Genetic studies of accelerometer-based sleep measures in 85,670 individuals yield new insights into human sleep behaviour

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Sleep patterns are associated with obesity and type 2 diabetes

The UK Biobank accelerometer dataset offers an unparalleled opportunity to investigate sleep patterns

About how many hours sleep do you get in every 24 hours? (please include naps)

hours

7 8 9 Clear

4 5 6 Do not know

1 2 3 Prefer not to answer

0

Do you have trouble falling asleep at night or do you wake up in the middle of the night?

Never/rarely

Sometimes

Usually

Prefer not to answer

Do you consider yourself to be?

Definitely a 'morning' person

More a 'morning' than 'evening' person

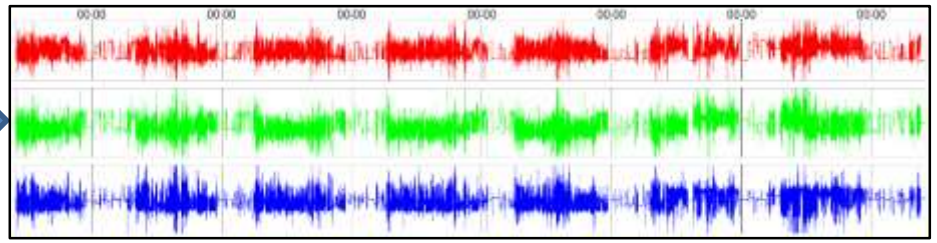
More an 'evening' than a 'morning' person

Definitely an 'evening' person

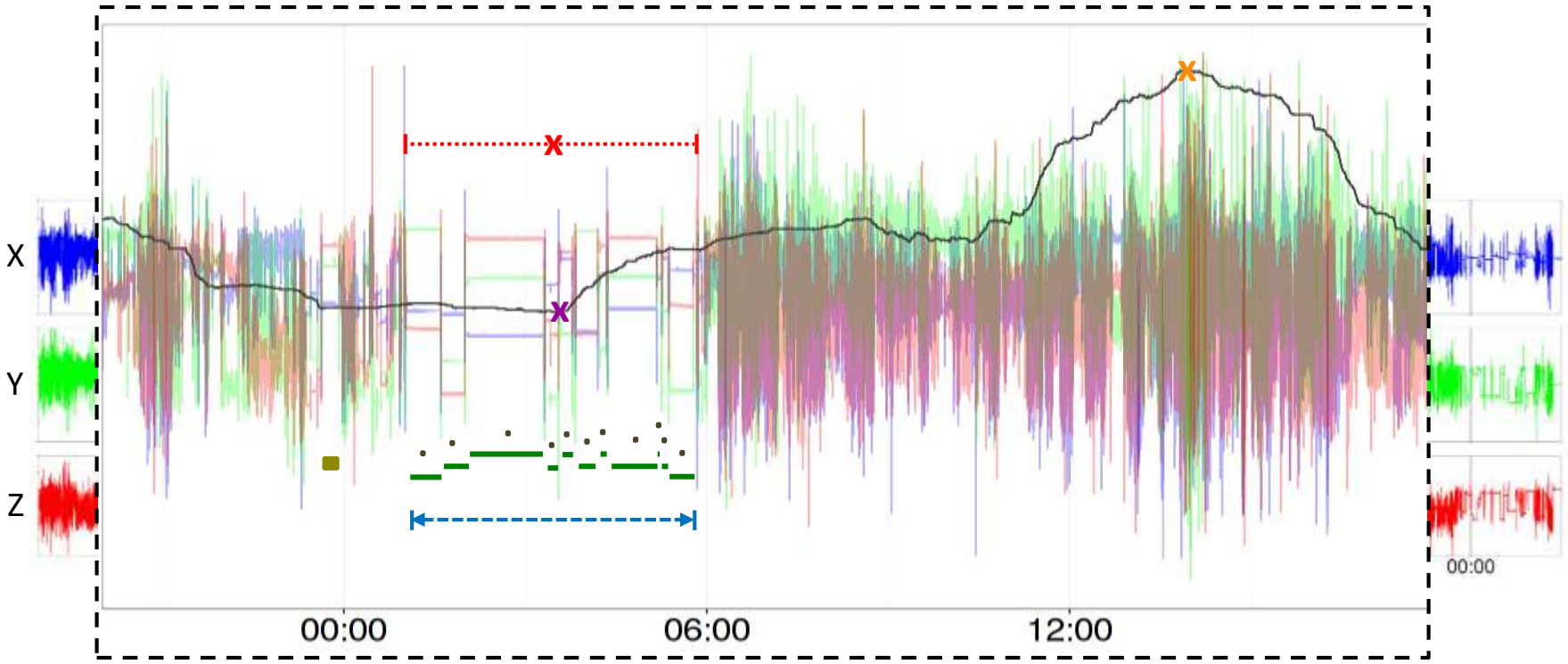
Do not know

Prefer not to answer

- ~103,000 participants
- 7 days continuous wear
- Worn on dominant wrist



We are able to define eight simple measures of sleep patterns using the software package GGIR



