Deep learning predicts all-cause mortality from longitudinal total-body DXA imaging

AI PRECISION HEALTH INSTITUTE
UNIVERSITY OF HAWAI'I

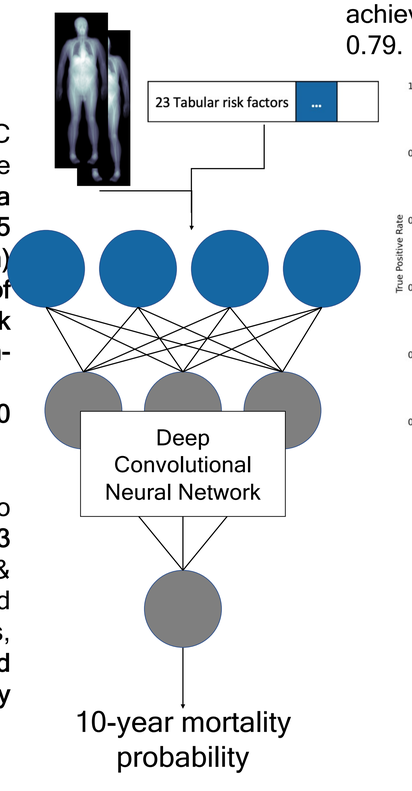
Mortality and body composition

Research has identified biomarkers predictive of all-cause mortality risk. Some, as body mass index, are predictive cross-sectionally, while for others the longitudinal change has been shown to be predictive. And while sometimes markers are derived from imaging modalities such as DXA, full scans are rarely used.
This study tests two hypotheses to improve all-cause mortality prediction:
1) Features derived from total-body DXA imaging are predictive of all-cause mortality with and without clinical risk factors
2) Sequential total-body DXA scans are more predictive than using only one observation with and without clinical risk factors.

Dataset and modelling

The data used is part of the Health ABC dataset we retrospectively analyze the completed cohort. **Health ABC is a prospective cohort study of 3075 participants (48.4% men, 51.6% women) aged 70 to 79 years at the time of recruitment, 41.6% of whom are Black with the remaining 58.4% being non-Hispanic White.**
The dataset consists of over **13,000 individual data points.**

Deep learning models are trained to predict all-cause mortality from **23 traditional risk factors** (demographics& anthropometric measurements, blood markers, general indicators of fitness, self-reported questionnaire answers), **and additionally a high- and low-energy attenuated total-body DXA scan.**



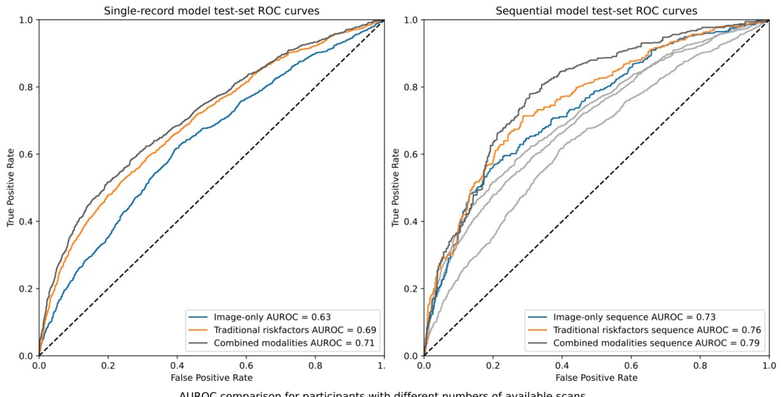
Key takeaways:

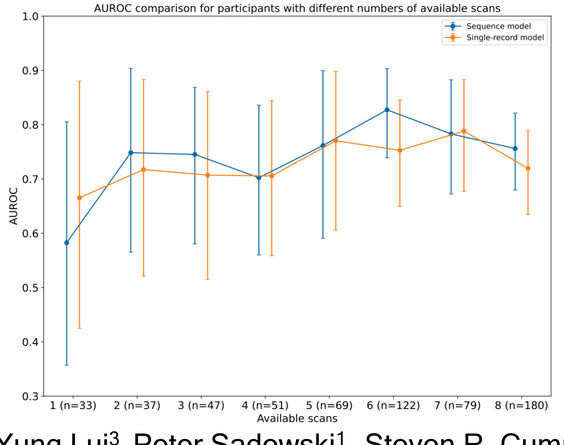
We derive a **mortality marker from raw total-body DXA and standard risk factors** using deep learning in a cross-sectional and longitudinal setting.

