

Acupoints for Headache with Blood Stasis Syndrome: a Literature Study Based on Data Mining Technology

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Objective: This study aimed to investigate the features and underlying principles of acupuncture points used in the treatment of headaches associated with blood stasis syndrome.

Methods: Literature on the treatment of blood stasis headache with acupuncture and moxibustion was searched across three Chinese databases and one English database from January 1st, 2000, to January 1st, 2024. Relevant data including titles, journals, authors, keywords, interventions, main acupoints, and outcomes were extracted for further analysis.

Results: A total of 112 papers with 102 complete prescriptions were analyzed. Of the 77 acupoints examined, 72 were meridian points, and 5 were extraordinary points, used 699 times in total. The top ten acupoints by frequency were Fengchi (GB20), Taiyang (EX-HN5), Baihui (GV20), Hegu (LI4), Shuaigu (GB8), Taichong (LR3), Xuehai (SP10), Touwei (ST8), Geshu (BL17), and Waiguan (TE5). Yang meridian points were used more frequently than Yin meridian points (82.8% vs 17.2%), with the Gallbladder Meridian of Foot Shaoyang being the most common. Nearly half of the acupoints (49.9%) were on the head and neck, and 23.1% on the lower limbs. Specific acupoints accounted for 53.5% of the total frequency. Fengchi (GB20) and Taiyang (EX-HN5) showed the highest correlation. Association rule mining highlighted combinations like Fengchi (GB20) with Taiyang (EX-HN5) and Baihui (GV20). Cluster analysis yielded five clusters.

Conclusion: The study provides insights into selecting effective acupoints and combinations for clinical acupuncture practice and experimental studies in treating blood stasis headaches. Acupoints like Fengchi (GB20), Taiyang (EX-HN5), and Baihui (GV20) may be effective for clinical treatment, but further studies are needed to validate their efficacy.

Keywords: headache, blood stasis syndrome, acupuncture, treatment rule, data mining

Introduction

Headache ranks among the most prevalent neurological disorders globally and significantly impacts both the global disease burden and reductions in health-adjusted life expectancy.¹ It usually refers to the pain confined to the upper part of the skull and above the connection between the upper rim of the eyebrow arch, ear wheel and the occipital outer protrusion.² In most cases, headache is a benign disease that less damage to the human body, but some types of headache can be seriously life-threatening, such as a brain tumour.³ The data indicates that headaches rank among the most prevalent conditions, as evidenced by prevalence surveys conducted among both men and women. According to the World Health Organization (WHO) fact sheet, around half to three-quarters of adults aged 18 to 65 reported experiencing headaches within a one-year period. Despite this, the incidence of headaches is on the rise.⁴ Headaches are varied, The

International Headache Society (IHS) classifies headaches in The International Classification of Headache Disorders, 3rd edition, published in 2018. In the ICHD-3, headache is classified as primary or secondary; primary headache is classified as migraine, tension-type headache, trigeminal autonomic cephalalgias, and other primary headache disorders.⁵ The pathogenesis of headaches is still unclear and many theories try to clarify its mechanism.

The trigeminovascular system (TGVS) and cortical spreading depression (CSD) are pivotal in the pathogenesis of headache.⁶ Based on the neurovascular theory, TGVS becomes activated, leading to the release of various neuropeptides, among them calcitonin gene-related peptide (CGRP), which play a role in the development of headaches.^{7,8} The CSD can trigger the depolarization of brain neurons and microglia, and then the depolarization spreads along the cortex, leading to the activation of TGVS to participate in the pathogenesis.⁹ Besides, The CGRP theory and the endocannabinoid system (ECS) theory have gradually become the research hotspots in recent years.^{10,11} This could potentially offer novel insights for investigating the pathogenesis of headache.

Other neurotransmitters and neuromodulators are also implicated in the development of headaches. For instance, serotonin (5-HT) is crucial in migraine pathophysiology, variations in serotonin levels result in the dilation and constriction of blood vessels, which can trigger migraines.^{12,13} Dopamine is another neurotransmitter linked to headaches, particularly during the prodromal phase of migraines, where symptoms such as yawning, nausea, and mood changes occur.¹⁴ Additionally, nitric oxide (NO) is associated with headache and its increased levels may induce the vascular changes related to migraine, cluster headache and tension-type headache.^{15–17}

Medication therapy is the mainstay of the treatment.^{18,19} Nonsteroidal anti-inflammatory drugs (NSAIDs) are usually preferred in patients with mild to moderate headaches, but they are nonspecific choice for headache and have adverse effects in gastrointestinal adverse effects, as well as antihistamines, opioid sedatives, and tricyclic antidepressants.²⁰ CGRP Related drug research and development is a major progress in migraine treatment in recent years, the CGRP receptor antagonist and CGRP monoclonal antibody of application for the clinical treatment of migraine provides more options, the former can be used for acute target treatment, the latter as a preventive treatment, not only curative effect, and less adverse reactions, low cardiovascular risk, greatly reduce the overuse of drugs, slow the chronic progress of migraine.^{21,22} However, the long-term efficacy and adverse reactions of such new drugs still need further observation and research.^{23,24}

Traditional Chinese medicine (TCM) divides headache into two categories: external contraction and internal damage, among which internal damage headache has a slow onset, the course of a long course and has complex mechanisms of disease. The blood stasis syndrome headache is a kind of internal damage headache. The meaning of blood stasis is not simply refers to the stay stasis of blood, but the current overall state of the patient, including the fixation of the pain site, pain feeling like a needle sticking into the skin, light pain during the day and aggravation at night, purple and dark tongue, accompanied by ecchymosis. It is caused by poor blood circulation or stagnant blood flow and trauma, so traditional Chinese medicine treats the disease with prescriptions or acupuncture and other therapies that can promote blood circulation and remove blood stasis.²⁵ In contemporary medical and clinical research, the underlying pathology of headaches associated with blood stasis syndrome involves abnormalities in microcirculation, characterized by irregularities in hemorheology, hemodynamics, and the formation of scar tissue.²⁶ Hence, the treatment approach for headache characterized by blood stasis syndrome continues to focus on promoting blood circulation and resolving stasis.

Acupuncture, a treasure of traditional Chinese medicine, now is widely used in clinical practice as a treatment for headache.^{27,28} Reports indicate that acupuncture is among the most prevalent complementary therapies globally and is gaining acceptance in Western nations as an alternative approach to treating headaches and various other pain-related conditions.²⁹ The selection and combination of acupoints are regarded as fundamental components of the acupuncture treatment methodology. In clinical settings, practitioners frequently combine two or more acupoints to augment their synergistic effects and enhance the overall therapeutic outcomes of acupuncture.³⁰ At present, TCM has carried out many clinical studies on the selection of acupoints of headache with blood stasis syndrome, but the selections of the acupoints are different. Fortunately, the emergence of data mining techniques has introduced novel approaches for analyzing acupuncture data related to headache. The advantage of data mining is that it can automatically classify without prior classification method, extract unknown information from the data, find the similarities and differences between the item sets, summarize and organize a large number of imperfect, imprecise, and random data, analyze and evaluate them on this

basis.³¹ The data mining technology can comb and integrate on the basis of a large number of clinical research programs. Provides us with a core combination of acupoints for wider use.

In this study, we employed data mining techniques to systematically analyze studies conducted over the past two decades, with the purpose of summarizing acupuncture treatment regular acupoint selection of blood stasis headache and hope it can provide a reference for acupuncture therapy in the future.

