Postprint of the Study on the Development and Psychometric Validation of the Chinese Version of the Modified York COVID-19 Recovery Scale (C19-YRSm)

Authors: Deng Jie, Tao Liyuan, Nan Liu, Li Jun, Yan Wenxin, Qin Chenyuan, Liu Qiao, Du Min, Wang Yaping, Liu Jue, Liu Jue

Date: 2023-12-28T00:00:00+00:00

Abstract

Background The Modified York COVID-19 Recovery Scale (C19-YRSm) has been proven effective for assessing and monitoring post-COVID-19 symptoms in developed countries, but its reliability and validity in the Chinese population remain unclear. Objective To translate and culturally adapt the C19-YRSm and evaluate the reliability and validity of the Chinese version of C19-YRSm. Methods After obtaining authorization for translation and use of the C19-YRSm from the MANOJ SIVAN team at the University of Leeds, the research team translated and culturally adapted the C19-YRSm following the translation and cross-cultural adaptation process, resulting in the Chinese version of C19-YRSm through translation, back-translation, and cross-cultural adaptation. From May 1–7, 2023, COVID-19 survivors were selected from the "Wenjuanxing" platform sample database using simple random sampling as study participants, and investigated using a general information questionnaire and the Chinese version of C19-YRSm. Thirteen experts were invited to evaluate the content validity of the scale. Item analysis, reliability testing, and validity testing were conducted on the Chinese version of C19-YRSm. Results A total of 512 questionnaires were distributed, and 370 valid questionnaires were collected, with a valid response rate of 72.3%. Item analysis results showed that the |CR values| of each item ranged from 6.589 to 22.725 ($P<0.001$), and the |r values| with the total scale score ranged from 0.547 to 0.806 ($P<0.001$). For reliability, the Cronbach's α coefficient of the Chinese version of C19-YRSm was 0.881, the Guttman split-half coefficient was 0.837, and the test-retest reliability was 0.816. For content validity, the Item-level Content Validity Index (I-CVI) of each item of the Chinese version of C19-YRSm ranged from 0.692 to 1.000, and the Scale-level Content Validity Index (S-CVI) was 0.914. Confirmatory Factor

Analysis (CFA) results indicated that the initial model fit was unsatisfactory. After adding a correlation between error variables e12 and e13 as suggested, all fit indices of the modified model were within acceptable ranges except for the Adjusted Goodness-of-Fit Index (AGFI). Discriminant validity analysis results showed that differences in scores on the four subscales of the Chinese version of C19-YRSm were statistically significant (P<0.05) among participants with different chronic disease statuses and cumulative numbers of infections. Comparisons of scores on the three subscales (excluding other symptoms) before and after COVID-19 infection showed statistically significant differences (P<0.05). Conclusion The Chinese version of C19-YRSm demonstrates good reliability and validity, with satisfactory applicability in the Chinese population, and can be used for assessment and monitoring of recovery status in Chinese patients post-COVID-19.

Full Text

Reliability and Validity of the Chinese Version of the Modified COVID-19 Yorkshire Rehabilitation Scale

DENG Jie[1], TAO Liyuan[2], LIU Nan[3], LI Jun[4], YAN Wenxin[1], QIN Chenyuan[1], LIU Qiao[1], DU Min[1], WANG Yaping[1], LIU Jue[1]*

[1]Department of Epidemiology and Biostatistics, Peking University School of Public Health, Beijing 100191, China
[2]Research Center of Clinical Epidemiology, Peking University Third Hospital, Beijing 100191, China
[3]Department of Rehabilitation Medicine, Peking University Third Hospital, Beijing 100191, China
[4]Department of Language and Culture in Medicine, School of Health Humanities, Peking University, Beijing 100191, China

Corresponding author: LIU Jue, Researcher/Doctoral supervisor; E-mail: jueliu@bjmu.edu.cn