Our marker outperforms traditional risk factors, integrates multiple modalities, and shows promise for providing insights into what drives mortality in older adults.

Results

Our results demonstrate that longitudinal total-body DXA scans are predictive of all-cause mortality and improve performance of traditional mortality prediction models. On a held-out test set, the strongest model achieves an area under the receiver operator characteristic curve of 0.79.





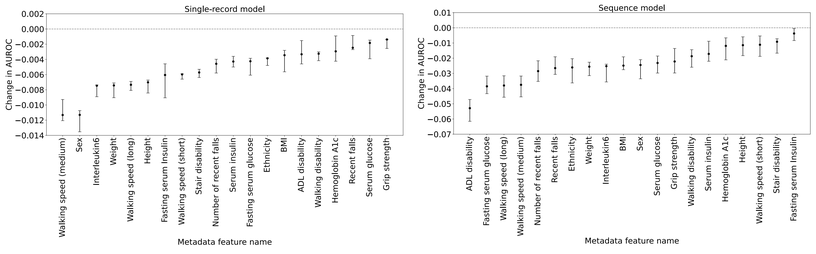
Conclusion

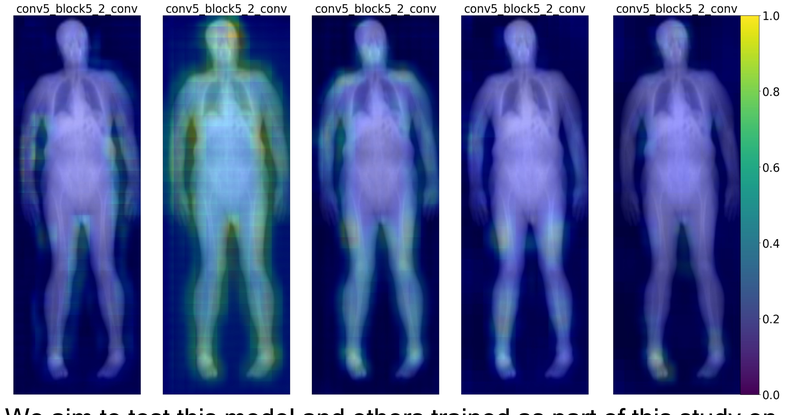
This predictor sheds light specifically on **musculoskeletal correlates of mortality** that have not been explored before.

We analyze what constitutes healthy aging and simultaneously hope to pave the way for new clinical intervention strategies based on highly personalized healthcare insights.

Next steps

Because the model achieves strong predictive performance by fusing multiple sources of information including DXA imaging scans, these results are part of an **ongoing effort to use explainable AI to understand risk factors** for patients.





We aim to test this model and others trained as part of this study on **other datasets** with more diverse population characteristics and eventually validate it for the clinical setting.

Yannik Glaser[1], John Shepherd[2], Lambert Leong[2], Thomas Wolfgruber[2], Li-Yung Lui[3], Peter Sadowski[1], Steven R. Cummings MD.[3]
[1] Information and Computer Sciences, University of Hawai'i at Mānoa, Honolulu, HI
[2] University of Hawai'i at Mānoa Cancer Center, Honolulu, HI
[3] San Francisco Coordinating Center, California Pacific Medical Center Research Institute, San Francisco, CA

INFORMATION & COMPUTER SCIENCES
UNIVERSITY of HAWAI'I at MĀNOA

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