Study on the Medication Rules of Traditional Chinese Medicine Prescriptions for the Treatment of New Crown Pneumonia Based on Data Mining Technology

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Abstract ［**Objectives**］ This study was conducted to analyze the medication rules of clinical prescriptions of traditional Chinese medicine decoction pieces for the treatment of novel coronavirus pneumonia (COVID-19) during the epidemic in multiple regions based on data mining technology, so as to provide a reference for the treatment of COVID-19 with traditional Chinese medicine. ［**Methods**］ The traditional Chinese medicine prescriptions used since the outbreak of COVID-19 in Hubei Province during the fight against the epidemic from February 25, 2020 to February 14, 2022, the traditional Chinese medicine prescriptions used by Guizhou traditional Chinese medicine expert team aiding Hubei Province, the traditional Chinese medicine prescriptions for rehabilitation and conditioning of patients in Ezhou of Hubei Province after discharge, the traditional Chinese medicine prescriptions for the prevention and treatment of COVID-19 in Guizhou Province, and the traditional Chinese medicine prescriptions for the treatment of COVID-19 collected from the end of 2019 to the present from the Chinese database of CNKI were collected as the data of this study. Excel was used to establish a database and enter it into the TCM inheritance calculation platform V3.5, and the association rules and k-means clustering algorithm were used to analyze the frequency of herbal medicines in prescriptions during the treatment of COVID-19, the frequency of four natures, five flavors, meridian distribution, and drug combinations. ［**Results**］ A total of 1 859 COVID-19 patients treated with traditional Chinese medicine were included, and the proportion of males was higher than that of females, and middle-aged and elderly people were the most common group. A total of 2 170 prescriptions of traditional Chinese medicine were included, involving a total of 383 traditional Chinese medicines. High-frequency medicines included poria, Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae, Flos Loniceraeetc. The four natures were mainly concentrated in cold, warm and neutral, and the five flavors were mainly concentrated in bitter, pungent and sweet. The herbal medicines were mainly attributed to the lungs and stomach meridians, and were mainly of heat-clearing, exterior syndrome-relieving and diuresis-promoting and damp-clearing types. A total of 24 high-frequency herbal combinations and 35 association rule were excavated, and 3 types of formulas were obtained by cluster analysis. ［**Conclusions**］ The analysis results and medicine combinations obtained in the formulas are consistent with the traditional Chinese medicine treatment theory of COVID-19 caused by wind-heat filth accompanied with damp and toxin.

Key words Medicinal herb; Medication rule; COVID; Association rule; Cluster analysis

DOI：10.19759/j.cnki.2164 − 4993.2024.05.013

Epidemic disease refers to a kind of disease with rapid onset, large number of infected people, rapid spread and high mortality. It mostly used as the general term for infectious diseases, also known as "plague" or "pestilence"[1]. *Treatise on Acute Epidemic Febrile Diseases* wrote by Wu Youxing in the Ming Dynasty clearly points out："Epidemic febrile diseases are diseases, which are not infected by wind, cold, summer heat or damp, but by a peculiar qi between heaven and earth." This peculiar qi is called "Li Qi" by Wu Youxing, *i. e.*, the pestilential qi today. People get sick because of the feeling of pestilential qi. Epidemic disease belongs to the evil of filth and turbidity, which is absorbed from the nose and mouth, goes straight to the middle road, and spreads the triple energizer[2]. The evil of filth and turbidity includes summer heat filth, damp heat filth, miasma, plague and other evils. The medical records of epidemic diseases can be traced back to the classic theoretical works of traditional Chinese medicine, such as *Inner Canon of the Yellow Emperor*, *Suwen · Qijiaobian Dalun*, *Suwen · Benbing Lun and Suwen · Cifa Lun*[3], in which warm epidemics, water epidemics, wood epidemics, soil epidemics and warm pestilence have already appeared. *Analytical Dictionary of Characters* put forward that "epidemic disease is also common among people". *Suwen Cifa Lun* says "When the five epidemics arrive, people are infected easily, and regardless of the age, the symptoms are similar." The concept of "epidemic disease" in traditional Chinese medicine is equivalent to infectious diseases in modern medicine[4]. From the trial of the third edition, the Diagnosis and Treatment Plan for Pneumonia Infected in novel coronavirus made it clear that the disease belongs to the category of "epidemic disease" in traditional Chinese medicine, and the cause is the qi of epidemic disease with "dampness" as its basic attribute, which can be called "wet toxic epidemic disease". *The Scheme for Diagnosis and Treatment of Pneumonia Infected by Novel Coronavirus* defined that the disease belongs to the category of "epidemic disease" in traditional Chinese medicine since the third version of the trial, and the cause is pestilential qi with the basic attribute of "dampness", which can be called "damp toxin epidemic". At present, modern medicine still lacks effective treatment measures

for this disease[5], and traditional medicine has a long history of anti-epidemic and accumulated rich and effective experience. Traditional medicine played an outstanding role in the fight against the COVID-19 epidemic and showed obvious advantages[6].