Methods

Literature Source and Search Strategy

We conducted a comprehensive search for literature studies on the treatment of blood stasis headaches using acupuncture from January 1st, 2000, to January 1st, 2024. The search encompassed three Chinese databases (VIP Database for Chinese Technical Periodicals, China National Knowledge Infrastructure, and Wanfang data) and one English database (PubMed). Only studies published in English or Chinese were included. For searches conducted in Chinese databases, we utilized medical subject terms consistent with their Chinese translations corresponding to medical subject headings. The detailed search strategy is outlined in Table 1.

Criteria for Selection

Selection of Literature Types

We included randomized controlled trials designed to assess the efficacy of acupuncture in treating blood stasis headaches. Excluded were animal studies, reviews, meta-analyses, retrospective studies, case reports and systematic reviews. Additionally, studies where acupuncture failed to demonstrate a clear clinical effect or where patients did not meet diagnostic criteria were also excluded. The literature obtained from the final search and its content was evaluated by one author to maximize the elimination of the heterogeneity present in the literature data.

Participants

Participants must meet the diagnostic criteria for primary headaches as outlined in the ICHD-3⁵ and adhere to the Traditional Chinese Medicine (TCM) diagnostic criteria for blood stasis syndrome.³² Each group should consist of a minimum of ten participants, studies with insufficient sample sizes should be excluded.

Table 1 Search Strategy for Literature on Acupoints in Headache with Blood Stasis Syndrome

Search Strategy	Keywords Content
A. Search Strategy for "headache"	1. headache 2. headache disorders 3. primary headache 4. migraine 5. tension-type headache 6. trigeminal autonomic cephalalgias 7. cephalalgias
B. Search Strategy for "blood stasis"	8. blood stasis 9. stasis of blood
C. Search Strategy for "acupuncture interventions"	10. acupuncture 11. acupuncture therapy 12. acupuncture points 13. body acupuncture 14. electroacupuncture 15. electro-acupuncture 16. electrical acupuncture 17. scalp acupuncture 18. acupoint 19. acupuncture and moxibustion

Intervention

The included studies must incorporate acupuncture as part of the treatment regimen, either alone or in combination with other conventional interventions such as Chinese herbal prescriptions or Western medicine. Literature using acupuncture methods but does not clearly indicate acupuncture points should be excluded. Unconventional acupuncture types such as head acupuncture, ear acupuncture were also excluded. The final results of clinical trials must conclude that the acupuncture intervention treatment is effective, and the literature of invalid results of clinical trials should be excluded.

Data Selection and Extraction

On the Windows11 platform, the software Microsoft Office Excel 2016 was used to establish the database by using the preprocessed data, including: literature source, author's name, main acupuncture points, interventions, results, eg. The input method is: if there is no matching point, all acupoints will be recorded according to the main point; if there are main and auxiliary matching points, they will be recorded according to the main point and matching points. The standard treatment of the name of the acupoints is based on the 2006 Chinese National standard edition "Acupoint Name and Positioning" (GB/T12346-2006),³³ "Acupuncture",³⁴ and the name of the acupoints was corrected. In order to ensure the accuracy of the data, two authors are used to check and input the data. Any inconsistencies will be resolved through arbitration by a third reviewer. Next, we analyzed the total frequency of the use of all acupuncture acupoints, the frequency of different individual acupoints, the distribution of the belonging meridians, the distribution of acupoints in different parts of the human body and the frequency of the use of specific acupoints through the data summarized above.

Association rule analysis is an important method used to explore the connection of different acupuncture points.³⁵ We used SPSS Modeler 18.0 software (IBM SPSS Statistics, RRID: SCR_019096) to analyze the high frequency acupoints by Apriori algorithm. The top ten acupoints in the highest frequency of prescriptions were edited, and the high frequency acupoints present in each prescription were marked Y, and not marked N, which were recorded in Microsoft Office Excel 2016.

The likelihood of the concurrent presence of anterior and posterior items is denoted by support, while confidence represents the probability of the occurrence of the subsequent item given the occurrence of the former.³⁶ The best minimum support and the lowest confidence were set after multiple trials, the maximum preceding item was set to 2, and the complex network map is drawn, and the correlation between acupoints was analyzed by the chart.

Systematic cluster analysis operates as an exploratory technique without predetermined standards for classification. It autonomously organizes sample data into new clusters, which are then scrutinized to discern the unique characteristics of each cluster.³⁷ In this study, we employed SPSS Statistics 26.0 for conducting cluster analysis on acupoints exhibiting high frequencies. Following this, we constructed a dendrogram using cluster analysis to investigate the clustering relationships among the acupoints.

Results

Search Findings and Prescription Profiles

In the preliminary search, we included 633 studies from four databases, after excluding duplicate articles from the 676 search results. Following adherence to the inclusion and exclusion criteria, a total of 112 eligible articles were ultimately incorporated. The procedure for literature screening and prescription extraction is depicted in [Figure 1](#).

Utilization of Acupuncture Points

In 112 articles, we extracted 102 acupoint prescriptions, including 77 acupoints, and the total frequency of use was 699 times. Among the 77 acupoints, 72 belong to meridians, 5 to extraordinary acupoints. The top ten acupoints in the frequency of use are Fengchi(GB20), Taiyang(EX-HN5), Baihui(GV20), Hegu(LI4), Shuaigu(GB8), Taichong(LR3), Xuehai(SP10), Touwei(ST8), Geshu(BL17), Waiguan(TE5) which are listed in [Table 2](#).

A total of 7 acupoints were used more than 40 times, and 16 acupoints were used more than 10 times. [Figure 2](#) records acupoints with frequencies exceeding ten occurrences.

