Validation of the Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale

Ji-Hyun Choi[a]*, Jee-Young Lee[a]*, Jin Whan Cho[b], Seong-Beom Ko[c], Tae-Beom Ahn[d], Sang Jin Kim[e], Sang-Myung Cheon[f], Joong-Seok Kim[g], Yoon-Joong Kim[h], Hyeo-Il Ma[h], Jong Sam Baik[i], Phil Hyu Lee[j], Sun Ju Chung[k], Jong-Min Kim[l], In-Uk Song[m], Han-Joon Kim[n], Young-Hee Sung[o], Do Young Kwon[p], Jae-Hyeok Lee[q], Ji-Young Kim[r], Ji Sun Kim[b], Ji Young Yun[s], Hee Jin Kim[t], Jin Yong Hong[u], Mi-Jung Kim[c], Jinyoung Youn[b], Ji Seon Kim[v], Eung Seok Oh[w], Hui-Jun Yang[x], Won Tae Yoon[y], Sooyeoun You[z], Kyum-Yil Kwon[A], Hyung-Eun Park[g], Su-Yun Lee[f], Younsoo Kim[B], Hee-Tae Kim[C], Mee Young Park[D]

[a]Department of Neurology, Seoul Metropolitan Government-Seoul National University Boramae Medical Center, Seoul National University College of Medicine, Seoul, Korea.
[b]Department of Neurology and Neuroscience Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
[c]Department of Neurology, Korea University Guro Hospital, Korea University College of Medicine, Seoul, Korea
[d]Department of Neurology, Kyung Hee University College of Medicine, Seoul, Korea
[e]Department of Neurology, Inje University Busan Paik Hospital, Inje University College of Medicine, Busan, Korea
[f]Department of Neurology, Dong-A University College of Medicine, Busan, Korea
[g]Department of Neurology, Seoul St. Mary's Hospital, The Catholic University of Korea College of Medicine, Seoul, Korea
[h]Department of Neurology, Hallym University College of Medicine, Anyang, Korea
[i]Department of Neurology, Inje University Sanggye Paik Hospital, Inje University College of Medicine, Seoul, Korea
[j]Department of Neurology, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea
[k]Department of Neurology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea
[l]Department of Neurology, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seongnam, Korea
[m]Department of Neurology, Incheon St. Mary's Hospital, The Catholic University of Korea, Incheon, Korea
[n]Department of Neurology, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Korea
[o]Department of Neurology, Gachon University Gil Hospital, Incheon, Korea
[p]Department of Neurology, Korea University Ansan Hospital, Korea University College of Medicine, Ansan, Korea
[q]Department of Neurology, Pusan National University Yangsan Hospital, Yangsan, Korea
[r]Department of Neurology, Inje University Seoul Paik Hospital, Seoul, Korea
[s]Department of Neurology, Ewha Womans University Mokdong Hospital, Ewha Womans University School of Medicine, Seoul, Korea
[t]Department of Neurology, Konkuk University School of Medicine, Seoul, Korea
[u]Department of Neurology, Yonsei University Wonju College of Medicine, Wonju, Korea
[v]Department of Neurology, Chungbuk National University Hospital, Chungbuk National University School of Medicine, Cheongju, Korea
[w]Department of Neurology, Chungnam National University Hospital, Chungnam National University School of Medicine, Daejeon, Korea
[x]Department of Neurology, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, Korea
[y]Department of Neurology, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, Korea
[z]Department of Neurology, Keimyung University School of Medicine, Daegu, Korea
[A]Department of Neurology, Soonchunhyang University Seoul Hospital, Soonchunhyang University School of Medicine, Seoul, Korea
[B]Department of Neurology, Changwon Samsung Hospital, Changwon, Korea
[C]Department of Neurology, Hanyang University College of Medicine, Seoul, Korea
[D]Department of Neurology, Yeungnam University College of Medicine, Daegu, Korea

Correspondence
Mee Young Park, MD, PhD, Department of Neurology, Yeungnam University College of Medicine, 170 Hyeunchung-ro, Nam-gu, Daegu 42415, Korea
Tel +82-53-620-3682, **Fax** +82-53-627-1688, **E-mail** mypark@med.yu.ac.kr

Correspondence
Jin Whan Cho, MD, PhD, Department of Neurology and Neuroscience Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Korea
Tel +82-2-3410-1279, **Fax** +82-2-3410-0052, **E-mail** jinwhan.cho@samsung.com

*These authors contributed equally to this work.

Background and Purpose Impulse-control disorder is an important nonmotor symptom of Parkinson's disease (PD) that can lead to financial and social problems, and be related to a poor quality of life. A nationwide multicenter prospective study was performed with the aim of validating the Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale (K-QUIP-RS).

Methods The K-QUIP-RS was constructed using forward and backward translation, and pre-testing of the prefinal version. PD patients on stable medical condition were recruited from 27 movement-disorder clinics. Participants were assessed using the K-QUIP-RS and evaluated for parkinsonian motor and nonmotor statuses and for PD-related quality of life using a predefined evaluation battery. The test–retest reliability of the K-QUIP-RS was assessed over an interval of 10−14 days, and correlations between the KQUIP-RS and other clinical scales were analyzed.

Results This study enrolled 136 patients. The internal consistency of the K-QUIP-RS was indicated by a Cronbach's α coefficient of 0.846, as was the test–retest reliability by a Guttman split-half coefficient of 0.808. The total K-QUIP-RS score was positively correlated with the scores for depression and motivation items on the Unified PD Rating Scale (UPDRS), Montgomery-Asberg Depression Scale, and Rapid-Eye-Movement Sleep-Behavior-Disorders Questionnaire. The total K-QUIP-RS score was also correlated with the scores on part II of the UPDRS and the PD Quality of Life-39 questionnaire, and the dopaminergic medication dose.

Conclusions The K-QUIP-RS appears to be a reliable assessment tool for impulse-control and related behavioral disturbances in the Korean PD population.

Key Words parkinson disease, impulsive behavior, compulsive behavior, rating scale, validation study.

