Original Article

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Cross-Cultural Adaptation and Psychometric Properties of the Thai Version of the Modified COVID-19 Yorkshire Rehabilitation Scale in Individuals with Long COVID

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Abstract:

Objective: To translate and cross-culturally adapt the modified coronavirus disease 2019 (COVID-19) Yorkshire Rehabilitation Scale (C19-YRSm) into a Thai version, and assess its psychometric properties in individuals with long COVID.

Material and Methods: The C19-YRSm underwent translation and cross-cultural adaptation to produce a Thai version. Its 2 subscales, symptom severity and functional ability, were examined using confirmatory factor analysis (CFA). In instances where the results were deemed unfit, alternative factor structures were explored through exploratory factor analysis (EFA). After that, internal consistency and test-retest reliability were calculated at 2-day intervals. Construct validity was assessed by examining correlations between the Thai version of the 36-item Short Form Health Survey questionnaire (Thai SF-36) and the Thai Fall Efficacy Scale-International (Thai FES-I).

Results: The study sample comprised 338 individuals with long COVID. The results of the CFA indicated a poor fit. Subsequent evaluation using EFA revealed that the symptom severity and functional ability subscales were rearranged into 3 new subscales: major symptoms, minor symptoms, and functional ability. Internal consistency was found to be good to excellent (Cronbach's alpha: 0.77-0.90). Test-retest reliability for all subscales of the Thai C19-YRSm demonstrated high consistency (intraclass correlation coefficients ($ICC_{(2,1)}$): 0.88-0.95). Convergent validity showed moderate to strong correlations with the Thai SF-36, while discriminant validity, compared to the FES-I, showed fair to poor correlations.

Conclusion: The vigorous psychometric properties of the questionnaire make it highly suitable for cross-cultural research, enabling the assessment of long COVID severity among Thai individuals in clinical and research settings.

Keywords: cross-cultural adaptation, C19-YRSm, long COVID, long haul COVID, reliability, validity

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic was caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and began in Wuhan, China, in December 2019[1]. In August 2023, the World Health Organization reported 769,806,130 global SARS-CoV-2 infections, with 6,955,497 resulting in deaths[2]. Generally, COVID-19 patients have shown abnormal symptoms in various bodily systems, such as the pulmonary, cardiovascular, neurological, musculoskeletal, and digestive systems[3].

COVID-19 can have long-lasting effects on patients even after the infection period. Studies have shown that a significant percentage of COVID-19 patients in the United Kingdom[4] and the United States of America experienced long-term symptoms[5]. These symptoms include physical issues such as breathlessness, fatigue, cough, and mental health problems like depression and anxiety[6]. In addition, evidence indicates that the prevalence of long COVID in Thailand is 32.9%[7]. The most commonly reported long COVID symptoms in Thailand are anxiety (28.5%), fatigue (26.1%), and dyspnea (13.4%)[7].

The National Institute for Health and Care Excellence (NICE) has provided a clear definition of the different stages of the long-term effects of COVID-19, including acute COVID-19 (signs and symptoms of COVID-19 for up to 4 weeks), ongoing symptomatic COVID-19 (signs and symptoms of COVID-19 from 4 weeks up to 12 weeks), and post-COVID-19 syndrome (signs and symptoms of COVID-19 continue for more than 12 weeks). Long COVID encompasses both ongoing symptomatic COVID-19 and post-COVID-19-syndrome, which can persist for more than 4 weeks[8]. The long COVID symptoms might lead to disability or decreased quality of life[9]. Evidence suggests that long COVID not only impacts health but also imposes substantial financial burdens, including increased medical expenses, loss of income, caregiving responsibilities, and overall economic instability[10]. Therefore, symptom assessment and monitoring are essential.

