

Original Article

Ranking clinical indicators for stroke pattern identification according to clinical importance in traditional Korean medicine

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Abstract: Differences in the value that individual clinicians place on each clinical indicator, when performing pattern identification, can be a significant obstacle in achieving accurate and consistent pattern identification. In this study, we aimed to identify and rank the importance of clinical indicators that correspond to each pattern. During the fundamental study to standardize and objectify the identification of patterns in traditional Korean medicine (TKM) treatment for stroke (the SOPI-Stroke project), we developed the Third Standardization for Pattern Identification (K-SPI-Stroke-III), which includes 44 clinical indicators that belong to one of the four patterns (Dampness-Phlegm, Fire-Heat, Qi deficiency, and Yin deficiency). Between September 2006 and December 2010, a total of 105 TKM doctors from 11 hospitals performed four examinations on 4,012 subjects based on the clinical indicators in the K-SPI-Stroke-III, and they were asked to leave a special mark on the indicators they thought were important, regardless of the number of the indicators. A total of 1,018 patients were included in the study. Among the 44 clinical indicators of the K-SPI-Stroke-III, four indicators were highly significant in differentiating between patterns and the frequency within a pattern. In contrast, another seven indicators were almost useless. Meanwhile, six confounding indicators had outlying values for differentiating between patterns and the frequency within a pattern. In conclusion, the four significant indicators should be actively considered when identifying patterns for strokes in clinical practice. Regarding the six confounding indicators, a further study should be conducted to modify some parts of the current K-SPI-Stroke-III.

Keywords: Ranking, pattern identification, stroke, clinical indicators, traditional Korean medicine

Introduction

Pattern identification (PI) is a unique diagnostic system of traditional Korean medicine (TKM) in which the cause and the nature of the disease, its location, and the patient's physical condition are identified using four examinations (inspection, listening and smelling, inquiry, and palpation) [1, 2]. However, due to the subjectivity and ambiguity of PI there are some probabilities that TKM doctors can potentially diagnose the same patient completely differently [3].

To standardize stroke diagnosis using pattern identification (PI), the fundamental study for the Standardization and Objectification of Pattern Identification in Traditional Korean Medicine for Stroke (SOPI-Stroke project) [4] has been conducted.

The Korean Standard Pattern Identification for Stroke (K-SPI-Stroke) I [5], II [6], and III [7], concomitant studies (questionnaire) of the SOPI-Stroke project, were developed in consecutive order. Finally, K-SPI-Stroke III [8-12] has included four patterns (Qi-deficiency, Dampness-phlegm, Yin-deficiency, and Fire-heat) and 44 pattern indicators which originally belonged to only one of four patterns. However, these 44 pattern indicators were merely extracted only when they met some inclusion criteria by a statistical method [13] and do not guarantee the identical clinical importance of each pattern indicator. Actually, some pattern indicators are more useful in a clinical field, whereas, others are less.

Therefore, it was needed to verify how much clinical importance each of 44 pattern indica-

tors has in its own pattern, and to extract some key indicators and confounding ones.

Methods

SOPI-stroke

The SOPI-Stroke project [10] was conducted to standardize stroke diagnosis using pattern identification, to construct a biobank, and to find biomarkers associated with stroke patterns. This project spans nine years, from April 2005 to December 2013. These nine years were divided into three phases of three years per phase. KIOM played a leading role in this project.

Korean standard pattern identification for stroke (K-SPI-stroke)

A TKM expert committee (EC) composed of 19 professors who specialized in stroke from 11 oriental medicine hospitals was organized for this project. The Korean Standard Pattern Identification for Stroke (KSPI-Stroke-I) [11] was established using clinical indicators ($n = 117$) based on 10 academic sources [12] and was developed by EC consensus before being translated into Korean [6, 10].

After this clinical field test, certain pattern indicators were separated, combined, or eliminated [12]. The remaining indicators ($n = 60$) were then discussed. The EC for developing the K-SPI-Stroke-II [13] reached its consensus in September 2006. Finally, the K-SPI-Stroke-III [14] was created. It was composed of short-form questions in Korean that measure four patterns [Dampness-Phlegm (DP), Fire-Heat (FH), Qi deficiency (QD), and Yin deficiency (YD)] and 44 pattern indicators that enable TKM doctors to make a diagnosis. The details of the K-SPI-Stroke survey development process are presented in **Figure 1**.

Study designs

This study was a cross-sectional, multicenter trial. The patients were admitted to one of 11 TKM hospitals participating in this study. A total of 4,012 patients participated in this study from September 2006 to December 2010. Finally, 1,286 patients were enrolled, a detailed inclusion procedures was presented in **Figure 2**. Stroke patients were enrolled within 30 days

of the onset of symptoms. The diagnosis was confirmed using imaging methods, such as computerized tomography or magnetic resonance imaging. Patients with traumatic stroke types, such as subarachnoid, subdural, and epidural hemorrhages, were excluded from the study.

The TKM doctors had at least three years of clinical experience with stroke patients beyond their regular six years of TKM education. The TKM doctors (total 105 persons) attended regular training courses on standard operating procedures (SOP) twice per year.