INTRODUCTION

Impulse-control disorder (ICD) and compulsive repetitive behaviors such as hobbyism/punding and dopamine dys-regulation syndrome (DDS) are common in Parkinson's disease (PD). The prevalence of ICD and related behaviors in PD patients has been reported to be 10−20%.[1-16] A recent study found that the 5-year cumulative incidence of ICD and related behaviors in PD was 46%.[17,18] It is important to assess ICD and related behaviors because these behavioral disturbances can lead to devastating financial problems, emerging problems with online gambling or shopping, and impaired quality of life in both patients and their caregivers.[19]

The Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease (QUIP) has been developed for screening pathological gambling, hypersexuality, excessive buying, overeating, hobbyism/punding, and DDS in PD patients.[8] However, it cannot be used to assess the severity of these behavioral disturbances, nor monitor changes in these behaviors. The Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale (QUIP-RS) is a self-reported tool for assessing the severity of ICD and related behaviors that uses a 5-point Likert scale based on frequency.[20]

The present nationwide multicenter prospective study aimed to validate the Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale (K-QUIP-RS) and to determine the correlations between the severity of impulsive-compulsive behaviors and clinical features and the quality of life in the Korean PD population.

METHODS

Study participants

We recruited patients with PD from 27 movement-disorder centers at university-affiliated hospitals in Korea. Korean PD patients who met the diagnostic criteria of the UK Parkinson's Disease Society Brain Bank[21] and had been taking stable doses of antiparkinsonian medications for at least 4 weeks prior to their participation were included in this study. Patients were excluded when they had a diagnosis of secondary parkinsonism or symptoms suggesting Parkinson-plus syndrome (e.g., multiple system atrophy,[22] progressive supranuclear palsy,[23] corticobasal degeneration,[24] or dementia with Lewy bodies[25]), had undergone deep-brain stimulation, had a history of psychiatric diseases with antipsychotic or antidepressant medications that could secondarily affect behaviors, or had taken medication that can cause drug-induced parkinsonism. The Institutional Review Board at each participating hospital approved this study (SMG-SNU Boramae Medical Center, IRB No. 16-2014-119). Informed consent was obtained by all subjects.

We constructed the K-QUIP-RS through forward and back-

ward translation of the original QUIP-RS.[20] After expert panels had reviewed the draft of the K-QUIP-RS, it was applied to four Korean PD patients to confirm its validity prior to this study. The final version of the K-QUIP-RS is provided as supplementary data.

Assessment

Clinical assessments were performed using the following components: the total daily levodopa equivalent dose (total LED) and the agonist LED from the doses of dopamine agonists only,[26] the Hoehn and Yahr (H&Y) stage,[27] the Unified Parkinson's Disease Rating Scale (UPDRS) parts I, II, and III,[28] the Korean Version of the Mini Mental State Examination (K-MMSE),[29] the Korean Version of the Montreal Cognitive Assessment (MoCA-K),[30] the Korean Version of the Montgomery-Asberg Depression Scale (K-MADS),[31] the Korean Version of the 39-item Parkinson's Disease Questionnaire (K-PDQ39),[32] and the Korean Version of the Rapid-Eye-Movement Sleep-Behavior-Disorders Screening Questionnaire (K-RBDQ).[33,34] The test–retest reliability was measured by performing K-QUIP-RS assessments twice within 10−14 days after the first assessment, which allowed sufficient time to minimize learning effects.

Statistical analysis

We used Cronbach's α coefficient to check the internal consistency of the K-QUIP-RS with a criterion of ≥0.70. The test–retest reliability of the K-QUIP-RS was assessed using the Guttman split-half coefficient. Spearman's correlation analysis was used to investigate correlations of the K-QUIP-RS score with other clinical scales. SPSS software (version 21.0, IBM Corp., Armonk, NY, USA) was used for statistical analysis, with the significance cutoff set at 0.05 (two-tailed).

RESULTS

This study enrolled 136 patients (65 males) aged 66.8±9.0 years (mean±SD) and with a PD duration of 47.3±46.8 months. The retest evaluation was completed in 133 of these patients. The demographic and clinical characteristics of the participants finally included in the analysis are summarized in Table 1.

K-QUIP-RS scores in the study population

The total K-QUIP-RS score was 2.5±5.0 (range, 0 to 28), and the total ICD items score—comprising the summation score in the domains of gambling, hypersexuality, buying, and eating—was 1.2±2.7 (range, 0 to 16). The frequencies of positive responders for the gambling, hypersexuality, buying, and eating items were 5.9%, 9.6%, 11.8%, and 20.6%, respectively. The frequency of positive responders for any of these

Table 1. Characteristics of the 136 patients included in this study

Variable	Value
Age, years	66.8±9.0 (39–85)
Sex, male	65 (47.8)
Disease duration, months	47.3±46.8 (1–252)
Total LED, mg/day	654.8±473.4 (0–2250)
Agonist LED, mg/day	107.5±149.7 (0–825)
H&Y stage	2.1±0.7 (1–5)
UPDRS part I score	2.0±2.0 (0–8)
UPDRS part II score	7.8±6.0 (0–29)
UPDRS part III score	20.2±11.0 (0–54.5)
K-MMSE score	26.9±3.7 (4–30)
MoCA-K score	22.6±5.0 (1–30)
K-MADS score	10.3±9.6 (0–40)
K-PDQ39 summary index	33.1±28.5 (0–123)
K-RBDQ score	3.3±2.9 (0–13)

Data are mean±SD (range) or n (%) values.
H&Y: Hoehn and Yahr, K-MADS: Korean Version of the Montgomery-Asberg Depression Scale, K-MMSE: Korean Version of the Mini Mental State Examination, K-PDQ39: Korean Version of the Parkinson's Disease Quality of Life-39, K-RBDQ: Korean Version of the Rapid-Eye-Movement Sleep-Behavior-Disorders Screening Questionnaire, LED: levodopa equivalent dose, MoCA-K: Korean Version of the Montreal Cognitive Assessment, UPDRS: Unified Parkinson's Disease Rating Scale.

