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Validation of the Dutch version of the King's Parkinson's disease pain scale

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Abstract

Background Pain in patients with Parkinson's disease (PD)is often underdiagnosed and, therefore, undertreated. The King's Parkinson's Pain Scale (KPPS) is one of the few validated tools specifically designed to assess pain in patients with Parkinson's disease but lacks a Dutch version. This study aims to validate the KPPS for patients in the Netherlands and to examine which cognitive functions are related to the comprehension of the KPPS.

Methods The KPPS was translated into Dutch and validated in 70 patients with PD through internal consistency, convergent and discriminant validity testing. Patients had been diagnosed with PD for an average of 5.65 years. Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA).

Results The Dutch KPPS showed acceptable reliability (Cronbach's alpha = 0.69), though its factor structure differed from the original. Convergent validity was confirmed via significant correlations with the Numerical Rating Scale (NRS), while discriminant validity was supported through correlations with the Non-Motor Symptoms Scale (NMSS) and EQ-5D-3 L. Verbal memory and abstract thinking showed a tendency toward significance in their association with pain scores.

Conclusion The Dutch KPPS is a reliable and valid tool for assessing pain in Dutch patients with PD, though its structure differs from the original. These differences may reflect variability in pain perception or classification, highlighting the need for further research integrating the PD-PCS framework to refine pain assessment in PD.

Keywords Parkinson's disease, Pain, King's parkinson's disease pain scale, Translation, Validation, Cognition, Dutch population

Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder primarily characterized by motor disturbances [1] such as bradykinesia, tremor, and rigidity [2, 3, 4]. In addition to motor symptoms, PD is associated with various non-motor symptoms, including cognitive impairment, psychiatric disturbances, sleep issues, autonomic dysfunction, and pain—many of which can precede motor onset [2, 5, 6]. These non-motor symptoms significantly impact quality of life and are often underrecognized [7]. Although the likelihood of experiencing nonmotor symptoms varies among patients and is

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contingent upon the disease stage, at least one nonmotor symptom is present in 100% of patients with PD [6–9].

Among all the abovementioned symptoms, pain is often unrecognized and is consequently undertreated [10]. Pain is a common but underreported non-motor symptom in PD, affecting 30–83% of patients and significantly reducing quality of life [11, 12]. Many patients (40.5%) do not report their pain, possibly due to the lack of validated assessment tools [12, 13]. Assessing pain in PD is challenging, as it encompasses various underlying mechanisms, including nociceptive, neuropathic, and nociplastic pain [14]. The Parkinson's Disease Pain Classification System (PD-PCS) has been developed not only to categorize pain into these mechanistic subtypes, but also to distinguish PD-related pain from non-PD-related pain and to assess its chronicity and interference with daily functioning, thereby facilitating more targeted clinical assessment and treatment strategies [14].

The King's Parkinson's Pain Scale (KPPS) is a validated tool designed to assess different types of pain in Parkinson's disease, including musculoskeletal, neuropathic, and orofacial pain [11]. It has been translated and validated in multiple languages, including Swedish, Bulgarian, Japanese, Arabic, and German [15–19]. However, a validated Dutch version is currently lacking. This study aims to validate a Dutch version of the KPPS and assess its convergent and discriminant validity by examining its correlation with non-motor symptoms, anxiety, depression, and quality of life in patients with PD.

The second research question concerns the applicability of pain scales in cognitively impaired patients. After all, patients with PD often suffer from cognitive impairments [6, 20]. The results from former studies, including patients with neurological disorders, such as dementia, suggest that a single type of pain scale may not be suitable for each neurological disorder [21]. Test scores may depend on a participant's level of cognitive functioning. For example, only 50% of patients in early-stage Alzheimer's disease comprehended the purpose of the Facial Affective Scale, a visual analog scale composed of painful faces [22]. In another study in mildly to severely cognitively impaired older persons, the Iowa Pain Thermometer, which is also a visual analog scale, and the Verbal Descriptor Scale appeared to be the most suitable for assessing pain intensity [23]. These authors concluded that even in the case of a decline in cognitive function, pain intensity can be assessed via these two types of pain scales. Notably, in older persons with intact cognition, the numerical pain scale and the verbal descriptor scale are the most reliable for assessing pain intensity [24]. The KPPS is a verbal descriptor scale that has been successfully applied in patients with PD who are cognitively mildly impaired or intact. The patients with PD included in those studies had a mean MMSE score of 26.65 [25], a Montreal Cognitive Assessment score > 24 [26], a mean MMSE score of 25.66 [27], or underwent cognitive pretesting of the Japanese version of the KPPS [28].

