A transformative resource: early outcomes from use of the UK Biobank brain imaging data

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UK Biobank’s Imaging Enhancement

- UK Biobank enhancement evaluation for 100,000 of the 500,000 subjects was initiated in pilot phase from 2014 and entered its full phase in 2017

- **25,000 people have now been imaged**

- Providing a comprehensive, quantitative imaging phenotype (brain, cardiac, whole body MRI, 3D Carotid US, DEXA)

- An open resource for researchers world-wide
Relating brain structure and function to cognitive variation

Associations with cognitive test scores only
Influences of lifestyle and environment on brain structure
White matter structure explains even more of the variance attributable to environment and lifestyle

Brain images from Miller et al. Nature Neurosci 2016; body fat images courtesy of Prof. J. Bell, Univ of Westminster
Subclinical brain white matter pathology associated with hypertension and pre-hypertension.

Differences in hypertensive population propensity matched to non-hypertensive controls:
- Blue- significantly decreased;
- Red- significantly increased.

Relative impacts of modifiable risk factors on age-associated brain atrophy

Replicated age (brown), BMI (green/yellow), SDP (red) and DM (blue) across two randomly assigned UK Biobank populations (n= 4156)

Graphical representation of regional risk factor effect sizes

H. Suzuki et al, unpublished
Reduced white matter integrity with major depressive disorder (MDD) in mid-late life

White matter tracts tested

Relative effect of diagnosis of probable MDD on tract fractional anisotropy (FA)

N= 335 MDD, 754 healthy controls; mean age 55±7 years
Genetic determinants of late life disease

GWAS for T2* hyperintensity, a measure of brain tissue iron concentration
Genetic determinants of late life disease

HFE, encoding the hemochromatosis protein
A common SNP in the hemochromatosis gene (HFE) reduces neuronal cholesterol synthesis and accelerates neurodegeneration.
AI based prediction of brain health outcomes

Brain structure as a predictor of clinical outcome

3D convolutional neural network with 50 layers and 22 million parameters. Trained on 6,423 pairs of T1 and T2 images

Enhanced modeling of brain-predicted age (N=1864)

JH Cole et al Mol Psych 2017

Arinnbjorn Kolbeinsson, Abbas Dehghan, Ioanna Tzoulaki, unpublished
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