# Validation of the Wisconsin Upper Respiratory Symptom Survey-24, Chinese version

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# Abstract

Background

The Wisconsin Upper Respiratory Symptom Survey (WURSS) is a validated English questionnaire to evaluate the severity of upper respiratory tract infections (URTIs). We aimed to develop a Chinese version of WURSS-24 (WURSS-24-C) and evaluate its reliability, validity and minimal important difference (MID).

Methods

The WURSS-24 was translated into Mandarin Chinese using the forward-backward translation procedure. People with Jackson-defined common cold symptoms within 48 hours of onset were recruited in Guangzhou, China, and followed for up to 14 days. The SF-8 (24 hours recall) assessing general mental and physical health was used as external comparator. Reliability, validity, and MID were evaluated.

Results

The WURSS-24-C was developed and found to be acceptable, relevant, and easy to complete in cognitive debriefing interviews. A total number of 300 participants (age 28.4±9.3, female 70%) were monitored for 2,500 person-days. Factor analysis: Exploratory factor analysis (EFA) suggested 4 domains, defined as activity and function, systemic symptoms, nasal symptoms, and throat symptoms. Confirmatory factor analysis (CFA) supported this 4-domain model with a Comparative Fit Index (CFI) of 0.93. Reliability assessment of the 4-domain-structure found Cronbach's alphas of 0.943, 0.859, 0.882 and 0.849, respectively. Convergent validity indicator: The Pearson correlation coefficients between daily WURSS-24-C and the SF-8 were -0.780 and -0.721, for the SF-8 physical and mental health respectively. Estimates of MID for individual items varied from -0.41 to -1.14.

Conclusion

The WURSS-24-C is a reliable and valid questionnaire for assessing illness-specific quality-of-life health status in Chinese speaking patients with URTIs.


# Background

Upper respiratory tract infections (URTIs), including the common cold and influenza, are among the most common human illnesses [1, 2]. Although generally mild and self-limited, these illnesses can lead to pneumonia and can even be life-threatening, especially in elderly persons and those with underlying disease, such as chronic obstructive pulmonary disease, heart failure and chronic kidney disease, etc [3–5]. In addition, URTIs lead to increases in inappropriate antibiotics use [6–7], hospitalizations and mortality [8], resulting in substantial economic burden.

Those with URTIs usually have symptoms such as sore throat, rhinitis, rhinorrhea, cough and malaise, which are associated with poorer health-related quality of life (HRQoL) [2]. Although laboratory measures

of URTI, like counts of white blood cells and identification of virus are sometimes useful, none of them correlate well with specific symptoms and functional impairments [9]. Proper assessment of both HRQoL and symptoms is therefore urgently required.

The Wisconsin Upper Respiratory Symptom Survey (WURSS), developed by Barrett et al [10, 11], is such an illness-specific questionnaire instrument assessing URTIs emphasizing patient-oriented outcomes. WURSS has different language versions including English, Spanish, French, German, Korean, etc., whose reliability and validity have been tested in previous studies [12, 13]. WURSS-24 is a version aiming to assess influenza-like illness, and has been used for extensive assessment of patients with URTIs in clinical practice [14, 15].

However, the lack of WURSS Chinese version limits its potential application in China. In the present study, we translated the WURSS-24, and evaluated the validity, reliability and MID of the Mandarin Chinese version in Chinese patients with URTIs.

## Methods

The present study was designed as a prospective observational study. It was approved by the ethical committee of Guangdong provincial hospital of Chinese medicine, Guangzhou, China (GPHCM; B2016-090-02). Written informed consent was provided by all participants.

# Translation of the WURSS-24

A three-step linguistic validation procedure was employed.

# Forward translation

Independent forward translations were performed by two bicultural native speakers of Chinese. One is a professional of clinical medicine, comprehending health care terminology and the content area of the construct of the instrument. Another is familiar with colloquial phrases, health care slang and jargon, idiomatic expressions, and emotional terms in common use. Then reconciliation of two forward translations was made by a third bilingual and bicultural independent translator regarding ambiguities and discrepancies of words, sentences and meanings.

# Back translation

Following forward translation, a literal back translation was completed by two native speakers of American English, who have the same characteristics described above in forward translation. They were blind to the original version of the survey.

The translation reconciliation was finished by a committee, including all the four bilinguals and a respiratory clinician. They compared the back-translated version with the source to highlight and investigate discrepancies between the source and the translation. After the proofing/formatting of the

reconciled translation, the committee detected possible translation discrepancies between different language versions, and harmonized linguistic solutions across both languages.

# Cognitive debriefing interviews and finial review

A group of 5 subjects were recruited in mainland China to evaluate alternative wording and to check understanding, interpretation and cultural relevance of the translation. In the cognitive debriefing, 5 participants were interviewed to comment on questionnaire items and instructions. All of them are native speakers residing in mainland China who were experiencing a common cold illness.