---

Abstract

Background: The modified COVID-19 Yorkshire Rehabilitation Scale (C19-YRSm) has demonstrated utility for assessing and monitoring post-COVID-19 syndrome in developed countries, but its reliability and validity in Chinese populations remain unclear. **Objective:** To translate the C19-YRSm into Chinese and evaluate the psychometric properties of the Chinese version. **Methods:** After obtaining authorization for translation and use from MANOJ SIVAN's team at the University of Leeds, UK, the research team translated the C19-YRSm following established translation and cross-cultural adaptation procedures, producing a Chinese version through forward translation, back-translation, and cultural adaptation. From May 1–7, 2023, post-COVID-19 survivors were recruited

from the Wenjuanxing platform sample pool using simple random sampling. Participants completed a general information questionnaire and the Chinese C19-YRSm, while 13 experts evaluated the scale's content validity. Item analysis, reliability testing, and validity assessment were conducted. **Results:** Of 512 questionnaires distributed, 370 valid responses were collected (72.3% valid response rate). Item analysis revealed critical ratio (CR) values of 6.589–22.725 ($P<0.001$) and item-total correlations of 0.547–0.806 ($P<0.001$). Reliability was strong: Cronbach's α coefficient was 0.881, Guttman split-half coefficient was 0.837, and test-retest reliability was 0.816. For content validity, item-level content validity indices (I-CVI) ranged from 0.692 to 1.000, with a scale-level CVI (S-CVI) of 0.914. Confirmatory factor analysis (CFA) indicated poor fit for the initial model; however, after adding a covariance between error variables e12 and e13, all fit indices except the adjusted goodness-of-fit index (AGFI) fell within acceptable ranges. Discriminant validity analysis showed statistically significant differences in scores across the four subscales among participants with different chronic disease statuses and cumulative infection counts ($P<0.05$), as well as significant differences in three subscales (excluding "other symptoms") when comparing pre- and post-infection status ($P<0.05$). **Conclusion:** The Chinese version of the C19-YRSm demonstrates good reliability and validity, showing strong applicability in Chinese populations for assessing and monitoring post-COVID-19 rehabilitation status.

Keywords: COVID-19; Post-COVID-19 syndrome; Rehabilitation; C19-YRSm; Reliability; Validity; Reproducibility of results

---

Introduction

According to World Health Organization (WHO) statistics, over 760 million confirmed COVID-19 cases and more than 6.9 million deaths have been reported globally, though actual infection and mortality figures may be substantially higher [1]. While COVID-19 is typically mild and transient for most patients, some experience persistent symptoms following the acute infection phase [2]. Terminology for these symptoms remains debated; the UK's National Institute for Health and Care Excellence defines "long COVID" as symptoms persisting 4–12 weeks post-infection and post-COVID-19 syndrome (PCS) as symptoms lasting $ $12 weeks [3]. Chinese cohort studies following hospitalized COVID-19 patients found that approximately 68% reported at least one symptom six months after discharge, decreasing to 49% at 12 months but rising again to 55% at 24 months [4-6]. Long-term effects can occur regardless of initial infection severity, manifesting as diverse symptoms across multiple organ systems and creating negative impacts on individuals, families, and society—an increasingly significant public health concern [7-9].

Previous follow-up studies of post-COVID-19 patients have exhibited considerable heterogeneity in case definitions and assessment tools, leaving substantial

uncertainty about true recovery patterns. This underscores the need for validated measurement instruments to accurately and quantitatively evaluate post-infection rehabilitation status and PCS severity and their impact on daily functioning and quality of life. The multidisciplinary team led by MANOJ SIVAN at the University of Leeds developed the modified COVID-19 Yorkshire Rehabilitation Scale (C19-YRSm), a self-report instrument for assessing PCS symptoms and grading their severity and functional impairment to inform healthcare management and interventions [10]. The C19-YRSm comprises 17 items across four subscales: symptom severity, functional capacity, other symptoms, and overall health status. After completing the scale, patients can provide supplementary information about work status and the perspectives of partners, family members, or caregivers regarding COVID-19's impact.

The WHO's International Classification of Functioning, Disability and Health (ICF) provides a theoretical framework for classifying various health states [Figure 1: see original paper]. The domains measured by the C19-YRSm map onto all components of the ICF framework, demonstrating its capacity for comprehensive biopsychosocial assessment of rehabilitation status in PCS patients [10-11]. To date, the C19-YRSm has not been translated or adapted into any other languages. After obtaining authorization from MANOJ SIVAN's team, our research group translated and revised the C19-YRSm following international standard procedures for scale adaptation and conducted psychometric testing of the Chinese version to provide a scientifically reliable tool for PCS assessment and monitoring in China.