To our knowledge, few studies have examined how specific cognitive domains relate to the comprehension and reporting of pain using the KPPS in non-demented PD patients. On the one hand, more pain is expected to be associated with lower cognitive functions; on the other hand, understanding and interpreting pain scales also requires certain cognitive abilities. This could imply that there might actually be a positive correlation between pain and cognitive ability.

In summary, the goal of the study was to examine the validity and reliability of the KPPS in a Dutch population of patients with PD and to examine whether reporting pain on the KPPS might be related to cognitive functioning.

Methods

Study population

The study population consisted of patients with PD diagnosed according to the UK PD Society Brain Bank Clinical Diagnostic Criteria by experienced neurologists specializing in movement disorders. Patients with an unclear diagnosis, dementia and inability to consent to complete a questionnaire were excluded.

To determine the sample size for the study population, a guideline of 10 respondents per item for adequate factor analysis was employed, requiring a minimum of 70 patients with PD. Every patient with PD visiting the neurology outpatient clinic of a general hospital, the OLVG West in Amsterdam, from July to November 2018 was invited to participate in the study. The questionnaires were administered by outpatient clinic staff or designated students. Patients were assessed in the "on" state. This is comparable to the criteria used in validating the original KPPS [11].

Medical-ethical considerations

This research does not require approval from the Medical Ethics Review Committee (METC), as questionnaire-based research involving noninvasive questions is not obligatory according to the Medical Research Involving Human Subjects Act (WMO). A non-WMO declaration was obtained for this study. Patients were approached during a regular outpatient clinic visit or contacted by phone to inquire about their willingness to participate. Upon providing consent, they received an information leaflet by mail. The questionnaires were administered in person by the outpatient clinic staff or a student. Home visits were arranged if necessary for questionnaire administration.

The following demographic characteristics were collected: age, sex, education level, and duration of the disease.

Materials and procedure

Validation

The reliability and validity of the Dutch version of the KPPS were assessed following the validation process of the original KPPS through internal consistency and validity via factor analysis and convergent and discriminant validity.

The following scales were administered to validate the KPPS: the KPPS itself, the Numeric Rating Scale (NRS; 39), the Non-Motor Symptoms Scale (NMSS) [29], the EQ-5D-3 L Quality of Life Questionnaire (including the visual analog scale [VAS]) [30], the Hospital Anxiety and Depression Scale [31] and the Montreal Cognitive Assessment (MoCA) [5].

Pain assessment

Pain is assessed via the KPPS and the NRS. The NRS measures pain over the past month, where a number is assigned to indicate pain intensity (0 = no pain, 100 = worst pain imaginable). The KPPS is a verbal assessment of pain that has also been measured over the past month. It contains 14 items across 7 domains. The items are scored on the basis of severity (0–3) and frequency (0–4), with a total possible score of 168. The domains and corresponding item numbers are shown in Table 1.

Cognitive assessment

The Montreal Cognitive Assessment (MoCA) is a brief cognitive screening tool used to detect mild cognitive impairment [32]. It assesses multiple cognitive domains, with a total score of 30, where higher scores indicate better cognitive function. The Dutch version has shown strong reliability and validity [33]. In this study, we analyzed MoCA subdomain scores to explore their potential relationship with pain reporting.

Availability of data and material

The data supporting the findings of this study are available in the Castor Electronic Data Capture (EDC) platform. Castor ensures secure storage and management of research data in compliance with regulatory and ethical standards. Access to the datasets can be provided upon reasonable request to the corresponding author, subject to ethical approval and institutional guidelines to protect participant confidentiality and privacy.

Table 1 KPPS domains

Domain	Items
1. Musculoskeletal pain	1
2. Chronic pain	2, 3
3. Fluctuation-related pain	4, 5, 6
4. Nocturnal pain	7, 8
5. Oro-facial pain	9, 10, 11
6. Discoloration, edema/swelling	12, 13
7. Radicular pain	14

