B05 - Single-case predictions of motor abilities in health and disease

# Handgrip strength prediction using anthropometric and age features in health and disease from the UK Biobank

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## Introduction

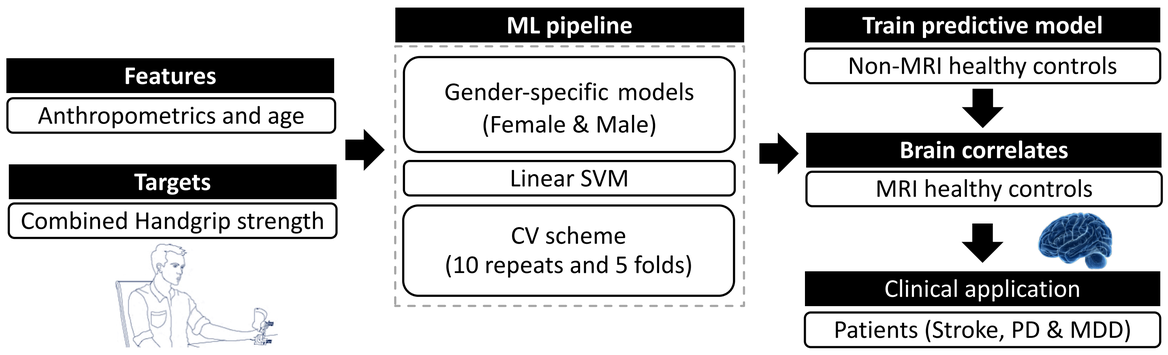
- Handgrip strength (HGS) is a valid biomarker for motor performance [1].
  - is an inexpensive, non-invasive, and commonly available measure in clinics.
  - is a powerful health condition predictor [2].
  - can diagnose and prognosticate patients [2].
- Normative models can identify abnormality and in turn brain changes that affect HGS and other motor functions.
  - Using anthropometric and age features.
- The bias-adjustment scheme provides an enhanced measurement of HGS [3].

**Aim:** Use anthropometric and age features to predict HGS in health and disease.

## Data and Methods

- Data from the UK Biobank
  - Data types for healthy controls and patients: non-MRI and MRI
  - Disorders: Stroke, Parkinson's disease (PD) and major depressive disorder (MDD)
- Healthy participants with dominant HGS < 4 kg and dominant HGS less than non-dominant HGS were excluded [2].
- Features: anthropometrics (BMI, height and waist-to-hip circumference ratio) and age
- Models were also built for the genders separately.
- Predictive models: Linear support vector Machine (SVM)
  - CV scheme with 10 repeats and 10 folds
  - Pearson correlation coefficient (r-value) for evaluation
  - Sample size effects were analysed
- Apply a statistical bias-adjustment scheme to the HGS prediction [3]
- Matching samples scenario in patients
  - Propensity score matching (PSM) technique
  - 1:10 matching sample ratio

