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Validation of the Korean Version of the Scales for Outcomes in Parkinson's Disease-Sleep

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ABSTRACT

Background: Sleep problems commonly occur in patients with Parkinson's disease (PD), and are associated with a lower quality of life. The aim of the current study was to translate the English version of the Scales for Outcomes in Parkinson's Disease-Sleep (SCOPA-S) into the Korean version of SCOPA-S (K-SCOPA-S), and to evaluate its reliability and validity for use by Korean-speaking patients with PD.

Methods: In total, 136 patients with PD from 27 movement disorder centres of university-affiliated hospitals in Korea were enrolled in this study. They were assessed using SCOPA, Hoehn and Yahr Scale (HYS), Unified Parkinson's Disease Rating Scale (UPDRS), Parkinson's Disease Sleep Scale 2nd version (PDSS-2), Non-motor Symptoms Scale (NMSS), Montgomery Asberg Depression Scale (MADS), 39-item Parkinson's Disease Questionnaire (PDQ39), Neurogenic Orthostatic Hypotension Questionnaire (NOHQ), and Rapid Eye Movement Sleep Behaviour Disorder Questionnaire (RBDQ). The test-retest reliability was assessed over a time interval of 10–14 days.

Results: The internal consistency (Cronbach's α -coefficients) of K-SCOPA-S was 0.88 for nighttime sleep (NS) and 0.75 for daytime sleepiness (DS). Test-retest reliability was 0.88 and 0.85 for the NS and DS, respectively. There was a moderate correlation between the NS sub-score and PDSS-2 total score. The NS and DS sub-scores of K-SCOPA-S were correlated with motor scale such as HYS, and non-motor scales such as UPDRS I, UPDRS II, MADS, NMSS, PDQ39, and NOHQ while the DS sub-score was with RBDQ.

Conclusion: The K-SCOPA-S exhibited good reliability and validity for the assessment of sleep problems in the Korean patients with PD.

Keywords: Parkinson's Disease; Scales for Outcomes in Parkinson's Disease-Sleep; SCOPA-Sleep; Validation

INTRODUCTION

Sleep disturbance, which is one of the most common non-motor symptoms of Parkinson's disease (PD), increases in frequency with advancing disease.¹ A community-based study reported that 60% of patients with PD (144 of 239 patients) had sleep problems, compared with 33% of healthy age- and sex-matched controls (33 of 100 healthy participants).² A study on prevalence, using a non-motor symptoms questionnaire, demonstrated daytime sleepiness (DS) in 31% of patients with PD, insomnia in 46%, restless legs in 42%, vivid dreams in 34%, and acting out during dreams in 36%.³ Sleep problems have a significant negative impact on the quality of life of patients and their caregivers.^{4,5} Therefore, recognition and appropriate management of sleep problems are vitally important in PD treatment.

The Scales for Outcomes in Parkinson's Disease-Sleep (SCOPA-S) evaluates sleep problems using a self-administered questionnaire.⁶ The nighttime sleep (NS) section, which addresses sleep problems during the night in the prior month, consists of five items with four response options (i.e., 0 [not at all] to 3 [a lot]), with a maximum score of 15. The DS section evaluates sleepiness during the daytime in the prior month, and includes six items with four response options (i.e., 0 [never] to 3 [often]), with a maximum score of 18. Additionally, overall sleep quality (SQ) is also assessed with seven response options (i.e., 0 [slept very well] to 6 [slept very badly]).

In the present study, we translated SCOPA-S into Korean and evaluated its reliability and validity for use in Korean patients with PD.

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Disclosure

The authors have no potential conflicts of interest to disclose.

