

LETTER TO THE EDITOR **OPEN ACCESS**

Reply to Comments on the Article “Machine Learning Predicts Risk of Falls in Parkinson’s Disease Patients in a Multicenter Observational Study”

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Dear Editor,

We read with interest the letters by Ren [1] and Sathian et al. [2] who commented on our recent article “Machine Learning Predicts Risk of Falls in Parkinson’s Disease Patients in a Multicenter Observational Study” [3]. We appreciate their shared recognition of the clinical relevance of fall risk prediction in Parkinson’s Disease (PD) and the potential of Machine Learning to support personalized care.

Here below we provide clarifications in relation to the core issues raised by the colleagues.

1 | Use of Baseline Data vs. Longitudinal Modeling

We acknowledge the limitation of using baseline clinical data to predict 3-year fall risk, reflecting the pragmatic scope and routine data of the NeuroArtP3 initiative. We plan to extend the analysis with longitudinal data, recognizing the value of temporal models in capturing disease dynamics. Still, this study offers a meaningful contribution to exploring AI-based fall risk prediction in this population.

2 | Model Selection and Performance

As both letters note, different modeling strategies could have potentially improved predictive performance. It is worth noting that other standard benchmarking methods such as XGBoost and Random Forest were indeed explored during the early stages of the NeuroArtP3 analysis. Given the nature and scale of the NeuroArtP3 dataset, we selected methods best suited to its structure, as other approaches are often more appropriate for larger datasets. We agree sensitivity is essential for clinical use. The analysis, based on cross-sectional data, highlights both potential and limits of the algorithm and is not yet intended as a stand-alone diagnostic tool.

3 | SHAP Interpretations and Variable Associations

The colleagues share some concerns about SHAP-derived findings, particularly regarding hyposmia and MDS-UPDRS III scores. We caution against overinterpreting isolated feature effects, especially with potential confounders. The observed

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UPDRS III trend may reflect reduced need for fall prediction and risk in advanced cases receiving closer care [4]. We also acknowledge that dichotomizing variables like hyposmia is a simplification, though useful; this point is discussed in the paper, along with its novelty and need for further stratification.

4 | Subgroup Analyses and Interactions

We agree that exploring subgroup-specific risks and including interaction terms or socioenvironmental factors is valuable. Although limited by sample size in this case, this remains a priority for future analysis.

5 | Clinical Integration and Fall Prevention

We support the vision of integrating ML into multi-level fall management, in line with predictive, preventive, and personalized medicine [5]. Our study lays the groundwork, and we agree on linking risk prediction with tailored interventions and follow-up.

In conclusion, we thank the colleagues for their comments, which highlight both the potential and complexity of applying ML to PD care. We agree that future research would benefit from longitudinal data alongside richer phenotyping, socioenvironmental factors, and advanced algorithms—an asset that remains relatively uncommon and available to only a limited number of research groups—to integrate AI into multi-level care. Our aim is translational: we used routinely collected clinical data from NeuroArtP3 to ensure broader applicability across potential sites. While longitudinal data would add value, its collection remains challenging, reinforcing the relevance of our current approach.

Author Contributions

Maria Chiara Malaguti: conceptualization, writing – review and editing, methodology, validation, supervision. **Chiara Longo:** conceptualization, writing – review and editing. **Monica Moroni:** conceptualization, writing – review and editing. **Flavio Ragni:** conceptualization, writing – review and editing. **Stefano Bovo:** conceptualization, writing – review and editing. **Marco Chierici:** writing – review and editing. **Lorenzo Gios:** writing – original draft, conceptualization, project administration, writing – review and editing. **Laura Avanzino:** writing – review and editing. **Roberta Marchese:** writing – review and editing. **Francesca Di Biasio:** writing – review and editing. **Matteo Pardini:** writing – review and editing. **Denise Cerne:** writing – review and editing. **Paola Mandich:** writing – review and editing. **Manuela Marengo:** writing – review and editing. **Antonio Uccelli:** writing – review and editing, conceptualization. **Bruno Giometto:** writing – review and editing, conceptualization. **Giuseppe Jurman:** conceptualization, writing – review and editing. **Venet Osmani:** writing – review and editing, conceptualization.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Linked Articles

This article is linked to Malaguti et al. paper. To view this article, visit <https://doi.org/10.1111/ene.70118>.

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