Methods

Study Subjects From May 1–7, 2023, post-COVID-19 survivors were recruited from the sample pool of Wenjuanxing (Changsha Ranxing Information Technology Co., Ltd.), China's largest online survey platform with over 6.2 million registered members nationwide, providing representative and authentic samples for research [12]. Inclusion criteria were: (1) age $ $18 years; (2) previous SARS-CoV-2 infection; and (3) informed consent to participate. Exclusion criterion was absence of positive nucleic acid or antigen test records. Based on the scale's 17 items, we determined sample size using a 10:1 ratio [13], yielding a minimum of 204 participants. Accounting for a 20% refusal/invalid questionnaire rate, the target sample size was 245. However, since larger samples are preferable for factor analysis, we maximized enrollment while ensuring the minimum requirement was met.

Instruments **General Information Questionnaire:** Developed by the research team, this collected data on participants' gender, age, household registration type, chronic disease history, COVID-19 vaccination status, and infection history.

Chinese Version of the C19-YRSm Self-Report Scale

Translation and Back-Translation: After obtaining authorization from MANOJ SIVAN's team at the University of Leeds, we followed the translation and cross-cultural adaptation procedure recommended by the International Society for Pharmacoeconomics and Outcomes Research [14]. (1) Forward translation: Two bilingual researchers (one PhD and one master's student in epidemiology and health statistics) independently translated the C19-YRSm into Chinese. After discussion and reconciliation, the two forward translations were merged into a Chinese harmonized version. (2) Back-translation: Two different bilingual researchers (one PhD and one master's student in epidemiology and health statistics) back-translated the harmonized Chinese version into English. The research team and back-translators discussed discrepancies between the original and back-translated versions, corrected translation errors in context, and finalized a Chinese pre-test version.

Cultural Adaptation: The Chinese pre-test version underwent cross-cultural adaptation through expert consultation and pilot testing. (1) Expert consultation: A committee comprising four experts (one each in methodology, linguistics, rehabilitation medicine, and epidemiology/health statistics) and all translators/back-translators reviewed each item of the English and Chinese versions, evaluating whether the Chinese version achieved semantic, idiomatic, experiential, and conceptual equivalence and assessing readability. The original title "The modified COVID-19 Yorkshire Rehabilitation Scale" was initially translated as "改良的新冠约克郡康复量表" (Improved COVID-19 Yorkshire Rehabilitation Scale). Experts recommended adjusting the word order to "约克郡新冠康复量表改良版" (COVID-19 Yorkshire Rehabilitation Scale Modified Version) to align with Chinese linguistic conventions where core terms appear later. The research team adopted this suggestion. The original and pre-test versions used slashes "/" to denote "or" in multiple items, but experts noted this symbol might confuse respondents and recommended replacing all "/" with "或" (or). This recommendation was accepted. Additionally, some item descriptions were modified based on expert input to better conform to Chinese language habits while preserving semantic meaning. (2) Pilot testing: Using convenience sampling, 28 participants (meeting the same inclusion/exclusion criteria) completed the Chinese pre-test version and evaluated its clarity, readability, and comprehensibility, with completion time and modification suggestions recorded. Pilot results indicated participants easily understood all items, with no modification suggestions, demonstrating good feasibility and applicability in Chinese populations.

Based on expert consultation and pilot feedback, the Chinese pre-test version was further revised to produce the final Chinese C19-YRSm. The scale comprises 17 items across four subscales: symptom severity, functional capacity, other symptoms, and overall health status. Items 1–15 use a 0–3 rating scale: 0="none," 1="mild (does not affect daily life)," 2="moderate (somewhat affects daily life)," and 3="severe (affects all aspects of daily life and is disruptive)."

The symptom severity subscale (items 1–10) uses the worst score for each symptom, with summed scores ranging from 0–30 (higher scores indicating greater severity). The functional capacity subscale (items 11–15) sums item scores from 0–15 (higher scores indicating greater functional limitation). Item 16 (other symptoms) comprises 25 symptoms scored as present (1) or absent (0), with total scores of 0–25 (higher scores indicating more symptoms). Item 17 assesses overall health status via self-rating from 0–10 (higher scores indicating better health). The scale also evaluates participants' current status (past 7 days) and pre-infection status for comparison.

Survey Implementation and Quality Control The online survey was administered anonymously through the Wenjuanxing platform to randomly selected participants. The study followed voluntary participation and informed consent principles, with consent forms presented on the first page and participants informed that "submitting the questionnaire indicates your informed consent to participate." Participants self-administered the questionnaire, which could only be submitted after completing all items. Researchers carefully reviewed authenticity and completeness, excluding questionnaires with obvious logical errors, completion time <4 seconds per item, incorrect quality control responses, or duplicate submissions.

