

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

Samuel Jones
University of Exeter Medical School, UK

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Sleep patterns are associated with obesity and type 2 diabetes

Meta-Analysis of Short Sleep Duration and Obesity in Children and Adults

Francesco P. Cappuccio, MD, FRCP¹; Frances M. Taggart, PhD¹; Ngianga-Bakwira, MD, PhD¹; Michelle A. Miller, PhD¹

High-Fat Diet Disrupts Behavioral and Molecular

The **Adverse metabolic and cardiovascular consequences of circadian misalignment**

Ch **With Glycemi**

SIRIMON REUTRAKUL, MD, CDE¹
MEGAN M. HOOD, PhD²
STEPHANIE J. CROWLEY, PhD²
MARY K. MORGAN, RD¹

Frank A. J. L. Scheer^{a,b,1}, Michael F. Hilton^{a,2}, Christos S. Mantzoros^{b,c}, and Steven A. Shea^{a,b}

There is considerable epidemiological evidence that shift work is associated with increased risk for obesity, diabetes, and cardiovascular disease, perhaps the result of physiologic maladaptation to chronically sleeping and eating at abnormal circadian times. To begin to understand underlying mechanisms, we determined the effects of such misalignment between behavioral cycles (fasting/feeding and sleep/wake cycles) and endogenous circadian cycles on metabolic, autonomic, and endocrine predictors of obesity, diabetes, and cardiovascular risk. Ten adults (5 female) underwent

ton Hospital, Evanston, IL 60208, USA

CK and diabetes

Hong Su³, Caroline H. Ko²,
⁶, Louis H. Philipson⁶,
h S. Takahashi^{10,11}

Evening Chronotype Disorders and Blood Pressure in Adults

Ji Hee Yu,* Chang-Ho Yun,* Jae Hee Ahn, Sooyoung Seung Ku Lee, Hye Jin Yoo, Ji A Seo, Sin Gon Kim, Sei Hyun Baik, Dong Seop Choi, Chol Shin,* and

lock Mutant Mice

McDearmon^{2,5}, Aaron Laposky², Sue Olson², Amy Easton², Dalan R. Jensen⁶, Robert H. Eckel⁶, Joseph S. Takahashi^{1,2,5}, and Joseph Bass^{2,3,4,7}

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?

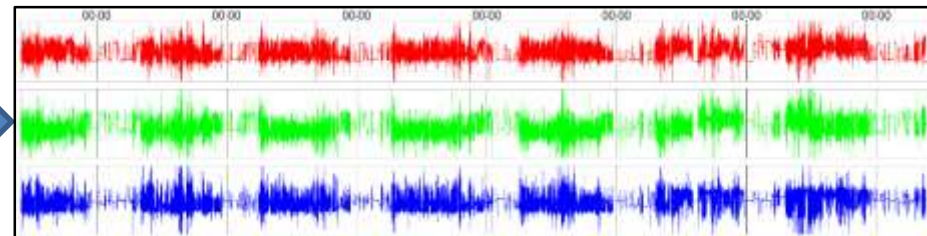
- Never/rarely
- Sometimes
- Usually
- Prefer not to answer

Do you consider yourself to be?