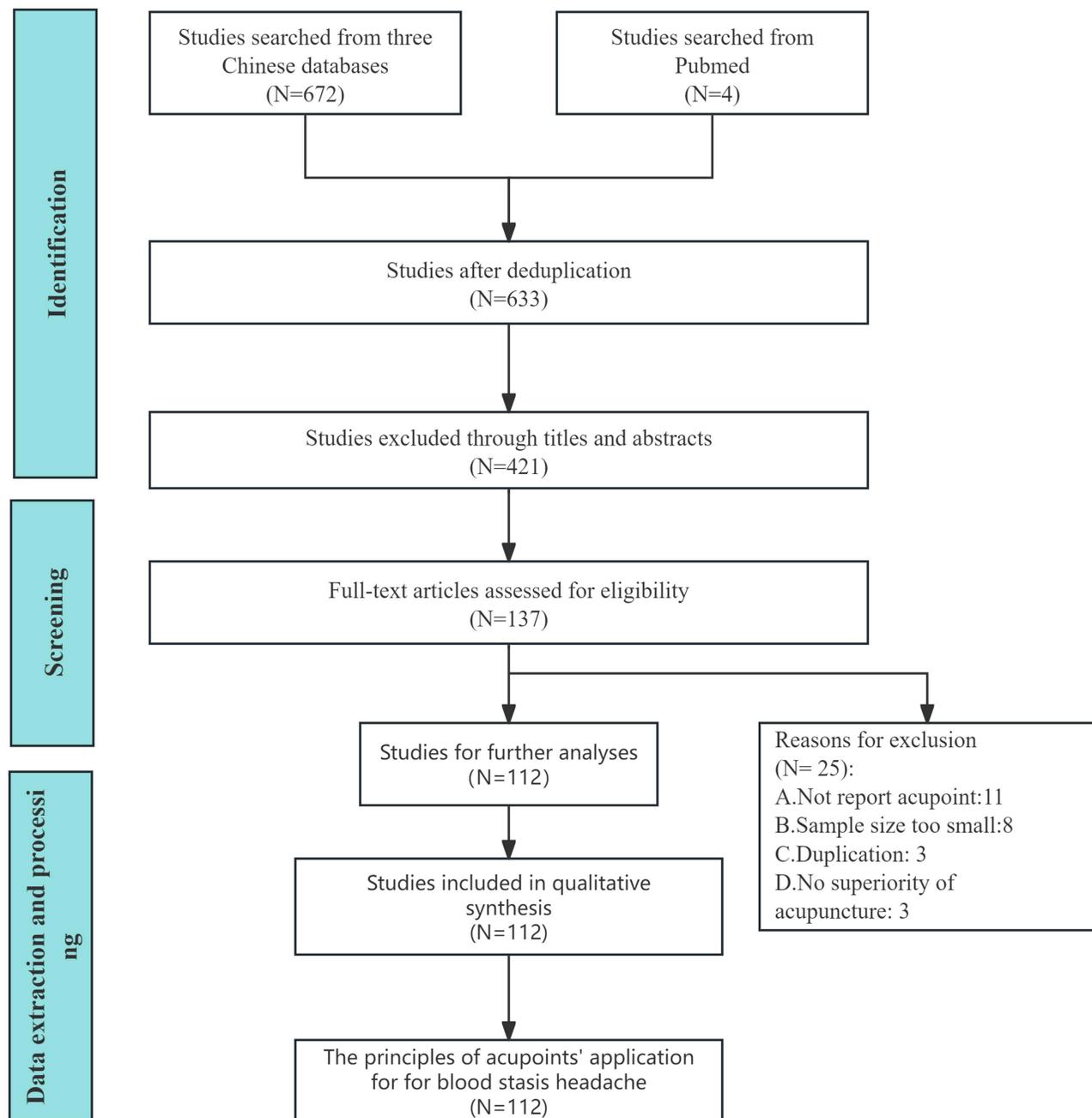


Figure 1 Flow diagram of the study selection process.

Correlation Between Meridians and Acupuncture Points

In traditional Chinese medicine, acupoints are classified into two main categories: meridian acupoints and extraordinary acupoints.³⁸ The frequency of acupoints along the Gallbladder Meridian of Foot Shaoyang was found to be the highest. Following the Yin-Yang classification in TCM, 82.8% (467 out of 564) of the acupoints were associated with Yang meridians, while 17.2% (97 out of 564) were associated with Yin meridians (Table 3, Figure 3A-C).

Association of Acupuncture Points with Anatomical Regions

After the statistics of the proportion of all acupoints in the human body, the human body was divided into five parts: head and neck, lower limbs, upper limbs, back, chest and abdomen. Among them, the acupoints on the head accounted for the

Table 2 The Top Fifteen Acupoints for Blood Stasis Headache Treatment

Number	Acupoint	Frequency	Proportion (%)
1	Fengchi(GB20)	84	76.4
2	Taiyang(EX-HN5)	60	54.5
3	Baihui(GV20)	55	50.0
4	Hegu(LI4)	51	46.4
5	Shuaigu(GB8)	40	36.4
6	Taichong(LR3)	40	36.4
7	Xuehai(SP10)	34	30.9
8	Touwei(ST8)	31	28.2
9	Geshu(BL17)	30	27.3
10	Waiguan(SJ5)	27	24.5
11	Sanyinjiao(SP6)	20	18.2
12	Zulinqi(GB41)	18	16.4
13	Zusanli(ST36)	15	13.6
14	Houxi(SI3)	10	9.1
15	Lieque(LU7)	10	9.1

Notes: Proportion refers to the percentage that an acupoint frequency accounts for the total frequency of all acupoints.

highest proportion and were applied the most times, followed by the lower limbs and upper limbs, chest and abdomen. Back accounted for the least proportion. Detailed information is listed in Table 4 and showed in Figure 4A and B.

Application of Specific Acupoints

The specific acupoint are a series of acupoints with special therapeutic effect in the fourteen meridian acupoint and summarized by a specific title.³⁹ According to its different distribution characteristics, meanings and therapeutic effects, it is divided into “five transport point”, “source point”, “collateral point”, “low sea point”, “alarm point”, “eight meeting point”, “confluence points of eight extraordinary meridians” and so on.

Among the 77 acupoints included, 32 belong to the category of specific acupoints, with a total frequency of 374 times, accounting for 53.5% of the total frequency of all acupoints. The highest frequency of use was for the source point (111 times, 36.22%), followed by five transport points (92 times, 13.2%). Detailed information is listed in Table 5 and shown in Figure 5A and B.

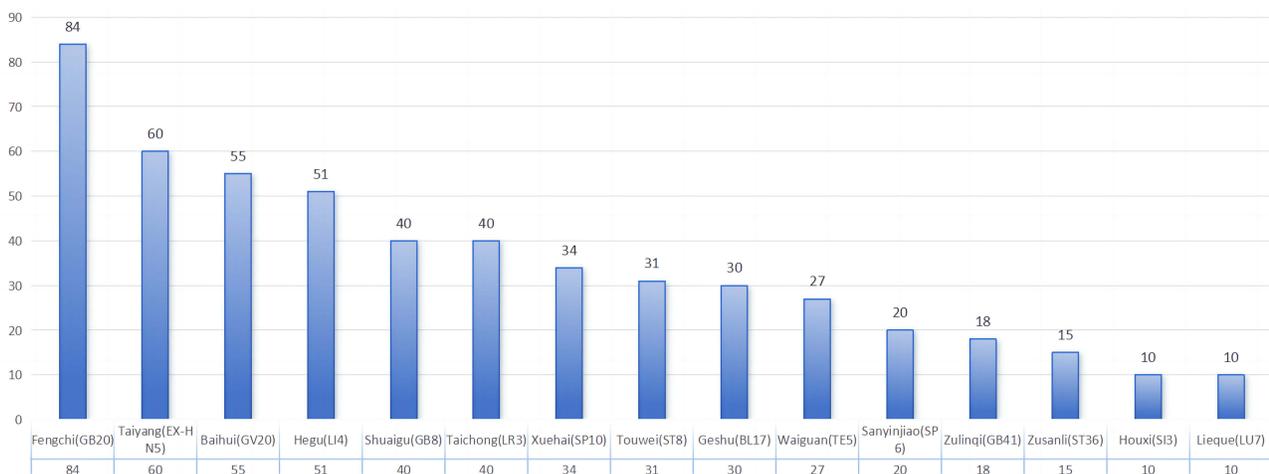


Figure 2 Bar chart depicting acupoints with frequencies exceeding ten occurrences.

Table 3 Association Analysis of Meridians and Acupoints Used in Blood Stasis Headache Treatment

