Psychometric validation of the Chinese version of the PaArticular Scales among elderly residents in long-term care facilities with joint contractures

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Abstract

Background: Joint contractures, which affect activity, participation, and quality of life, are common complications of neurological conditions among elderly residents in long-term care facilities. The aim of this study is to examine the reliability and validity of the Chinese version of the PaArticular Scales in a population with joint contractures.

Methods: A cross-sectional study design was used. The sample included elderly residents older than 64 years with joint contractures in an important joint who had lived at one of 12 long-term care facilities in Taiwan for more than 6 months ($N = 243$). The Chinese version of the PaArticular Scales of joint contractures was generated in 5 stages: translation, review, back-translation, review by a panel of specialists, and a pretest. Test-retest reliability, internal consistency reliability, construct validity, and criterion validity were evaluated, and the results were compared with those for the World Health Organization Quality of Life scale and the World Health Organization Disability Assessment Schedule.

Results: The Chinese version of the PaArticular Scales had excellent reliability with a Cronbach's α coefficient of .975 ($M = 28.98$; $SD = 17.34$). An exploratory factor analysis showed 3 factors and 1 factor with an eigenvalue > 1 that explained 75.176% and 62.83% of the total variance in the Activity subscale and Participation subscale, respectively. The subscale-to-total scale correlation analysis showed a Pearson correlation coefficient of .881 for the Activity subscale and .843 for the Participation subscale. Pearson's product-moment correlation revealed that the correlation coefficient (r) between the Chinese version of the PaArticular Scales and the World Health Organization Disability Assessment Schedule was .770, and that for the World Health Organization Quality of Life scale was -.553; these values were interpreted as large coefficients.

Conclusions: The underlying theoretical model of the Chinese version of the PaArticular Scales functions well in Taiwan, and it has acceptable levels of reliability and validity. However, the Chinese version needs to be further tested for applicability and generalizability in future studies, preferably with a larger sample and in different clinical domains.

Trial registration: Chinese Clinical Trial Registry, ChiCTR2000030413. Registered 1 March 2020, <http://www.chictr.org.cn/usercenter.aspx>

Background

Joint contractures are common complications of nervous system diseases and are problematic during rehabilitation [1]. Between 20% and 75% of elderly residents in long-term care (LTC) facilities suffer from joint contractures [2], which result in functional restrictions and limitations of joint mobility and thus produce activity limitations and participation restrictions [2–4]. Many studies have noted that activity limitations and participation restrictions, such as the inability to write or visit friends, are most relevant to patients with joint contractures [5, 6].

Unfortunately, activity limitations and participation restrictions are closely related to the quality of life (QoL) of elderly residents in LTC facilities [7]. Many experts even believe that QoL is an important outcome indicator for elderly residents in LTC facilities [8, 9]. Recent studies have examined the explanatory power of various factors for the QoL of elderly residents in LTC facilities and have found that activity and participation have the best explanatory power, explaining approximately 52% of the variance in QoL of elderly residents in LTC facilities [10]. This finding can help scholars and experts concerned about the QoL of elderly residents in LTC facilities in simplifying the complex QoL connotation. Therefore, elderly individuals with joint contractures may have severely limited mobility, which could lead to participation restrictions and negatively affect their QoL [5–7, 11].