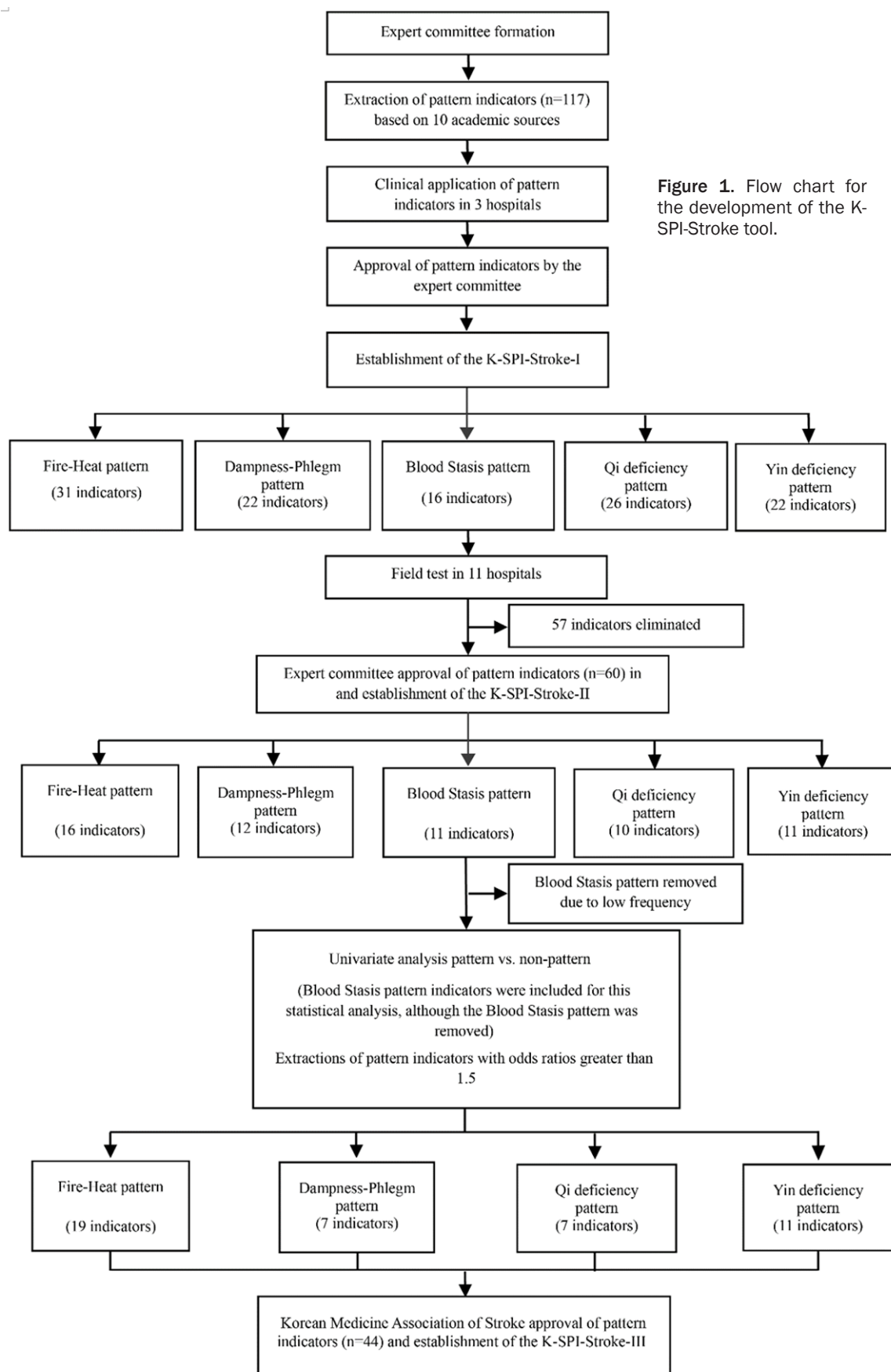
Stroke inpatients were informed of this study, and participation was voluntary, without consecutive inclusion. After all participants provided their informed consent, the data were collected using K-SPI-Stroke-III that consisted of 44 clinical pattern indicators. This study was approved by the Institutional Review Boards of the KIOM and each participating TKM hospital.

The 44 pattern indicators, which were classified into one of four patterns, were used to identify pattern. The severity of each pattern indicator was scored as follows: 1 = not significant, 2 = significant and 3 = very significant (**Table 1**). Only the indicators that earned scores of 2 or 3 points were considered eligible for checking as decisive indicators (DIs), which were recognized as decisive pattern indicators to decide a pattern clinically. Two observers independently diagnosed a stroke patient as one of four patterns using these 44 pattern indicators, and then one of two observers checked the DIs. DIs were marked in a blank next to each indicator on the K-SPI-Stroke III regardless of the number of decisive indicators (**Table 1**).

