

Physical activity and its health consequences

Aiden Doherty

Big Data Institute

Nuffield Department of Population Health





Institute of Biomedical Engineering

NIHR Oxford Biomedical Research Centre

BHF Centre for Research Excellence

University of Oxford

Physical activity benefits for adults and older adults

-  BENEFITS HEALTH
-  IMPROVES SLEEP
-  MAINTAINS HEALTHY WEIGHT
-  MANAGES STRESS
-  IMPROVES QUALITY OF LIFE







REDUCES YOUR CHANCE OF

Type II Diabetes	-40%
Cardiovascular Disease	-35%
Falls, Depression and Dementia	-30%
Joint and Back Pain	-25%
Cancers (Colon and Breast)	-20%

What should you do?

For a healthy heart and mind




Be Active

VIGOROUS	MODERATE
 RUN	 WALK
 SPORT	 CYCLE
 STAIRS	 SWIM

MINUTES PER WEEK
75 OR 150
VIGOROUS INTENSITY (BREATHING FAST, DIFFICULTY TALKING)
MODERATE INTENSITY (INCREASED BREATHING, ABLE TO TALK)
OR A COMBINATION OF BOTH

To keep your muscles, bones and joints strong




Sit Less

 TV
 SOFA
 COMPUTER




BREAK UP SITTING TIME

To reduce your chance of falls

Build Strength

 GYM
 YOGA
 CARRY BAGS

Improve Balance

 DANCE
 TAI CHI
 BOWLS

2 DAYS PER WEEK

Something is better than nothing.
Start small and build up gradually: just 10 minutes at a time provides benefit.
MAKE A START TODAY: it's never too late!

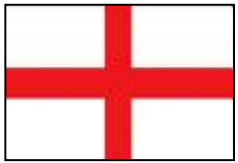
Measuring physical activity

% adults meeting physical activity recommendations



Self report : %

Device : %



Self-report : **38%**

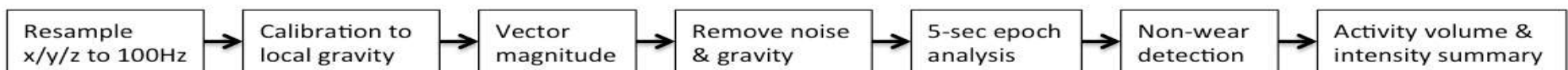
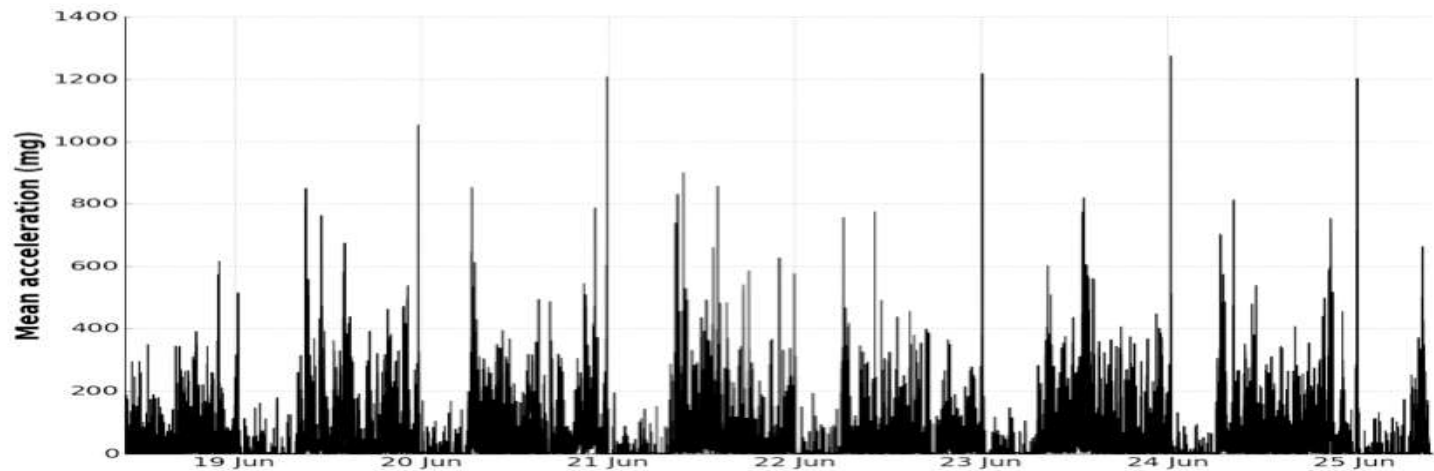
Device : %