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Conceptualization: Koh SB, Kim JS, Kim SJ, Cheon SM, Ahn TB. Data curation: Sung YH, Kim HJ, Ahn TB. Formal analysis: Kim HJ. Investigation: Sung YH, Kim HJ, Koh SB, Kim JS, Kim SJ, Cheon SM, Cho JW, Kim YJ, Ma HI, Park MY, Baik JS, Lee PH, Chung SJ, Kim JM, Song IU, Kim HJ, Kim JY, Kwon DY, Lee JH, Lee JY, Kim JS, Yun JY, Hong JY, Kim MJ, Youn J, Kim JS, Oh ES, Yang HJ, Yoon WT, You S, Kwon KY, Park HE, Lee SY, Kim Y, Kim HT, Ahn TB. Methodology: Koh SB, Kim JS, Kim SJ, Cheon SM, Ahn TB. Writing - original draft: Sung YH, Kim HJ. Writing - review & editing: Ahn TB.

METHODS**Study design and setting***Study participants*

We recruited patients with PD, aged above 39 years, from 27 movement disorder centres of university-affiliated hospitals in Korea. The diagnosis of PD was made according to the clinical diagnostic criteria of the United Kingdom Parkinson's Disease Society Brain Bank.⁷

The exclusion criteria were as follows; diagnosis of secondary Parkinsonism or symptoms suggesting Parkinson plus syndrome, history of psychiatric illness, and current or past use of antidepressants or medication that can cause drug-induced Parkinsonism.

Translation

The following steps were taken to translate the original English version of SCOPA-S⁶ (**Appendix 1**) into Korean: forward translation and backward translation, expert committee review, pretest of the pre-final version, and development of the final Korean version.

First, two independent bilingual translators translated the English version of SCOPA-S into Korean, literally. A panel consisting of five authors (Ahn TB, Cheon SM, Kim JS, Kim SJ, and Koh SB) reviewed the translations to form a single forward translation. Another bilingual translator translated the Korean version draft of SCOPA-S back into English. The panel then evaluated discrepancies between the original English form and the first draft of the Korean translation. Interview with four patients was performed to test the interpretation of the translation. Thereafter, we generated the final Korean version of SCOPA-S (K-SCOPA-S) (**Appendix 2**).

Assessment

Clinical assessment was conducted using the following tools: modified Hoehn and Yahr Scale (HYS),⁸ Unified Parkinson's Disease Rating Scales part I, II, and III (UPDRS I, II, and III),⁹ the Korean version of the SCOPA-cognition, autonomic, and psychosocial, the Korean version of the Mini-Mental Status Examination (K-MMSE),¹⁰ the Korean version of the Montreal Cognitive Assessment (MoCA-K),¹¹ the Korean version of the Montgomery-Asberg Depression Scale (K-MADS),¹² the Parkinson's Disease Sleep Scale 2nd version (PDSS-2),¹³ the Korean version of the 39-item Parkinson's Disease Questionnaire (K-PDQ39),¹⁴ the Korean version of the Non-motor Symptoms Scale (K-NMSS),¹⁵ the Rapid Eye Movement Sleep Behavior Disorders Screening Questionnaire (RBDQ),¹⁶ and the Neurogenic Orthostatic Hypotension Questionnaire (NOHQ).¹⁷

For the test-retest reliability, K-SCOPA-S assessments were repeated twice, with an interval of 10–14 days, allowing sufficient time to minimize learning effect.

Statistical analysis

The quality of data was considered satisfactory if more than 95% of the scale data were fully computable. Reliability was tested for internal consistency and stability of measures. Internal consistency was analyzed using the Cronbach's α -coefficient (criterion value for α : ≥ 0.70). The item homogeneity (mean of the inter-item correlation coefficients, criterion value: ≥ 0.30) and corrected item-total correlations (without contribution of the tested item, criterion value: ≥ 0.40) were determined to ascertain the internal consistency of K-SCOPA-S.

The test-retest reliability was assessed using intraclass correlation coefficient (ICC). Correlation values of 0.70 or greater were considered satisfactory. Comparison of baseline and follow-up scores was performed using a Wilcoxon's test. In addition to identifying the association between variables, the Spearman's rank correlation coefficients (r_s) were used to analyze the construct validity with other scales. All statistical analyses were performed using SPSS 17.0 (SPSS, Inc., Chicago, IL, USA).

Ethics statement

The Institutional Review Board at each hospital reviewed and approved this study protocol (Kyung Hee University Medical Center, IRB No. 2014-12-204). Informed consent was submitted by all subjects when they were enrolled.