In this study, V3. 5, a traditional Chinese medicine inheritance computing platform, was used to mine and analyze the traditional Chinese medicine prescriptions used since the outbreak of COVID-19 in Hubei province, the traditional Chinese medicine prescriptions used by Guizhou traditional Chinese medicine expert team aiding Hubei Province, the traditional Chinese medicine prescriptions for rehabilitation and conditioning of patients in Ezhou of Hubei province after discharge, the traditional Chinese medicine prescriptions for preventing and treating COVID-19 in Guizhou Province, and the traditional Chinese medicine prescriptions for treating Covid-19 collected from the Chinese database of CNKI since the outbreak of COVID-19, so as to guide clinical medication. We can not only discover the prevention and treatment laws and medicine application laws in traditional Chinese medicine by mining the prescription data of traditional Chinese medicine, but also provide reference for clinical medication, as well as prescription sources for the research and development of new drugs for treating COVID-19 and diseases with the same syndrome.

Clinical Data
Data sources
The traditional Chinese medicine prescriptions used since the outbreak of COVID-19 in Hubei Province, the traditional Chinese medicine prescriptions used by Guozhou traditional Chinese medicine expert team aiding Hubei province, the traditional Chinese medicine prescriptions for rehabilitation and conditioning of patients in Ezhou area of Hubei province after discharge, the traditional Chinese medicine prescriptions for preventing and treating COVID-19 in Guizhou Province, and the traditional Chinese medicine prescriptions for treating Covid-19 collected from the Chinese database of CNKI from the end of 2019 to the present were the data of this study. The research data represented the practice of COVID-19 treatment by distinguished veteran doctors of TCM and related Chinese medicine clinicians from all over the country and even Hubei and Guizhou Provinces since the outbreak of COVID-19.
Inclusion criteria
(1) Complete medical record information; (2) use of traditional Chinese medicine for treatment, with clear prescription composition and dosage.
Exclusion criteria
(1) Missing medical record information; (2) no Chinese medicine treatment; (3) traditional Chinese medicine treatment, but lack of corresponding TCM prescription data; (4) discontinue medication during hospitalization.

Research Method
Data processing
With the first part of *Chinese Pharmacopoeia* (2020 edition)

as the reference standard, the names of traditional Chinese medicines in the prescriptions of traditional Chinese medicine in COVID-19 were sorted out and standardized, and the treatment principles were as follows:

(1) The medicines included in *Chinese Pharmacopoeia* (2020 edition)[7] were supplemented by *Chinese Materia Medica*[8] and *Traditional Chinese pharmacology*[9] according to strict standards. For example, "coltsfoot" was specified as "Farfarae Flos", Liriope spicata was specified as "Radix ophiopogonis", and "Ophiopogon japonicus" was specified as "Perillae Folium". (2) The processing methods of medicines were omitted, unless the processed products which are listed separately in *Chinese Pharmacopoeia*. For example, bran fried Macrocephalae Rhizoma was specified as Macrocephalae Rhizoma, and fried chicken gizzard-membrane was specified as Galli Gigerii Endothelium Corneum.
Data entry and analysis
COVID-19 cases were screened according to the inclusion criteria, and 2 170 cases were finally entered. The collected medical records were entered into Excel data collection table by two people.

Research Results
Age distribution
A total of 2 170 prescriptions were entered in this study. Among them, 893 were women and 966 were men (male : female = 1. 08 : 1). The oldest was 92 years old, and the youngest was 8 years old, and the average age was 48. 1 years old. The age distribution of patients is shown in Table 1, and the gender statistics are shown in Fig. 1.

Table 1   Age distribution of 1 859 patients

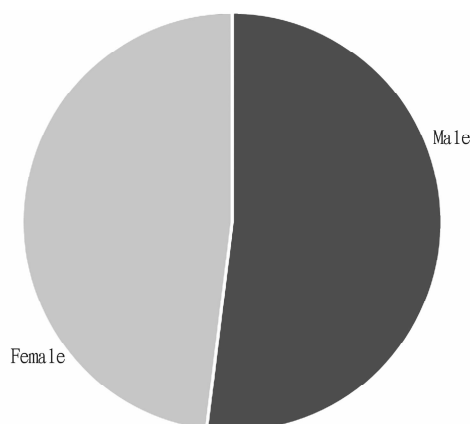| Age	No.	Proportion∥%
≤19	38	2.0
20 – 29	296	16.0
30 – 39	330	17.8
40 – 49	264	14.2
50 – 59	378	20.3
60 – 69	383	20.6
70 – 79	158	8.5
≥80	12	0.6

Fig. 1   Gender statistics chart

Distribution of syndrome types

Among the 2 170 prescriptions with syndrome types, there were 1 107 prescriptions recording the syndrome of damp evil stagnation of lung, accounting for 51.1%; and 369 prescriptions recorded the syndrome of damp heat accumulating lung, accounting for 17.0%. The statistical results are shown in Table 2.

Frequency analysis of Chinese herbal medicines

There were 2 170 prescriptions of traditional Chinese medicine and 383 kinds of Chinese herbal medicines with a cumulative frequency of 64 720 times. Among them, there were 28 kinds of Chinese herbal medicines with frequency ≥300 times, and the top 10 Chinese herbal medicines were poria, Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae, Flos Lonicerae, Herba Taraxaci, Herba Artemisiae Annuae, Rhizoma Atractylodis, Folium Isatidis, Herba Ephedrae and Semen Phaseoli, with a total of 23 304 times. The use and distribution of Chinese herbal medicines are shown in Table 3.