The final revision of WURSS-24-C was adapted according to the review of cognitive debriefing results and reporting. This process involves comparing each subject's interpretation of

the translation with the source version to highlight discrepancies and adjust translations as needed; as well as, compiling and documenting the detailed accounts of each subject interview.

# Participants

Participants with new-onset common cold were recruited from smartphone online application and in outpatient in Guangdong provincial hospital of Chinese medicine. This hospital has four hospital branches located in different districts of Guangzhou city, Guangdong province, South China. Participants were recruited at outpatient clinics, or by advertisement on WeChat, a widely used chatting app in China with function of messaging and social networking. Respondents were invited by research assistants to meet for screening and informed consent.

# Inclusion, exclusion and termination criteria

Participants who satisfied the following criteria were included: (1) age 18 or older; (2) diagnosis of "common cold" or "influenza" by research physicians according to Jackson scale[16, 17], with at least one symptom from the following cold symptoms (or synonyms): a) nasal discharge (runny nose), b) nasal obstruction (plugged nose, stopped up nose, stuffiness), c) sneezing ,or d) sore throat (scratchy throat). (3) With onset of symptoms within 48 hours. (4) Physically and mentally prepared and willing to participate.

The exclusion criteria were: (1) Any symptoms likely due to allergy, or other non-URTI cause, such as asthma, allergic rhinitis, etc.; or (2) those patients who require hospitalization; or (3) those with previous history of chronic respiratory diseases, such as chronic obstructive pulmonary disease, bronchiectasis, sinusitis recurring more than twice per year, anatomical nasal obstruction or deformity, otitis, and exudative pharyngitis.

The observation of the participants was terminated if one of the following criteria was fulfilled: (1) The disease of common cold progressed to lower respiratory tract infection, such as bronchitis or pneumonia, etc., confirmed by chest X-ray or physical examination by physicians. (2) The condition of the common

cold was getting worse or developing into complications that requires hospitalization. (3) The course of the illness exceeded 14 days.

# Sample size

According to one guideline for cross-cultural health care research [18], the sample size should be at least 10 subjects for each item of the instrument scale and for item analysis and exploratory factor analysis. Therefore a sample of at least 240(= 24 × 10) participants were considered the minimum required.

# Measures

Participants were asked to fill in the WURSS-24-C every day until they answered “Not sick” two days in a row to the question, “How sick do you feel today?”, otherwise to a maximum of 14 days. Summary scores for WURSS-24-C were calculated by summing scores of individual item scores, excluding the first and last items, which had categorically different reference domains, and were analyzed separately. Another health-related questionnaire, the SF-8 (24 hours recall)[19] was simultaneously applied to the study population along with the WURSS-24-C daily. The SF-8 is a short form 24-hour recall version of the widely used SF-36[20], and yields separate summary scores for physical and mental health, calculated using algorithms and scoring software provided by OptumInsight Life Sciences, Inc (QualityMetric Health Outcomes(tm) Scoring Software 4.5).

Medicine was permitted during the study. Protocol adherence was supported by regular message contact. WURSS-24-C and SF-8 were returned at an in-person exit interview or mailed to the researchers after the cold ended.

# Statistical analysis

Data were double entered, with resolution of discrepancies by comparison to paper questionnaires. Missing data, disallowed values, and outliers were hand-checked, and corrected if appropriate. Data were presented in frequencies for categorical variables and means (Standard Deviations, SD) for continuous variables if normal distribution was confirmed.

Exploratory factor analysis (EFA) was used to extract the factor structure using the principal components analysis method [21]. The data of Day 3 was used for this analysis based on the usual duration and recovery process of the common cold. Factorial structures were assessed for 22 items (excluding the first and last items measuring global severity and global change) using principal component analysis.

Confirmatory factor analysis (CFA) was followed to assess the model fit, according to the method of Mulaik [22]. Several goodness-of-fit indices were reported including goodness of fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), comparative fit index (CFI), standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA).

Reliability was chosen as the measure of internal consistency, using the data of Day 3 with the factor structure conducted by EFA, and estimated by using Cronbach's alpha coefficient.

Convergent validity was evaluated by testing correlation between WURSS-24-C and SF-8.

Correlations was calculated using Pearson's correlation coefficients.

Minimal important different (MID) was considered as day-to-day change for those indicating minimal improvement. Using methods developed by Guyatt et al. [23, 24], MID was defined as the average amount of instrument-assessed change for all subjects who rated themselves as "a litter better" or "somewhat better".