Procedure

Translation

For the translation of the KPPS, we followed the 10-step ISPOR guidelines for the translation and cultural adaptation of patient-reported outcomes [34]. This structured approach ensured that the Dutch version of the KPPS was both linguistically accurate and culturally appropriate for Dutch-speaking patients with PD: *(1) Preparation*: The original KPPS was reviewed to identify potential linguistic and cultural adaptation challenges. *(2) Forward Translation*: Two independent translators, with expertise in medical and linguistic fields, translated the KPPS into Dutch. *(3) Reconciliation*: The two translations were compared, and discrepancies were resolved through discussion, producing a single synthesized version. *(4) Back Translation*: A bilingual translator, blinded to the original KPPS, back-translated the Dutch version into English to assess conceptual equivalence. *(5) Back Translation Review*: The original KPPS authors reviewed the back-translated version to ensure consistency with the intended meaning and structure. (6) *Harmonization*: The Dutch version was compared with other existing translations to maintain consistency across languages. *(7) Cognitive Debriefing*: The preliminary Dutch version was tested on five patients with PD (3 males, 2 females; aged 48–80 years) to assess readability, clarity, and cultural relevance. Patients were selected to represent a diverse range of disease severity and educational backgrounds. No content-related issues were reported, but minor modifications were made to improve sentence structure, including adjustments to punctuation such as brackets and commas. *(8) Review of Cognitive Debriefing Results*: Feedback was analyzed, and minor modifications were made to improve comprehension. *9.Proofreading*: The final Dutch version was reviewed for grammatical accuracy and coherence. *10. Final Report*: A full report documenting the translation and adaptation process was compiled for transparency.

Cultural adaptation

Beyond linguistic accuracy, cultural adaptation was integral to ensuring that the KPPS was meaningful and relevant to Dutch-speaking patients with PD. Several modifications were made based on linguistic norms and patient feedback:

- Item 3 (Pain related to internal organs): The original wording was unclear to Dutch patients. To improve

comprehension, we added specific examples: *"pijn rond de lever, maag of darmen" (pain around the liver, stomach, or intestines).*

- Item 7 (Restless legs at night): The term "restless legs" was initially translated literally but was reworded to *"onprettig tintelend rusteloos gevoel in de benen"* to provide a more descriptive, commonly understood phrase in Dutch.
- Item 14 (Shooting or stabbing pain): The phrase "shooting pain" was directly translated as *"schietende pijn"*, but cognitive debriefing revealed that *"pijnscheuten"* was more natural in Dutch medical terminology, so this change was implemented.

These cultural adaptations ensured that the Dutch KPPS retains conceptual equivalence with the original while improving clarity and relevance for Dutch-speaking patients.

Data analyses

Internal consistency and validity testing

Data analysis was conducted via SPSS version 29. Internal consistency was measured with Cronbach's alpha, which requires values greater than 0.70 for adequacy. Factor analysis was performed to determine if the study results aligned with the components identified in the original validation of the English KPPS. Specifically, principal component analysis (PCA) was utilized to analyze the KPPS scores, and orthogonal rotation was used to establish the number of factors. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were applied to assess the suitability of the data for factor analysis. KMO values above 0.60 and Bartlett's test results with a p value below 0.05 were deemed satisfactory.

Hypothesis testing and known contrast groups

The correlation of test scores on the KPPS with various other measurement instruments for cross-validation was determined via the Pearson correlation coefficient, with values above 0.35 indicating the scale's validity. Prior to these analyses, the distribution of the data was assessed on the basis of skewness and kurtosis. For variables where skewness and kurtosis values ranged between −1 and 1, indicating normality, Pearson correlation was applied.

The Numeric Rating Scale (NRS) for pain was included in the analysis. Although NRS is often treated as an interval/ratio scale, it is more appropriately considered an ordinal scale, as it consists of ranked categories without guaranteed equal spacing between values [35]. To account for this, we applied Spearman's rank correlation when analyzing NRS scores, following best practices for ordinal data interpretation. This ensured the robustness of statistical analyses involving the NRS.

Correlations between the KPPS scores and the various subtests of the MoCA were calculated via Spearman's rho, following the analysis of skewness and kurtosis, which indicated that the data were not normally distributed, necessitating the use of nonparametric tests.

Results

Demographics and clinical characteristics

Seventy patients, comprising 36 males and 34 females, were included in the study. The mean age of the participants was 71.49 years (SD = 9.58), with a minimum age of 48 years and a maximum age of 89 years. On average, patients had been diagnosed with PD for 5.65 years, ranging from 0 to 30 years, with a standard deviation of 5.39. Unfortunately, we did not record the levodopa equivalent.

We do not have access to the data from the KPPS validation study [11], so we cannot compare the means statistically. However, we placed them side by side in table form (Table 2, see Supplementary Material) and highlighted notable differences. The participants in our study were, on average, older, experienced fewer nonmotor symptoms, reported less pain on the KPPS, and had higher quality of life scores (higher EQ-5D-3 L and VAS scores). The scores on the KPPS are shown in Table 3.

