

# It's not a bug, it's a feature: Estimating bone mineral density from T1-weighted MR images

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## Background

Low bone mineral density (BMD) is associated with neurodegenerative diseases, especially AD [1-3]. However, not many neuroimaging studies collect BMD data, and at the same time discard the skull tissue.

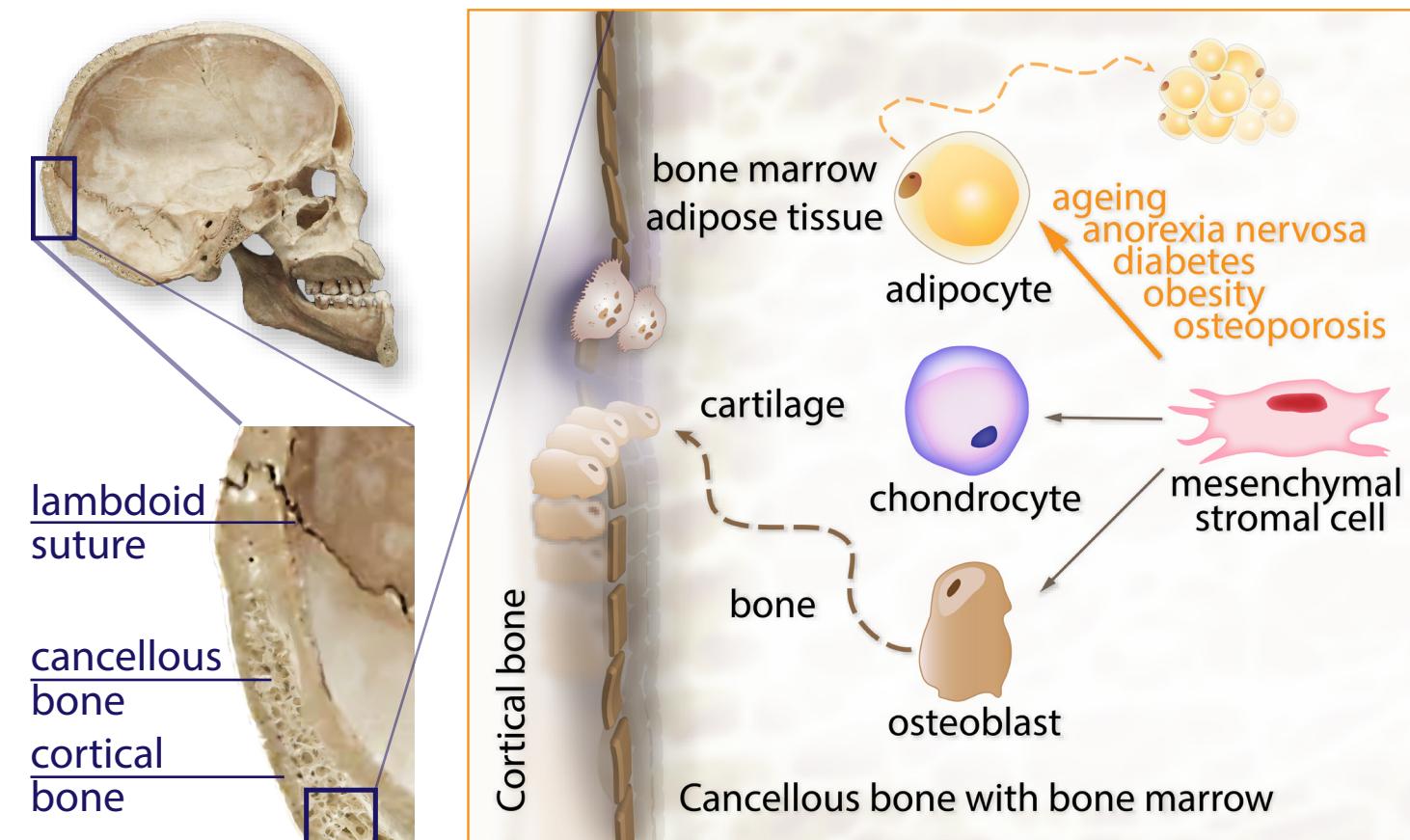


Figure 1. Bone microenvironment.