Table 2. Distribution of the K-QUIP-RS scores in the Parkinson's disease patients included in this study

K-QUIP-RS domain	Mean±SD	Median (range)	n (%) for score ≥1	n (%) for score ≥ suggested cutoff*
Gambling	0.3±1.3	0 (0–12)	8 (5.9)	1 (0.7)
Hypersexuality	0.2±0.9	0 (0–7)	13 (9.6)	0 (0.0)
Buying	0.2±0.8	0 (0–5)	16 (11.8)	0 (0.0)
Eating	0.5±1.2	0 (0–8)	28 (20.6)	1 (0.7)
Hobbyism/punding	1.1±2.6	0 (0–18)	33 (24.3)	6 (4.4)
DDS	0.2±1.2	0 (0–10)	6 (4.4)	NA
Summed score for ICD†	1.2±2.7	0 (0–16)	39 (28.7)	5 (3.7)
Total K-QUIP-RS score	2.5±5.0	0 (0–28)	47 (34.6)	NA

*Cutoffs from the original American Version of the QUIP-RS: gambling, ≥6; hypersexuality, ≥8; buying, ≥8; eating, ≥7; hobbyism/punding, ≥7; and summed score for ICD, ≥10, †Summed score for ICD domains includes gambling, hypersexuality, buying, and eating.
DDS: dopamine dysregulation syndrome, ICD: impulse-control disorder, K-QUIP-RS: Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale, NA: not available.

four ICD domains was 28.7%. Based on a recommended cutoff of the total ICD items score of ≥10 for diagnosing ICD in PD,[20] 3.7% of the participants were classified as having ICD. The scores and frequencies in the individual domains and for the total K-QUIP-RS score are presented in Table 2.

Internal consistency and test–retest reliability of the K-QUIP-RS

Cronbach's α coefficient for the total K-QUIP-RS was 0.846, and it was also ≥0.70 in each K-QUIP-RS domain. The scores in each domain of the K-QUIP-RS were correlated with the total K-QUIP-RS score (Spearman's rank correlation coefficient=0.392−0.887, $p<0.001$ in all) (Table 3). The Guttman split-half coefficient for the total K-QUIP-RS score was 0.808, and it was also ≥0.70 for the sum of the ICD items and for the score in all except two ICD domains: hypersexuality (0.079) and DDS (0.347) (Table 3).

Correlation between the K-QUIP-RS score and other clinical measures

The total K-QUIP-RS score and the summed score for ICD items were not correlated with age, PD duration, parkinsonian motor severity (H&Y stage and UPDRS part III score), or global cognition (K-MMSE and MoCA-K scores). However, the total K-QUIP-RS score was positively correlated with the UPDRS part I score, specifically for depression and motivation items (r=0.176 and 0.239, and p=0.041 and 0.005, respectively), and with the UPDRS part II score (r=0.214 and p=0.012). Both the total K-QUIP-RS score and the summed scores for ICD domains were positively correlated with scores on the K-MADS (r=0.224 and 0.230, and p=0.009 and 0.007,

Table 3. Test–retest reliability of the K-QUIP-RS and coefficients for the correlations between the various domains and the total K-QUIP-RS score

K-QUIP-RS domain	Guttman split–half coefficient	Spearman's rank correlation	
		rS	p
Gambling	0.908	0.392	<0.001
Hypersexuality	0.079	0.539	<0.001
Buying	0.863	0.551	<0.001
Eating	0.708	0.723	<0.001
Hobbyism/punding	0.830	0.820	<0.001
DDS	0.347	0.379	<0.001
Summed score for ICD	0.726	0.887	<0.001
Total K-QUIP-RS score	0.808	-	-

Summed score for ICD domains includes gambling, hypersexuality, buying, and eating.
DDS: dopamine dysregulation syndrome, ICD: impulse-control disorder, K-QUIP-RS: Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale, rS: Spearman's rank correlation coefficient.

respectively), K-RBDQ (r=0.220 and 0.216, and p=0.010 and 0.012), and K-PDQ39 (r=0.223 and 0.171, and p=0.009 and 0.048) (Fig. 1). The total K-QUIP-RS score was also correlated with the total and agonist LEDs (r=0.209 and 0.181, and p=0.019 and 0.043, respectively) (Fig. 1). The results obtained in the correlation analysis are summarized in Table 4.

DISCUSSION

This nationwide multicenter study has demonstrated that the K-QUIP-RS has good consistency and reliability in the Korean PD population. Cronbach's α coefficient was 0.846 for the total K-QUIP-RS and also ≥0.70 in every K-QUIP-RS domain. The test–retest reliability was good for the total K-QUIP-RS and in four of the six K-QUIP-RS domains, and suboptimal for the hypersexuality (0.079) and DDS (0.347) domains (based on the Guttman split-half coefficient).

In this study population, the frequency of positive responders for any of four ICD domains in the K-QUIP-RS was 28.7%, and for any of all six domains was 34.6%. However, the prevalence of ICD in this study population was estimated to be 3.7% when we applied the suggested cutoff.[20] This was lower than the range of reported prevalence rates of ICD (5–20%),[1-3,5-7,9-16] and also much lower than those reported for the French QUIP-RS study (12.5%) and the Mexican QUIP-RS study (4.6%) with the same cutoff applied.[16,35]