RESULTS

Demographic features

Among the 136 patients who were enrolled in this study, 133 patients completed the retest step. The study cohort comprised 65 men and 71 women, with a mean age of 66.8 ± 9.0 years. The median HYS was 2 (19 patients at stage 1, 7 at stage 1.5, 55 at stage 2, 32 at stage 2.5, 21 at stage 3, 1 at stage 4, and 1 at stage 5). The demographic and clinical characteristics are summarized in **Table 1**.

Validation results

The mean sub-scores of K-SCOPA-S were 3.8 for NS and 2.6 for DS. The median score of K-SCOPA-S SQ was 2. Descriptive data and acceptability parameters of K-SCOPA-S are shown in **Table 2**.

Table 1. Demographics and clinical characteristics

Characteristics	Mean	SD	No. of patients
Age, yr	66.76	9.03	136
Education, yr	3.08	1.72	136
Disease duration, mon	47.25	46.81	136
HYS	2.14	0.67	136
UPDRS I	2.00	1.99	136
UPDRS II	7.77	6.00	136
UPDRS III	20.19	11.03	135
K-MMSE	26.90	3.70	134
MoCA-K	22.60	5.04	134
K-MADS	10.26	9.61	136
K-NMSS	35.89	28.03	136
K-PDQ39 SI	33.07	28.45	135
K-SCOPA cognition	22.08	7.36	131
K-SCOPA autonomic	16.78	9.70	135
K-SCOPA psychosocial	6.43	6.96	136
RBDQ	3.32	2.94	136
NOHQ	22.27	19.16	136

SD = standard deviation, HYS = Hoehn and Yahr Scale, UPDRS = Unified Parkinson's Disease Rating Scale, K-MMSE = Korean version of the Mini-Mental Status Examination, MoCA-K = Korean version of the Montreal Cognitive Assessment, K-MADS = Korean version of the Montgomery-Asberg Depression Scale, K-NMSS = Korean version of the Non-motor Symptoms Scale, K-PDQ39 SI = Korean version of the 39-item Parkinson's Disease Questionnaire summary index, K-SCOPA = Korean version of Scales for Outcomes in Parkinson's Disease, RBDQ = Rapid Eye Movement Sleep Behavior Disorders Screening Questionnaire, NOHQ = Neurogenic Orthostatic Hypotension Questionnaire.

Table 2. Descriptive statistics, and acceptability parameters of the K-SCOPA-S

K-SCOPA-S (n = 136)	Fully computable, %	Mean	Median	SD	Range
NS		3.77	3	3.72	0–15
Item 1	100	0.69	0	0.92	0–3
Item 2	100	0.80	1	0.93	0–3
Item 3	100	0.79	1	0.89	0–3
Item 4	100	0.78	0	0.93	0–3
Item 5	100	0.71	0	0.88	0–3
SQ	100	2.14	2	1.66	0–6
DS		2.57	2	2.55	0–15
Item 1	100	0.57	0	0.71	0–3
Item 2	100	0.65	0.5	0.79	0–3
Item 3	100	0.84	1	0.79	0–3
Item 4	100	0.11	0	0.42	0–3
Item 5	100	0.30	0	0.64	0–3
Item 6	100	0.08	0	0.32	0–2

K-SCOPA-S = Korean version of Scales for Outcomes in Parkinson's Disease-Sleep, SD = standard deviation, NS = nighttime sleep, SQ = sleep quality, DS = daytime sleepiness.