Currently, the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) is a widely used scale for the global assessment of activity and participation; however, the scale has several issues. First, the population dynamics are heterogeneous with regard to the somatic and psychological symptoms of individuals; both individuals who are frail but still able to walk and individuals with severely constrained mobility are included. Second, personal situations of individuals are diverse, including different LTC service needs and available resources. Third, the contracture categories and contracture sites of individuals differ; for example, individuals may have both or isolated upper and lower limb joint contractures. Fourth, individuals with different categories and contracture sites have varied representations in terms of activities and participation [12]. However, the WHODAS 2.0 is designed to be applicable to all health conditions, including diseases, illnesses, injuries, mental or emotional problems, and alcohol or drug abuse. It does not attempt to assign aetiology or apportion impairment or disability to any particular disorder [13]. The evaluation of activity and participation is complicated, and the complex individual experience of impaired individuals must be recognized [12]. Therefore, an outcome questionnaire that quantifies the activity and participation of a particular population is especially important. To date, no universally accepted scale can address the abovementioned key issues [12]. However, the International Classification of Functioning, Disability, and Health (ICF) is the common basis of the WHO's patient-centred measures and intervention plan and comprehensively classifies all health and health-related fields [5]. Therefore, the PaArticular Scales, developed using the ICF as a standard, can fill in the gap. Furthermore, the validity and reliability of the PaArticular Scales has been documented in Germany (German version, supplementary file 1) [5] and the United States (English version, supplementary file 2) [12]. To date, no nationwide survey has been conducted in Taiwan.

Methods

Aim

The purpose of this study was to examine the reliability and validity of the Chinese version of the PaArticular Scales among elderly residents in LTC facilities with joint contractures.

Design

This study was designed as a questionnaire-based cross-sectional survey.

Settings and sample population

During the period from April to June 2020, random sampling was performed using the multi-stage sampling method. For factor analysis, the sample size for items was 5–10, according to previous studies [14, 15]. The Chinese version of the PaArticular Scales (supplementary file 3) has a total of 35 items; therefore, a sample size of 175–350 participants was determined to be appropriate for factor analysis in this study [16]. The inclusion criteria of the participants were as follows: (1) ≥ 65 years old; (2) living at a facility for more than 6 months; (3) having sufficient language skills to fill out or answer the questionnaire; (4) severe joint contractures in any single important joint (hand, elbow, shoulder, ankle, knee, or hip) with authentication from a doctor, nurse, or therapist. Severe joint contractures were defined as 3 on a 4-point scale (loss $> 2/3$ of joint range of motion) [17, 18]. Those with cognitive impairment and major mental illness diagnosed by physicians were excluded.

Study instrument

Demographic data

The methodology of classifying levels of disability as mild, moderate, severe, and extremely severe was determined based on the Taiwan statutory of LTC policies for older people. To further depict personal characteristic data of participants, the minimum dataset (MDS) tool, recommended in the InterRAI Country Websites, was used to record demographic data (such as education and religion) and the location and number of joint contractures (based on medical records and the MDS) [19].

Cognitive status

The Mini-Mental Status Examination (MMSE) was used to evaluate the cognitive status of participants [20]. The MMSE has a total of 13 items, with a total score of 33 and takes only 5–10 minutes to complete. It is a simple quantitative assessment scale that is widely used in clinics and research studies to evaluate cognitive function and screen cognitive impairment. A higher score indicates better cognitive function. The test-retest reliability of the MMSE is good, and the inter-rater reliability correlation coefficient is .8 [20]. An MMSE score less than 25 is defined as cognitive dysfunction.

Chinese version of the PaArticular Scales

The Chinese version of the PaArticular Scales was generated in 5 stages: translation, review, back-translation, review by a panel of specialists, and a pretest using the English version of the PaArticular Scales. The Chinese version of the PaArticular Scales contains the 35 items; the Activity subscale has 24 items, and the Participation subscale has 11 items. Because the scale is an organized face-to-face contact scale to assess activity and participation, before the assessment, the assessor emphasized that the study participants must describe their present surroundings, not imaginary surroundings or their original home surroundings. In terms of reliability, the Cronbach's α coefficients of the internal consistency of the Activity subscale and the Participation subscale are .96 and .92, respectively, in the English version of the PaArticular Scales. Additionally, the McDonald's ω totals are .98 and .95, respectively [12], indicating high internal consistency. The Pearson correlation coefficients of the 2 subscales (the Activity and Participation subscales) determined using the criterion validity of the visual

analogue scale of the EuroQol-five dimensions (EQ-5D), which is one of the most frequently used generic health status measurement tools, demonstrated good validity and reliability, at $-.40$ ($p > .001$) and $-.30$ ($p > .001$), respectively [12].