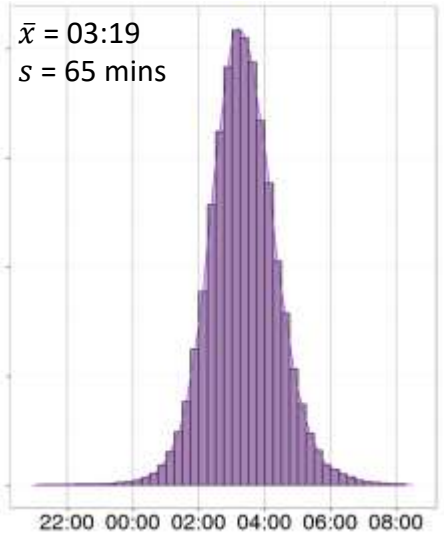
Timing phenotypes:
- L5 time (midpoint of least-active 5 hours)
- M10 time (midpoint of most-active 10 hours)
- Sleep midpoint

Quantitative phenotypes:
- Sleep duration
- Diurnal inactivity duration (quantity of rest/sleep during the day*)
- Sleep duration variability

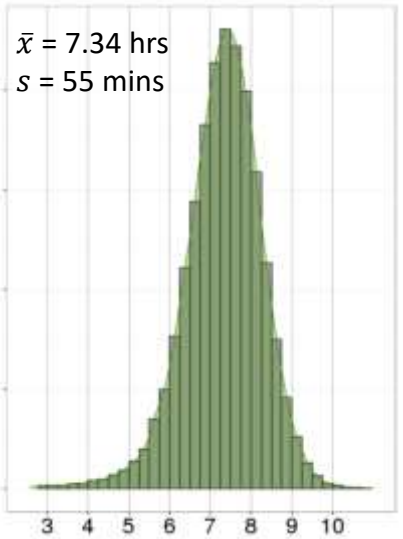
Quality phenotypes:
- Sleep efficiency (sleep duration ÷ time in bed)
- Number of sleep episodes

The average participant sleeps 7h20m per night, with minimum activity occurring around 3:20am