Table 3. Internal consistency and test-retest reliability of the K-SCOPA-S for PD

K-SCOPA-S (n = 136)	Cronbach's α	Item homogeneity	Corrected item-total correlation	Cronbach's α if item deleted	ICC (n = 133)
NS	0.876	0.59	N/A	N/A	0.88
Item 1		0.34–0.68	0.65	0.86	0.85
Item 2		0.53–0.72	0.74	0.84	0.83
Item 3		0.53–0.72	0.81	0.82	0.84
Item 4		0.34–0.58	0.58	0.88	0.84
Item 5		0.58–0.70	0.77	0.83	0.84
SQ	N/A	N/A	N/A	N/A	0.85
DS	0.749	0.34	N/A	N/A	0.85
Item 1		0.15–0.52	0.54	0.70	0.77
Item 2		0.17–0.63	0.65	0.66	0.81
Item 3		0.23–0.63	0.57	0.69	0.81
Item 4		0.27–0.55	0.52	0.72	0.66
Item 5		0.23–0.55	0.43	0.73	0.63
Item 6		0.15–0.32	0.32	0.76	0.80

K-SCOPA-S = Korean version of Scales for Outcomes in Parkinson's Disease-Sleep, PD = Parkinson's disease, ICC = intraclass correlation coefficient (using mixed model, type consistency, averaged measures), NS = nighttime sleep, N/A = not applicable, SQ = sleep quality, DS = daytime sleepiness.

Internal consistency

Table 3 displays data on internal consistency of K-SCOPA-S. The Cronbach's α -coefficients were 0.88 and 0.75 for the NS and DS subscales, respectively. The corrected item-total correlations ranged from 0.58 to 0.81 for the NS subscale and from 0.32 to 0.65 for the DS subscale. The corrected item-total correlations for all items, except K-SCOPA DS item 6, were ≥ 0.40 . The inter-item correlation coefficient was 0.59 and ranged from 0.34 (items 1 and 4) to 0.72 (items 2 and 3) for the NS subscale, and was 0.34 and ranged from 0.15 (items 1 and 6) to 0.63 (items 2 and 3) for the DS subscale.

Test-retest reliability

There was no significant difference between initial and follow-up scores ($P > 0.05$, Wilcoxon's test). Test-retest reliability of K-SCOPA-S, which was determined in 133 patients who performed the test twice, was 0.88 (ranged from 0.83 to 0.85) for the NS subscale, 0.85 for single-item on SQ, and 0.85 (ranged from 0.63 to 0.81) for DS (**Table 3**). The ICCs for all the items, except DS items 4 (0.66) and 5 (0.63) were ≥ 0.70 .

Construct validity

The correlation coefficient between K-SCOPA-S SQ and NS section was 0.66 ($P < 0.001$), whereas there was no significant correlation between K-SCOPA-S SQ and DS section. The SQ and NS sub-scores of K-SCOPA-S were significantly correlated with PDSS-2 item 1 (the overall quality of your night's sleep is), PDSS-2 total score, and sleep/fatigue sub-score of the K-NMSS (Table 4). Among the PDSS-2 items, item 2 (difficulty falling asleep) had the highest correlation ($r_s = 0.64$; $P < 0.001$) with K-SCOPA-S NS subscale (Table 4). There was a significant, but weak correlation between the DS sub-score, and the PDSS-2 total score ($r_s = 0.29$; $P < 0.001$) and sleep/fatigue sub-score of K-NMSS ($r_s = 0.26$; $P < 0.001$).

Correlation between K-SCOPA-S and other clinical variables

Correlation coefficients of K-SCOPA-S sub-scores with the PD-related scales are shown in Table 5. The correlations of K-SCOPA-S DS and NS sub-scores with HYS, UPDRS I, and UPDRS II were significant. The DS sub-score of K-SCOPA-S was significantly correlated with UPDRS III, while SQ and the NS sub-scores of K-SCOPA-S were not. K-MMSE and MoCA-K scores were not correlated with K-SCOPA-S scores.

The K-SCOPA-S DS sub-score had a moderate correlation with the cognitions sub-score of K-PDQ39 ($r_s = 0.48$). The SQ sub-score was moderately correlated with K-MADS score ($r_s = 0.44$), while the NS and DS sub-scores were weakly correlated ($r_s = 0.32$ and 0.27 , respectively). All the sub-scores of K-SCOPA-S had a significant correlation with the K-NMSS total, the K-PDQ39, the K-SCOPA autonomic and psychosocial, and the NOHQ scores. The DS sub-score of K-SCOPA-S was significantly correlated with RBDQ, while SQ and the NS sub-score of K-SCOPA-S was not.