Table 2　Distribution of syndrome types

Syndrome type	Number of prescriptions	Proportion %
Damp evil stagnation of lung	1 107	51.1
Damp heat accumulating lung	369	17.0
Damp toxin accumulating lung	276	12.7
Deficiency of both qi and yin	222	10.2
Lung-spleen qi deficiency	130	5.9
Epidemic toxin closing lung	28	1.3
Qi deficiency and liver depression	12	0.5
Damp stagnation transforming into heat	8	0.4
Inner blocking causing collapse	6	0.3
Damp toxin stagnation	4	0.2
liver stagnation damaging yin	4	0.2
heat toxin blocking lung	4	0.2

Table 3　Distribution of Chinese herbal medicines

No.	Chinese herbal medicines	Frequency	Average dose // g	Frequency %	No.	Chinese herbal medicines	Frequency	Average dose // g	Frequency %
1	Poria	1 915	25.0	2.96	15	Rhizoma Atractylodis	583	13.0	0.90
2	Radix Bupleuri	1 858	14.8	2.87	16	Semen Coicis	536	26.5	0.83
3	Radix Scutellariae	1 767	11.1	2.73	17	Rhizoma Dioscoreae	495	16.2	0.76
4	Herba Pogostemonis	1 632	8.6	2.52	18	Peucedani Radix	462	12.1	0.71
5	Fructus Forsythiae	1 590	12.4	2.46	19	Semen Armeniacae Amarum	423	10.2	0.65
6	Flos Lonicerae	1 587	14.1	2.45	20	Tatarian Aster Root	412	10.5	0.64
7	Herba Taraxaci	1 297	12.0	2.00	21	Radix Rhizoma Glycyrrhizae	389	6.3	0.60
8	Herba Artemisiae Annuae	1 238	12.1	1.91	22	Radix Platycodonis	354	11.5	0.55
9	Rhizoma Atractylodis	1 165	8.5	1.80	23	Farfarae Flos	348	10.2	0.54
10	Folium Isatidis	1 152	11.8	1.78	24	Gypsum	343	25.2	0.53
11	Herba Ephedrae	1 067	7.1	1.65	25	Herba Schizonepetae	333	12.1	0.51
12	Semen Phaseoli	1036	17.7	1.60	26	Polyporus	329	10.8	0.51
13	Citrus reticulata Blanco	994	6.8	1.50	27	Eriobotryae Folium	303	12.5	0.47
14	Herba Eupatorii	833	11.6	1.29	28	Blackberrylily Rhizome	300	9.3	0.46

Table 4　Frequency of four natures of Chinese medicines in prescriptions

No.	Four nature	Frequency	Proportion // %
1	Cold	14 756	48.51
2	Warm	8 367	27.51
3	Neutral	6 173	20.29
4	Cool	1 072	3.52
5	Hot	49	0.16

Four natures and five flavors and meridial distribution

The four natures are warm, hot, cold, cool and neutral. The Chinese medicines for treating COVID-19 showed the highest frequency of using cold medicines, accounting for 48.51%, as shown in Table 4. The statistical radar chart of the four natures is shown in Fig. 2. The five flavors are divided into bitter, sour, sweet, salty and pungent, and bitter medicines were used most frequently, accounting for 37.65%, as shown in Table 5. The statistical radar chart of the five flavors is shown in Fig. 3. It could be seen by analyzing the meridial distribution that the main Chinese

medicines for treating COVID-19 were attributive to the lung, stomach and spleen, as shown in Table 6. The statistical radar chart of the meridial distribution is shown in Fig. 4.
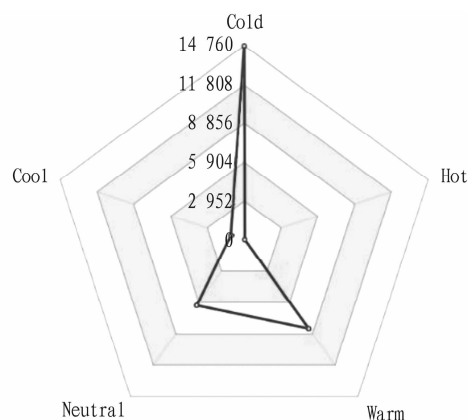

Fig. 2　Statistical radar chart of four natures

Table 5 Frequency of five flavors of medicines in prescriptions

No.	Five flavors	Frequency	Proportion∥%
1	Bitter	16 690	37. 65
2	Pungent	13 410	30. 25
3	Sweet	12 614	28. 46
4	Sour	1 443	3. 26
5	Salty	169	0. 38

Efficacy analysis of Chinese herbal medicines

Through the analysis of efficacy, the results showed that the most important medicines were heat-clearing medicines, followed by damp-eliminating medicines, and the medicines for tonifying deficiency, resolving phlegm, relieving cough and asthma and regulating qi also accounted for a certain proportion, as shown in Fig. 4.
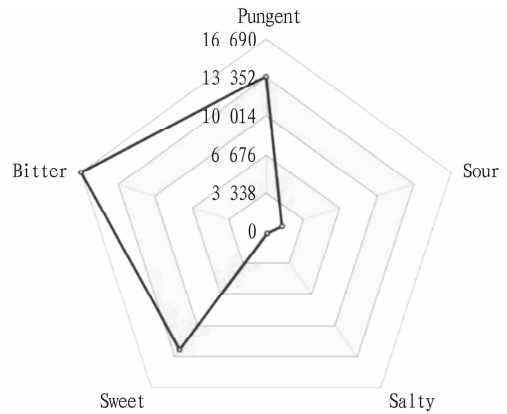
Fig. 3 Statistical radar chart of five flavors