Statistical analysis was performed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA) and LISREL 8.8 (Scientific Software International, Chicago, IL, USA)

## Results

# Translation of WURSS-24 and cognitive debriefing interviews

No major difficulties were experienced during the forward translation process; minor discrepancies were harmonized after discussion by the committee. After comparison of the back-translated version with the original English version, there was no significant differences in linguistic and conceptual contents. We then adapted a reconciled translation across both languages and used it in the cognitive debriefing interviews. There were 5 subjects (3 female and 2 males, aging from 21–69) interviewed who reported no difficulty in understanding the items or answering the questions. The final version was produced after iterative refinement, reconciliation, and proof-reading (Supplementary item 1).

# Baseline characteristics and descriptive data

A total of 315 participants were initially enrolled from May 2018 to February 2019. Eleven participants did not return their questionnaires, 4 participants' information were incomplete, and therefore 300 were included in the analysis, for 2,500 person-days covered by this study.

Table 1 described sociodemographic and clinical characteristics for the study participants. The mean age of participants was 28.4 years (SD = 9.3) and 70% of participants were women. Almost all of the participants (99.3%) were Han population, some 76% were at least high school education level, and 89% did not smoke. Most of the participants (96.3%) were healthy people without comorbidities. The mean time from first symptom to enrollment were 20.8 hours (SD = 14.6). A majority of 181 (60.3%) had body temperature that was normal at enrollment; 77 (25.7%) had low fever (37.3 ~ 38°C), 35 (11.7%) had temperature of 38.1 ~ 39°C, and 7 (2.3%) were higher than 39°C. 140 out of 300 participants had not taken medicine before enrollment, others had taken Chinese medicine (115), antipyretic analgesics (31), antivirals (27), and antihistamine (3).

Table 1
Demographics of the study participants who had common cold during May 2018 to February 2019 visited Guangdong provincial hospital of Chinese medicine, China

| Variable | Value |
|---|---|
| | |
| Number of participants | 300 |
| Age, years | |
| Mean (SD) | 28.4(9.3) |
| Gender, no./total (%) | |
| Female | 210(70) |
| Ethnicity, no./total (%) | |
| Han | 298(99.3) |
| Education, highest, no./total (%) | |
| High school or less educated | 76(25.4) |
| College degree | 121(40.3) |
| Graduate degree | 103(34.3) |
| Tobacco use, no./total (%) | |
| Current | 31(10.3) |
| Past | 2(0.7) |
| Nonsmoker | 267(89) |
| Comorbidities/Disease history, no./total (%) | |
| No | 289(96.3) |
| Yes | 11(3.7) 3 pharyngitis, 2 anemia, 1 chronic bronchitis, 1 hypertension 1 hypothyroidism, 1 optic neuritis, 1 calculus of kidney and 1 appendicitis |
| Time from first symptom to enrollment (hours) | |
| Mean (SD) | 20.8(14.6) |
| Inter-quartile range | 24–30 |

| Variable | Value |
|---|---|
| Maximum body temperature before enrollment | |
| Mean (SD) | 37.3(0.7) |
| ≤ 37.2℃, no./total (%) | 181(60.3) |
| 37.3 ~ 38℃, no./total (%) | 77(25.7) |
| 38.1 ~ 39℃, no./total (%) | 35(11.7) |
| 39℃, no./total (%) | 7(2.3) |
| Having taken medicine before enrollment, no. | |
| No medicine | 140 |
| Chinese medicine | 115 |
| Antipyretic analgesics | 31 |
| Antivirals | 27 |
| Antihistamine | 3 |
| Other | 6 |
| | |

The total WURSS-24-C scores of all participants from the 1st to the 14th day are shown in Table 2. All of the participants filled in the questionnaire for at least 3 days. A total of 27(9%) participants continued to report being sick at the end of their 14-day monitoring period. The symptoms and functions improved over time. The mean score ranged from 54.11 (SD = 30.28) in the first day to 7.69 (SD = 10.33) in the 14th day.

Table 2
The WURSS-24-C item and summary descriptive statistics

| Day | N | Mean (SD) | Min | Max |
|---|---|---|---|---|
| | | | | |
| 1 | 300 | 54.11(30.28) | 4 | 137 |
| 2 | 300 | 49.82(27.67) | 0 | 130 |
| 3 | 300 | 41.74(27.39) | 0 | 108 |
| 4 | 298 | 30.89(27.14) | 0 | 125 |
| 5 | 290 | 21.00(22.05) | 0 | 123 |
| 6 | 264 | 13.78(18.35) | 0 | 112 |
| 7 | 223 | 10.16(15.67) | 0 | 82 |
| 8 | 168 | 8.79(14.55) | 0 | 87 |
| 9 | 119 | 8.41(14.23) | 0 | 71 |
| 10 | 81 | 8.02(12.73) | 0 | 66 |
| 11 | 57 | 7.70(12.83) | 0 | 66 |
| 12 | 41 | 9.59(14.47) | 0 | 66 |
| 13 | 32 | 10.63(14.03) | 0 | 45 |
| 14 | 27 | 7.96(10.33) | 0 | 30 |

# Factor analysis

The scree plot of the EFA indicated that the 4-domain structure was accepted which explained 68.25% of the total square deviation. The 4 domains were defined as activity and function, systemic symptom, nasal symptom, and throat symptom. The factor loading coefficients of

individual items in each domain are showed in Table 3, only those with promax rotation factor loaded greater than 0.4 were accepted. All of the items loaded onto the 4-domain structure.

