

Research Article

Development and evaluation of short form of constitution in Chinese medicine questionnaire: a national epidemiological survey data of 21 948 cases

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Abstract

OBJECTIVE: To develop the best short form of constitution in Chinese medicine questionnaire (CCMQ) and evaluate its psychometric properties in Chinese population.

METHODS: A total of 21 948 subjects were used to refine the short form. Correlation coefficient, exploratory factor analysis (EFA) and Cronbach's alpha coefficient were used to analyze and select items to form the short form. Separate sample of 205 subjects were collected to further evaluate the short form. EFA, confirmatory factor analysis (CFA), item-scale correlation, discriminant validity, internal consistency reliability and split-half reliability were carried out to evaluate the short form.

RESULTS: The short form CCMQ included 26 items.

Seven common factors of characteristic root > 1 were extracted to explain 58.488% of the total variation. Result of CFA was consistent with the 9-factors structure. The mean differences of Blood-stasis body constitution and Qi-stagnation body constitution had statistical significance in body mass index differentiation. Cronbach's alpha coefficient of short form CCMQ was 0.863. The split-half reliability of total scale was 0.813, and each scale was 0.568-0.770. The item-scale correlations ranged from 0.620-0.849.

CONCLUSION: The short form CCMQ consisted of 26 items with good psychometric properties. The short form should be recommended for the measurement of health of Chinese population in any clinical trial.

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Keywords: constitution in Chinese medicine questionnaire; form; scale evaluation; reproducibility of results

1. INTRODUCTION

The World Health Organization (WHO) and the National Medical Products Administration (NMPA) have been focused on the use of patients reported outcomes (PRO) in clinical practice by means of drug development, clinical evaluation and public health planning among different populations since 2004.^{1,2} China adopted national public health policy by the use of PRO with its respect to the both conventional and Traditional Chinese Medicine (TCM). Apart from Western medicine, TCM also protects the health of Chinese people in Asian countries including China, Korea, and Japan^{3,4} that are well-recognized in WHO.⁵ However, the measurement of health concepts in TCM has been found to be unique but lacks a valid instrument for reflecting its practice.⁶ The consolidation of measurement of the latent variables measuring the 9 body constitution (BC) scale tool was firstly established by Prof. Wang Qi in China.⁷ Further cross-cultural adoption has confirmed the psychometric properties of this scale in China, Japan, Korea and other regions or specific populations.⁸⁻¹⁴ The 9 BC scale

formally changed to the constitution in the Chinese medicine questionnaire (CCMQ) in 2006 for wider application.¹⁵⁻¹⁷ CCMQ has also been benchmarked as the national standard of Classification and Determination of Constitution in TCM in 2009.¹⁸ Within 5 years after promulgating of the standard, 2369 academic papers related to constitution of TCM had been retrieved from the China National Knowledge Infrastructure database (CNKI).¹⁹ CCMQ shares the same values of Western developed generic PRO such as World Health Organization Quality Of Life (WHOQOL), the MOS item short form health survey (SF-36) and 12-item short form health survey (SF-12).^{16, 20-22} The psychometric properties have been found to have complementary to SF-12v2 in the health concept of Western culture of physical or mental for Chinese.²² The CCMQ has been used to investigate the constitution-disease correlation such as hypertension, hyperlipidemia or diabetes mellitus as one of major instruments.²³⁻²⁶ With its application in national level and lifetime health maintenance, a series of epidemiological studies have been undergoing.^{8, 12, 27, 28}

There are 9 BC types in CCMQ that consist of 1 balanced BC type: Gentleness, and 8 imbalanced BC types: *Qi*-deficiency, *Yang*-deficiency, *Yin*-deficiency, Phlegm-dampness, Damp-heat, Blood-stasis, *Qi*-stagnation, and special-diatheisis.^{7, 29} Each of the BC types is identified by one scale. There are a total of 60 items, and each BC scale contains 6-8 items, respectively. The lower the imbalanced summary score implied the increase the healthiness of a respondent.^{7, 16}

Despite the success of CCMQ in evaluating psychometric properties, there are shortcomings, including the long completion time, not amenable to the lower education population in China, and sub-optimal response rates were found of CCMQ in Chinese population.^{30, 31} These hinder the wide application of a good instrument for research or clinical application in the practice of TCM or measuring the health of the Chinese population. Although the scale has been well validated and scholars have tried to reduce it to a short form with 30-41 items, the psychometric properties of the short form were found to be non-satisfactory of biased sample, and a population sample was needed to enhance the psychometric properties of short form CCMQ to improve the measurement tool for protection of the accurate measurement of the health of the Chinese population.³²⁻³⁴ Therefore, this study aimed at developing a more sufficient short form of CCMQ from a national database and confirming its psychometric properties for clinical use in the population level.

2. MATERIALS AND METHODS

2.1. Ethical approval

This investigation was approved by the Ethics Committee of Beijing University of Chinese Medicine (No. 2020BZHILL0102).