Key questions

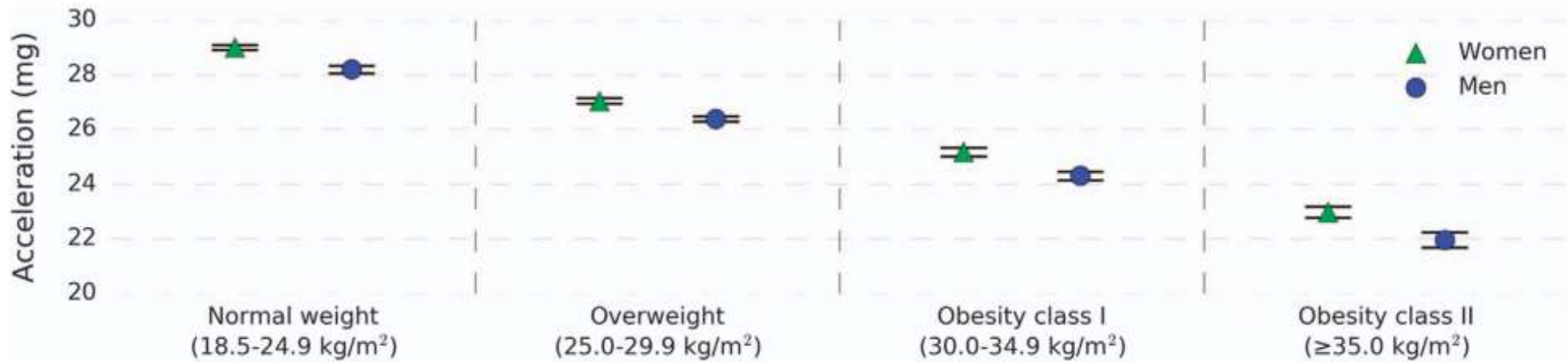
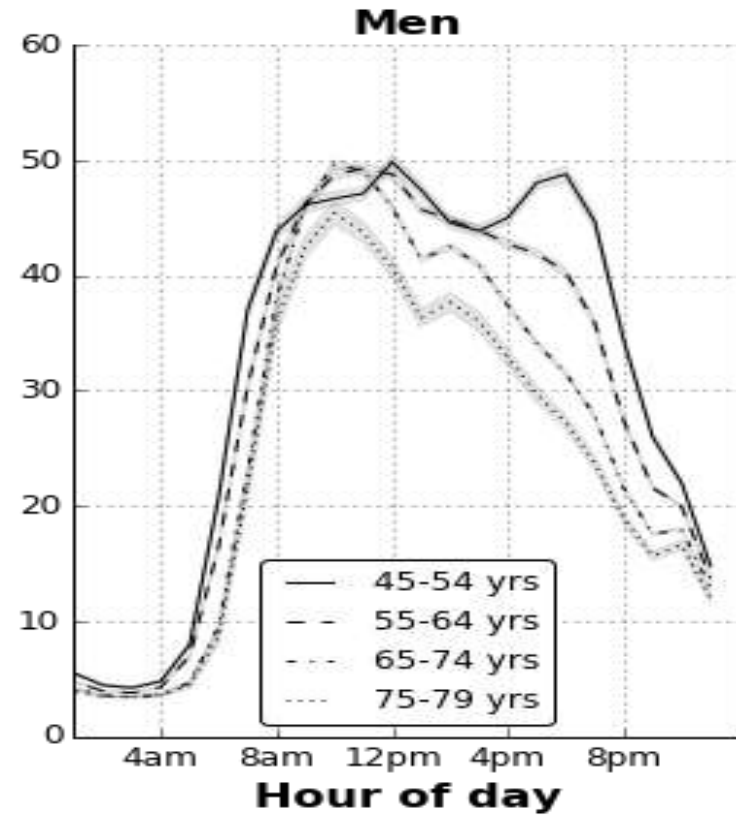
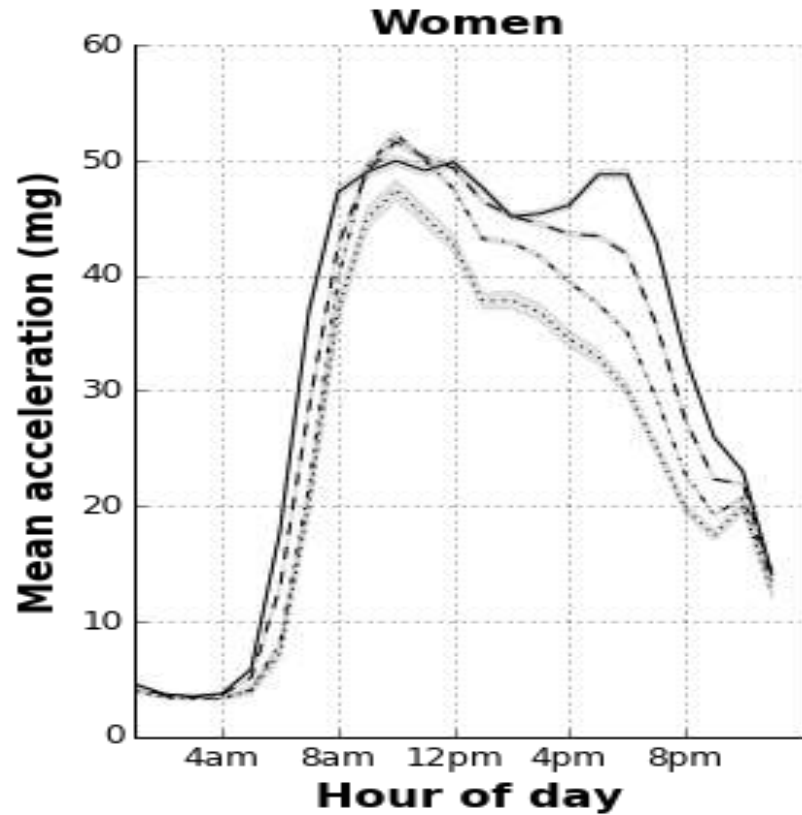
- How much physical activity is beneficial for health?
- How often, and intensely, should it be done?
- What types of activity are best?
- How much of this is heritable?
- What interventions/drugs actually work when trying to increase mobility?

