PATTERN OF EXECUTIVE IMPAIRMENT IN MILD TO MODERATE PARKINSON’S DISEASE

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Executive functions

“[EF is] a shorthand description of a complex set of processes that have been broadly and variously defined”

(Strauss et al., 2006)

“The executive functions consist of those capacities that enable a person to engage successfully in independent, purposive, self-serving behavior” (Lezak, 1995, p. 42).

 “[EF is] a set of interrelated control processes involved in the selection, initiation, execution, and monitoring of cognition, emotion, and behaviour, as well as aspects of motor and sensory functioning” (Roth, Isquith & Gioia, 2005)
Executive functions in PD

• Impairment of executive functions (EF) is reported as a distinctive characteristic of cognitive impairment in PD (Owen, 2004; Zgaljardic, et al., 2003)

• Reports on executive dysfunction are accompanied by studies reporting normal performance in EF tests (e.g. Dalrymple-Alford et al., 1994; Uekermann et al, 2004 versus Colman et al., 2019; Fournet et al., 1996)

• Varying prevalence rates of impairment are reported for different aspects of EF (Muslimovic et al., 2007)

• In a systematic review of 33 studies, EF were operationalized in terms of 30 abilities, tested by 60 different tasks and variously interpreted (Kudlicka et al., 2011)
Study aims

Pattern of Executive Impairment in Mild to Moderate Parkinson’s Disease

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• Which areas of executive functioning are particularly problematic in mild to moderate PD?
• What is the clinical significance of executive deficits?
Assessment

Screening:
- The Addenbrooke’s Cognitive Examination-Revised, ACE-R
- Hospital Depression and Anxiety Scale, HADS
- The Frontal Assessment Battery, FAB

In depth assessment of EF:
- Delis-Kaplan Executive Function System, D-KEFS
## Participants

<table>
<thead>
<tr>
<th></th>
<th>M (SD)</th>
<th>Range</th>
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<tbody>
<tr>
<td>N=34 (15 men)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>72.62 (8.27)</td>
<td>48 – 89</td>
</tr>
<tr>
<td>Hoehn and Yahr stage</td>
<td>1.42 (0.56)</td>
<td>1 – 3</td>
</tr>
<tr>
<td>PD duration (months)</td>
<td>68.21 (52.39)</td>
<td>10 – 204</td>
</tr>
<tr>
<td>LED n = 33</td>
<td>596.21 (626.55)</td>
<td>100 – 3125</td>
</tr>
<tr>
<td>MMSE</td>
<td>29.41 (1.10)</td>
<td>25 – 30</td>
</tr>
<tr>
<td>ACE-R</td>
<td>94.18 (4.65)</td>
<td>82 – 100</td>
</tr>
<tr>
<td>FAB</td>
<td>13.74 (0.96)</td>
<td>12 – 15</td>
</tr>
<tr>
<td>HADS-Depression</td>
<td>4.18 (2.04)</td>
<td>1 – 9</td>
</tr>
</tbody>
</table>
Assessment of Executive Functions

Delis-Kaplan Executive Function System, D-KEFS

1. Trail Making (TM)
2. Verbal Fluency (VF)
3. Design Fluency (DF)
4. Colour Word Interference (CWI)/ Stroop paradigm
5. Sorting
6. 20 Questions
7. Word Context
8. Tower
9. Proverb

Scaled scores: 1 - 19
- **Normal**: scaled scores > 7
- **Poor**: scaled scores of 6 and 7; comparable to the 9 - 24 percentile and 1.3-0.7 SD below the mean
- **Impaired**: scaled scores ≤ 5; comparable to ≤ 5th percentile and ≤ 1.5 SD below the mean
Pattern of performance: Cluster Analysis

Ward hierarchical grouping based on squared Euclidean distance

Cluster 1: Attentional control

Cluster 2: Abstract reasoning

Average performance was significantly better on the Cluster 2 tests (mean = 11.33, SD = 1.81) than on the Cluster 1 tests (mean = 9.86, SD = 2.71); t(26) = -2.53, p = .018
Pattern of performance: Discussion

• Progression of dopaminergic depletion in PD

**Attentional control cluster:** Striatal dopaminergic depletion
→ disturbances in the inhibitory control and attentional shifting

**Abstract reasoning cluster:** Anterior and frontopolar regions of the PFC and interconnections with other cortical sensory systems
→ difficulties in perceiving conceptual relationships and adopting different interpretations and understandings
Frequency of impairment in D-KEFS tests (1)

Cluster 1: Attentional control
Cluster 2: Abstract reasoning

<table>
<thead>
<tr>
<th>Test</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWI</td>
<td>79.4%</td>
</tr>
<tr>
<td>Tower</td>
<td>79.4%</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>82.4%</td>
</tr>
<tr>
<td>Design Fluency</td>
<td>87.9%</td>
</tr>
<tr>
<td>TMT</td>
<td>63.6%</td>
</tr>
<tr>
<td>Word Context</td>
<td>90.9%</td>
</tr>
<tr>
<td>Proverb</td>
<td>100.0%</td>
</tr>
<tr>
<td>Sorting</td>
<td>80.0%</td>
</tr>
<tr>
<td>20 Quest.</td>
<td>87.9%</td>
</tr>
</tbody>
</table>

Legend:
- **Normal**
- **non-EF deficits**
- **Poor**
- **Impaired**
Frequency of impairment in D-KEFS tests (2)

- No impairment: 56%
- Impairment in 1 of the 9 tests: 29%
- Impairment in 2-5 of the 9 tests: 15%
Frequency of impairment: discussion

- EF impairment in 15% of PwPD in the study group
  - Varying ways to define cognitive impairment [Liepelt-Scarfone et al., 2011]
    - 1SD vs. 2SD below mean
    - 1 impaired score vs. 2 or more impaired scores
  - 1 score 1.5 SD below mean (29%): area of possible difficulty
  - 2 or more scores 1.5 SD below mean (15%): estimate of the frequency of EF impairment in our group of PwPD
Limitations

• The frequency rates may apply only to the subgroup of PwPD who underperformed in the screening test (FAB)
• The FAB may have distinguished PwPD with a specific profile of executive abilities
Conclusions

• It seems that PD in the mild to moderate stages affects the attentional control to a greater extent than the abstract reasoning aspect of EF
• More than half of PwPD in the sample performed within the normal range on all nine EF tests
• 15% of PwPD in the study had significantly impaired scores in more than 1 test of D-KEFS.
Acknowledgements

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THANK YOU