

ECG monitoring in the participants of UK Biobank



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503,317 participants 40-69 years old were recruited between 2006-10

Baseline assessment

Touchscreen questionnaire

- Socio-demographics
- Lifestyle
- Environment
- Early life
- Family history
- Psychosocial
- Health
- Hearing test
- Cognitive test

Verbal medical interview

- More detail on
- Early life
 - Employment
 - Medical conditions
 - Medications
 - Operations

Physical measures

- Blood pressure
- Arterial stiffness
- Hand grip
- BMI/weight
- Spirometry
- Heel US
- Eye

Sample Collection

- Blood (45 ml)
- Urine (9ml)
- Saliva (2.5ml)

At baseline all participants consented to future re-contact, indefinite linkage to medical records, and to receive no feedback

Ongoing enhanced phenotyping of cohort



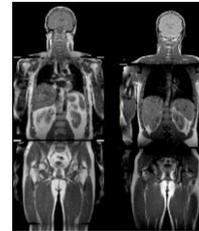
Genotyping (N=500,000)



Online questionnaires
(N=330,000 with emails)



34 Biomarkers (N=500,000)



Multimodal imaging
(N=100,000)



Accelerometer (N=100,000)



Record linkage (N=500,000)

- Death
- Cancer
- Hospital inpatient

The **biobank**^{uk} Imaging Cohort

Repeat
baseline
assessment

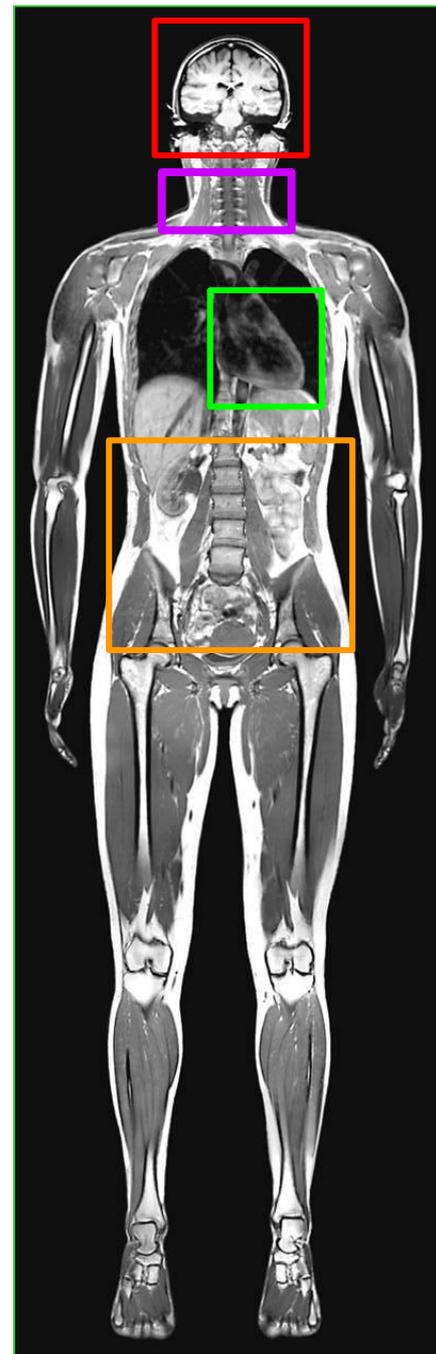
MRI
brain*,
cardiac, body

Carotid
ultrasound

DXA scan

Repeat++
cognitive
assessment

* To evaluate brain anatomical and neuropathological structure, activity (both task and resting-state functional MRI), and local tissue microstructure (diffusion MRI). Three structural modalities are included: T1-weighted, T2-weighted and susceptibility-weighted MRI)



ECG monitoring in the UKBB Imaging Cohort: WHY?

To evaluate:

- the relationship between SCAF/AF and imaging parameters and cognitive function
- the impact of SCAF/AF on the future risk of non-fatal myocardial infarction, coronary death, stroke or thrombembolism and dementia.
- whether, in addition to the CHA₂DS₂-VASc score, other parameters (e.g., indices of cognitive function, MR evidence of cerebrovascular disease, carotid plaque burden or blood biomarkers) can refine risk stratification in individuals with SCAF/AF.