The scores in four ICD domains in this study were also lower than those in the original report on an American population and in reports from other countries including France, Mexico, Germany, and Philippines.[16,35-37] These discrepancies might be related to the low proportion of users of high-dose dopamine agonist in this study, because dopamine agonist is a strong risk factor for ICD in PD, which is dose-dependent.[5,17,18] In addition, our study population included patients who were much older at the onset of PD and included a lower proportion of males than the other studies, and both of these factors are negatively associated with the risk of ICD.[1,18] In line with this, the inclusion of only a small number of early-onset PD patients in our study might have contributed to the relatively low ICD prevalence in the study population. Previous studies found that the susceptibility to ICD was higher in patients with *parkin* or *PINK1* mutations,[38-41] and that the ICD scores of the QUIP-RS were higher in PD/ICD with *parkin* mutation than in gene-negative early-onset PD/ICD.[41] However, the genetic predisposition to develop ICD was not investigated in the present validation study. Moreover, the lower severity of ICD in the present population might have also been related to the tendency of Korean patients to underreport their behaviors on self-reported questionnaires. Influences of variations in ethnic characteristics and cultural
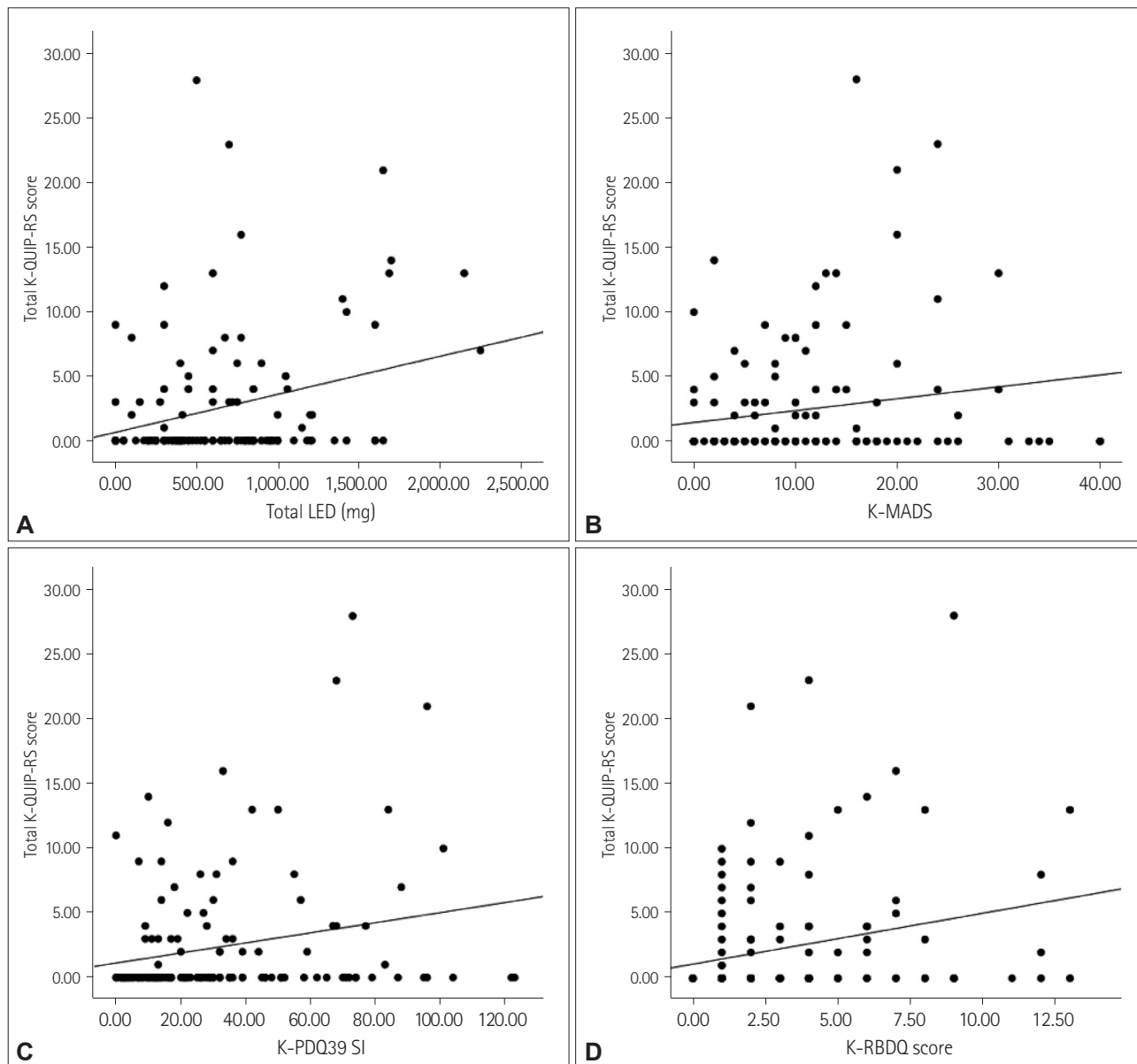
Fig. 1. Correlations between the total score on the K-QUIP-RS and other clinical measures. (A) total LED (R^2=0.078, *p*=0.019) and scores on the (B) K-MADS (R^2=0.033, *p*=0.009), (C) K-PDQ39 SI (R^2=0.052, *p*=0.009), and (D) K-RBDQ (R^2=0.057, *p*=0.010). K-MADS: Korean Version of the Montgomery-Asberg Depression Scale, K-PDQ39: Korean Version of the Parkinson's Disease Questionnaire-39, K-QUIP-RS: Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale, K-RBDQ: Korean Version of the Rapid-Eye-Movement Sleep-Behavior-Disorders Screening Questionnaire, LED: levodopa equivalent dose, SI: summary index.

backgrounds might result in the optimal cutoff for ICD of the QUIP-RS differing between populations. In a German validation study, the optimal cutoff was 3 points lower than that in the original QUIP-RS developed in the US.[36] Further investigations of the K-QUIP-RS are deemed necessary to confirm whether the suggested cutoff from the original version[20] is reliable in the Korean PD population.