Statistical Analysis Data were analyzed using SPSS 27.0 and AMOS 26.0. Normally distributed continuous variables were presented as mean ± standard deviation; categorical data as frequencies and percentages. (1) Item analysis: Critical ratio (CR) method and item-total correlation were used. For CR, total scores on items 1–16 were ranked; the top 27% constituted the high group and bottom 27% the low group. Independent samples t-tests yielded CR values, with |CR|>3.000 indicating high discriminability. For item-total correlation, Pearson's r between each item and total score was calculated; r<0.400 suggested weak consistency with overall measurement and potential deletion. (2) Reliability: Cronbach's α and Guttman split-half coefficients assessed internal consistency (>0.700 considered good) [15]. Test-retest reliability was assessed in 16 participants after one week using Pearson correlation (>0.700 considered stable) [16]. (3) Content validity: Thirteen national experts evaluated the relevance of each item to post-COVID-19 rehabilitation status, calculating item-level CVI (I-CVI), chance agreement probability (Pc), adjusted kappa (K*), and scale-level CVI (S-CVI) [17]. I-CVI$ $0.780 indicated good content validity; K* criteria: 0.40–0.59=fair, 0.60–0.74=good, >0.74=excellent [17]. S-CVI was calculated as the mean I-CVI across items, with $ $0.900 recommended [17]. (4) Construct validity: Kaiser-Meyer-Olkin (KMO) and Bartlett's tests of sphericity assessed factorability; confirmatory factor analysis (CFA) used maximum likelihood estimation. (5) Discriminant validity: Independent samples t-tests or one-way ANOVA compared subscale scores across gender, age, chronic disease history, vaccination status, and infection history groups (P<0.05 indicating discriminant validity).

Results

Participant Characteristics Of 512 questionnaires distributed, 370 valid responses were collected (72.3% valid response rate). Among 370 participants, 209 (56.5%) were female; mean age was 31.6$±$6.1 years, with 174 (47.0%) aged 18–30, 170 (45.9%) aged 31–40, and 26 (7.1%) aged $ $41. Most were urban residents (296, 80.0%); 219 (59.2%) had no chronic disease history; 286 (77.3%) had received three vaccine doses; and 347 (93.8%) had been infected only once.

Item Analysis Post-infection scores on the Chinese C19-YRSm were: symptom severity 8.81$±6.14, $functionallimitation1.55±2.29, othersymptoms2.21±2.85, andoverallhealthstatus7.4$ All items showed |CR| values of 6.589–22.725 (>3.000, P<0.001), indicating high discriminability. Pearson correlations between items 1–16 and total score ranged from 0.547–0.806 (all >0.400, P<0.001), demonstrating strong consistency with overall measurement. Item 17 correlated negatively with the total score (r=-0.564), indicating that worse symptoms and functional limitations corresponded to poorer overall health status .

Reliability Analysis The Chinese C19-YRSm demonstrated excellent internal consistency: Cronbach's α=0.881 overall, with subscale α values of 0.927 for symptom severity and 0.846 for functional limitation. The Guttman split-half coefficient was 0.837 (all >0.700). Test-retest reliability after one week was 0.816 overall, with subscale retest reliabilities of 0.839 for symptom severity, 0.603 for other symptoms, and 0.707 for overall health status (P<0.05). Functional capacity subscale retest reliability could not be estimated due to floor effects (most scores were 0).

Validity Analysis Content Validity: I-CVI values ranged from 0.692–1.000; Pc values from 0.0001–0.0873; and K* values from 0.66–1.00. Based on K* criteria, all items were rated excellent except items 11 and 13, which were rated good . The mean S-CVI was 0.914 (>0.900), indicating good content validity.

Construct Validity: KMO=0.955 (>0.8) and Bartlett's test ^{2}=3,286.734 (P<0.001) confirmed factorability. Initial CFA model (M1) showed poor fit . Based on modification indices, a covariance was added between error variables e12 and e13, creating revised model M2 [Figure 2: see original paper]. In M2, all fit indices except AGFI fell within acceptable ranges , indicating good model fit [16] and supporting the scale's construct validity.

Discriminant Validity: Significant differences were found across the four subscales for chronic disease status and cumulative infection counts (P<0.05). Comparing pre- and post-infection status, three subscales (excluding "other symptoms") showed significant differences (P<0.05). No significant differences were observed by gender, age, or vaccination status (P>0.05) .