The COVID-19 Yorkshire Rehabilitation Scale (C19-YRS) was developed by Sivan et al. from the University of Leeds. This tool has been recommended in the National Guidance of the National Health Services (NHS) England and the NICE for assessment of patients with long COVID[8]. The original English version of the C19-YRS has demonstrated robust psychometric properties, evidenced by a Cronbach's alpha coefficient of 0.891. Additionally, its subscales exhibited a strong intercorrelation. Notably, no ceiling effects were observed[11].

The developers utilized Rasch analysis to create a modified version of the tool, now known as C19-YRSm, to enhance the management of long COVID 19 patients by improving the updating of clinically crucial information[12]. This version has 17 items divided into 4 subscales: symptom severity (10 items: breathlessness, cough/throat sensitivity/voice change, fatigue, smell/taste, pain/discomfort, cognition, palpitations/dizziness, post-exertional malaise, anxiety/mood, and sleep), functional ability (5 items: communication, walking or moving around, personal care, other activities of daily living, and social role), overall health (1 item), and other symptoms (1 item). Moreover, evidence has been reported regarding the good psychometric properties of the C19-YRSm[13]. It displayed good internal reliability (Cronbach's alpha>0.8), while the intraclass correlation coefficients (ICC) for the subscales implied a moderate-to-strong content structure over time[13]. Additionally, it demonstrated good convergent validity with the Functional Assessment of Chronic Illness Therapy – Fatigue Scale (FACIT-Fatigue)[13]. Furthermore, confirmatory factor analysis (CFA) indicated a satisfactory model fit for the two-factor model, aligning with symptom severity and functional disability subscales[13]. Using C19-

YRSm, healthcare professionals can monitor patient symptoms and develop appropriate rehabilitation programs to improve their quality of life and reduce disability.

Unfortunately, the C19-YRSm had not yet been translated and culturally adapted into Thai. Therefore, this study aimed to translate the original version of the C19-YRSm into Thai and then evaluate its psychometric properties in a sample of individuals with long-COVID in Thailand, thus addressing the need for a Thai version of the C19-YRSm to assess long-COVID symptoms in the Thai population.

Material and Methods

This study received ethical approval from the Research Ethics Review Committee for Research Involving Human Research Participants, Chulalongkorn University's Group I (COA No. 021/66), and the Central Chest Institute of Thailand (REC No. 029/2566). This study was carried out in 2 distinct phases. All participants provided informed consent.

Phase 1: cross-cultural adaptation

The Thai version of the C19-YRSm questionnaire was created through cross-cultural adaptation, following the recommendations by Beaton et al[14]. The University of Leeds, United Kingdom, licensing authority approved the researchers' request for cross-cultural adaptation and examined the psychometric properties. The 6 stages of the cross-cultural adaptation are as follows:

Stage I: translation

Two bilingual translators, including 1) a doctor with experience in assessing, treating, and managing COVID-19 cases, who can use fluent English (clear and accurate spoken and written communication with logical flow) and 2) a language professional from the Language Institute of Chulalongkorn University, translated the questionnaire from the original language to Thai. After completing this stage, we acquired 2 distinct translations, T1 and T2.

Stage II: synthesis

The translators, identical to those in stage I, and researchers synthesized the T1 and T2 versions into the T-12 version.

Stage III: back-translation

The English translation of the T-12 version was expertly handled by 2 bilingual translators who are native English speakers from the Language Institute of Chiang Mai University and the Translation Unit of the Faculty of Arts, Chulalongkorn University. Neither translator possesses a medical background. As a result, 2 distinct versions were produced, namely BT1 and BT2.

Stage IV: expert committee review

An expert committee, including translators (identical to those in Stage I, II, and III), a language professional, a medical professional, and a methodologist, reviewed the original and all the translated questionnaires (T1, T2, T-12, BT1, and BT2) in order to develop a pretesting version for field testing.