2.2. Scoring algorithm of the CCMQ

As the standard of China Association of Chinese Medicine, the summary score of each scale was calculated by simple summation of the categorized items. The derived score of each scale transformed into 0-100 points. The derived score = 100* (original score minus the minimum possible score of the scale)/the difference between the maximum possible score and the minimum possible score of the subscale. Each item may be applicable to map different BC types. The threshold of Gentleness BC was 60 while the other imbalanced BC types were 30 (towards yes) and 40 (yes). In determining the BC types, the higher the score of the balanced BC, it implied the healthiness of the respondent. On the contrary, the lower the imbalanced BC scores, the more healthy the respondents. From previous studies demonstrating the good psychometric properties of CCMQ, the 5-point Likert scale was retained.^{15, 35}

2.3. Development of the short form CCMQ

A dataset of 21 948 respondents were extracted from an epidemiological survey conducted between December 2005 and January 2007 in China covering 9 provinces and municipalities in Jiangsu, Anhui, Gansu, Qinghai, Fujian, Beijing, Jilin, Jiangxi and He'nan. Subjects over 15 years old were included in the analysis. This dataset consisted of 11 695 females (53.29%), and ages ranged from 15-92 years old with an average of (35 ± 15) years old.⁸ Based on the principle that there should be at least three items in each subscale or dimension,³⁶ this study aims to identify BC types with the minimum number of items. To retain the 9 scales construct of the CCMQ, the best 3 items for each BC type that could explain the model would be chosen. To determine the best items under the 9 scales, correlation coefficient, exploratory factor analysis and Cronbach's alpha coefficient were used to select the best items for the construct from international recommendation.³⁷⁻⁴⁰ First, the most important 3 items will be selected with each method, then, the item will be retained eventually if equal or more than 2 methods indicate to reserve. Together, this constitutes the best short form with 26 items for the total of the CCMQ in the preliminary structural design.

2.3.1. Correlation coefficient analysis

By calculating the correlation coefficient analysis of items, the correlation between item-scale correlations would reveal the representative of the CCMQ. Items with a correlation coefficient of < 0.4 were discarded in this study.^{41, 42}

2.3.2. Exploratory factor analysis (EFA) method

EFA aimed to select and retain the items from the perspective of item representativeness to scales by using the factor loading of items on each common factor or scale. The above method was used to assess how well the data fit the theoretical model, and also used in the development of other short-forms of scale or questionnaire.^{43, 44} Principal component analysis was

used for EFA to obtain the load coefficient of items on the corresponding common factor, and items with a large load coefficient were selected, conversely were deleted to simplify the complicated scale. Factor load coefficient 0.4 was used as the standard for selection and deletion.^{41, 45}

2.3.3. Cronbach's alpha coefficient method

Item retention was considered in terms of its contribution to the internal consistency of the scale. Any item that increased the Cronbach's alpha coefficient of each scale was retained or vice versa. Generally, Cronbach's alpha coefficient for the total questionnaire of > 0.6 has been acceptable,^{41, 46} but is better at > 0.7 and between 0.7-0.95.^{47, 48} Additionally, each dimension or subscale was acceptable at > 0.5 and considered better at > 0.6 .³⁶ Therefore, the cut-off > 0.6 as an acceptable level was used in this study.

2.4. Evaluation on the psychometric properties of the short form CCMQ

After deriving the best 26 items for the proposed short form, we proceeded to evaluate its psychometric properties. From an independent sample of 205 subjects recruited from internet from 15-29 January 2020, a snowball sample was collected. All statistical analysis was carried out using SPSS 25.0 (IBM-SPSS, Chicago, IL, USA) and LISREL 9.5 (SSI Inc, Lincolnwood, IL, USA) and $P < 0.05$ was considered statistically significant. The primary outcome of the short form CCMQ was evaluated on (a) construct validity (b) reliability and (c) item analysis.⁴⁹

2.4.1. Construct validity

The construct validity of the total scale and each body scale was evaluated by EFA and confirmatory factor analysis (CFA). In the EFA, factor of the characteristic value > 1 was extracted by the maximum variance rotation method, and the factor loading of the item was required to be > 0.4 .^{42, 50} CFA was used to evaluate the fitting degree of items with 9 BC theory. The below fit indices were focused, such the ratio of chi-square to degrees of freedom (χ^2/df), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), incremental fit index (IFI), and parsimony goodness of fit index (PGFI). The standards of $\chi^2/df < 5$, RMSEA and SRMR < 0.08 , CFI and IFI > 0.9 , PGFI > 0.5 were adopted in this study.^{6, 41, 50, 51}

2.4.2. Item analysis

The construct validity was further tested by the correlations of item and composed body scale, and an item was discarded if the correlation coefficient was < 0.4 .^{41, 42} Both item and scale level of correlation were investigated in this study.