The World Health Organization Quality of Life (WHOQoL)-BREF

To evaluate the criterion validity of the Chinese version of the PaArticular Scales, we used the Chinese version of the WHOQoL-BREF developed the WHO's WHOQoL group, which contains 26 items. Questionnaires with over 20% of data missing were discarded. Missing values were replaced by the average domain value. If more than 2 values were missing in a domain, the domain score was not calculated (except for domain 3, for which the score was only calculated if the missing value was < 1). The Cronbach's α coefficient of the internal consistency of the overall questionnaire is .90, and the test-retest reliability of each category is .75 or above. For the Pearson correlation, the correlation between each item and its category ranges from .45 to .82 ($p < .01$), and the correlation between different categories ranges from .48 to .63 ($p < .01$). For the confirmatory factor analysis (CFA) of the construct validity, the structural equation model of the 4 factors replicates the potential structure designed by the questionnaire, and the comparative fitness indices (CFI) of these 2 analyses had values of .886, which is equivalent to that of the Hong Kong version of the questionnaire (CFI = .894) and similar to that of the questionnaire using global data (CFI = .903) [21].

The WHO Disability Assessment Schedule 2.0 (WHODAS 2.0)-36 items

To evaluate the criterion validity of the Chinese version of the PaArticular Scales, we used the Chinese version of the WHODAS 2.0–36 items. A 5-point Likert scale was used by participants to answer questions related to difficulties in performing activities. The score ranged from 0 (least difficulty) to 100 (maximum difficulty) and was calculated as the sum of each domain score [22]. A higher score indicated a higher degree of disability and more severe restriction. Restriction severity refers to the difficulty level classification method of the ICF and WHODAS 2.0. The classification of impairment severity was as follows: below 4%, none; 5–24%, mild; 25–49%, moderate; 50–95%, severe; and more than 96%, extremely severe [23]. In this study, only 32 items were calculated because all participants were retired and unemployed. Regarding the reliability indices of the Chinese version of the WHODAS 2.0, Cronbach's α for internal consistency is between .70 and .99, and the intra-class correlation coefficient is between .80 and .89 [24, 25]. Among the validity indices, the content and the concurrent validity have some correlation, and based on exploratory factor analyses (EFAs), 5–7 factors have an explanatory power higher than 55%. The factor loadings of the CFA are all higher than .56 [24]. Therefore, the Chinese version of the WHODAS 2.0 has excellent reliability and validity and is consistent with the item response theory (IRT).

Data collection procedure

The resident list was obtained approximately 1 week after communicating with the LTC facilities, and institutional residents who met the criteria were selected from the list. The study participants generally completed the questionnaire independently. However, if a participant was unable to complete the questionnaire independently because of vision, hearing, reading, or writing limitations, then the researchers provided assistance (e.g., explaining some sentences to clarify the meaning). Care was taken

that the method of assistance provided by the researchers in answering the questions was consistent for all of the participants (e.g., the examples provided for answering the questions were the same), which followed the data collection procedure of Chen et al. [10].

Data analysis

During survey completion, due to refusal of the respondents, negligence of the investigators, or issues with the questionnaire itself, some data were not collected but were resolved by linear interpolation. The goal of using descriptive statistics was to gain understanding from personal characteristic data of participants. Absolute and relative frequencies were determined for categorical data, while the mean and standard deviation (*SD*) were determined for continuous data.

Test-retest reliability

The current study determined the test-retest reliability of the Chinese version of the scale by evaluating participants. Residents were revisited 3 days later by a different assessor who they had not met previously, and the scale was assessed again. Using the comprehensive Cohen's κ statistic including 95% confidence intervals (CI95), the personal items and the administrator rating were compared under continuous testing. The κ value is expressed as a number between 0 and 1, where 0 indicates no agreement and 1 indicates complete agreement. κ values of $\geq .81$ indicate almost perfect agreement, those between .80 and .61 indicate substantial agreement, and those between .60 and .41 indicate moderate agreement [26].