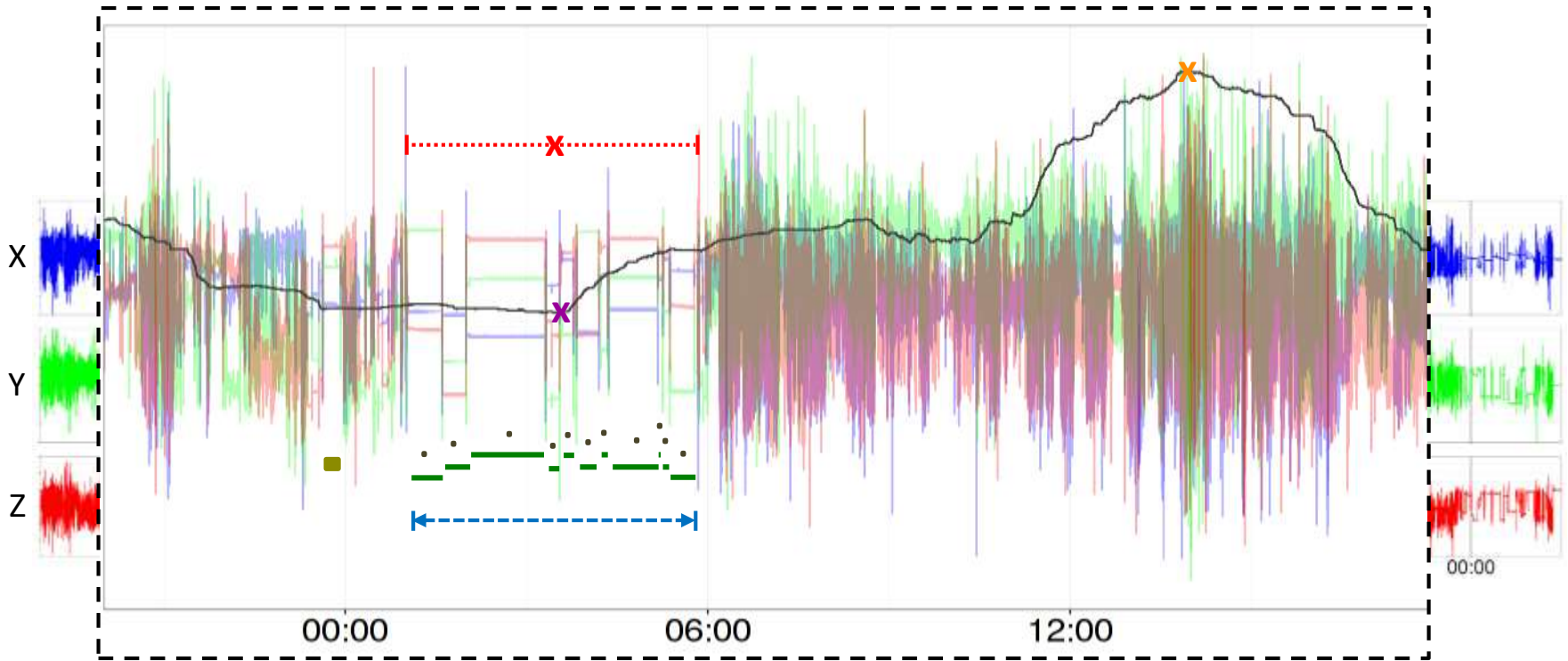
- Definitely a 'morning' person
- More a 'morning' than 'evening' person
- More an 'evening' than a 'morning' person
- Definitely an 'evening' person
- Do not know
- Prefer not to answer



