

**BRIEF COMMUNICATION**

Validation of the Thai Version of the Movement Disorder Society–Sponsored Revision of the Unified Parkinson's Disease Rating Scale

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ABSTRACT

Objective This study aims to validate the Thai translation of the Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS).

Methods The English version was translated into Thai and then back-translated into English. The translated version underwent 2 rounds of cognitive pretesting to assess the ease of comprehension, ease of use and comfort with the scale. Then, it underwent large clinimetric testing.

Results The Thai version was validated in 354 PD patients. The comparative fit index (CFI) for all four parts of the Thai version of the MDS-UPDRS was 0.93 or greater. Exploratory factor analysis identified isolated item differences in factor structure between the Thai and English versions.

Conclusion The overall factor structure of the Thai version was consistent with that of the English version based on the high CFIs (all CFI \geq 0.90). Hence, it can be designated the official Thai version of the MDS-UPDRS.

Keywords MDS-UPDRS; Parkinson's disease; Thai; UPDRS; Validation.

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Parkinson's disease (PD) is a common neurodegenerative disorder. In the 1980s, the Unified Parkinson's Disease Rating Scale (UPDRS) was developed to provide a unified, comprehensive instrument for the assessment of different domains of symptoms and disabilities in PD patients.¹ The Movement Disorder Society (MDS) commissioned a review of the UPDRS in 2001. The revised version, the MDS-sponsored revision of the UPDRS (MDS-UPDRS), was published for use in 2008 after passing rigorous clinimetric testing.²

The MDS-UPDRS is divided into 4 parts as the original UPDRS with some changes.² Part I includes "non-motor experiences of daily living," Part IA is rater rated, and Part IB is rated by the patient and/or caregiver. Part II includes "motor experiences of daily living," to be filled by the patient and/or caregiver. Part III is the "motor examination," like the UPDRS but with new additions of items and choices in tremor rating for improved consistency. Part IV concerns "motor complications" like the UPDRS but with a revised assessment method.

Here, we present the results of the clinimetric assessments of the Thai translated version of the MDS-UPDRS.

MATERIALS & METHODS

Six institutions in Thailand were involved in this study. The Institutional Review Board of each center approved the study (IRB No. 542/57, IRB No. MTU-EC-IM-5-159/57). Informed consent was obtained from all participants. The study consisted of 3 phases—translation, cognitive pretesting of the translated version, and validation (clinimetric testing).

Translation

The English version of the MDS-UPDRS questionnaire was translated into Thai (SS, AP) and then independently back-translated into English (SP, PJ, NL) by movement disorder neurologists fluent in both English and Thai. The back-translation was reviewed by the USA team (GTS, CGG, NLP). Suggestions for changes were incorporated into the Thai translation. Once the finalized version was developed, it went through the cognitive pretesting phase.

Cognitive pretesting

Cognitive pretesting is used to qualitatively assess whether upon completion of the questionnaire, the task is at an appropriate difficulty level for the assessor and the assessed, the assessed can maintain interest and attention, and the assessed feels comfortable and is able to comprehend the questionnaire.³ The purpose is to assess the ease of comprehension, ease of use, and comfort with the scale. The cognitive pretesting packets have specific

questions for both raters and patients and request feedback on specific scale items. The scale items that were different when back-translated from Thai to English and the items that were used in this phase of the English version were chosen for cognitive pretesting.

Three raters (OP, PS, PP) not involved in the original translation administered the cognitive pretesting package to a total of 10 patients. Once no problems were noted, the final translation (Official Working Document) was obtained. This version then underwent large clinimetric testing for validation.

Validation

The Thai version of the MDS-UPDRS was administered to native Thai-speaking PD patients. Once all the data were collected, they were analyzed by a team in the USA.

Statistical analysis

Factor analysis

M-plus Version 7 (Muthen & Muthen, Los Angeles, CA, USA) was used to perform the primary confirmatory and secondary exploratory factor analyses. Factor estimation was conducted using an unweighted least squares approach that minimizes the sum of squared differences between observed and estimated correlation matrices and ignoring diagonal elements. To assist in interpretation, orthogonal CF-varimax rotation was used to minimize the correlation between factors.

To perform the statistical analysis, 5 subjects were needed for each item of the questionnaire.⁴ Given there are 65 items on the MDS-UPDRS, a sample of at least 350 was required. If there were missing values from a subject, only the part with those missing values was excluded from the analysis. Hence, the sample size of various parts may vary.

Primary analysis

Confirmatory factor analysis (CFA) was conducted to address the primary interest in determining whether the factor structure for the English language MDS-UPDRS² can be confirmed with data collected using the Thai translation.

The CFA constructing Thai data to fall into the factors defined in the English language data was conducted separately for MDS-UPDRS Parts I to IV. The comparative fit index (CFI) was used to evaluate the CFA results. According to the protocol, a successful translation and an official translation of the MDS-UPDRS would require CFIs for parts I-IV of the translated MDS-UPDRS of 0.90 or greater relative to the English version. To validate the model fit, we further examined the mean- and variance-adjusted weighted least squares.