Internal consistency reliability

The internal consistency reliability was tested by using McDonald's ω (hierarchical), Cronbach's α , and McDonald's ω total for each competency [27]. The α value is expressed as a number between 0 and 1. An α value of $\geq .91$ indicates excellent reliability, and a value between .90 and .71 indicates acceptable reliability [28]. Two types of item analysis were used, including (1) the within-item relevance and (2) the correlation between item-to-total, to analyse the homogeneity of the research tool. Finally, the correlation between the subscale and the total scale was analysed. Cronbach's α coefficient was used to measure the internal consistency reliability between the Chinese version of the PaArticular Scales and its subscales.

Construct validity

According to the principle of the varimax rotation, EFA was used to assess the validity of the Chinese version of the PaArticular Scales. The original English version of the PaArticular Scales has good criterion validity and internal consistency reliability [12]. EFA was used to determine the essential structure of multivariate observations. The factors were first selected based on a screening index of an eigenvalue > 1.0 [29]. Based on a scree plot, clinical experience, and the original factor structure of the scales, the factors were selected again [30–33]. Finally, the items were selected, provided that minimum variance of each factor was 5%.

Criterion validity

Convergent construct validity was evaluated by comparing the Pearson correlation coefficients of the Chinese version of the PaArticular Scales to both the WHOQoL-BREF and WHODAS 2.0–36 item, which have been used previously among elderly residents in LTC facilities. These comparisons are valuable because alterations in activity and participation are accompanied by alterations in participants' QoL [34, 35]. The point-biserial correlation coefficient was used to calculate the correlations among the Chinese version of the WHOQoL-BREF, the Chinese version of the WHODAS 2.0–36 items, and the Chinese version of the PaArticular Scales total score to establish concurrent validity. All data were statistically analysed using the SPSS 22.0 software package (IBM, Armonk, NY, USA).

Results

In this study, we randomly sampled 300 participants from 12 LTC facilities who met the inclusion criteria; 8 individuals were unwilling to complete the consent form, and 49 were unwilling to complete the questionnaire due to emotional factors. Finally, 243 participants were enrolled in the study. Among them, 14.8% ($N=36$) had upper extremity contractures, 64.2% ($N=156$) had lower extremity contractures, and 21.0% ($N=51$) had upper and lower extremity contractures. The demographic characteristics of this study are provided in Table 1.

Table 1
Demographic and condition-specific characteristics of the participants (N= 243)

Characteristics	Mean	SD	Min–max
Number of joint contractures	1.96	1.22	1–6
Age (years)	72.35	11.91	65–97
Length of residency (months)	38.28	46.36	1–240
BMI	22.30	3.42	12.1–34.7
Characteristics	n	%	
Contracture sites			
Upper limbs	36	14.8	
Lower limbs	156	64.2	
Upper and lower limbs	51	21.0	
Gender			
Male	156	64.2	
Female	87	35.8	
Ancestry/Ethnicity			
Min Nan	228	93.8	
Hakka	9	3.7	
Aboriginal	3	1.2	
Mainland Chinese	3	1.2	
Education			
Primary and below	144	59.3	
Junior high	57	23.5	
Senior secondary	24	9.9	
Higher	9	3.7	
College/university and above	9	3.7	
Occupation			
Military	0	0	

SD = standard deviation; BMI = body mass index.