2.4.3. Discriminant validity

The discriminant validity of short form CCMQ was analyzed by independent sample *t*-test to investigate if

the short form could differentiate subjects with different body mass index (BMI). The BMI standard of 25 was used to classify overweight.⁵² The scores of each respondent and their corresponding BC types were analyzed BC scale to evaluate the discriminant validity of the short form scale.^{53, 54}

2.4.4. Reliability analysis

The reliability of short form CCMQ was evaluated by internal consistency reliability and split-half reliability. Cronbach's alpha coefficient and Cronbach's alpha coefficient based on standardized items were used to evaluate the internal consistency reliability, and Spearman-Brown split-half coefficient was for split-half reliability.⁴²

2.5. Sample size calculation

To evaluate the short form CCMQ, the construct validity in preserving of the full form was the primary outcome of this study. Therefore, the item-scale correlation of 0.4 was used as one of the benchmarks, and the number of cases should not be less than 5 times about the item numbers of the simplified scale.⁵⁵ The samples size should be greater than 175, for the short form has 26 items as observed variables and 9 BC types as a latent variables measurement.

3. RESULTS

3.1. Short form of CCMQ

By the correlation coefficient analysis, EFA and Cronbach's alpha coefficient method, 26 items were selected for the short form from a national sample survey. There were 3 items for all BC types, with 4 items for Damp-heat and 2 items for special-diathesis. All items distribution of the original and short form is shown in Table 1.

3.2. Confirmation of the short form of the CCMQ

A total of 204 subjects recruited provided informed consent and completed a structured questionnaire that consisted of the short form CCMQ and demographic information. There were 70 males and 134 females with a mean age of (30 ± 7) years old (range: 20-50 years old). The completion rate was 99.5% and the completion time of the short form CCMQ was (2.7 ± 0.6) min.

3.3. Evaluation of the psychometric properties of the short form CCMQ by factor analyses

EFA was applied to evaluate the construct validity. Results of both the Kaiser-Meyer-Olkin (KMO) test ($r = 0.840$) and Bartlett's test of sphericity ($\chi^2 = 1665.273$, $df = 325$, $P < 0.001$) indicated that the data of short form CCMQ was feasible for factor analysis of total short form CCMQ. Seven characteristic roots > 1 were extracted by applying principal component analysis and varimax orthogonal rotation method. The initial eigenvalues were

Table 1 Comparison of the original and the short form of the CCMQ (n = 21 948) ^a

Scale	Item of original scale (CCMQ)	Correlation coefficient with BC scale score		Factor loading affiliated BC scale	Cronbach's alpha coefficient after remove the item	Final items were selected	
Gentleness	(1) Were you energetic?	0.612 ^b	√	0.652	√	0.458	√
	(2) Did you get tired easily?	0.641 ^b	√	0.706	√	0.329	√
	(7) Was your voice weak when talking?	0.584 ^b		0.616		0.323	
	(8) Did you feel in low spirits and depressed?	0.599 ^b		0.627	√	-0.147	√
	(21) Did you feel more vulnerable to the cold than others (winter coldness, air conditioners, fans, etc.)?	0.501 ^b		0.488		-0.157	√
	(27) Did you forget things easily?	0.567 ^b		0.547		-0.202	
	(53) Could you adapt yourself to external natural or social environment changes?	0.441 ^b		0.31		0.016	√
Qi-deficiency	(54) Did you easily experience insomnia?	0.613 ^b	√	0.586		0.316	
	(2) Did you get tired easily?	0.653 ^b	√	0.679	√	0.727	√
	(3) Did you experience shortness of breath?	0.673 ^b	√	0.72	√	0.723	√
	(4) Did you get palpitations?	0.688 ^b	√	0.732	√	0.72	√
	(5) Did you get dizzy easily or become dizzy when standing up?	0.647 ^b		0.654		0.731	
	(6) Did you prefer quietness and not like to talk?	0.603 ^b		0.57		0.746	
	(7) Was your voice weak when talking?	0.639 ^b		0.652		0.73	
	(22) Did you catch colds more easily than others?	0.579 ^b		0.515		0.756	
Yang-deficiency	(26) Did you sweat easily when your physical activity increased slightly?	0.458 ^b		0.403		0.764	
	(17) Did your hands or feet feel cold or clammy?	0.455 ^b		0.457		0.726	
	(18) Did you feel cold easily in your abdomen, back, lower back or knees?	0.631 ^b	√	0.639		0.693	
	(19) Were you sensitive to cold and tended to wear more clothes than others?	0.718 ^b	√	0.73	√	0.667	√
	(21) Did you feel more vulnerable to the cold than others (winter coldness, air conditioners, fans, etc.)?	0.518 ^b		0.544		0.707	
	(22) Did you catch colds more easily than others?	0.742 ^b	√	0.701	√	0.677	√
	(52) Did you feel uncomfortable when you drank or ate something cold, or did you avoid to drinking or eating cold items?	0.614 ^b		0.642	√	0.692	√
Yin-deficiency	(55) Did you easily contract diarrhea when you were exposed to cold or ate (or drank) something cold?	0.538 ^b		0.571		0.706	
	(16) Did the palms of your hands or soles of your feet feel hot?	0.606 ^b	√	0.631	√	0.68	√
	(20) Did your body and face feel hot?	0.574 ^b		0.543		0.697	
	(29) Were your lips redder than in the past?	0.480 ^b		0.435		0.714	
	(35) Did your skin or lips feel dry?	0.600 ^b		0.584		0.689	
	(38) Did you experience hot flashes?	0.506 ^b		0.51		0.7	
	(44) Did your eyes feel dry and you used eye drops?	0.644 ^b	√	0.668	√	0.672	√
	(46) Did you often feel parched and need to drink water?	0.666 ^b	√	0.697	√	0.665	√
Phlegm-dampness	(57) Did you get constipated easily or have dry stools?	0.566 ^b		0.566		0.691	
	(13) Did you feel chest or abdominal stuffiness?	0.499 ^b		0.499		0.667	
	(15) Did your body feel heavy or lethargic?	0.567 ^b		0.573		0.653	
	(28) Did you have an excessively oily forehead and/or T-zone?	0.581 ^b	√	0.601	√	0.647	√
	(42) Did you have upper eyelid swelling?	0.572 ^b		0.583	√	0.65	√
	(49) Did your mouth feel sticky?	0.643 ^b	√	0.686	√	0.629	√
	(50) Was your abdomen flabby?	0.505 ^b		0.435		0.682	
	(51) Did you have an abundance of phlegm, especially in your throat?	0.574 ^b	√	0.57		0.651	
Damp-heat	(58) Did your tongue have a thick coating?	0.547 ^b		0.534		0.659	
	(39) Did your nose or your face feel greasy, oily, or shiny?	0.050 ^b		0.593		0.641	
	(41) Did you get acne or sores easily?	0.054 ^b	√	0.599		0.632	√
	(48) Did you have a bitter or strange taste in your mouth?	0.035 ^b		0.603		0.644	
	(56) Did you pass sticky stools and/or feel that your bowel movement was incomplete?	0.061 ^b	√	0.643	√	0.632	√
	(59) Did your urethral canal feel hot when you urinated, or did your urine have a dark color?	0.052 ^b	√	0.637	√	0.639	√
	(60) Was your vaginal discharge yellowish (only for female interviewees)? /Was your scrotum always wet (only for male interviewees)?	0.040 ^b		0.658	√	0.629	√