## Block Diagram of Study




## HGS Predictions

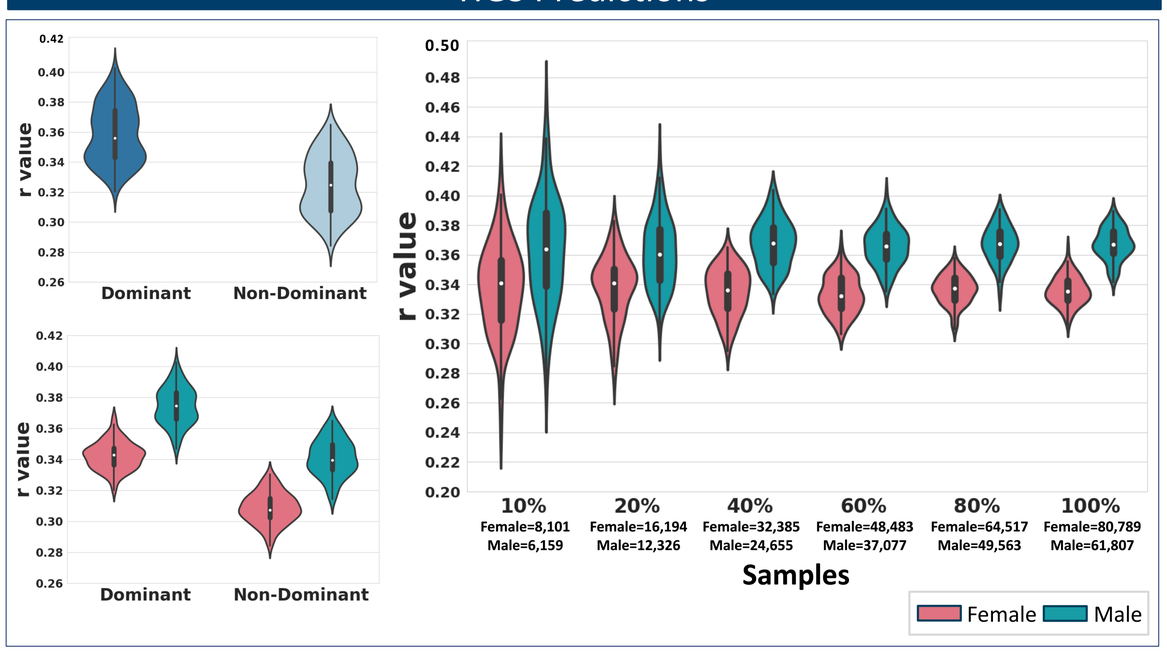



**Figure 1:**

- 142,596 non-MRI controls with measurements of anthropometrics and age
- (Non-)dominant HGS could be predicted but the combined HGS (Left + Right) predictions were more accurate.
- Predictions in males were better than in females at all sample sizes.
- The difference became pronounced and more significant with increasing sample size.

## References

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[3] Ann-Marie G. de Lange, James H. Cole, "Commentary: Correction procedures in brain-age prediction" 2020, doi.org/10.1016/j.nicl.2020.102229
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[5] Harris, M.A. et al, "Structural neuroimaging measures and lifetime depression across levels of phenotyping in UK biobank". Transl Psychiatry 12, 157 (2022). doi.org/10.1038/s41398-022-01926-w.
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Acknowledgements: "This research has been conducted using data from UK Biobank, a major biomedical database". www.ukbiobank.ac.uk

## Brain Correlates: Raw HGS vs Delta adjusted HGS

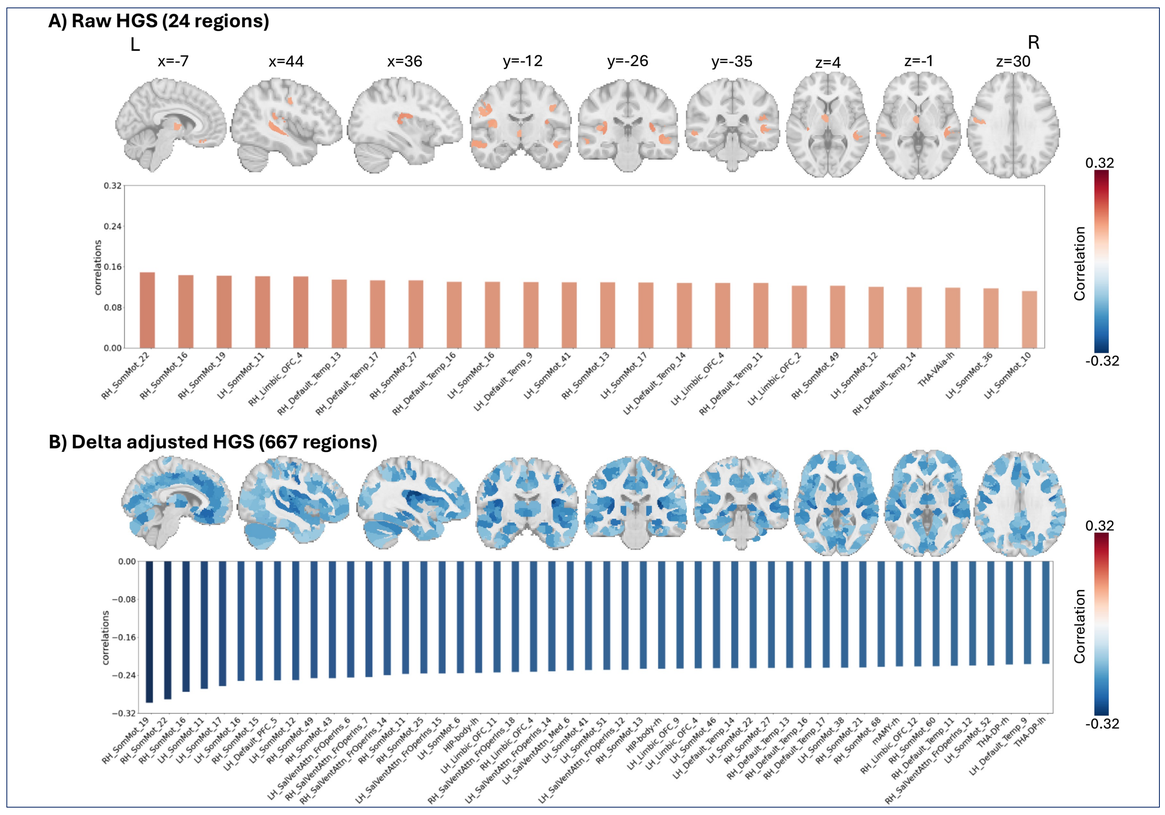


**Figure 2:**

- The intersection of suprathreshold brain regions at r-value > 0.1 in males and females after p-value correction, grouped concerning brain networks.
- The bias-adjustment scheme demonstrated strong results in brain correlates.
- Dorsal attention, ventral attention, frontoparietal, and visual networks appeared only with delta adjusted HGS.