Stage V: pretesting

Thirty participants with long COVID in Bangkok and nearby cities were included in the pretesting if they met specific criteria, including being at least 18 years old, having received a positive COVID-19 diagnosis through reverse transcription polymerase chain reaction (RT-PCR) or antigen testing over a month earlier, being native Thai speakers, and experiencing at least one symptom of long COVID as defined by the C19-YRSm. Participants who could not answer the questionnaire due to medical

conditions affecting cognitive ability were excluded. The participants completed the pretesting version of the Thai C19-YRSm, and the researchers interviewed them to gather their thoughts, responses, and suggestions regarding each item on the questionnaire. These interviews were conducted to better understand the participants' perspectives and refine the questionnaire for future use. Suggestions and questions from participants were incorporated into the final version of the Thai C19-YRSm questionnaire.

Stage VI: submission of documentation to the developer or coordinating committee for appraisal of the adaptation process

The final stage was the submission of all of the reports and forms to the University of Leeds.

Phase 2: evaluation of psychometric properties

Participants

This study recruited participants experiencing long COVID symptoms who resided in Bangkok and nearby provinces between January and June 2023. Potential participants underwent a screening process to determine their eligibility. Following the recommended guidelines for internal consistency[15] and factor analysis[16], 300 participants were enrolled in this study. To advance to Phase 2, individuals were required to meet criteria similar to those established during the pretesting stage in Phase I.

Procedure

All eligible participants were asked to complete the questionnaire either online or using a hard-copy version on 2 occasions. Moreover, each online and hard-copy version contained identical items and presented a similar format. Participants were able to select the format that was most convenient for them to answer. At the initial assessment, they completed the demographic questionnaire, the Thai C19-YRSm, the Thai version of the 36-item Short Form Health Survey (SF-36), and the Thai Fall Efficacy Scale-International (Thai FES-I).

The SF-36 questionnaire evaluated the quality of life of the participants. It consisted of 36 items measuring 9 health concepts: physical functioning, role limitations due to physical health, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, mental health, and health transition. Each dimension was scored on a scale of 0 (worst possible health state) to 100 (best possible health state)[17]. Seven SF-36 scales were used as validity criteria in the current study, including bodily pain, vitality, mental health, physical function, role-physical, social function, and general health perception. In addition, the original English version reported a Cronbach's alpha ranging from 0.85 to 0.87, and the test-retest reliability analysis indicated no significant differences in health-related quality of life, except for social functioning[17]. Furthermore, the Thai version of the SF-36 demonstrated good internal consistency, with Cronbach's alpha exceeding 0.70 for 6 scales, except for the social functioning and vitality scales, which had values of 0.55 and 0.68, respectively[18].

The Thai FES-I was a 16-item measure of fear of falling, and fear aspects of falling, with each item scored on a 4-point Likert scale[19]. The total score of this questionnaire was 64, and higher scores indicated a greater fear of falling. This questionnaire was used as a validity criterion in this study. Moreover, the original version of the FES-I demonstrated excellent internal consistency, with a Cronbach's alpha of 0.96 and a high intraclass correlation coefficient of 0.82[20]. Additionally, the FES-I has been translated into Thai, showing similarly strong internal consistency, with a Cronbach's alpha of 0.95[21].

Following the initial assessment, all participants were asked to complete the Thai C19-YRSm again after 2 days

and rate the level of change in their condition using the global perceived effect (GPE) scale, which ranged from -5 (Vastly Worse) to 5 (Completely Recovered)[22] to ensure the scales' test-retest stability, only participants who reported little to no change in their condition (GPE ratings from -1 to 1) were included in the analysis.

Data analyses

The data were analyzed using the statistical package for social sciences (SPSS) for Windows version 28.0, except for CFA, which was calculated by IBM SPSS analysis of moment structures version 29.0. Descriptive statistics were used to present the characteristics of the participants. Frequencies, means, and standard deviations were used to delineate both the sample and study variables.