Secondary analysis

In the secondary analysis, to explore the underlying factors without the constraint of a predefined factor structure, an exploratory factor analysis (EFA) was performed in the Thai version of the MDS-UPDRS Parts I–IV. For each part of the MDS-UPDRS, the number of factors was chosen using a scree plot.

A scree plot⁵ is a line plot of the eigenvalues on the y-axis and the number of factors on the x-axis. It displays a downward curve, starting high on the left, descending toward the right, and then flattening out after the cutting-off point. After the factors are chosen, items with factor loadings greater than 0.40 were retained. To assist in the interpretation of the factors, orthogonal CF-varimax rotation was used to minimize the correlation among the factors.

RESULTS

Cognitive pretesting

Questions included for this phase were cognitive impairment, anxious mood, handwriting, freezing, hand movements, arising from chair, time spent with dyskinesia, and functional impairment of dyskinesia.

Sixteen patients along with their examiners were interviewed in two rounds. In the first round of cognitive pretesting, word changes were suggested for items in Parts I, II, and IV. The second round of cognitive pretesting demonstrated successful revisions to the above listed items. This version, called the Official Working Document, was then validated in a large group of patients.

Validation

Factor analysis

The demographic characteristics of the sample are shown in Table 1. The Thai dataset included 354 native Thai-speaking PD patients who were examined using the Official Working Document of the Thai MDS-UPDRS. Supplementary Table 1 (in the online-only Data Supplement) shows the frequency of responses for each answer choice of each item for both the Thai and English datasets.

Primary analysis

The CFA models for each part of the MDS-UPDRS are displayed in Table 2. The CFI was 0.93 or greater for all four parts of the Thai MDS-UPDRS in comparison with the factor structure of the English language. Dopamine dysregulation syndrome did not load on any factor in the original English version and was thus excluded from this analysis.⁵

Table 1. Demographic characteristics of Parkinson's disease patients in two datasets

Variables	Thai (n = 354)	English (n = 876)
Male	198 (55.93)	554 (63.2)
Age (yr)	65.0 ± 10.6	67.5 ± 10.9
Years of disease diagnosed	13.3 ± 8.6	8.3 ± 6.7

Values are presented as n (%) or mean ± standard deviation.

Table 2. Confirmatory factor analysis model fit for each part of MDS-UPDRS

	CFI	RMSEA
Part I: Non-motor aspects of experiences of daily living (a 2-factor model)*		
Thai (n = 354)	0.93	0.07
English (n = 849)	0.96	0.06
Part II: Motor aspects of experience of daily living (a 3-factor model)		
Thai (n = 354)	0.97	0.09
English (n = 851)	0.97	0.09
Part III: Motor examination (a 7-factor model)		
Thai (n = 354)	0.97	0.07
English (n = 801)	0.95	0.07
Part IV: Motor complications (a 2-factor model)		
Thai (n = 354)	1.00	< 0.001
English (n = 848)	1.00	0.04

*dopamine dysregulation syndrome was excluded from this analysis because it did not load on any factor. The MDS journal has been notified of the need for correction to Factor 1.⁵ CFI, comparative fit index; RMSEA, root mean square error of approximation.

Secondary analysis

The EFA analysis for the Thai and English datasets differed in some areas. The results are shown in Supplementary Table 2 (in the online-only Data Supplement). Supplementary Figure 1 (in the online-only Data Supplement) shows the scree plots for all four parts.

Several factors were extracted from the scree plot—2 from Part I, 3 from Part II, 7 from Part III, and 2 from Part IV. In contrast to the English version, in Part I, “cognitive impairment and light headedness on standing” did not load on any factors, while fatigue loaded on both factors. For Part II, “handwriting” loaded on Factor 2, but loaded on Factor 1 in the English version. “Eating tasks” and “tremor” loaded on Factor 2 instead of on Factor 3 in the original English version. “Getting out of bed” loaded on Factor 3, but loaded on Factor 2 in the English version. In Part III, both the English and Thai versions loaded on different factors in 12 of the 33 items, and 9 items loaded on more than one factor. Both versions demonstrated that most items loaded on different factors had multiple cross-loadings. “Time spent with dyskinesias” in Part IV did not load on any of the factors. “Time spent in the OFF state” of the Thai version loaded on Factor 2, while it loaded on Factor 1 in the English version. “Complexity of motor fluctuations,” “functional impact of fluctuations,” and

“painful OFF state dystonia” in the Thai version loaded on both Factor 1 and Factor 2.

Internal consistency

To evaluate the internal consistency of the Thai version of the MDS-UPDRS, Cronbach's alpha was calculated for each part. In addition, 95% confidence intervals were reported based on 1,000 bootstrap samples (Supplementary Table 3 in the online-only Data Supplement). All four parts have good internal consistency with alpha larger than 0.8.