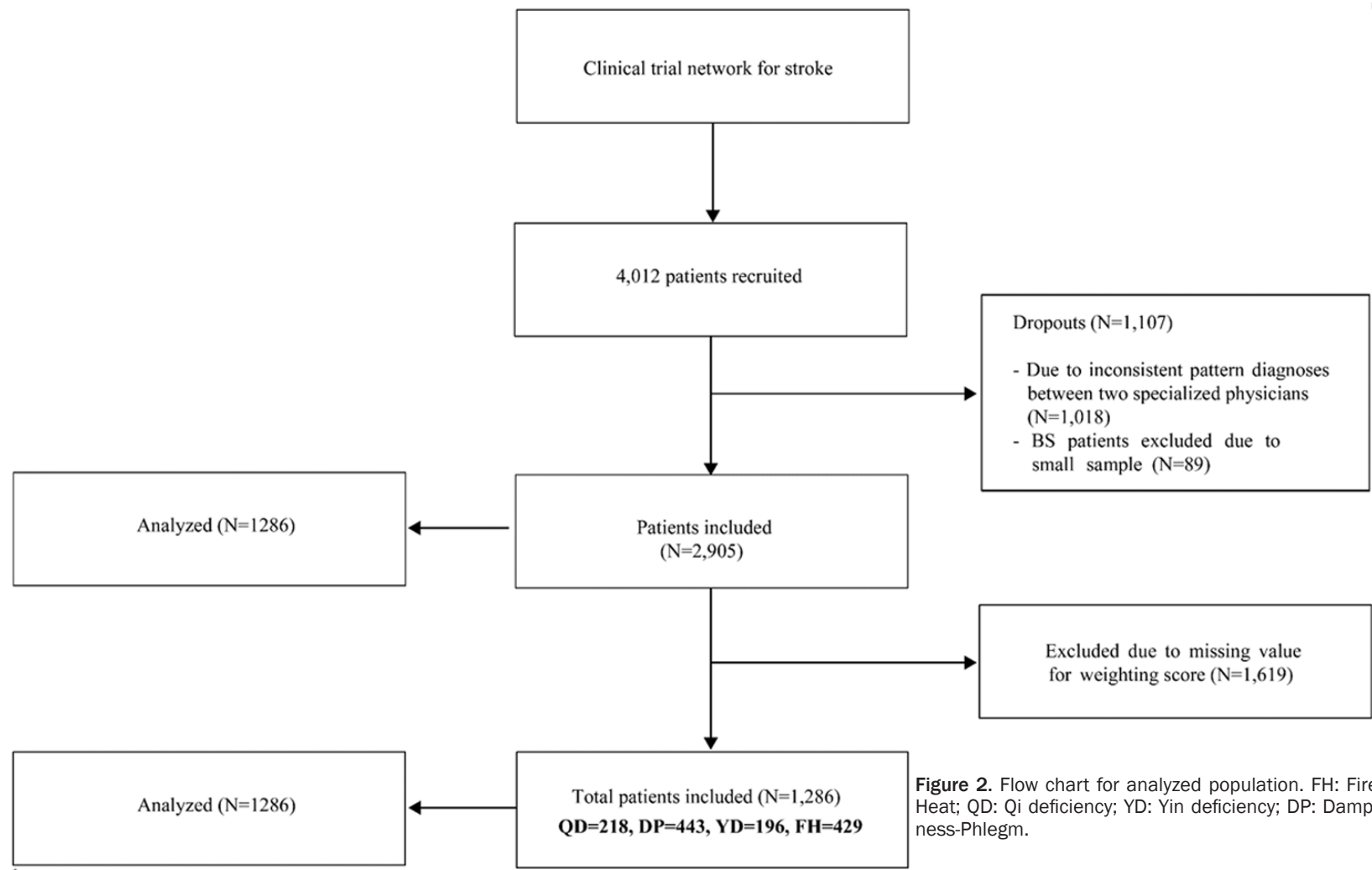
How to extract key indicators and confounding indicators

Key indicators were extracted considering two aspects; intergroup comparison (A/B) and intragroup comparison (A/C). The meaning of A, B and C are as follows; A = the frequency of the indicator's occurrence with the corresponding pattern, B = the sum of the frequency of the four patterns in a certain indicator, C = the whole number of patients belonging to each pattern.

Ranking clinical indicators for stroke pattern identification



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Table 1. Pattern indicators of K-SPI-Stroke-III, according to the pattern

| Pattern | DI | Symptoms and signs | 1 | 2 | 3 |
|------------------|--------------------------|--|--------------------------|--------------------------|--------------------------|
| Qi deficiency | <input type="checkbox"/> | Drowsiness, prefers lying down | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Feels weak and lethargic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Looks weak and lethargic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Pale complexion | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Reluctant to speak | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Pale tongue | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Teeth-marked tongue | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Slow pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Weak pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Fine pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Reversed cold in the extremities | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Dampness-Phlegm | <input type="checkbox"/> | Sallow complexion | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Dark inferior palpebral | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Dizziness with nausea | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | White tongue fur | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Enlarged tongue | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Slippery pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Heaviness | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Yin deficiency | <input type="checkbox"/> | Pale face and red zygomatic sites | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Dry mouth | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Dry tongue fur | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Bare and red mirror-like tongue | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Night sweating | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Tidal fever | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Thinness | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Fire-Heat | <input type="checkbox"/> | Vexation and insomnia | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Reddened complexion | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Flush-like headache | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Bloodshot eyes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Wheezing in the throat with sputum | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Aphtha or tongue sores | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Fetid mouth odor | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Thirst | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Red tongue | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Yellow tongue fur | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Thick tongue fur | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Heat vexation in the chest | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Turbid urine | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Rapid pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Strong pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Surging pulse | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Heat vexation and aversion to heat | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Heat in the palms and soles | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | Vexing heat in the extremities | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Pattern decision | TKM Doctor 1 | <input type="checkbox"/> Qi deficiency <input type="checkbox"/> Dampness-Phlegm <input type="checkbox"/> Yin deficiency <input type="checkbox"/> Fire-Heat | | | |
| | TKM Doctor 2 | <input type="checkbox"/> Qi deficiency <input type="checkbox"/> Dampness-Phlegm <input type="checkbox"/> Yin deficiency <input type="checkbox"/> Fire-Heat | | | |

DI: Decisive indicators for pattern identification.