Table 6 Frequency of meridian distribution of medicines in prescriptions

No.	Meridian distribution	Frequency	Proportion∥%	No.	Meridian distribution	Frequency	Proportion∥%
1	Lung	20 925	25. 42	7	Small intestine	4 517	5. 49
2	Stomach	12 909	15. 68	8	Kidney	4 209	5. 11
3	Spleen	12 466	15. 14	9	Bladder	2 464	2. 99
4	Heart	9 292	11. 29	10	Large intestine	2 299	2. 79
5	Liver	7 647	9. 29	11	Triple energizer	128	0. 16
6	Gallbladder	5 425	6. 59	12	Pericardium	47	0. 06

shown in Table 7.
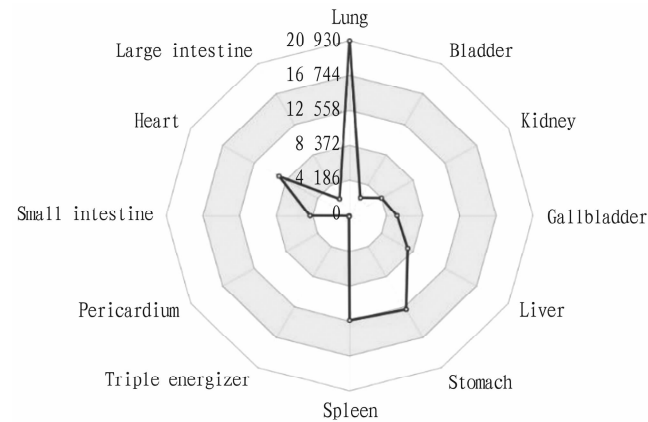
Fig. 4 Statistical radar chart of meridian distribution

Fig. 5 Statistical chart of medicine efficacy

Distribution of tongue manifestations

Through the analysis of tongue manifestations, the results showed that the top ten manifestations in COVID-19 patients were reddish tongue 448 times, pale tongue 442 times, thin tongue coating 200 times and white and greasy tongue coating 188 times, as

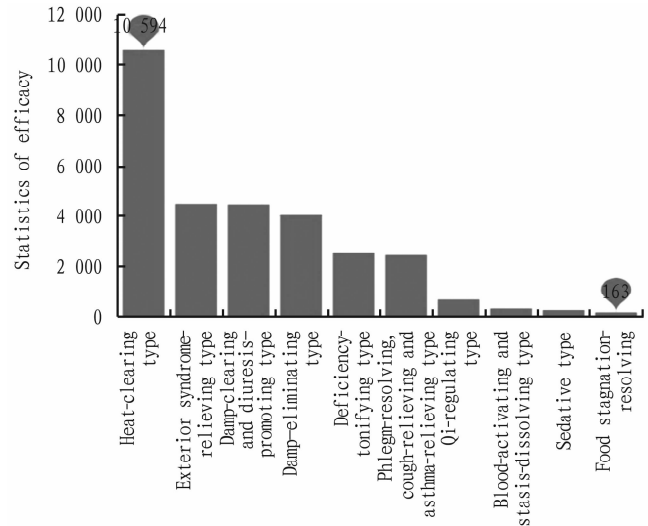**Table 7 Frequency of tongue manifestations of medicines in prescriptions**

No.	Tongue manifestation	Frequency	No.	Tongue manifestation	Frequency
1	Reddish tongue	448	6	Greasy tongue coating	142
2	Pale tongue	442	7	Pale and dull tongue	120
3	White tongue coating	320	8	Red tongue tip	76
4	Greasy tongue coating	188	9	Thin and yellow tongue coating	74
5	Red tongue	158	10	Yellow and greasy tongue coating	65

Statistical results on association rules of core medicines

Apriori algorithm was used to analyze the association rules of

Chinese herbal medicines to get their relationship in clinical prescriptions of traditional Chinese medicine for treating COVID-19.

The number of support was set as 1 300 and the confidence was set as 0.98, and 24 medicine combinations were obtained. Next, the association rules of medicines were analyzed (confidence ≥0.98),

as shown in Table 8 and Table 9. Through the "network topology" function of the platform, the relationship of core medicine combinations was visualized, as shown in Fig. 6.