6.870, 2.024, 1.536, 1.394, 1.204, 1.170 and 1.009. The explainable variances were 13.206%, 11.627%, 8.392%, 6.565%, 6.327%, 6.299% and 6.081%. The accumulated

contribution rate was 58.488%. Factor variables and loadings in the common factor are shown in Table 2. EFA of 9 BC scales of the short form CCMQ were also

Table 1 Comparison of the original and the short form of the CCMQ ($n = 21\ 948$)^a (continued)

Scale	Item of original scale (CCMQ)	Correlation coefficient with BC scale score	Factor loading affiliated BC scale	Cronbach's alpha coefficient after remove the item	Final items were selected
Blood-stasis	(27) Did you forget things easily?	0.528 ^b	0.462	0.698	
	(33) Did black or purple bruises appear on your skin for no reason?	0.508 ^b	0.514	0.685	
	(36) Did you have visible capillary (thread) veins on your cheeks?	0.604 ^b	0.581	0.676	
	(37) Did you feel pain somewhere in your body?	0.588 ^b	0.572	0.672	
	(40) Did you have a dark face or get brown spots easily?	0.696 ^b	√ 0.739	0.634	√
	(43) Did you get dark circles under the eyes easily?	0.621 ^b	√ 0.635	0.663	√
<i>Qi</i> -stagnation	(45) Were your lips darker, more blue or purple than usual?	0.656 ^b	√ 0.688	0.649	√
	(8) Did you feel in low spirit and depressed?	0.606 ^b	0.564	0.78	
	(9) Did you easily feel anxious and worried?	0.741 ^b	√ 0.775	0.74	√
	(10) Did you feel overly sensitive, vulnerable or emotionally upset?	0.761 ^b	√ 0.798	0.735	√
	(11) Were you easily scared or frightened?	0.737 ^b	√ 0.764	0.743	√
	(12) Did you experience distention in the underarm or breast?	0.708 ^b	0.732	0.749	
Special-diathesis	(14) Did you sigh without reason?	0.573 ^b	0.544	0.778	
	(47) Did your throat feel strange (i.e., as if something was stuck or there was a lump in your throat)?	0.539 ^b	0.466	0.795	
	(23) Did you sneeze even when you did not have a cold?	0.569 ^b	0.505	0.708	
	(24) Did you have a runny or stuffy nose even when you did not have a cold?	0.630 ^b	√ 0.596	0.684	
	(25) Did you cough due to seasonal changes, temperature changes or unpleasant odors?	0.622 ^b	0.603	0.682	√
	(30) Did you have allergies? (E.g. medicine, food, odors, pollen, pet dander or during seasonal or weather change etc.)	0.649 ^b	√ 0.688	0.673	√
	(31) Did you get hives/urticaria easily?	0.643 ^b	√ 0.692	0.674	√
	(32) Did your skin have purpura (purple spots, ecchymosis) due to allergies?	0.565 ^b	0.629	0.691	
(34) Did your skin turn red and show traces when you scratched it?	0.624 ^b	0.595	0.695		

