To BMI, or not to BMI?

Adiposity estimation from head T1-weighted MR images

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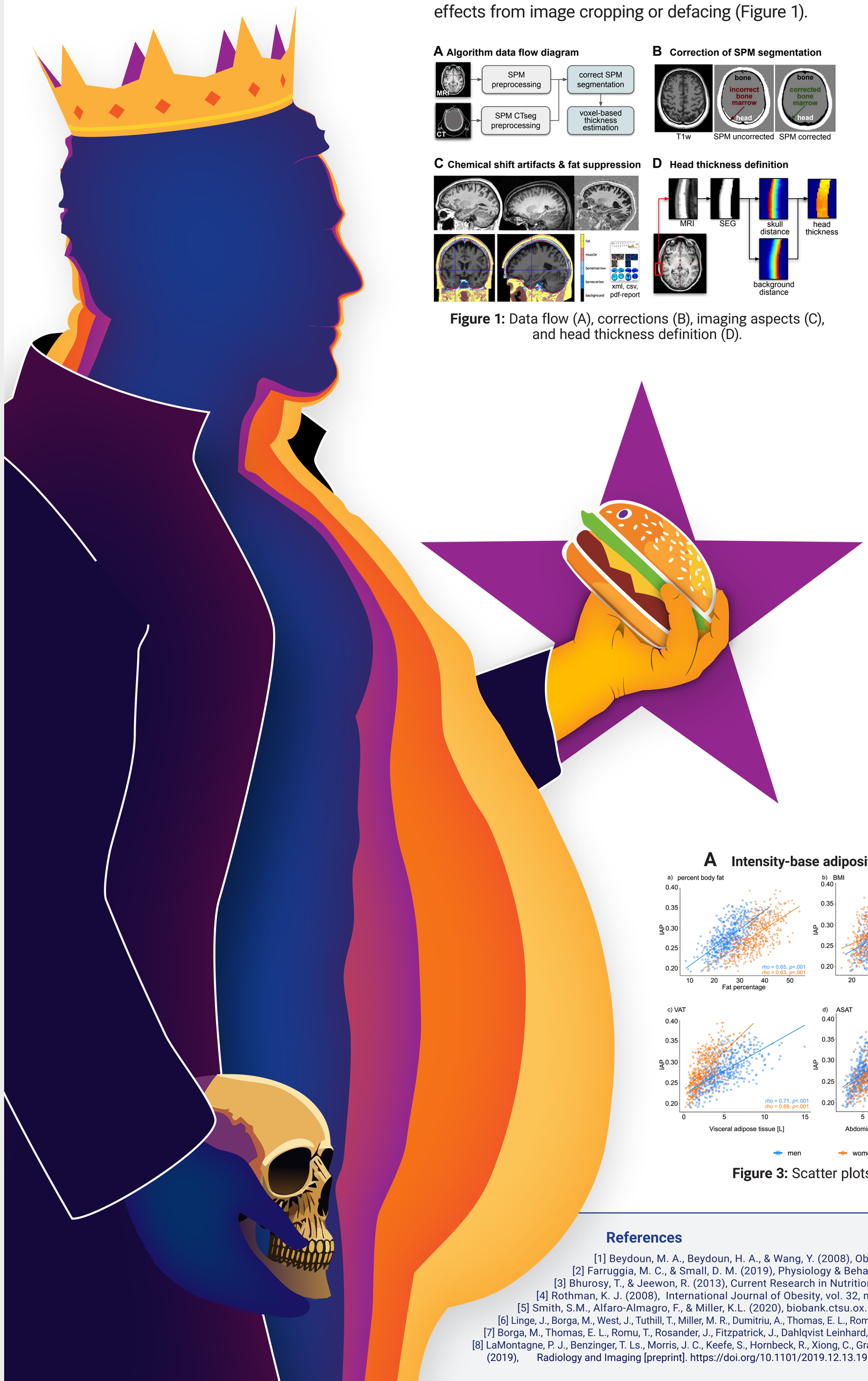
Background

Obesity has detrimental effects on cognitive and brain health [1,2], but is often only approximated by coarse measures, such as the *body mass index* (BMI) [3,4].

Therefore, we present a novel method to directly approximate body adiposity within neuroimaging data.



Method

To approximate body composition, we estimated *intensity-* and *thickness-based adiposity proxy* (**IAP**/**TAP**). IAP is defined as a weighted average of the (refined) SPM-derived Gaussians of the soft head tissue class normalised by the WM Gaussian, whereas TAP is estimated as an average sum of the shortest distance to (i) the hard head tissue and (ii) the background within a maximum brain distance of 30 mm to reduce side effects from image cropping or defacing (Figure 1).