DISCUSSION

We translated the SCOPA-S into Korean using a standard method to overcome the language barrier. We found K-SCOPA-S to be a reliable and valid instrument applicable to a Korean-

Table 4. Convergent validity of the K-SCOPA-S for PD

PDSS-2	K-SCOPA-S		
	NS	Overall SQ	DS
Item 1	0.58 ^a	0.69 ^a	-0.03
Item 2	0.64 ^a	0.56 ^a	0.01
Item 3	0.60 ^a	0.53 ^a	0.20 ^b
Item 4	0.24 ^a	0.22 ^b	0.13
Item 5	0.34 ^a	0.32 ^a	0.16
Item 6	0.21 ^b	0.22 ^b	0.13
Item 7	0.15	0.08	0.19 ^b
Item 8	0.24 ^a	0.11	0.23 ^a
Item 9	0.29 ^a	0.19 ^b	0.16
Item 10	0.29 ^a	0.24 ^a	0.10
Item 11	0.27 ^a	0.33 ^a	0.16
Item 12	0.19 ^b	0.15	0.09
Item 13	0.09	0.18 ^b	0.16
Item 14	0.42 ^a	0.37 ^a	0.19 ^b
Item 15	0.20 ^b	0.17 ^b	0.23 ^a
PDSS-2 total	0.63 ^a	0.58 ^a	0.29 ^a
K-NMSS sleep/fatigue	0.42 ^a	0.52 ^a	0.26 ^a

K-SCOPA-S = Korean version of Scales for Outcomes in Parkinson's Disease-Sleep, PD = Parkinson's disease, NS = nighttime sleep, SQ = sleep quality, DS = daytime sleepiness, PDSS-2, Parkinson's Disease Sleep Scale 2nd version, K-NMSS = Korean version of the Non-motor Symptoms Scale.

^a $P < 0.01$ by Spearman correlation; ^b $P < 0.05$ by Spearman correlation.

Table 5. Correlation of the K-SCOPA-S for PD with clinical variables

Variables	K-SCOPA-S		
	NS	Overall SQ	DS
Age, yr	-0.02	-0.09	0.01
Disease duration, mon	0.04	0.02	0.24 ^a
HYS	0.18 ^b	0.11	0.25 ^a
UPDRS I	0.27 ^a	0.31 ^a	0.27 ^a
UPDRS II	0.24 ^a	0.21 ^b	0.21 ^b
UPDRS III	0.02	0.03	0.19 ^b
K-MMSE	-0.12	-0.17	0.03
MoCA-K	-0.07	-0.08	-0.06
K-MADS	0.32 ^a	0.44 ^a	0.27 ^a
K-NMSS	0.34 ^a	0.40 ^a	0.33 ^a
Cardiovascular	0.12	0.14	0.16
Sleep/fatigue	0.42 ^a	0.52 ^a	0.26 ^a
Mood	0.20 ^b	0.35 ^a	0.18 ^b
Perceptual problems	0.01	0.04	0.23 ^a
Attention/memory	0.30 ^a	0.25 ^a	0.32 ^a
Gastrointestinal	0.06	0.12	0.23 ^a
Urinary	0.23 ^a	0.20 ^a	0.32 ^a
Sexual function	0	0.06	0.16
Miscellaneous	0.11	0.18 ^a	0.28 ^a
K-PDQ39 SI	0.30 ^a	0.33 ^a	0.30 ^a
Mobility	0.26 ^a	0.24 ^a	0.24 ^a
Activities of daily living	0.16	0.21 ^b	0.17 ^b
Emotional well-being	0.26 ^a	0.35 ^a	0.22 ^b
Stigma	0.22 ^a	0.26 ^a	0.08
Social support	0.16	0.22 ^a	0.27 ^a
Cognitions	0.29 ^a	0.32 ^a	0.48 ^a
Communication	0.17 ^b	0.19 ^b	0.29 ^a
Bodily discomfort	0.15	0.22 ^b	0.38 ^a
K-SCOPA cognition	-0.08	-0.13	-0.01
K-SCOPA autonomic	0.31 ^a	0.30 ^a	0.31 ^a
K-SCOPA psychosocial	0.34 ^a	0.34 ^a	0.28 ^a
RBDQ	0.10	0.07	0.28 ^a
NOHQ	0.26 ^a	0.28 ^a	0.35 ^a

