Prediction of Long-Term Functional Independence in Traumatic Brain Injury Patients: Insights from a Machine Learning-Based Retrospective Study in a Neurorehabilitation Setting

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Motivation

- TBI can lead to long-term impairments, with survivors often facing cognitive, physical, communication, and behavioral and psychiatric difficulties, as well as an increased risk of neurodegenerative diseases[1].
- As a result, people with TBI can show reduced functional independence and quality of life, and increased dependency[2].
- This study aims to predict the functional independence of patients with TBI one year after admission to a neurorehabilitation center.

Methods

Participants

- 206 patients with TBI who were not in a post-traumatic confusional state (PCTS) and 125 patients with TBI who where in participated in the study.

Intervention

- Motor and cognitive functions, communication abilities, behavior, and functional independence (measured with the FIM+FAM) were assessed at admission, 6 and 12 months with standardized clinical scales and tests.

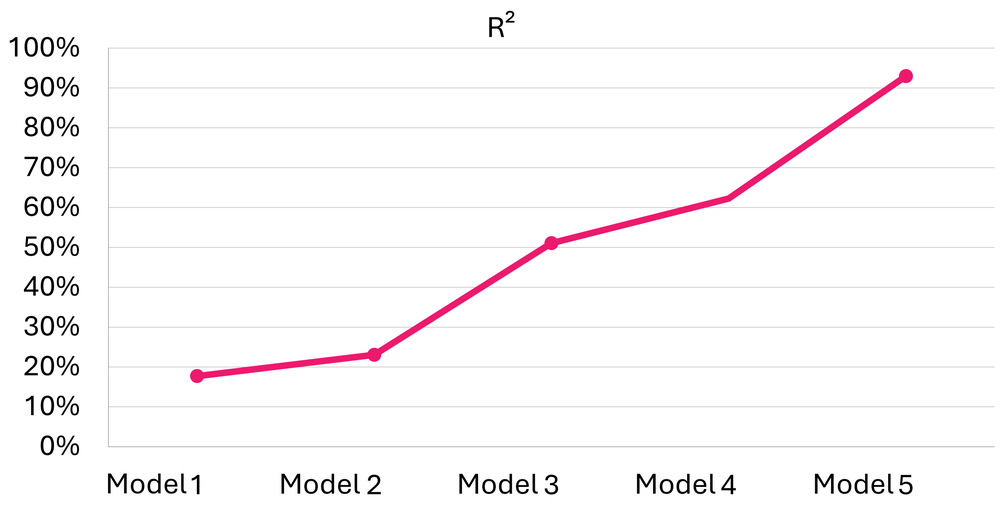
Data analysis

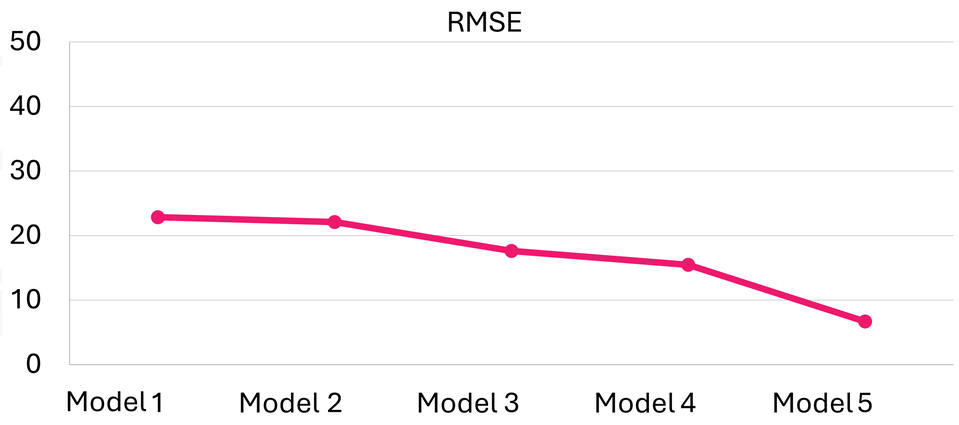
- Different machine learning models were trained incrementally to predict FIM+FAM scores one year after admission.
- The additional data incorporated by the models included: (i) demographic information; (ii) injury-related details; (iii) global neurological outcome; (iv) clinical condition at the time of admission to the neurorehabilitation program; (v) clinical condition at 6 months post-admission and the progression from admission to the 6-month follow-up.

