers and newspaper articles were excluded, leaving a final total of 309 articles.

English Search: The Web of Science Core Collection database was searched, the search field is “Subject,”

and the search formula is (“Mucocutaneous Lymph Node Syndrome” OR “Kawasaki Syndrome” OR “Lymph Node Syndrome, Mucocutaneous” OR “Kawasaki Disease”) AND (Nurse OR “Pediatric care” OR intervention), the search time is from January 1, 2014, to January 1, 2024, the literature type is “Article,” and the language is “English.” After review by researchers, and screening according to the Hena Pai standard, 251 articles were finally included.

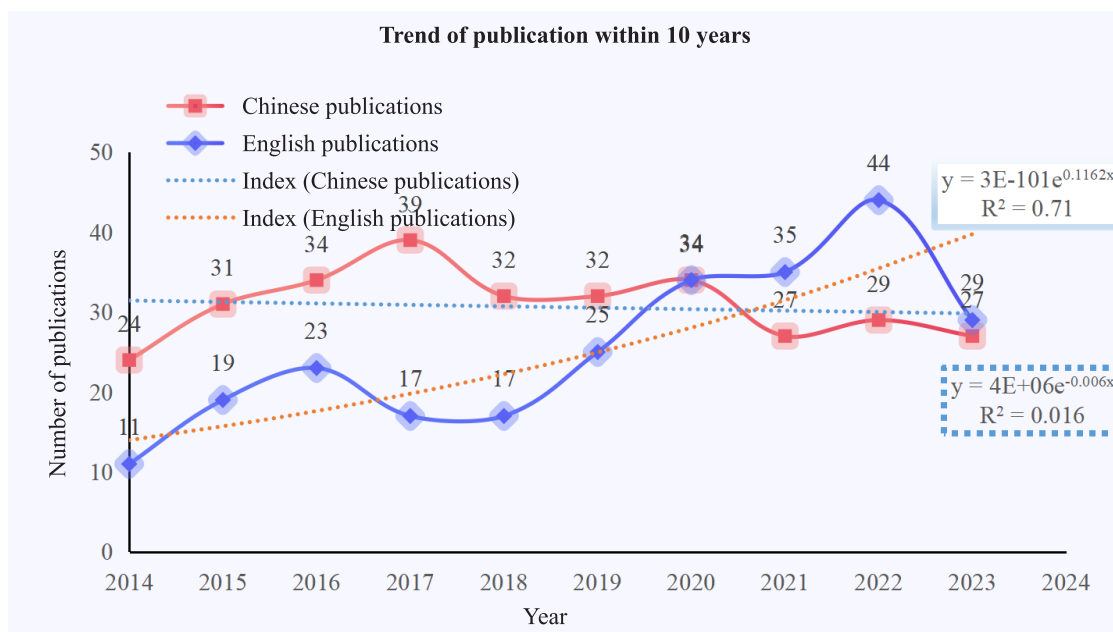
## **2.2. Data analysis tools and methods**

This study uses CiteSpace 6.1.R6 for visualization analysis. CiteSpace is a visualization software developed by Professor Chen Chaomei’s team, which can analyze the literature records of a certain research field from multiple perspectives and present the structure, regularity and distribution of knowledge<sup>[8]</sup>. The literature retrieved from the database, the Chinese literature incorporated in the CNKI database was exported in the Refworks format, and the English literature included in the Web of Science Core Collection database was exported in plain text format. The literature records containing Full Record and Cited References were selected to export TXT text documents. The downloaded files were renamed in the form of “download\_” for unified naming and placed in the CNKI and Wos folders respectively. These data, after undergoing format conversion through CiteSpace, can be directly utilized for CiteSpace analysis. The data was imported into CiteSpace 6.1.R6 for analysis, with the time slicing set from 2014 to 2024. Since there were no publications in 2024, the software automatically set the time span to January 2014 to December 2023. The time slice (years per slice) defaulted to 1, the threshold was set to the system default of Top 50, the association strength was set to the system default value, and the pruning method was set as required according to the selected nodes. The analysis and mapping were conducted respectively with authors, institutions, and keywords as nodes.

## **2. Results**

### **2.1. Document volume analysis**

From January 2014 to December 2023, a total of 309 Chinese articles were published on pediatric KD care over the past decade, with an average annual publication rate of 30.9 articles. In 2017, there was one peak with 39 publications. For foreign language literature, a total of 251 articles were published on pediatric KD care, with an average annual publication rate of 25.1 articles. In 2022, there was another peak with 44 publications. Since the outbreak of COVID-19, clinical symptoms similar to KD in affected children have drawn attention from researchers both domestically and internationally, leading to an overlap in publications in 2020. An exponential line is introduced in the graph, where the fitting function results for Chinese literature are not significant, indicating a stable trend in domestic pediatric KD care research. The fitting function results for foreign language literature are more significant, suggesting an upward trend in international pediatric KD care research. The number of publications is shown in **Figure 1**.



**Figure 1.** Analysis of the number of publications.

## 2.2. Author analysis

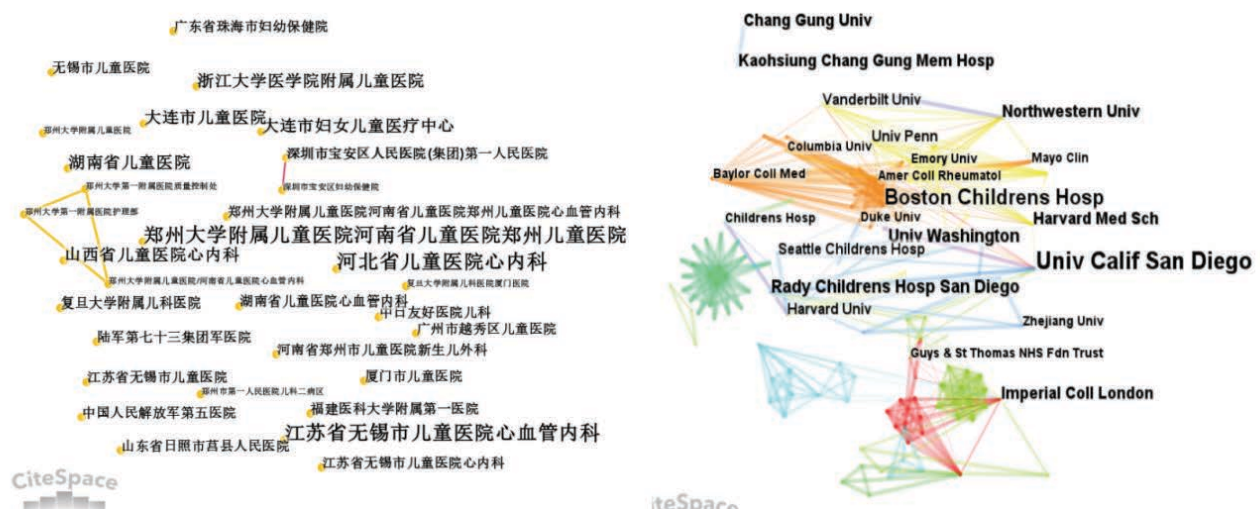
CiteSpace can generate an author network map by analyzing the author information of literature, showcasing the cooperative relationships and influence among different authors. The author network map shows that each node represents an author, with lines connecting nodes indicating collaborations between authors. Authors sharing the same color are co-authors in the same study. Among Chinese literature, the authors with the highest number of publications are represented by Huang Rimai, Zhou Chuanen, and Feng Dongling. Huang Rimai has published 5 papers, while the author team represented by Huang Rimai and Zhou Chuanen published before 2016, and Feng Donglings team has been highly active since 2022, with no evidence of collaboration among high-productivity authors; among English literature, the authors with the highest number of publications are represented by Burns, Jane C, Tremoulet, Adriana H, Newburger, Jane W, Friedman, and Kevin G. The high-productivity author Burns JC has published 12 papers, indicating collaboration among high-productivity authors, and their network maps show close interconnections (**Figure 2**).



**Figure 2.** Analysis of authors. Chinese publications (left) and English publications (right).

## 2.3. Institutional analysis

By analyzing the institutional information of literature, a network map of institutional cooperation is generated to illustrate the cooperative relationships and influence among different institutions. The analysis chart of institutional cooperation in the literature shows that each node represents an institution, with connected nodes indicating collaborations between institutions. Institutions with a higher volume of Chinese literature publications include the Children's Hospital affiliated with Zhengzhou University, where closely collaborating units are mostly sister institutions, such as the Nursing Department of the First Affiliated Hospital of Zhengzhou University, Quality Control Department of the First Affiliated Hospital of Zhengzhou University, Cardiovascular Internal Medicine Department of the Children's Hospital affiliated with Zhengzhou University / Henan Provincial Children's Hospital. However, their centrality is all 0, lacking multi-center research institutions. Institutions with a higher volume of English literature publications include the University of California, San Diego, and Boston Children's Hospital, where collaborating units are more dispersed but closely connected. For detailed institutional analysis, see **Figure 3**, while for the top 5 institutions in terms of publication volume, see **Table 1** and **Table 2**.



**Figure 3.** Analysis of institutions. Chinese publications (left) and English publications (right).

**Table 1.** Top five publishing institutions of pediatric KD nursing research (WOS)

Ranking	Number of publications	Centrality	Institution
1	13	0.11	University of California San Diego
2	10	0.04	Boston Children's Hospital
3	6	0	National Cerebral & Cardiovascular Center
4	6	0.01	Northwestern University
5	6	0.02	Rady Children's Hospital of San Diego



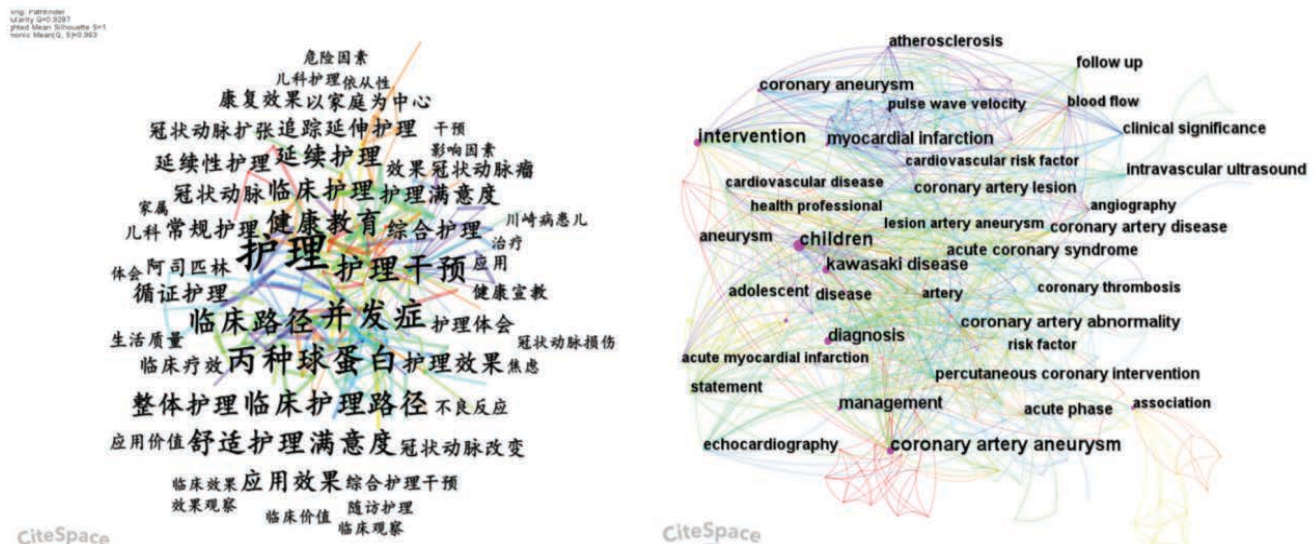
**Table 2.** Top five publishing institutions of pediatric KD nursing research (CNKI)

Ranking	Number of publications	Centrality	Institution
1	4	0	Children's Hospital Affiliated to Zhengzhou University Henan Zhengzhou
2	4	0	Department of Cardiology, Hebei Children's Hospital
3	4	0	Department of Cardiovascular Medicine, Children's Hospital of Wuxi, Jiangsu Province
4	3	0	Hunan Provincial Children's Hospital
5	3	0	Children's Hospital Affiliated to Zhejiang University School of Medicine

## 2.4. Analysis of research hotspots

### 2.4.1. Keyword co-occurrence analysis

Draw a keyword co-occurrence network knowledge map, removing the same keywords related to pediatric KD care, such as Kawasaki disease in children, nursing, Kawasaki disease, and children. The keyword co-occurrence network knowledge map of Chinese literature shows that the most frequently occurring keywords are complications, gamma globulin, clinical nursing pathways, nursing interventions, continuous care, health education, nursing outcomes, comfort care, and satisfaction. Keywords with high centrality include influencing factors, anxiety, nursing interventions, complications, clinical nursing pathways, and continuous care. For English literature, the most frequently occurring keywords are diagnosis, coronary artery aneurysm, percutaneous coronary intervention, intervention, healthcare professionals, and long-term management. Keywords with high centrality are diagnosis, coronary artery aneurysm, intervention, management, and cardiovascular diseases. See **Figure 4** for the keyword co-occurrence analysis. **Table 3** and **Table 4** show the top 20 high-frequency keywords in the field of pediatric KD care research, while **Table 5** and **Table 6** show the top 10 high-frequency keywords by centrality.

