Updated Criteria for the Diagnostic Procedure for Parkinson's Disease Dementia on Level I and their Validity in Deep Brain Stimulation Cohort

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Introduction

Parkinson's disease (PD) is a neurodegenerative disorder characterised by the slow, progressive onset of rigidity, bradykinesia, and resting tremors that ultimately advance to motor and non-motor impairment (Postuma et al., 2015).

The diagnostic criteria for Parkinson's disease dementia (PDD) were developed in 2006 and their procedure followed shortly after (Dubois et al., 2007; Emre et al., 2007). At that period the PDD criteria were oriented at criteria originating in Alzheimer's disease (AD) since there was a lack of PD biomarkers to promote a biological classification of PD (Höglinger et al., 2024; Yamashita et al., 2023).

The newer Parkinson's disease mild cognitive criteria (PD-MCI) led to an advance in different aspects of PD research (Litvan et al., 2012). These included progress in clinical, genetic, therapeutic modalities, clinical trials or conversion rates to PDD (Aarsland et al., 2021; Hoogland et al., 2017, 2019).

At present, there is an ongoing effort to revisit the PDD criteria to secure the comparability of studies and clinical trials across different sites (Kulisevsky et al., n.d.). In our previous research, we aimed at establishing rigorous psychometric procedure to differentiate PD-MCI from PDD (Bezdicek et al., 2016, 2017). Hence the diagnosis of PDD is an exclusion criterion in deep brain stimulation (DBS), we decided to test the revisited PDD criteria in our PD cohort selected for undergoing DBS (Deuschl et al., 2006).

The current study aims at showing the agreement and differences between establishing the diagnosis using only Level 1 criteria as suggested by previous diagnostic procedure (the Movement Disorders Society (MDS)-Task Force screening checklist for detecting PD) (Dubois et al., 2007; Emre et al., 2007) in comparison to newly revised (Kulisevsky et al., n.d.) one to validate them. The second objective of our study was to determine the agreement of revised PDD criteria with full neuropsychological testing at Level 2.

Methods

Participants

The data of patients with idiopathic PD diagnosed by a movement disorder specialist fulfilling the Movement Disorder Society (MDS) Clinical Diagnostic Criteria for Parkinson's disease (PD) (Postuma et al., 2015) were retrospectively gathered from clinical records acquired between January 2014 and December 2023. All the patients underwent a neuropsychological assessment by a trained clinical psychologist (OB) during a routine examination of cognitive functions as a part of the evaluation process for the indication of Deep Brain Stimulation (DBS) at General University Hospital in Prague. The Ethics Committee of the General University Hospital in Prague had approved the study protocol. All patients provided written informed consent prior to the examination.

Neuropsychological Assessment

Participants were assessed with both MMSE (Folstein et al., 1975; Stepankova et al., 2015) and MoCA (Kopecek et al., 2016; Nasreddine et al., 2005) to measure overall cognitive performance. Moreover, a comprehensive neuropsychological assessment was performed in accordance with MDS Task Force Level 2 criteria for MCI in PD (Litvan et al., 2012). We described our battery including a regression based calculator for normative scores in another study (Bezdicek et al., 2017). Besides other neuropsychological tests, the comprehensive assessment employed Clock Drawing Test (CDT) and Letter Fluency. To establish cognitive performance in individual cognitive domains according to Level 1 criteria for PDD, we used test scores proposed by (Dubois et al., 2007) and their analogues in MoCA, see Table A for details.

Table 1

Comparison of criteia.

Criteria	Former	New
	MMSE < 26	MoCA < 26
Attention	Serial 7's/months reversed	Serial 7's
Executive functions	Lexical Fluency (S)/ Clock Drawing Test	Lexical Fluency (K)/ Clock Drawing Test
Visuo-spatial functions	Drawing of Pentagons	Drawing of Cube
Memory	3-Word Recall	5-Word Recall
Language	-	Naming of Animals

To measure independence in activities of daily living, we administered the Functional Activities Questionnaire (FAQ) (Bezdicek et al., 2011; Pfeffer et al., 1982). To assess neuropsychiatric functioning, we used Beck Depression Inventory-II (BDI) (Beck et al., 1996; Ciharova et al., 2020) and State-Trait Anxiety Inventory (STAI)

(Mullner et al., 1980; Spielberger et al., 1983). Psychotic symptoms were assessed in an interview by a trained psychiatrist.