Ranking clinical indicators for stroke pattern identification

Table 2. Demographic characteristics of the stroke patients

| Variables | Total (n = 1286) | Qi deficiency (n = 218) | Dampness-Phlegm (n = 443) | Yin deficiency (n = 196) | Fire-Heat (429) | P-value |
|-----------------------------------|-------------------------|--------------------------------------|------------------------------------|---------------------------------------|------------------------------------|---------|
| N (mean \pm standard deviation) | | | | | | |
| Age (years) | 1,284 (67.5 \pm 11.5) | 218 (66.7 \pm 12.9) ^{b,c} | 441 (68.1 \pm 10.1) ^b | 196 (71.3 \pm 10.9) ^a | 429 (65.7 \pm 12.0) ^c | < .0001 |
| Weight (kg) | 1,187 (62.0 \pm 11.3) | 208 (56.6 \pm 9.5) ^b | 419 (63.6 \pm 11.4) ^a | 171(57.2 \pm 10.5) ^b | 389 (65.3 \pm 10.8) ^a | < .0001 |
| Height (cm) | 1,160 (160.6 \pm 9.2) | 205 (157.4 \pm 8.4) ^c | 409 (160.0 \pm 9.1) ^b | 169 (158.6 \pm 10.8) ^{b,c} | 377 (164.0 \pm 8.3) ^a | < .0001 |
| NIHSS score | 1,151 (4.4 \pm 3.8) | 203 (4.2 \pm 3.7) ^{b,c} | 400 (3.8 \pm 3.2) ^c | 172 (4.5 \pm 3.8) ^{a,b} | 376 (5.0 \pm 4.1) ^a | < .0001 |
| N (%) | | | | | | |
| Gender | | | | | | |
| Male | 619 (48) | 153 (70) | 238 (54) | 114 (58) | 114 (27) | < .0001 |
| Female | 667 (52) | 65(30) | 205 (46) | 82 (42) | 315 (73) | |
| Drinking | | | | | | |
| No | 510 (40) | 83 (38) | 145 (33) | 74 (38) | 208 (48) | < .0001 |
| Yes | 774 (60) | 134 (62) | 297 (67.) | 122 (62) | 221 (52) | |
| Smoking | | | | | | |
| No | 442 (34) | 69 (32) | 137 (31) | 62 (32) | 174 (41) | 0.013 |
| Yes | 842 (66) | 148 (68) | 305 (69) | 134 (68) | 255 (59) | |
| Marital status | | | | | | |
| Single | 30 (2) | 7 (3) | 6 (1) | 5 (32) | 12 (3) | < .0001 |
| Married | 885 (70) | 133 (61) | 294 (67) | 127 (66) | 331 (78) | |
| Divorce | 29 (2) | 6 (3) | 9 (2) | 1 (1) | 13 (3) | |
| Widowed | 328 (26) | 71 (33) | 131 (30) | 58 (30) | 68 (16) | |
| Diabetes | | | | | | |
| No | 950 (74) | 153 (71) | 319 (72) | 154 (79) | 324 (76) | 0.18 |
| Yes | 333 (26) | 64 (29) | 123 (28) | 42 (21) | 104 (24) | |
| Hyperlipidemia | | | | | | |
| No | 1,103 (86) | 190 (88) | 373 (85) | 172 (89) | 368 (86) | 0.47 |
| Yes | 175 (14) | 26 (12) | 68 (15) | 22 (11) | 59 (14) | |
| Hypertension | | | | | | |
| No | 531 (41) | 100 (46) | 166 (37) | 84 (43) | 181 (42) | 0.16 |
| Yes | 752 (59) | 117 (54) | 277 (63) | 112 (57) | 246 (58) | |
| Anticoagulant treatment | | | | | | |
| No | 854 (69) | 147 (70) | 291 (67) | 115 (62) | 301 (73) | 0.04 |
| Yes | 387 (31) | 64 (30) | 141 (33) | 71 (38) | 111 (27) | |

The sum of N does equal the total number of patients for all variables because some items had missing data. Different letters indicate significant differences in pattern identification in the same row ($p < 0.05$).