Table 3
The factor loading of WURSS-24-C items

| Item | Symptom | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| | | | | | |
| 2 | Runny nose | | | 0.867 | |
| 3 | Plugged nose | | | 0.759 | |
| 4 | Sneezing | | | 0.812 | |
| 5 | Sore throat | | | | 0.721 |
| 6 | Scratchy throat | | | | 0.798 |
| 7 | Cough | | | | 0.686 |
| 8 | Hoarseness | | | | 0.654 |
| 9 | Head congestion | | 0.563 | | |
| 10 | Chest congestion | | 0.552 | | |
| 11 | Feeling tired | 0.505 | 0.586 | | |
| 12 | Headache | | 0.786 | | |
| 13 | Body aches | | 0.812 | | |
| 14 | Fever | | 0.687 | | |
| 15 | Think clearly | 0.693 | | | |
| 16 | Sleep well | 0.636 | | | |
| 17 | Breath easily | 0.426 | | 0.664 | |
| 18 | Walk/Climb stairs | 0.828 | | | |
| 19 | Accomplish daily activities | 0.868 | | | |
| 20 | Work outside the home | 0.864 | | | |
| 21 | Work inside the home | 0.839 | | | |
| 22 | Interact with others | 0.845 | | | |
| 23 | Live your personal life | 0.843 | | | |
| Definition of the 4 domains | | Activity and function | Systemic symptom | Nasal symptom | Throat symptom |
| | Cronbach's α | 0.943 | 0.859 | 0.882 | 0.849 |

CFA was performed to evaluate the 4-factor structure validity of the WURSS-24-C. The goodness-of-fit indices and the structure graphs are shown in Fig. 1. The CFI was 0.94, RMSEA was 0.14, and SRMR was 0.11, which suggest acceptable model fit in this four factorial model (Fig. 1).

# Reliability

After establishing the 4-domain-structure, we tested the Cronbach's alpha for internal reliability. Cronbach alpha coefficients were 0.943, 0.859, 0.882 and 0.849 for activity and function, systemic symptom, nasal symptom, and throat symptom respectively (Table 3). In addition, we tested the internal reliability of the whole questionnaire (based on the data of Day 3), of which the Cronbach's alpha was 0.940.

# Convergent validity

Figure 2 showed daily change of illness severity over time as measured by the WURSS-24-C and the SF-8(both physical and mental health scores). The number of participants decreased as their symptoms decreased, from N = 300 on Day 1 to N = 27 on Day 14. As measured by the SF-8, the trend of general physical health and mental health was similar during the illness process.

WURSS-24-C had similar change with the SF-8. All changes were more rapid in the first 7 days than the later periods.

Convergent validity was respectively evaluated by the scores of SF-8 physical/mental and the total scores of the WURSS-24-C. The Pearson correlation coefficient of the WURSS-24-C yielded − 0.780 for SF-8 physical health, and − 0.721 for SF-8 mental health (Fig. 3).

# Frequency, Severity and MID

Table 4 displayed the pattern of experienced symptoms and functional limitations in the first three days. The most reported items were Feeling tired (98%) and Sleep well (91.7%), followed by nasal symptoms: Plugged nose (87.7%); affected abilities: Think clearly (86.3%); and throat symptoms: Sore throat (85.7%). The most severe symptom was Plugged nose with a score of 3.50, followed by Feeling tired (3.37), Sore throat (3.34) and Runny nose (3.31). MID was presented item-by-item for the WURSS-24-C, ranged from − 0.41(Chest congestion) to -1.14 (How sick).