DISCUSSION

The MDS-UPDRS is a standard scale to evaluate different domains of PD. It has been translated into many languages and is used worldwide. The Thai version of MDS-UPDRS encountered a few hurdles in translation and cognitive pretesting. Some of the sentences were too long, which made the patients confused. This was resolved by asking the questions in parts. For example, for question 1.1 on cognitive impairment: “Over the past week have you had problems remembering things, following conversations, paying attention, thinking clearly, or finding your way around the house or in town?” The question was asked in parts, such as, “Over the past week have you had problems remembering things?”; wait for an answer, then ask “following conversations?”; wait for an answer, and so on. Once this was done and a few words were changed, the questionnaire was properly understood and passed the cognitive pretesting phase.

Because the developers suggested that each part of the scale be used individually,² we conducted clinimetric assessments for each part separately. For validation of the Thai translation, we required a minimum CFI of 0.90. The minimum CFI we obtained was 0.93 (Part I), and the maximum was 1.00 (Part IV). Therefore, we considered the Thai translation's factor structure to be consistent with the English language version.

We expected variations between the target language factor structure and the unconstrained factor structure of the Thai translation. This is a common occurrence in CFA and represents the natural variability from sample to sample. As expected, we found isolated item differences in the factor structure between the original English version and the Thai translation. We found cross-loadings for different items in the various factors of the Thai translation. These differences in the factor loadings across the two versions are most likely due to cultural differences. The differences are also seen in other language translations, albeit differently.⁶⁻⁸ Nonetheless, the overall factor structures were confirmed to be consistent with the English version, hence rendering them suitable for use as a validated translation.

Overall, our results met the criteria for validation of the Thai translation of the MDS-UPDRS, with noted high CFIs for each part of the scale. The Thai version demonstrated a global factor structure similar to that of the English version, and thus, the Thai translation is considered an official Thai version of the MDS-UPDRS.

Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.14802/jmd.21104>.

Conflicts of Interest

The authors have no financial conflicts of interest.

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The official Thai version of the MDS-UPDRS is available at <https://www.movementdisorders.org/MDS/MDS-Rating-Scales/MDS-Unified-Parkinsons-Disease-Rating-Scale-MDS-UPDRS.htm>.

Author Contributions

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Supplementary Table 1. Distribution of Responses of MDS-UPDRS by Language

Part 1										
	English		Thai			English		Thai		
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent	
Cognitive impairment					Daytime sleepiness					
0	428	48.86	179	50.4	0	212	24.2	73	20.6	
1	256	29.22	106	29.9	1	216	24.66	119	33.5	
2	121	13.81	44	12.4	2	364	41.55	126	35.5	
3	53	6.05	24	6.8	3	59	6.74	29	8.2	
4	17	1.94	1	0.3	4	16	1.83	7	2	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Hallucinations and psychosis					Pain and other sensations					
0	687	78.42	268	75.5	0	303	34.59	140	39.4	
1	89	10.16	53	14.9	1	289	32.99	119	33.5	
2	51	5.82	23	6.5	2	130	14.84	58	16.3	
3	35	4	8	2.3	3	106	12.1	32	9	
4	13	1.48	2	0.6	4	39	4.45	5	1.4	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Depressed mood					Urinary problems					
0	471	53.77	205	57.7	0	325	37.1	146	41.1	
1	265	30.25	114	32.1	1	281	32.08	105	29.6	
2	81	9.25	23	6.5	2	137	15.64	53	14.9	
3	45	5.14	12	3.4	3	88	10.05	37	10.4	
4	12	1.37	0	0.0	4	38	4.34	13	3.7	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Anxious mood					Constipation problems					
0	413	47.15	165	46.5	0	354	43.84	102	28.7	
1	307	35.05	130	36.6	1	287	32.76	97	27.3	
2	96	10.96	40	11.3	2	119	13.58	70	19.7	
3	41	4.68	19	5.4	3	70	7.99	67	18.9	
4	17	1.94	0	0.0	4	9	1.03	18	5.1	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Apathy					Light headedness on standing					
0	584	66.67	205	57.7	0	490	55.94	181	51	
1	141	16.1	93	26.2	1	216	24.66	95	26.8	
2	88	10.05	40	11.3	2	103	11.76	51	14.4	
3	52	5.94	16	4.5	3	51	5.82	23	6.5	
4	8	0.91	0	0.0	4	9	1.03	4	1.1	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Features of DDS					Fatigue					
0	747	85.27	281	79.2	0	217	24.77	114	32.1	
1	57	6.51	54	15.2	1	335	38.24	125	35.2	
2	44	5.02	11	3.1	2	184	21	71	20	
3	19	2.17	7	2	3	81	9.25	40	11.3	
4	6	0.68	1	0.3	4	50	5.71	4	1.1	
Total	876	100	354	100.0	Total	876	100	354	100.0	
Sleep problems										
0	280	31.96	149	42						
1	202	23.06	67	18.9						
2	207	23.63	58	16.3						
3	140	15.98	66	18.6						
4	40	4.57	14	3.9						
Total	876	100	354	100.0						
Part2										
	English		Thai			English		Thai		
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent	
Speech					Doing hobbies and other activities					
0	252	28.77	145	40.8	0	227	25.91	184	51.8	
1	236	26.94	87	24.5	1	289	32.99	92	25.9	
2	233	26.6	65	18.3	2	185	21.12	44	12.4	
3	126	14.38	48	13.5	3	81	9.25	25	7	
4	22	2.51	9	2.5	4	84	9.59	9	2.5	