Notes: BC: body constitution; CCMQ: constitution in Chinese medicine questionnaire. ^a: the numbers of original scale (CCMQ) used. √: the item that should be retained; ^b $P < 0.01$.

computed. Results of KMO and Bartlett's test of sphericity indicated that the EFA was also appropriate for the great mass of BC type scales. The P-values of Bartlett's test of sphericity for the 9 BC scales of the short form CCMQ were < 0.01 , except Special-diathesis BC, and KMO values between 0.500-0.698 for the 9 BC scales. In every BC scale of the short form CCMQ, only 1 common factor which eigenvalue > 1 has been successful extracted and $> 50\%$ of the total variance was explained except for the Damp-heat BC type (Table 2). All other BC type scales had satisfactory factor loading (Table 3). CFA (Tables 3, 4, Figure 1) confirmed the 9 factor structure model of the short form CCMQ in the hypothesized theory structure. The fit indices met the requirements of statistics, except CFI and IFI, which were suboptimal.

3.4. Item analysis

The item-scale correlations of all BC type scales were all high that ranged from 0.620-0.849 and a P-value of < 0.001 (Table 3).

3.5. Discriminant validity

In this study, 203 subjects that provided BMI information were classified as overweight with a BMI ≥ 25 . The score

of Blood-stasis BC type ($P = 0.026$) and *Qi*-stagnation BC type ($P = 0.008$) were found statistically different from other BC types, implying that specific BC types did lead to BMI changes and are able to be reflected by the short form CCMQ (Table 5).

3.6. Reliability analysis

Cronbach's alpha coefficient and Cronbach's alpha coefficient based on standardized items of the short form of CCMQ were 0.836 and 0.867, and each BC type was 0.505-0.771 and 0.510-0.774, respectively. Spearman-Brown split-half coefficient of short form of CCMQ was 0.813 and each BC type scale was 0.568-0.770 (Table 5). This implied the short form CCMQ had a good reliability.

4. DISCUSSION

The CCMQ is an excellent Chinese PRO with sufficient psychometric properties in different Chinese populations within China and other countries, ⁸⁻¹¹ as well as several regions or specific populations. ¹²⁻¹⁴ However, it has been considered too long and took (11.6 ± 7.6) min for completion, which greatly has hindered its application. ⁵³ The short form CCMQ developed from a national survey used purposive sampling provided a foundation for

Table 2 The total variance of short form CCMQ ($n = 204$)^a

Body constitution	Component	Initial eigenvalues			Extraction sums of squared loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Gentleness	1	1.660	55.345	55.345	1.660	55.345	55.345
	2	0.745	24.832	80.177			
	3	0.595	19.823	100.000			
<i>Qi</i> -deficiency	1	1.634	54.475	54.475	1.634	54.475	54.475
	2	0.853	28.424	82.900			
	3	0.513	17.100	100.000			
<i>Yang</i> -deficiency	1	1.743	58.106	58.106	1.743	58.106	58.106
	2	0.776	25.883	83.988			
	3	0.480	16.012	100.000			
<i>Yin</i> -deficiency	1	1.531	51.024	51.024	1.531	51.024	51.024
	2	0.843	28.111	79.136			
	3	0.626	20.864	100.000			
Phlegm-dampness	1	1.523	50.756	50.756	1.523	50.756	50.756
	2	0.851	28.359	79.115			
	3	0.627	20.885	100.000			
Damp-heat	1	1.955	48.887	48.887	1.955	48.887	48.887
	2	0.841	21.030	69.917			
	3	0.655	16.386	86.304			
	4	0.548	13.696	100.000			
Blood-stasis	1	1.598	53.280	53.280	1.598	53.280	53.280
	2	0.874	29.126	82.406			
	3	0.528	17.594	100.000			
<i>Qi</i> -stagnation	1	2.066	68.855	68.855	2.066	68.855	68.855
	2	0.500	16.680	85.536			
	3	0.434	14.464	100.000			
Special-diathesis	1	1.137	56.847	56.847	1.137	56.847	56.847
	2	0.863	43.153	100.000			

Notes: CCMQ: constitution in Chinese medicine questionnaire. a: extraction of using principal component analysis.

improving the time of completion from 11 to 2.75 min. This greatly facilitates PRO measurement on specific-disease relationship or population survey in improving the health of populations. With consolidation, the completion rate would increase the wide acceptance of traditional or integrative medicine in the WHO.⁵

The good construct of the scale was verified by factor analysis. For EFA, 58.49% of the total variance of short form CCMQ can be explained by the seven common factors. The common factors extracted from each BC scale, with reference to the item-scale correlation, accounted for > 50% of the total variance of each BC scale. The factor loading of each item is 0.405-0.765, which was > 0.4. The EFA did not fully address the scale of special-diathesis, which may imply the 2 items may not be able to be fully explained with missing items. For CFA, although CFI and IFI below the standard requirements, and we may need larger sample size or broader sample spectrum for CFA in the short form in the future. The RMSEA is more worthy of fitting index less affected by the sample size, and reflects how closely the model fit approximates a reasonably fitted model.⁴¹ As a whole, a goodness of fit of short form CCMQ could be still considered. However, statistical mean differences were found in Blood-stasis BC and *Qi*-stagnation BC in BMI classification that implied the short form was still valid and deserves further study.⁵³ In addition, the results of item analysis demonstrated a sufficient correlation between item and scale which indicated items could

accurately reflect their BC characteristics by items level and scale level for the identification of BC types.