Discussion

Long-term effects of COVID-19 have garnered widespread attention, yet few tools exist for assessing PCS. The C19-YRSm developed by MANOJ SIVAN's team at the University of Leeds provides a validated instrument for evaluating post-COVID-19 rehabilitation status. This study translated, back-translated, and culturally adapted the C19-YRSm, conducting comprehensive psychometric testing to produce a Chinese version suitable for domestic use. Results demonstrate that the Chinese C19-YRSm possesses good reliability, as evidenced by Cronbach's α coefficient (0.881), Guttman split-half coefficient (0.837), and test-retest reliability (0.816). Subscale retest reliabilities were 0.839 for symptom severity, 0.603 for other symptoms, and 0.707 for overall health status ($P<0.05$). The functional capacity subscale's retest reliability could not be estimated due to floor effects. While overall retest reliability was acceptable, some subscale values were modest or unestimable, possibly reflecting small retest sample size and the inherently fluctuating nature of PCS symptoms, raising questions about the appropriateness of test-retest reliability for assessing stability of such variables.

Validity was evaluated through content, construct, and discriminant validity, all showing satisfactory results. Content validity expert review yielded I-CVI values of 0.692–1.000 and K* values of 0.66–1.00, with all items rated excellent except items 11 and 13 (rated good). The mean S-CVI of 0.914 (>0.900) confirmed good content validity. For construct validity, the C19-YRSm's four-dimensional structure (symptom severity [items 1–10], functional limitation [items 11–15], other symptoms [item 16], and overall health status [item 17]) was established through rigorous literature review, clinical experience, expert consensus, classical psychometric analysis, and Rasch analysis [10-11,19]. CFA results showed acceptable fit after adding a covariance between e12 and e13, supporting construct validity. Discriminant validity was demonstrated through the scale's ability to differentiate among patients with different chronic disease statuses, infection counts, and pre-/post-infection symptom severity and functional limitation levels—critical for monitoring symptom fluctuations over time and guiding personalized rehabilitation management strategies.

Several limitations warrant consideration. First, without a "gold standard" for post-COVID-19 rehabilitation assessment, criterion-related validity could not be evaluated. Second, although the original C19-YRS has been extensively validated and widely used, research on the modified C19-YRSm remains limited internationally, precluding cross-cultural comparison of psychometric results. Third, given the fluctuating nature of PCS, some uncommon symptoms and functional limitations may not be captured, suggesting the need for ongoing updates to the "other symptoms" subscale as PCS research evolves.

In summary, this study rigorously translated and culturally adapted the C19-YRSm self-report version according to standardized procedures. The Chinese

C19-YRSm demonstrates good reliability and validity, with strong applicability in Chinese populations. The scale is concise, clear, and comprehensible, enabling comprehensive biopsychosocial assessment of PCS patients' rehabilitation status. Future research should employ the Chinese C19-YRSm in multicenter epidemiological studies across China. Primary healthcare providers can utilize this tool to assess rehabilitation status in post-COVID-19 patients, understand the prevalence of long-term symptoms and healthcare needs, and provide early interventions to promote recovery.

References

[1] World Health Organization. WHO Coronavirus (COVID-19) Dashboard[DB/OL]. (2023-05-17)[2023-05-23]. https://covid19.who.int.
[2] SORIANO J B, MURTHY S, MARSHALL J C, et al. A clinical case definition of post-COVID-19 condition by a Delphi consensus[J]. Lancet Infect Dis, 2022, 22(4): e102-107. DOI: 10.1016/S1473-3099(21)00703-9.
[3] National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19[EB/OL]. (2021-11-11)[2023-05-23]. https://www.nice.org.uk/guidance/NG188.
[4] HUANG C, HUANG L, WANG Y, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study[J]. Lancet, 2021, 397(10270): 220-232. DOI: 10.1016/s0140-6736(20)32656-8.
[5] HUANG L X, YAO Q, GU X Y, et al. 1-year outcomes in hospital survivors with COVID-19: a longitudinal cohort study[J]. Lancet, 2021, 398(10302): 747-758. DOI: 10.1016/S0140-6736(21)01755-4.
[6] HUANG L X, LI X, GU X Y, et al. Health outcomes in people 2 years after surviving hospitalisation with COVID-19: a longitudinal cohort study[J]. Lancet Respir Med, 2022, 10(9): 863-876. DOI: 10.1016/S2213-2600(22)00126-6.
[7] BLOMBERG B, MOHN K G, BROKSTAD K A, et al. Long COVID in a prospective cohort of home-isolated patients[J]. Nat Med, 2021, 27(9): 1607-1613. DOI: 10.1038/s41591-021-01433-3.
[8] MOHTASHAM-AMIRI Z, KEIHANIAN F, RAD E H, et al. Long-COVID and general health status in hospitalized COVID-19 survivors[J]. Sci Rep, 2023, 13(1): 8116. DOI: 10.1038/s41598-023-35413-z.
[9] 胡芳芳, 赵燕, 李梦华, 等. 新型冠状病毒肺炎长期后遗症负面影响及对策建议 [J]. 中国公共卫生, 2022, 38(9): 1229-1232. DOI: 10.11847/zgggws1139286.
[10] SIVAN M, PRESTON N, PARKIN A, et al. The modified COVID-19 Yorkshire Rehabilitation Scale (C19-YRSm) patient-reported outcome measure for Long Covid or Post-COVID-19 syndrome[J]. J Med Virol, 2022, 94(9): 4253-4264. DOI: 10.1002/jmv.27878.
[11] SIVAN M, HALPIN S, GEES J, et al. The self-report version and digital format of the COVID-19 Yorkshire Rehabilitation Scale (C19-YRS) for Long Covid or Post-COVID syndrome assessment and monitoring[J].