Total	876	100	354	100.0	Total	876	100	354	100.0
Saliva and drooling	Freq.	Percent	Freq.	Percent	Turning in bed	Freq.	Percent	Freq.	Percent
0	341	38.93	177	49.9	0	277	31.62	202	56.9
1	115	13.13	62	17.5	1	378	43.15	95	26.8
2	203	23.17	61	17.2	2	111	12.67	28	7.9
3	157	17.92	37	10.4	3	55	6.28	15	4.2
4	53	6.05	17	4.8	4	50	5.71	14	3.9
Total	876	100	354	100.0	Total	876	100	354	100.0
Chewing and swallowing	Freq.	Percent	Freq.	Percent	Tremor	Freq.	Percent	Freq.	Percent
0	549	62.67	231	65.1	0	189	21.58	117	33
1	230	26.26	82	23.1	1	360	41.1	158	44.5
2	54	6.16	21	5.9	2	212	24.2	41	11.5
3	34	3.88	19	5.4	3	72	8.22	28	7.9
4	3	0.34	1	0.3	4	36	4.11	10	2.8
Total	876	100	354	100.0	Total	876	100	354	100.0
Eating tasks	Freq.	Percent	Freq.	Percent	Getting out of bed	Freq.	Percent	Freq.	Percent
0	363	41.44	200	56.3	0	180	20.55	149	42
1	265	30.25	89	25.1	1	317	36.19	108	30.4
2	187	21.35	50	14.1	2	199	22.72	44	12.4
3	42	4.79	10	2.8	3	104	11.87	37	10.4
4	10	1.14	5	1.4	4	70	7.99	16	4.5
Total	876	100	354	100.0	Total	876	100	354	100.0
Dressing	Freq.	Percent	Freq.	Percent	Walking and balance	Freq.	Percent	Freq.	Percent
0	220	25.11	201	56.6	0	184	21	133	37.5
1	322	36.76	88	24.8	1	336	38.36	123	34.6
2	211	24.09	41	11.5	2	105	11.99	35	9.9
3	76	8.68	15	4.2	3	172	19.63	49	13.8
4	42	4.79	9	2.5	4	74	8.45	14	3.9
Total	876	100	354	100.0	Total	876	100	354	100.0
Hygiene	Freq.	Percent	Freq.	Percent	Freezing	Freq.	Percent	Freq.	Percent
0	342	39.04	220	62	0	453	51.71	127	35.8
1	367	41.89	102	28.7	1	182	20.78	115	32.4
2	88	10.05	13	3.7	2	89	10.16	49	13.8
3	33	3.77	10	2.8	3	90	10.27	47	13.2
4	38	4.34	9	2.5	4	56	6.39	16	4.5
Total	876	100	354	100.0	Total	876	100	354	100.0
Handwriting	Freq.	Percent	Freq.	Percent					
0	161	18.38	124	34.9					
1	251	28.65	123	34.6					
2	222	25.34	50	14.1					
3	146	16.67	45	12.7					
4	87	9.93	12	3.4					
Total	876	100	354	100.0					

Part3

	English		Thai			English		Thai	
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
Speech					Arising from chair				
0	189	21.58	157	44.2	0	422	48.17	228	64.2
1	379	43.26	130	36.6	1	245	27.97	72	20.3
2	213	24.32	46	13	2	78	8.9	25	7
3	69	7.88	18	5.1	3	71	8.11	12	3.4
4	22	2.51	3	0.8	4	55	6.28	17	4.8
Total	876	100	354	100.0	Total	876	100	354	100.0
Facial expression	Freq.	Percent	Freq.	Percent	Gait	Freq.	Percent	Freq.	Percent
0	96	10.96	120	33.8	0	202	23.06	85	23.9
1	300	34.25	114	32.1	1	351	40.07	175	49.3
2	361	41.21	95	26.8	2	167	19.06	62	17.5
3	89	10.16	23	6.5	3	97	11.07	13	3.7
4	26	2.97	2	0.6	4	55	6.28	19	5.4
Total	876	100	354	100.0	Total	876	100	354	100.0
Rigidity– Neck	Freq.	Percent	Freq.	Percent	Freezing of gait	Freq.	Percent	Freq.	Percent
0	260	29.68	144	40.6	0	655	74.77	231	65.1
1	247	28.2	107	30.1	1	95	10.84	64	18
2	274	31.28	82	23.1	2	60	6.85	24	6.8
3	73	8.33	20	5.6	3	26	2.97	15	4.2
4	16	1.83	1	0.3	4	38	4.34	20	5.6
Total	876	100	354	100.0	Total	876	100	354	100.0
Rigidity– RUE	Freq.	Percent	Freq.	Percent	Postural stability	Freq.	Percent	Freq.	Percent
0	176	20.09	114	32.1	0	422	48.17	176	49.6