Results

Discussion

References

Aarsland, D., Batzu, L., Halliday, G. M., Geurtsen, G. J., Ballard, C., Ray Chaudhuri, K., & Weintraub, D. (2021). Parkinson disease-associated cognitive impairment. *Nature Reviews Disease Primers*, *7*(1). https://doi.org/10.1038/s41572-021-00280-3

Beck, A. T., Steer, R. A., & Brown, G. (1996). *Beck depression inventory–II*. American Psychological Association (APA). https://doi.org/10.1037/t00742-000

Bezdicek, O., Lukavsky, J., & Preiss, M. (2011). Validizační studie české verze dotazníku FAQ. *Ceska a slovenska neurologie a neurochirurgie*, *74*(107), 36–42.

Bezdicek, O., Nikolai, T., Michalec, J., Růžička, F., Havránková, P., Roth, J., Jech, R., & Růžička, E. (2016). The Diagnostic Accuracy of Parkinson's Disease Mild Cognitive Impairment Battery Using the Movement Disorder Society Task Force Criteria. *Movement Disorders Clinical Practice*, *4*(2), 237–244. https://doi.org/10.1002/mdc3.12391

Bezdicek, O., Sulc, Z., Nikolai, T., Stepankova, H., Kopecek, M., Jech, R., & Růžička, E. (2017). A parsimonious scoring and normative calculator for the Parkinson's disease mild cognitive impairment battery. *The Clinical Neuropsychologist*, *31*(6-7), 1231–1247. https://doi.org/10.1080/13854046.2017.1293161

Ciharova, M., Cígler, H., Dostálová, V., Šivicová, G., & Bezdicek, O. (2020). Beck depression inventory, second edition, Czech version: demographic correlates, factor structure and comparison with foreign data. *International Journal of Psychiatry in Clinical Practice*, *24*(4), 371–379. https://doi.org/10.1080/13651501.2020.1775854

Deuschl, G., Schade-Brittinger, C., Krack, P., Volkmann, J., Schäfer, H., Bötzel, K., Daniels, C., Deutschländer, A., Dillmann, U., Eisner, W., Gruber, D., Hamel, W.,

Herzog, J., Hilker, R., Klebe, S., Kloß, M., Koy, J., Krause, M., Kupsch, A., … Voges, J. (2006). A Randomized Trial of Deep-Brain Stimulation for Parkinson's Disease. *New England Journal of Medicine*, *355*(9), 896–908. https://doi.org/10.1056/nejmoa060281

Dubois, B., Burn, D., Goetz, C., Aarsland, D., Brown, R. G., Broe, G. A., Dickson, D., Duyckaerts, C., Cummings, J., Gauthier, S., Korczyn, A., Lees, A., Levy, R., Litvan, I., Mizuno, Y., McKeith, I. G., Olanow, C. W., Poewe, W., Sampaio, C., … Emre, M. (2007). Diagnostic procedures for Parkinson's disease dementia: Recommendations from the movement disorder society task force. *Movement Disorders*, *22*(16), 2314–2324. https://doi.org/10.1002/mds.21844

Emre, M., Aarsland, D., Brown, R., Burn, D. J., Duyckaerts, C., Mizuno, Y., Broe, G. A., Cummings, J., Dickson, D. W., Gauthier, S., Goldman, J., Goetz, C., Korczyn, A., Lees, A., Levy, R., Litvan, I., McKeith, I., Olanow, W., Poewe, W., … Dubois, B. (2007). Clinical diagnostic criteria for dementia associated with Parkinson's disease. *Movement Disorders*, *22*(12), 1689–1707. https://doi.org/10.1002/mds.21507

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". *Journal of Psychiatric Research*, *12*(3), 189–198. https://doi.org/10.1016/0022-3956(75)90026-6

Höglinger, G. U., Adler, C. H., Berg, D., Klein, C., Outeiro, T. F., Poewe, W., Postuma, R., Stoessl, A. J., & Lang, A. E. (2024). A biological classification of Parkinson's disease: the SynNeurGe research diagnostic criteria. *The Lancet Neurology*, *23*(2), 191–204. https://doi.org/10.1016/s1474-4422(23)00404-0