K-SCOPA-S, Korean version of Scales for Outcomes in Parkinson's Disease-Sleep, PD = Parkinson's disease, NS = nighttime sleep, SQ = sleep quality, DS = daytime sleepiness, HYS = Hoehn and Yahr Scale, UPDRS = Unified Parkinson's Disease Rating Scale, K-MMSE = Korean version of the Mini-Mental Status Examination, MoCA-K = Korean version of the Montreal Cognitive Assessment, K-MADS = Korean version of the Montgomery-Asberg Depression Scale, K-NMSS = Korean version of the Non-motor Symptoms Scale, K-PDQ39 SI = Korean version of the 39-item Parkinson's Disease Questionnaire summary index, K-SCOPA = Korean version of Scales for Outcomes in Parkinson's Disease, RBDQ = Rapid Eye Movement Sleep Behavior Disorders Screening Questionnaire, NOHQ = Neurogenic Orthostatic Hypotension Questionnaire.

^aP < 0.01 by Spearman correlation; ^bP < 0.05 by Spearman correlation.

speaking PD population. The assessment was done in 27 different movement-disorder clinics by different investigators, which strengthened the impact of our study and the usefulness of K-SCOPA-S in clinical practice.

The mean NS and DS sub-scores of the K-SCOPA-S were lower in comparison to the results found using the Dutch and Thai versions of SCOPA-S.^{6,18} This discrepancy could be attributed to the milder severity and earlier stages of PD in patients in the current study cohort, compared to those in the original Netherlands study, or to the effect of weather (e.g., tropical night phenomenon) on SQ in Thailand. The mean NS and sub-scores of the current study were, however, similar to those reported using the Swedish version of K-SCOPA-S.¹⁹ The disease duration and severity in the Swedish patients with PD in that previous study was similar to those in the Korean patients with PD included in the current study.

Since a cut-off above 0.7 for Cronbach's α -coefficients is acceptable for internal consistency and reliability, the internal consistency of K-SCOPA-S was satisfactory, as Cronbach's α -coefficient was 0.876 and 0.749 for NS and DS, respectively. Test-retest reliability, which was 0.88 and 0.85 for NS and DS, respectively, when assessed by ICC, was also adequate. These results suggested that the K-SCOPA-S is a valid and reliable instrument to assess SQ in Korean patients with PD.

The SQ and NS sub-scores of K-SCOPA-S were significantly correlated with PDSS-2 item 1, PDSS-2 total score, and the sleep/fatigue sub-score of K-NMSS. However, the DS sub-score of K-SCOPA-S was only significantly correlated with the PDSS-2 total score and K-NMSS sub-score. This discrepancy may be related to the fact that PDSS-2 mainly evaluated NS (only 1 item assesses DS), whereas K-SCOPA-S evaluated both NS and DS in a more balanced way (5 and 6 items, respectively). The strength of SCOPA-S in the assessment of both nocturnal and daytime sleep problems was similarly addressed in a previous study comparing SCOPA-S and PDSS.²⁰

K-SCOPA-S was significantly correlated with scales for non-motor symptoms (namely, UPDRS I, K-NMSS, K-MADS, K-SCOPA autonomic, and K-SCOPA psychosocial), activities of daily living (UPDRS II), quality of life (K-PDQ39), neurogenic hypotension (NOHQ), and RBDQ (Table 5). The close correlations between sleep and mood/depression or quality of life in PD have been previously highlighted in other studies.²⁰⁻²⁷ This study showed that sleep problems measured by K-SCOPA-S were correlated with specific non-motor symptoms such as dysautonomia (K-SCOPA-autonomic and NOHQ) in addition to a general measure (K-NMSS) or psychosocial measure (K-SCOPA psychosocial). In line with these findings, it was reported that dysautonomia was more severe in those with sleep problems in PD.²⁸ Interestingly, the DS sub-score rather than the NS sub-score was significantly correlated with RBDQ. The importance of DS in rapid eye movement sleep behavior disorder (RBD) was previously reported. DS was higher in those with RBD than without RBD in PD and an important predictor for the conversion into neurodegenerative disorders in idiopathic RBD, suggesting that DS could be related to more severe pathologies in the brain including arousal system.^{29,30} Our study showed that K-SCOPA-S was useful in detecting sleep problems in PD and its clinical significance was substantiated by the close association with other non-motor scales, which was consistent with previous studies.