Table 8   Statistical results of medicine combinations with high frequency (number of support≥1 300 times)

No.	Medicine combination	Frequency	No.	Medicine combination	Frequency
1	Radix Scutellariae, Flos Lonicerae, Fructus Forsythiae	1 721	13	Poria, Radix Bupleuri, Radix Scutellariae, Flos Lonicerae	1 442
2	Radix Scutellariae, Herba Pogostemonis, Flos Lonicerae, Fructus Forsythiae	1 654	14	Poria, Radix Bupleuri, Herba Pogostemonis, Fructus Forsythiae	1 439
3	Poria, Radix Scutellariae, Flos Lonicerae, Fructus Forsythiae	1 604	15	Poria, Fructus Forsythiae, Taraxaci Herba	1 435
4	Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae	1 552	16	Poria, Herba Pogostemonis, Flos Lonicerae	1 413
5	Poria, Radix Bupleuri, Radix Scutellariae, Flos Lonicerae, Taraxaci Herba	1 549	17	Poria, Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis	1 410
6	Radix Bupleuri, Fructus Forsythiae, Taraxaci Herba	1 546	18	Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae	1 394
7	Radix Bupleuri, Flos Lonicerae, Fructus Forsythiae	1 497	19	Radix Bupleuri, Herba Pogostemonis, Fructus Forsythiae	1 365
8	Radix Bupleuri, Fructus Forsythiae	1 496	20	Poria, Herba Pogostemonis, Fructus Forsythiae	1 358
9	Radix Bupleuri, Artemisiae Annuae Herba	1 478	21	Radix Bupleuri, Radix Scutellariae, Fructus Forsythiae	1 352
10	Poria, Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae	1 460	22	Poria, Radix Bupleuri, Radix Scutellariae, Fructus Forsythiae	1 350
11	Poria, Taraxaci Herba	1 458	23	Poria, Herba Pogostemonis, Flos Lonicerae, Fructus Forsythiae	1 336
12	Poria, Radix Scutellariae, Flos Lonicerae	1 444	24	Poria, Radix Bupleuri	1 316

Table 9   Statistical results of medicine core association rules (confidence≥0.98)

No.	Association rule	Confidence	No.	Association rule	Confidence
1	Poria, Radix Scutellariae, Herba Pogostemonis→Radix Bupleuri	0.99	19	Radix Bupleuri, Taraxaci Herba→Fructus Forsythiae	0.98
2	Poria, Radix Bupleuri, Herba Pogostemonis→Radix Scutellariae	0.99	20	Flos Lonicerae, Fructus Forsythiae→Radix Bupleuri	0.98
3	Poria, Radix Bupleuri, Radix Scutellariae→Herba Pogostemonis	0.99	21	Radix Bupleuri, Fructus Forsythiae→Flos Lonicerae	0.98
4	Flos Lonicerae, Fructus Forsythiae→ Radix Scutellariae	0.99	22	Radix Bupleuri, Flos Lonicerae→Fructus Forsythiae	0.98
5	Radix Scutellariae, Fructus Forsythiae→Flos Lonicerae	0.99	23	Fructus Forsythiae→ Radix Bupleuri	0.98
6	Radix Scutellariae, Flos Lonicerae→Fructus Forsythiae	0.99	24	Artemisiae Annuae Herba→Radix Bupleuri	0.98
7	Herba Pogostemonis, Flos Lonicerae, Fructus Forsythiae→Radix Scutellariae	0.99	25	Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae→poria	0.98
8	Radix Scutellariae, Herba Pogostemonis, Fructus Forsythiae→Flos Lonicerae	0.99	26	Poria, Herba Pogostemonis, Fructus Forsythiae→Radix Scutellariae	0.98
9	Radix Scutellariae, Herba Pogostemonis, Flos Lonicerae→Fructus Forsythiae	0.99	27	Taraxaci Herba→poria	0.98
10	Radix Scutellariae, Flos Lonicerae, Fructus Forsythiae→poria	0.99	28	Radix Scutellariae, Flos Lonicerae→poria	0.98
11	Poria, Radix Scutellariae, Fructus Forsythiae→ Flos Lonicerae	0.99	29	Radix Bupleuri, Radix Scutellariae, Flos Lonicerae→poria	0.98
12	Poria, Radix Scutellariae, Flos Lonicerae→Fructus Forsythiae	0.99	30	Poria, Radix Scutellariae, Flos Lonicerae→Radix Bupleuri	0.98
13	Herba Pogostemonis, Fructus Forsythiae→Radix Scutellariae	0.99	31	Poria, Radix Bupleuri, Flos Lonicerae→Radix Scutellariae	0.98
14	Radix Bupleuri, Radix Scutellariae, Flos Lonicerae, Taraxaci Herba→poria	0.99	32	Radix Bupleuri, Herba Pogostemonis, Fructus Forsythiae→poria	0.98
15	Poria, Radix Scutellariae, Flos Lonicerae, Taraxaci Herba→Radix Bupleuri	0.99	33	Poria, Herba Pogostemonis, Fructus Forsythiae→Radix Bupleuri	0.98
16	Poria, Radix Bupleuri, Flos Lonicerae, Taraxaci Herba→Radix Scutellariae	0.99	34	Fructus Forsythiae, Taraxaci Herba→poria	0.98
17	Poria, Radix Bupleuri, Radix Scutellariae, Taraxaci Herba→Flos Lonicerae	0.99	35	poria, Taraxaci Herba→Fructus Forsythiae	0.98
18	Fructus Forsythiae, Taraxaci Herba→Radix Bupleuri	0.99			