Number	Meridian	Frequency	*Proportion (%)	Number	#Proportion (%)	Acupoints and their frequency
1	GB	171	27.8	17	23.6	Fengchi(GB20) 84, Shuaigu(GB08) 40, Zulinqi(GB41) 18, Qiuxu(GB40) 5 Yanglingquan (GB34) 3, Xuanlu (GB05) 3, Xuanzhong (GB39) 3 Xiashi(GB43) 3, Yangbai(GB14) 2, Toulinqi(GB15) 2, Tongziliao(GB1) 2, Yangfu(GB38) 1, Xuanli(GB6) 1, Wangu (GB12) 1 Hanyan(GB4) 1, Naokong(GB19) 1, Tianchong(GB9) 1
2	GV	76	12.4	7	9.7	Baihui (GV20) 55, Shenting (GV24) 6, Dazhui (GV14) 6, Fengfu (GV16) 4 Houding (GV19) 3, Naohu (GV17) 1, Shangxing (GV23) 1
3	SP	56	9.1	4	5.6	Xuehai(SPI0) 34, Sanyinjiao (SP06) 20, Gongsun(SP4) 1, Yinlingquan(SP9) 1
4	ST	55	8.9	8	11.1	Touwei (ST8) 31, Zusanli (ST36) 15, Fenglong (ST40) 4, Neiting (ST44) 1 Tianshu (ST25) 1, Guilai(ST29) 1, Sibai(ST2) 1, Xiaguan(ST7) 1
5	TE	53	8.6	7	9.7	Waiguan (TE5) 27, Sizhukong (TE23) 9, Jiaosun (TE20) 7, Zhongzhu (TE3) 6 Tianjing(TE10) 2, Yifeng (TE17) 1, Yemen(TE2) 1
6	LI	53	8.6	2	2.8	Hegu (LI4) 51, Quchi (LI11) 2
7	BL	49	8.0	8	11.1	Geshu(BL17) 30, Tianzhu(BL10) 9, Shenmai(BL62) 3, Shenshu(BL23) 2 Weizhong(BL40) 2, Ciliao(BL32) 1, Yuzhen(BL9) 1, Tongtian(BL7) 1
8	LR	45	7.3	4	5.6	Taichong (LR3) 40, Xingjian (LR2) 3, Zhongfeng(LR4) 1, Ligou(LR5) 1
9	CV	17	2.8	6	8.3	Guanyuan (CV04) 7, Qihai (CV06) 5, Danzhong (CV17) 2, Xiawan(CV10) 1 Zhongwan(CV12) 1, Chengjiang(CV24) 1
10	HT	10	1.6	2	2.8	Shenmen (HT7) 7, Shaochong(HT9) 3
11	SI	10	1.6	1	1.3	Houxi (SI3) 10
12	LU	10	1.6	1	1.3	Lieque (LU7) 10
13	PC	6	1.0	2	2.8	Neiguan (PC6) 5, Daling (PC7) 1
14	KI	4	0.7	3	4.2	Taixi (KI3) 2, Fuliu(KI7) 1, Yindu(KI19) 1

Notes: GB refers to the Gallbladder Meridian of Foot Shaoyang. GV refers to the Governor Vessel. ST stands for the Stomach Meridian of Hand Yangming. BL refers to the Bladder Meridian of Foot Taiyang. LR refers to the Liver Meridian of Foot Jueyin. LI refers to the Large Intestine Meridian of Hand Yangming. SP refers to the Spleen Meridian of Foot Taiyin. TE refers to Triple Energizer of Hand Shaoyang. CV refers to the Conception Vessel. HT refers to the Heart Meridian of Hand Shaoyin. PC refers to the Pericardium Meridian of Hand Jueyin. LU refers to the Lung Meridian of Hand Taiyin. SI refers to the Small Intestine Meridian of Hand Taiyang. KI refers to the Kidney Meridian of Foot Shaoyin. *Proportion means the percentage that a specific meridian frequency accounts for the total frequency of all meridians. #Proportion refers to the percentage that the number of acupoints in a meridian accounts for the total number of meridian acupoints.

Analysis of Acupoint Association Rules

Since the combination of acupoints and acupoints will appear in acupoint prescription, the association rule analysis of acupoints refers to the simultaneous occurrence of one or a group of acupoints in the prescription data.⁴⁰ Indicators commonly used in association analysis include confidence, support degree and improvement degree. Support degree is the probability of the simultaneous prescription of the preceding and subsequent items in all prescriptions, it reflects the law of mutual compatibility of the acupoints in the acupuncture scheme, and the probability of the previous acupoints under the premise of the appearance of the latter acupoints. Confidence degree is the probability of the occurrence of the latter item indicating the utility of the compatibility relationship of the acupoints.^{41,42} The operation method of the association analysis is to run the Apriori algorithm in the SPSS modeler 18.0. In the process of operation, the setting of confidence degree and support degree are related to the data situation and the characteristics of different disciplines.⁴³ Using the Apriori algorithm in SPSS modeler 18.0, we found that the minimum support of 20% and the minimum confidence of 80% were optimal. Seventeen acupoint groups met these conditions. The top 5 acupoint combinations with the highest frequency of use were: Fengchi (GB20) - Taiyang (EX-HN5), Fengchi (GB20) - Baihui (GV20), Fengchi (GB20) - Hegu (LI4), Fengchi (GB20) - Shuaigu (GB8), and Fengchi (GB20) - Taichong (LR3). The findings are presented in Table 6, and Figure 6 displays the corresponding network diagram.

Acupoints Clustering Analysis

By using SPSS statistics 27.0, we performed systematic clustering analysis on 15 acupoints used more than ten times, yielding a total of five clusters, Cluster 1 includes: Fengchi(GB20), Taiyang(EXHN5), Baihui(GV20), Hegu(LI4), Shuaigu(GB8), Taichong(LR3), Xuehai(SPI0), Touwei(ST8) and Geshu(BL18). Cluster 2 includes: Zulinqi(GB41) and

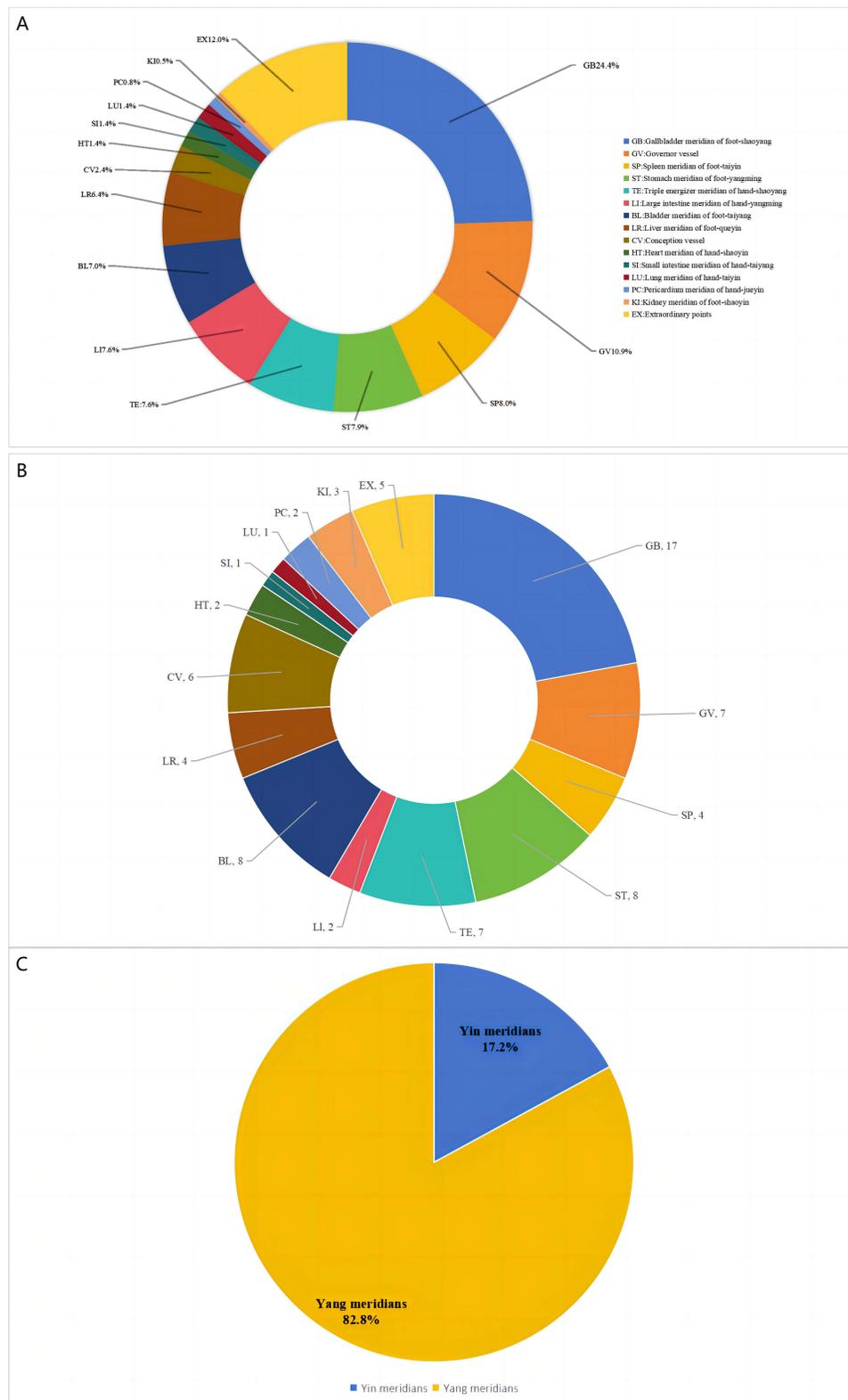


Figure 3 (A) The percentage of the fourteen meridians and extraordinary points. (B) The number of acupoints from the fourteen meridians and extraordinary points. (C) The percentage of acupoints from the Yin meridians and Yang meridians.