## Clinical application: Raw HGS vs Delta adjusted HGS

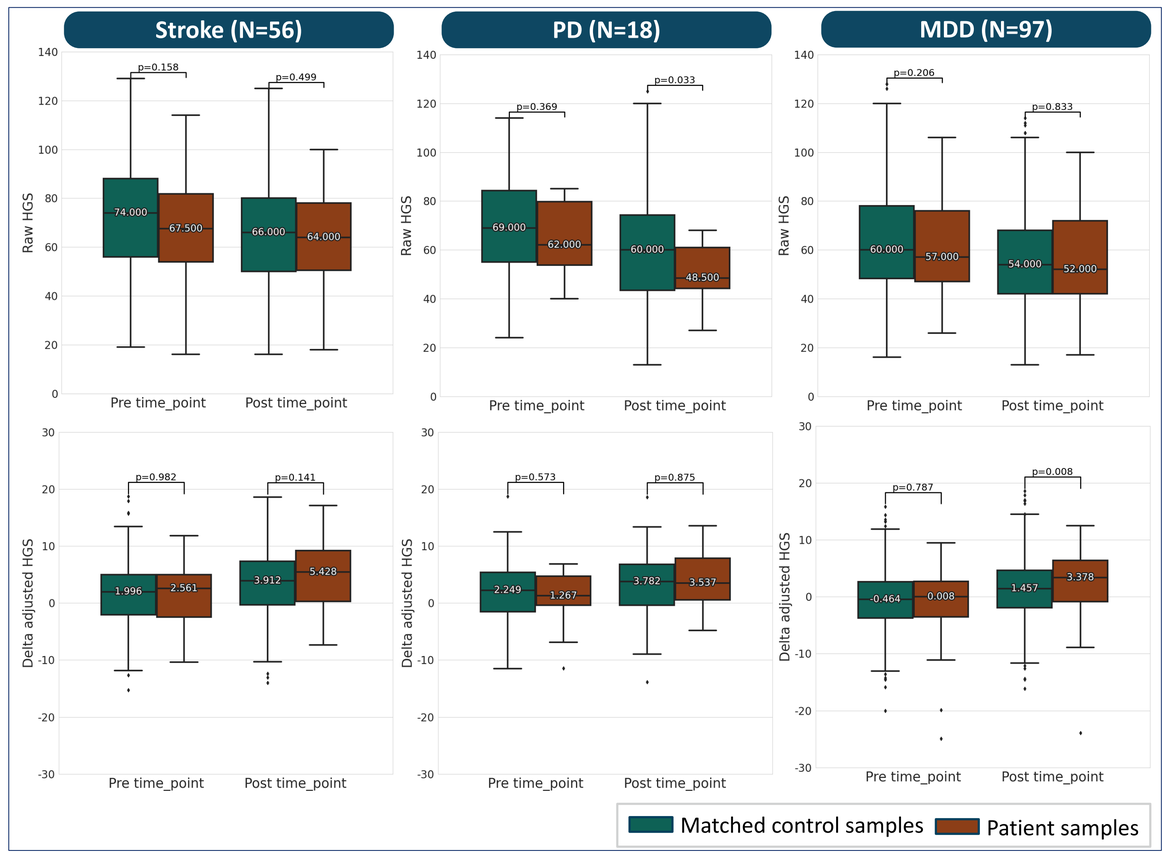


**Figure 3:**

- The post-condition exhibited lower median values compared to the pre-condition in both matched controls and patients.
- The bias-adjustment scheme remains sensitive to clinical differences.
- The delta adjusted HGS showed patient effect in PD.

## Conclusion

- HGS could be predicted by anthropometric measures and age.
- Predictions in males were better than in females with anthropometric and age features.
- The delta adjusted HGS demonstrated strong results in brain correlates.
- The bias-adjustment scheme remains sensitive to clinical differences.
- The delta adjusted HGS showed the patient effect in PD.

## Next steps

- Apply the pipeline to clinical data from Uniklinik Köln

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CRC1451 | Funded by the DFG – Project-ID 431549029 – SFB 1451 – Project B05 | Funded by Deutsche Forschungsgemeinschaft German Research Foundation