The low test–retest reliability found for the hypersexuality domain of the K-QUIP-RS in this study might be explained by the characteristics of Confucian culture in Korea. Con-

fucian culture emphasizes concealing sexual desire or being ashamed to be revealed as having abnormal sexual behavior,[42] which could contribute to the tendency of Korean PD patients to underreport hypersexuality more than other ICD behaviors, and could also result in greater variations in their reported values during repeated screening. Another possibility is that the questionnaire for hypersexuality is not sufficiently sensitive to detect this type of ICD in Korean PD patients. An intriguing finding of this study was that the most-frequent and severe ICD type was eating, whereas a previous

Table 4. Coefficients for the correlations between the K-QUIP-RS score and clinical variables

Variable	Summed score for ICD	Total QUIP–RS score
Age	-0.063	-0.160
Disease duration	0.044	0.077
Total LED	0.134	0.209*
Agonist LED	0.117	0.181*
H&Y stage	0.091	0.121
UPDRS part I	0.091	0.200*
Intellectual impairment	0.114	0.133
Thought disorder	0.078	0.105
Depression	0.026	0.176*
Motivation/initiative	0.152	0.239†
UPDRS part II	0.114	0.214*
UPDRS part III	0.058	0.084
K-MMSE score	-0.133	-0.132
MoCA-K score	-0.028	-0.044
K-MADS score	0.230**	0.224†
K-PDQ39 summary index	0.171*	0.223†
Mobility	0.110	0.160
Activities of daily living	0.139	0.171*
Emotional well-being	0.145	0.213*
Stigma	0.040	0.122
Social support	0.170*	0.219*
Cognition	0.259*	0.273†
Communication	0.238**	0.264†
Bodily discomfort	0.231**	0.302†
K-RBDQ score	0.216*	0.220*

Summed score for ICD domains includes gambling, hypersexuality, buying, and eating. Spearman's rank correlation test: *$p<0.05$, †$p<0.01$. H&Y: Hoehn and Yahr, ICD: impulse-control disorder, K-MADS: Korean Version of the Montgomery-Asberg Depression Scale, K-MMSE: Korean Version of the Mini Mental State Examination, K-PDQ39: Korean Version of the Parkinson's Disease Quality of Life-39, K-QUIP-RS: Korean Version of the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale, K-RBDQ: Korean Version of the Rapid-Eye-Movement Sleep-Behavior-Disorders Screening Questionnaire, LED: levodopa equivalent dose, UPDRS: Unified Parkinson's Disease Rating Scale.

single-center study of screening ICD using the QUIP[8] and a multicenter study using the mMIDI (modified Minnesota Impulsive Disorders Interview)[43] in the Korean PD population found that hypersexuality was the most-common ICD.[6,44] In contrast to these two previous studies, we strictly excluded subjects who had previously received or were currently receiving treatment for psychiatric diseases; this might have contributed to the inconsistent finding of ICD being less devastating or problematic in our study than in those previous ones. However, the low reliability in the hypersexuality domain of the K-QUIP-R suggested that hypersexuality was underestimated, for the reasons mentioned above. On the oth-

er hand, the prevailing ICD in PD has varied between different countries, being hypersexuality in Finland (22.8%), Brazil (11.8%), India (11.4%), and Denmark (9%), eating in Norway (10%), Malaysia (8.7%), and Mexico (8.6%), buying in the US and Canada (5.7%), and gambling in Japan (6.5%) and the US and Canada (5%).[1,5,9,11-16]

We found a low test–retest reliability for DDS ($r=0.347$) in this study. Previous studies of the QUIP-RS in other populations have also found low reliability in the DDS domain, with r values of 0.58 and 0.61 in French and German populations, respectively.[35,36] DDS is usually accompanied by mood swings such as hypomanic, manic, or cyclothymic mood in the medication-on state, and withdrawal dysthymia or depression when dopaminergic medications are reduced.[45-47] These fluctuating symptoms might affect the reliability of using the QUIP-RS to detect DDS. PD patients with DDS take more dopaminergic medications to alleviate the medication-off mood states and motor symptoms, but patients with DDS experience smaller improvements than PD patients without DDS when treated with the same medication.[48] This might result in them underreporting their condition in such a self-reported questionnaire, or discriminating DDS from true dopaminergic medication use might be difficult when patients suffer dopa-responsive nonmotor medication-off symptoms based on the self-reports. On the other hand, the ICD severity was found to be lower when assessed in a self-reported questionnaire than in caregiver reports, and the assessment of ICD can be improved by using a clinician-rated scale.[49,50]

The total K-QUIP-RS score and the ICD-item summed scores were not related to the parkinsonian motor severity or global cognition, but they were correlated with depression, quality of life, and rapid-eye-movement sleep-behavior disorders (RBD). Other than dopaminergic drugs, the previously reported risk factors for ICD include being younger at PD onset, male,[1,5,16-18] and having depression, alexithymia, anxiety, aggression, impulsivity, or obsessive-compulsiveness.[51-54] Previous findings for the relationship between RBD and ICD in PD have been controversial, with some studies showing an association and others finding no significant relationship.[55-57] According to a recent large population-based epidemiological study of RBD, the risk of RBD development is associated with male sex, alcohol use, smoking, antidepressant use for depression, and psychological distress,[58] which are also shared risk factors for ICD.[13,51,59] Our study supports the presence of associations between ICD and depression and RBD. However, since this study had a cross-sectional design, future longitudinal studies are needed that consider other risk factors for ICD including the history of smoking, alcohol use, and drug- and substance-use disorders.

This multicenter validation study has shown that the K-

QUIP-RS is a useful screening tool with good consistency and reliability for assessing ICD and related behavioral disturbances in the Korean PD population. However, further validation studies are needed to determine the optimal cut-off score of the K-QUIP-RS, how to implement a confirmative interview between the physician and both patients and caregivers, and how best to examine patients when ascertaining the presence of ICD, particularly for assessing hypersexuality and DDS.