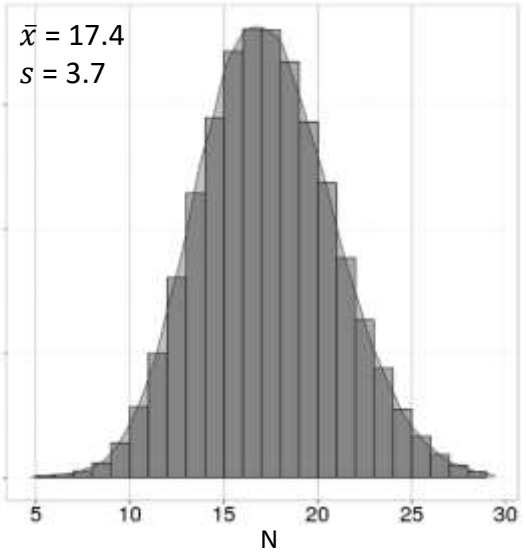
L5 time



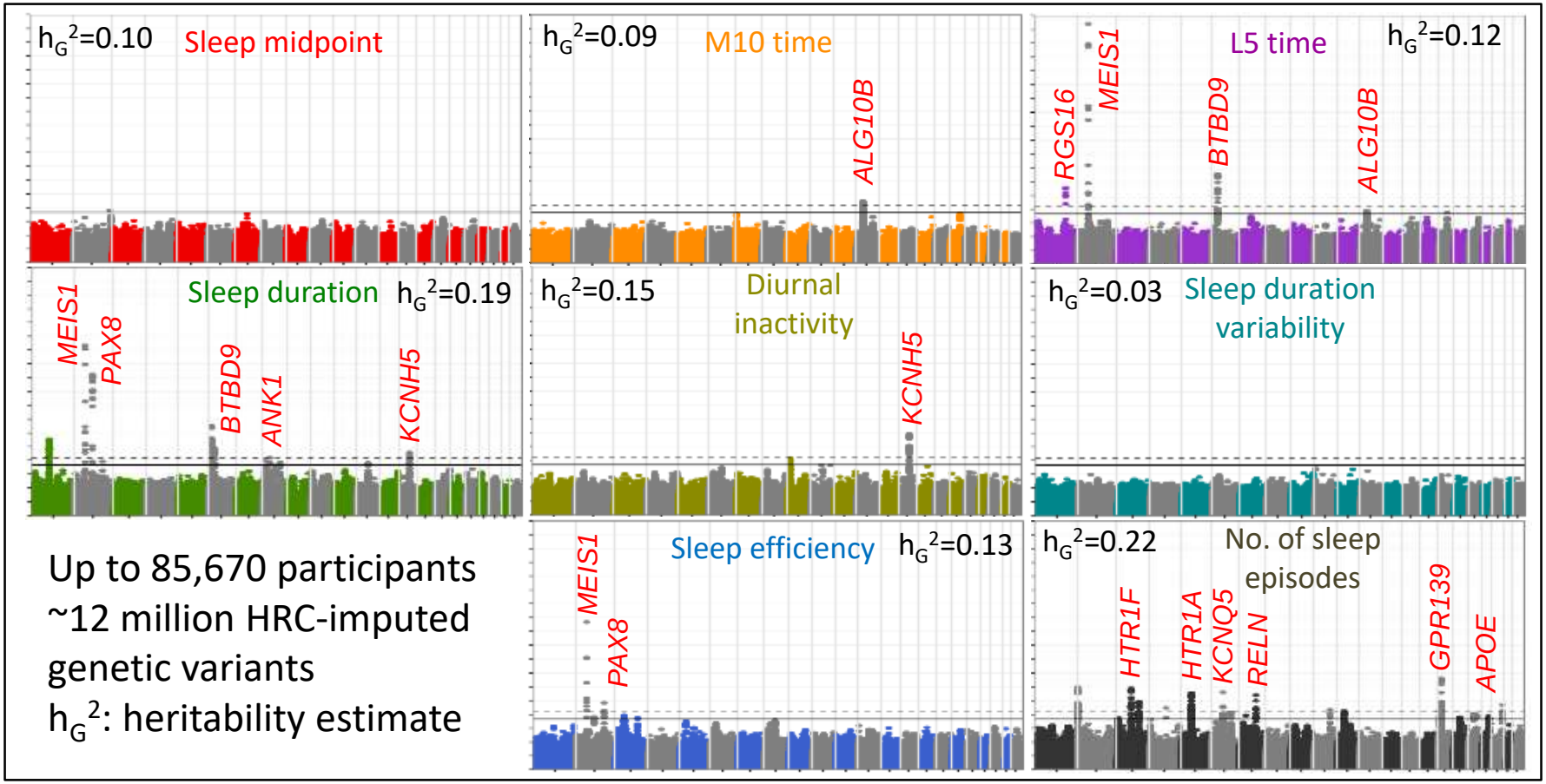
Sleep duration



Number of sleep episodes



Through genome-wide association analyses (GWAS) we identify 40 distinct loci associated with our sleep measures ($P<5x10^{-8}$)



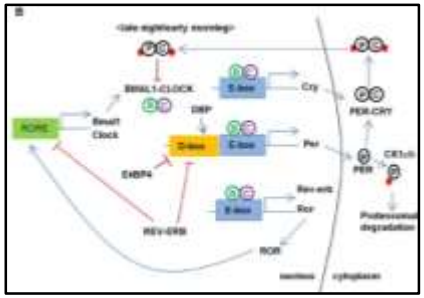
Why is this work important?

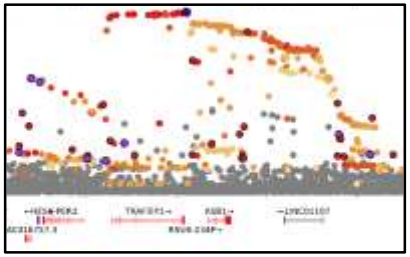
Identify genetic variants associated with sleep

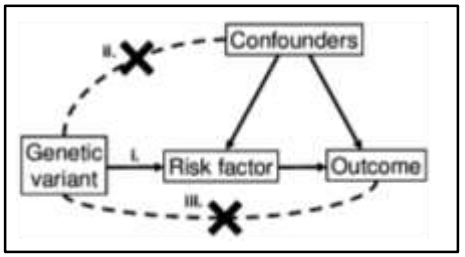
Better understand the molecular mechanisms of sleep

Identifying potential therapeutic targets

Disentangle causal influences of sleep patterns with disease







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Improving the health of future generations

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Supplementary Results: Actigraphy-derived phenotypes show low correlations with self-report measures

Phenotype	M10 time	L5 time	Sleep midpoint	Sleep duration	Sleep duration variation	Sleep efficiency	Diurnal inactivity	No. of sleep episodes	Self-report hours slept
L5 time	0.460								
Sleep midpoint	0.383	0.591							
Sleep duration	0.012	-0.023	-0.039						
Sleep duration variation	0.059	-0.007	-0.102	-0.303					
Sleep efficiency	0.009	0.035	0.119	0.566	-0.165				
Diurnal inactivity	0.043	0.083	-0.105	0.269	0.098	-0.200			
No. of sleep episodes	0.036	-0.023	-0.054	0.142	-0.182	-0.250	0.202		
Self-report hours slept	0.025	0.010	0.008	0.189	-0.043	0.133	0.040	0.082	
Self-report chronotype	-0.277	-0.293	-0.237	0.027	-0.042	0.018	-0.044	-0.006	-0.005