King's Parkinson's disease pain scale (KPPS)

The means, standard deviations, and ranges of the scores on the various items and domains of the KPPS for the patients with PD in the present study are presented in Table 3. The data show that musculoskeletal pain (M = 4.17) is the most frequently reported type of pain, whereas some items, such as pain from teeth grinding, are not reported (M = 0.00). The mean total KPPS score was 15.03, with a standard deviation of 15.78, reflecting considerable variability in pain levels among the patients in this study.

Internal consistency and validity testing

Factor analysis (table 4)

Factor analysis was conducted to validate the KPPS. However, factor analysis identified different components than the components mentioned by Chaudhuri et al. (2015). Four factors in the KPPS explained 64% of the variance (Kaiser–Meyer–Olkin, 0.58; sphericity test, $P < 0.001$). Cronbach's alpha was 0.69. See Table 4 for detailed information.

Convergent and discriminant validity

Pearson and Spearman correlations were used to analyze the relationships between variables. The correlation coefficients of the KPPS and NRS with other domains are presented in Table 5. The results revealed significant correlations between the KPPS score and the NRS score,

Table 2 Demographic variables and clinical characteristics of the participants

Demographic variables	Our study		Chaudhury et al., 2015	
	M	*SD*	*M*	*SD*
Age	71.49	9.58	64.38	11.38
Duration of disease in years	5.65	5.39	5.40	4.93
Hospital Anxiety and Depression Scale (HADS) Depression Scale	5.87	4.01	5.44	3.96
Hospital Anxiety and Depression Scale (HADS) Anxiety Scale	6.12	4.17	6.17	4.56
Non-Motor Symptoms Scale (NMSS)	49.17	36.65	60.71	44.31
Numeric Rating Scale (NRS)	3.18	2.59	-	-
King's Parkinson's disease pain scale (KPSS)	15.03	15.78	25.19	22.14
Visual Analog Scale (VAS) Severity-Last month	63.05	17.02	55.57	25.27
Visual Analog Scale (VAS) Severity-Today	66.29	15.58	-	-
European Quality of Life-5 Dimensions-3Levels (EQ-5D-3 L)	0.62	0.28	0.52	0.28
Montreal Cognitive Assessment (MoCA) total score (adjusted for education)	23.02	4.62	-	-

Table 3 Scores of the King's Parkinson's disease pain scale (KPPS)

Items	M	SD	Range
1. Pain around joints (musculoskeletal)	4.17	4.48	0–12
2. Pain deep within the body	0.51	1.99	0–12
3. Pain related to internal organ	1.03	2.60	0–12
4. Dyskinetic pain	0.62	2.18	0–12
5. "Off" dystonia in a region	2.17	3.67	0–12
6. Generalized "off" period pain	0.94	2.99	0–12
7. PLM or RLS-associated pain	1.41	3.23	0–12
8. Pain while turning in bed	1.39	3.15	0–12
9. Pain when chewing	0.28	1.70	0–12
10. Pain due to grinding teeth	0	0	0–0
11. Burning mouth syndrome	0.25	1.17	0–8
12. Burning pain in the limbs	1.04	2.96	0–12
13. Lower abdominal pain	0.62	1.96	0–8
14. Shooting pain/pins & needles	1.38	2.80	0–12
Domains			
1. Musculoskeletal pain	4.17	4.48	0–12
2. Chronic pain	1.51	3.25	0–12
3. Fluctuation-related pain	3.68	6.80	0–36
4. Nocturnal pain	2.76	4.80	0–24
5. Oro-facial pain	0.53	2.01	0–12
6. Discoloration, edema/swelling	1.01	2.94	0–16
7. Radicular pain	1.36	2.78	0–12
Total score	15.03	15.78	0–72

Table 4 Results of the factor analysis of the KPPS

Factor	Items	Items found by Chaudhuri et al. (2015)
Factor 1	1, 2, 5, 6, 8	2, 3, 13, 14
Factor 2	3, 9, 13	4, 5, 6
Factor 3	7, 12	1, 7, 8, 12
Factor 4	11	9, 10, 11

indicating that higher pain scores on the KPPS are associated with higher pain scores on the NRS.