Author Contributions

Conceptualization: Mee Young Park, Jin Whan Cho, Jee-Young Lee, Seong-Beom Ko, Tae-Beom Ahn. Data curation and Investigation: Ji-Hyun Choi, Jee-Young Lee, Jin Whan Cho, Seong-Beom Ko, Tae-Beom Ahn, Sang Jin Kim, Sang-Myung Cheon, Joong-Seok Kim, Yoon-Joong Kim, Hyeo-Il Ma, Jong Sam Baik, Phil Hyu Lee, Sun Ju Chung, Jong-Min Kim, In-Uk Song, Han-Joon Kim, Young-Hee Sung, Do Young Kwon, Jae-Hyeok Lee, Ji-Young Kim,Ji Sun Kim, Ji Young Yun, Hee Jin Kim, Jin Yong Hong, Mi-Jung Kim, Jinyoung Youn, Ji Seon Kim, Eung Seok Oh, Hui-Jun Yang, Won Tae Yoon, Sooyeoun You, Kyum-Yil Kwon, Hyung-Eun Park, Su-Yun Lee, Younsoo Kim, Hee-Tae Kim, Mee Young Park. Methodology: Mee Young Park, Jin Whan Cho, Jee-Young Lee. Writing—original draft: Ji-Hyun Choi, Jee-Young Lee. Writing—review & editing: Mee Young Park, Jin Whan Cho.

ORCID iDs

Ji-Hyun Choi	https://orcid.org/0000-0003-2310-1368
Jee-Young Lee	https://orcid.org/0000-0002-9120-2075
Jin Whan Cho	https://orcid.org/0000-0002-9145-6729
Seong-Beom Ko	https://orcid.org/0000-0002-9411-4863
Tae-Beom Ahn	https://orcid.org/0000-0002-7315-6298
Sang Jin Kim	https://orcid.org/0000-0001-7240-2154
Sang-Myung Cheon	https://orcid.org/0000-0001-5905-2188
Joong-Seok Kim	https://orcid.org/0000-0001-8087-7977
Yoon-Joong Kim	https://orcid.org/0000-0002-2956-1552
Hyeo-Il Ma	https://orcid.org/0000-0001-6733-9779
Jong Sam Baik	https://orcid.org/0000-0002-5300-203X
Phil Hyu Lee	https://orcid.org/0000-0001-9931-8462
Sun Ju Chung	https://orcid.org/0000-0003-4118-8233
Jong-Min Kim	https://orcid.org/0000-0001-5723-3997
In-Uk Song	https://orcid.org/0000-0002-0181-0844
Han-Joon Kim	https://orcid.org/0000-0001-8219-9663
Young-Hee Sung	https://orcid.org/0000-0002-2840-1338
Do Young Kwon	https://orcid.org/0000-0002-5414-0397
Jae-Hyeok Lee	https://orcid.org/0000-0002-4274-7415
Ji-Young Kim	https://orcid.org/0000-0002-0666-927X
Ji Sun Kim	https://orcid.org/0000-0003-3669-9151
Ji Young Yun	https://orcid.org/0000-0001-9648-9450
Hee Jin Kim	https://orcid.org/0000-0003-1554-2657
Jin Yong Hong	https://orcid.org/0000-0002-2476-3737
Mi-Jung Kim	https://orcid.org/0000-0001-9097-2759
Jinyoung Youn	https://orcid.org/0000-0003-3350-5032
Ji Seon Kim	https://orcid.org/0000-0002-8117-5114
Eung Seok Oh	https://orcid.org/0000-0003-2068-3235
Hui-Jun Yang	https://orcid.org/0000-0002-3593-1134
Won Tae Yoon	https://orcid.org/0000-0002-7026-3899
Sooyeoun You	https://orcid.org/0000-0003-4753-4491
Kyum-Yil Kwon	https://orcid.org/0000-0001-5443-0952
Hyung-Eun Park	https://orcid.org/0000-0003-4000-1051
Su-Yun Lee	https://orcid.org/0000-0003-1072-8452
Younsoo Kim	https://orcid.org/0000-0002-0292-1538
Hee-Tae Kim	https://orcid.org/0000-0002-7722-4841
Mee Young Park	https://orcid.org/0000-0002-5683-1634

REFERENCES

1. Weintraub D, Koester J, Potenza MN, Siderowf AD, Stacy M, Voon V, et al. Impulse control disorders in Parkinson disease: a cross-sectional study of 3090 patients. *Arch Neurol* 2010;67:589-595.
2. Weintraub D, Siderowf AD, Potenza MN, Goveas J, Morales KH, Duda JE, et al. Association of dopamine agonist use with impulse control disorders in Parkinson disease. *Arch Neurol* 2006;63:969-973.
3. Voon V, Hassan K, Zurowski M, de Souza M, Thomsen T, Fox S, et al. Prevalence of repetitive and reward-seeking behaviors in Parkinson disease. *Neurology* 2006;67:1254-1257.
4. Lee JY, Kim JM, Kim JW, Cho J, Lee WY, Kim HJ, et al. Association between the dose of dopaminergic medication and the behavioral disturbances in Parkinson disease. *Parkinsonism Relat Disord* 2010; 16:202-207.
5. Callesen MB, Weintraub D, Damholdt MF, Møller A. Impulsive and compulsive behaviors among Danish patients with Parkinson's disease: prevalence, depression, and personality. *Parkinsonism Relat Disord* 2014;20:22-26.
6. Kim J, Kim M, Kwon DY, Seo WK, Kim JH, Baik JS, et al. Clinical characteristics of impulse control and repetitive behavior disorders in Parkinson's disease. *J Neurol* 2013;260:429-437.
7. Voon V, Hassan K, Zurowski M, Duff-Canning S, de Souza M, Fox S, et al. Prospective prevalence of pathologic gambling and medication association in Parkinson disease. *Neurology* 2006;66:1750-1752.
8. Weintraub D, Hoops S, Shea JA, Lyons KE, Pahwa R, Driver-Dunckley ED, et al. Validation of the questionnaire for impulsive-compulsive disorders in Parkinson's disease. *Mov Disord* 2009;24:1461-1467.
9. Lim SY, Tan ZK, Ngam PI, Lor TL, Mohamed H, Schee JP, et al. Impulsive-compulsive behaviors are common in Asian Parkinson's disease patients: assessment using the QUIP. *Parkinsonism Relat Disord* 2011;17:761-764.
10. Avanzi M, Baratti M, Cabrini S, Uber E, Brighetti G, Bonfà F. Prevalence of pathological gambling in patients with Parkinson's disease. *Mov Disord* 2006;21:2068-2072.
11. Tanaka K, Wada-Isoe K, Nakashita S, Yamamoto M, Nakashima K. Impulsive compulsive behaviors in Japanese Parkinson's disease patients and utility of the Japanese version of the questionnaire for impulsive-compulsive disorders in Parkinson's disease. *J Neurol Sci* 2013; 331:76-80.
12. Joutsa J, Martikainen K, Vahlberg T, Voon V, Kaasinen V. Impulse control disorders and depression in Finnish patients with Parkinson's disease. *Parkinsonism Relat Disord* 2012;18:155-160.
13. Valença GT, Glass PG, Negreiros NN, Duarte MB, Ventura LMGB, Mueller M, et al. Past smoking and current dopamine agonist use show an independent and dose-dependent association with impulse control disorders in Parkinson's disease. *Parkinsonism Relat Disord* 2013;19:698-700.
14. Sharma A, Goyal V, Behari M, Srivastva A, Shukla G, Vibha D. Impulse control disorders and related behaviours (ICD-RBs) in Parkinson's disease patients: assessment using "Questionnaire for impulsive-compulsive disorders in Parkinson's disease" (QUIP). *Ann Indian Acad Neurol* 2015;18:49-59.
15. Erga AH, Alves G, Larsen JP, Tysnes OB, Pedersen KF. Impulsive and compulsive behaviors in Parkinson's disease: the Norwegian ParkWest Study. *J Parkinsons Dis* 2017;7:183-191.
16. Rodríguez-Violante M, González-Latapi P, Cervantes-Arriaga A, Camacho-Ordoñez A, Weintraub D. Impulse control and related dis-