Core cluster statistics

K-means clustering algorithm was used to analyze the entered prescriptions, and all the data were divided into three categories, that is, three core combinations. The statistical results of core

medicine combinations are shown in Table 10. Meanwhile, the kmeans algorithm clustering diagram and kmeans algorithm regression simulation diagram of prescription clustering analysis were obtained, as shown in Fig. 7 and Fig. 8.
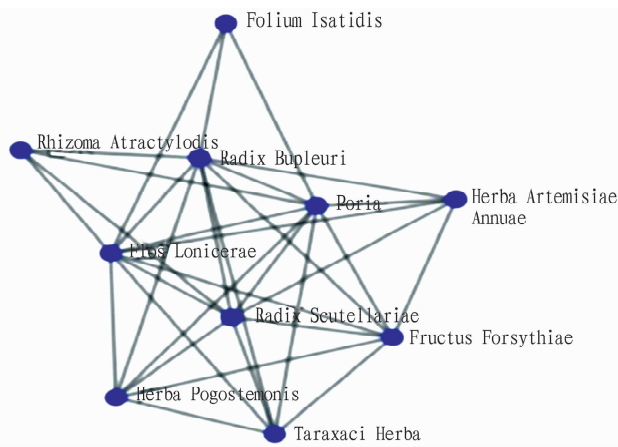
Fig. 6   Association rule network presentation diagram

Table 10   Statistical results of core medicine combinations

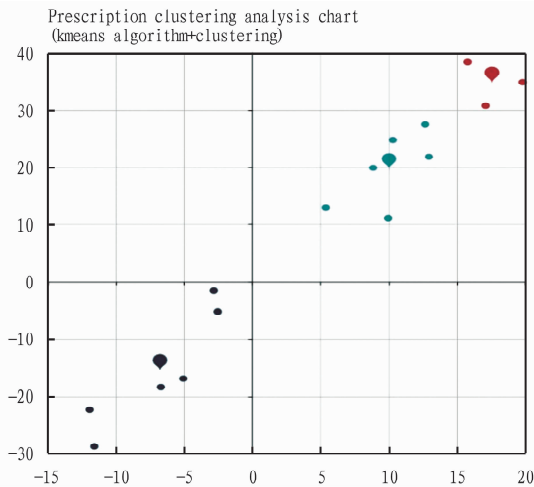| No.	Name
1	Poria, Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis and Rhizoma Atractylodis
2	Poria, Radix Scutellariae, Fructus Forsythiae, Radix Bupleuri and Flos Lonicerae
3	Radix Scutellariae, Fructus Forsythiae, poria, Radix Bupleuri and Flos Lonicerae

Fig. 7   Clustering diagram obtained by kmeans algorithm

Conclusions and Disscussion

Novel coronavirus is an acute new infectious disease caused by novel coronavirus infection, with fever, dry cough and fatigue as the main clinical manifestations in the early stage. At present, the main viewpoints about the TCM name of COVID-19 are "cold-damp epidemic"[10], "damp-warm epidemic"[11], "damp toxin epidemic" and "damp toxin with dryness"[12], but it is basically agreed that COVID-19 belongs to the category of "damp toxin epidemic" in TCM[13-15]. Different scholars have different understandings on the etiology and pathogenesis of COVID-19. Most scholars argue with "damp", "heat", "stasis" and "toxin"[16] to explain COVID-19's etiology and pathogenesis. The etiology is "damp-toxin evil", and the pathogenic attribute of COVID-19 is

mainly damp evil, which runs through the whole process of the disease[17]. COVID-19 is mainly located in the lung, followed by the spleen and stomach[18]. "The lung is the master of qi" and "the spleen produces blood, and blood produces qi". Damp belongs to yin evil, which stagnates and turns into heat, and damp-heat accumulates in the lung and spleen, which causes the lung qi to fail to disperse and descend[19] and the stomach qi lose to fail to descend. Damp has the characteristics of heavy turbidity, and belongs to yin evil, and it is sticky and downward[20]. "Suwen · Zhizhen Dalun Pian" says: "Many diseases such as general edema or abdominal fullness caused by water-dampness are mostly related to the spleen". The data mining results of meridian tropism showed that the medicines were mainly attributive to the lung, stomach and spleen meridians, which is consistent with the locations of COVID-19 mentioned above.
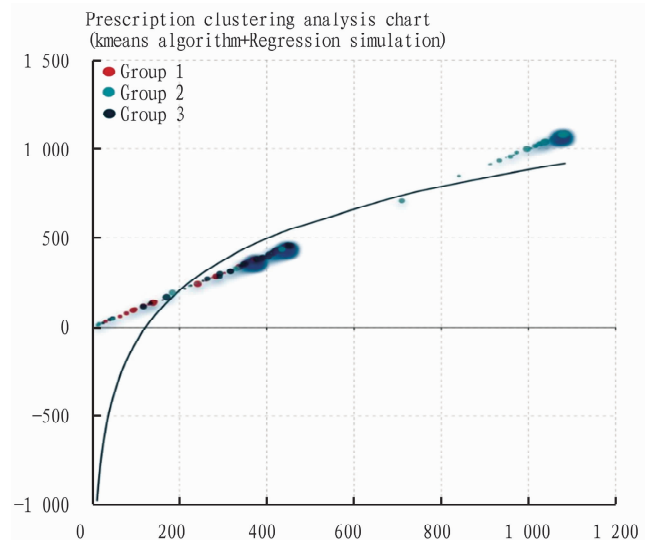

Fig. 8   Clustering analysis regression simulation diagram obtained by kmeans algorithm