Dimensionality

A two-dimensional structure encompassing the symptom severity and functional ability was explored using CFA. The model fit was evaluated using the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standard root mean square residual (SRMR). A model was considered a good fit if the CFI and TLI values were above 0.95, the RMSEA values were below 0.06, and the SRMR values were below 0.08[23]. If the results from the CFA model were unfit, the data underwent analysis using the exploratory factor analysis (EFA) model. Before conducting factor analysis, we assessed the suitability of our data for this type of analysis. This was done using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, which ranges from 0 to 1. A minimum score of 0.6 is required for accurate factor analysis[24]. Additionally, Bartlett's test of sphericity needed to yield a significant result (p-value<0.05) for factor analysis to be applicable[24]. The next step involved factor extraction using principal axis factoring and oblique rotation using the Promax method. The number of components considered was determined by the Kaiser Eigenvalues, which represent the total variance a given principal component can explain: each component had to have Eigenvalues greater than 1.0[24]. After this stage, each component's items were evaluated based on their factor loading, which indicated how closely the items were associated with the component. Generally, a factor loading of more than 0.4 signified a moderate correlation between the items and the component[25].

Reliability

The internal consistency and test-retest reliability were evaluated. For internal consistency, Cronbach's alpha was evaluated using data from the first session. The range of Cronbach's alpha was reported between 0 and 1, with an acceptable coefficient level of 0.7 to 0.9, while a value exceeding 0.90 may suggest redundancy[24]. To assess test-retest reliability, $ICC_{(2,1)}$ were calculated for the Thai C19-YRS among participants who reported little to no change in their condition (GPE score between -1 to 1) at the second session. A level of ICC equal to or greater than 0.75 indicated good reliability[24].

Ceiling and floor effects

The percentage of responses that reached the highest or lowest possible scores within each subscale was calculated to assess the presence of ceiling and floor effects. Rates of greater than 15% for the highest and lowest scores were indicative of a potential ceiling or floor effect, respectively[24].

Construct validity

The Kolmogorov-Smirnov test was used to assess the normality of the data. Pearson's correlation coefficient was used to analyze the data when it followed a normal distribution. At the same time, Spearman's rank correlation

coefficient was used for data that did not follow a normal distribution. For the convergent validity, the correlation between the following score pairs was examined: the symptom severity of Thai-C19-YRSm and bodily pain, vitality, mental health, and physical function of SF-36; the functional ability of Thai-C19-YRSm and physical function, social function, role-physical, and bodily pain of SF-36; the overall health perception of Thai-C19-YRSm and general health perception of SF-36. The correlation between the following score pairs was calculated to examine the discriminant validity: the overall health perception of Thai-C19-YRSm and bodily pain of SF-36; the symptom severity and the functional ability of Thai-C19-YRSm and the Thai FES-I. A Spearman's rank correlation coefficient of at least 0.7 was deemed acceptable for convergent validity, while a coefficient of 0.3 or less was considered acceptable for discriminant validity[24].

Results

Phase 1: Cross-cultural adaptation

The pretesting version of the Thai C19-YRSm was pretested with 30 Thai individuals who had experienced long-COVID. The majority of participants were female (66.7%), with 36.7% holding bachelor's degrees, while 3.33% had the lowest level of education, with no formal education. Moreover, the participants had an average age of 40.47 years (standard deviation (S.D.), 13.08; range 19 to 71 years) and a mean duration of COVID-19 infection of 258.2 days (S.D., 142.84; range 38 to 665 days).

All participants demonstrated a comprehensive understanding of the questionnaire; however, specific items, including fatigue, cognition, and post-exertional malaise, presented persistent challenges in comprehension. The committee diligently assessed and integrated all the feedback and suggestions provided, thereby refining the final iteration of the Thai C19-YRSm.

Phase 2: Evaluation of psychometric properties

Three hundred and forty-three individuals suffering from long COVID participated in this study, and 338 (98.54%) individuals completed the questionnaire (11.8% of participants completed the questionnaires using the online form, while 88.2% opted for the hard-copy format). The descriptive characteristics of participants are presented in Table 1. Most participants were women (59.8%), and almost all had received a COVID-19 vaccination (96.2%). On average, the participants were 44.02 years old (S.D., 16.54; range 18 to 91 years) and had been infected with COVID-19 for 278.51 days (S.D., 142.98; range 31 to 807 days).