orders in Mexican Parkinson's disease patients. *Parkinsonism Relat Disord* 2014;20:907-910.

17. Corvol JC, Artaud F, Cormier-Dequaire F, Rascol O, Durif F, Derkinderen P, et al. Longitudinal analysis of impulse control disorders in Parkinson disease. *Neurology* 2018;91:e189-e201.

18. Bastiaens J, Dorfman BJ, Christos PJ, Nirenberg MJ. Prospective cohort study of impulse control disorders in Parkinson's disease. *Mov Disord* 2013;28:327-333.

19. Weiss HD, Marsh L. Impulse control disorders and compulsive behaviors associated with dopaminergic therapies in Parkinson disease. *Neurol Clin Pract* 2012;2:267-274.

20. Weintraub D, Mamikonyan E, Papay K, Shea JA, Xie SX, Siderowf A. Questionnaire for impulsive-compulsive disorders in Parkinson's disease-rating scale. *Mov Disord* 2012;27:242-247.

21. Hughes AJ, Daniel SE, Blankson S, Lees AJ. A clinicopathologic study of 100 cases of Parkinson's disease. *Arch Neurol* 1993;50:140-148.

22. Gilman S, Wenning GK, Low PA, Brooks DJ, Mathias CJ, Trojanowski JQ, et al. Second consensus statement on the diagnosis of multiple system atrophy. *Neurology* 2008;71:670-676.

23. Höglinger GU, Respondek G, Stamelou M, Kurz C, Josephs KA, Lang AE, et al. Clinical diagnosis of progressive supranuclear palsy: the movement disorder society criteria. *Mov Disord* 2017;32:853-864.

24. Armstrong MJ, Litvan I, Lang AE, Bak TH, Bhatia KP, Borroni B, et al. Criteria for the diagnosis of corticobasal degeneration. *Neurology* 2013;80:496-503.

25. McKeith IG, Boeve BF, Dickson DW, Halliday G, Taylor JP, Weintraub D, et al. Diagnosis and management of dementia with Lewy bodies: fourth consensus report of the DLB consortium. *Neurology* 2017;89:88-100.

26. Tomlinson CL, Stowe R, Patel S, Rick C, Gray R, Clarke CE. Systematic review of levodopa dose equivalency reporting in Parkinson's disease. *Mov Disord* 2010;25:2649-2653.

27. Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology* 1967;17:427-442.

28. Movement Disorder Society Task Force on Rating Scales for Parkinson's Disease. The Unified Parkinson's Disease Rating Scale (UPDRS): status and recommendations. *Mov Disord* 2003;18:738-750.

29. Kang Y, Na DL, Hahn S. A validity study on the Korean Mini-Mental State Examination (K-MMSE) in dementia patients. *J Korean Neurol Assoc* 1997;15:300-308.

30. Lee JY, Lee DW, Cho SJ, Na DL, Jeon HJ, Kim SK, et al. Brief screening for mild cognitive impairment in elderly outpatient clinic: validation of the Korean version of the Montreal Cognitive Assessment. *J Geriatr Psychiatry Neurol* 2008;21:104-110.

31. Ahn YM, Lee KY, Yi JS, Kang MH, Kim DH, Kim JL, et al. A validation study of the Korean-Version of the Montgomery-Asberg Depression Rating scale (K-MADRS). *Journal of Korean Neuropsychiatric Association* 2005;44:466-476.

32. Kwon DY, Kim JW, Ma HI, Ahn TB, Cho J, Lee PH, et al. Translation and validation of the Korean Version of the 39-item Parkinson's disease questionnaire. *J Clin Neurol* 2013;9:26-31.

33. Stiasny-Kolster K, Mayer G, Schäfer S, Möller JC, Heinzel-Gutenbrunner M, Oertel WH. The REM sleep behavior disorder screening questionnaire--a new diagnostic instrument. *Mov Disord* 2007;22:2386-2393.

34. Lee SA, Paek JH, Han SH, Ryu HU. The utility of a Korean version of the REM sleep behavior disorder screening questionnaire in patients with obstructive sleep apnea. *J Neurol Sci* 2015;358:328-332.

35. Marques A, Vidal T, Pereira B, Benchetrit E, Socha J, Pineau F, et al. French validation of the Questionnaire for Impulsive-compulsive disorders in Parkinson's disease-Rating Scale (QUIP-RS). *Parkinsonism Relat Disord* 2019;63:117-123.