**Figure 4.** Keyword co-occurrence analysis. Chinese publications (left) and English publications (right).



**Table 3.** Top 20 high-frequency keywords in the field of pediatric KD care research (CNKI)

Ranking	Frequency	Centrality	Keywords
1	21	0.35	Complication
2	19	0.1	Gamma globulin
3	17	0.4	Nursing intervention
4	14	0.04	Clinical pathway
5	13	0.21	Clinical care pathways
6	11	0.18	Comfort care
7	11	0.12	Health education
8	11	0.33	Satisfaction
9	9	0.04	Holistic care
10	9	0.09	Continuing care
11	9	0.07	Clinical care
12	8	0.14	Nursing effect
13	8	0.13	Application effect
14	7	0.02	Nursing satisfaction
15	7	0.2	Evidence-based care
16	7	0.06	Comprehensive care
17	7	0	Routine care
18	6	0.15	Continuing care
19	6	0.14	Coronary artery
20	6	0.04	Track extended care

**Table 4.** Top 20 high-frequency keywords in the field of pediatric KD care research (WOS)

Ranking	Frequency	Centrality	Keywords
1	34	0.18	Diagnosis
2	27	0.15	Coronary artery aneurysm
3	26	0.11	Management
4	25	0.06	Percutaneous coronary intervention
5	20	0.12	Intervention
6	19	0.06	Coronary aneurysm
7	17	0.03	Long term management
8	17	0.03	Health professional
9	16	0.09	Myocardial infarction
10	15	0.03	Coronary artery disease
11	14	0.03	Statement
12	13	0.03	Multisystem inflammatory syndrome
13	13	0.04	Case report
14	12	0.04	Lesion
15	12	0.04	Aneurysm
16	11	0.04	Risk factor
17	9	0.04	COVID-19
18	9	0.01	Prevalence
19	9	0.05	Acute coronary syndrome
20	9	0.05	Young adult

**Table 5.** Top 10 high-frequency keywords by centrality (CNKI)

Ranking	Centrality	Keywords
1	0.74	Affecting factor
2	0.41	Anxiety
3	0.4	Nursing intervention
4	0.35	Complication
5	0.33	Satisfaction
6	0.29	Coronary artery aneurysm
7	0.21	Clinical care pathways
8	0.2	Evidence-based care
9	0.18	Comfort care
10	0.15	Continuing care

**Table 6.** Top 10 high-frequency keywords by centrality (WOS)

Ranking	Centrality	Keywords
1	0.18	Diagnosis
2	0.15	Coronary artery aneurysm
3	0.12	Intervention
4	0.11	Management
5	0.1	Cardiovascular disease
6	0.09	Myocardial infarction
7	0.07	Mucocutaneous lymph node syndrome
8	0.06	Percutaneous coronary intervention
9	0.06	Coronary aneurysm
10	0.05	Acute coronary syndrome

#### 2.4.2. Keyword clustering analysis

Cluster ranking is based on the number of document keywords; the smaller the number, the more keywords it contains. CiteSpace provides two metrics that are modularity (Q-value) and average silhouette (S-value), to evaluate the effectiveness of graph mapping, considering both network structure and clustering clarity. Generally, a Q-value > 0.3 indicates significant clustering structure, an S-value > 0.5 suggests reasonable clustering, and an S-value > 0.7 signifies convincing clustering <sup>[8]</sup>. The knowledge graph of the keyword clustering analysis for Chinese literature shows that there are currently 8 clusters in Chinese literature, namely #0 Nursing, #1 Kawasaki disease in children, #2 Intravenous immunoglobulin, #3 Clinical pathways, #4 Coronary arteries, #5 Nursing interventions, #6 Influencing factors, and #7 Extended care. The Q-value is 0.5511, and the S-value is 0.8707; English literature has a total of 9 clusters, namely #0 Percutaneous coronary intervention, #1 Multisystem inflammatory syndrome in children, #2 Multi-scale model, #3 Long-term management, #4 Kawasaki disease, #5 Atopic dermatitis, #6 Steroid pulse therapy, #7 Intravenous immunoglobulin treatment, and #8 Fontan surgery. The Q-value is 0.4969, and the S-value is 0.8243. This indicates that the keyword clustering results for both Chinese

and foreign literature are reliable and highly credible. See **Figure 5** for the keyword clustering analysis.



**Figure 5.** Keyword clustering analysis. Chinese publications (left) and English publications (right).

### 2.4.3. Keyword time evolution analysis

The emergence time of keywords can reveal the evolution process of hot topics in pediatric KD care research. The time-evolution analysis map of Chinese literature keywords shows that nursing measures for pediatric KD have been continuously under focus from 2014 to 2023; the application effects of nursing interventions were noted from 2015 to 2023; coronary artery changes caused by cardiovascular complications due to KD gained attention from 2016 to 2023; factors affecting children with KD were highlighted from 2014 to 2023; and continuous care for children with KD has been consistently emphasized since 2016, making it a current research hotspot in pediatric KD care, including parent education, key points of care, treatment compliance, and extended services through internet platforms. The time-evolution analysis map of English literature keywords shows that long-term management has been a persistent focus from 2014 to 2023. In 2014, researchers began using intravascular ultrasound to examine cardiovascular injuries and performed percutaneous coronary intervention. In 2020, researchers introduced a new surgical technique, the great artery bypass grafting procedure, to reconstruct blood flow in children with KD coronary artery injuries<sup>[9]</sup>. Due to the outbreak of COVID-19, multisystem inflammatory response syndrome began in 2020<sup>[10]</sup>. It has attracted attention as an inflammatory disease affecting multiple organ systems. Studies have shown that it may be associated with novel Coronavirus infection. Atopic dermatitis has been of concern from 2016 to 2022, while steroid pulse therapy and gamma globulin for KD treatment have received sustained attention from 2014 to 2022. The time evolution analysis of keywords is shown in **Figure 6** and **Figure 7**.

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 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
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 Weighted Mean Silhouette S=0.8707  
 Harmonic Mean(Q, S)=0.575

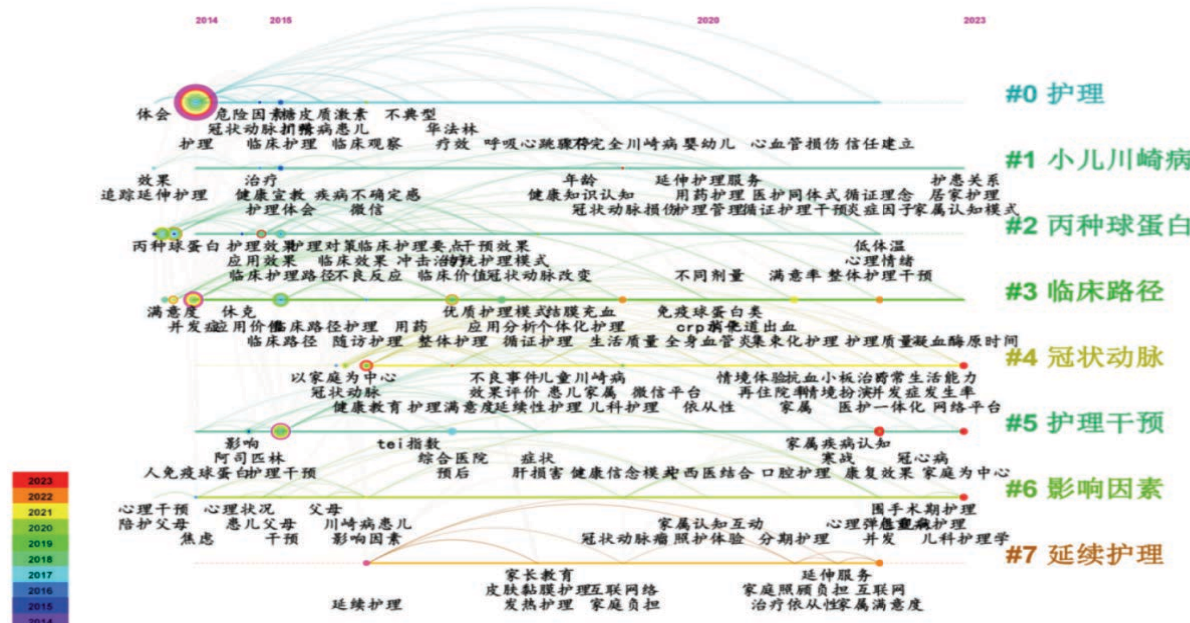


Figure 6. Time evolution analysis of keywords (Chinese publications).

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 Network: N=278, E=702 (Density=0.0337)  
 Largest CC: 278 (100%)  
 Nodes Labeled: 1.75%  
 Pruning: None  
 Modularity Q=0.8243  
 Weighted Mean Silhouette S=0.8243  
 Harmonic Mean(Q, S)=0.8243

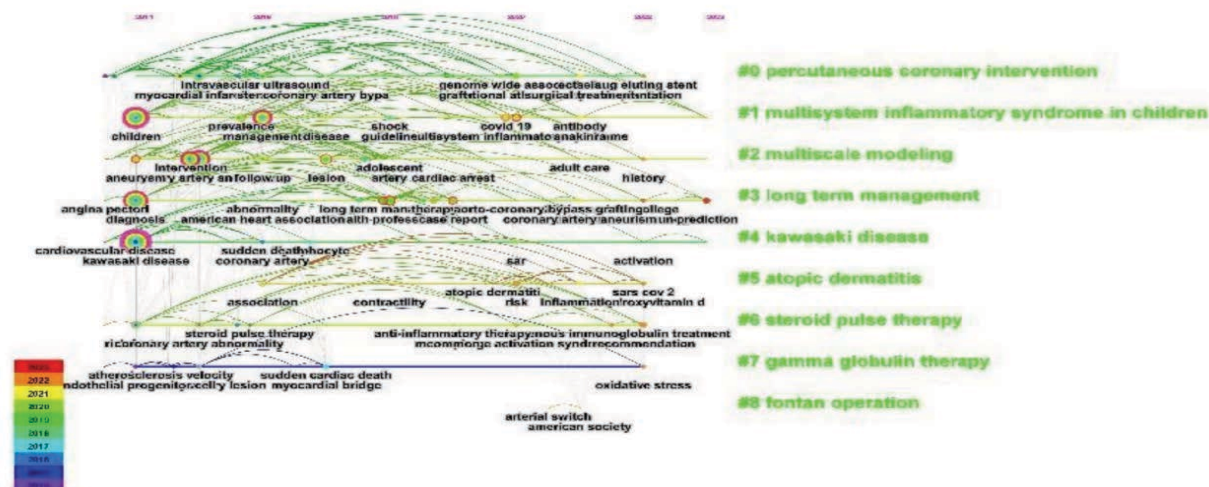


Figure 7. Time evolution analysis of keywords (English publications).

## 2.4.4. Keyword analysis

Keyword emergence can help analyze the development frontiers in pediatric KD care (Figure 8). The red area indicates the time periods when emergent words appear, clearly and intuitively showing the sustained attention



and development trends of different keywords. A total of 15 emergent words were identified from Chinese literature, among which coronary artery changes are common complications in pediatric KD <sup>[11]</sup>. It should be classified as one category. The cardiovascular complications of KD mainly include coronary artery dilation, valve disease, coronary artery aneurysm, giant coronary artery aneurysm, coronary artery stenosis and acute myocardial infarction <sup>[12]</sup>. In the early stages of research, emergent terms in clinical nursing and nursing experiences mainly reflected the practical experience and case reports of healthcare professionals. These experiences were of great significance for inspiring and guiding the research. As the research progressed and expanded, academic studies gradually evolved from case reports to more systematic research papers. In this process, terms such as clinical nursing and nursing experiences may be gradually replaced by more specific and scientific terminology. In actual clinical practice, as patients' families' demand for nursing services continues to rise, medical institutions and nursing staff also need to adjust and improve their nursing models continuously. Nursing personnel began to focus on the needs of patients' families to better meet high-quality patient care. New nursing models and concepts have emerged with the deepening and development of research in disease nursing. The emergence of follow-up care may indicate that healthcare professionals have discovered more effective nursing methods in practice, which need to be discussed and promoted in academia. Complications and continuity care received attention in 2019 and have continued to this day. English literature analyzed a total of 25 emergent terms, among which the diagnosis, clinical symptoms, and treatment of cardiovascular complications have always been key areas of focus for researchers. Since the outbreak of COVID-19, the clinical symptoms of KD-like conditions have attracted significant attention from researchers, leading to a research boom from 2020 to 2022. The research frontier of the tide is a multi-system inflammatory syndrome and intravenous immunoglobulin, which has certain reference values.

**Top 15 Keywords with the Strongest Citation Bursts**

Keywords	Year	Strength	Begin	End	2014 - 2023
护理	2014	6.01	2014	2015	
焦虑	2014	1.23	2014	2016	
临床护理	2015	2.3	2015	2016	
护理体会	2015	1.74	2015	2016	
儿童	2014	1.67	2015	2016	
治疗	2015	1.46	2015	2016	
阿司匹林	2015	1.27	2015	2018	
随访护理	2016	1.41	2016	2017	
常规护理	2014	1.86	2017	2018	
应用效果	2015	1.63	2017	2018	
整体护理	2017	1.4	2017	2018	
冠状动脉改变	2018	1.2	2018	2020	
并发症	2014	2.14	2019	2023	
延续性护理	2018	1.2	2020	2023	
家属	2021	1.27	2021	2023	

**Top 25 Keywords with the Strongest Citation Bursts**

Keywords	Year	Strength	Begin	End	2014 - 2024
acute myocardial infarction	2014	1.61	2014	2016	
cardiovascular disease	2014	1.33	2014	2016	
atherosclerosis	2014	1.14	2014	2015	
myocardial infarction	2015	3.27	2015	2017	
coronary artery aneurysm	2015	2.54	2016	2019	
intravascular ultrasound	2016	2.13	2016	2017	
giant aneurysm	2016	1.4	2016	2019	
american heart association	2016	1.34	2016	2018	
prevalence	2016	1.31	2016	2017	
lesion	2017	2.26	2017	2018	
coronary artery bypa	2017	1.22	2017	2020	
anterior descending artery	2017	1.07	2017	2018	
drug-eluting stent	2018	1.54	2018	2019	
angioplasty	2018	1.15	2018	2020	
therapy	2019	1.41	2019	2020	
covid 19	2020	2.36	2020	2022	
disease	2017	1.95	2020	2021	
infection	2016	1.69	2020	2021	
risk	2020	1.3	2020	2022	
follow up	2016	1.25	2020	2021	
multisystem inflammatory syndrome	2020	2.45	2021	2024	
coronary artery disease	2015	1.71	2021	2022	
gamma globulin	2021	1.57	2021	2022	
coronary artery abnormality	2015	1.05	2021	2022	
intravenous immunoglobulin	2022	1.68	2022	2024	

**Figure 8.** Keywords with citation bursts. Chinese publications (left) and English publications (right).



### **3. Discussion**

#### **3.1. Current status of nursing care for children with Kawasaki disease**

Childhood KD is a common systemic vasculitis in infants and young children, and its incidence has been increasing in recent years. However, diagnosis, treatment and nursing still face challenges <sup>[13]</sup>. In terms of early diagnosis, there are difficulties because of the diverse clinical manifestations and atypical initial symptoms, which can be misdiagnosed or missed. Such children are called incomplete Kawasaki disease <sup>[14]</sup>. The key to early care is to control the progression of the disease and prevent complications. However, due to the difficulty in diagnosis, the accuracy and timeliness of early care are challenged. If timely treatment and care are not provided, KD may lead to serious complications such as coronary artery lesions and myocarditis. Coronary artery damage caused by KD has become one of the common causes of acquired heart disease in children, even endangering the lives of children <sup>[15]</sup>. Currently, in clinical practice, intravenous immunoglobulin combined with aspirin and anti-inflammatory drugs is primarily used to treat KD patients, which helps alleviate symptoms, suppress inflammatory responses, and prevent complications. After the acute phase of treatment, children still require long-term follow-up care, which faces numerous challenges, including continuous monitoring of their condition, medication management, and preventing complications. To effectively address these challenges, it is necessary to enhance healthcare providers' early recognition and diagnosis of KD and establish standardized care protocols; additionally, establishing a comprehensive follow-up care system is also crucial to improve treatment outcomes and quality of life for patients.