UK Biobank activity monitor project

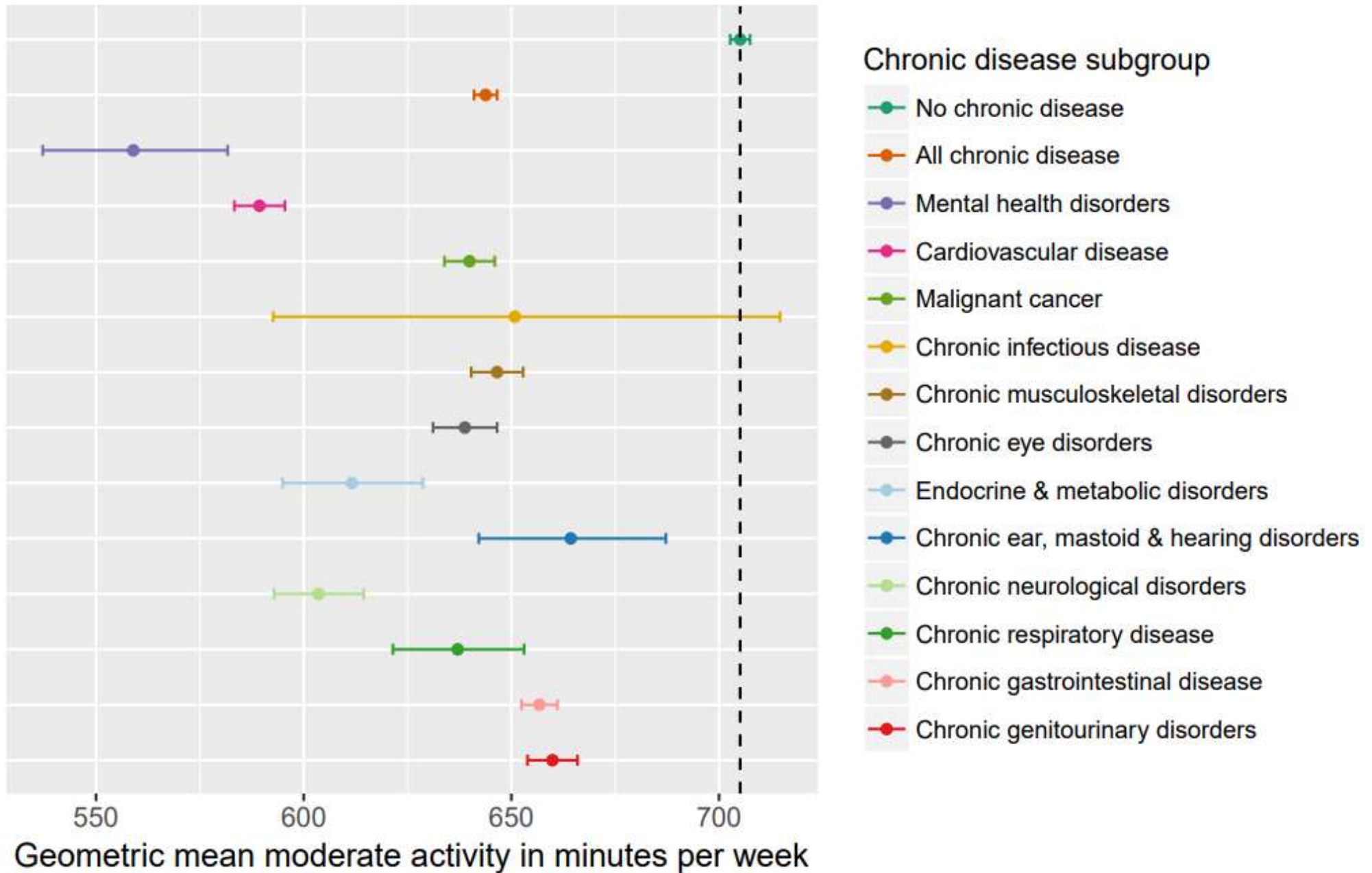
- 103,712 participants
- 7 days data / participant
- 100Hz tri-axial acceleration data
- 180 million movement readings / participant