In the current study, specialized scales for cognition, such as K-MMSE, MoCA-K, and K-SCOPA cognition showed poor correlation with K-SCOPA-S, whereas sub-scores of K-NMSS (attention/memory) and K-PDQ39 (cognition) showed significant correlations. Previous studies showed that sleep disturbance exerted an adverse effect on cognitive function in patients with PD.³¹ According to a recent meta-analysis, sleep disorders in patients with PD were associated with memory and executive function.³² Patients with PD and RBD reported more cognitive dysfunction.³³ Thus, it is plausible that sleep problems have a significant effect on the cognition of patients with PD. Rather than directly measuring cognitive function, the questions on cognition of patients with PD, in the K-NMSS and K-PDQ39, are actually designed to identify practical problems related to cognitive dysfunction. Therefore, the significant correlation between K-SCOPA-S and the cognitive items in K-NMSS/K-PDQ39 may support the usefulness of these scales in the practical management of patients with PD.

The subscales of K-SCOPA-S, except SQ, were partly correlated with motor scales of PD (HYS and UPDRS III), although the correlation was not strong. A preliminary study of PDSS

reported a significant difference between advanced and early PD,³⁴ which was not confirmed by others.^{35,36} In other studies, sleep problems were associated with disease severity.^{37,38} Thus, sleep deteriorates with disease progression. Interestingly, an 8-year follow-up study showed a significant fluctuation of the severity of insomnia in a cohort of patients with PD.³⁹ Thus, sleep disorder in PD was not homogeneous along the course of the disease and its manifestation may not be determined by a simple factor (disease severity).³⁷⁻³⁹

A few limitations in our study must be noted. The majority of patients in the current cohort had a HYS score of 2.5 or less (81.8%), which could be a limitation. Since this study required two consecutive visits at an interval of 2 weeks, it was challenging to recruit patients with advanced PD. Nonetheless, the correlation between disease severity and K-SCOPA-S was only partial and weak, suggesting that disease severity was not a strong confounder. The second potential limitation of this study is the use of a self-questionnaire for data acquisition. However, the test-retest reliability of K-SCOPA-S was excellent enough to argue against the uncertainties associated with the subjective assessment of sleep problems.

In conclusion, the results of the current study demonstrated that K-SCOPA-S exhibited good reliability and validity to assess sleep problems in Korean patients with PD. Moreover, its clinical usefulness was substantiated by its significant correlation with other measures of clinical assessment.

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Appendix 1. Scale for Outcomes in Parkinson's Disease-Sleep (original version)

Aim of the Questionnaire

By means of this questionnaire, we would like to find out to what extent *in the past month* you have had problems with sleeping. Some of the questions are about problems with sleeping *at night*, such as, for example, not being able to fall asleep or not managing to sleep on. Another set of questions is about problems with sleeping *during the day*, such as dozing off (too) easily and having trouble staying awake.

First read these instructions before you answer the questions!

Place a cross in the box above the answer which best reflects your situation.

If you wish to change an answer, fill in the 'wrong' box and place a cross in the correct one. If you have been using sleeping tablets, then the answer should reflect how you have slept while taking these tablets.

NS: Nighttime Sleep Problems

response options: not at all – a little – quite a bit – a lot

In the past month, ...

1. ... have you had trouble falling asleep when you went to bed at night?
2. ... to what extent do you feel that you have woken *too often*?
3. ... to what extent do you feel that you have been lying awake for *too long* at night?
4. ... to what extent do you feel that you have woken up *too early* in the morning?
5. ... to what extent do you feel you have had *too little* sleep at night?