Ranking clinical indicators for stroke pattern identification

Table 3. Value-weighted distribution according to pattern identification

| Label | Variables | No. 1 | | No. 2 | | Total (N = 1,286) |
|-------|------------------------------------|----------------------|---------|----------------------|---------|----------------------|
| | | Frequency (A/B, A/C) | Pattern | Frequency (A/B, A/C) | Pattern | B |
| FH-1 | Reddened complexion | 255 (78.95/59.44) | FH | 40 (12.38/20.41) | YD | 323 |
| FH-2 | Heat vexation and aversion to heat | 214 (67.51/49.88) | FH | 58 (18.3/29.59) | YD | 317 |
| FH-3 | Yellow fur | 181 (69.08/42.19) | FH | 54 (20.61/12.19) | DP | 262 |
| FH-4 | Red tongue | 177 (65.8/41.26) | FH | 75 (27.88/38.27) | YD | 269 |
| FH-5 | Strong pulse | 162 (80.2/37.76) | FH | 37 (18.32/8.35) | DP | 202 |
| FH-6 | Thirst | 144 (72.73/33.57) | FH | 37 (18.69/18.88) | YD | 198 |
| FH-7 | Rapid pulse | 126 (67.02/29.37) | FH | 41 (21.81/20.92) | YD | 188 |
| FH-8 | Thick fur | 182 (55.32/41.08) | DP | 120 (36.47/27.97) | FH | 329 |
| FH-9 | Fetid mouth odor | 86 (65.15/20.05) | FH | 29 (21.97/6.55) | DP | 132 |
| FH-10 | Bloodshot eyes | 79 (78.22/18.41) | FH | 11 (10.89/5.61) | YD | 101 |
| FH-11 | Turbid urine | 71 (60.68/16.55) | FH | 30 (25.64/15.31) | YD | 117 |
| FH-12 | Heat vexation in the chest | 63 (67.02/14.69) | FH | 20 (21.28/10.2) | YD | 94 |
| FH-13 | Vexation and insomnia | 53 (65.43/12.35) | FH | 23 (28.4/11.73) | YD | 81 |
| FH-14 | Surging pulse | 47 (88.68/10.96) | FH | 5 (9.43/1.13) | DP | 53 |
| FH-15 | Vexing heat in the extremities | 41 (87.23/9.56) | FH | 3 (6.38/1.53) | DP | 47 |
| FH-16 | Heat in the palms and soles | 34 (51.52/7.93) | FH | 28 (42.42/14.29) | YD | 66 |
| FH-17 | Flush-like headache | 31 (83.78/7.23) | FH | 5 (13.51/2.55) | YD | 37 |
| FH-18 | Aphtha or tongue sores | 24 (68.57/5.59) | FH | 8 (22.86/4.08) | YD | 35 |
| FH-19 | Wheezing in the throat with sputum | 85 (87.63/19.19) | DP | 6 (6.19/1.4) | FH | 97 |
| DP-1 | Slippery pulse | 258 (81.39/58.24) | DP | 51 (16.09/11.89) | FH | 317 |
| DP-2 | White fur on the tongue | 211 (70.1/47.63) | DP | 58 (19.27/26.61) | QD | 301 |
| DP-3 | Sallow complexion | 200 (80.97/45.15) | DP | 29 (11.74/13.3) | QD | 247 |
| DP-4 | Heaviness | 143(85.12/32.28) | DP | 12 (7.14/5.5) | QD | 168 |
| DP-5 | Dizziness with nausea | 81 (73.64/18.28) | DP | 20 (18.18/9.17) | QD | 110 |
| DP-6 | Enlarged tongue | 77 (80.21/17.38) | DP | 12 (12.5/5.5) | QD | 96 |
| DP-7 | Dark inferior palpebral | 50 (86.21/11.29) | DP | 6 (10.34/2.75) | QD | 58 |
| YD-1 | Dry mouth | 155 (50.32/36.13) | FH | 108 (35.06/55.1) | YD | 308 |
| YD-2 | Pale face and red zygomatic sites | 70 (66.04/35.71) | YD | 28 (26.42/6.53) | FH | 106 |
| YD-3 | Dry fur on the tongue | 73 (51.77/17.02) | FH | 49 (34.75/25) | YD | 141 |
| YD-4 | Night sweating | 46 (47.42/23.47) | YD | 25 (25.77/5.83) | FH | 97 |
| YD-5 | Tidal fever | 35 (57.38/17.86) | YD | 16 (26.23/3.73) | FH | 61 |
| YD-6 | Thinness | 35 (43.21/17.86) | YD | 23 (28.4/10.55) | QD | 81 |
| YD-7 | Bare and red mirror-like tongue | 31 (88.57/15.82) | YD | 2 (5.71/0.92) | QD | 35 |
| QD-1 | Looks weak and lethargic | 141 (61.04/64.68) | QD | 47 (20.35/10.61) | DP | 231 |
| QD-2 | Feels weak and lethargic | 133 (56.12/61.01) | QD | 58 (24.47/13.09) | DP | 237 |
| QD-3 | Weak pulse | 94 (64.38/43.12) | QD | 37 (25.34/18.88) | YD | 146 |
| QD-4 | Drowsiness, prefers lying down | 83 (58.04/38.07) | QD | 38 (26.57/8.58) | DP | 143 |
| QD-5 | Reluctance to speak | 70 (56.91/32.11) | QD | 28 (22.76/6.32) | DP | 123 |
| QD-6 | Pale complexion | 66 (81.48/30.28) | QD | 9 (11.11/2.03) | DP | 81 |
| QD-7 | Fine pulse | 57 (47.9/29.08) | YD | 55 (46.22/25.23) | QD | 119 |
| QD-8 | Pale tongue | 58 (59.79/13.09) | DP | 35 (36.08/16.06) | QD | 97 |
| QD-9 | Teeth-marked tongue | 34 (53.13/15.6) | QD | 25 (39.06/5.64) | DP | 64 |
| QD-10 | Slow pulse | 23 (76.67/10.55) | QD | 6 (20/1.35) | DP | 30 |
| QD-11 | Reversed cold in the extremities | 19 (82.61/8.72) | QD | 2 (8.7/0.45) | DP | 23 |

Definition of A, B, and C values. C refers to the frequency with which the indicator occurred among patients whose significant indicators were checked; A refers to the frequency of the indicator's occurrence with the corresponding pattern divided by C, multiplied by 100; B refers to the frequency of the indicator's occurrence divided by the whole number of patients belonging to each pattern, multiplied by 100. FH: Fire-Heat; DP: Dampness-Phlegm; YD: Yin deficiency; QD: Qi deficiency.