## Why not using the discard?



## Method

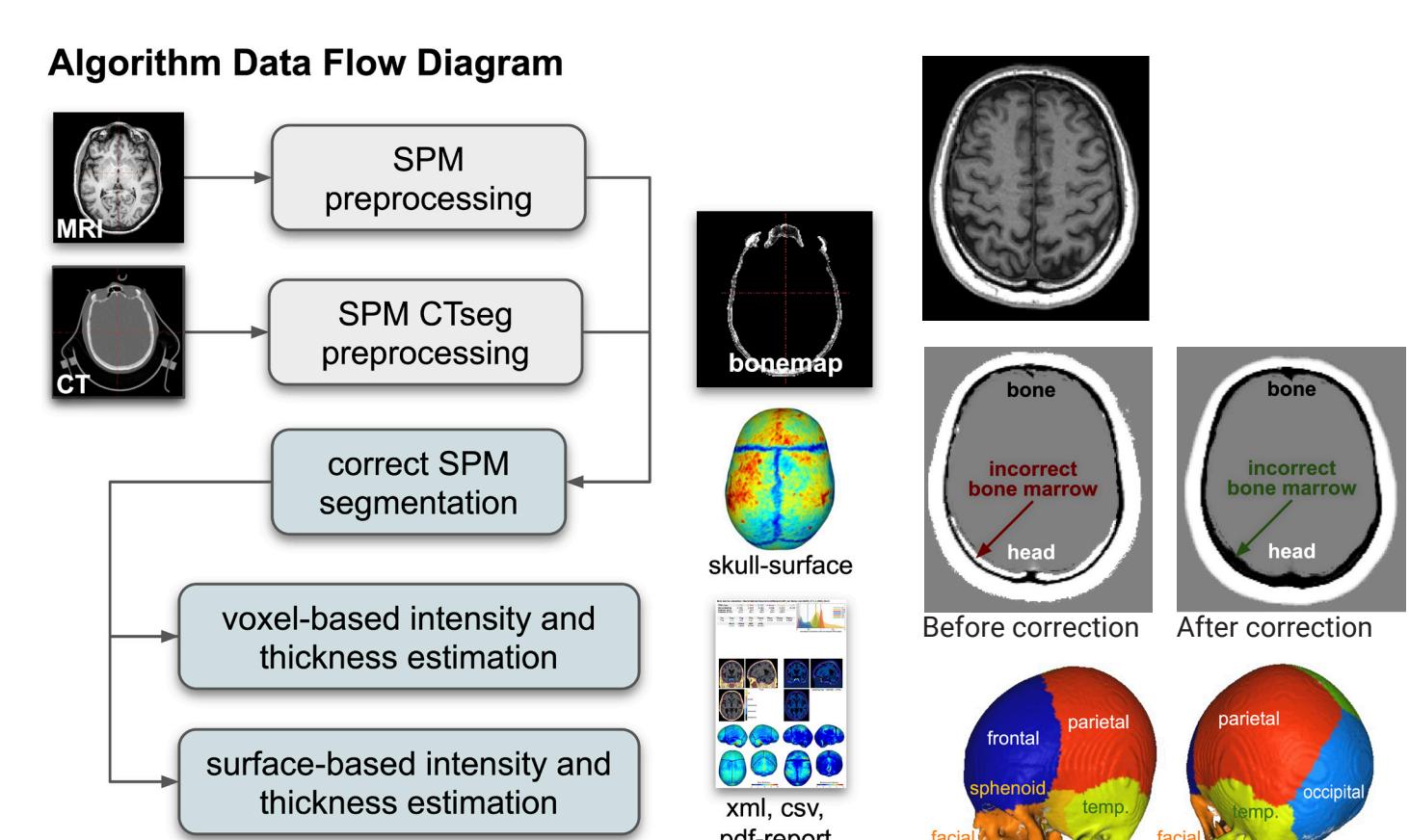
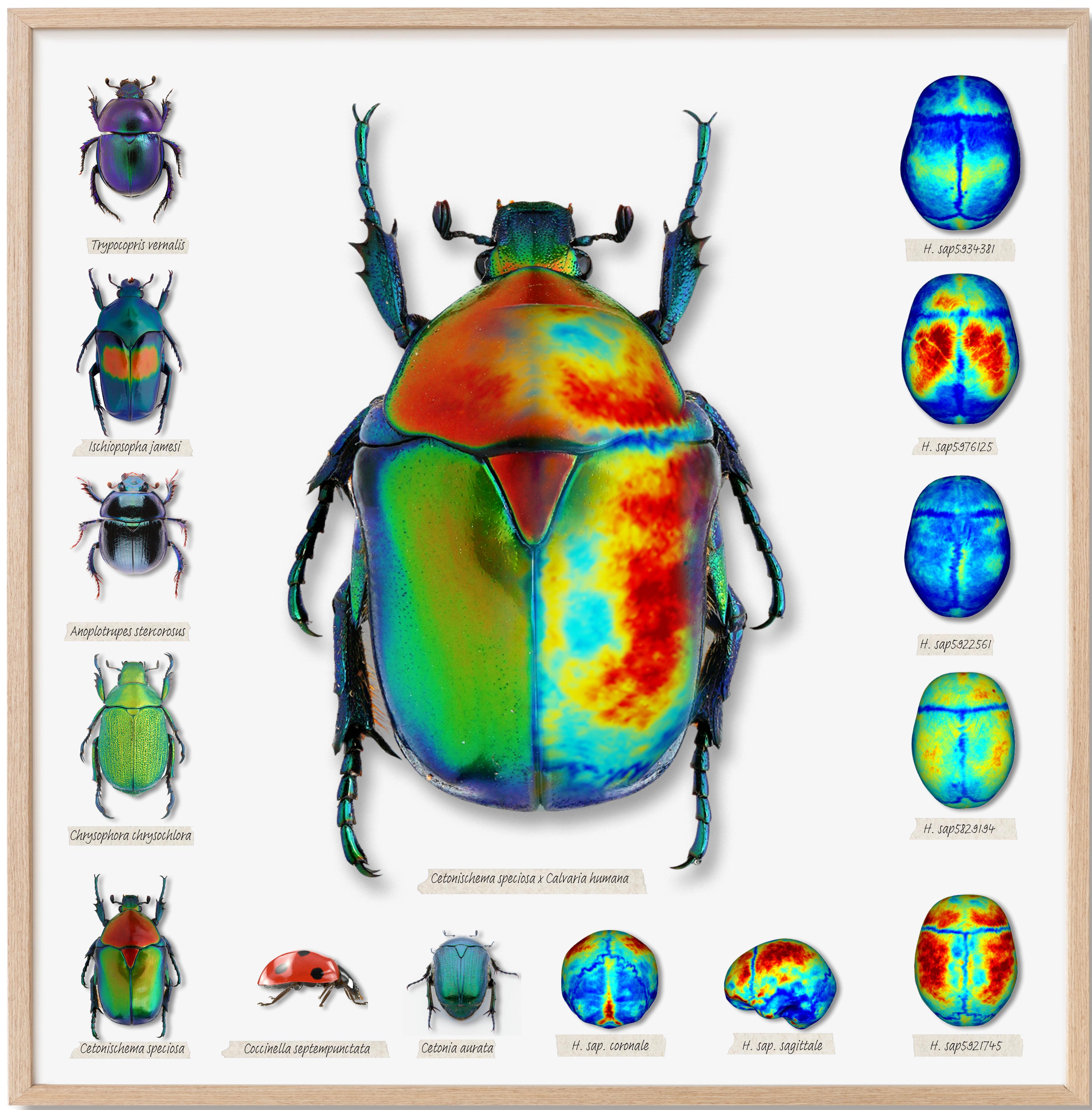