#### **3.2. Authors and institutions of pediatric Kawasaki disease nursing**

The analysis of authors and institutions in the field of pediatric KD care shows some key characteristics. In Chinese journals, there are relatively few core articles on pediatric KD care, and the overall trend of publications is stable, with insufficient influence. Among high-producing authors, Huang Rimai is the most prominent <sup>[16–21]</sup>, which is represented by Zhengzhou University Children's Hospital, which is a representative of the main research direction of integrated nursing services in hospitals and communities. Despite a high volume of publications, there is a lack of extensive collaboration between authors and publishing institutions, mostly among sister units, indicating a lack of centrality. In contrast, in English literature, Burns JC is among the most prominent ones <sup>[22–25]</sup>. He is a highly influential author, primarily focusing on the treatment and long-term management of cardiovascular complications in KD. He collaborates with multiple authors and institutions on multicenter projects, consistently producing research outcomes in recent years. The visualization analysis of author institutions reveals that overall, research on pediatric KD care in Chinese journals still needs to be strengthened, with low centrality in related studies. More institutions and authors need to participate to foster more collaboration and exchange. In the future, research in pediatric KD care can enhance cooperation between authors and institutions, increasing the centrality and impact of studies. At the same time, it is necessary to guide more experts and scholars to focus on the field of KD care, working together to improve diagnostic and therapeutic standards, and providing better support and outcomes for children with KD.

#### **3.3. Trends in nursing care of children with Kawasaki disease**

A key indicator of development trends is the frequency of keywords <sup>[26]</sup>. The keywords of the Chinese literature on KD all revolve around nursing. First, with increasing societal attention to children's health and continuous advancements in medical technology, more precise and efficient diagnostic tools and methods for early diagnosis of KD may emerge in the future, helping healthcare professionals detect and treat the condition earlier. Second,

as information technology develops and patient needs change, early tracking has gradually shifted towards personalized extended care and internet-based extended care <sup>[27–29]</sup>. This may include clinical care pathways <sup>[30,31]</sup>, further optimization, as well as the use of information technology to provide telecare support <sup>[32]</sup>. To make it easier for parents of children with KD to access medical resources and information, research on the factors affecting complications of KD and nursing care will become a future focus. As understanding of subsequent impacts such as cardiovascular complications in KD deepens, nursing staff will place greater emphasis on preventing and treating complications to reduce health risks for children, while also promoting a family-coordinated care model <sup>[33]</sup>. The promotion and application will become a crucial direction for future nursing care. Through home-based care guidance and support, it helps patients and their families better cope with the disease and rehabilitation process. Moreover, as people place greater emphasis on health management and prevention, preventive nursing will become an essential part of future KD care. By enhancing health education and awareness campaigns, public understanding of KD can be improved, and the importance of follow-up visits can be recognized, which is expected to effectively reduce the incidence and complication rates of KD. The future development trends in KD care will focus on improving diagnostic and therapeutic levels, optimizing nursing services, increasing attention to complications, and promoting the implementation of preventive nursing measures, providing more comprehensive and effective support and protection for children's health.

## 4. Summary

This study, due to the limitations of CiteSpace software, has specific requirements for database and literature format, only including information from CNKI and Web of Science core collection databases. This may lead to incomplete information bias when analyzing domestic and international literature. However, through this study's visual analysis of pediatric KD care literature, reliable, true, and objective data information has been obtained, providing a reference for future research directions and offering valuable insights for further standardizing pediatric KD care. In the future, cooperation between different regions and institutions should be strengthened, conducting multicenter, cross-regional studies, implementing clinical care pathways, and improving continuity of care. This will help reduce severe complications of KD, promote integration of medical and nursing practices, and advance long-term management in line with current trends, all contributing to better outcomes for patients.

## Funding

Kunming Health Science and Technology Talent Cultivation Project (Project No.: 2023-Cultivation Category-00); Health Research Project of Kunming Municipal Health Commission (Project No.: 2022-14-04-006)

## Disclosure statement

The authors declare no conflict of interest.

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# Analysis of the Effect of Continuous Nursing Pathway on Improving the Accuracy of Aerosol Use in Elderly Patients with Chronic Obstructive Pulmonary Disease

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**Abstract:** *Objective:* To explore nursing measures for elderly patients with chronic obstructive pulmonary disease (COPD) and analyze the effect of continuous nursing pathways on improving the accuracy of aerosol use. *Methods:* From April 2023 to April 2024, 76 elderly COPD patients admitted to our hospital were randomly selected for nursing research. They were divided into two groups using a computer double-blind method, with 38 patients in each group. The control group received routine nursing, while the observation group applied the continuous nursing pathway. The nursing effects of the two groups were investigated and compared, including (1) aerosol accuracy; (2) cardiopulmonary function; (3) subjective well-being and self-care ability; (4) quality of life; and (5) nursing satisfaction. *Results:* Compared with the control group, the observation group had a significantly higher accuracy rate of aerosol use ( $P < 0.05$ ). Before nursing, there were no significant differences in cardiopulmonary function indicators, MUNSH scores, and ESCA scores between the two groups ( $P > 0.05$ ). After nursing, the patient's cardiopulmonary function improved significantly, and their subjective well-being and self-care ability increased. The observation group was significantly better than the control group in all the above indicators ( $P < 0.05$ ). The quality of life scores of the observation group were significantly higher than those of the control group ( $P < 0.05$ ). *Conclusion:* In the nursing of elderly patients with chronic obstructive pulmonary disease, the application of the continuous nursing pathway can effectively improve the accuracy of aerosol use and improve patients' cardiopulmonary function.

**Keywords:** Continuous nursing pathway; Chronic obstructive pulmonary disease; Aerosol; Accuracy rate

**Online publication:** March 6, 2025

## 1. Introduction

Chronic obstructive pulmonary disease (COPD) is a common clinical respiratory disease, which is a multiple



disease of the elderly population and affects multiple organ systems of patients, posing a significant threat to their lives and health. In addition, the disease has the characteristic of recurrent episodes, so nursing intervention for patients is particularly important. As a widely used nursing model in recent years, the continuous nursing pathway can extend nursing services from the hospital to outside the hospital, allowing patients to continue to receive targeted and high-quality nursing guidance at home after discharge. This ensures that patients use aerosols correctly, effectively stabilizes their condition, and significantly improves their self-care ability and quality of life<sup>[1]</sup>. Therefore, this article conducts nursing research on 76 elderly COPD patients admitted to the hospital in recent years, aiming to explore the application effect of the continuous nursing pathway and its impact on the accuracy of aerosol use by patients. The following report was made.

## **2. Materials and methods**

### **2.1. General information**

From April 2023 to April 2024, 76 elderly patients with COPD admitted to the hospital were studied. They were divided into two groups using a computer-generated double-blind method. In the control group, there were 38 patients, including 20 males and 18 females, with an age range of 66 to 82 years old and an average age of  $(71.53 \pm 4.33)$  years old. The duration of the disease ranged from 1 to 11 years, with an average of  $(7.02 \pm 2.54)$  years. In the observation group, there were also 38 patients, with a male/female ratio of 19:19. The age range was 65 to 83 years old, with an average age of  $(70.92 \pm 4.34)$  years old. The duration of the disease ranged from 1.5 to 10.5 years, with an average of  $(7.36 \pm 2.61)$  years. After analyzing the clinical baseline data of the two groups, there were no significant differences in age, gender, and duration of the disease, indicating comparable research value ( $P > 0.05$ ). The hospital ethics committee approved the implementation of the research project. Inclusion criteria: All selected patients met the diagnostic criteria for chronic obstructive pulmonary disease; were over 60 years old; and both the patients and their families were fully informed about the study, volunteered to participate, and signed informed consent forms. Exclusion criteria: Patients with severe organic diseases such as heart, liver, and kidney diseases; diabetes mellitus; bronchiectasis; severe mental abnormalities or cognitive impairments; malignant tumor lesions; poor compliance; incomplete clinical data, etc., were excluded from the study.

### **2.2. Methods**

Routine care was provided to patients in the control group. This included guidance on the use of aerosols, informing them of relevant precautions, and conducting health education and discharge guidance.

Patients in the observation group received continuous nursing care with the following specific measures:

- (1) Formation of a COPD nursing team consisting of 1 head nurse, 1 doctor, and 4 nursing staff. The head nurse served as the team leader and provided professional training to the team members. Only those who passed the assessment were allowed to work, ensuring that the nursing staff mastered the relevant content and operating procedures of continuous nursing care<sup>[2]</sup>.
- (2) Health education: Nursing staff distributed health knowledge manuals to patients, patiently answered questions raised by patients and their families, organized regular health lectures to strengthen patients' awareness of the disease, and provided guidance on the correct use of aerosols.
- (3) Follow-up intervention: In the first month after discharge, nursing staff conducted weekly telephone follow-ups. In the second month, follow-ups were conducted every two weeks, and from the third month

onward, follow-ups were conducted monthly for a total of 6 months. During the follow-up period, the nursing staff assessed the patient's recovery status, daily life and behaviors, and aerosol usage to provide timely guidance on any errors, especially advising patients who smoke or consume alcohol excessively. They also provided guidance on healthy eating and exercise <sup>[3-5]</sup>.

- (4) Establishment of a WeChat group: Nursing staff created a WeChat group for patients to occasionally share methods of disease care, introduce the correct use of aerosols through videos and graphics, and provide real-time answers to patients' questions to continuously improve their self-care abilities <sup>[6]</sup>.
- (5) Home visits: Based on the specific conditions of patients, nursing staff provided one home visit service to assess the patient's aerosol usage, identify any deficiencies or issues, and check their daily diet, medication, and exercise. Individualized guidance was provided based on the patient's condition. During the home visit, the nursing staff also paid attention to identifying and addressing any potential problems the patient may have <sup>[7]</sup>

### 2.3. Observation Indices

- (1) Observation of Aerosol Usage: Based on the follow-up of the two patient groups, the correct usage rate of the aerosol will be recorded and calculated.
- (2) Observation of Cardiopulmonary Function: Lung function testers will be used to examine FEV1 (Forced Expiratory Volume in the first second) and PEF 50% (Peak Expiratory Flow at 50% of lung capacity) for both patient groups. The test values will be accurately recorded. Additionally, echocardiography will be performed to measure EF (Ejection Fraction) for both groups, before and after nursing care.
- (3) Observation of Subjective Well-being and Self-care Ability: Before and after nursing care, subjective well-being will be evaluated using the MUNSH (Memorial University of Newfoundland Scale of Happiness) on a scale of 0–50 points. Self-care ability will be assessed using the ESCA (Exercise of Self-Care Agency Scale) on a scale of 0–180 points. Scores will be accurately recorded for both groups, with higher scores indicating higher subjective well-being and self-care ability.
- (4) Observation of Quality of Life: Referring to the GQOL-74 (Generic Quality of Life Inventory-74) scale, patients from both groups will be evaluated in four aspects: psychological function, social function, physical status, and material function. Each aspect will be scored on a scale of 0–100, with higher scores indicating a higher quality of life.

### 2.4. Statistical Analysis

Statistical analysis of the research data will be performed using SPSS 23.0. For comparison of measurement data, the *t*-test will be used, and the data will be described in the form of mean  $\pm$  standard deviation (SD). For comparison of enumeration data, the chi-squared test ( $\chi^2$ ) will be applied, and the correct usage rate of the aerosol will be described in the form of (*n*, %). Statistical significance will be determined at  $P < 0.05$ .

## 3. Results

### 3.1. Comparison of correct usage rate of aerosol between two groups

As shown in **Table 1** below, the correct usage rate of aerosol in the observation group was significantly higher than that in the control group ( $P < 0.05$ ).

**Table 1.** Comparison of correct usage rate of aerosol between two groups

Group	Number of cases ( <i>n</i> )	Correct ( <i>n</i> )	Incorrect ( <i>n</i> )	Correct rate (%)
Observation group ( <i>n</i> )	38	36	2	94.74
Control group ( <i>n</i> )	38	26	12	68.42
$\chi^2$ value	-	-	-	12.067
<i>P</i> value	-	-	-	< 0.05

### 3.2. Comparison of cardiopulmonary function indices between two groups

Through cardiopulmonary function testing of patients in both groups, the data shown in **Table 2** indicates that there were no significant differences in FEV1, PEF50%, and EF before nursing intervention ( $P > 0.05$ ). However, after the nursing intervention, the cardiopulmonary function of patients in both groups improved significantly, and the observation group showed better improvement in all indices compared to the control group ( $P < 0.05$ ).

**Table 2.** Comparison of cardiopulmonary function between two groups

Group	Number of cases ( <i>n</i> )	FEV1 (L)		PEF 50% (L/s)		EF (%)	
		Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing
Observation group ( <i>n</i> )	38	1.28 ± 0.16	3.24 ± 0.28	1.07 ± 0.24	1.98 ± 0.34	62.65 ± 2.61	73.46 ± 3.71
Control group ( <i>n</i> )	38	1.25 ± 0.19	2.39 ± 0.21	1.11 ± 0.22	1.75 ± 0.27	62.63 ± 2.58	68.45 ± 2.55
<i>T</i> value	-	0.284	17.261	0.207	4.737	0.039	7.876
<i>P</i> value	-	> 0.05	< 0.05	> 0.05	< 0.05	> 0.05	< 0.05

### 3.3. Comparison of subjective well-being and self-care ability between the two groups

Both groups of patients underwent MUNSH and ESCA assessments. The results in **Table 3** show no statistically significant difference in the two scores between the two groups before nursing intervention ( $P > 0.05$ ). However, after the nursing intervention, the patient's subjective well-being and self-care ability improved significantly. The observation group had higher scores compared to the control group ( $P < 0.05$ ).

**Table 3.** Comparison of MUNSH and ESCA scores between the two groups [(mean ± SD), points]

Group	Number of cases ( <i>n</i> )	MUNSH		ESCA	
		Before nursing	After nursing	Before nursing	After nursing
Observation group ( <i>n</i> )	38	28.93 ± 4.22	40.66 ± 2.98	110.94 ± 10.59	158.98 ± 15.25
Control group ( <i>n</i> )	38	29.09 ± 4.31	33.26 ± 3.19	111.22 ± 11.01	125.96 ± 12.61
<i>T</i> value	-	0.163	13.922	0.338	13.645
<i>P</i> value	-	> 0.05	< 0.05	> 0.05	< 0.05

### 3.4. Comparison of Quality of Life Between the Two Groups

According to the assessment using the GQOL-74 scale, as shown in **Table 4**, there are significant differences in scores between the two groups, with the observation group scoring significantly higher than the control group ( $p < 0.05$ ).