The pattern indicators were graphed on an x-axis that represents intergroup comparison (A/B) and a y-axis that represents intragroup comparison (A/C). The indicators on the first quadrant were recognized as key indicators because of high intergroup and intragroup distinction. In contrast, the indicators on the third quadrant were insignificant indicators. Confounding indicators were defined to be those that

show the difference between the dominant pattern as a result of analysis and the previous pattern in which they had belonged to in K-SPI-Stroke-III.

Statistical analysis

Continuous variables were expressed as the mean \pm standard deviation, and categorical

variables were expressed as n (%). ANOVA was used to compare the means between the pattern identifications for continuous variables, and the Duncan's test was used for post-hoc comparisons. The chi-squared test was used to compare the frequencies between the patterns for categorical data. All statistical analyses were conducted using SAS Version 9.1.3 (USA Institute, Cary, NC, USA). Frequency analysis was used to extract significant, insignificant or confounding indicators.

Results

Demographic characteristics of the stroke patients

The mean age of the 1,286 subjects was 67.54 ± 11.50 years (66.67 ± 12.91 for the Qi deficiency pattern, 68.06 ± 10.09 for the Dampness-Phlegm pattern, 71.27 ± 10.86 for the Yin pattern, and 65.74 ± 11.97 for the Fire-Heat pattern; the same order of description applies hereafter). There was a significant difference in the mean age among the patterns. The gender distribution was 619 males (48.13%) and 667 females (51.87%). Regarding the gender distribution for the four patterns, 153 males and 65 females had the Qi deficiency pattern, 238 males and 205 females had the Dampness-Phlegm pattern, 114 males and 82 females had the Yin deficiency pattern, and 114 males and 315 females had the fire-heat pattern, indicating a significant difference in the gender ratio among the patterns. Moreover, statistically significant differences among the patterns were found with regards to drinking history, weight, height, marital status, and NIHSS score. However, there was no significant difference among the patterns in terms of smoking history, diabetes, hyperlipidemia, hypertension, and anticoagulant treatment (**Table 2**).

Description of the significant clinical indicators adopted according to their differentiation between patterns and their frequency within each pattern

Table 1 presents the data comparing the indicators for each pattern identified in the K-SPI-Stroke III with the indicators that the experts deemed crucial to identifying specific patterns. Of 1,286 patients, 429 were classified as having the Fire-Heat pattern. The top-ranked indicator for Fire-Heat pattern was a reddened

complexion (78.95% [A], 59.44% [B], 255 cases [C], where C refers to the frequency with which the indicator occurred among patients whose significant indicators were checked; "A" refers to the frequency of the indicator's occurrence with the corresponding pattern divided by C, multiplied by 100; "B" refers to the frequency of the indicator's occurrence divided by the whole number of patients belonging to each pattern, multiplied by 100). The indicators for each pattern are listed in descending order of their C values in **Table 3**. The indicators' order of frequency in the Fire-Heat pattern was as follows: reddened complexion (78.95%, 59.44%, 323 cases); heat vexation (67.51%, 49.88%, 214 cases); yellow fur (69.08%, 42.19%, 181 cases); red tongue (65.8%, 41.26%, 177 cases); strong pulse (80.2%, 37.76%, 162 cases); thirst (72.73%, 33.57%, 144 cases); rapid pulse (67.02%, 29.37%, 126 cases); thick fur (36.47%, 29.97%, 120 cases); fetid mouth odor (65.15%, 20.05%, 86 cases); bloodshot eyes (78.22%, 18.41%, 79 cases); turbid urine (60.68%, 16.55%, 71 cases); heat vexation in the chest (67.02%, 14.69%, 63 cases); vexation and insomnia (65.43%, 12.35%, 53 cases); surging pulse (88.68%, 10.96%, 47 cases); vexing heat in the extremities (87.23%, 9.56%, 41 cases); heat in the palms and soles (51.52%, 7.93%, 34 cases); flush-like headache (83.73%, 7.23%, 31 cases); aphtha or tongue sores (68.57%, 5.59%, 24 cases); and wheezing in the throat with sputum (6.19%, 1.4%, six cases).

Of the 1,286 patients, 443 were classified as having a Dampness-Phlegm pattern. The Dampness-Phlegm indicators from the K-SPI-Stroke III were checked for these patients, and the order of frequency was as follows: slippery pulse (81.39%, 58.24%, 258 cases); white fur (70.1%, 47.63%, 211 cases); sallow complexion (80.97%, 45.15%, 200 cases); heaviness (85.12%, 32.28%, 143 cases); dizziness with nausea (73.64%, 18.28%, 81 cases); enlarged tongue (80.21%, 17.38%, 77 cases); and dark inferior palpebral (86.21%, 11.29%, 50 cases). Thick fur and wheezing in the throat with sputum were considered Fire-Heat indicators in the K-SPI-Stroke III, but A and B values for this indicator were rather high in the Dampness-Phlegm pattern.