Figure 2. Algorithm's workflow (left). Original T1-weighted image (right top), with SPM segmentation before and after correction (right middle), and template atlas regions created with Slicer3D [4] (right bottom).

A subsample of 2000 healthy subjects ( $64.17 \pm 6.34$  years, 50% women) from the UK Biobank was used to extract and validate our BMD estimate against the DXA-derived head BMD measure.



The beetle collection was inspired by the Montréal's Insectarium.

## Results

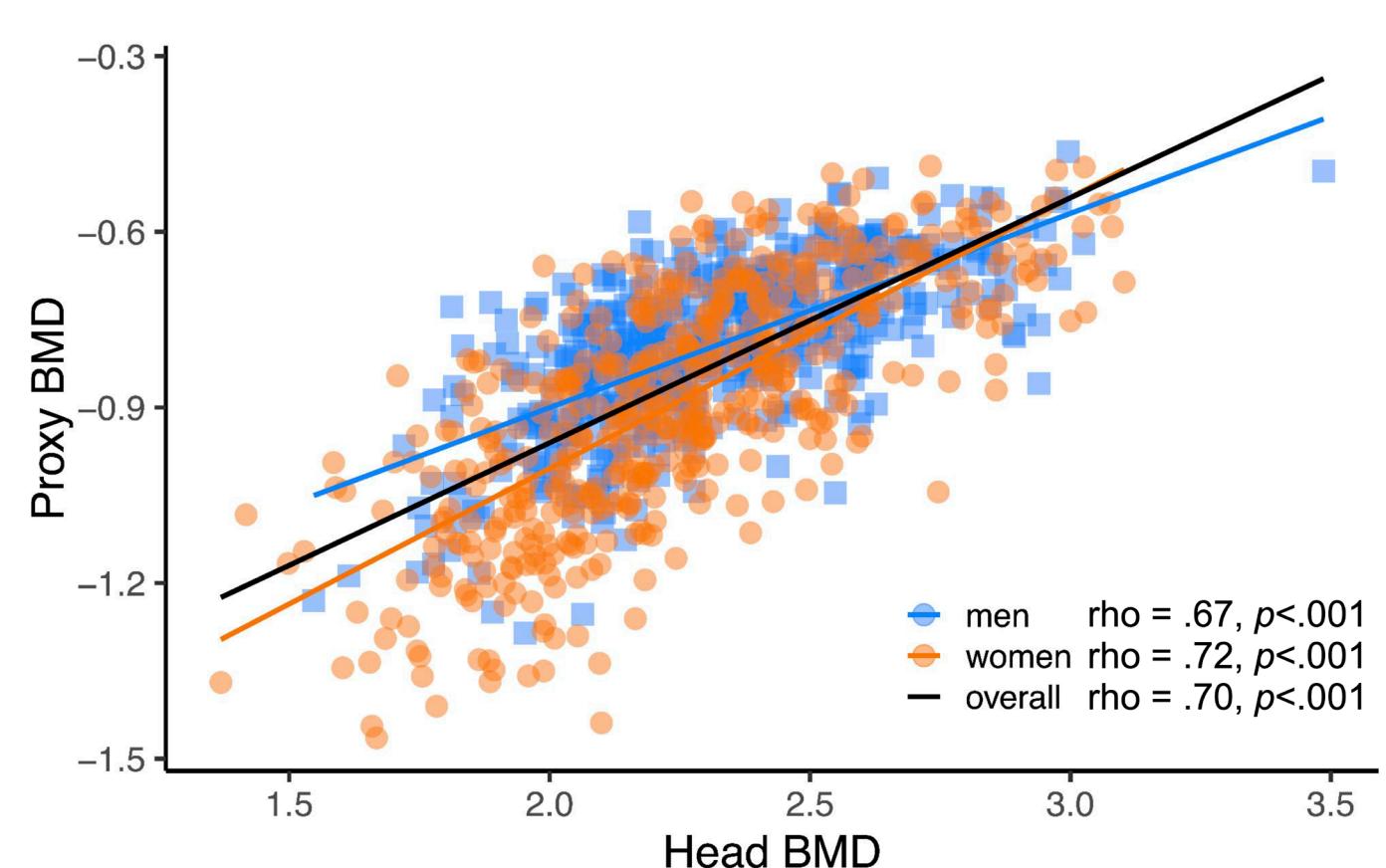


Figure 3. Association of head BMD and estimated skull BMD.