Table 4
Frequency, severity and minimal important difference of WURSS-24 Items

| Item | Symptom | Frequency% | Severity | MID |
|---|---|---|---|---|
| | | | | |
| 1 | How sick | 100.0 | 4.11(1.20) | -1.14 |
| 2 | Runny nose | 85.0 | 3.31(1.57) | -0.88 |
| 3 | Plugged nose | 87.7 | 3.50(1.58) | -0.95 |
| 4 | Sneezing | 84.3 | 3.10(1.54) | -0.91 |
| 5 | Sore throat | 85.7 | 3.34(1.57) | -0.95 |
| 6 | Scratchy throat | 83.3 | 2.84(1.54) | -0.73 |
| 7 | Cough | 82.7 | 3.18(1.68) | -0.67 |
| 8 | Hoarseness | 75.3 | 2.81(1.67) | -0.74 |
| 9 | Head congestion | 83.7 | 2.80(1.68) | -0.75 |
| 10 | Chest congestion | 59.0 | 2.03(1.57) | -0.41 |
| 11 | Feeling tired | 98.0 | 3.37(1.56) | -1.06 |
| 12 | Headache | 83.7 | 2.70(1.71) | -0.73 |
| 13 | Body aches | 68.0 | 2.36(1.48) | -0.61 |
| 14 | Fever | 60.7 | 2.19(1.40) | -0.58 |
| 15 | Think clearly | 86.3 | 2.54(1.42) | -0.76 |
| 16 | Sleep well | 91.7 | 2.99(1.51) | -0.93 |
| 17 | Breathe easily | 84.0 | 3.10(1.65) | -0.83 |
| 18 | Walk/Climb stairs | 84.3 | 2.49(1.52) | -0.73 |
| 19 | Accomplish daily activities | 81.0 | 2.24(1.41) | -0.67 |
| 20 | Work outside the home | 81.7 | 2.60(1.57) | -0.73 |
| 21 | Work inside the home | 78.3 | 2.22(1.44) | -0.61 |
| 22 | Interact with others | 79.3 | 2.40(1.45) | -0.67 |
| 23 | Live your personal life | 77.7 | 2.29(1.32) | -0.63 |

# Discussion

The current study confirmed that the Chinese version of WURSS-24-C demonstrated highly acceptable reliability and validity, similar to that found during validation studies of the original English language instrument [10, 11].

Exploratory and confirmatory procedures was used to assess item/domain structure of the WURSS-24-C. This version contained four domains, which was different from the original WURSS-21[11] with three domains (activity and function, nasal symptom and throat symptom). In the WURSS-21 study, the following items Head congestion, Chest congestion, Feeling tired was in the nasal symptom domain, which might not be suitable. In the WURSS-24-C, these items were included in the new domain defined as Systemic symptoms, which also contained the items for assessment of influenza-like illness, Headache, Body aches and Fever (Fig. 1). CFA then further indicated that individual items of the WURSS-24-C, agreed well with this 4-dimensional structure model, as fit indices met criteria suggested by Hu and Bentler [25].

As a measure of the reliability of a scale, Cronbach alpha has been widely used since it was developed by Lee Cronbach in 1951[26]. According to Tavakol [27] and Devellis [28], the alpha values of 0.8 to 0.9 are excellent, but if a coefficient alpha greater than 0.9, it may suggest redundancies and show that the test length should be shortened. We tested the 4 domains of the WURSS-24-C, and the Cronbach alpha perfectly ranges from 0.849 to 0.882, except for the “activity and function”, which is up to 0.943. Compared with the original version of WURSS-21, for which the value is 0.961[11], we believe this 9-item dimension might be further reduced or adjusted. Then we tested the reliability of the whole WURSS-24-C and found the value was over 0.90. This result suggested that the WURSS-24 might allow leeway for a shorter version, such as the WURSS-11developed by English-language WURSS researchers [29].

Convergent validity was evaluated by the Pearson correlation coefficient. According to Colton [24], correlations ranging from 0.50 to 0.75 are moderate to good; and values greater than 0.75 are considered good to excellent. The WURSS-24-C yielded correlation coefficient was over 0.75 when compared with SF-8 physical. The association was stronger than that between the WURSS-24-C with SF-8 mental, for which the coefficient was − 0.721. The results were similar to that of the original version of the WURSS [11].

Minimal important difference (MID) refers to the smallest difference in a score that is recognized as worthwhile or important [23]. For clinicians, MID could be used to determine meaningful clinical change in patients. Our results estimated MID for individual items of the WURSS-24-C, which could be considered clinically relevant in patients with URTIs. Compared with the data of the original WURSS-21[11], the instruments yielded similar MIDs indices, which indicated the WURSS-24-C could be sensitively reflected changes in items.

Strengths of this study include its large sample size, regional representativeness, careful translation of WURSS-24-C using three-step linguistic validation procedure, and high quality statistical analysis. Our study should, nonetheless, be interpreted along with several limitations. First, all participants were from the southern part of China with narrow age range, limiting generalizability. Second, the test-retest reliability and other reliability and validity assessments

were not evaluated in this study. Therefore, participants from a broader range of age groups from other parts of China and additional instruments as for the evaluation might be needed in future studies.

# Conclusion

In summary, the 24-item Chinese version of WURSS (WURSS-24-C) is a reliable and valid instrument applicable to Chinese URTIs patients for assessment of HRQoL. The WURSS-24-C could thus be incorporated into future research.