ECG monitoring in the UKBB Imaging Cohort: HOW?

- Prevalence of clinical AF in UK Biobank is as expected relative to age group (~16,000 cases).
- About 65% of eligible participants (>60 yrs) agree to wear the patch.
- Based on our pilot study in >3000 participants, median wear time was 12.6 days and median analysable ECG time of 99.1%.
- Other longer-term non-invasive cardiac rhythm monitoring solutions are also being explored



The **biobank**^{uk} Imaging Cohort

Activity monitor

Genotype

Blood biomarkers

Repeat baseline assessment

Carotid ultrasound

Repeat++ cognitive assessment

MRI brain, cardiac, body

DXA scan

ECG monitor

Linkage to medical records

What will the study achieve?

1. Evaluate the prevalence of silent AF and its risk factors

2. Establish causality of AF risk factors by Mendelian randomisation

3. Understand the relationship between silent AF, imaging, and cognitive function.

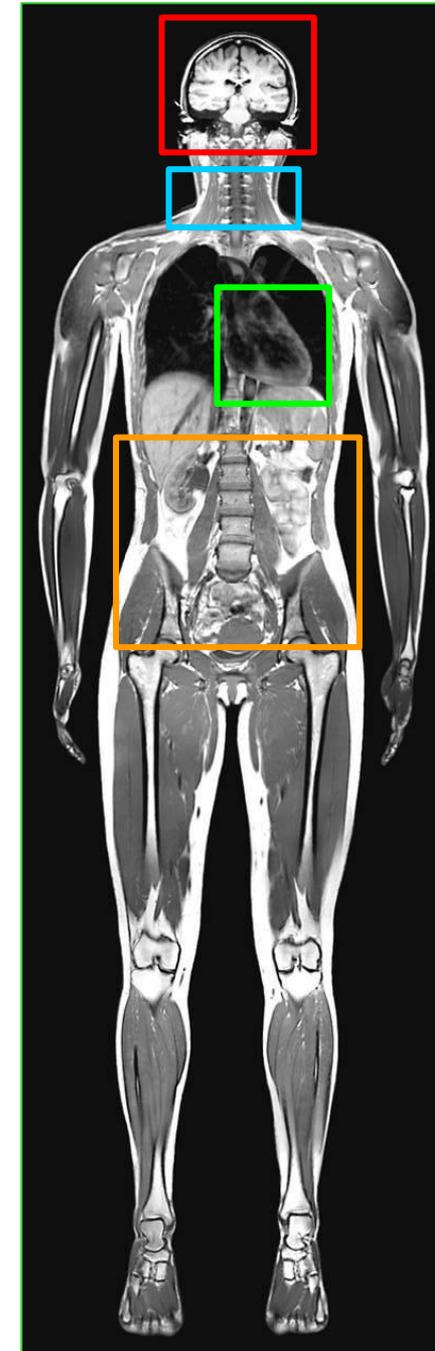
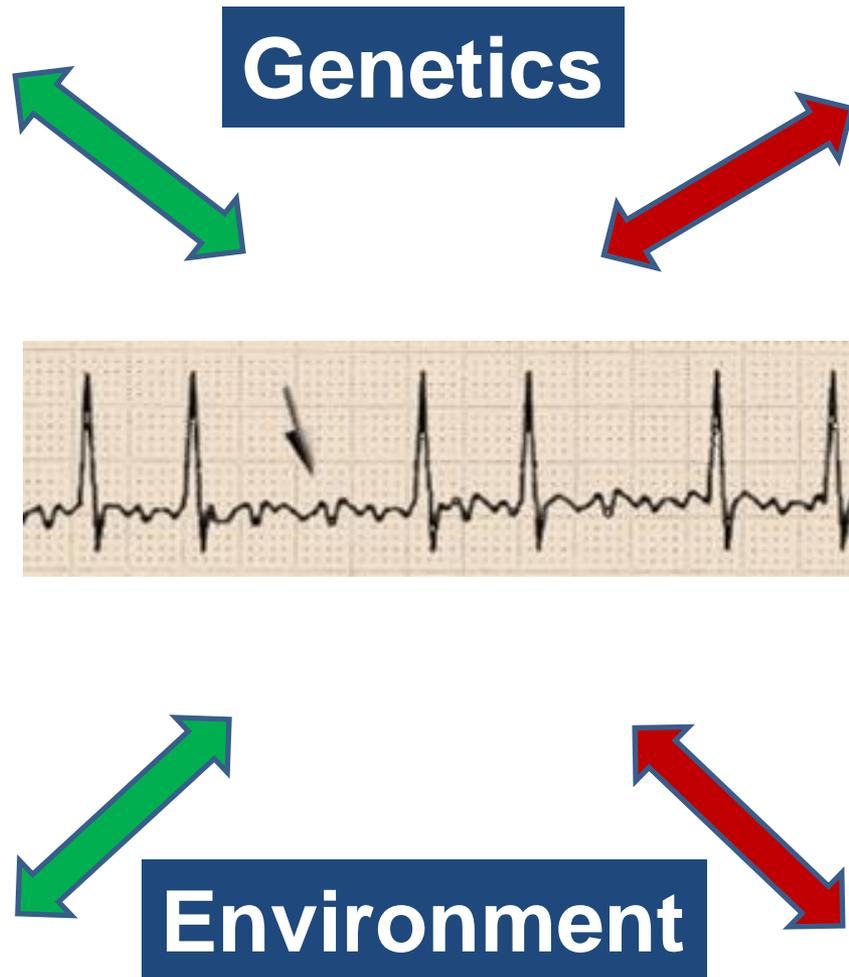
4. Evaluate the impact of silent AF on the future risk of clinical AF, stroke, MI, dementia and vascular death.