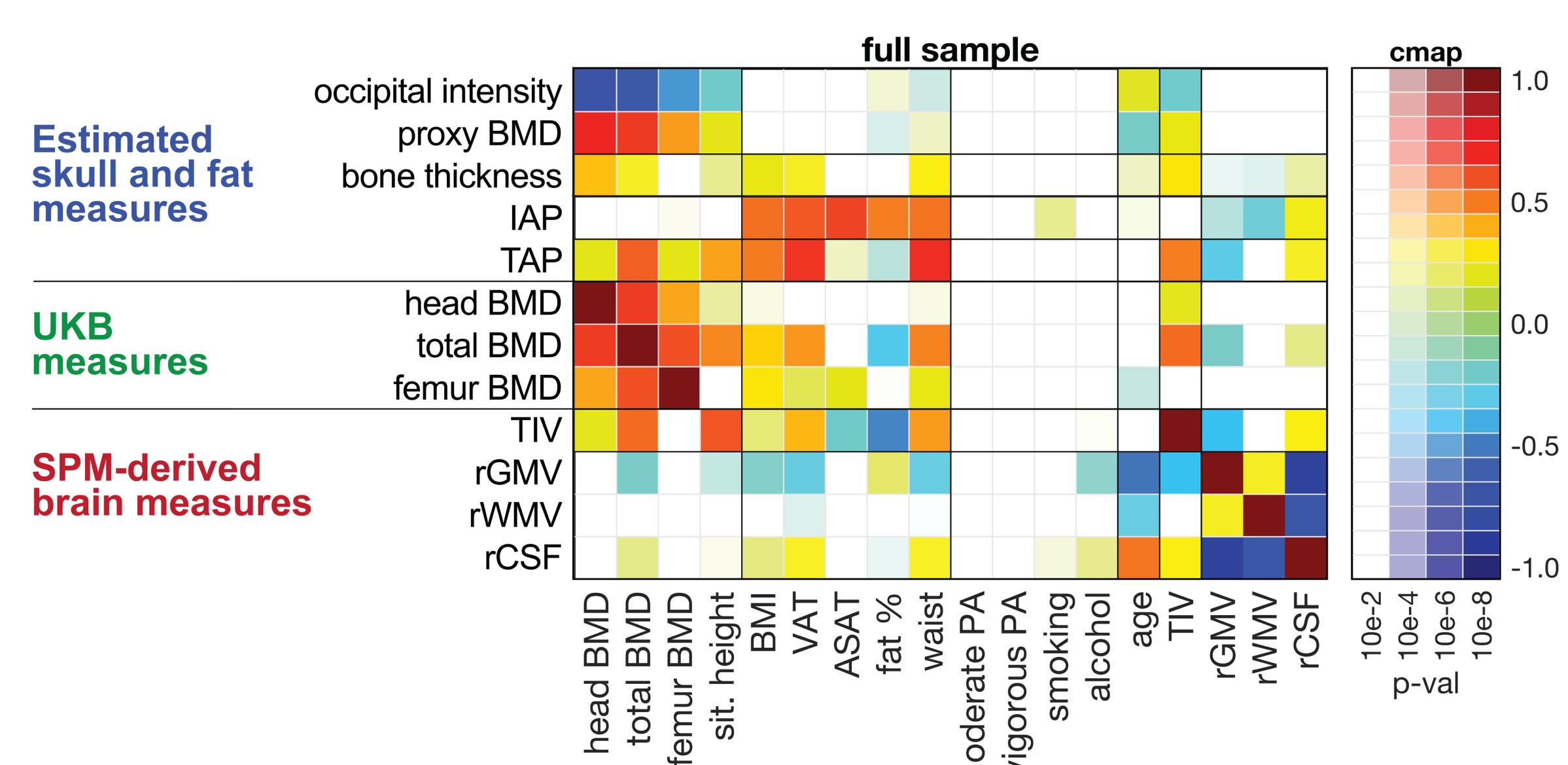


Figure 4. Spearman's correlation plot between the extracted and original UKB measures.

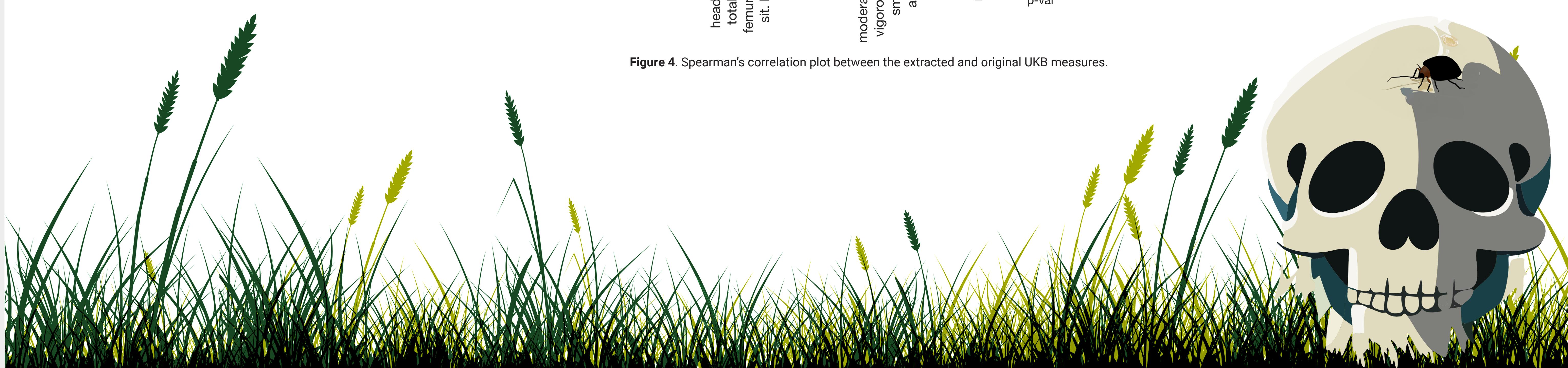
## Conclusion

We developed an approximation of skull BMD. The estimation may serve as a proxy for a person's total body BMD in research studies where such information would be relevant but has not been collected.



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## References:

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 [3] Zhang, X., et al. (2022). Journal of the American Medical Directors Association, 23(10): 1719.e9-1719.e19.  
 [4] Fedorov, A., et al. (2012). Magnetic Resonance Imaging, 30(9): 1323–1341.