Characteristics	Mean	<i>SD</i>	Min–max
Management	6	2.5	
Professional	18	7.4	
Technical activities and assistant professional	0	0	
Office and administrative support	36	14.8	
Sales and service	0	0	
Agriculture, forestry, fishing, and animal husbandry	12	4.9	
Arts, design, entertainment, sports, and media	57	23.5	
Installation, maintenance, and repair	12	4.9	
Production and labourers	69	28.4	
Unemployed	33	13.6	
Marital status			
Married	57	23.5	
Widowed	69	28.4	
Divorced	33	13.6	
Single	84	34.6	
Religion			
Buddhism	60	24.7	
Taoism	138	56.8	
Christianity/Catholicism	24	9.8	
Atheist	15	6.2	
Others	6	2.5	
Visitation frequency (weeks)			
0 ~ 1	174	71.6	
2 ~ 3	54	22.2	
4 ~ 5	9	3.7	
6 ~ 7	6	2.5	
Chronic diseases			
<i>SD</i> = standard deviation; BMI = body mass index.			

Characteristics	Mean	<i>SD</i>	Min–max
Hypertension	75	30.9	
Diabetes	60	24.7	
Stroke	63	25.9	
Cardiovascular disease	36	14.8	
Cancer	0	0	
Degenerative arthritis	54	22.2	
Cataract	3	1.2	
Glaucoma	3	1.2	
<i>SD</i> = standard deviation; BMI = body mass index.			

Research flow chart

A flow chart of this study is shown in Fig. 1, together with the instruments administered, sampling procedures, and number of responses for each sample.

Reliability test

Cronbach’s α of the Activity subscale, which consisted of 24 items, was .973, with an average score of 18.68 ($SD = 13.51$). Cronbach’s α coefficient of the Participation subscale, which consisted of 11 items, was .938, with an average score of 10.30 ($SD = 5.85$). Therefore, both subscales had excellent internal consistency. The 35-item Chinese version of the PaArticular Scales had a Cronbach’s α coefficient of .975 and an average score of 28.98 ($SD = 17.34$), indicating that this scale had excellent reliability (Table 2). The subscale-to-total scale correlation analysis showed Pearson correlation coefficients of .881 for the Activity subscale and .843 for the Participation subscale.

Table 2
Descriptive statistics and Cronbach’s α coefficients of the Chinese version of the PaArticular Scales ($N = 243$)

Subscale	Number of items	Mean (<i>SD</i>)	Cronbach’s α
Activities scale	24	18.68 ($SD = 13.51$)	.973
Participation scale	11	10.30 ($SD = 5.85$)	.938
PaArticular Scales total	35	28.98 ($SD = 17.34$)	.975

Validity testing

Both the Kaiser-Meyer-Olkin (KMO) and Bartlett Sphericity tests were performed to determine whether the data collected by the questionnaire were suitable for factor analysis. The test results showed that the KMO values of the Activity subscale and Participation subscale were .914 and .893, respectively; KMO values $> .5$ indicate common factors in the questionnaire items, i.e., the factors are independent. The results of Bartlett's chi-square test were all statistically significant ($p < .001$), indicating that the factors were independent and exclusive. Therefore, the questionnaire data collected in this study were suitable for factor analysis.

EFA was used to extract the construct of the scale. The Activity subscale had 3 factors with an eigenvalue > 1 , explaining 75.176% of the total variance in the scale. However, according to the scree plot, the curve flattened after the fourth factor. Therefore, based on the standard and scree plots for the factors with eigenvalues > 1.0 and combined with clinical experience and the factorial structure of the raw scores [30–33, 36], we postulated that the Activity subscale of the Chinese version of the PaArticular Scales had 3 main factors: lower limb activity, upper limb activity, and self-care activity. Table 3 shows the factor structure after rotation. One factor with an eigenvalue > 1 was obtained from the Participation subscale, explaining 62.83% of the total variance in the scale. However, according to the scree plot, the curve flattened after the second factor. The Participation subscale of the Chinese version of the PaArticular Scales had only 1 major factor: participation. Tables 3 and 4 show the factor structure after rotation of the Activity and Participation subscales.