1	282	32.19	128	36.1	1	157	17.92	85	23.9
2	342	39.04	93	26.2	2	60	6.85	21	5.9
3	69	7.88	18	5.1	3	149	17.01	48	13.5
4	6	0.68	1	0.3	4	86	9.82	24	6.8
Total	876	100	354	100.0	Total	876	100	354	100.0
Rigidity– LUE	Freq.	Percent	Freq.	Percent	Posture	Freq.	Percent	Freq.	Percent
0	205	23.4	148	41.7	0	173	19.75	91	25.6
1	268	30.59	100	28.2	1	337	38.47	147	41.4
2	317	36.19	86	24.2	2	206	23.52	71	20
3	77	8.79	19	5.4	3	125	14.27	31	8.7
4	7	0.8	1	0.3	4	33	3.77	14	3.9
Total	876	100	354	100.0	Total	876	100	354	100.0
Rigidity– RLE	Freq.	Percent	Freq.	Percent	Global spontaneity of movement	Freq.	Percent	Freq.	Percent
0	272	31.05	129	36.3	0	108	12.33	71	20
1	248	28.31	121	34.1	1	278	31.74	148	41.7
2	275	31.39	81	22.8	2	279	31.85	76	21.4
3	67	7.65	19	5.4	3	184	21	42	11.8
4	10	1.14	4	1.1	4	27	3.08	17	4.8
Total	876	100	354	100.0	Total	876	100	354	100.0
Rigidity– LLE	Freq.	Percent	Freq.	Percent	Postural tremor– Right hand	Freq.	Percent	Freq.	Percent
0	286	32.65	132	37.2	0	544	62.1	227	63.9
1	227	25.91	119	33.5	1	262	29.91	106	29.9
2	275	31.39	80	22.5	2	43	4.91	16	4.5
3	75	8.56	19	5.4	3	23	2.63	4	1.1
4	11	1.26	4	1.1	4	1	0.11	1	0.3
Total	876	100	354	100.0	Total	876	100	354	100.0
Finger tapping– Right hand	Freq.	Percent	Freq.	Percent	Postural tremor– Left hand	Freq.	Percent	Freq.	Percent
0	122	13.93	59	16.6	0	518	59.13	219	61.7
1	342	39.04	140	39.4	1	276	31.51	111	31.3
2	252	28.77	100	28.2	2	49	5.59	20	5.6
3	144	16.44	50	14.1	3	29	3.31	2	0.6
4	15	1.71	5	1.4	4	1	0.11	2	0.6
Total	876	100	354	100.0	Total	876	100	354	100.0
Finger tapping– Left hand	Freq.	Percent	Freq.	Percent	Kinetic tremor– Right hand	Freq.	Percent	Freq.	Percent
0	108	12.33	69	19.4	0	546	62.33	225	63.4
1	298	34.02	138	38.9	1	265	30.25	105	29.6
2	265	30.25	91	25.6	2	46	5.25	23	6.5
3	181	20.66	50	14.1	3	13	1.48	1	0.3
4	22	2.51	6	1.7	4	2	0.23	225	63.4
Total	876	100	354	100.0	Total	876	100	354	100.0
Hand movements– Right hand	Freq.	Percent	Freq.	Percent	Kinetic tremor– Left hand	Freq.	Percent	Freq.	Percent
0	187	21.35	86	24.2	0	493	56.28	205	57.7
1	346	39.5	138	38.9	1	293	33.45	111	31.3
2	231	26.37	93	26.2	2	72	8.22	36	10.1
3	98	11.19	34	9.6	3	14	1.6	2	0.6
4	12	1.37	3	0.8	4	0	0	205	57.7
Total	876	100	354	100.0	Total	876	100	354	100.0
Hand movements– Left hand	Freq.	Percent	Freq.	Percent	Rest tremor amplitude– RUE	Freq.	Percent	Freq.	Percent
0	164	18.72	90	25.4	0	586	66.89	256	72.1
1	311	35.5	148	41.7	1	112	12.79	54	15.2
2	250	28.54	73	20.6	2	121	13.81	34	9.6
3	125	14.27	38	10.7	3	53	6.05	10	2.8
4	25	2.85	5	1.4	4	3	0.34	0	0.0
Total	876	100	354	100.0	Total	876	100	354	100.0
Pronation- supination movements– Right hand	Freq.	Percent	Freq.	Percent	Rest tremor amplitude– LUE	Freq.	Percent	Freq.	Percent
0	199	22.72	113	31.8	0	603	68.84	259	73
1	335	38.24	131	36.9	1	120	13.7	55	15.5
2	216	24.66	81	22.8	2	99	11.3	27	7.6
3	107	12.21	25	7	3	45	5.14	11	3.1
4	17	1.94	4	1.1	4	5	0.57	2	0.6
Total	876	100	354	100.0	Total	876	100	354	100.0