Table 4 Association Analysis of Body Parts and Acupoints Used in Blood Stasis Headache Treatment

Number	Body part	Frequency	*Proportion(%)	Number	#Proportion(%)	Acupoints and their frequency
1	Head and neck	349	49.9	31	40.2	Fengchi(GB20) 84, Taiyang(EX-HN5) 60, Baihui (GV20) 55, Shuaigu(GB08) 40 Touwei (ST8) 31, Tianzhu(BL10) 9, Sizhukong (TE23) 9, Yintang(EX-HN3) 9 Sishencong(EX-HN1) 9, Jiaosun (TE20) 7, Shenting (GV24) 6, Fengfu (GV16) 4 Houding (GV19) 3, Xuanlu (GB05) 3, Tongziliao(GB1)2, Toulinqi(GB15) 2 Yangbai(GB14) 2, Naohu (GV17) 1, Shangxing (GV23) 1, Yuyao(EX-HN4) 1 Chengjiang(CV24) 1, Yifeng (TE17) 1, Hanyan(GB4) 1, Naokong(GB19) 1 Tianchong(GB9) 1, Wangu (GB12) 1, Xuanli(GB6) 1, Tongtian(BL7) 1 Yuzhen(BL9) 1, Sibai(ST2) 1, Xiaguan(ST7) 1
2	Lower limbs	162	23.2	21	27.3	Taichong (LR3) 40, Xuehai(SP10) 34, Sanyinjiao (SP6) 20, Zulinqi(GB41) 18, Zusanli (ST36) 15, Qiuxu(GB40) 5, Fenglong (ST40) 4, Xingjian (LR2) 3, Xiashi(GB43) 3, Xuanzhong (GB39) 3, Yanglingquan (GB34) 3, Shenmai(BL62) 3, Taixi (KI3) 2, Weizhong(BL40) 2, Ligou(LR5) 1, Zhongfeng(LR4) 1 Yangfu(GB38) 1, Fuliu(KI7), Gongsun(SP4) 1, Yinlingquan(SP9) 1 Neiting (ST44) 1
3	Upper limbs	125	17.9	12	15.6	Hegu (LI4) 51, Waiguan (TE5) 27, Houxi (SI3) 10, Lieque (LU7) 10 Shenmen (HT7) 7, Zhongzhu (TE3) 6, Neiguan (PC6) 5, Shaochong(HT9) 3 Tianjing(TE10) 2, Quchi(LI11) 2, Daling (PC7) 1, Yemen(TE2) 1
4	Back	44	6.3	5	6.5	Geshu(BL17) 30, Dazhui (GV14) 6, Jiaji(EX-B2) 5, Shenshu(BL23) 2 Ciliao(BL32) 1
5	Chest and abdomen	19	2.7	8	10.4	Guanyuan (CV04) 7, Qihai (CV06) 5, Danzhong (CV17) 2, Xiawan(CV10) 1, Zhongwan(CV12) 1, Tianshu (ST25) 1

Waiguan(TE5). Cluster 3 includes: Zusanli(ST36) and Sanyinjiao(SP6). Cluster 4 includes: Lieque(LU7) and Cluster 5 includes Houxi(SI3). The cluster analysis dendrogram was shown in [Figure 7](#).

Discussion

Traditional Chinese medicine (TCM) has consistently demonstrated unique strengths in addressing headaches, with herbal medicine prescriptions and acupuncture treatments proving to be effective in alleviating clinical symptoms for patients.^{44,45} Modern research had found that the acupuncture can improve the sympathetic nerve function, correct the spasm state of blood vessels and change microcirculation, then intervene the headache symptoms.^{46–48} The production of blood stasis headache is not only considered to be related to blood by traditional Chinese medicine. Based on the principles of TCM, the pathogenesis of headache can be divided into two categories which are named as “bu tong ze tong” and “bu rong ze tong”, mean that pain can occur when the body is weak or when substance like qi or blood is blocked in the human body.⁴⁹ Traditional Chinese medicine believes that qi in the human body is closely related to blood. When qi is lacking, it will reduce its ability to transport blood, leading to blood stasis headache.⁵⁰ In addition, the headache can be aggravated after the influence of external factors such as cold, wind and humidity. Hence, in the clinical management of blood stasis headache, varied treatment modalities are employed based on individual patient presentations. These may include diverse combinations of acupuncture points, techniques of needling, and types of needles utilized. Therefore, employing data mining techniques to analyze effective acupoints in clinical trials of acupuncture can enhance the precision of acupoint selection and combinations in both clinical practice and experimental research aimed at treating blood stasis headaches. From the frequency of acupoints, the most commonly used acupuncture point for the treatment of blood stasis headache is Fengchi(GB20), Taiyang(EX-HN5), Baihui(GV20), Hegu(LI4), Shuaigu(GB8), Taichong(LR3), Xuehai(SP10). The total number uses of Fengchi(GB20) was 84, and the probability of occurrence in the prescription was 71.8% (84/117), and this acupoint accounted for 0.12% of the total frequency of all acupoints. It had far exceeded the use of other acupoints and can be identified as a representative acupoint for blood stasis headache. Chinese medicine believes that Fengchi(GB20) can treat a series of diseases related to wind, such as headache, dizziness, cold, epistaxis, eye swelling and pain.³⁴ The anatomy found that the posterior branch of the trigeminal nerve, the occipital nerve and the occipital motor, the venous branch or the subordinate branch, deep adjacent to the vertebral artery,