One hundred ninety-six patients were classified as having a Yin deficiency pattern. The Yin defi-

Ranking clinical indicators for stroke pattern identification

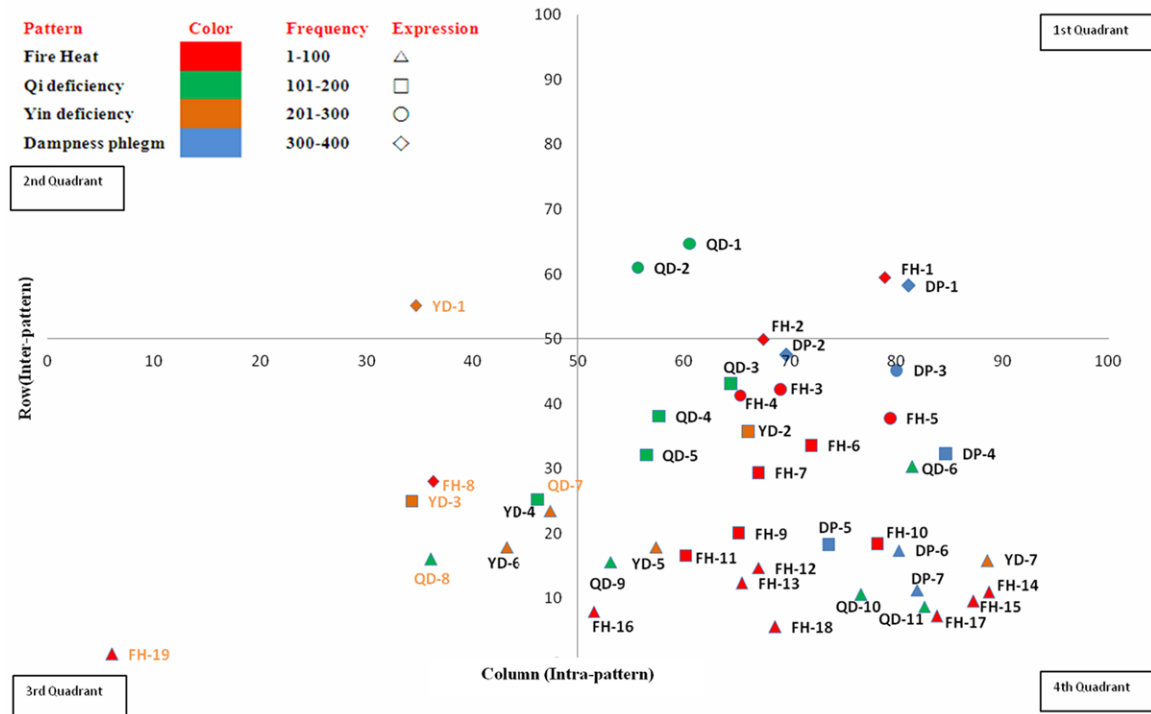


Figure 3. Distribution of the pattern indicators. FH: Fire Heat; QD: Qi deficiency; YD: Yin deficiency; DP: Dampness-Phlegm.

ciency indicators for these patients occurred with the following frequencies: dry mouth (35.06%, 55.1%, 108 cases); pale face and red zygomatic site (66.04%, 35.71%, 70 cases); dry fur (34.75%, 25.00%, 49 cases); night sweating (47.42%, 23.47%, 46 cases); tidal fever (57.38%, 17.86%, 35 cases); thinness (43.21%, 17.86%, 35 cases) and a bare, red, mirror-like tongue (88.57%, 15.82%, 31 cases). Dry mouth and dry tongue fur were considered Yin deficiency indicators in the K-SPI-Stroke III, but the A values for these indicators were high among patients with the Fire-Heat pattern.

The Qi deficiency indicators for the 218 Qi deficiency patients occurred in the following order of frequency: appears weak and lethargic (61.04%, 64.48%, 141 cases); feels weak and lethargic (56.12%, 61.01%, 133 cases); weak pulse (64.38%, 43.12%, 94 cases); drowsiness, needs rest (58.04%, 38.07%, 83 cases); reluctant to speak (56.91%, 32.11%, 70 cases); pale complexion (81.48%, 30.28%, 66 cases); fine pulse (46.22%, 25.23%, 55 cases); pale tongue (36.08%, 16.06%, 35 cases); teeth-marked tongue (53.13%, 15.60%, 34 cases); slow pulse (76.67%, 10.55%, 23 cases); and

reversed cold in the extremities (82.61%, 8.72%, 19 cases). “Fine pulse” and “pale tongue” were considered Qi deficiency indicators in the K-SPI-Stroke III, but the A and B values for fine pulse was high among Yin deficiency patients, and the A value for pale tongue was high among the Dampness-Phlegm patients.

When the corresponding clinical indicators were graphed on an x-axis that represents differentiation between the groups (A value) and a y-axis that represents frequency within the group (B value), as in **Figure 3**, most of the indicators were distributed in the fourth quadrant, while only one indicator (YD-1) was present in the second quadrant. Four indicators (QD-1, QD-2, FH-1, DP-1) were located in the first quadrant, indicating that they are the most clinically valuable indicators. Meanwhile, seven indicators (FH-19, FH-8, YD-3, QD-8, QD-7, YD-4, YD-6) were located in the third quadrant, indicating that they are the least useful indicators.

Discussion

There has been increasing interest [18-20] in pattern identification studies in recent years.