Pronation- supination movements– Left hand					Rest tremor amplitude– RLE				
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
0	162	18.49	106	29.9	0	777	88.7	301	84.8
1	297	33.9	137	38.6	1	52	5.94	35	9.9
2	235	26.83	76	21.4	2	35	4	11	3.1
3	150	17.12	30	8.5	3	9	1.03	7	2
4	29	3.31	5	1.4	4	0	0	0	0.0
Total	876	100	354	100.0	Total	876	100	354	100.0
Toe tapping–Right foot					Rest tremor amplitude– LLE				
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
0	168	19.18	84	23.7	0	795	90.75	309	87
1	323	36.87	140	39.4	1	46	5.25	29	8.2
2	228	26.03	80	22.5	2	20	2.28	13	3.7
3	129	14.73	40	11.3	3	12	1.37	3	0.8
4	27	3.08	10	2.8	4	0	0	0	0.0
Total	876	100	354	100.0	Total	876	100	354	100.0
Toe tapping– Left foot					Rest tremor amplitude– Lip/jaw				
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
0	154	17.58	84	23.7	0	780	89.04	311	87.6
1	251	28.65	144	40.6	1	63	7.19	32	9
2	268	30.59	67	18.9	2	18	2.05	8	2.3
3	154	17.58	49	13.8	3	13	1.48	3	0.8
4	46	5.25	10	2.8	4	1	0.11	0	0.0
Total	876	100	354	100.0	Total	876	100	354	100.0
Leg agility– Right leg					Constancy of rest				
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
0	250	28.54	98	27.6	0	409	46.69	202	56.9
1	329	37.56	144	40.6	1	214	24.43	84	23.7
2	190	21.69	74	20.8	2	91	10.39	31	8.7
3	86	9.82	31	8.7	3	85	9.7	22	6.2
4	18	2.05	7	2	4	67	7.65	15	4.2
Total	876	100	354	100.0	Total	876	100	354	100.0
Leg agility– Left leg									
	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent
0	216	24.66	96	27					
1	298	34.02	141	39.7					
2	213	24.32	71	20					
3	106	12.1	39	11					
4	38	4.34	7	2					
Total	876	100	354	100.0					

Part4

	English		Thai			English		Thai	
Time spent with dyskinesias	Freq.	Percent	Freq.	Percent	Functional impact of fluctuations	Freq.	Percent	Freq.	Percent
0	563	64.27	233	65.6	0	433	49.43	179	50.4
1	173	19.75	99	27.9	1	165	18.84	95	26.8
2	87	9.93	19	5.4	2	81	9.25	32	9
3	27	3.08	2	0.6	3	119	13.58	31	8.7
4	17	1.94	1	0.3	4	63	7.19	17	4.8
Total	876	100	354	100.0	Total	876	100	354	100.0
Functional impact of dyskinesias	Freq.	Percent	Freq.	Percent	Complexity of motor fluctuations	Freq.	Percent	Freq.	Percent
0	695	79.34	249	70.1	0	404	46.12	182	51.3
1	90	10.27	71	20	1	291	33.22	109	30.7
2	29	3.31	19	5.4	2	69	7.88	27	7.6
3	46	5.25	10	2.8	3	50	5.71	15	4.2
4	5	0.57	5	1.4	4	46	5.25	21	5.9
Total	876	100	354	100.0	Total	876	100	354	100.0
Time spent in the OFF state	Freq.	Percent	Freq.	Percent	Painful OFF-state dystonia	Freq.	Percent	Freq.	Percent
0	383	43.72	171	48.2	0	680	77.63	280	78.9
1	341	38.93	143	40.3	1	114	13.01	46	13
2	106	12.1	32	9	2	45	5.14	12	3.4
3	22	2.51	5	1.4	3	13	1.48	5	1.4
4	14	1.6	3	0.8	4	15	1.71	11	3.1
Total	876	100	354	100.0	Total	876	100	354	100.0

Supplementary Table 2. Comparison of English language and Thai Exploratory Factor structures for Parts I- IV of the MDS-UPDRS

Factor	Item	Item factor loading	
Part I: Non-Motor Aspects of Experiences of Daily Living			
(Section CFI* = 0.93, RSMEA† = 0.07)			
		English [‡]	Thai
Factor 1	<i>Percent variance</i>	34.0	36.1
	Daytime sleepiness	0.53	0.50
	Sleep problems	0.35	0.58
	Cognitive impairment	0.55	xxxx
	Pain and other sensations	0.43	0.42
	Hallucinations and psychosis	0.56	0.43
	Urinary problems	0.61	0.65
	Constipation problems	0.46	0.60
	Light headedness on standing	0.46	xxxx
	Fatigue	0.47	0.40 [§]
Factor 2	<i>Percent variance</i>	9.5	10.9
	Depressed mood	0.81	0.67
	Anxious mood	0.68	0.74
	Apathy	0.55	0.69
	Fatigue	xxxx	0.41 [§]