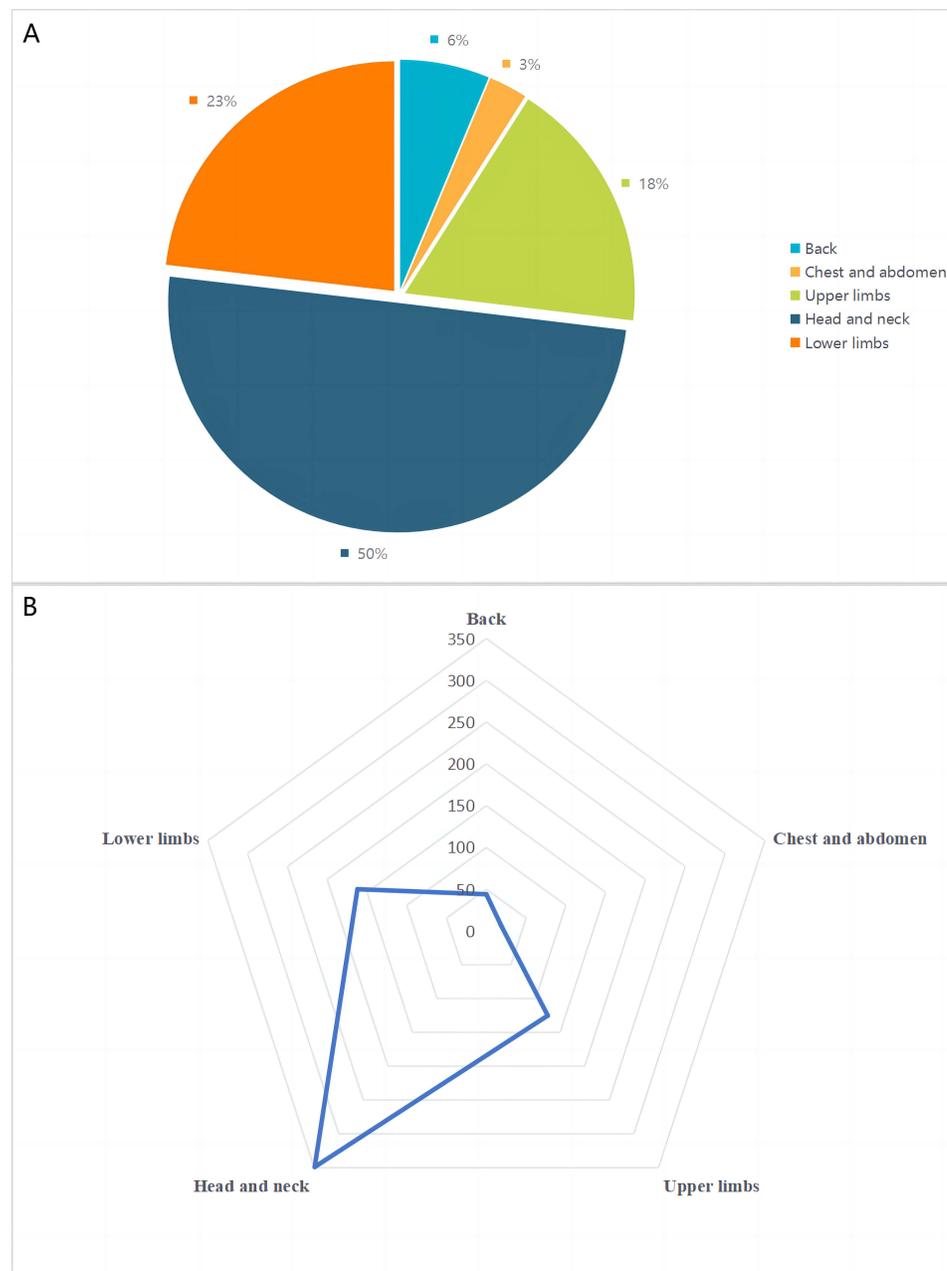


Figure 4 (A) The percentage distribution of acupoints across different regions of the human body. **(B)** Radar map of the acupoint distribution in different regions of the human body.

surrounded by rich sympathetic ganglia, and is closely related to the medulla.⁵¹ Studies have found that the acupuncture point can cause a variety of responses including neuromodulation and endocrine regulation, thus promoting cerebral vasomotor and regulating the blood flow velocity of the verteobasilar artery.⁵² Acupuncture treatment directed at Fengchi (GB20) has demonstrated efficacy in mitigating migraine pain and associated cutaneous allodynia by modulating the ascending pathway of the trigeminovascular system. This effect is partly achieved through the inhibition of CGRP expression in the trigeminal ganglion. Additionally, certain studies have indicated that Fengchi (GB20) can activate the brain's endogenous pain modulation system, leading to a reduction in headache duration by regulating pain, decreasing headache severity, and modulating related metabolic pathways.^{53,54} Taiyang(EX-HN5) is located in the temporal part, which has the effect of activating blood circulation and removing blood stasis. Acupuncture or short bleeding after

Table 5 Different Types of Specific Acupoints Applied in Blood Stasis Headache Treatment

Number	Specific Acupoint	Frequency	Amount of Acupoints	Selected Acupoints and Their Frequency
1	Source point	111	7	Hegu (LI4) 51, Taichong (LR3) 40, Shenmen (HT7) 7, Qihai (CV06) 5, Taixi (KI3) 2, Daling (PC7) 1, Qiuxu(GB40) 5
2	Five transport point	92	15	Taichong (LR3) 40, Zusanli (ST36) 15, Houxi (SI3) 10, Shenmen (HT7) 7, Shaochong(HT9) 3, Xiaxi(GB43) 3, Xingjian (LR2) 3, Taixi (KI3) 2, Weizhong(BL40) 2, Quchi (LI11) 2, Daling (PC7) 1, Yinlingquan(SP9) 1, Yemen(TE2) 1, Yangfu(GB38) 1, Neiting (ST44) 1
3	Eight meeting point	39	5	Geshu(BL17) 30, Yanglingquan (GB34) 3, Xuanzhong (GB39) 3, Danzhong (CV17) 2, Zhongwan(CV12) 1
4	Confluence points of eight extraordinary meridians	56	6	Waiguan (TE5) 27, Lieque (LU7) 10, Houxi (SI3) 10, Neiguan (PC6) 5, Shenmai(BL62) 3, Gongsun(SP4) 1,
5	Collateral point	48	6	Waiguan (TE5) 27, Lieque (LU7) 10, Neiguan (PC6) 5, Fenglong (ST40) 4, Gongsun(SP4) 1, Ligou(LR5) 1
6	Low sea point	17	2	Zusanli (ST36) 15, Weizhong(BL40) 2
7	Alarm point	11	4	Guanyuan (CV04) 7, Danzhong (CV17) 2, Zhongwan(CV12) 1, Tianshu (ST25) 1

collateral puncture this place can improve the symptoms of blood stasis headache.⁵⁵ In addition, Xuehai(SP10) is a common joint acupoint for TCM treatment of blood stasis syndrome.⁵⁶

In the statistics of the meridians of acupoints, acupoints appear in all fourteen meridians, and the number of Yang meridian acupoints (467/564) is much higher than that of Yin meridian acupoints (97/564). In the statistics of the fourteen meridians, the frequency of gallbladder meridian of foot shaoyang(GB) was far more than that of other meridian, not only the types of acupoints, but also the total frequency of acupoint use. The route of the foot Shaoyang gallbladder meridian passes through the head and neck and most of the acupoints in this statistics are also located in this route.⁵⁷ The acupoints of the gallbladder meridian are often used to treat headache according to the traditional Chinese medical theory which is called that “The place that meridians pass through demands priority in your diagnosis”.⁵⁸ The same principle is true for the governor vessel(GV). Studies have indicated that the locations of tender points, also known as myofascial trigger points (MTrPs), which can trigger headaches, correspond closely with the distribution pattern of the Gallbladder (GB) and Governing Vessel (GV) meridians in the head and neck region.⁵⁹ According to the above conclusions, we can also roughly infer that the part with the most densely distribution of acupoints was the head, and the result was the case. It is worth mentioning that the frequency of acupoints of the lower limbs ranked second. The rule of three yang meridians of foot start from the head and ends at the foot through the trunk. According to the principle of meridian and near acupoint extraction, TCM doctors usually choose the distal acupoints of the limbs to assist treatment, so the lower limbs have also received attention. Xuehai (SP10) is situated at the prominence of the medial aspect of the quadriceps femoris muscle, which means the sea of blood.⁵⁶ Studies had shown that electroacupuncture stimulation of the SP10 can significantly reduce the level of inflammatory cytokines by regulating neurotransmitters, and it can increase the content of opioid peptides in the spinal cord segment to exerting an analgesic effect.^{60,61} Xuehai(SP10) and Geshu(BL18) are considered to be the compatible acupoints of TCM acupuncture for blood stasis syndrome.³⁴