Through analysis, it could be seen that 52% of the patients according with the criteria were male and 48% were female, and males were more than females. The average age was 48.1 years old, and fewer people were over 80 and under 20. Most of the sick people were concentrated in middle-aged and elderly people, which may be related to the decreased sensitivity of middle-aged and elderly patients to physical discomfort or insufficient initiative to seek medical treatment after symptoms appear. The first few kinds of medicines have the efficacy of clearing heat, relieving exterior syndrome, promoting diuresis and eliminating dampness. According to the results of medicine frequency, the high-frequency medicines were poria, Rhizoma Atractylodis, Herba Pogostemonis, Flos Lonicerae, Radix Scutellariae, Herba Taraxaci, Fructus Forsythiae and gypsum. As the most important pathogenesis feature of patients with COVID-19, "damp-heat evil" runs through the whole disease. Damp epidemic disease is easy to attack the lung and spleen of Taiyin, often accompanied by limb aches, anorexia, loose stool and other symptoms. The main clinical symptoms are stagnation of damp evil and deficiency of both qi and yin. Suwen · Zhizhen Dalun Pian says: "Many diseases such as general edema or abdominal fullness caused by water-dampness are mostly related

to the spleen". For those suffering from mild damp evil and no obvious heat, Herba Pogostemonis, Fortune Eupatorium Herb, Amomi Fructus Rotundus and Fructus Amomi are selected to remove dampness by means of aromatics. The damp evil is sticky and hinders the middle energizer easily, which makes the spleen and stomach transport abnormal, and the symptoms are fever and anorexia. In view of damp-heat in the middle energizer, Coptidis Rhizoma, Scutellariae Radix, Coicis Semen, talcum and Magnoliae Officmalis Cortex are given to dry the dampness by cold medicines and clear the heat by bitter medicines, and Magnoliae Officmalis Cortex can dry the dampness and make qi descend to remove the fullness, thus helping the stomach qi to descend. Talcum and Coicis Semen can expel dampness from urine by clearing damp and promoting diuresis. Radix Scutellariae, Coicis Semen and poria can be selected for the evil of damp-heat and turbid phlegm in the lung. The combination of damp and heat is like oil entering flour, and for those who suffer from cemented damp and heat, the four methods of clearing, promoting, drying and converting can be combined to treat damp and heat separately, by selecting Herba Artemisiae Scopariae, Rhizoma Atractylodis, Sevenlobed Yam Rhizome and silkworm excrement. "The method of promoting diuresis and promoting bowel movements is applied to bring out the pathogenic factors from below", so for those with damp stagnation in the lower energizer, poria, Coicis Semen and Oriental Waterplantain Rhizome are chosen to relieve damp-heat evil qi from urine. *Suwen·Cifa Lun* says："External evils cannot invade the body as long as the body is healthy and strong. When the vital qi of human body is weak, external evils can easily invade human body, leading to the occurrence of diseases." Radix Astragali, Radix Ophiopogonis and Radix Rhizoma Glycyrrhizae have the functions of invigorating qi and nourishing yin, strengthening the defensive qi, and nourishing vital qi. Toxin evil is also one of the main pathogenesis. *Suwen·Wuchangzheng Dalun Pian* says："If the evils are too strong, they can all turn into toxin." The evil qi that is full and cannot be broken down can all be called toxin evil. Exogenous toxin includes exogenous six evils or plague, which turns into toxin when it is too vigorous. Wu Youke's *Treatise on Pestilence* says："The pestilential qi today is the toxic qi of the heaven and earth." The pestilential toxin is cold-damp pestilential qi, which attacks the yang collaterals of the lung, and the qi collaterals of the lung show abnormal dispersing and descending functions, resulting in aversion to cold, fever, aches all over the body, cough and so on. The locations of the disease involve the heart, liver and even triple energizer. The tongue manifestations of severe COVID-19 patients were observed with less tongue coating and dark purple tongue mostly. The pestilential toxin spreads into ying blood in the interior, and the damp pestilential toxin permeates the triple energizer, thereby hindering the movement of qi. Gypsum has the functions of clearing away heat and purging fire, relieving restlessness and quenching thirst, while Flos Lonicerae and Fructus Forsythiae can clear away heat and toxic materials, and disperse wind-heat by their pungent and cool nature. Herba Pogostemonis has the effects of eliminating dampness with aromatics and relieving summer-heat, and the combination of dampness-dissipating medicines and heat-clearing medicines can treat damp-heat stagnation of lung, excessive accumulation of toxic heat and poor circulation of qi and blood. For "stagnation" in "Correction

of the Errors of Medical Works", it is said "If the vitality is weak, it will not reach the blood vessels, and if the blood vessels lack qi, they will stay and stagnate". Deficiency of qi and stagnation of qi lead to poor circulation of qi, which leads to obstruction of blood circulation and blood stasis. If the qi is weak in promoting the blood circulation, it will cause slow blood flow and lead to blood stasis, and if the blood control function of qi is abnormal, the blood will come out of the blood vessels and cause blood stasis. The formed blood stasis serves as a new pathogenic factor. During the course of COVID-19, there may be symptoms such as chest tightness, shortness of breath, and cyanosis of lips and claws. Radix Rehmanniae, Radix Scrophulariae, Radix Ophiopogonis and Rhizoma Polygonati Odorati can nourish yin and fill arteries and veins, promote blood circulation and moisten arteries and veins, thereby promoting blood circulation, nourishing viscera and regulating blood circulation. According to the above analysis of the pathogenesis of "damp, heat, toxin and stasis", the types of medicines used are consistent with the results of medicines used with high frequency by data mining.