By investigating the short form, the result from the CFA can explain the conformity of the items of the scale to the hypothesis of 9 BC theory in TCM and could be explained and understood from the expertise and theory in TCM. Nonetheless, 7 common factors were extracted through EFA, which was not the same as the 9 BC types hypothesized. While results from the CFA were acceptable, the EFA was not considered from several reasons. First, from expertise of TCM, the results could be explained and understood. For example, in the theory of TCM, *Qi* stagnation is usually manifested as Liver *Qi* depression and caused *Qi* deficiency, specifically Spleen *Qi* deficiency, and then a new combination called liver depression and spleen deficiency was formed. This could possibly account for why the items from *Qi* depression and *Qi* deficiency appear in the same common factor. Second, as a result, the KMO and Bartlett's test of sphericity of the short form CCMQ indicated that EFA was not suitable for each BC type scale, although feasible overall. Third, among the models that have assumed the number of common factors in advance, CFA is more suitable.⁵⁶ Based on the theory of Constitutional Medicine in TCM, the number of the best common factors is known to be determined, and 9 are the best models. Therefore, CFA is more suitable for the short form CCMQ.

A good reliability of short form CCMQ was indicated in

Table 3 EFA, CFA and item-scale of the short form CCMQ (n = 204)

Scale	Items of original scale (CCMQ) ^a	Variable code in EFA	EFA of short form CCMQ		CFA of short form CCMQ		Item-scale of the short form CCMQ	
			Factor loading in the total scale ^b	Factor loading of item in each BC	Factor loading	R ²	Pearson correlation with affiliated BC	P value (two-tailed)
Gentleness	(1) Were you energetic?	I1GTC1	-0.467	0.681	0.380	0.144	0.754	<0.001
	(2) Did you get tired easily?	I2GTC2 (I2QDC1)	0.572	0.769	-0.420	0.176	0.720	<0.001
	(8) Did you feel in low spirit and depressed?	I5GTC3	0.756	0.779	0.700	0.490	0.750	<0.001
<i>Qi</i> -deficiency	(2) Did you get tired easily?	I2GTC2 (I2QDC1)	0.572	0.555	-0.050	0.003	0.620	<0.001
	(3) Did you experience shortness of breath?	I3QDC2	0.711	0.811	0.540	0.292	0.791	<0.001
	(4) Did you get palpitations?	I4QDC3	0.519	0.817	0.690	0.476	0.787	<0.001
<i>Yang</i> -deficiency	(19) Were you sensitive to cold and tended to wear more clothes than others?	I10YaDC1	0.626	0.847	0.910	0.828	0.846	<0.001
	(22) Did you catch colds more easily than others?	I11YaDC2	0.753	0.719	0.450	0.203	0.658	<0.001
	(52) Did you feel uncomfortable when you drank or ate something cold, or did you avoid to drinking or eating cold items?	I23YaDC3	0.541	0.713	0.700	0.490	0.766	<0.001
<i>Yin</i> -deficiency	(16) Did the palms of your hands or soles of your feet feel hot?	I9YiDC1	0.714	0.390	0.410	0.168	0.648	<0.001
	(44) Did your eyes feel dry and you used eye drops?	I19YiDC2	0.651	0.701	0.540	0.292	0.711	<0.001
	(46) Did you often feel parched and need to drink water?	I21YiDC3	0.502	0.794	0.590	0.348	0.778	<0.001
Phlegm-dampness	(28) Did you have an excessively oily forehead and/or T-zone?	I12PDC1	0.537/0.424 ^c	0.700	0.650	0.423	0.736	<0.001
	(42) Did you have upper eyelid swelling?	I17PDC2	0.751	0.633	0.430	0.185	0.652	<0.001
	(49) Did your mouth feel sticky?	I22PDC3	0.604	0.795	0.670	0.449	0.741	<0.001
Damp-heat	(41) Did you get acne or sores easily?	I16DHC1	0.695	0.565	0.610	0.372	0.639	<0.001
	(56) Did you pass sticky stools and/or feel that your bowel movement was incomplete?	I24DHC2	0.510	0.722	0.670	0.449	0.725	<0.001
	(59) Did your urethral canal feel hot when you urinated, or did your urine have a dark color?	I25DHC3	0.702	0.770	0.610	0.372	0.720	<0.001
	(60) Was your vaginal discharge yellowish (only for female interviewees)? /Was your scrotum always wet (only for male interviewees)?	I26DHC4	0.505	0.723	0.560	0.314	0.701	<0.001
Blood-stasis	(40) Did you have a dark face or get brown spots easily?	I15BSC1	0.758	0.818	0.730	0.533	0.760	<0.001
	(43) Did you get dark circles under the eyes easily?	I16BSC	0.405	0.529	0.390	0.152	0.657	<0.001
	(45) Were your lips darker, more blue or purple than usual?	I20BSC	0.617	0.806	0.710	0.504	0.755	<0.001
<i>Qi</i> -stagnation	(9) Did you easily feel anxious and worried?	I6QSC1	0.765	0.845	0.680	0.462	0.831	<0.001
	(10) Did you feel overly sensitive, vulnerable or emotionally upset?	I7QSC2	0.722	0.815	0.750	0.563	0.834	<0.001
	(11) Were you easily scared or frightened?	I8QSC3	0.618	0.829	0.610	0.372	0.824	<0.001
Special-diathesis	(30) Did you have allergies? (E.g. medicine, food, odors, pollen, pet dander or during seasonal or weather change etc.)	I13SDC1	0.733	0.754	0.540	0.292	0.849	<0.001
	(31) Did you get hives/urticaria easily?	I14SDC2	0.704	0.754	0.500	0.250	0.822	<0.001