- ~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

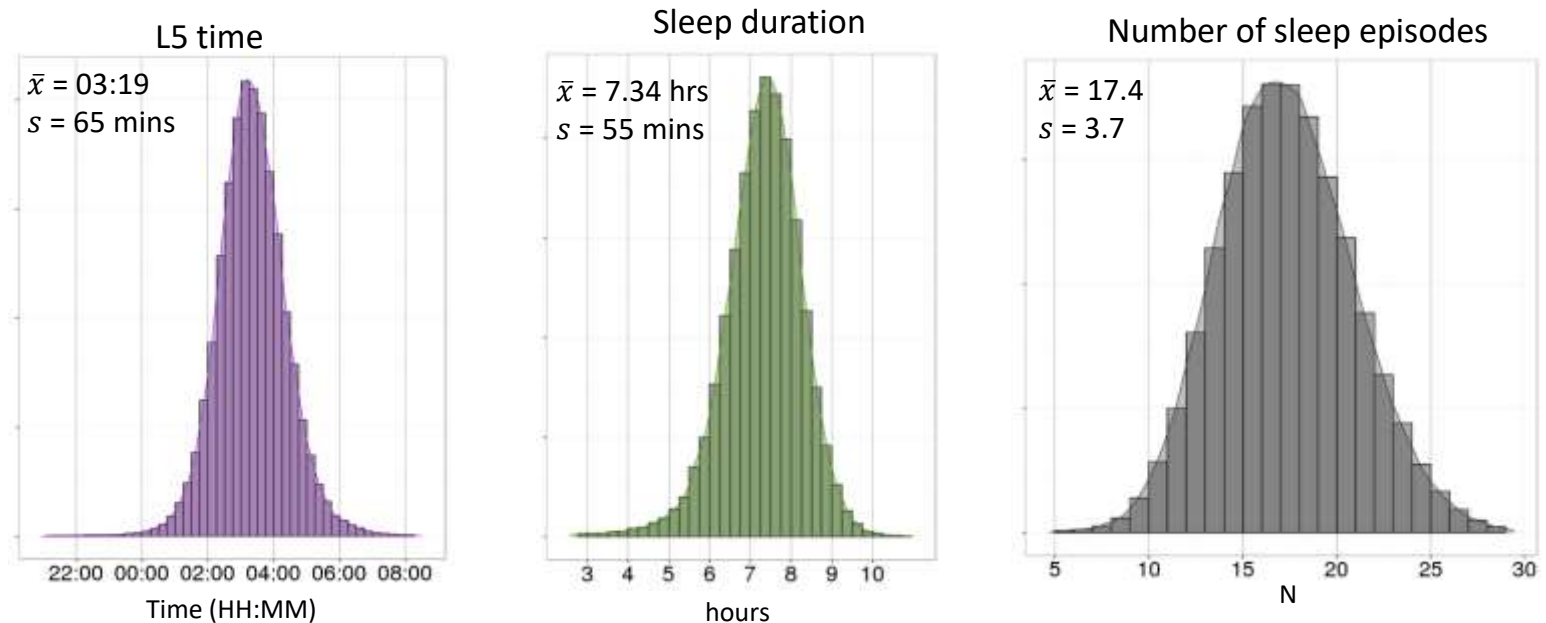
Quantitative phenotypes:

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

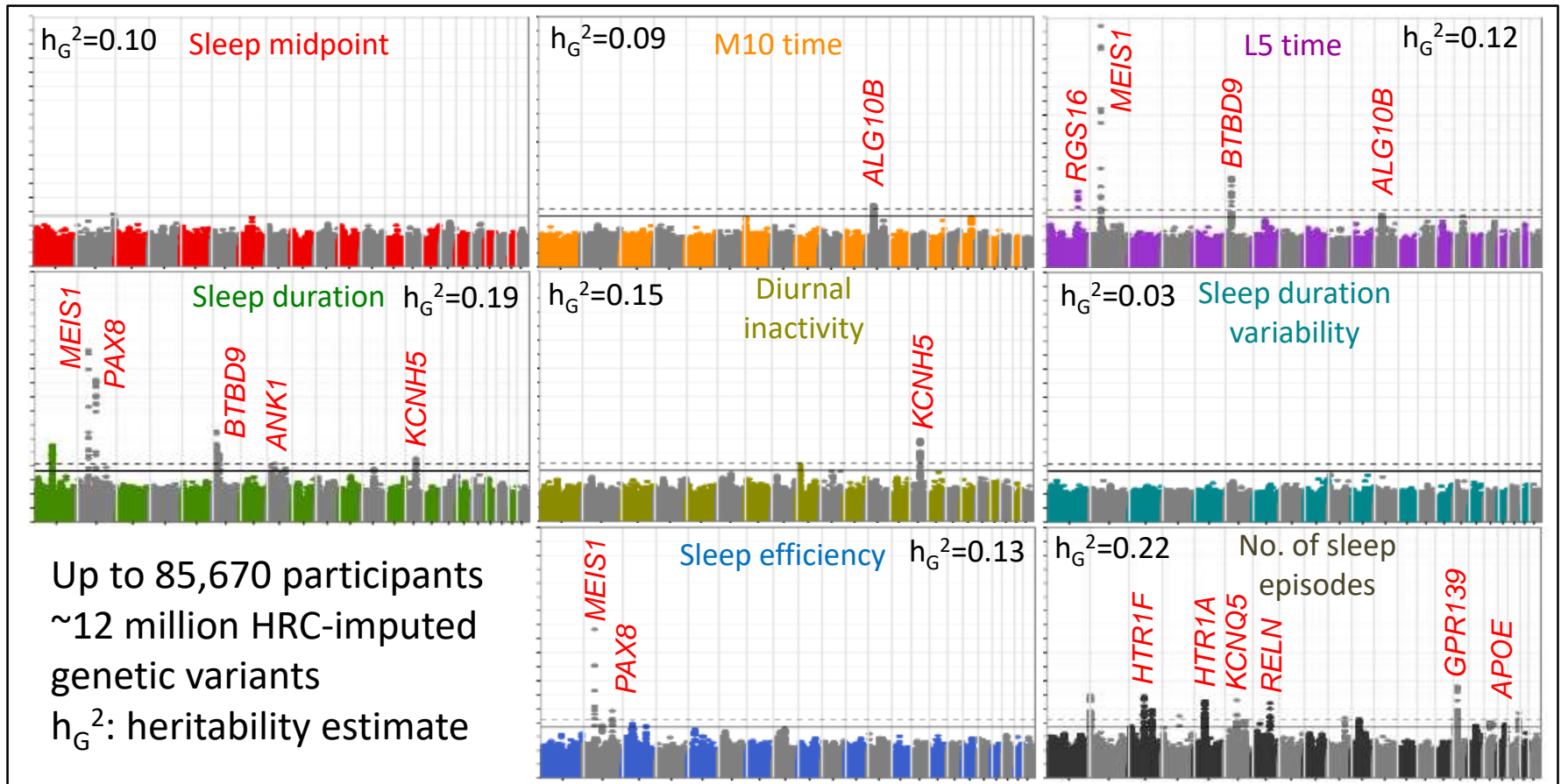
Quality phenotypes:

- 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



Through genome-wide association analyses (GWAS) we identify 40 distinct loci associated with our sleep measures ($P < 5 \times 10^{-8}$)



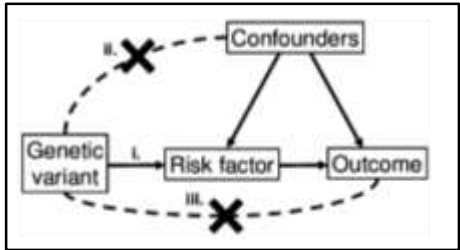
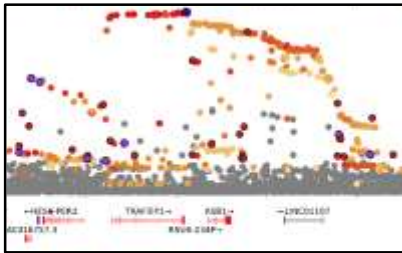
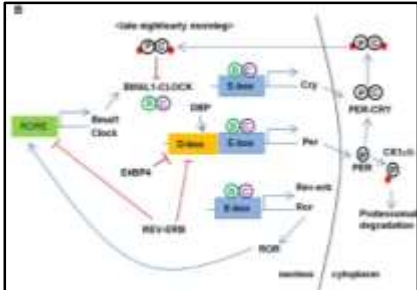
Why is this work important?

Identify genetic variants associated with sleep

Better understand the molecular mechanisms of sleep

Disentangle causal influences of sleep patterns with disease

Identifying potential therapeutic targets



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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