Part II: Motor Aspects of Experiences of Daily Living

(Section CFI=0.97, RSMEA =0.09)

		English[‡]	Thai
Factor 1	<i>Percent variance</i>	<i>53.10</i>	<i>55.65</i>
	Speech	0.79	0.41
	Saliva and drooling	0.45	0.84
	Chewing and swallowing	0.60	0.60
	Eating tasks	xxxx	0.59 [§]
	Dressing	xxxx	0.48 [§]
	Handwriting	0.46	xxxx
	Doing hobbies and other activities	0.46	0.47 [§]
	Turning in bed	xxxx	0.40 [§]
Factor 2	<i>Percent variance</i>	<i>7.70</i>	<i>7.29</i>
	Eating tasks	xxxx	0.42 [§]
	Dressing	0.64	0.62 [§]
	Hygiene	0.65	0.82
	Handwriting	xxxx	0.85
	Doing hobbies and other activities	xxxx	0.43 [§]
	Turning in bed	0.65	0.67 [§]
	Tremor	xxxx	0.76
	Getting out of bed	0.73	xxxx
	Walking and balance	0.82	0.77
	Freezing	0.76	0.70

Factor 3	<i>Percent variance</i>	8.70	9.00
	Eating tasks	0.68	xxxx
	Tremor	0.43	xxxx
	Getting out of bed	xxxx	0.71

Part III: Motor Examination

(Section CFI = 0.97, RSMEA = 0.07)

		English [†]	Thai
Factor 1	<i>Percent variance</i>	36.7	42.6
	Speech	0.60	0.45 [§]
	Facial expression	0.54	0.48 [§]
	Arising from chair	0.80	0.87
	Gait	0.87	0.81
	Freezing of gait	0.83	0.84
	Postural stability	0.80	0.82
	Posture	0.70	0.71
	Global spontaneity of movement	0.67	0.53
	Leg agility, right leg	xxxx	0.44 [§]
Factor 2	<i>Percent variance</i>	15.3	13.9
	Rest tremor amplitude, RUE	0.73	0.69 [§]
	Rest tremor amplitude, LUE	0.71	0.68
	Rest tremor amplitude, RLE	0.74	0.70

	Rest tremor amplitude, LLE	0.70	0.78
	Rest tremor amplitude, lip/jaw	0.60	0.69
	Constancy of rest tremor	0.88	0.87
Factor 3	<i>Percent variance</i>	6.6	7.3
	Rigidity, neck	0.68	0.60
	Rigidity, RUE	0.73	0.76
	Rigidity, LUE	0.74	0.75
	Rigidity, RLE	0.80	0.75
	Rigidity, LLE	0.82	0.77
Factor 4	<i>Percent variance</i>	6.2	6.2
	Finger tapping, right hand	0.67	0.74
	Hand movements, right hand	0.67	0.73 [§]
	Pronation/supination, right hand	0.70	0.70 [§]
	Leg agility, right leg	xxxx	0.64 [§]
	Toe tapping, right foot	xxxx	0.65
	Rigidity, RUE	xxxx	0.49 [§]
	Rest tremor amplitude, RUE	xxxx	0.42 [§]
Factor 5	<i>Percent variance</i>	4.9	5.6
	Finger tapping, left hand	0.67	0.80
	Hand movements, left hand	0.70	0.85
	Pronation/supination movements, left hand	0.65	0.81
	Toe tapping, left foot	xxxx	0.74

	Leg agility, left leg		xxxx	0.72
	Rigidity, LUE		xxxx	0.50 [§]
	Rigidity, LLE		xxxx	0.46 [§]
	Hand movements, right hand		xxxx	0.43 [§]
	Pronation/supination, right hand		xxxx	0.41 [§]
Factor 6	<i>Percent variance</i>	4.5		4.5
	Postural tremor, right hand	0.66		0.68
	Postural tremor, left hand	0.71		0.80
	Kinetic tremor, right hand	0.81		0.84
	Kinetic tremor, left hand	0.81		0.88
Factor 7	<i>Percent variance</i>	3.3		2.7
	Toe tapping, right foot	0.65		xxxx
	Toe tapping, left foot	0.62		xxxx
	Leg agility, right leg	0.62		xxxx
	Leg agility, left leg	0.60		xxxx
	Speech		xxxx	0.53 [§]
	Facial expression		xxxx	0.7 [§]

Part IV: Motor Complications

(Section CFI = 1.00, RSMEA <0.001)

		English [‡]	Thai
Factor 1	<i>Percent variance</i>	63.9	61.3

	Time spent in the OFF state	0.87	xxxx
	Functional impact of fluctuations	0.84	0.82
	Complexity of motor fluctuations	0.82	0.79
	Painful OFF state dystonia	0.5	0.75
Factor 2	<i>Percent variance</i>	<i>15.6</i>	<i>19.0</i>
	Time spent with dyskinesias	0.71	xxxx
	Functional impact of dyskinesias	0.95	0.99
	Time spent in the OFF state	xxxx	0.85
	Functional impact of fluctuations	xxxx	0.42 [§]
	Complexity of motor fluctuations	xxxx	0.46 [§]
	Painful OFF state dystonia	xxxx	0.43 [§]

