Inferring Rigidity Scores in MDS-UPDRS Motor Assessment from Other Items

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Objective

This study aimed to explore the possibility of inferring rigidity scores in MDS-UPDRS assessments from other items to enhance the accuracy of clinical evaluations in situations where retrieving all scores may be unfeasible.

Background

Remote assessment of Parkinson's disease with the MDS-UPDRS scale has been challenging due to the physical handling required for scoring rigidity and postural stability. Previous studies have suggested that rigidity may not be inferable from other items [1, 2]. However, theories imply that rigidity and bradykinesia share underlying processes [3, 4, 5]. In this study, we decided to implement a more advanced methodology to accurately determine the predictability of rigidity scores using other assessment items, in hopes of enhancing the accuracy of clinical evaluations settings where retrieving all scores may be unfeasible.

Methods

We used moderate and severe patients [6] from the PPMI dataset [7] and fitted a random forest classifier for each item in each cardinal group (rigidity, tremor, bradykinesia, axial symptoms). The total predicted score was calculated for each group and compared with the real group score and real total motor score. Inter-rater ICC (calculated with data from [8]) was used as the gold standard performance, while a random imputation of scores, was used as control.

Results

The inferred group score for rigidity performed proportionally worse than other groups, but the total retrieved information was sufficient to achieve an agreement above 90% with the real total motor score (See Figure 1). While the balanced accuracy for individual item prediction was low for all groups (See Table 1), 91% of the residuals for rigidity were within the range of a moderate clinically important difference (CID) [9] (See Figure 2), whereas less than 80% of other groups' residuals fitted within this range.

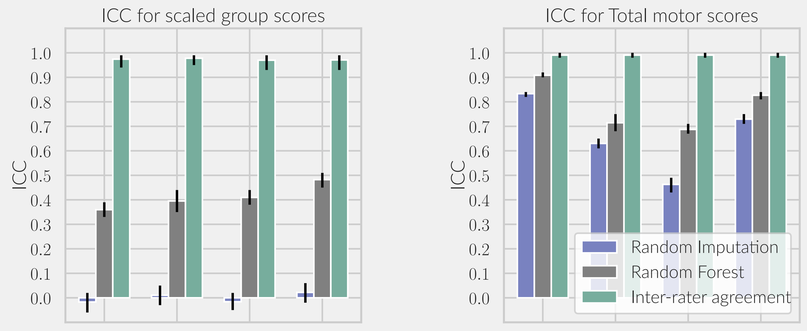

Figure 1. Model performance at retrieving group-specific information (Left) and group information in the context of a full assessment (Right).

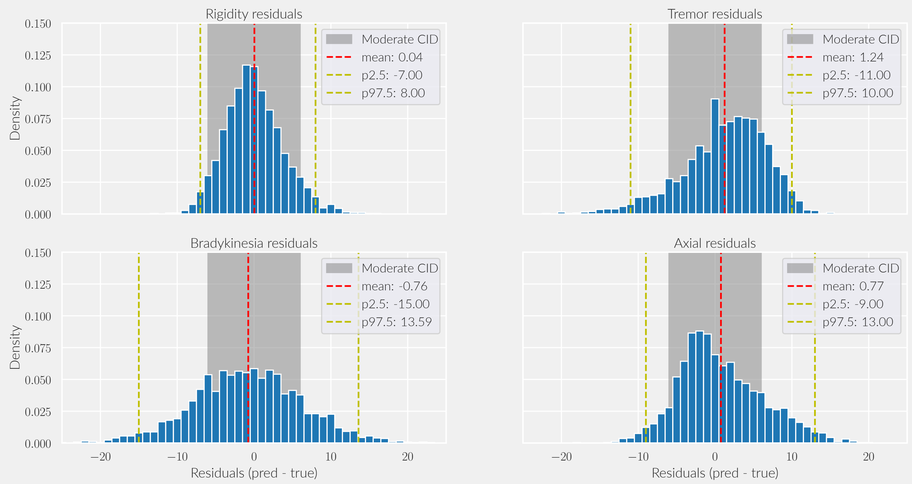

Figure 2. Model residuals. For rigidity (Top) 91% of residuals fall in the range of a moderate clinically important difference (|Moderate CID| $\leq$6)

Results

	Balanced accuracy		
	min	mean	max
Rigidity	0.335	0.395	0.469
Tremor	0.262	0.311	0.367
Bradykinesia	0.359	0.399	0.427
Axial	0.318	0.373	0.466

Table 1. Item specific performance per Parkinson's canonical group. Minimum and maximum balanced accuracies were calculated among each group items.

Conclusions

Our findings demonstrate that it is possible to recover some of the lost information for all canonical groups, including rigidity, with a performance that exceeds chance. However, we confirm that rigidity, like any other canonical group, cannot be reliably deduced from other groups' ratings with enough certainty to avoid the risk of mislabelling a clinically significant difference. Despite this, in the context of a full motor assessment, rigidity accounts for the least information compared to other groups. No advantage was found for the inference of rigidity or bradykinesia, as per the ICC metric (Figure 1, Left). On the assumption that rigidity and bradykinesia share an underlying mechanism, this is a surprising result and may be considered as evidence against this hypothesis. Our study enhances the comprehension of the constraints in accurately predicting rigidity scores from other assessment items, which can impact clinicians' evaluation of Parkinson's disease patients with incomplete data.

References

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