This is due to the rising expectation [21] that TKM can provide personalized medicine through pattern identification studies, unlike Western medicine, which provides across-the-board treatment based on the patient's illness. Certainly, complementary and alternative medicine research does not need to be viewed from the perspective of modern medicine; still, because of its subjectivity and the ambiguity of its judgment criteria, pattern identification has been under critique for a long time [22]. This study is an excellent source for such assessments.

The indicators assigned to one of the four K-SPI-Stroke-III patterns are listed in descending order of frequency in **Table 3**. The following indicators were ranked as the most frequent for each pattern in descending order: reddened complexion, heat vexation and aversion to heat, and yellow fur for the Fire-Heat pattern; slippery pulse, white fur, and sallow complexion for the Dampness-Phlegm pattern; dry mouth, pale face and red zygomatic sites, and dry fur for the Yin deficiency pattern; and looks weak and lethargic and feels weak and lethargic for the Qi deficiency pattern.

Furthermore, because the B values for the indicator frequency ranking used the frequency of the indicator as the numerator and the n value for the corresponding pattern as the denominator, the indicator frequency ranking is the same as the B value rank order.

However, there were instances in which the indicators that were predicted by literature and by expert consensus as belonging to a particular pattern were actually found to be more strongly associated with a different pattern. These are confounding indicators, which are written in boldface in **Table 3**. For example, thick fur, which the K-SPI-Stroke-III classified as a Fire-Heat pattern indicator, presented high A and B values (36.47/27.97) for Fire-Heat, but had even higher A and B values (55.32/41.08) as a Dampness-Phlegm indicator. Other indicators that showed higher A and B values in a pattern other than that originally assigned include thick fur and wheezing in the throat with sputum from the Fire-Heat pattern and fine pulse from the Qi deficiency pattern. In addition, dry mouth and dry fur from the Yin deficiency pattern and pale tongue from the Qi deficiency pattern had maximum B values for their originally

assigned pattern, but their A values were higher for another pattern. This indicates that indicators that represent a pattern well in an established situation can be even more helpful in differentiating another pattern in a clinical setting.

Among the three indicators that had higher A and B values for a pattern other than the one to which they were originally assigned, we may consider assigning wheezing in the throat with sputum to the Dampness-Phlegm indicator because it shows very notable differences in frequency between the Fire-Heat and the Dampness-Phlegm patterns (an outlying value is shown in **Figure 3**). For the indicators thick fur and fine pulse, additional consideration or research seems necessary before deciding whether to include them in both patterns, eliminate them from both patterns, or reassign them to the pattern in which they occur more frequently.

Moreover, for the three indicators with variations in A values (dry mouth, dry fur, and pale tongue), additional consideration or research seems necessary to determine whether they should be included in their originally assigned pattern, be included in both applicable patterns, or be eliminated from both patterns, given that the ranking is determined by the B values.

The A and B values for the 44 indicators were represented on the coordinates (**Figure 3**). In this study, the first condition an indicator must meet to be classified as significant is a high A value, which is the frequency of the indicator within its corresponding pattern divided by the total frequency of the corresponding indicator, multiplied by 100, followed by a high B value, which is the frequency with which the corresponding pattern is associated with the indicator divided by the frequency of the pattern, multiplied by 100. Considering these values, indicators located in the first quadrant would be classified as relatively significant indicators, whereas the indicators located in the third quadrant would be classified as relatively insignificant indicators. The indicators in the second and fourth quadrants would have mixed characteristics, with the fourth quadrant representing indicators that are relatively more relevant than those in the second quadrant. Furthermore, the YD-1 indicator in the second quad-

rant is a confounding indicator; it is a frequently occurring indicator in the Fire-Heat pattern. Therefore, it belongs among the indicators in the third quadrant, and there should be no indicator located in the second quadrant.

All six of the confounding indicators were confirmed to be located in the left quadrant. That is, their differentiation between the patterns did not exceed 50%. However, the night sweating and thinness indicators under the Yin deficiency pattern were located in the left quadrant, although they were not confounding indicators.

Indicators that clearly distinguish between patterns belong in the right quadrants, in which all pattern differentiations exceeded 50%. Thirty-six indicators met this criterion, including a total of four (QD-1, QD-2, FH-1, DP-1) located above Classification Line 1 (Classification Lines 1 and 2 were drawn to create 25% and 50% differential groups, respectively). These four indicators can be considered very significant indicators for pattern identification. The section above Classification Line 2 includes indicators that are relatively less significant than the top five indicators, and a total of 14 indicators (DP-2, QD-3, FH-2, FH-3, DP-3, FH-4, QD-4, YD-2, FH-5, QD-5, FH-6, FH-7, DP-4, QD-6) are included in this section. In addition, the indicators in the right quadrants that had the least significance appear in the section below the classification lines. A total of 18 corresponding indicators (FH-9, DP-5, FH-10, YD-5, FH-11, FH-12, DP-6, YD-7, QD-9, FH-13, DP-7, FH-14, QD-10, FH-15, QD-11, FH-16, FH-17, FH-18) appeared in this section.

Conclusion

Among the 44 clinical indicators listed in the K-SPI-Stroke-III, four were confirmed as clinically significant for pattern identification for stroke. Further research is necessary to classify the six confounding indicators.

In this article, we are to extract clinically important indicators based on subjective, additional and substantial decisions of each TKM doctors, this will be a foundation study to establish a modified version of K-SPI-III.

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Disclosure of conflict of interest

None.

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