Table 3
Item loadings for the Chinese version of the Activities Subscale

ICF code	Item No.	Item	Factor 1: lower limbs	Factor 2: upper limbs	Factor 3: self-care
d4104	2	Standing up and transitioning from a standing position to another position, such as lying down or sitting down	.836	.304	.191
d4103	1	Sitting down or standing up	.823	.283	.264
d415	3	Standing or sitting as long as you need to	.808	.313	.204
d4201	6	Sliding from one bed to another or to a stretcher for transport	.743	.380	.357
d4154	4	Staying in a standing position for some time as required	.729		.480
d4200	5	Moving from a sitting position on one seat to another seat without standing up completely	.679	.235	.464
d4600	15	Moving around between rooms and the adjacent corridor on the same floor within your home	.644	.315	.431
d430	7	Lifting an object or carrying something from one place to another	.602	.570	.349
d4601	16	Walking and moving around within unfamiliar buildings	.593	.246	.581
d4701	18	Using a private car or taxi as a passenger	.552	.195	.543
d4400	9	Lifting a small object with your hands and fingers, such as picking up a pencil	.266	.872	.215
d440	8	Fine coordination of your hands, e.g., writing, buttoning, or lacing your shoes	.272	.852	.204
d4450	13	Using fingers, hands, and arms to bring an object towards yourself or move it away from yourself, such as when closing a door or a curtain or pushing a chair aside	.164	.793	.353
d4453	14	Unscrewing a bottle cap, tying an apron, or turning a key with your fingers, hands and arms	.322	.793	.218
d4403	12	Releasing an object on purpose	.100	.773	.427
d4401	10	Grasping and holding an object using both hands, e.g., grasping a tool	.456	.751	.192

ICF code = code of the corresponding category of the International Classification of Functioning, Disability, and Health.

ICF code	Item No.	Item	Factor 1: lower limbs	Factor 2: upper limbs	Factor 3: self-care
d4402	11	Taking money out of an open purse in order to pay in a shop	.378	.612	.406
d550	23	Eating autonomously (including the use of a fork, knife, or spoon as well as opening bottles, cans, and packages)	.242	.559	.542
d5300	21	Toileting (e.g., visiting the bathroom, manipulating clothing before and after, cleaning yourself, or using incontinence aids)	.377	.286	.757
d570	24	Autonomously taking care of your well-being and health (e.g., managing daily medications, physical activity, and scheduling doctor's appointments)	.304	.321	.748
d465	17	Moving around using equipment, such as a walking stick, walker, or wheelchair both inside and outside	.416	.291	.670
d520	20	Maintaining your appearance and caring for body parts, such as the skin, face, teeth, scalp, nails, and genitals	.216	.462	.669
d540	22	Putting on and taking off clothes from head to foot without assistance (e.g., picking clothes, fastening buttons and zippers, and tying a bow)	.324	.347	.659
d4602	19	Using public transportation, such as being passenger on a bus, train, or aircraft	.408	.310	.515
% of variance			26.777	26.202	22.197
Cumulative %			26.777	52.980	75.176
Eigenvalue			14.823	2.066	1.152
ICF code = code of the corresponding category of the International Classification of Functioning, Disability, and Health.					

Table 4
Item loadings for the Chinese version of the Participation Subscale

ICF code	Item No.	Item	Factor 1: participation
d910	4	Taking part in community life according to your expectations	.889
d930	11	Practising your religion	.847
d9200	5	Participating in games (e.g., playing cards, memory games, or board games)	.842
d9205	10	Taking part in social gatherings/getting together with friends or relatives	.823
d9204	9	Pursuing your hobbies	.810
d9202	7	Realizing your cultural interests	.805
d9201	6	Participating in exercise and sports	.801
d7105	2	Bodily contact with others in a contextually and socially appropriate manner (e.g., hugging someone as a greeting)	.794
d750	3	Engaging and maintaining social relationships with other people	.752
d660	1	Supporting people who need assistance in different areas of daily life	.681
d9203	8	Doing handicraft or needlework	.641
% of variance			62.825
Cumulative %			62.825
Eigenvalue			6.911
ICF code = code of the corresponding category of the International Classification of Functioning, Disability, and Health.			