Results

Patients not in post-traumatic confusional state

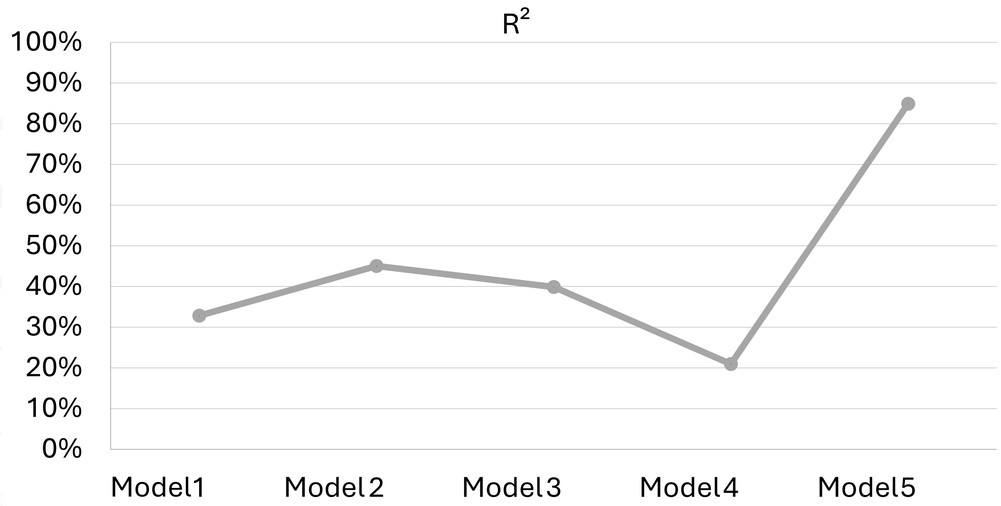
- For non-PTCS patients, the models had increasing accuracy at predicting FIM+FAM scores.

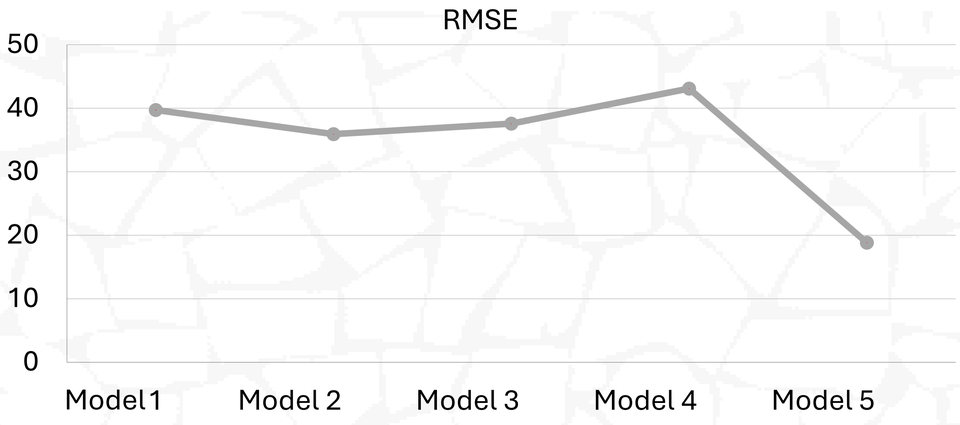




Patients in post-traumatic confusional state

- For PTCS patients, the models performed very poorly, except for the one that included the 6-month condition.





- In both groups of patients, FIM+FAM and Barthel scores at 6 months and the progression in the FIM+FAM from admission to the 6-month follow-up were the most relevant predictors.

Conclusions

- Data used in predictive studies during the acute stage have very limited value in the neurorehabilitation setting.
- Functional independence at 6 months post-admission, and the progress made from admission to this point (among other variables) can accurately predict functional independence one year after admission.

1. Brett BL, Gardner RC, Godbout J, Dams-O'Connor K, Keene CD. Traumatic Brain Injury and Risk of Neurodegenerative Disorder. Vol. 91, Biological Psychiatry. Elsevier Inc.; 2022. p. 498–507.
2. Stocchetti N, Zanier ER. Chronic impact of traumatic brain injury on outcome and quality of life: A narrative review. Vol. 20, Critical Care. BioMed Central Ltd.; 2016.

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