**Table 4.** Comparison of GQOL-74 scores between the two groups [(mean  $\pm$  SD), points]

Group	Number of cases ( <i>n</i> )	Psychological function	Social function	Physical status	Material function
Observation group ( <i>n</i> )	38	84.14 $\pm$ 1.63	78.33 $\pm$ 1.08	80.12 $\pm$ 1.56	83.32 $\pm$ 1.44
Control group ( <i>n</i> )	38	69.99 $\pm$ 1.04	66.21 $\pm$ 1.03	69.03 $\pm$ 1.07	66.25 $\pm$ 1.09
<i>T</i> value	-	12.021	11.945	10.096	11.271
<i>P</i> value	-	< 0.05	< 0.05	< 0.05	< 0.05

## 4. Discussion

Currently, aerosol inhalation therapy stands as the preferred treatment approach for elderly patients with chronic obstructive pulmonary disease (COPD), aiming to alleviate their clinical symptoms. However, a significant number of these patients transition to home-based care after discharge, where they often encounter difficulties with appropriate dosing and correct administration techniques of aerosols. Such improper usage not only undermines the therapeutic effectiveness but also potentially exacerbates the patient's condition. Therefore, it becomes clinically imperative to provide effective nursing guidance services to support patients' recovery<sup>[9]</sup>.

Conventional nursing practices typically focus on inpatient care, including health education, instructions on aerosol usage, and precautionary measures. Despite these efforts, the correct usage rate of aerosols among patients remains relatively low. The continuous nursing pathway emerges as a novel care model that extends beyond the hospital stay, ensuring patients continue to receive standardized nursing guidance and services. This model incorporates various strategies like telephone follow-ups, regularly scheduled health lectures, and the dissemination of health information through online platforms. These approaches enable timely monitoring of patients' condition changes, and identification of errors in aerosol usage, and unhealthy behaviors, allowing for individualized and targeted corrections. Notably, during home visits, nurses can provide hands-on demonstrations and guidance, enhancing patients' mastery of correct aerosol administration techniques and subsequently improving their self-care abilities<sup>[10]</sup>.

According to the study data presented here, the observation group demonstrated a significantly higher rate of correct aerosol usage compared to the control group ( $P < 0.05$ ). This finding underscores the effectiveness of the continuous nursing pathway in extending care beyond the hospital setting, facilitating patients' accurate use of aerosols to manage their condition. Furthermore, while there were no significant differences in cardiopulmonary function, subjective well-being, and self-care ability scores between the two groups before nursing intervention ( $P > 0.05$ ), the post-intervention data revealed significant improvements in all these indicators, with the observation group performing better than the control group. Additionally, the observation group exhibited higher scores in various aspects of quality of life compared to the control group ( $P < 0.05$ ). These results suggest that the continuous nursing pathway not only enhances patients' self-care abilities but also stabilizes their cardiopulmonary function indicators, leading to improved quality of life.

## 5. Conclusion

In summary, the implementation of the continuous nursing pathway in elderly patients with COPD effectively increases the correct usage rate of aerosols, significantly improves patients' cardiopulmonary function and quality

of life, and strengthens their self-care abilities. This approach holds promise for widespread clinical application.

## Disclosure statement

The authors declare no conflict of interest.

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# Cross-sectional Survey of Volume Management in Peri-dialysis Patients in a Single Center

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**Abstract:** *Objective:* To analyze the risk factors influencing volume overload in patients during the pre-dialysis and early post-dialysis period (peri-dialysis period) by investigating the current situation of volume management of such patients in our hospital, to reduce the incidence of volume overload during this period. *Methods:* A total of 86 patients in the peri-dialysis period (glomerular filtration rate eGFR less than 15 mL/(min·1.73 m<sup>2</sup>) to three months after dialysis) who received outpatient treatment, inpatient treatment, and hemodialysis in the hospital from June 2022 to December 2023 were selected as the research objects. General information, clinical symptoms, and laboratory data of the patients were collected. According to the disease evolution process of the patients, they were divided into the non-dialysis stage and the initial dialysis stage. The volume load index of the patients, namely the overhydration (OH) value, was measured by the multi-frequency bioelectrical impedance method. The relevant factors affecting the volume load of patients in the peri-dialysis period were compared and analyzed. *Results:* In the non-dialysis stage, 68 patients (86%) had volume overload, and 21 patients (21%) had normal volume load. In the initial dialysis stage, 53 patients (61%) had volume overload, and 33 patients (38%) had normal volume load. Among the patients with volume overload in the two stages combined, the primary diseases were diabetic nephropathy at 29%, hypertensive nephropathy at 29%, primary nephropathy at 34%, and other renal damage at 8%. Complications included heart failure at 29%, respiratory tract infection at 32%, coronary heart disease at 9%, and anemia at 21%. Among the patients with volume overload, 69% were male, 52% were over 60 years old, 53% had no family member accompaniment, 57% had insomnia, and 55% had an educational level of junior high school or below. *Conclusion:* More than half of the patients in the peri-dialysis period in the hospital are in a state of volume overload, which should arouse the attention of the department. For male patients, those with hypertension, diabetes, insomnia, respiratory tract infection, anemia, and without family member accompaniment, corresponding intervention measures should be taken to reduce the incidence of volume overload during the peri-dialysis period.

**Keywords:** Peri-dialysis period; Volume overload; Risk factors

**Online publication:** March 10, 2025

# 1. Introduction

The peri-dialysis period refers to the period from when the glomerular filtration rate eGFR is less than 15 mL/(min·1.73 m<sup>2</sup>) to three months after dialysis <sup>[1]</sup>. According to the evolution of the disease spectrum and big data analysis, it is expected that by the end of 2025, the number of dialysis patients in China will reach 870,000 <sup>[2]</sup>. Data released by the US Kidney Disease System in 2016 showed that the mortality rate was the highest in the two months before dialysis. Since most patients in stage 5 of chronic kidney disease (CKD) who enter the peri-dialysis period have different degrees of fluid retention, the high cardiovascular morbidity and mortality caused by systemic hypertension due to volume overload have attracted clinical attention. Professor Mei Changlin led the formulation of the “Chinese Guidelines for the Management of Chronic Kidney Disease in the Peri-dialysis Period,” which also analyzed the risk factors for high mortality in this stage, and provided guidelines for the volume management of patients in the peri-dialysis period <sup>[1]</sup>. This study intends to compare and analyze the relevant factors affecting the volume load of patients in the peri-dialysis period by investigating the current situation of volume management of such patients in our hospital, so as to provide a clinical basis for how to perform volume management well for patients with end-stage renal disease during the peri-dialysis period.

## 2. Subjects and methods

### 2.1. Research subjects

A total of 86 patients in the peri-dialysis period, with glomerular filtration rate eGFR < 15 mL/(min·1.73 m<sup>2</sup>) to three months after dialysis, who received outpatient treatment, inpatient treatment, and hemodialysis in our hospital from June 2022 to December 2023 were selected as the research subjects. Inclusion criteria: aged ≥ 18 years old, voluntarily choosing to receive outpatient treatment, inpatient treatment, or hemodialysis in the hospital, having basic language communication ability, being conscious, having no severe cardio-pulmonary system diseases, no active tumors, no metal implants in the body, no limb amputations, no significant differences in local body water distribution. Both patients and their families were informed about this study and signed the informed consent form.

### 2.2. Measurement methods

A multi-frequency bioelectrical impedance analyzer (BLA) was used to measure the volume of patients during the non-dialysis period, and at the 4<sup>th</sup>, 8<sup>th</sup>, and 12<sup>th</sup> weeks after the start of hemodialysis. During the measurement, patients were instructed to remove all metal items. Electrode patches were pasted on the middle fingers, thumbs, and left and right heels (6 skin sites) of the patients as required, and then the wires were connected for detection. The instrument directly outputs the patient's body mass index (BMI), total body water (TBW), extracellular fluid (ECW), intracellular fluid (ICW), extracellular fluid/height (ECW/Height), intracellular fluid/height (ICW/Height), and edema index (ECW/TBW).

### 2.3. Data collection

General information such as age, gender, body index, smoking history, family escort situation, sleep status, and educational background was collected. Information related to dialysis treatment, including the patient's primary disease, concurrent clinical complications (such as cardiovascular diseases, infections, respiratory diseases, gastrointestinal bleeding, etc.), start time of hemodialysis, and dialysis frequency, was also gathered. In addition,

examination data such as cardiac ultrasound, hemoglobin (Hb), serum albumin (ALB), brain natriuretic peptide (BNP), blood calcium (Ca), blood sodium (Na), left ventricular mass index (LVMI), total urea clearance index (Kt/V), 4-hour dialysis creatinine/blood creatinine ratio (4hD/PCr), and 24-hour urine volume were collected.

## 2.4. Data analysis

Data collection and data analysis were carried out simultaneously. That is, within 24 hours after each volume measurement, hemodialysis-related information, laboratory tests, and cardiac ultrasound of the patients were collected to record the volume load management of patients. The non-dialysis stage was evaluated once, and the volume collection at the 4<sup>th</sup>, 8<sup>th</sup>, and 12<sup>th</sup> weeks after the start of hemodialysis was used to evaluate the volume management of patients in the initial dialysis stage.

## 2.5. Statistical methods

Binary logistic regression was used to analyze the factors influencing volume overload in patients during the peridialysis period. The test level was  $\alpha = 0.05$ . A  $P$ -value  $< 0.05$  was considered to indicate a statistically significant difference.

## 3. Results

In the non-dialysis stage, 68 patients (86%) had volume overload, and 21 patients (21%) had normal volume load. In the initial dialysis stage, 62 patients (72%) had volume overload, and 24 patients (28%) had normal volume load. Among the patients with volume overload in the two stages combined, the primary diseases were diabetic nephropathy at 29%, hypertensive nephropathy at 29%, primary nephropathy at 34%, and other renal damage at 8%. Complications included heart failure at 29%, respiratory tract infection at 32%, coronary heart disease at 9%, and anemia at 21%. Among the patients with volume overload, 69% were male, 52% were over 60 years old, 53% had no family member accompaniment, 57% had insomnia, and 55% had an educational level of junior high school or below.

## 4. Discussion

The results of volume measurement of patients in the peri-dialysis period using bioelectrical impedance technology showed that the volume overload in the non-dialysis stage was significantly higher than that in the initial dialysis stage. During this stage, 6 patients had to undergo emergency hemodialysis due to severe fluid retention or blood potassium levels higher than the critical value (the critical value of blood potassium in our hospital is  $> 5.5$  mmol/L). At the same time, 17% of the patients had concurrent heart failure and respiratory tract infection. In this stage, the volume-overloaded state made it difficult to control the patient's blood pressure and adjust antihypertensive drugs. The combined effect of these two factors led to myocardial cell hypertrophy and fibrosis in some patients, ultimately causing left ventricular hypertrophy (LVH)<sup>[3]</sup>. This study found that the volume-overloaded state of patients was positively correlated with the patient's age, frequency of insomnia, and duration of the primary disease, and negatively correlated with the total amount of albumin, degree of anemia, and 24-hour total urine volume. Due to the large individual differences in self-management, whether there is family accompaniment was not considered as a factor affecting the patient's volume overload for the time being.

In the initial stage of dialysis, the volume load of patients was controlled to a large extent. The volume measurement of patients in the initial stage of hemodialysis showed that the proportion of patients with volume overload was 70% in the 4<sup>th</sup> week. However, with the gradual start of regular hemodialysis, the proportion of patients with volume overload decreased to 46% in the 8<sup>th</sup> week and then increased somewhat compared with the previous level in the 12<sup>th</sup> week. In the initial stage of hemodialysis, the ultrafiltration effect of hemodialysis improved the overload state of some patients. However, the gradual decline of the patient's residual renal function led to a decrease in urine output. At the same time, the clearance of small and medium-sized molecular toxins gradually restored the patients' appetite. Under the combined effect of these two factors, the volume management of some patients was poor.

Among them, dialysis patients with diabetic nephropathy had more difficulties in volume management during this stage. Moreover, there were occasional symptoms of hypotension and hypoglycemia during dialysis [4]. The habit of excessive drinking and eating in diabetic patients directly led to difficulties in volume management. Due to the autonomic nerve disorder and decreased vascular regulation function in some diabetic patients, it could not effectively stimulate the medulla to secrete adrenaline to regulate blood pressure when the blood volume decreased. Since the patient's ability to regulate osmotic pressure was reduced, hypotension was likely to occur during hemodialysis, resulting in a decrease in the ultrafiltration volume and making it difficult to improve the volume-overloaded state [5]. In addition, the blood glucose level was also an important factor affecting the volume control of patients.

In addition, the patient's comorbidities such as diabetes, hypertension, anemia, malnutrition, and insomnia were also factors affecting the volume management of patients. At the same time, anemia, malnutrition, and diabetes led to a decline in the patients' resistance, resulting in respiratory system infections. Some patients received intravenous infusion treatment, which further increased the patients' volume load. Through interview surveys, it was found that family accompaniment could slightly improve the patients' insomnia, malnutrition, blood pressure, and blood glucose control. Therefore, improving the patient's self-management of the primary disease may play a positive role in their volume management.

## 5. Conclusion

Bioelectrical impedance technology is a new type of volume evaluation tool that is simple, direct, and capable of quickly providing information on the distribution of body fluids in patients. It has been adopted in clinical practice and can help judge patients' volume loads. Since this study was a single-center investigation, the data provided had the disadvantage of a small sample size. Therefore, further research on the volume management of peri-dialysis patients is still needed.

## Disclosure statement

The authors declare no conflict of interest.

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# Analysis of Risk Factors for Delirium in Elderly Patients with Stanford-type B Aortic Dissection

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**Abstract:** *Objective:* To investigate the incidence of delirium in elderly patients with Stanford-type B aortic dissection and analyze its risk factors. *Methods:* A convenience sample of 767 elderly patients with Stanford-type B aortic dissection admitted to the ICU from January 2020 to December 2023 was selected. Data were collected using a delirium-related questionnaire and the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). *Results:* The incidence of delirium in elderly Stanford B aortic dissection patients was 23.73%. Logistic regression analysis showed that gender, length of stay in the ICU, and duration of sedative drug use were independent risk factors for delirium in elderly patients ( $P < 0.05$ ). The model likelihood ratio test  $\chi^2 = 28.462$ ,  $P < 0.001$ ; Hosmer-Lemeshow goodness-of-fit test  $\chi^2 = 0.715$ ,  $P = 0.878$ . *Conclusion:* The incidence of delirium in elderly patients with Stanford-type B aortic dissection is relatively low. Medical staff should conduct adequate and effective preoperative assessment according to the condition of elderly Stanford-type B aortic dissection patients, and use analgesic and sedative drugs reasonably to create a good treatment environment for patients, thereby minimizing the incidence of delirium in elderly patients with Stanford-type B aortic dissection as much as possible.