* CFI, comparative fit index

† RMSEA, root mean square error of approximation

‡ Results from M-Plus Version 7

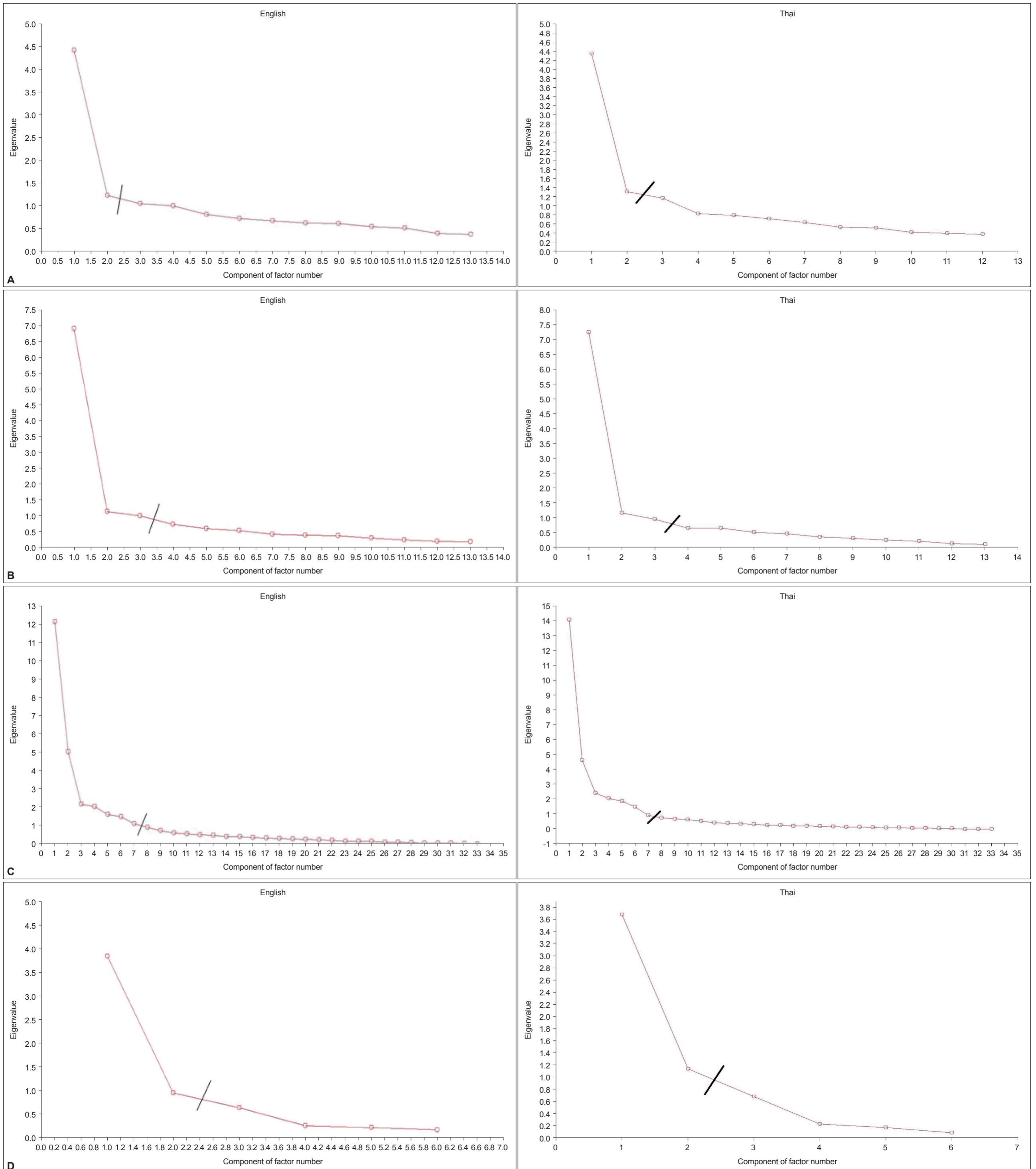
§ Item load on more than one factor with factor loading ≥ 0.40

xxxx implies the listed item did not load on the Factor indicated.

Supplementary Table 3. Internal consistency of each MDS-UPDRS part

MDS-UPDRS part	Cronbach's alpha (95% CI)
Part 1	0.804 (0.767–0.831)
Part 2	0.913 (0.894–0.927)
Part 3	0.942 (0.934–0.950)
Part 4	0.818 (0.786–0.843)

MDS-UPDRS, Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale.



Supplementary Figure 1. Scree plot for exploratory factor analysis. A: Part I: Non-motor aspects of experiences of daily living. B: Part II: Motor aspects of experiences of daily living. C: Part III: Motor examination. D: Part IV: Motor complications.