# Abbreviations

WURSS: the Wisconsin Upper Respiratory Symptom Survey; WURSS-24-C: the Chinese version of Wisconsin Upper Respiratory Symptom Survey with 24 items; URTIs: upper respiratory tract infections; HRQoL: health-related quality of life; SF-8: the 8-item short-form; MID: minimal important difference; EFA: exploratory factor analysis; CFA: confirmatory factor analysis; CFI: comparative Fit Index; GFI: goodness of fit index; AGFI: adjusted goodness of fit index; NFI: normed fit index; SRMR: standardized root mean square residual; SRMR: root mean square error of approximation; SD: standard deviations; NSAIDs: non-steroidal anti-inflammatory drugs.

# Declarations

### Ethics approval and consent to participate

This study was approved by the ethical committees of Guangdong provincial hospital of traditional Chinese medicine, Guangzhou, China (GPHCM; B2016-090-02). Written informed consent was provided by all participants.

### Consent for publication

Not applicable.

### Availability of data and materials

The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request and approved by Guangdong provincial hospital of Chinese medicine.

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

YW contributed to the design, supervised data collection and analysis, and wrote the manuscript. ZH contributed to the design, conducted statistical analysis, and contributed to the manuscript. SC conducted data collection, entered, cleaned and analyzed data, and contributed to the manuscript. YL contributed to the design, coordinated data collection, and contributed to the manuscript. FL coordinated data collection and contributed to the manuscript.BB contributed to the research idea and give advice for statistical analysis and results interpretation, and helped write and revise the manuscript. CSL was responsible for supervision or mentorship. ZZ contributed to the design, conducted statistical analysis, and contributed to the manuscript.GS contributed to the design, supervised data collection and analysis, and contributed to the manuscript.

All authors contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

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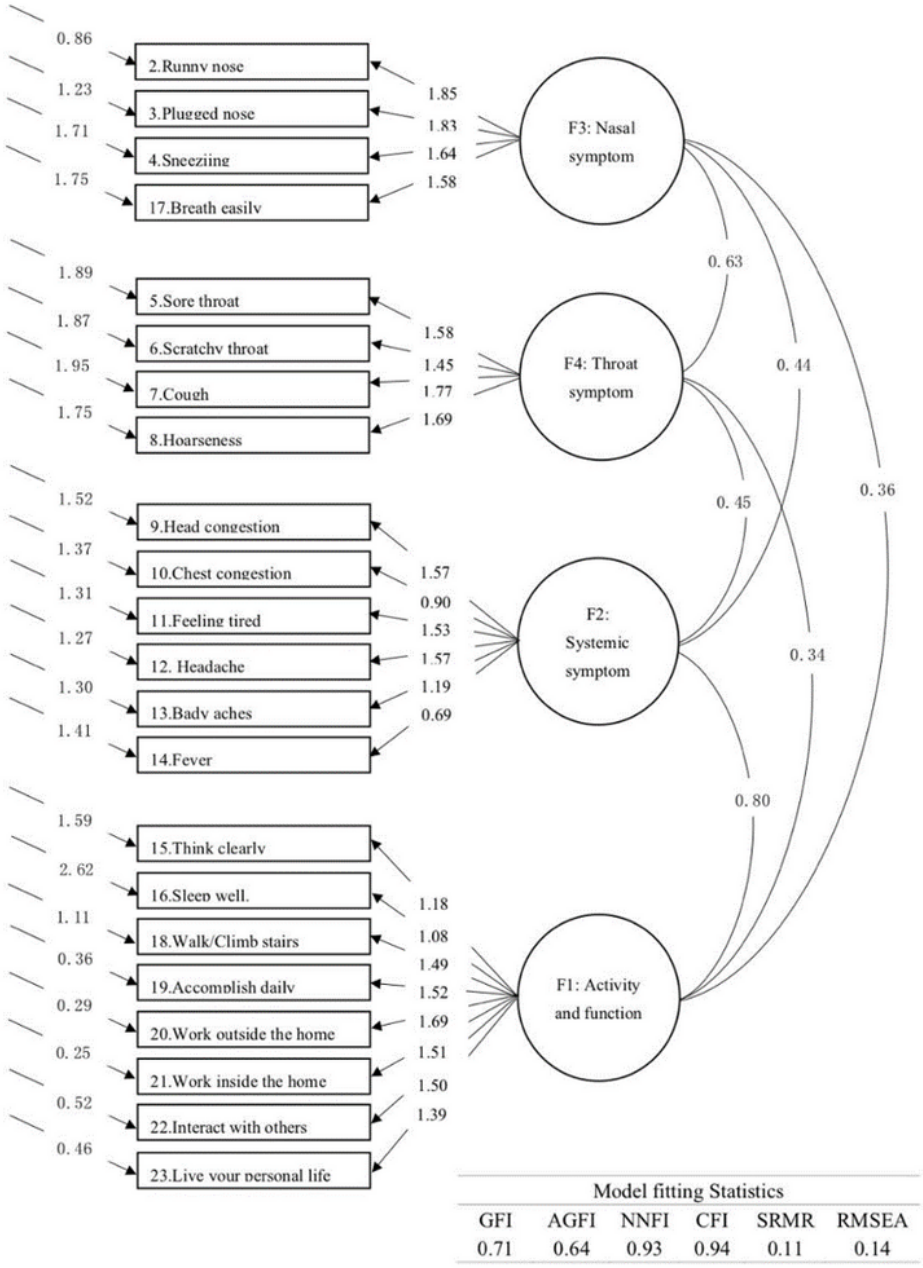
# Figures