**Keywords:** Elderly; Aortic dissection; Delirium; Risk factors

**Online publication:** March 10, 2025

## 1. Introduction

Aortic dissection (AD) is a relatively common critical illness in cardiovascular surgery <sup>[1]</sup>. Its onset is sudden, and the etiology is still unclear. Often caused by multiple factors such as hypertension, atherosclerosis, and cystic medial degeneration. If not treated in time, it will seriously threaten the lives of patients <sup>[2]</sup>. According to the Stanford classification, AD is divided into Type A and Type B. Stanford-type A AD has a more dangerous course, and almost all cases require complex surgeries with a higher incidence of postoperative complications. Currently, domestic and international scholars have conducted extensive research on it. For Stanford-type B AD, with the increasing number

of hypertensive patients, its incidence rate is also rising, but research on it is relatively limited. Delirium is a common complication in AD patients, often manifested as confusion in thinking, decreased clarity of consciousness, and even cognitive function damage<sup>[3]</sup>. Due to a series of changes in the brain during aging<sup>[4]</sup>, the elderly population is at a higher risk of delirium. The occurrence of delirium in the elderly prolongs the length of hospital stay, increases hospitalization costs, and increases the incidence of perioperative complications and mortality<sup>[5,6]</sup>, thereby increasing the burden on patients' families and society. Some studies have pointed out that understanding the risk factors for delirium and actively taking relevant intervention measures can effectively prevent the occurrence of delirium to a certain extent<sup>[7-8]</sup>. Currently, there are few reports on delirium in elderly patients with Stanford-type B AD. This study aims to explore the occurrence and related risk factors of delirium in elderly patients with Stanford-type B AD, hoping to lay a foundation for the prevention and treatment of delirium in this patient population.

## **2. Subjects and methods**

### **2.1. Research subjects**

From January 2020 to December 2023, a convenience sample of 767 elderly patients with Stanford-type B aortic dissection admitted to the ICU was selected. Inclusion criteria: (1) Age  $\geq 60$  years old; (2) Confirmed as Stanford-type B AD by aortic computed tomography angiography (CTA) and/or echocardiography; (3) Underwent endovascular aortic repair; (4) Previously in good health, without a history of neurological or psychiatric diseases, and with normal communication ability; (5) Informed consent and voluntary participation in this study. Exclusion criteria: (1) With a history of neurological or psychiatric diseases; (2) Unable to complete the study due to changes in the condition during the research process; (3) Those who are treated in the ICU for less than 24 hours.

### **2.2. Research tools**

#### **2.2.1. Delirium-related data questionnaire**

Designed by the researcher after consulting relevant materials and experts. It includes two parts: general information about patients and clinically relevant information. The content consists of 15 factors such as the patient's gender, age, educational level, body mass index (BMI), Acute Physiology and Chronic Health Evaluation (APACHE II) score, smoking history (smoking within 3 months before surgery), drinking history (drinking within 3 months before surgery), history of hypertension and diabetes, length of stay in the ICU (days), duration of analgesic drug use (hours), duration of sedative drug use (hours), patient's operation time (hours), postoperative mechanical ventilation time (hours), and limb restraint time (hours).

#### **2.2.2. Confusion Assessment Method for the Intensive Care Unit (CAM-ICU)**

The CAM-ICU was used as a diagnostic tool for delirium. Its diagnostic criteria include four items: (1) Sudden change or fluctuation in the state of consciousness; (2) Attention disorder; (3) Confusion in thinking; (4) Change in the level of consciousness. If both (1) and (2) are positive, and either (3) or (4) is positive, then delirium is diagnosed. The sensitivity of this scale in diagnosing delirium in ICU patients is 93–100%, and the specificity is 98–100%<sup>[5]</sup>.

### **2.3. Data collection and delirium assessment**

All members of the research team received professional training on delirium-related knowledge, and only those

who passed the assessment were allowed to participate in this study. The researcher extracted the general and clinical-related information of patients with delirium from the medical records, such as the doctor's progress records and relevant nursing records in the electronic medical record system. The diagnosis of delirium was mainly completed by the attending doctors in the research team in strict accordance with the assessment standards and procedures, and recorded in the progress of the disease.

## 2.4. Statistical methods

SPSS 25.0 was used for data analysis. Examples, percentages, and mean  $\pm$  standard deviation (SD) were used for statistical description. *t*-tests, chi-square tests, and other methods were used for statistical analysis, and binary logistic regression was used for regression analysis.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Incidence of delirium in elderly patients with Stanford-type B AD

Among the 767 research subjects, 182 patients developed delirium, with an incidence rate of 23.73%.

### 3.2. Univariate Analysis of Delirium in Elderly Patients with Stanford-type B AD

The 767 research subjects were divided into a delirium group and a non-delirium group based on whether delirium occurred or not. The comparison of general information between the two groups is shown in **Table 1**. As can be seen from **Table 1**, there were seven factors, including the patient's gender, age, drinking history, length of stay in the ICU, duration of analgesic drug use, duration of sedative drug use, and postoperative mechanical ventilation time, that had statistically significant differences in the occurrence of delirium in elderly patients with Stanford-type B AD ( $P < 0.05$ ).

**Table 1.** Analysis of general data of research subjects [ $n(\%)$ ]

Items	Delirium group ( $n = 182$ )	Non-delirium group ( $n = 585$ )	$t/\chi^2$ Value	$P$ Value
Gender			1.646	0.199
Male	127 (69.78)	378 (64.62)		
Female	55 (30.22)	207 (35.38)		
Age (years)			11.569	0.001
60–70	146 (80.22)	392 (67.01)		
> 70	36 (19.78)	193 (32.99)		
Educational Level			2.903	0.088
Junior high school and below	140 (76.92)	412 (70.43)		
High school and above	42 (23.08)	173 (29.57)		
Body Mass Index	20.48 $\pm$ 3.67	21.05 $\pm$ 3.42	0.875	0.348
APACHEII score	20.22 $\pm$ 4.41	21.57 $\pm$ 5.27	0.976	0.475
Smoking history			0.898	0.343
Yes	120 (65.93)	363 (62.05)		
No	62 (34.07)	222 (37.95)		

**Table 1 (Continued)**

Items	Delirium group (n = 182)	Non-delirium group (n = 585)	$t/\chi^2$ Value	P Value
Drinking history			2.436	0.119
Yes	117 (64.29)	338 (57.78)		
No	65(35.71)	247(42.22)		
Hypertension history			3.037	0.081
Yes	108 (59.34)	304 (51.97)		
No	74 (40.66)	281 (48.03)		
Diabetes history			0.168	0.682
Yes	58 (31.87)	196 (33.50)		
No	124 (68.13)	389 (66.50)		
ICU treatment duration (d)	5.37 ± 1.28	3.12 ± 1.02	3.468	0.021
Analgesic drug use duration (h)	68.72 ± 15.14	45.24 ± 12.87	2.677	0.036
Sedative drug use duration (h)	82.42 ± 23.85	28.95 ± 10.16	4.325	0.025
Operation time (h)	3.06 ± 1.48	3.15 ± 1.37	1.276	0.582
Post-operative mechanical ventilation time (h)	4.54 ± 1.22	2.98 ± 0.87	2.206	0.035
Limb restraint time (h)	5.98 ± 1.37	4.69 ± 1.17	0.972	0.586

### 3.3. Logistic regression analysis of delirium in elderly patients with Stanford-type B AD

Taking the occurrence of delirium as the dependent variable, and the factors with statistical significance in the univariate analysis as independent variables. The assignment methods of independent variables are shown in **Table 2**. The forward stepwise Wald  $\chi^2$  method was used for Logistic regression analysis (an entry = 0.05, an exit = 0.10), and  $P < 0.05$  was considered as a statistically significant difference. The results showed that gender, drinking, time of delirium diagnosis, and sedative drug use duration were independent risk factors affecting the occurrence of delirium in elderly patients with Stanford-type B AD. The model likelihood ratio test  $\chi^2 = 28.462$ ,  $P < 0.001$ , indicating that the regression model was meaningful; the Hosmer-Lemeshow goodness-of-fit test  $\chi^2 = 0.715$ ,  $P = 0.878$ , indicating that the model fits well.

**Table 2.** Assignment methods of independent variables

Items	Assignment methods
Gender	Male = 1, Female = 2
Age	60–70 years old = 1, > 70 years old = 2
Drinking history	Yes = 1, No = 2
ICU treatment duration (d)	Input actual value
Analgesic drug use duration (h)	Input actual value
Sedative drug use duration (h)	Input actual value
Post-operative mechanical ventilation time (h)	Input actual value

**Table 3.** Logistic regression analysis of delirium in elderly patients with Stanford-type B AD

Items	B value	SD	P value	OR value	95% CI
Constant	-6.258	1.386	0.001	0.618	
Gender	0.486	0.878	0.008	4.025	1.182–6.378
ICU treatment duration (d)	0.674	0.723	0.004	5.174	2.336–8.891
Sedative drug use duration (h)	0.882	0.746	0.000	5.878	1.078–7.364

## 4. Discussion

### 4.1. Analysis of the occurrence of delirium in elderly patients with Stanford-type B AD

The results of this study showed that the incidence of delirium in elderly patients with Stanford-type B AD was 23.73%, which is essentially consistent with the result of 20.8% reported by Shen *et al.* <sup>[9]</sup>, lower than the result of 30.0% obtained by Wu *et al.* <sup>[10]</sup> in their study on elderly postoperative patients in the ICU, and also lower than the result of 30.67% reported by Wu *et al.* <sup>[11]</sup> in their study on patients with Stanford-type A AD.

The reason for this may be that, compared to Stanford-type A AD, the condition of patients with Stanford-type B AD may not be as complex and dangerous. Most of them do not need long-term surgery under general anesthesia and deep hypothermic circulatory arrest. Instead, they generally undergo endovascular repair of thoracic aortic dissection under interventional guidance. This surgery is less invasive and has fewer postoperative complications. The duration of treatment in the ICU for these patients is also relatively shorter <sup>[12,13]</sup>. Therefore, the incidence of postoperative delirium in patients with Stanford-type B AD is lower than that in patients with Stanford-type A AD.

### 4.2. Analysis of risk factors for delirium in elderly patients with Stanford-type B AD

Logistic regression analysis shows that gender, alcohol consumption, duration of treatment in the ICU, duration of analgesic drug use, and duration of sedative drug use are independent risk factors affecting the occurrence of delirium in elderly patients with Stanford-type B AD.

### 4.3. Gender

Research indicates that male patients are more prone to postoperative delirium than female patients <sup>[14]</sup>. The incidence of Stanford-type B AD is higher in males than in females, with a ratio that can reach 2.00 to 3.00:1.00 <sup>[15]</sup>. Therefore, the incidence of delirium is also relatively higher. In this study, the ratio of male to female patients was approximately 1.50:1.00, and among the patients who developed delirium, the ratio of male to female patients was even higher, around 3.50:1.00, which also confirms previous studies. The reason for this may be that among the male patients selected in this study, a relatively higher proportion had bad living habits such as smoking and alcohol consumption. Moreover, male patients may experience greater stress in their daily life and work. Under the influence of these psychological and social factors, the incidence of Stanford-type B AD may increase, thereby increasing the incidence of delirium in patients with Stanford-type B AD.

### 4.4. Duration of treatment in the ICU

Some studies have pointed out that a long duration of treatment in the ICU is an independent risk factor for the occurrence of delirium in critically ill patients. The results of this study also show that the longer the duration of treatment in the ICU, the higher the incidence of delirium in elderly patients with Stanford-type B AD. The reason



for this may be related to the closed management model of the ICU. At present, due to various reasons, most ICUs in China, restrict family members from visiting patients, which will cause separation anxiety in patients, increasing the risk of delirium. In addition, research has shown that frequent changes of beds, lack of time orientation tools such as clocks or watches, physical restraints, or a “passive immobilization” state due to treatment are closely related to the occurrence of delirium <sup>[16]</sup>. Due to the stimulation of sound and light in the ICU, coupled with the fact that most patients with Stanford-type B AD need to be on absolute bed rest and cannot get out of bed to move around, these factors can easily lead to changes in the patient’s sleep schedules and disruption of their biological rhythms, thereby causing delirium.

#### **4.5. Use of sedative drugs**

Elderly patients, due to reasons such as cellular aging, degenerative changes in brain tissue, degeneration of neural regulation functions, aging and decline of systems and organs, poor stress resistance, and slow drug metabolism rates, are themselves a high-risk group for delirium. In addition, some sedative drugs have the effect of reducing cerebral blood flow and central anticholinergic action, which can affect the conduction of pain signals and reduce the reactivity to internal and external environmental stimuli <sup>[17]</sup>. At the same time, sedative drugs themselves also have side effects such as hallucinations and delusions. Withdrawal symptoms similar to delirium may occur when the drug dosage changes or is interrupted, which all promote the occurrence of delirium to a certain extent <sup>[12]</sup>. Therefore, the incidence of delirium in elderly patients who use sedative drugs for a long time and in large quantities is relatively high.

### **5. Conclusion**

In summary, the incidence of delirium in elderly patients with Stanford-type B AD is relatively low, which may be related to factors such as gender, duration of treatment in the ICU, and duration of sedative drug use. Therefore, medical staff should conduct a full and effective assessment of elderly patients with Stanford-type B AD before surgery according to their conditions, and use analgesic and sedative drugs reasonably. They should also create a good treatment environment for patients to minimize the incidence of delirium in elderly patients with Stanford-type B AD as much as possible. Due to the limited sample size collected in this study and the limitations of clinical work, the discussion has certain limitations. In the future, more large-sample, multi-center, and prospective studies are still needed for verification.

### **Funding**

Philosophy and Social Sciences Research Project of the Hubei Provincial Department of Education (Project No.: 23D108)

### **Disclosure statement**

The authors declare no conflict of interest.