Dimensionality

The results of CFA suggested poor model fit and are presented in Table 2. Thus, an EFA was conducted. The KMO index was 0.904, and Bartlett's test of sphericity was statistically significant (<0.001), which suggested that the data were suitable for analysis. Based on Kaiser's Eigenvalues, only 3 subscales showed values greater than 1.0[24] (Table 3). The results of factor loading are presented in Table 4. The results indicated that the symptom severity and functional ability subscales were rearranged into 3 new subscales, with the major symptoms including breathlessness, cough/throat sensitivity/voice change, fatigue, smell/taste, pain/discomfort, and palpitations/dizziness items. The minor symptoms included cognition, post-exertional malaise, anxiety/mood, and sleep items. Functional ability included communication, walking or moving around, personal care, other activities of daily living, and social role items. Thus, the Thai C19-YRSm consisted of 5 subscales comprised of the major symptoms, minor symptoms, functional ability, overall health, and other symptoms.

Table 1 Demographic data of the study participants (n=338)

Characteristic	Mean±S.D.	n (%)
Gender		
Female		202 (59.8)
Male		136 (40.2)
Age (years)	44.02±16.54	
Body mass index (kilogram/square meter)	24.87±5.08	
Underlying diseases		
Yes		109 (32.2)
Hypertension		62 (18.3)
Diabetes mellitus		28 (8.3)
Dyslipidemia		15 (4.4)
Allergy		14 (4.1)
Heart disease		12 (3.6)
Musculoskeletal disease		5 (1.5)
Pulmonary disease		5 (1.5)
Chronic kidney disease		1 (0.3)
Liver disease		1 (0.3)
Other		18 (5.3)
No		229 (67.8)
Education		
No education		11 (3.3)
Primary school		38 (11.2)
Junior high school		55 (16.3)
Senior high school		41 (12.1)
Vocational certificate		35 (10.4)
High vocational certificate		36 (10.7)
Bachelor degree		113 (33.4)
Above bachelor's degree		9 (2.7)
Number of days from infection	278.51±142.98	
COVID-19 treatment		
No treatment		25 (7.4)
Self-medication		129 (38.2)
Home isolation		148 (43.8)
Field hospital/hospitel		14 (4.1)
Admitted to the regular ward		22 (6.5)
COVID-19 vaccination before infected		
Yes		325 (96.2)
Inactivated vaccine		52 (15.4)
Viral vector vaccine		65 (19.2)
mRNA vaccine		22 (6.5)
Inactivated and viral vector vaccine		39 (11.5)
Inactivated and mRNA vaccine		62 (18.3)
Viral vector and mRNA vaccine		54 (16.0)
Inactivated, viral vector, and mRNA vaccine		32 (9.5)
No		13 (3.8)

Table 1 (continued)

Characteristic	Mean±S.D.	n (%)
Number of COVID-19 vaccinations before current infection (times)		
1		7 (3.8)
2		110 (32.5)
3		101 (29.9)
4		94 (27.8)
5		13 (3.8)
Effect of COVID-19 on work		
No change		232 (68.6)
On reduced working hours		29 (8.6)
On sickness leave		53 (15.7)
Changes made to role/working arrangements		24 (7.1)

S.D.=standard deviation, COVID-19=Coronavirus disease 2019, n=number

Table 2 Confirmatory factor analysis fit indices (n=338)

Scale	CFI	TLI	RMSEA (90% CI)	SRMR
Thai C19-YRSm	0.91	0.88	0.10 (0.94-0.12)	0.05

CFI=comparative fit index, TLI=Tucker-Lewis index, RMSEA=root mean square error of approximation, CI=confidence interval, SRMR=standard root of mean square residual