The source points and five transport points are the most frequently used specific points. TCM believes that the early development of the disease is the first reflected in the source points, and the treatment should first start from the source points. The acupoint selection of headache is mainly in the head, face and lower limbs. The treatment method is that local acupoint selection is compatible with the remote acupoint selection, and local acupoint selection is for the local disease, reflecting the close treatment effect of the acupoints. Five transport points are usually distributed in the elbow joint or below the knee joint, and the use of five transport points reflects the remote treatment effect of acupoints.⁶² Taichong (LR3) belongs to both the source points and the five transport points.³⁴ Most studies have shown that Taichong(LR3) can specifically affect the brain areas involved in the regulation of blood pressure, play an antihypertensive effect, and improve dizziness and headache symptoms.^{63–65} In TCM theory, Taichong(LR3) is the source point of the liver meridian, liver can store blood and govern free flow of qi. By stimulating Taichong point can relieve the symptoms of liver

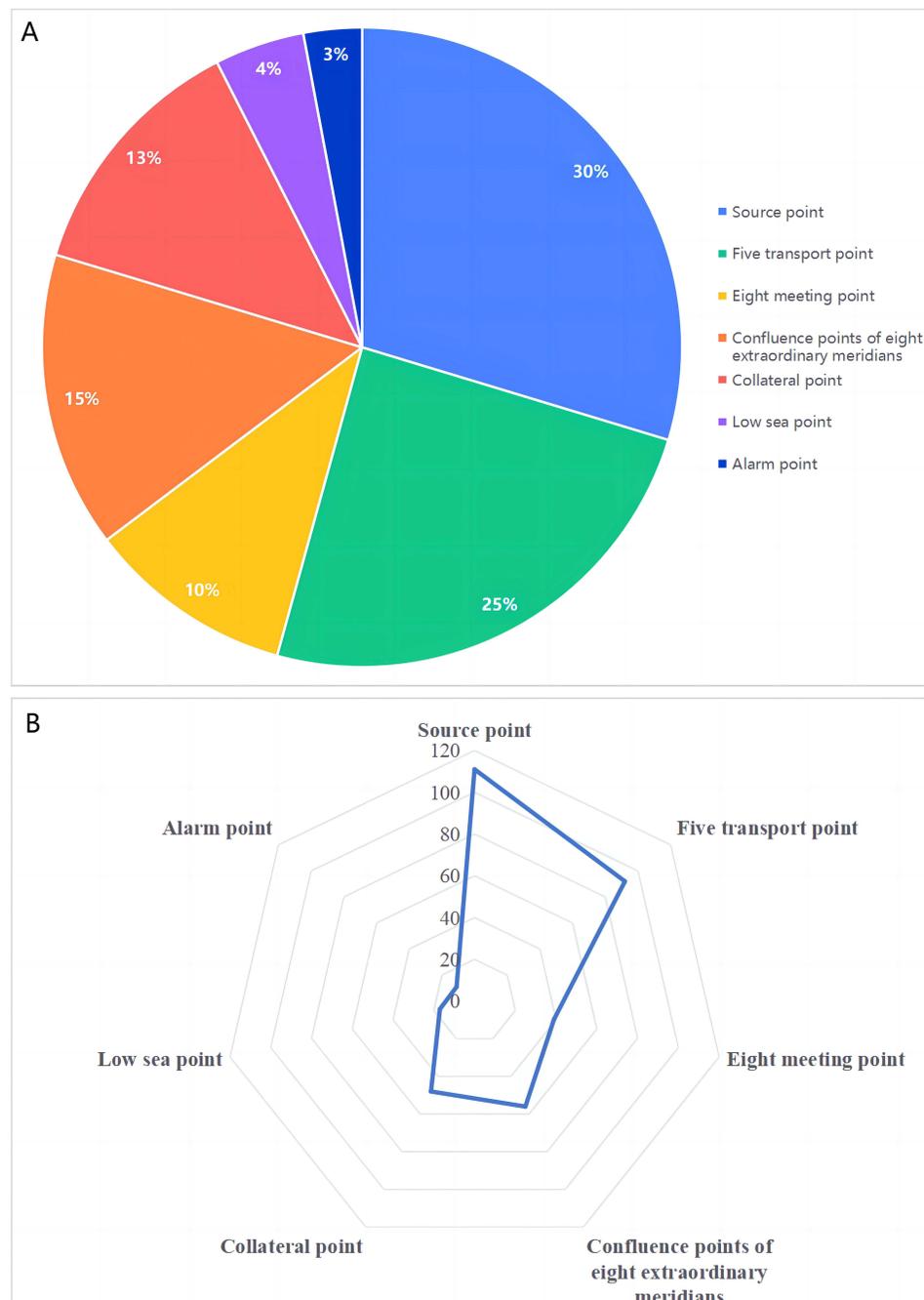


Figure 5 (A) The percentage of specific acupoint types. **(B)** The radar chart depicting the distribution of different types of specific acupoints.

stagnation, the qi is unobstructed, the blood is unobstructed, the blood flow fluent and pain will soon disappear.³⁸ That is why it is located in the foot but play an important role in blood stasis headache.

In terms of the association rules of acupoints, all combinations included Fengchi (GB20). The acupoints combined with it were Taiyang (EX-HN5), Baihui (GV20), Hegu (LI4), Shuaigu (GB8), Taichong (LR3), Xuehai (SP10), Touwei (ST8), and Geshu (BL17). (Fengchi (GB20)-Taiyang (EX-HN 5)) and (Fengchi (GB20)-Baihui (GV20)) had the highest degree of support, indicating that the above points were supposed to be the key points for the treatment of blood stasis type headache, which can effectively improve the clinical symptoms of patients. In recent years, there had been continuous basic studies proving that the above acupoints may improve headache symptoms by improving

Table 6 The Acupoint Combinations in Blood Stasis Headache Treatment

Number	Former item	Latter item	Support (%)	Confidence (%)
1	Taiyang(EX-HN5)	Fengchi(GB20)	54.1	86.7
2	Baihui(GV20)	Fengchi(GB20)	49.5	85.5
3	Hegu(LI4)	Fengchi(GB20)	45.9	86.3
4	Shuaigu(GB8)	Fengchi(GB20)	36.0	90.0
5	Taichong(LR3)	Fengchi(GB20)	36.0	87.5
6	Baihui(GV20) and Taiyang(EX-HN5)	Fengchi(GB20)	32.4	91.7
7	Xuehai(SPI0)	Fengchi(GB20)	30.6	85.3
8	Touwei(ST8)	Fengchi(GB20)	27.9	90.3
9	Hegu(LI4) and Baihui(GV20)	Fengchi(GB20)	27.9	93.5
10	Geshu(BL17)	Fengchi(GB20)	27.0	86.7
11	Shuaigu(GB8) and Taiyang(EX-HN5)	Fengchi(GB20)	27.0	93.3
12	Hegu(LI4) and Taiyang(EX-HN5)	Fengchi(GB20)	26.1	96.6
13	Waiguan(SJ5)	Fengchi(GB20)	24.3	92.6
14	Taichong(LR3) and Taiyang(EX-HN5)	Fengchi(GB20)	23.4	96.2
15	Taichong(LR3) and Baihui(GV20)	Fengchi(GB20)	22.5	88.0
16	Xuehai(SPI0) and Baihui(GV20)	Fengchi(GB20)	20.7	87.0
17	Taichong(LR3) and Hegu(LI4)	Fengchi(GB20)	20.7	91.3

hemodynamics, improving depression, and regulating the function of pain-related brain areas.^{29,66} Therefore, we believe that the above acupoints can be used as the core acupoints for the treatment of blood stasis headache.