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# Exploring the Clinical Value of Combined Detection of Blood Lipids, Blood Glucose, and Liver Function in Non-alcoholic Fatty Liver Disease

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**Abstract:** *Objective:* To study the clinical value of combined detection of blood lipids, blood glucose, and liver function in non-alcoholic fatty liver disease. *Methods:* 105 patients with non-alcoholic fatty liver disease treated in our hospital from May 2022 to July 2024 were selected as the research subjects. All patients underwent a B-ultrasound examination. According to the severity of the disease, they were divided into group A (mild,  $n = 35$ ), group B (moderate,  $n = 44$ ), and group C (severe,  $n = 26$ ). Another 30 healthy residents who came to the hospital for physical examination during the same period were selected as group D. The differences in blood lipids, blood glucose, and liver function indicators between groups were compared. *Results:* The triglyceride (TG), total cholesterol (TC), and low-density lipoprotein cholesterol (LDL) levels in groups A, B, and C were higher than those in group D, while the high-density lipoprotein cholesterol (HDL) level was lower ( $P < 0.05$ ). The fasting plasma glucose (FPG) levels in groups B and C were higher than those in group D ( $P < 0.05$ ). The TG, LDL, and FPG levels in groups B and C were higher than those in group A ( $P < 0.05$ ). The TC level in group C was higher than that in group A, while the HDL level was lower ( $P < 0.05$ ). The TC and FPG levels in group C were higher than those in group B ( $P < 0.05$ ). The total bilirubin (TBil), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) levels in groups A, B, and C were higher than those in group D ( $P < 0.05$ ). The TBil and ALT levels in groups B and C were higher than those in group A ( $P < 0.05$ ). The AST level in group C was higher than that in group A ( $P < 0.05$ ). The AST and ALT levels in group C were higher than those in group B ( $P < 0.05$ ). *Conclusion:* Patients with non-alcoholic fatty liver disease have disordered glucose and lipid metabolism. Blood lipids, blood glucose, and liver function are closely related to the severity of the disease. Strengthening exercise and dietary intervention early on can help control the progression of simple fatty liver disease and reduce the risk of severe liver diseases such as steatohepatitis and cirrhosis.

**Keywords:** Non-alcoholic fatty liver disease; Blood lipids; Blood glucose; Liver function

**Online publication:** March 10, 2025

# 1. Introduction

Fatty liver disease refers to a condition where there is an excessive accumulation of fat in liver cells due to various factors such as overnutrition, drug-induced factors, and long-term excessive alcohol consumption. Based on the etiology, it can be classified into four major categories: alcoholic liver disease, non-alcoholic fatty liver disease (NAFLD), special types of fatty liver disease, and acute fatty liver disease<sup>[1]</sup>. Among them, NAFLD is the most common type of fatty liver disease, characterized by fatty degeneration of liver cells caused by factors other than alcohol and other known liver-damaging agents. Initially, it manifests as a simple fatty liver with a high cure rate and good prognosis. However, if not treated on time, it may progress to non-alcoholic steatohepatitis and related liver cirrhosis, which can lead to liver failure and affect the patient's quality of life<sup>[2,3]</sup>. Therefore, early detection, diagnosis, and active intervention are crucial for controlling the progression of the disease. Biochemical index detection refers to the measurement of biochemical substance levels in human samples using biological and chemical methods. It has advantages such as comprehensiveness, accuracy, non-invasiveness, and good reproducibility, and has been widely used in the diagnosis of liver diseases<sup>[4,5]</sup>. In this study, 105 patients with NAFLD from May 2022 to July 2024 in the hospital were selected to investigate the clinical value of combined detection of blood lipids, blood glucose, and liver function in NAFLD. The results are summarized below.

## 2. Subjects and methods

### 2.1. General information

A total of 105 patients with NAFLD from May 2022 to July 2024 in the hospital were selected as the study subjects. Inclusion criteria were: (1) meeting the diagnostic criteria in the "Diagnostic Criteria for Non-alcoholic Fatty Liver Disease"<sup>[6]</sup>; (2) normal communication ability; (3) complete clinical data. Exclusion criteria were: (1) special types of fatty liver disease; (2) alcoholic fatty liver disease; (3) acute fatty liver disease; (4) comorbid blood system diseases; (5) comorbid mental and consciousness dysfunction. All patients underwent B-ultrasound examination and were divided into group A (mild,  $n = 35$ ), group B (moderate,  $n = 44$ ), and group C (severe,  $n = 26$ ) based on the severity of their condition. Additionally, 30 healthy residents who underwent physical examination in our hospital during the same period were selected as group D. Group A consisted of 19 males and 16 females, aged between 45 and 68 years old with a mean age of  $(59.40 \pm 4.55)$  years old, and a body mass index (BMI) ranging from 20 to 27 kg/m<sup>2</sup> with a mean BMI of  $(23.82 \pm 1.62)$  kg/m<sup>2</sup>. B-ultrasound showed no significant increase in liver size, clear ductal structure, and enhanced internal echoes. Group B consisted of 23 males and 21 females, aged between 46 and 69 years old with a mean age of  $(58.97 \pm 4.63)$  years old, and a BMI ranging from 20 to 27 kg/m<sup>2</sup> with a mean BMI of  $(24.02 \pm 1.53)$  kg/m<sup>2</sup>. B-ultrasound showed no significant increase in liver size, less clear ductal structure, and significantly enhanced internal echoes. Group C consisted of 14 males and 12 females, aged between 35 and 70 years old with a mean age of  $(43.57 \pm 3.98)$  years old, and a BMI ranging from 20 to 27 kg/m<sup>2</sup> with a mean BMI of  $(23.98 \pm 1.59)$  kg/m<sup>2</sup>. B-ultrasound showed a significant increase in liver size, completely blurred ductal structure, and significantly enhanced internal echoes. Group D consisted of 16 males and 15 females, aged between 35 and 68 years old with a mean age of  $(42.96 \pm 4.73)$  years old, and a BMI ranging from 20 to 27 kg/m<sup>2</sup> with a mean BMI of  $(24.08 \pm 1.47)$  kg/m<sup>2</sup>. There were no statistically significant differences in general information between the four groups ( $P > 0.05$ ).

## 2.2. Methods

All participants were required to provide 5mL of fasting venous blood, which was then centrifuged at 3000 r·min<sup>-1</sup> for 15 minutes to separate the serum. An automatic biochemical analyzer (Guangdong Medical Device Registration Certificate No. 20172221214; Model: BS-830; Mindray Medical International Co., Ltd.) was used to detect blood lipids, blood glucose, and liver function indicators. The blood lipid indicators included triglyceride (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL). The blood glucose indicator was fasting plasma glucose (FPG). The liver function indicators included total bilirubin (TBil), aspartate aminotransferase (AST), and alanine aminotransferase (ALT).

## 2.3. Observation indicators

- (1) Comparison of blood lipid and blood glucose levels: Compare the differences in blood lipids (TG, TC, HDL, LDL) and blood glucose (FPG) levels among the four groups.
- (2) Comparison of liver function indicators: Compare the differences in liver function indicators (TBil, AST, ALT) among the four groups.

## 2.4. Statistical methods

Statistical analysis was performed using SPSS 25.0 software. Measurement data conforming to a normal distribution were expressed as mean  $\pm$  standard deviation (SD), and an independent sample *t*-test was used. Enumeration data were expressed as rates, and a chi-square test was used. The test level was set at  $\alpha = 0.05$ .

## 3. Results

### 3.1. Comparison of blood lipid and blood glucose levels between the two groups

The levels of TG, TC, and LDL in Groups A, B, and C were higher than those in Group D, while HDL was lower ( $P < 0.05$ ). The FPG levels in Groups B and C were higher than those in Group D ( $P < 0.05$ ). The levels of TG, LDL, and FPG in Groups B and C were higher than those in Group A ( $P < 0.05$ ). In Group C, TC was higher and HDL was lower than in Group A ( $P < 0.05$ ). The levels of TC and FPG in Group C were higher than those in Group B ( $P < 0.05$ ). See **Table 1** for details.

**Table 1.** Comparison of blood lipid and blood glucose levels between the two groups (mean  $\pm$  SD, mmol/L)

Group	Number of cases	TG	TC	HDL	LDL	FPG
Group C	35	2.29 $\pm$ 1.05 <sup>#*</sup>	6.01 $\pm$ 1.36 <sup>#*&amp;</sup>	1.01 $\pm$ 0.24 <sup>#*</sup>	4.16 $\pm$ 0.62 <sup>#*</sup>	6.97 $\pm$ 0.82 <sup>#*&amp;</sup>
Group B	44	2.23 $\pm$ 0.96 <sup>#*</sup>	5.36 $\pm$ 1.05 <sup>#</sup>	1.04 $\pm$ 0.26 <sup>#</sup>	4.07 $\pm$ 0.71 <sup>#*</sup>	6.16 $\pm$ 0.69 <sup>#*</sup>
Group A	26	1.65 $\pm$ 0.95 <sup>#</sup>	5.13 $\pm$ 1.06 <sup>#</sup>	1.14 $\pm$ 0.22 <sup>#</sup>	3.58 $\pm$ 0.59 <sup>#</sup>	5.04 $\pm$ 0.63
Group D	30	1.13 $\pm$ 0.57	3.96 $\pm$ 0.87	1.53 $\pm$ 0.35	2.67 $\pm$ 0.57	4.83 $\pm$ 0.56
<i>F</i> value		3.813	5.015	5.123	6.825	5.107
<i>P</i> value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note: Compared with Group D, <sup>#</sup> $P < 0.05$ ; compared with Group A, <sup>\*</sup> $P < 0.05$ ; compared with Group B, <sup>&</sup> $P < 0.05$ .

### 3.2. Comparison of liver function indices between two groups

The levels of TBil, AST, and ALT in Groups A, B, and C were higher than those in Group D ( $P < 0.05$ ); TBil and



ALT levels in Groups B and C were higher than those in Group A ( $P < 0.05$ ); AST level in Group C was higher than that in Group A ( $P < 0.05$ ); AST and ALT levels in Group C were higher than those in Group B ( $P < 0.05$ ) (Table 2).

**Table 2.** Comparison of liver function indices between two groups (mean  $\pm$  SD)

Group	Number of cases	TBil ( $\mu\text{mol/L}$ )	AST (U/L)	ALT (U/L)
Group C	35	18.82 $\pm$ 4.90 <sup>**</sup>	43.56 $\pm$ 13.05 <sup>**&amp;</sup>	45.25 $\pm$ 14.50 <sup>**&amp;</sup>
Group B	44	17.01 $\pm$ 3.93 <sup>**</sup>	34.46 $\pm$ 8.12 <sup>#</sup>	36.82 $\pm$ 10.12 <sup>**</sup>
Group A	26	14.42 $\pm$ 2.54 <sup>#</sup>	31.43 $\pm$ 8.08 <sup>#</sup>	32.34 $\pm$ 6.48 <sup>#</sup>
Group D	30	10.92 $\pm$ 1.35	23.43 $\pm$ 3.39	15.37 $\pm$ 5.19
<i>F</i> -value		7.154	5.417	11.355
<i>P</i> value		< 0.001	< 0.001	< 0.001

Note: Compared with Group D, <sup>#</sup> $P < 0.05$ ; compared with Group A, <sup>\*</sup> $P < 0.05$ ; compared with Group B, <sup>&</sup> $P < 0.05$ .

## 4. Discussion

Nonalcoholic fatty liver disease (NAFLD) is currently the most common type of chronic liver disease encountered in clinical practice. It includes two major categories: primary and secondary. Primary NAFLD is mainly caused by insulin resistance and genetic predisposition, while secondary NAFLD is primarily induced by special factors such as parenteral nutrition support, malnutrition, and industrial poisoning<sup>[7,8]</sup>. In the recent years, with the rapid socio-economic development and changing lifestyles and dietary structures, the prevalence of NAFLD has increased rapidly. As of 2023, the global prevalence is around 25%, and it is estimated to reach approximately 33.5% by 2030, making it one of the significant diseases threatening public health<sup>[9]</sup>. Most patients with NAFLD have no self-perceived symptoms or may experience nonspecific symptoms such as fatigue, indigestion, and localized pain. Some patients may exhibit symptoms associated with metabolic syndrome, such as overweight, visceral obesity, and elevated blood glucose levels<sup>[10,11]</sup>. Studies suggest that NAFLD is a manifestation of metabolic disorder syndrome in the liver. Metabolic disorders like obesity, hyperglycemia, and dyslipidemia are closely related to its onset and progression. By adjusting dietary habits and maintaining regular aerobic exercise, most patients with NAFLD can control their weight, blood glucose, and blood lipids, thereby promoting liver function recovery<sup>[12,13]</sup>.

The data from this study shows that Groups A, B, and C had higher levels of TG, TC, and LDL than Group D, while their HDL levels were lower ( $P < 0.05$ ). Groups B and C had higher FPG levels than Group D ( $P < 0.05$ ), and groups B and C also had higher levels of TG, LDL, and FPG than Group A ( $P < 0.05$ ). Group C had higher TC and lower HDL levels than Group A ( $P < 0.05$ ), and Group C's TC and FPG levels were higher than those of Group B ( $P < 0.05$ ). These findings suggest the presence of lipid and glucose metabolism disorders in non-alcoholic fatty liver disease, with blood glucose and lipid levels closely correlated to the severity of the patient's condition. The analysis of the reasons behind this shows that insulin can affect lipid metabolism by regulating glucose metabolism. Insulin resistance can lead to disordered glucose and lipid metabolism, preventing blood glucose from being converted into glycogen and increasing fatty degeneration of liver cells. Large amounts of fat accumulate in the liver, leading to liver function damage<sup>[14]</sup>. The liver is the body's primary metabolic organ, responsible for synthesizing, storing, converting, and decomposing glycogen and blood lipids<sup>[15]</sup>. A decline in liver metabolic function can lead to abnormal blood glucose and lipid levels. Therefore, liver function damage can

cause abnormalities in blood glucose and lipids, which can further damage liver function, creating a vicious cycle. This study also revealed that groups A, B, and C had higher levels of TBil, AST, and ALT than Group D ( $P < 0.05$ ). Groups B and C had higher levels of TBil and ALT than Group A ( $P < 0.05$ ), and Group C had higher AST levels than Group A ( $P < 0.05$ ). Additionally, Group C's AST and ALT levels were higher than those of Group B ( $P < 0.05$ ), indicating a close correlation between liver function indicators and the severity of non-alcoholic fatty liver disease. The analysis of the reasons for this shows that TBil includes direct and indirect bilirubin. Indirect bilirubin can be converted into direct bilirubin in liver cells and metabolized through the bile duct <sup>[16,17]</sup>. When liver function is damaged, the liver cells' conversion function declines, leading to an increase in indirect bilirubin levels. Additionally, since the liver is connected to the bile duct, non-alcoholic fatty liver disease can damage the capillary bile duct to some extent, affecting direct bilirubin metabolism. Therefore, the more severe the non-alcoholic fatty liver disease is, the higher the TBil level will be <sup>[18,19]</sup>. AST is mainly present in the mitochondria of liver cells, while ALT is primarily found in the cytoplasm of liver cells. When liver cells are damaged, AST and ALT are released into the blood, leading to increased serum levels of AST and ALT <sup>[20]</sup>.