Advances in Clinical Neuroscience & Rehabilitation, 2021, 20(3): 8-11. DOI: 10.47795/QROO4168.
[12] 问卷星. 样本服务・数据回收从未如此简单 [EB/OL]. (2023-05-17)[2023-05-23]. https://www.wjx.cn/sample/service.aspx.
[13] SOUSA V D, ROJJANASRIRAT W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline[J]. J Eval Clin Pract, 2011, 17(2): 268-274. DOI: 10.1111/j.1365-2753.2010.01434.x.
[14] WILD D, GROVE A, MARTIN M, et al. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation[J]. Value Health, 2005, 8(2): 94-104. DOI: 10.1111/j.1524-4733.2005.04054.x.
[15] TSANG S, ROYSE C F, TERKAWI A S. Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine[J]. Saudi J Anaesth, 2017, 11(Suppl 1): S80-89. DOI: 10.4103/sja.SJA_{{{203}}_{{17}}}.
[16] 万崇华, 罗家洪. 高级医学统计学 [M]. 北京: 科学出版社, 2024.
[17] 史静琤, 莫显昆, 孙振球. 量表编制中内容效度指数的应用 [J]. 中南大学学报 (医学版), 2012, 37(2): 49-52. DOI: 10.3969/j.issn.1672-7347.2012.02.007.
[18] O'CONNOR R J, PRESTON N, PARKIN A, et al. The COVID-19 Yorkshire Rehabilitation Scale (C19-YRS): application and psychometric analysis in a post-COVID-19 syndrome cohort[J]. J Med Virol, 2022, 94(3): 1027-1034. DOI: 10.1002/jmv.27415.
[19] SIVAN M, HALPIN S, GEE J, et al. Assessing long-term rehabilitation needs in COVID-19 survivors using a telephone screening tool (C19-YRS tool)[J]. Adv Clin Neurosci Rehabil, 2020, 19(4): 14-17. DOI: 10.47795/nele5960.

Author Contributions

DENG Jie: Data curation, statistical analysis, chart preparation, manuscript writing. **LIU Jue, TAO Liyuan, LIU Nan, LI Jun:** Study conception and design. **DENG Jie, YAN Wenxin, QIN Chenyuan, LIU Qiao, DU Min, WANG Yaping:** Study implementation and data collection. **LIU Jue:** Primary research objectives, quality control and review, overall responsibility for the manuscript.

Conflict of Interest Statement: The authors declare no conflicts of interest.

ORCID IDs:
DENG Jie: https://orcid.org/0009-0002-3372-880X
TAO Liyuan: https://orcid.org/0000-0003-3497-1326
YAN Wenxin: https://orcid.org/0000-0003-2725-9840
QIN Chenyuan: https://orcid.org/0000-0001-9668-9778

LIU Qiao: https://orcid.org/0000-0002-6958-2091
DU Min: https://orcid.org/0000-0002-9958-7686
WANG Yaping: https://orcid.org/0000-0001-9668-9778
LIU Jue: https://orcid.org/0000-0002-1938-9365

Received: October 12, 2023; Revised: December 15, 2023
Edited by: CUI Sha

Note: Figure translations are in progress. See original paper for figures.