The correlation coefficients for factors 1, 2, and 3 and the item-to-subscale were obtained to determine content validity; the ranges for these coefficients were .725 to .888, 706 to .886, and .622 to .853, respectively, and the Cronbach's α values were .958, .951, and .910, respectively.

The criterion-related validity was determined according to the classification proposed by Cohen [37], and Pearson's product-moment correlation revealed that the correlation coefficient (r) between the Chinese version of the PaArticular Scales and the WHODAS 2.0–36 items was .770, which was interpreted as a large coefficient, with a p -value less than .001, indicating a highly significant result. The correlation coefficient (r) between the Chinese version of the PaArticular Scales and the WHOQoL-BREF was $-.553$, which was interpreted as a large coefficient, with a p -value less than .001, indicating a highly significant

result. The correlation coefficients between the Activity subscale and the WHODAS 2.0–36 item and WHOQoL-BREF were .722 and – .502, respectively, the correlation coefficients between the Participation subscale and the WHODAS 2.0 –36 item and WHOQoL-BREF were .742 and – .580, respectively; all correlation coefficients were highly significant (Table 5).

Table 5
Correlations between the Chinese version of the PaArticular Scales and the WHODAS 2.0–36 items and WHOQoL-BREF (N= 243)

	WHODAS 2.0	WHOQoL-BREF
PaArticular Scales Total	.770**	– .553**
Activity Subscale	.722**	– .502**
Factor 1: lower limbs	.733**	– .431**
Factor 2: upper limbs	.521**	– .454**
Factor 3: self-care	.735**	– .530**
Participation Subscale	.742**	– .580**
Factor 1: participation	.742**	– .580**
** $p < .01$ (two-tailed). WHODAS 2.0: The WHO Disability Assessment Schedule; WHOQoL-BREF: The WHO Quality of Life Scale Abbreviated Version.		

Discussion

The reliability of the outcome of the Chinese version of the PaArticular Scales assessment tool was verified in Taiwan and satisfied the item analysis for items associated with the validity. Moreover, this study found that the Activity subscale had 3 factors (i.e., latent variables), and the Participation subscale had a single factor. The 3 factors in the Activity subscale were lower limb activity, upper limb activity, and self-care activity, and the 1 factor in the Participation subscale was participation. The 2 subscales explained 75.176% and 62.825% of the variance of the scale, respectively, indicating that the results had practical significance.

The Chinese version of the PaArticular Scales had excellent internal consistency and reliability. Cronbach's α coefficients for the Activity subscale and Participation subscale were .97 and .94, respectively, which were slightly higher than those found by Müller et al. [12] for 191 elderly residents with joint contractures in German LTC facilities ($\alpha = .96$ and .92). Although the 2 studies were carried out in different countries, the α coefficients were very similar. According to the standard set by Nunnally and Bernstein (α coefficient $\geq .80$) [38], the PaArticular Scales have excellent internal consistency and reliability across ethnic groups.

The criterion validity tests showed that for individuals older than 64 years with severe joint contractures, strong evidence indicates that the Chinese version of the PaArticular Scales is linearly related to the WHODAS 2.0–36 items ($r = .770, p < .001$). Furthermore, the Pearson correlation coefficient was large. These results show that, similar to the WHODAS 2.0–36 items, the PaArticular Scales developed using the ICF of the WHO as the standard can be used as another simple tool for clinical measurement of activity and participation, and this tool addresses the gap in measuring patients with joint contractures [5]. However, although the Chinese version of the PaArticular Scales is also based on the ICF, it is mainly used for patients with joint contractures, which is different from the widely used WHODAS 2.0–36 items. Perhaps this difference can explain why the correlation between the 2 scales was not very high. Another reason may be that the majority of the participants in this study were institutionalized residents and required nursing care. These characteristics are clearly not considered to be associated with the applicable subjects for the WHODAS 2.0–36 items; therefore, the results may be attributable to many different characteristics of the participants, for example, physical conditions.