In total, five clusters were extracted by systematic cluster analysis. Cluster 1 includes: Fengchi(GB20), Taiyang(EX-HN5), Baihui(GV20), Hegu(LI4), Shuaigu(GB8), Taichong(LR3), Xuehai(SPI0), Touwei(ST8) and Geshu(BL18). The above acupoints have the highest frequency and correlation, which can be identified as the basic combination for the

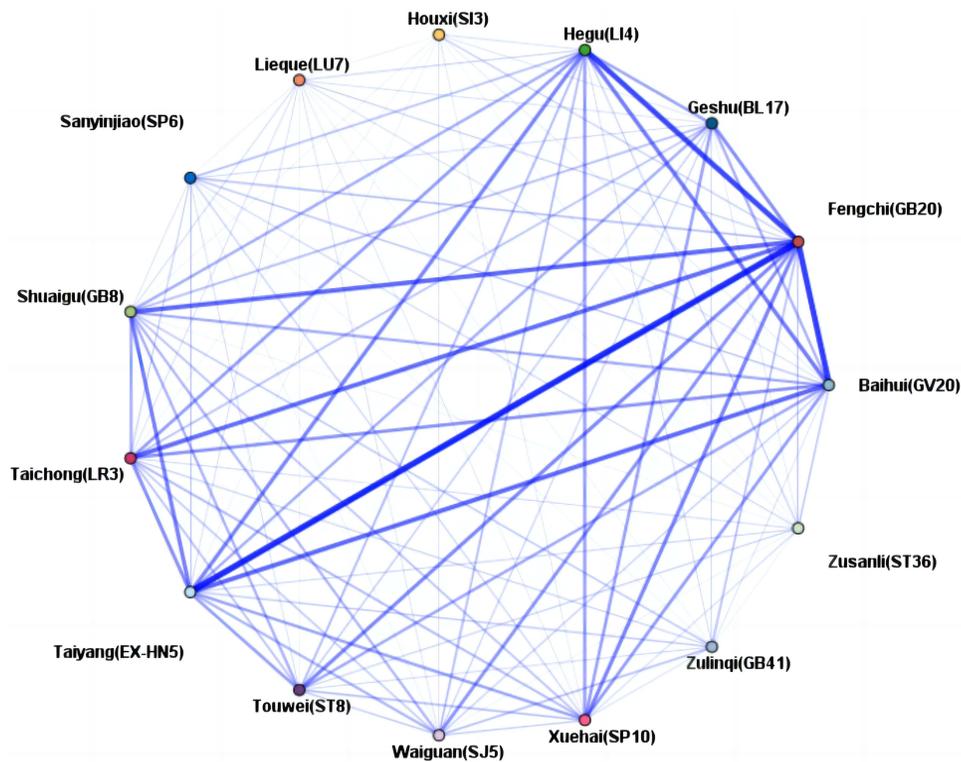


Figure 6 The corresponding network diagram.

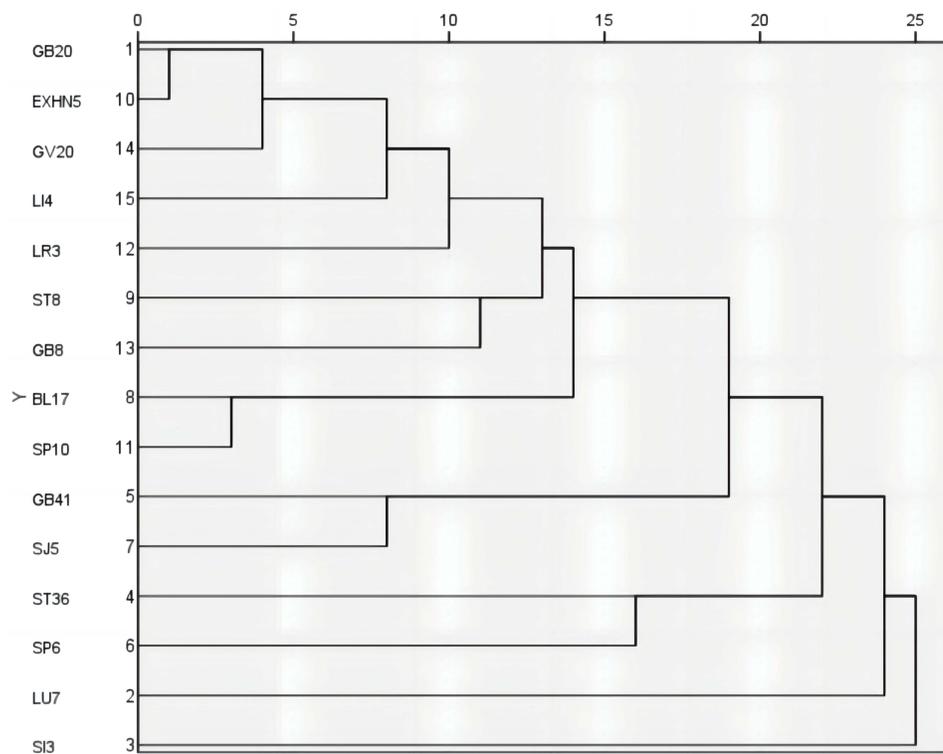


Figure 7 The cluster analysis dendrogram.

treatment of blood stasis headache. Cluster 2 includes: Zulinqi(GB41) and Waiguan(TE5). The two holes are distributed at the end of the limbs, belong to the distal acupoint, play a regulatory role. Cluster 3 includes: Zusanli(ST36) and Sanyinjiao(SP6). These two points are distributed in the lower limbs of the human body, which belong to the main acupoints of daily human health care which In line with the concept of holism in TCM.⁶⁷ In addition, both points have been shown to have an anti-inflammatory and labor pain effect in the literature in recent years.⁶⁸⁻⁷⁰ Cluster 4 includes: Lieque (LU7) is a common acupoint for the treatment of headache, the four total point song of TCM said:⁴³ all above the neck including the pain and discomfort of the head can be treated with Lieque(LU7). The last cluster was Houxi(SI3).

Although Houxi(SI3) is located at the end of the little finger, it is confluence point of eight extraordinary meridians that can connect with governor vessel(GV).The Governor vessel follows through the head, neck and waist,By stimulating Houxi(SI3) stimulation, the Yang qi of Governor vessel.⁷¹ Thus, it is often used as an auxiliary acupoint for headache.⁷²

Conclusion

This study conducted data mining and analyzed the selection rules of acupuncture in the treatment of blood stasis headache, and sorted out the compatibility rules of common acupoints, meridians, locations and acupoints. Fengchi (GB20), Taiyang(EX-HN5), Baihui(GV20) and other acupoints were the most selected acupuncture points for the treatment of blood stasis headache. Foot Shaoyang gallbladder meridian and governor vessel were the most selected meridians. The type and frequency of acupoints on the head were the highest. The source points and the five transport points were the most common specific points. The acupoints with the highest degree of correlation was Fengchi(GB20)-Taiyang(EX-HN5).

Fengchi(GB20), Taiyang(EX-HN5), Baihui(GV20), Hegu(LI4), Shuaigu(GB8), Taichong(LR3), Xuehai(SP10), Touwei(ST8) and Geshu(BL18) were recommended as the main acupoints for blood stasis headache.In clinical practice, the above core acupoints can be added and decreased according to the specific situation of patients. However, our current research also has several limitations. Firstly, the majority of studies originate from databases in China, with diagnoses

and assessments of clinical efficacy relying on subjective factors, and issues such as small sample sizes. Consequently, the validity and reliability of the selected literature are lacking. Additionally, this paper includes literature on other traditional Chinese medical therapies combined with acupuncture, which poses certain risks in terms of the safety and efficacy of such combined treatments, necessitating further validation through large-scale randomized controlled trials in the future.

In conclusion, This prescription can provide some reference significance for the standardized treatment of acupuncture for the treatment of blood stasis headache, and the subsequent clinical research and pathogenesis research still need to be improved.

Data Sharing Statement

Data are available from the corresponding author upon reasonable request.

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