## 5. Conclusion

In summary, patients with non-alcoholic fatty liver disease have disordered glucose and lipid metabolism, and their blood lipids, blood glucose, and liver function are closely related to the severity of their condition. Strengthening exercise and dietary interventions early on can help control the progression of simple fatty liver disease and reduce the risk of severe liver diseases such as steatohepatitis and cirrhosis.

## Disclosure statement

The authors declare no conflict of interest.

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# Ambulatory Blood Pressure Characteristics and Risk Factors for Circadian Thym Abnormalities in Elderly Patients with Hypertension

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**Abstract:** *Objective:* To analyze the characteristics of ambulatory blood pressure in elderly patients with hypertension and find out the risk factors of abnormal circadian rhythm. *Methods:* According to the circadian rhythm of patients' blood pressure, they were divided into Group A, Group B and Group C, and all the data of hypertension patients in this study were collected, including age, gender, BMI, smoking, drinking, basic diseases (diabetes, cerebrovascular disease, hyperlipidemia, etc.), fasting blood glucose, ambulatory blood pressure (24-hour mean systolic pressure, 24-hour mean diastolic pressure, daytime mean systolic pressure and daytime mean diastolic pressure). *Results:* There were significant differences in mean systolic blood pressure and mean diastolic blood pressure at night among Group A, Group B and Group C ( $P < 0.05$ ). Age, hyperlipidemia and fasting blood glucose were risk factors for circadian rhythm abnormality ( $P < 0.05$ ), and 24-hour urinary sodium was a protective factor for circadian rhythm abnormality ( $P < 0.05$ ). *Conclusion:* Age, hyperlipidemia and fasting blood glucose are risk factors for circadian rhythm abnormality ( $P < 0.05$ ), and 24-hour urinary sodium is a protective factor for circadian rhythm abnormality ( $P < 0.05$ ).

**Keywords:** Elderly patients; Hypertension; Ambulatory blood pressure; Abnormal circadian rhythm

**Online publication:** March 10, 2025

## 1. Introduction

With China gradually entering an aging society, society is paying more attention to the health status of the elderly, and hypertension has become the main risk factor leading to cerebrovascular emergencies and death of the elderly. According to foreign research data, in patients with essential hypertension, the possibility of abnormal circadian rhythm of blood pressure is in the range of 41% to 62%<sup>[1,2]</sup>. After Li *et al.* conducted a study on ambulatory blood pressure monitoring of 106 elderly hypertensive patients, they found that only 21% of them had normal blood pressure rhythm, while 79% had abnormal blood pressure rhythm<sup>[3]</sup>. Through ambulatory blood pressure

monitoring, the study can not only accurately observe the blood pressure changes of hypertensive patients throughout the day, but also deeply understand their blood pressure fluctuations and irregular rhythm between day and night. This method is helpful in evaluating the damage to target organs, predicting the potential risks related to cardiovascular and cerebrovascular diseases, and providing immediate and powerful treatment suggestions for clinicians, thus reducing the possibility of hypertension-related complications <sup>[4-6]</sup>. Therefore, when monitoring the circadian rhythm of blood pressure in elderly hypertensive patients, clinical medical workers must pay high attention to it, which will help to manage the blood pressure level of the elderly population more efficiently, restore their normal rhythm of blood pressure, and further reduce the possibility of cardiovascular events and deaths.

## **2. Data and methods**

### **2.1. General information**

According to the inclusion and exclusion criteria, 272 elderly patients with hypertension who were treated in the hospital from January 2022 to January 2024 were selected, including 126 males, accounting for 46.32%, and 146 females, accounting for 53.68%, aged between 61 and 77, with an average of  $(68.19 \pm 9.23)$  years old. This study has been approved by the Ethics Committee, and strictly abides by the ethical principles of medical research and clinical trial regulations.

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

Inclusion criteria: (1) Patients over 60 years old; (2) Meet the diagnostic criteria of hypertension in the Guidelines for Prevention and Treatment of Hypertension in China (revised edition in 2018) <sup>[7]</sup>; (3) Patients with complete clinical data; (4) Patients who are willing and able to cooperate with this study.

Exclusion criteria: (1) Patients with liver and kidney dysfunction; (2) Patients participating in other intervention projects; (3) Patients who have a history of lumbar surgery, lumbar tumors, etc., and may have low back pain; (4) Patients with serious diseases such as COPD or malignant tumor; (5) Patients with mental illness or taking psychotropic drugs.

### **2.3. Methods**

There are no patients with dipper in this study, so this study is divided into Groups A, B and C according to the circadian rhythm of patients' blood pressure. Group A is dipper (the blood pressure decreased by more than 10% at night compared with that during the day), Group B is non-dipper (the blood pressure decreased by less than 10% at night compared with that during the day) and Group C is inverse dipper (the blood pressure decreased by less than 10% during the day). All the data of hypertension patients in this study were collected, including age, gender, BMI, smoking, drinking, basic diseases (diabetes, cerebrovascular diseases, hyperlipidemia, etc.), fasting blood glucose, ambulatory blood pressure (24-hour mean systolic blood pressure, 24-hour mean diastolic blood pressure, daytime mean systolic blood pressure, daytime mean diastolic blood pressure, nighttime mean systolic blood pressure, nighttime mean diastolic blood pressure), 24-hour urine electrolyte, and blood pressure.

### **2.4. Statistical methods**

All the collected values are entered into SPSS 25.0 software for statistical analysis. The counting data are recorded in the form of examples and percentages, and analyzed by  $\chi^2$  test, and the measuring data are recorded in the form



of mean and standard deviation. The data are analyzed by *t*-test, univariate and multivariate analysis, and there is a difference in statistical level with  $P < 0.05$ .

### 3. Results

#### 3.1. Comparison of general data of patients in different groups

Among the patients who participated in this study, there were significant differences in age, sex, BMI, smoking, hyperlipidemia and fasting blood sugar among Group A, Group B and Group C ( $P < 0.05$ ).

**Table 1.** Comparison of general data of patients in different groups

Variable	Group	Group A ( <i>n</i> = 57)	Group B ( <i>n</i> = 124)	Group C ( <i>n</i> = 91)	F/X <sup>2</sup>	<i>P</i>
Age		63.18 ± 8.24	70.27 ± 8.11*	71.13 ± 8.97*	5.144	0.000*
Gender	Man	34 (59.65%)	51 (41.13%)*	41 (45.05%)*	5.377	0.020*
	Woman	23 (40.35%)	73 (58.87%)	50 (54.95%)		
BMI		24.23 ± 3.12	25.69 ± 3.73	25.72 ± 3.11	2.463	0.015*
Smoke	Yes	5 (8.77%)	46 (37.10%)*	41 (45.05%)*	15.481	0.000*
	No	52 (91.23%)	78 (62.90%)	50 (54.95%)		
Drink wine/alcohol	Yes	11 (19.30%)	23 (18.55%)	14 (15.38%)	0.369	0.544
	No	46 (80.70%)	101 (81.45%)	77 (84.62%)		
Combined with basic diseases						
Diabetes	Yes	9 (15.79%)	21 (16.94%)	12 (13.19%)	1.152	0.283
	No	48 (83.21%)	103 (83.06%)	79 (86.81%)		
Cerebrovascular disease	Yes	7 (12.28%)	19 (15.33)	12 (13.19%)	0.294	0.588
	No	50 (87.72%)	105 (84.68%)	79 (86.81%)		
Hyperlipoidemia	Yes	32 (56.14%)	49 (39.52%)*	19 (20.88%)*	4.365	0.037*
	No	25 (43.86%)	75 (60.48%)	72 (79.12%)		
Fasting blood glucose		5.61 ± 1.73	6.83 ± 2.81*	6.52 ± 2.33*	2.945	0.004*

\*Compared with Group A, there is a significant difference ( $P < 0.05$ ).

#### 3.2. Comparison of ambulatory blood pressure in different groups of patients

Among the patients who participated in this study, there were significant differences in mean systolic blood pressure and mean diastolic blood pressure at night among Group A, Group B and Group C ( $P < 0.05$ ), but there were no significant differences in mean systolic blood pressure at 24 hours, mean diastolic blood pressure at 24 hours, mean systolic blood pressure at day and mean diastolic blood pressure at day ( $P > 0.05$ ).

**Table 2.** Comparison of ambulatory blood pressure in different groups of patients

	Group A (n = 57)	Group B (n = 124)	Group C (n = 91)	F	P
24-hour mean systolic pressure (mmHg)	131.27 ± 9.23	134.19 ± 12.31	135.24 ± 11.21	1.539	0.126
24-hour mean diastolic blood pressure (mmHg)	71.28 ± 8.13	73.37 ± 9.21	72.33 ± 7.83	1.404	0.162

**Table 2 (Continued)**

	Group A (n = 57)	Group B (n = 124)	Group C (n = 91)	F	P
Daytime mean systolic blood pressure (mmHg)	136.38 ± 9.11	135.72 ± 6.29	132.13 ± 9.06	0.521	0.603
Daytime mean diastolic blood pressure (mmHg)	74.13 ± 6.22	75.43 ± 8.22	72.53 ± 7.11	1.024	0.308
Mean systolic blood pressure at night (mmHg)	118.62 ± 9.11	131.58 ± 10.27	140.82 ± 12.33	7.796	0.000*
Mean diastolic blood pressure at night (mmHg)	62.33 ± 5.81	71.59 ± 6.43	71.29 ± 8.08	8.843	0.000*

\* stands for significantly different from Group A ( $P < 0.05$ ), # stands for significantly different from Group B ( $P < 0.05$ ).

### 3.3. Comparison of 24-hour urinary electrolytes and microalbuminuria in different groups of patients

Among the patients who participated in this study, there were significant differences in 24-hour urinary sodium and microalbuminuria among Group A, Group B and Group C ( $P < 0.05$ ), but there were no significant differences in 24-hour urinary potassium and 24-hour urinary chloride ( $P > 0.05$ ).

**Table 3.** Comparison of 24-hour urinary electrolytes and urinary microalbumin in different groups of patients

	Group A (n = 57)	Group B (n = 124)	Group C (n = 91)	F	P
24-hour urine potassium (mmol/24h)	24.51 ± 7.23	25.63 ± 6.21	23.46 ± 6.22	1.002	0.318
24-hour urinary chloride (mmol/24h)	71.38 ± 10.37	73.28 ± 11.28	69.34 ± 12.52	1.028	0.306
24-hour urinary sodium (mmol/24h)	103.27 ± 10.12	87.42 ± 9.15*	83.29 ± 9.11*	9.842	0.000*
24-hour urinary microalbumin (mg/24h)	42.79 ± 9.27	43.18 ± 8.01	49.72 ± 8.22*	4.750	0.000*

\* is significantly different from Group A ( $P < 0.05$ ), # is significantly different from Group B ( $P < 0.05$ ).

### 3.4. Analysis of risk factors for patients with abnormal circadian rhythm

Taking the patient's circadian rhythm abnormality as the dependent variable, and taking age, sex, hyperlipidemia, fasting blood glucose, BMI, smoking or not, 24-hour urinary sodium and 24-hour urinary microalbumin as the independent variables, the results showed that age, hyperlipidemia and fasting blood glucose were the risk factors for the patient's circadian rhythm abnormality ( $P < 0.05$ ), and 24-hour urinary sodium was the protective factor for the patient's circadian rhythm abnormality ( $P < 0.05$ ).

**Table 4.** Analysis of risk factors of abnormal circadian rhythm in patients

	$\beta$	SE	Wald $\chi^2$	P	OR	95% CI
Age	1.928	0.832	6.318	0.029	1.534	1.217–2.484
Gender	0.681	0.448	3.022	0.087	2.068	0.265–9.264
Hyperlipidemia	0.013	0.468	4.152	0.043	1.132	1.096–1.472
Fasting blood glucose	1.525	1.211	7.969	0.024	2.332	1.142–3.225
Smoke	0.922	0.561	3.155	0.075	1.255	0.361–10.642
BMI	1.021	0.395	2.569	0.111	1.258	0.148–4.291
24-hour urinary sodium	-0.581	0.247	10.222	0.001	4.936	2.163–9.358
24-hour urinary microalbumin	0.922	0.561	3.155	0.075	1.255	0.361–10.642

## 4. Discussion

In the past 20 years, a large number of clinical studies have proved that ambulatory blood pressure monitoring is closely related to the incidence and severity of cardiovascular diseases<sup>[8,9]</sup>. Using ambulatory blood pressure monitoring technology, the clinic can more objectively understand the actual level and fluctuation of blood pressure within 24 hours, and this monitoring method is less interfered with by the external world and shows excellent repeatability. For patients with hypertension, the core of treatment is not only to restore their blood pressure to normal level but also to clarify the specific types of their blood pressure rhythm. When carrying out treatment, we must ensure that blood pressure is maintained in normal rhythm and avoid using drugs that may cause abnormal rhythm.

With the gradual increase of people's age, the functions of many endocrine glands and key organs began to decline, and the cycle of sleep and awakening also changed, which led to the disorder of autonomic nervous activity, especially the decrease of sensitivity to pressure receptors and the activity of vagus nerve, which led to the disorder of hypothalamic-pituitary-adrenal axis function, thus weakening its regulation of blood pressure, and further leading to the loss of its inherent regularity in day and night changes of blood pressure<sup>[10-13]</sup>.

Studies have pointed out that there is a certain correlation between abnormal rhythm of blood pressure and diabetes<sup>[14,15]</sup>. Once the cardiac autonomic nervous system of diabetic patients is abnormal, their blood pressure circulation will be gradually interrupted day and night. Its most remarkable feature is that the blood pressure fluctuates at a relatively high level all day, with no obvious peak or valley changes, and the blood pressure does not drop significantly at night. This situation may be caused by the damage to autonomic nervous system function and the imbalance of neurohumoral regulation in diabetic patients, which leads to the increase of peripheral vascular resistance<sup>[16,17]</sup>, which is similar to the results of this study.

Previous studies have found that in elderly hypertensive patients with dyslipidemia, blood pressure increased significantly at night, which means that the normal blood pressure circadian rhythm of elderly hypertensive patients with dyslipidemia has disappeared<sup>[18,19]</sup>. The increase in blood lipid level may damage the normal function of vascular endothelium and gradually lead to atherosclerosis. This change will reduce the elasticity of the artery, weaken the buffering effect of pulse pressure, increase pulse pressure, and eventually lead to the disappearance of the circadian rhythm of normal blood pressure.