36. Probst CC, Winter LM, Möller B, Weber H, Weintraub D, Witt K, et al. Validation of the questionnaire for impulsive-compulsive disorders in Parkinson's disease (QUIP) and the QUIP-rating scale in a German

speaking sample. *J Neurol* 2014;261:936-942.

37. de Guzman JKP, Yap AD, Go CL. Prevalence of impulse control disorders among adult Filipino patients with idiopathic Parkinson's disease seen at Jose R. Reyes Memorial Medical Center. *J Neurol Res Ther* 2016;1:13-19.

38. Ricciardi L, Petrucci S, Guidubaldi A, Ialongo T, Serra L, Ferraris A, et al. Phenotypic variability of PINK1 expression: 12 years' clinical follow-up of two Italian families. *Mov Disord* 2014;29:1561-1566.

39. Ephraty L, Porat O, Israeli D, Cohen OS, Tunkel O, Yael S, et al. Neuropsychiatric and cognitive features in autosomal-recessive early parkinsonism due to PINK1 mutations. *Mov Disord* 2007;22:566-569.

40. Criscuolo C, Volpe G, De Rosa A, Varrone A, Marongiu R, Mancini P, et al. *PINK1* homozygous W437X mutation in a patient with apparent dominant transmission of parkinsonism. *Mov Disord* 2006;21:1265-1267.

41. Morgante F, Fasano A, Ginevrino M, Petrucci S, Ricciardi L, Bove F, et al. Impulsive-compulsive behaviors in parkin-associated Parkinson disease. *Neurology* 2016;87:1436-1441.

42. Hwang IK, Kim KH. Confucianism and mental health in Korea. *J Korean Psychoanal Soc* 2002;13:146-152.

43. Mamikonyan E, Siderowf AD, Duda JE, Potenza MN, Horn S, Stern MB, et al. Long-term follow-up of impulse control disorders in Parkinson's disease. *Mov Disord* 2008;23:75-80.

44. Lee JY, Jeon B, Koh SB, Yoon WT, Lee HW, Kwon OD, et al. Behavioural and trait changes in parkinsonian patients with impulse control disorder after switching from dopamine agonist to levodopa therapy: results of REIN-PD trial. *J Neurol Neurosurg Psychiatry* 2019;90:30-37.

45. Cantello R. Hedonistic homeostatic dysregulation in patients with Parkinson's disease on dopamine replacement therapies. *J Neurol Neurosurg Psychiatry* 2000;69:566-567.

46. Cilia R, Siri C, Canesi M, Zecchinelli AL, De Gaspari D, Natuzzi F, et al. Dopamine dysregulation syndrome in Parkinson's disease: from clinical and neuropsychological characterisation to management and long-term outcome. *J Neurol Neurosurg Psychiatry* 2014;85:311-318.

47. Warren N, O'Gorman C, Lehn A, Siskind D. Dopamine dysregulation syndrome in Parkinson's disease: a systematic review of published cases. *J Neurol Neurosurg Psychiatry* 2017;88:1060-1064.

48. Evans AH, Lawrence AD, Cresswell SA, Katzenschlager R, Lees AJ. Compulsive use of dopaminergic drug therapy in Parkinson's disease: reward and anti-reward. *Mov Disord* 2010;25:867-876.

49. Baumann-Vogel H, Valko PO, Eisele G, Baumann CR. Impulse control disorders in Parkinson's disease: don't set your mind at rest by self-assessments. *Eur J Neurol* 2015;22:603-609.

50. Okai D, Askey-Jones S, Mack J, Martin A, Chaudhuri KR, Samuel M, et al. Parkinson's impulse-control scale for the severity rating of impulse-control behaviors in Parkinson's disease: a semistructured clinical assessment tool. *Mov Disord Clin Pract* (Hoboken) 2016;3:494-499.

51. Voon V, Sohr M, Lang AE, Potenza MN, Siderowf AD, Whetteckey J, et al. Impulse control disorders in Parkinson disease: a multicenter case--control study. *Ann Neurol* 2011;69:986-996.

52. Isaias IU, Siri C, Cilia R, De Gaspari D, Pezzoli G, Antonini A. The relationship between impulsivity and impulse control disorders in Parkinson's disease. *Mov Disord* 2008;23:411-415.

53. Pontone G, Williams JR, Bassett SS, Marsh L. Clinical features associated with impulse control disorders in Parkinson disease. *Neurology* 2006;67:1258-1261.

54. Goerlich-Dobre KS, Probst C, Winter L, Witt K, Deuschl G, Möller B, et al. Alexithymia-an independent risk factor for impulsive-compulsive disorders in Parkinson's disease. *Mov Disord* 2014;29:214-220.

55. Kim YE, Jeon BS, Yang HJ, Ehm G, Yun JY, Kim HJ, et al. REM sleep behavior disorder: association with motor complications and impulse control disorders in Parkinson's disease. *Parkinsonism Relat Disord* 2014;20:1081-1084.

56. Fantini ML, Macedo L, Zibetti M, Sarchioto M, Vidal T, Pereira B, et al. Increased risk of impulse control symptoms in Parkinson's disease

with REM sleep behaviour disorder. *J Neurol Neurosurg Psychiatry* 2015;86:174-179.

57. Romenets SR, Gagnon JF, Latreille V, Panniset M, Chouinard S, Montplaisir J, et al. Rapid eye movement sleep behavior disorder and subtypes of Parkinson's disease. *Mov Disord* 2012;27:996-1003.

58. Yao C, Fereshtehnejad SM, Keezer MR, Wolfson C, Pelletier A, Pos-

tuma RB. Risk factors for possible REM sleep behavior disorder: a CLSA population-based cohort study. *Neurology* 2019;92:e475-e485.

59. Voon V, Thomsen T, Miyasaki JM, de Souza M, Shafro A, Fox SH, et al. Factors associated with dopaminergic drug-related pathological gambling in Parkinson disease. *Arch Neurol* 2007;64:212-216.