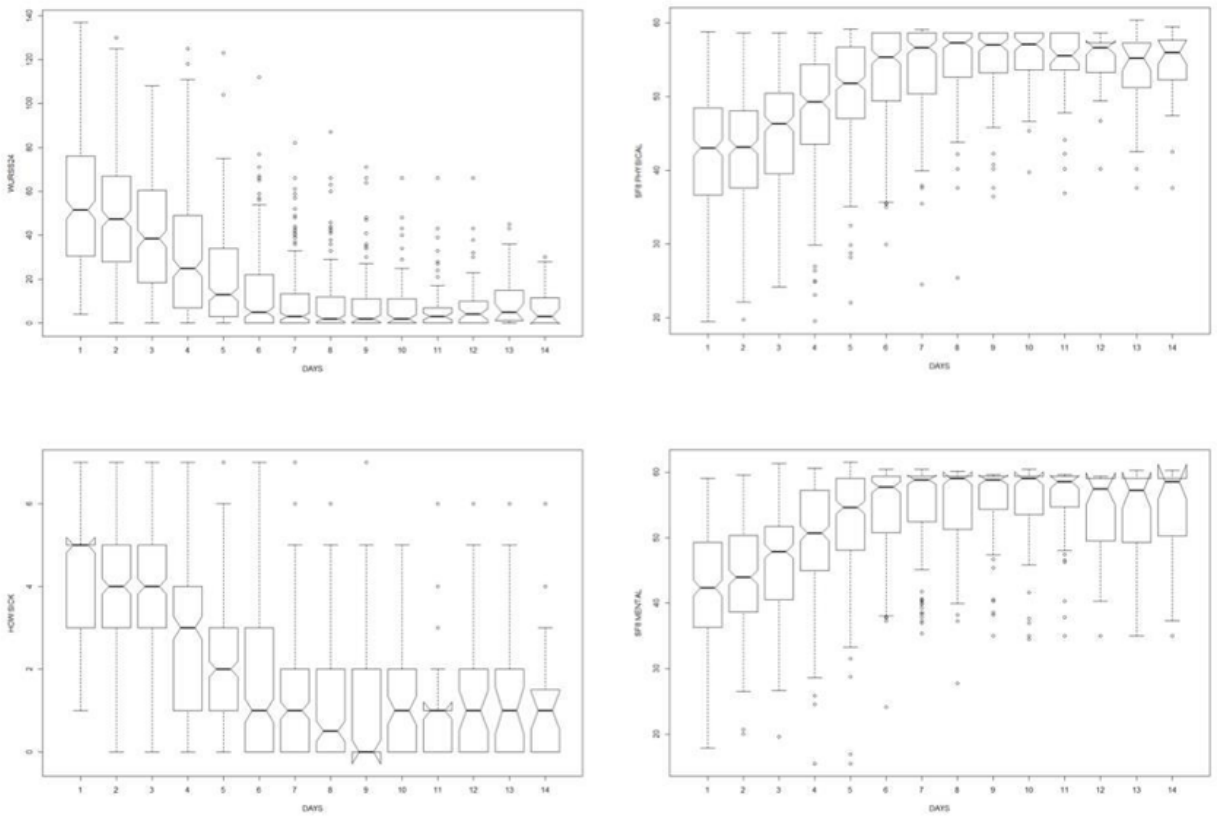



Model fitting Statistics

| GFI | AGFI | NNFI | CFI | SRMR | RMSEA |
|---|---|---|---|---|---|
| 0.71 | 0.64 | 0.93 | 0.94 | 0.11 | 0.14 |

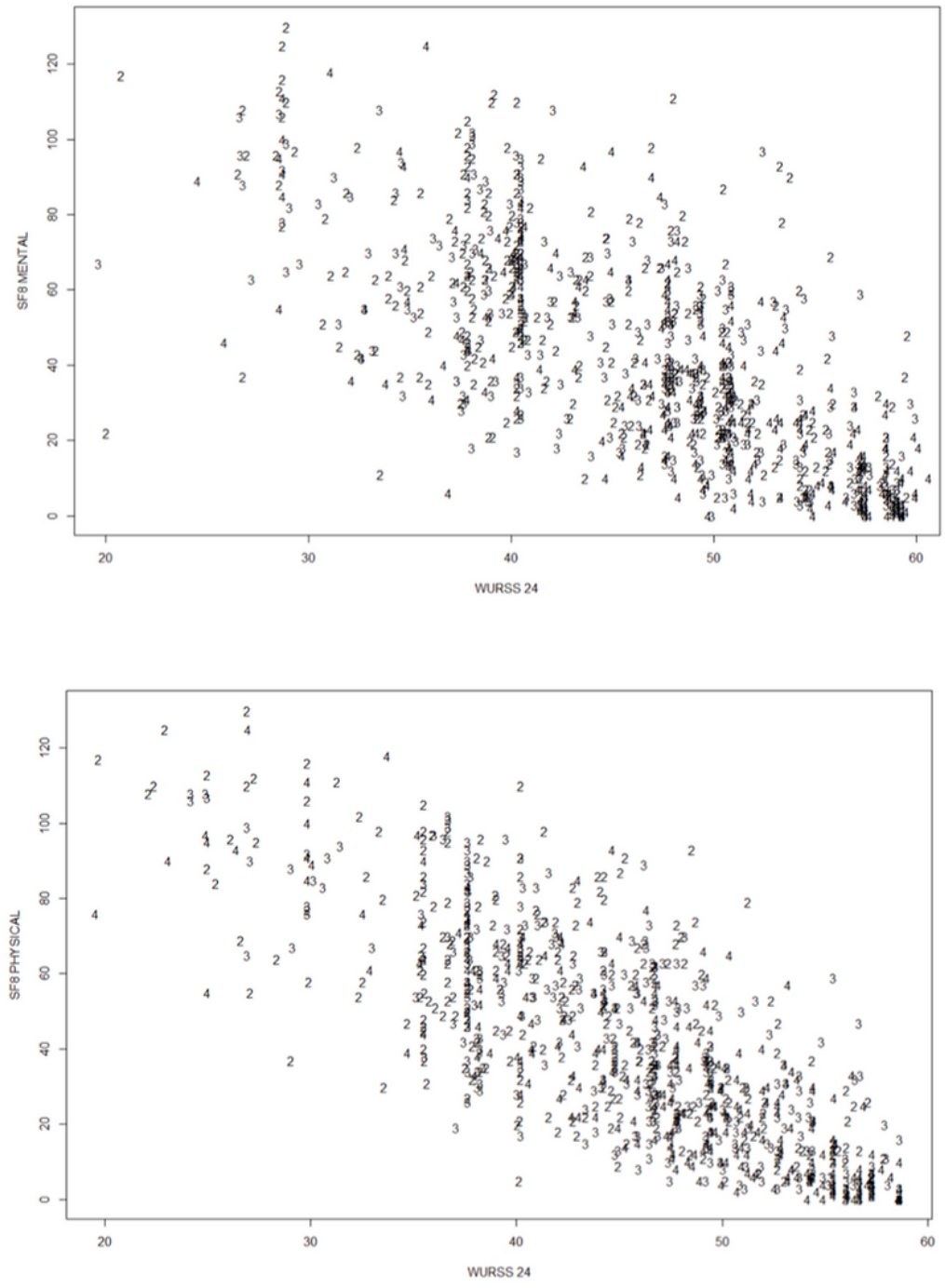
## Figure 1

The 4-domains model fit confirmatory factor analysis (CFA) for the WURSS-24-C. Chi-Square=1673.47, df=203, P-value=0.0000. GFI: Goodness of Fit Index; AGFI: Adjusted Goodness of Fit Index; NNFI: Non-Normed Fit Index; CFI: Comparative Fit Index; SRMR: Standardized Root Mean Square Residual; RMSEA: Root Mean Square Error of Approximation.




## Figure 2

The average daily score of WURSS-24-C and SF-8 from Day 1 to Day 14. Sample size diminishes as participants' colds resolve, from N=300 on Day 1 to N=27 on Day 14. The center of the notched boxes is the median summed score for that day. The top of the notched boxes indicates the 25% and 75% percentiles, respectively. The notches portray the median ±1.57 (interquartile range=IQR) / N-2 and thus can be compared to assess difference at the P = 0.05 level of significance. The ends of the vertical lines indicate the last actual data point within 1.5 (IQR) from the 25%ile and 75%ile. The symbols above and below these lines are actual outlying data points.




## Figure 3

The scatterplot correlations of the WURSS-24-C with SF-8. Data shown represent Day 2,3 and 4, where sample size was N=300, N=300, and N=298, respectively. The WURSS-24 correlated more statistically with physical than mental health, yielding Pearson correlation coefficient of -0.780 for SF-8 physical health, and -0.721 for SF-8 mental health.

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- YuanyuanWangGuobinSuetal.supplemental.pdf