There are still different views in academic circles on how sodium in urine affects the fluctuation of blood pressure between day and night within 24 hours. When there is a problem with the regulation function of sodium, it may lead to the accumulation of sodium, which may further lead to the continuous increase of arterial blood pressure. It may be that the discharge pattern of sodium during the day and night is disrupted, and the decrease of sodium in urine during the day is closely related to the increase in blood pressure at night<sup>[20]</sup>.

## 5. Conclusion

Age, hyperlipidemia and fasting blood glucose are the risk factors of circadian rhythm abnormality ( $P < 0.05$ ), and 24-hour urinary sodium is the protective factor of circadian rhythm abnormality ( $P < 0.05$ ).

## Disclosure statement

The author declares no conflict of interest.

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# Early Chest HRCT Findings and Dynamic Imaging Analysis of COVID-19 in Qinghai Province

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**Abstract:** This study aimed to analyze the early high-resolution CT (HRCT) manifestations and dynamic imaging changes of coronavirus disease 2019 (COVID-19) in Qinghai Province. A total of 24 nucleic acid-positive COVID-19 patients admitted to our hospital between January 2020 and November 2021 were included. All patients underwent HRCT examinations, and lesion characteristics—including number, distribution, morphology, and surrounding involvement—were analyzed. Among the 24 patients, systemic and respiratory circulatory symptoms were more common than other symptoms ( $P < 0.05$ ). There were no significant differences in the lung lobes, relative positions, quantity, size, and density of lesions across different stages of the disease course ( $P > 0.05$ ). Within the same disease stage, lesions were primarily located in the lower lobes of both lungs, the peripheral lung fields, and a combination of peripheral and central regions, with single and multiple lesions being the most common. Lesion morphology varied significantly across disease stages ( $P < 0.05$ ), including differences between patchy and striped lesions, striped and massive lesions ( $P < 0.05$ ), and patchy and massive lesions ( $P < 0.05$ ). The incidence of striped lesions was higher in the progressive and recovery stages than in the early stage, showing an upward trend. There were no significant differences in pleural thickening, pleural effusion, mediastinal lymph node enlargement, or pericardial effusion across different disease stages ( $P > 0.05$ ). Common HRCT signs observed at all stages included air bronchograms, paving stone patterns, halo signs, subpleural lines, and grid-like patterns. The main patterns of lesion progression were an increase in lesion size (16/24, 66.67%), an increase in the number of lesions (17/24, 70.83%), changes in lesion density (20/24, 80.33%), and localized lesion increase and partial absorption (6/24, 25.00%). In conclusion, the HRCT manifestations and evolution of lung lesions in COVID-19 patients are complex and varied, with a progressive increase in striped lesions potentially serving as a characteristic imaging feature of the disease.

**Keywords:** Coronavirus; Pneumonia; Chest HRCT; Imaging

**Online publication:** March 6, 2025

## 1. Introduction

At the end of 2019 and the beginning of 2020, many cases of pneumonia of unknown cause were diagnosed

in multiple hospitals in Hubei Province, China. These cases were later confirmed to be caused by a novel coronavirus infection <sup>[1]</sup>. The virus quickly spread across the country, greatly affecting the physical and mental health of Chinese citizens. The National Health Organization named this virus SARS-CoV-2. This virus is highly infectious and has a wide range of transmission routes, posing a huge challenge to global healthcare <sup>[2]</sup>. As a newly emerging respiratory infectious disease, early detection, diagnosis, isolation, and treatment are essential. Conventional diagnostic methods primarily involve testing respiratory specimens and blood samples <sup>[3]</sup>. However, this diagnostic approach is highly susceptible to the quality of test kits, requiring a large number of test kits, and prone to false positives.

High-Resolution Computed Tomography (HRCT) of the chest is the primary diagnostic method for COVID-19, enabling the diagnosis of lesions <sup>[4]</sup>. It has high application value for determining the nature and severity of the disease. Additionally, HRCT provides superior image resolution compared to conventional chest CT, allowing for earlier diagnosis of the disease. Qinghai Province reported its first COVID-19 case on December 24, 2019. As of November 2021, Qinghai Province had 29 confirmed cases, with 24 of them being treated and isolated in our hospital. Based on this, we selected 24 nucleic acid-positive COVID-19 patients admitted between January 2020 and November 2021 as the study subjects to investigate the early chest HRCT manifestations and imaging analysis of COVID-19 in Qinghai Province.

## **2. Materials and methods**

### **2.1. General information**

The study subjects were patients with nucleic acid-positive COVID-19 admitted to our hospital between January 2020 and November 2021, including 14 male patients and 10 female patients. Their ages ranged from 7 to 80 years old, with an average age of  $(34.42 \pm 10.58)$  years. The highest body temperature ranged from 36.0° to 39.5°, with an average highest body temperature of  $(37.1^\circ \pm 0.65)$ .

Inclusion criteria for this study are: Patients who tested positive for both nucleic acid detection and respiratory specimen testing; Patients who underwent HRCT examination within one week of symptom onset.

Exclusion criteria include: Cardiopulmonary insufficiency; Hepatorenal insufficiency; Receives other treatments before admission; Patients with severe artifacts on chest HRCT examination.

### **2.2. Methods**

#### **2.2.1. Imaging examination**

CT scans were performed on patients using the GE Optima 680 CT equipment with the following specific parameters: tube voltage of 120 KV, tube current set to automatic milliamperes, slice thickness of 5 mm, slice spacing of 5 mm, field of view of 500 × 500 mm, and a matrix of 512 × 512. Lung window reconstruction was achieved using a high-resolution algorithm, with the scanning range extending from the thoracic inlet to the base of the lungs. During image processing, multi-planar reconstruction, minimum intensity projection, and maximum intensity projection techniques were employed for image analysis.

#### **2.2.2. Imaging analysis**

Two radiologists with rich clinical experience reviewed the images, analyzing the lesion location, distribution, number, shape, density, consolidation, margins, and complications. In cases of disagreement, the two doctors

would confer to provide accurate recommendations.

## 2.3. Observation Indices

The observation indices selected for this study were all related to HRCT, including the number of lesions, lesion distribution, lesion morphology, and surrounding involvement.

### (1) Number and Distribution of Lesions

The number of segments involved by lesions was recorded, and the distribution around bronchial vascular bundles, subpleural regions, and scattered areas was analyzed.

### (2) Lesion Morphology

The observed morphologies included nodular, mass-like, patchy, cord-like, extending towards the hilum, subpleural extension, cross-segmental, and cross-lobar.

### (3) Surrounding Involvement.

## 2.4. Statistical Methods

Statistical analysis was conducted using SPSS 22.0 software. Measurement data were expressed as mean  $\pm$  standard deviation and analysis of variance was used for comparisons between multiple groups. Count data were represented as relative numbers (rates) and chi-square tests were applied for comparisons between groups. A  $P$ -value  $< 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of Clinical Symptoms

Among the 24 patients included in this study, systemic symptoms and respiratory and circulatory symptoms were found to be more common compared to other clinical symptoms ( $P < 0.05$ ). Detailed data are presented in **Table 1**.

**Table 1.** Comparison of clinical symptoms in COVID-19 patient

System Name	Number of Cases (%)	$P$
Systemic symptoms	13 (54.17)	$< 0.05$
Respiratory and circulatory symptoms	15 (62.50)	
Digestive system symptoms	5 (20.83)	
Neurological symptoms	3 (12.50)	
Olfactory and Gustatory system symptoms	5 (20.83)	

### 3.2. Comparison of lesion quantity, location, distribution, and morphology results

According to the research results, there was no statistical significance in the comparison of lesion quantity, size, and density across different disease stages ( $P > 0.05$ ). Within the same disease stage, the main distribution locations were the lower lobes of both lungs, the peripheral lung fields, and the peripheral + central regions, with single and multiple lesions being the most common. Among the morphologies of the lesions, there were certain differences based on different disease stages ( $P < 0.05$ ), specifically in patchy vs. cord-like, cord-like vs. mass-like, and patchy vs. mass-like lesions ( $P < 0.05$ ). The incidence rates in the progressive and recovery

stages of the disease were higher than those in the early clinical stage, showing an upward trend. In the comparison of CT signs, no statistical significance was found in the data comparison across different disease stages ( $P > 0.05$ ). See **Table 2** for details.

**Table 2.** Comparison of lesion quantity, location, distribution, and morphology results in COVID-19 patients at different disease stages

Indicator	Category	Early Stage ( <i>n</i> =24)	Progressive Stage ( <i>n</i> =24)	Recovery Stage ( <i>n</i> =24)	<i>P</i>
Lesion quantity	Average quantity	27.21 ± 3.25	28.04 ± 3.87	28.01 ± 3.26	0.462
Lesion location	Right upper lung	2	1	1	< 0.001
	Right middle lung	2	3	2	
	Lower lobes of both lungs	7	6	8	
	Peripheral lung fields	6	7	6	
	Peripheral + Central	6	6	6	
	Right lower lung	1	2	1	
Onset pattern	Single	13	12	12	0.582
	Multiple	11	12	12	
Lesion morphology patchy	Patchy	5	7	8	< 0.001
	Cord-like	10	5	2	
	Mass-like	9	12	14	
CT signs	Pleural thickening	5	6	7	0.152
	Pleural effusion	6	6	5	
	Mediastinal lymph node enlargement	6	5	6	
	Pericardial effusion	7	7	6	

### 3.3. Analysis of lesion density at different stages

Research results indicate that among various stages of the disease, the most common signs include air bronchogram, crazy paving pattern, halo sign, subpleural line, and reticulation. Details are shown in **Table 3**.

**Table 3.** Analysis of lesion density at different stages for COVID-19 patients

Lesion Density	Early Stage ( <i>n</i> = 24)	Progressive Stage ( <i>n</i> = 24)	Recovery Stage ( <i>n</i> = 24)
Pure consolidation	1 (4.17)	0 (0.00)	1 (4.17)
Ground-glass Opacity	1 (4.17)	1 (4.17)	0 (0.00)
Air bronchogram	6 (25.00)	6 (25.00)	5 (20.83)
Crazy paving Pattern	4 (16.67)	5 (20.83)	6 (25.00)
Halo sign	4 (16.67)	5 (20.83)	6 (25.00)
Subpleural line	5 (20.83)	3 (12.50)	3 (12.50)
Reticulation	3 (12.50)	4 (16.67)	4 (16.67)

### 3.4. Analysis of disease progression patterns

In the statistical analysis of disease progression patterns, the main patterns observed include lesion enlargement, increase in lesion count, density changes, and localized increase or absorption of lesions. Details are presented in **Table 4**.

**Table 4.** Analysis of disease progression patterns for COVID-19 patients

Progression Pattern	Case	Count Proportion (%)
Lesion enlargement	16	66.67
Increase in lesion count	17	70.83
Density changes	20	80.33
Localized increase or absorption of lesions	6	25.00

## 4. Discussion

The novel coronavirus is one of the most infectious viruses discovered in recent years. As a  $\beta$ -genus positive-strand single-stranded RNA virus, it is characterized by small particle size and strong infectivity, with a diameter of only 100 nm<sup>[5]</sup>. It shares a high degree of similarity with bat-derived coronaviruses and pangolin  $\beta$ -coronaviruses. The novel coronavirus exists in many forms and has low stability, making it prone to mutations. Some research teams have directly pointed out that the novel coronavirus can mutate into three types, all of which are distributed globally<sup>[6]</sup>.

According to current epidemiological data, COVID-19 patients are the main source of infection. Some patients have very subtle clinical symptoms, while virus carriers are potential sources of transmission. The virus can be transmitted through the air and in enclosed spaces, with a possibility of aerosol transmission. Studies have extracted blood and feces samples from COVID-19 patients for testing, and the novel coronavirus has also been detected, suggesting the possibility of mother-to-child transmission<sup>[7]</sup>.

Generally, the incubation period of the novel coronavirus is about two weeks, with a median incubation period of one week and a maximum incubation period of three weeks. This virus has strong reproductive and replication abilities, significantly higher than other viruses. Due to the lack of antibodies against the novel coronavirus in the human body during the early stages of the disease, it is very easy to be infected. After infection with the novel coronavirus, the human body secretes antiviral interferons, but the novel coronavirus can still neutralize these interferons, making it difficult to detect the virus after infection<sup>[8]</sup>.

In the early clinical stage, the main symptoms are dry cough, fever, fatigue, etc<sup>[9]</sup>. Some patients may also experience diarrhea, sore throat, and nasal congestion. The total white blood cell count may decrease, procalcitonin levels remain normal, and C-reactive protein (CRP) may show a significant increase. Attention should be paid to these symptoms in the early clinical stage. Studies have confirmed that the lower respiratory tract has relatively weak defenses, so the novel coronavirus may attack the subpleural alveolar tissue, causing diffuse damage to the airways<sup>[10]</sup>. The lesions may involve the lung interstitium. Pathologically, inflammatory cell infiltration and vascular fluid leakage may also occur.

Based on this, this study focused on 24 nucleic acid-positive patients with COVID-19 who were admitted to our hospital between January 2020 and November 2021. We investigated the imaging manifestations of high-resolution chest CT scans in COVID-19 patients in Qinghai Province. The research results indicated that



systemic symptoms and respiratory and circulatory symptoms of the novel coronavirus were more common ( $P < 0.05$ ). During the progression of the disease, there was no statistically significant difference in the location, size, relative position, and density of lesions across different stages of the disease ( $P > 0.05$ ).

Within the same disease stage, the lesions were primarily located in the lower lobes of both lungs, the periphery of the lungs, and a combination of peripheral and central regions, with single and multiple lesions being the most common. Among lesion morphologies, there was a statistically significant difference based on different disease stages ( $P < 0.05$ ). The incidence of cord-like lesions was higher in the progressive and recovery stages compared to the early stage, showing an upward trend.

Among the CT signs, there was no statistically significant difference in pleural thickening, pleural effusion, mediastinal lymph node enlargement, and pericardial effusion across different stages of the disease ( $P > 0.05$ ). Based on different stages of the disease, the main CT signs observed were air bronchogram, crazy-paving pattern, halo sign, subpleural line, and reticulation. Disease progression primarily included an increase in lesion size, an increase in the number of lesions, changes in lesion density, and local increases or resolution of lesions.

In summary, regarding the HRCT manifestations of the novel coronavirus, the HRCT findings and their evolution are quite complex. Chest HRCT plays a significant role in screening for COVID-19. As the disease progresses, cord-like lesions may be one of the important characteristic manifestations. However, the sample size of this study was relatively small and more cases will be included in subsequent studies to ensure data reliability.

## Funding

Qinghai Provincial Health Commission Medical and Health Science and Technology (Project No.: 2022-wjzdx-63)

## Disclosure statement

The authors declare no conflict of interest.

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