Notes: EFA: exploratory factor analysis; CFA: confirmatory factor analysis; CCMQ: constitution in Chinese medicine questionnaire; BC: body constitution. ^a: the numbers of original scale (CCMQ) used; ^b: factor 1 include items (9) (10) (8) (11) (2) (1); factor 2 include items (16) (59) (49) (28) (56) (60) (46); factor 3 include items (40) (44) (45) (43); factor 4 include items (41) (42); factor 5 include items (3) (4) (52); factor 6 include items (30) (31); factor 7 include items (19) (22); ^c: 0.537: the factor loading in factor 2; 0.424: the factor loading in factor 4.

this study with Cronbach's alpha coefficient and Spearman-Brown coefficient of the total scale. Although, the reduction of items has an impact on the internal consistency of the scale, for the Cronbach's alpha coefficient based on standardized items of 9 BC scales

was better than Cronbach's alpha coefficient in most BC scale, except for *Qi*-deficiency and *Yin*-deficiency. Additionally, the item-scale correlation also reflects the justification of each BC scale to accurately determine in the short form CCMQ.

Table 4 Goodness of fit statistics for the short form CCMQ^a

χ^2	df	χ^2/df	P value	RESEA	90% CI for RMSEA	SRMR	CFI	IFI	PGFI
423.65	262	1.617	<0.001	0.055	0.045 ; 0.06	0.061	0.87	0.87	0.64

Notes: CCMQ: constitution in Chinese medicine questionnaire; χ^2 : Chi-square statistic; df: degree of freedom; CI: confidence interval; RMSEA: root mean square error of approximation; SRMR: standardized root mean square residual; CFI: comparative fit index; IFI: incremental fit index; PGFI: Parsimony goodness of fit index. ^a: the numbers of original scale (CCMQ) used.