Figure 1: Data flow (A), corrections (B), imaging aspects (C), and head thickness definition (D).

Results

A sub-sample of 2000 healthy participants from the UKB [5] (64.17±6.34 years, 50% women) was used to validate the proxies against BMI, waist circumference, body fat percentage, abdominal *subcutaneous adipose tissue* (**ASAT**), and *visceral adipose tissue* (**VAT**), obtained by abdominal MRI [6,7]. IAP and TAP were moderately associated with BMI in the total sample, but more so in men/women (rho=.53/.63/.62; p<.001) and highly associated with VAT (rho=.74, p<.001; Figure 2-3).

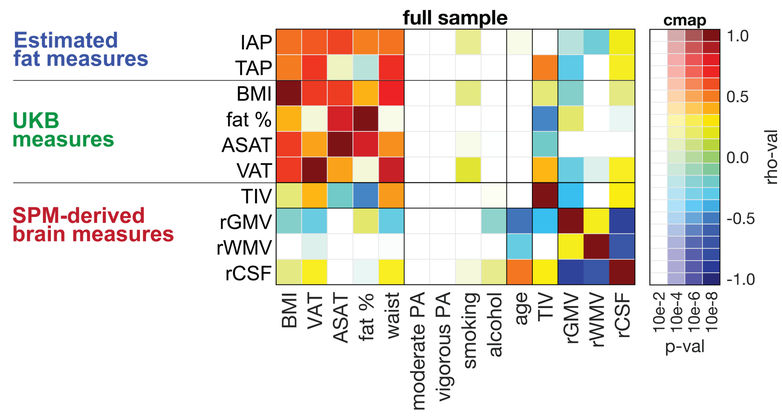


Figure 2: Correlation table of proxies and UKB measures.

Retest reliability was r=.74/.58 for IAP/TAP with p<.001 tested in 63 OASIS-3 [8] subjects rescanned within 3 month (67.66±8.22 years, 56% women).

Conclusion

We developed an approximation of subcutaneous fat using a class of tissue that is normally discarded when processing brain MR images. Both measures may provide valuable information beyond the commonly used BMI, which has several limitations, especially in cohorts of older people [3,4].

In addition, they may have applications not only in basic research as markers of brain health and ageing, but also in intervention studies and clinical settings as indicators (or predictors) of the effectiveness of therapies and interventions.

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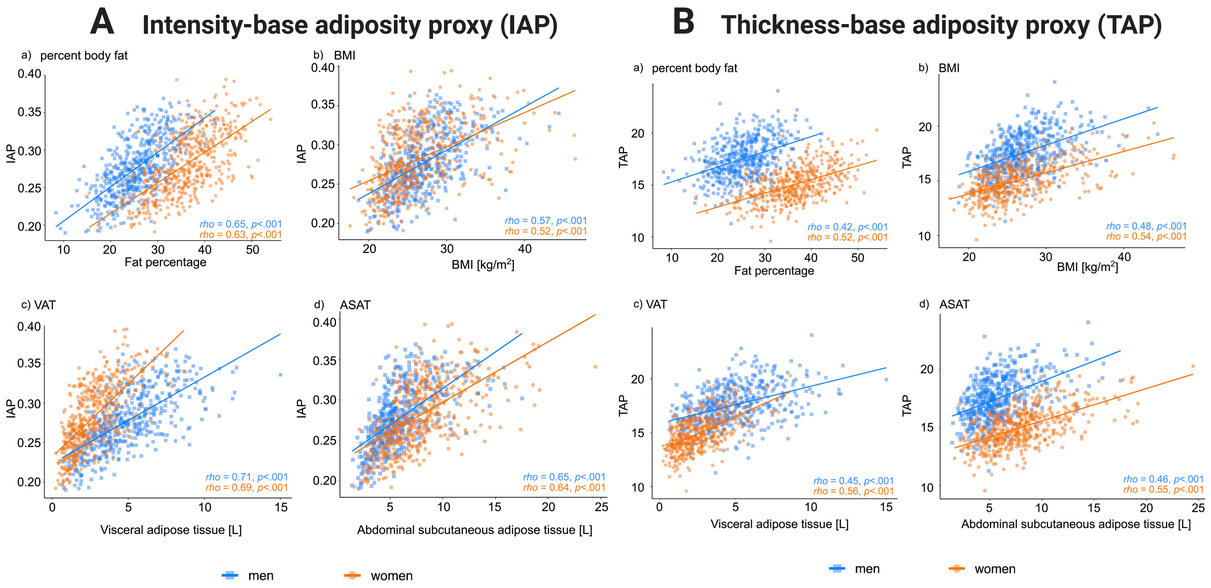

Figure 3: Scatter plots of IAP (A) and TAP (B) proxies agains UKB measures.

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