Table 3 Kaiser Eigenvalues of the Thai C19-YRSm

Component	Kaiser eigenvalues
1	7.601
2	1.301
3	1.111
4	0.825
5	0.692
6	0.604
7	0.540
8	0.462
9	0.434
10	0.337
11	0.310
12	0.282
13	0.200
14	0.170
15	0.126

Internal consistency

In the study sample, the internal consistency of the Thai C19-YRSm was excellent, as indicated by a Cronbach's alpha of 0.90. We also evaluated the internal consistency of its subscales: the major symptoms subscale with a Cronbach's alpha of 0.86, the minor symptoms subscale with a Cronbach's alpha of 0.77, and the functional ability subscale with a Cronbach's alpha of 0.90, indicating good to excellent reliability.

Test-retest reliability

Of 338 participants, 298 (88.16%) reported that their condition remained unchanged when assessed over 2 days following the first session, as determined by the GPE score. Thus, the ICC value was calculated from the 298 stable patients. The $ICC_{(2,1)}$ scores for major symptoms, minor

symptoms, functional ability, and overall health subscale were 0.95, 0.93, 0.94, and 0.88, respectively, indicating good to excellent test-retest reliability.

Ceiling and floor effects

This study revealed that Thai C19-YRSm did not exhibit a ceiling or floor effect because no respondents scored the lowest or highest on the questionnaire.

Construct validity

The results of construct validity are shown in Table 5. For discriminant validity, all subscales of Thai C19-YRSm exhibited significant correlations with the FES-I. For convergent validity, significant moderate to very strong correlations were found.

Table 4 Factor loading of the Thai C19-YRSm

Items	1	2	3
Question 1: Breathlessness	0.654		
Question 2: Cough/throat sensitivity/voice change	0.785		
Question 3: Fatigue	0.677		
Question 4: Smell/taste	0.540		
Question 5: Pain/discomfort	0.673		
Question 6: Cognition			0.496
Question 7: Palpitation/dizziness	0.691		
Question 8: Post-exertional malaise			0.633
Question 9: Anxiety/mood			0.803
Question 10: Sleep			0.835
Question 11: Communication		0.819	
Question 12: Walking or moving around		0.724	
Question 13: Personal care		0.768	
Question 14: Other activities of daily living		0.629	
Question 15: Social role		0.657	

Table 5 Convergent and discriminant validity

Thai C19-YRSm Subscale	Convergent validity	r_s	Discriminant validity	r_s
Major symptoms	Thai SF-36: Physical functioning	-0.77*	Thai FES-I	0.25*
	Thai SF-36: Role-physical	-0.72*		
	Thai SF-36: Bodily pain	-0.79*		
	Thai SF-36: Vitality	-0.71*		
Minor symptoms	Thai SF-36: Physical functioning	-0.74*	Thai FES-I	0.30*
	Thai SF-36: Mental health	-0.60*		
	Thai SF-36: Role-emotional	-0.74*		
Functional ability	Thai SF-36: Physical functioning	-0.75*	Thai FES-I	0.28*
	Thai SF-36: Bodily pain	-0.77*		
	Thai SF-36: Role-physical	-0.71*		
	Thai SF-36: Social functioning	-0.68*		
Overall health	Thai SF-36: General health	0.83*	Thai FES-I	-0.26*

*p-value<0.001, Thai C19-YRSm=the Thai version of the modified COVID-19 Yorkshire Rehabilitation Scale, Thai SF-36=the Thai version of the 36-item Short Form Health Survey, Thai FES-I=the Thai Fall Efficacy Scale-International, r_s=Spearman's Rank Correlation Coefficient

Discussion

The C19-YRSm questionnaire was translated and culturally adapted from its original version into Thai. During the cross-cultural adaptation process, some participants needed help understanding certain words, thus increasing the risk of misunderstandings. All their comments and suggestions were considered when adjusting the questionnaire for the final version. The findings support the successful cross-cultural adaptation process of the C19-YRSm into Thai. In addition, the Thai C19-YRSm has been shown to have acceptable reliability and validity and can be used for Thai patients suffering from long-COVID.