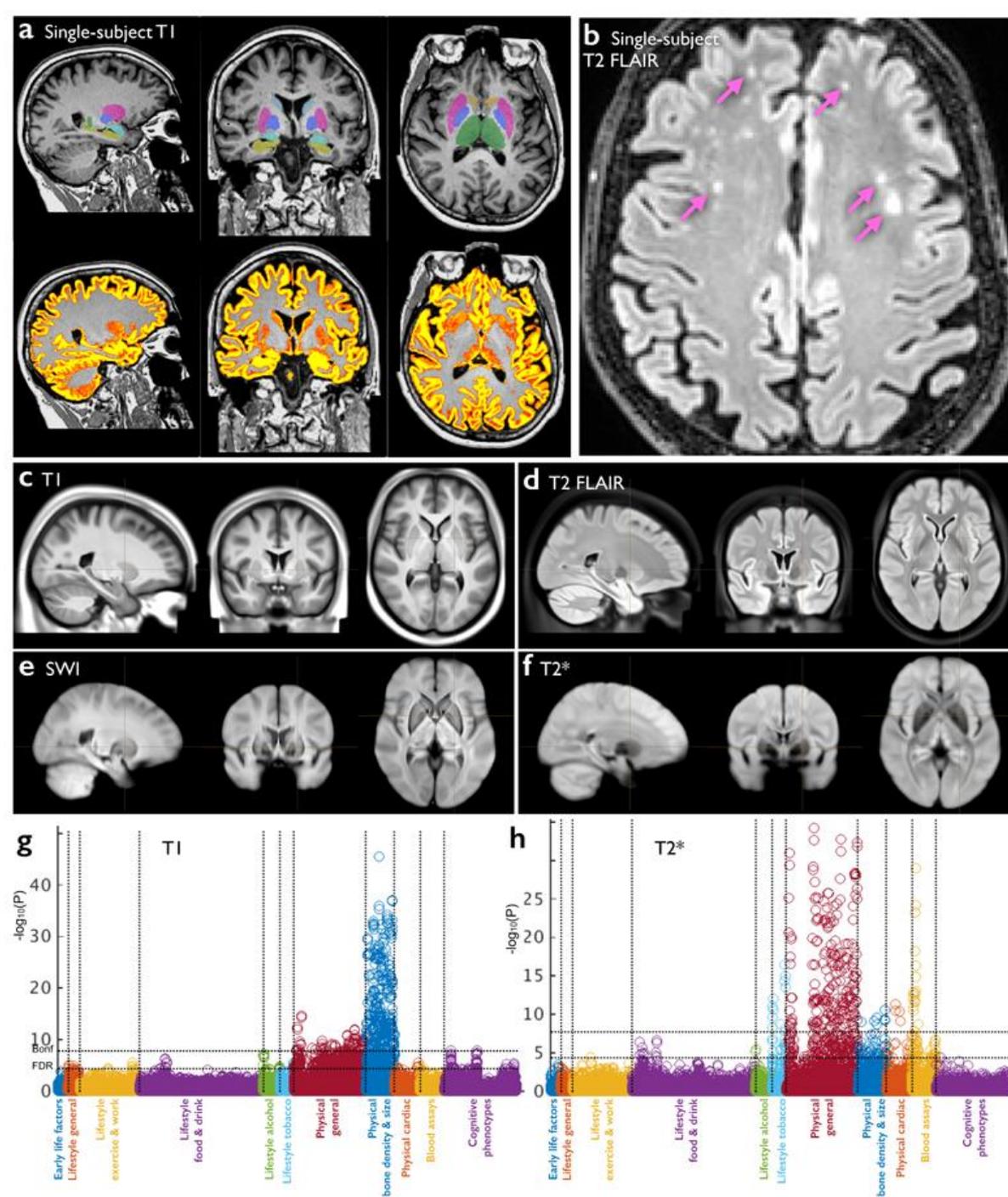
5. Clarify the relationship between AF burden and cognitive decline prospectively, in the presence or absence of stroke