Analysis showed that high-frequency TCM syndrome types were mainly damp evil stagnation of lung, damp-heat accumulating lung, damp toxin accumulating lung, and deficiency of both qi and yin. In the early stage, COVID-19 manifested as damp cold obstructing lung or mainly damp-heat stagnation of lung, and in the middle stage, damp obstructing Moyuan and heat toxin congestion and excessiveness. Damp evil stagnation of lung is one of the most common syndromes of patients. Damp heat congestion in the upper, middle and lower triple energizer leads to failed dispersion of lung qi and damp-heat stagnation. Clinically, fever, slight aversion to cold, cough, yellow and white phlegm, chest tightness, sore throat, anorexia, red tongue with yellow and greasy coating and floating pulse could be observed. Sweet and cold products are chosen more, and the treatment method is to clear away heat and toxic materials and clear away lung heat, so as to dispel damp evil and make the spleen and stomach healthy. Through frequency statistics, it was found that Radix Scutellariae was the most frequently used drug in the damp-heat type. Radix Scutellariae is bitter in taste, cold in nature, good at entering the upper energizer, and has the effects of clearing away heat and dampness, purging fire and removing toxic materials, which is consistent with the damp-heat nature of COVID-19. The damp-heat accumulating lung syndrome of was characterized by fever, cough, sticky or thick phlegm, asthma, dry mouth and chest tightness. The white and thick tongue coating is consistent with the symptom of damp-heat accumulating lung. The treatment method is to clear away heat and promote diuresis, relieve cough and resolve phlegm, and Sanren decoction can be given to the patients for treatment. The damp toxin type was characterized by fever, cough with little phlegm, and yellow and greasy tongue coating. In view of the treatment of this syndrome, Chen *et al*. [21] deemed that the first priority should be eliminating the evil, and it could be treated by dispelling filth with aroma, promoting qi-flowing, and separating dispersion and mobilizing discharge. Liu *et al*. [22] reckoned that the early treatment of traditional Chinese medicine could be preventing the disease and evil from going deep by dispersing the lung and dispelling the evil, and eliminating dampness with aromatics. Analysis showed that the tongue coating of patients was mainly reddish, pale, thin and

white, and white and greasy. The results are consistent with the main symptoms of COVID-19.

Association analysis found that medicine combination with the highest using frequency was "Radix Scutellariae, Flos Lonicerae and Fructus Forsythiae". The medicine combination with the highest correlation coefficient was "poria, Radix Scutellariae, Herba Pogostemonis and Radix Bupleuri". Flos Lonicerae is a kind of heat-clearing and detoxicating medicine, sweet in taste and cold in nature, and attributive to the lung, heart and stomach meridians. It can treat exterior syndrome of wind-heat and turn heat into qi. Radix Scutellariae is matched with Radix Bupleuri to relieve shaoyang. Radix Bupleuri can relieve the evil which is half exterior and half interior, and Radix Bupleuri can clear inner heat which is half exterior and half interior. Radix Bupleuri can raise lucid yang, and Radix Scutellariae can descending turbid fire, and the combining the two can achieve the effects of raising lucid yang and descending turbid fire, reconciling exterior and interior, and relieving shaoyang. The high-frequency medicines in prescriptions were analyzed by K-means clustering algorithm, obtaining three groups of core medicine combinations, namely, combination 1: poria, Radix Bupleuri, Radix Scutellariae, Herba Pogostemonis and Rhizoma Atractylodis, combination 2: poria, Radix Scutellariae, Fructus Forsythiae, Radix Bupleuri and Flos Lonicerae, and combination 3: Radix Scutellariae, Fructus Forsythiae, poria, Radix Bupleuri and Flos Lonicerae. Flos Lonicerae, Fructus Forsythiae and Herba Pogostemonis in prescriptions have the effects of relieving the exterior syndrome based on pungent flavor and cool nature, and removing dampness by means of aromatics, and can treat wind-heat with dampness syndrome and relieve symptoms such as fever, aversion to cold, thirst, dry throat and sore throat after infection. Herba Pogostemonis, Rhizoma Atractylodis and poria can relieve the exterior syndrome based on pungent flavor and warm nature, and remove dampness by means of aromatics, and can treat syndrome of wind-cold with dampness. Fructus Forsythiae and Radix Scutellariae can eliminate dampness and removing toxic materials and treat damp evil stagnation of lung syndrome. Poria, Herba Pogostemonis and Flos Lonicerae have the effects of clearing heat and freeing lung and removing dampness by means of aromatics, and can treat the syndrome of damp-heat accumulating lung. In a word, the efficacy of Chinese herbal medicines is consistent with the main pathogenesis of COVID-19, which shows that the new prescriptions excavated by the software are reasonable and effective and have certain clinical application value. We can not only discover the prevention and treatment laws and medicine application laws in traditional Chinese medicine by mining the prescription data of traditional Chinese medicine, but also provide reference for clinical medication, as well as prescription sources for the research and development of new drugs for treating COVID-19 and diseases with the same syndrome.

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