Both the KPPS and NRS correlate significantly with NMSS scores, indicating an association between nonmotor symptoms and pain. Anxiety and depression scores were significantly correlated with KPPS scores but not with NRS scores (Table 5). Significant negative correlations were found between the KPPS scores and the VAS measurements (today and last month). Strong correlations were found between the EQ-5D-3 L score and the

Table 5 Correlation coefficients between pain scales (KPPS and NRS) and other domains (Pearson for continuous variables, *spearman for NRS-related analyses)*

Pearson correlation	KPPS *r* (*p*)	NRS *r* (*p*)
KPPS	-	-
NRS	0.48** (< 0.001)	-
NMSS	0.42** (< 0.001)	0.43** (0.001)
HADS Depression	0.36** (0.006)	0.16 (0.23)
HADS Anxiety	0.31* (0.014)	0.22 (0.10)
VAS today	-0.43** (< 0.001)	-0.35** (0.006)
VAS last month	-0.50** (< 0.001)	-0.39** (0.002)
EQ-5D-3 L	-0.29** (< 0.01)	-0.38** (0.002)

Note. Pearson correlation coefficients are presented for continuous variables, while Spearman's rank correlation coefficients are used for all NRS-related analyses

Significance levels: ***0.01 level (2-tailed), *0.05 level (2-tailed)*

Table 6 Spearman's correlation coefficients of the KPPS and NRS with the MOCA subdomains

Spearman's correlation	KPPS *r* (*p*)	NRS *r* (*p*)
MOCA Total Score	0.05 (0.70)	0.10 (0.45)
MOCA Verbal Memory	**0.21 (0.09)**	**0.28 (0.03)***
MOCA Abstraction	**0.28 (0.03)***	**0.23 0.09**
MOCA Visiospatial/Executive Functions	-0.02 (0.88)	0.22 (0.10)
MOCA Attention	0.04 (0.74)	-0.19 (0.16)
MOCA Language	-0.03 (0.81)	-0.01 (0.95)
MOCA Orientation	0.14 (0.26)	0.09 (0.49)
MOCA Naming	-0.10 (0.41)	0.15 (0.27)

Note. Spearman's rho correlation coefficients are presented

Significance levels: *0.05 level (2-tailed)

pain scores on the KPPS and NRS. These findings indicate that lower quality of life scores are associated with higher pain scores.

Relationships between cognitive function and various pain scale scores

The total scores on the cognitive screening tool MOCA do not correlate with the scores on the KPPS or NRS. However, after analyzing the MOCA subscales independently, we observe the following. As shown in Table 6, the verbal memory domain of the MOCA is significantly positively correlated with the NRS score, and there is a trend toward significance with the scores on the KPPS last month. A similar finding is observed in the MOCA abstraction domain, which also shows a positive significant correlation with the KPPS Last-month scores and a trend toward significance with the NRS. We performed multiple correlation analyses to examine the relationships between the MoCA subdomains and pain scales. To account for the increased risk of Type I errors due to multiple comparisons, we applied the Bonferroni correction, adjusting the alpha level to 0.00071 (0.05/7). After this correction, none of the correlations remained statistically significant. Table 6 provides detailed information about the various cognitive domains of the MOCA and their correlations with the pain scales.

Discussion

The goal of the present study was twofold. First, the study was meant to validate a Dutch translation of the KPPS by comparing our factor analysis results with those from the validation of the original English KPPS. Second, we studied the relationship between the KPPS score and cognitive function, as assessed by the MoCA.

Concerning the first goal of the study, the results show that the factor analysis yielded different results. The items are loaded on different factors, which means that the categories of the items differ from those in the study by Chaudhuri et al. (2015). This might be due to the lower average pain scores on the KPPS, fewer nonmotor symptoms, and higher quality of life scores in our study than in the original validation study. While the KPPS categorizes pain based on type and location, the recently developed Parkinson's Disease Pain Classification System (PD-PCS) offers a broader and clinically oriented framework. In addition to classifying pain by mechanism—nociceptive, neuropathic, and nociplastic—it introduces a disease-associated approach by distinguishing Parkinson's disease-related pain from non-disease-related pain. It also evaluates chronicity and impact on daily life, supporting more individualized treatment strategies [14, 36]. Future studies may benefit from integrating PD-PCS classifications alongside KPPS to refine pain assessment and better understand mechanistic differences between PD pain subtypes.