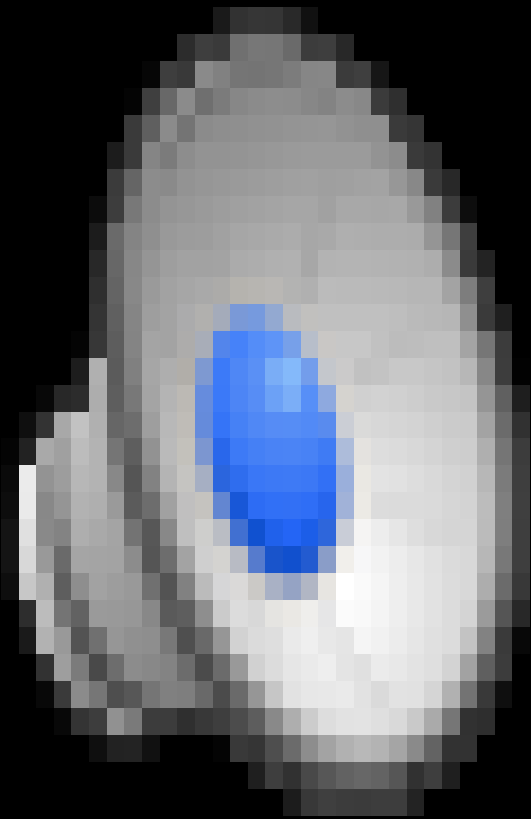
UK Biobank: Activity profiles + health



Consequences of disease on mobility

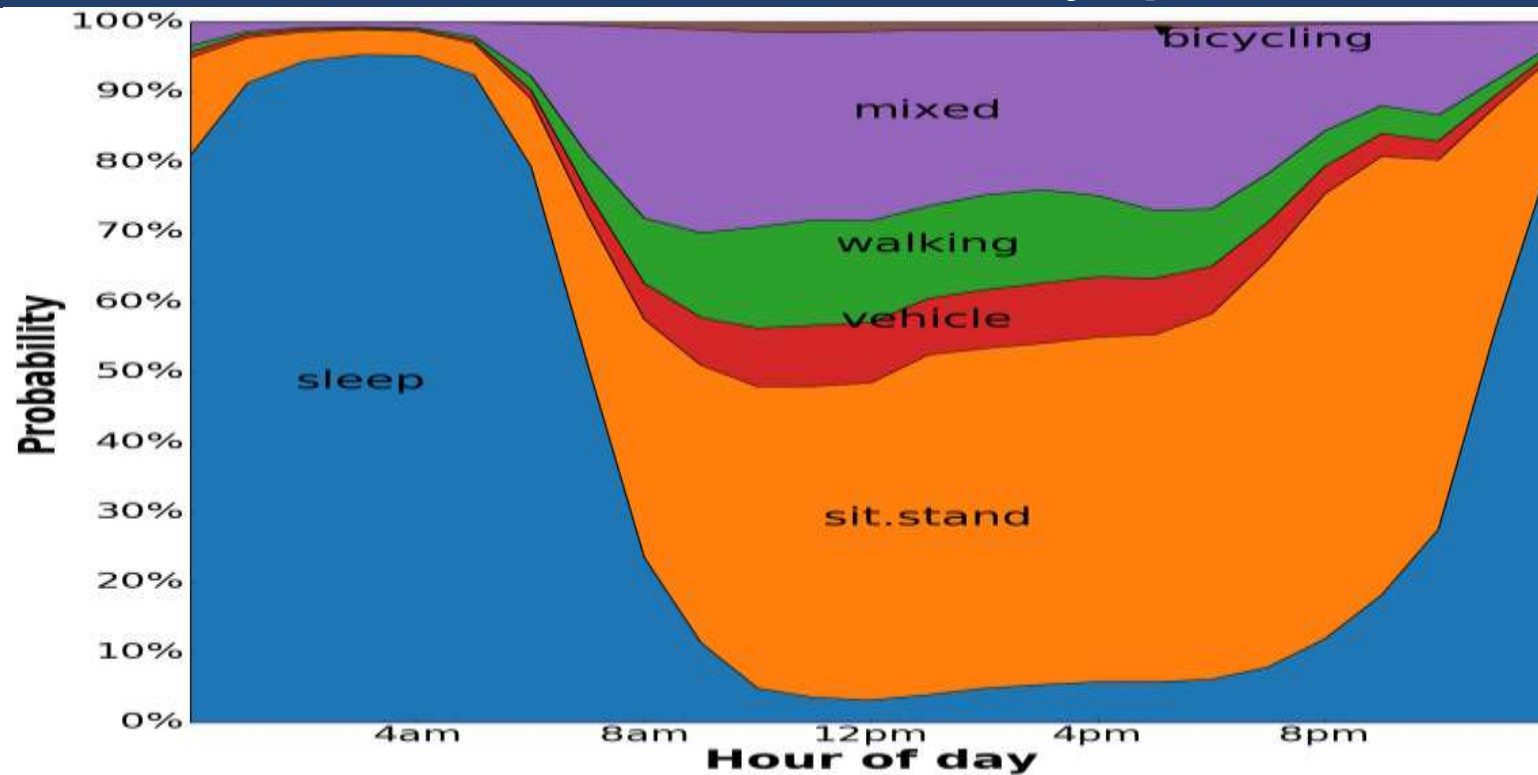


Machine learning of behaviours from sensor data



150 people – activity monitors + cameras

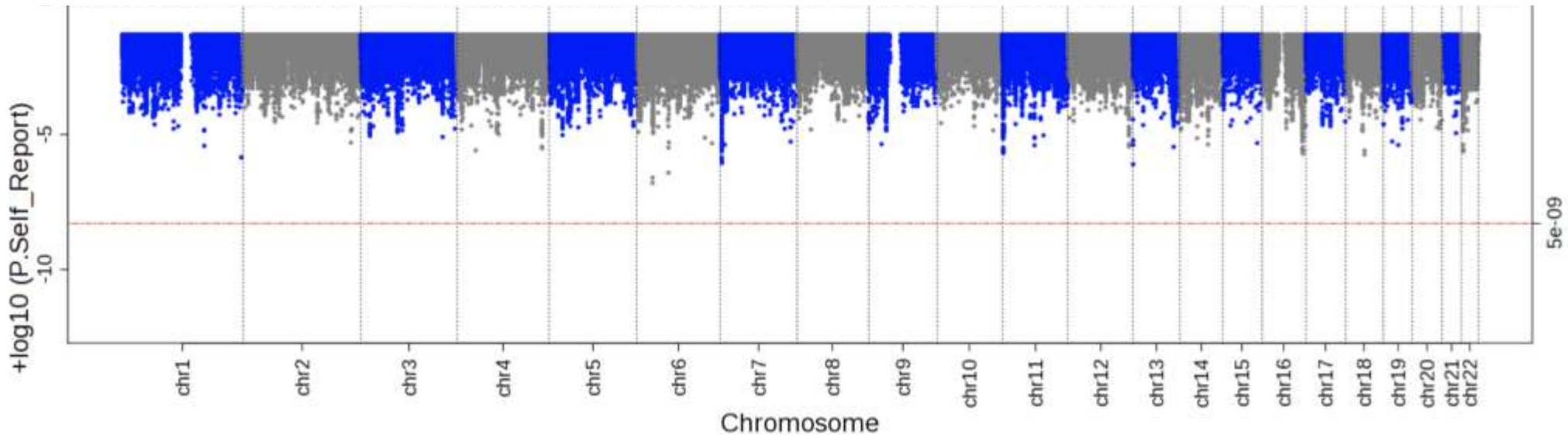
UK Biobank: Activity profiles



- Men spent more time walking (7.2% vs 6.2%, $p < 10^{-100}$)
- Women spend more time in mixed behaviours (17.4% vs 13.2%, $p < 10^{-100}$)
- Walking time is highest in spring (6.9% vs. 6.4% in winter, $p = 4 \times 10^{-51}$)

Precise measures of phenotype enhance biological understanding

Figure 11 Miami plot of European sex-combined GWAS of physical activity in UK Biobank measured by accelerometer (*top*, $n=91,112$) and self-report (*below*, $n=351,154$).