6. Assess whether indices of cognitive function, imaging or other biomarkers can refine stroke risk stratification.

7. Inform on the cost-effectiveness of prolonged ECG monitoring in the population.

- Socio-demographics
- **Ethnicity**
- **Physical activity**
- Smoking
- **Diet**
- Alcohol
- **Early life factors**
- Family history of common diseases
- General health
- Past medical history & medications
- Psychological status
- **Cognitive function**
- Blood pressure & HR
- Height
- **Blood-based markers**
- Waist/hip circumference
- Weight/impedance
- Spirometry





Data from the three structural imaging modalities in UK Biobank brain imaging.

(a) Single-subject **T1-weighted structural image**. Colour overlays show automated modelling of several subcortical structures (above) and segmentation of grey matter (below).

(b) Single-subject **T2-weighted FLAIR image** with the same minimal pre-processing showing hyperintense lesions in the white matter (arrows).

(c) **Group-average ($n \approx 4,500$) T1 atlas**; all subjects' data were aligned together and averaged, achieving high-quality alignment, with clear delineation of deep grey structures

(d) **Group-average T2 FLAIR atlas**.

(e) Group-average atlas derived from SWI processing of swMRI phase and magnitude images.

(f) Group-average T2* atlas, also derived from the swMRI data.

(g) Manhattan plot relating all 25 IDPs from the T1 data to 1,100 non-brain-imaging variables extracted from the UK Biobank database, with the latter arranged into major variable groups along the x axis

(h) Plot relating all 14 T2* IDPs to 1,100 non-imaging variables.

Cognitive function tests

- **Pairs matching** (cards): visual episodic memory
- **Reaction time** (snap): processing speed
- **Fluid intelligence**: logical reasoning
- **Prospective memory**: short-term memory
- **Numeric memory test**: working memory
- **Trail-making test**: executive function (switching)
- **Symbol digit subtraction test**: processing speed
- **NIH toolbox picture vocabulary tests**: cognitive level
- **Matrices**: fluid intelligence
- **One touch tower of London test**: planning
- **NIH Toolbox dimensional change card sort test**: executive function (switching)