Hoogland, J., Boel, J. A., Bie, R. M. A. de, Geskus, R. B., Schmand, B. A., Dalrymple-Alford, J. C., Marras, C., Adler, C. H., Goldman, J. G., Tröster, A. I., Burn, D. J., Litvan, I., & Geurtsen, G. J. (2017). Mild cognitive impairment as a risk factor for Parkinson's disease dementia. *Movement Disorders*, *32*(7), 1056–1065. https://doi.org/10.1002/mds.27002

Hoogland, J., Boel, J. A., Bie, R. M. A. de, Schmand, B. A., Geskus, R. B., Dalrymple-Alford, J. C., Marras, C., Adler, C. H., Weintraub, D., Junque, C.,

Pedersen, K. F., Mollenhauer, B., Goldman, J. G., Tröster, A. I., Burn, D. J., Litvan, I., & Geurtsen, G. J. (2019). Risk of Parkinson's disease dementia related to level I MDS PD-MCI. *Movement Disorders*, *34*(3), 430–435. https://doi.org/10.1002/mds.27617

Kopecek, M., Stepankova, H., Lukavsky, J., Ripova, D., Nikolai, T., & Bezdicek, O. (2016). Montreal cognitive assessment (MoCA): Normative data for old and very old Czech adults. *Applied Neuropsychology: Adult*, *24*(1), 23–29. https://doi.org/10.1080/23279095.2015.1065261

Kulisevsky, J., Litvan, I., & Weintraub, D. (n.d.). *A call for change: Updating the operational definition for dementia in parkinson's disease.*

Litvan, I., Goldman, J. G., Tröster, A. I., Schmand, B. A., Weintraub, D., Petersen, R. C., Mollenhauer, B., Adler, C. H., Marder, K., Williams-Gray, C. H., Aarsland, D., Kulisevsky, J., Rodriguez-Oroz, M. C., Burn, D. J., Barker, R. A., & Emre, M. (2012). Diagnostic criteria for mild cognitive impairment in Parkinson's disease: *Movement* Disorder Society Task Force guidelines. *Movement Disorders*, *27*(3), 349–356. https://doi.org/10.1002/mds.24893

Mullner, J., Ruisl, I., & Farkas, G. (1980). *Dotaznik na meranie uzkosti a uzkostlivosti - STAI.* Bratislava: Psychodiagnostické a didaktické testy.

Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J. L., & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A Brief Screening Tool For Mild Cognitive Impairment. *Journal of the American Geriatrics Society*, *53*(4), 695–699. https://doi.org/10.1111/j.1532-5415.2005.53221.x

Pfeffer, R. I., Kurosaki, T. T., Harrah, C. H., Chance, J. M., & Filos, S. (1982). Measurement of Functional Activities in Older Adults in the Community. *Journal of Gerontology*, *37*(3), 323–329. https://doi.org/10.1093/geronj/37.3.323

Postuma, R. B., Berg, D., Stern, M., Poewe, W., Olanow, C. W., Oertel, W., Obeso, J., Marek, K., Litvan, I., Lang, A. E., Halliday, G., Goetz, C. G., Gasser, T., Dubois, B., Chan, P., Bloem, B. R., Adler, C. H., & Deuschl, G. (2015). MDS clinical

diagnostic criteria for Parkinson's disease. *Movement Disorders*, *30*(12), 1591–1601. https://doi.org/10.1002/mds.26424

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. &. (1983). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stepankova, H., Nikolai, T., Lukavsky, J., Bezdicek, O., Vrajova, M., & Kopecek, M. (2015). Mini-Mental State Examination – česká normativní studie. *Ceska a slovenska neurologie a neurochirurgie*, *78*(111), 57–63.

Yamashita, K. Y., Bhoopatiraju, S., Silverglate, B. D., & Grossberg, G. T. (2023). Biomarkers in Parkinson's disease: A state of the art review. *Biomarkers in Neuropsychiatry*, *9*, 100074. https://doi.org/10.1016/j.bionps.2023.100074