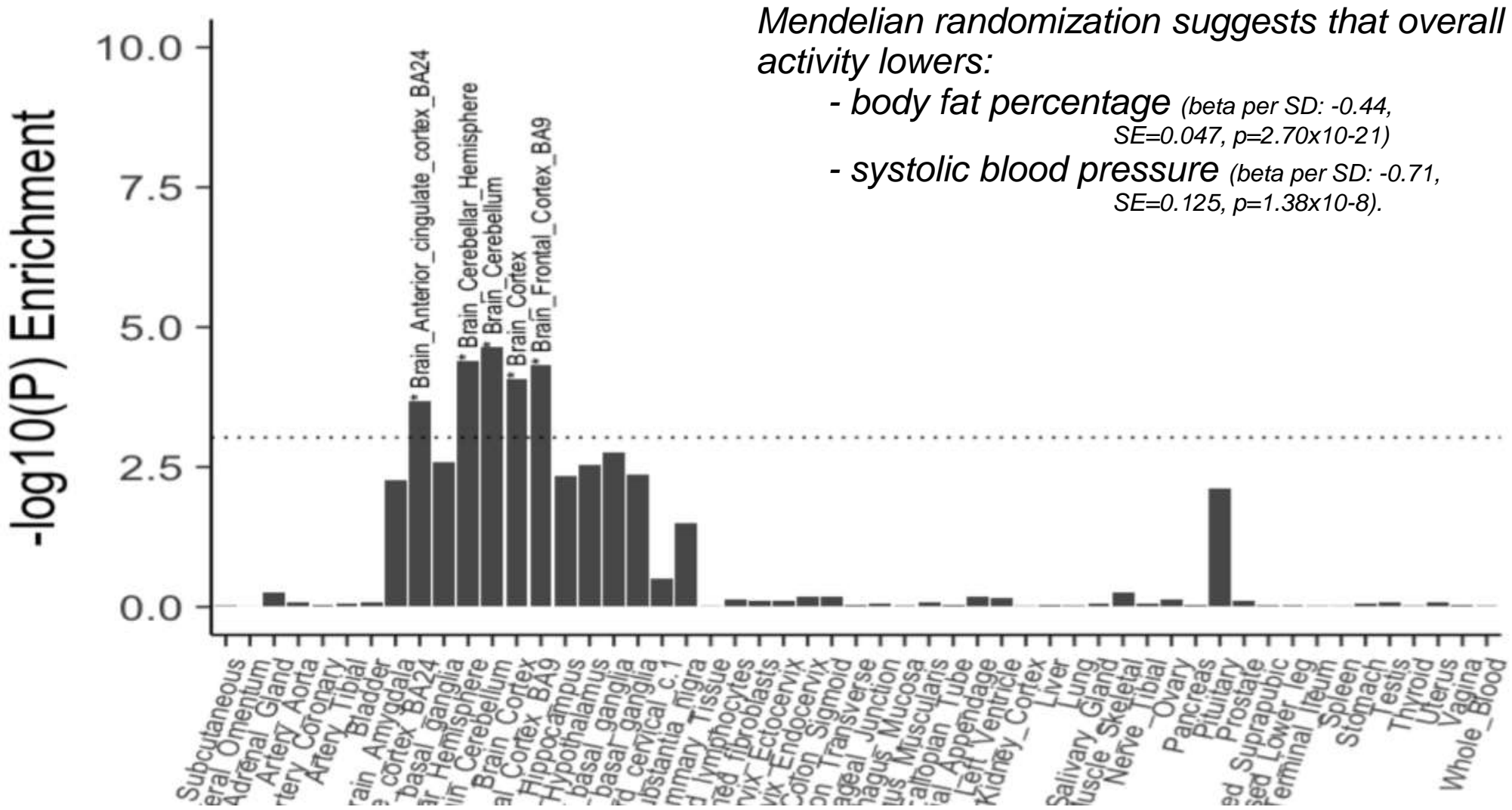


Self-reported activity (n=351k): $\lambda = 1.05$, LD intercept = 1.01, $h^2 = 0.06$, $R^2(\text{GWS loci}) = \text{nan}\%$, $R^2(5 \times 10^{-3} \text{ loci}) = 0.8\%$

Genomic control (λ), explained variance (R^2) and heritability (h^2) estimates are also provided.

Physical activity, sleep, and disease pathways

Figure 3 | Tissue enrichment analysis using eQTL data from GTEx for median value across 5 physical activity and sleep traits.



Physical activity & sleep: Where next?

Long-term associations with disease:

- Long-term follow-up
- Genetic studies including other biobanks worldwide

Identify new health-relevant patterns:

- Semi- and unsupervised 'artificial intelligence' methods
- New sensors

Physical activity & brain health:

- UK Biobank imaging study