Overall, how well have you slept at night during the past month?

response options: very well – well – rather well – not well but not badly – rather badly – badly – very badly

DS: Daytime Sleepiness

response options: never – sometimes – regularly – often

1. How often in the past month have you fallen asleep unexpectedly either during the day or in the evening?
2. How often in the past month have you fallen asleep while sitting peacefully?
3. How often in the past month have you fallen asleep while watching TV or reading?
4. How often in the past month have you fallen asleep while talking to someone?
5. In the past month, have you had trouble staying awake during the day or in the evening?
6. In the past month, have you experienced falling asleep during the day as a problem?

Appendix 2. Scale for Outcomes in Parkinson's Disease-Sleep (Korean version)

SCOPA-수면

이 설문지는 지난 한달 동안 수면에 어떤 문제가 있는 지를 파악하기 위한 것입니다. 질문 중 일부는 잠들지 못하거나, 중간에 잠이 깨는 것과 같은 야간 수면 문제입니다. 다른 질문들은 낮에 너무 쉽게 잠들거나 깨어 있기 어려운 낮 시간의 수면 문제에 대한 것입니다.

A. 수면제 사용

A1. 지난 몇 개월 동안 수면제를 몇 번 복용하하셨습니까?

(의사 처방을 받거나 그렇지 않았거나)

전혀 없음

일주일당 1회 미만

일주일당 1, 2회

일주일당 3회 이상

A2. 지난 한달 동안 수면제를 몇 번 복용하하셨습니까?

이름: _____ 한달 복용량: _____ 1회 복용량: _____

이름: _____ 한달 복용량: _____ 1회 복용량: _____

이름: _____ 한달 복용량: _____ 1회 복용량: _____

B. 야간 수면

다음은 야간 수면에 대한 질문입니다. 수면제를 복용하고 있다면, 약을 복용하는 상태를 기준으로 답을 하시면 됩니다.

B1. 지난 한달 동안 밤에 잠이 들기가 어려운 일이 어느 정도 있었습니까?

전혀 없음

약간

상당히 많음

많음

B2. 지난 한달 동안 너무 자주 깬다고 느낀 일이 어느 정도 있었습니까?

전혀 없음

약간

상당히 많음

많음

B3. 지난 한달 동안 밤에 너무 오래 잠이 들지 않았다고 느꼈던 일이 어느 정도 있었습니까?

전혀 없음

약간

상당히 많음

많음

B4. 지난 한달 동안 아침에 너무 일찍 깬다고 느낀 일이 어느 정도 있었습니까?

전혀 없음

약간

상당히 많음

많음

B5. 지난 한달 동안 밤에 잠을 너무 적게 잔다고 느낀 일이 얼마나 있었습니까?

전혀 없음

약간

상당히 많음

많음

(continued to the next page)

Appendix 2. (Continued) Scale for Outcomes in Parkinson's Disease-Sleep (Korean version)

C1. 전반적으로 평가할 때 지난 한달 동안 잠을 얼마나 잘 잤습니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
매우 잘 잤다	잘 잤다	다소 잘 잤다	그럭저럭 잤다	다소 못 잤다	잘 못 잤다	아주 못 잤다

D. 낮과 저녁 시간 수면

D1. 지난 한달 동안 낮 또는 저녁에 갑자기 잠에 든 일이 몇 번입니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주

D2. 지난 한달 동안 편안하게 앉아 있다가 잠 든 일은 얼마나 자주 있었습니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주

D3. 지난 한달 동안 TV를 보거나, 책을 읽다가 잠이 든 일은 얼마나 자주 있었습니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주

D4. 지난 한달 동안 다른 사람과 이야기하다가 잠든 일이 얼마나 자주 있었습니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주

D5. 지난 한달 동안 낮 또는 저녁에 깨어 있기 힘들었던 일이 있습니까?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주

D6. 지난 한달 동안 낮에 잠이 들어서 문제가 된 적이 있나요?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
전혀 없음	가끔	주기적으로	자주