Since both scales are pain scales, we expected the KPPS score to be positively correlated with the NRS score, which our results confirmed. The EQ-5D-3 L and VAS scores are negatively correlated with the pain scores on the KPPS and NRS, indicating that a lower quality of life is associated with greater pain levels. This finding is supported by another study in which significant correlations were found between lower quality of life and increased pain in cancer patients [37]. In fact, there is

ample evidence for a positive relationship between pain, depression, and anxiety [38, 39, 40] and between pain and nonmotor symptoms [41, 42]. We address these findings within the scope of the second goal of our study, namely, the relationship between cognitive functions and scores on various pain scales. Completing pain scales may require specific cognitive abilities. For example, we observed a positive correlation between the scores on the KPPS and NRS with the verbal memory domain and abstraction domain of the MoCA. We argue that while the NRS is a simple questionnaire that relies on numerical comprehension, both scales appeal to verbal memory, i.e., asking patients to express their pain from the past month in a number [43]. In addition, to be able to translate the questions or the number into one's own concept of pain experience, a certain level of abstraction is required [44].

Our findings show that the higher the score on verbal memory and abstraction (MoCa domains) is, the higher the pain scores on the KPPS and the NRS. In PD, verbal recall might be impaired due to executive dysfunction [45]. A recent study showed that patients with PD without dementia had to exert significantly more effort on a verbal abstract reasoning task than individuals without PD did [46]. From a clinical point of view, these cognitive functions—verbal memory and abstraction—are particularly vulnerable in this patient group and warrant attention. However, it is important to note that the relationship between these cognitive functions and pain scores disappears when a Bonferroni correction is applied, suggesting that these correlations should be interpreted with caution.

Limitations

This study included only non-demented patients, limiting the generalizability of our findings. Pain processing differs in individuals with dementia, as cognitive impairments affect pain perception and reporting [47]. Future research should validate the KPPS in cognitively impaired populations to assess its broader applicability. Also, we did not record the levodopa dosages of our patients, which may have influenced the reporting of pain symptoms. Importantly, levodopa, the most common medication used in PD, can have pain-relieving effects, as it may reduce certain types of discomfort associated with motor symptoms [4, 48]. Therefore, variations in levodopa dosage could impact patients' experience and reporting of pain [48]. Additionally, the effects of levodopa on pain perception are partly dependent on the motor state of the patient at the time of testing. Using a scale, such as the Unified Parkinson's Disease Rating Scale (UPDRS) [49], to account for the severity of motor symptoms might be even more critical for understanding the relationship between motor symptoms and pain reporting. This aspect was not assessed in our study and represents an important area for future research.

Ideally, testing should be conducted in patients in the "off" state to validate the pain scale among those not currently using pain medication. On the one hand, testing patients in the "off" state might be preferable, as it seems counterintuitive to study pain while patients are simultaneously receiving pain-relieving medication such as levodopa. On the other hand, our study focused on general patterns of pain reporting rather than acute pain at the time of testing, as the pain scales used assess pain over the past month. Therefore, the motor state at the time of testing might not significantly influence the results. Notably, the original validation study of the scale was also conducted primarily in patients in the "on" state.

In summary, our findings affirm the convergent and discriminant validity of the KPPS, indicating that it aligns well with other established pain and symptom scales. Nonetheless, factor analysis revealed differences from the original study, suggesting that the KPPS may measure different aspects of pain in our patient population or that these variations could stem from differences between our cohort and that of the original study. Another main finding is that specific cognitive functions may influence the scores on the KPPS, highlighting the potential importance of considering cognitive abilities when interpreting pain assessments. This finding highlights the importance of combining neuropsychological testing with pain assessment in patients who might suffer from cognitive impairment.

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Author contributions

Nour Alkaduhimi contributed to the study design, data collection, statistical analysis, and manuscript preparation.Yvonne Kerst primarily assisted with data collection.Annemarie Vlaar and Henk Berendse contributed to statistical analysis and supported manuscript preparation.Henry Weinstein provided additional supervision and guidance during the research.Erik Scherder, the supervising professor, provided oversight of the study and critical feedback during manuscript development.All authors reviewed and approved the final version of the manuscript.

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Data availability

The datasets generated and analyzed during the current study are available in the Castor Electronic Data Capture (EDC) platform. Data can be made available from the corresponding author on reasonable request, subject to ethical and institutional guidelines.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the ethical standards outlined in the Declaration of Helsinki. A non-WMO (Wet Medisch-Wetenschappelijk Onderzoek) declaration was obtained, confirming that the study did not

require approval from a medical ethical review board. Written informed consent was obtained from all participants prior to their inclusion in the study.

Consent for publication
All participants provided written consent for the publication of anonymized data.

Competing interests
The authors declare no competing interests.

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