Criterion validity was also assessed to test the correlation between the Chinese version of the PaArticular Scales and the established Chinese version of the WHOQoL-BREF. For individuals older than 64 years with severe joint contractures, very strong evidence indicates that the Chinese version of the PaArticular Scales is linearly related to the WHOQoL-BREF ($r = -.553, p < .001$). Furthermore, the Pearson correlation coefficient was large. The newly developed scale demonstrated criterion validity, which was consistent with findings by Chen et al. [10]. The study noted that activity and participation, personal factors, and body function and structure are determinants of QoL for elderly residents in LTC facilities. Among them, activity and participation have the greatest explanatory power, up to 52%, indicating that activity and participation have practical significance for the QoL of elderly residents. The results also echo the view of Rantanen et al. [11], in that providing outdoor activities for elderly residents with severely limited mobility may positively affect their QoL.

Some potential limitations should be considered. First, the data in this study were obtained from a self-reported questionnaire. Although most of the responses were fully validated, it is still difficult to predict or estimate the subjective bias of reported data. For example, in the analysis of the reported data, deviations in the actual experience of the participants might exist. Second, the participants were recruited from LTC facilities, and the design considerations of this study could only reflect the view of the included ethnic groups. Although the demographic variables, such as the participants' age, gender, education, and visitation rate, were controlled, caution should be used when generalizing these findings to other settings or to other elderly populations. Third, although the sample size of this study satisfied the requirements for establishing stable person and item estimates and power analysis [16], it is still necessary to study the Chinese version of the PaArticular Scales with a larger sample size to obtain more complete and reliable data. Finally, the Chinese version needs to be further tested in future studies for applicability and generalizability, preferably in a larger sample and in different clinical domains.

Conclusions

This study demonstrated that the Chinese version of the PaArticular Scales is a reliable and effective tool for measuring the activity and participation of elderly individuals with joint contractures. As a sound outcome measurement tool, the Chinese version of the PaArticular Scales developed in this study not only fills the gap in assessing the activity and participation of elderly Chinese individuals but also makes the evaluation of elderly individuals with joint contractures more comprehensive, which can provide a basis for improving their activity, participation, and QoL. Furthermore, this tool can be used in the treatment, rehabilitation, prevention, and research programmes of LTC facilities.

List Of Abbreviations

CFA: confirmatory factor analysis; CFI: comparative fitness indices; EFAs: exploratory factor analyses; EQ-5D: EuroQol-five dimensions; ICF: International Classification of Functioning, Disability, and Health; IRT: item response theory; KMO: Kaiser-Meyer-Olkin; LTC: long-term care; MDS: minimum dataset; MMSE: Mini-Mental Status Examination; QoL: Quality of life; SD: Standard deviation; WHODAS 2.0: WHO Disability Assessment Schedule 2.0; WHOQoL: World Health Organization Quality of Life

Declarations

Ethics approval and consent to participate

This study was approved by the National Taiwan University Research Ethics Committee (No. 201905HM137), and official written informed consent was obtained from each participant. No incentive was given to respondents.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are available in the Chinese Clinical Trial Registry (ChiCTR2000030413) repository, <http://www.chictr.org.cn/usercenter.aspx>

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YCC and KCL were the main investigators. YCC, KCL, SHY, and AWP contributed to the study design, data curation, funding acquisition, resources, and supervision of the study. SHY, AWP, and HLC substantially contributed to the investigation, methodology, and project administration of the study. SHY, HLC, and CJC helped perform the formal analysis, data entry, validation, and visualization. YCC, KCL, and AWP contributed to writing – original draft, review, and editing. All authors read and approved the manuscript.

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Figures

Figure 1

The “Strengthening the Reporting of OBservational Studies in Epidemiology” (STROBE) Diagram: Flow of Participants Through the Study. WHODAS 2.0 36 items: The WHO Disability Assessment Schedule 2.0-36 items; WHOQoL-BREF: The World Health Organization Quality of Life-BREF.