The results of the CFA revealed that the structure of the Thai C19-YRSm was unfit and differed from the original C19-YRSm model in its original language, thereby confirming the two-factor model. Discrepancies might have arisen due to variations in language, culture, and ethnic backgrounds. Furthermore, ethnicity was related to the incidence of long COVID, as evidenced by the differing probabilities among various ethnic groups[26].

For internal consistency, Cronbach's alpha of C19-YRSm revealed 0.82 and 0.81 for the symptom severity and the functional disability subscales, respectively[13]. In this study, the Thai C19-YRSm demonstrated even higher reliability, with an overall Cronbach's alpha of 0.90. Additionally, the major symptoms subscale had a Cronbach's alpha of 0.86, the minor symptoms subscale 0.77, and the functional ability subscale 0.90. These results indicate good to excellent reliability, aligning well with the original English version.

The subscales of Thai C19-YRSm exhibited good to excellent test-retest reliability, with $ICC_{(2,1)}$ ranging between 0.88 and 0.95. Moreover, the ICC of the Thai C19-YRSm exceeded that of the original C19-YRSm, with the ICC for the latter ranging between 0.58 and 0.76 across the subscales[13]. This finding underscores the questionnaire's stability and confirms its solid core psychometric properties. In addition, this study calculated the $ICC_{(2,1)}$ among the participants who reported no change in their condition during the 2 assessments conducted using GPE. Thus, we can ensure that a particular value isn't affected by a patient's condition.

The analysis of the correlation between the Thai C19-YRSm and the Thai SF-36 was revealed to be moderate to very strong. This suggests that the 2 questionnaires reflect similar underlying phenomena, and as a result, their respective scores are likely to be correlated and yield comparable results. In addition, the results from the Thai C19-YRSm can be linked to quality of life, as it correlates with the Thai SF-36. The same as a prior study conducted by Chen et al.[27] in 2020, which demonstrated that long-COVID patients exhibited a diminished quality of life when evaluated using the SF-36 assessment. Furthermore, the findings indicate a low correlation between the Thai C19-YRSm and Thai FES-I questionnaires. In the discriminant validity analysis, weak correlations were expected and observed between the 2 measures. This suggests that the instruments assess distinct or contrasting constructs.

This is the first study to translate the C19-YRSm into Thai following the cross-cultural adaptation process and to examine the reliability and validity. Moreover, the test-retest reliability in this study was managed through the T-GPE score in order to identify the participants who exhibited no change in the severity of long-COVID symptoms. Confirmation was sought to ensure they presented with the same signs and symptoms of COVID-19 as observed during the initial session. Furthermore, this study included a participant count exceeding the recommended threshold[15-16]. However, there are some limitations in the present study. Firstly, it's important to note that we cannot identify the specific variants of COVID-19 in these individuals, and the severity of long-term COVID-19 symptoms may vary

among those who were initially infected with different variants of the virus[28]. Secondly, the duration of infection in this study ranged from 31 to 807 days. In participants with a prolonged infection, long-COVID symptoms may have been influenced by other factors, potentially leading to symptoms that resemble long-COVID. Lastly, other critical psychometric properties of the Thai C19-YRSm, such as responsiveness, should have been reported in the present study. Such information is helpful for clinicians when deciding whether to incorporate this questionnaire into their settings. Therefore, further research is needed in order to identify the responsiveness of the C19-YRSm.

Conclusion

Despite the study's limitations, the findings provide necessary initial support for the cultural appropriateness and psychometric properties of the Thai C19-YRSm as a measure of long-COVID symptoms in both clinical treatment and research settings among Thai individuals. Clinicians and researchers can use this questionnaire to assess, monitor, and track long-COVID symptoms. Further research is needed to evaluate additional psychometric properties, such as responsiveness.

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Conflict of interest

There are no conflicts of interest to declare.

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