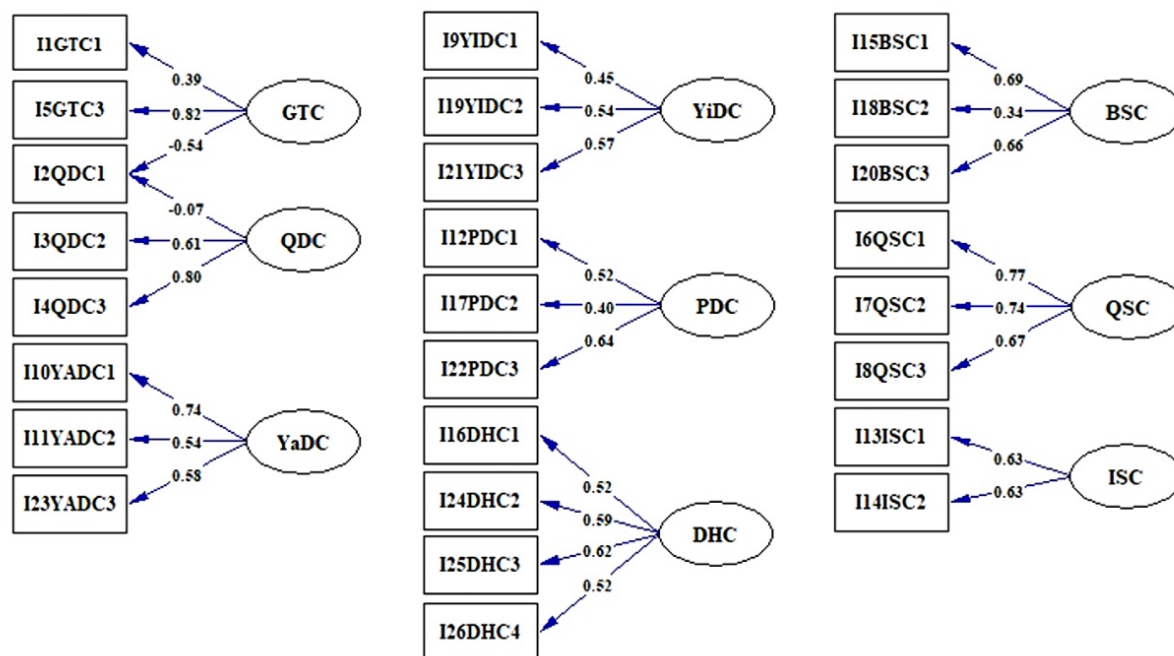


Figure 1 Results of confirmatory factor analysis

GTC: balanced body constitution (Gentleness); QDC: Qi-deficiency body constitution; YaDC: Yang-deficiency body constitution; YiDC: Yin-deficiency body constitution; PDC: Phlegm-dampness body constitution; DHC: Damp-heat body onstitution; BSC: Blood-stasis body constitution; QSC: Qi-stagnation body constitution; SDC: Special-diathesis body constitution. Item number: take “I1GTC1” for an example. “I” is the initial of “item”; “1” refers to the number in short form of total questionnaire; “GTC” refers to the constitutional type; “1” indicates the number in short form of each BC scale.

Table 5 Discriminant validity and reliability of the short form CCMQ

Body constitution	Number of items	Discriminant validity of the short form CCMQ of different BMI (mean ± SD)				Reliability analysis of the short form CCMQ		
		BMI ≥ 25 (n = 47)	BMI < 25 (n = 156)	t value	P value	Cronbach's alpha coefficient	Cronbach's alpha coefficient based on standardized items	Split-half Reliability
Gentleness	3	8.3±1.9	7.8±1.9	-1.571	0.118	0.584	0.595	0.621
Qi-deficiency	3	6.8±1.9	6.7±1.9	-0.329	0.743	0.576	0.570	0.657
Yang-deficiency	3	6.3±2.6	6.5±2.5	0.502	0.616	0.631	0.635	0.601
Yin-deficiency	3	6.1±3.0	6.7±2.1	1.531	0.127	0.519	0.516	0.604
Phlegm-dampness	3	6.2±2.0	6.7±2.4	1.001	0.318	0.505	0.510	0.603
Damp-heat	4	8.5±2.9	8.9±3.1	0.830	0.407	0.640	0.646	0.593
Blood-stasis	3	5.9±2.2	6.8±2.4	2.178	0.026	0.541	0.547	0.605
Qi-stagnation	3	6.2±1.7	7.1±2.4	2.715	0.008	0.771	0.774	0.770
Special-diathesis	2	3.2±1.3	3.2±1.4	0.063	0.949	0.567	0.568	0.568

Notes: CCMQ: constitution in Chinese medicine questionnaire; BMI: body mass index; SD: standard deviation.

Further research should be explored on the compliance of e-form completion or paper format of adoption in psychometric properties. With the big data approach, the data collection of valid instruments in different population on the internet will provide a surge of improvement of psychometric properties for specific populations. As the International Society for Quality of Life had recently established an umbrella of a special interest group for quality of life instruments that are specific for the Chinese population. A large and representative sample from various Chinese populations

will facilitate the development and application of PRO. This is the first study to develop the short form CCMQ by national survey data. One limitation however is that the independent sample for further confirmation is small. In addition, due to COVID-19, we were only able to recruit subjects by online means rather than in person, potentially introducing population bias. Furthermore, the data for developing the short form was collected in 2005 to 2007; therefore, updated data should be collected and used in future studies. Another limitation is the relationship and difference between short form CCMQ

and international popular health scales. Future studies should adopt the WHOQOL-BREF or SF-12 for differentiation for the health concept between the east and west for further testing the psychometric properties of the short form CCMQ. The short form CCMQ is important to Chinese health measurement and clinical practice of TCM in Chinese populations. We believe that this work would build the foundation of the short form for further clinical testing or application.

In conclusion, different from general PRO such as WHOQOL-BREF and SF-12, this is a significant study to reduce CCMQ, which is the only Chinese cultural-specific instrument that uses data that from a national sample survey. The reduction process was adopted from international instruments such as WHOQOL-BREF with good feasibility in providing further insights into health concepts from the Chinese population.

The short form CCMQ reduced items from 60 to 26. It not only successfully retained 9 scales structure that were hypothesized in the original CCMQ, but also retained the similar psychometric properties. The short form greatly shortens the completion time and improves compliance for PRO collection to inform research and clinical practice. This will facilitate the understanding and practice of TCM in the field of medicine or integrative medicine. Simultaneously, less completion time can ensure more acceptance and participation rate, which can provide a good evaluation instrument for rapid screening of large sample population. Furthermore, the short form CCMQ will be named the short form Wang Qi 9 Body Constitution scale in TCM (SFWQBC-26).

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