



The shaping of genetic trade-offs and human life-history evolution by variable environments



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Life-history theory predicts that reproduction is costly. The strength of trade-offs should depend on the available resources and changes in selective pressures with increasing age. In humans, high reproductive rate is associated with reduced health, post-reproductive lifespan, and offspring fitness. However, it is unclear how these phenotypic trade-offs reflect the genetic correlations determining multivariate selection patterns since they also include an environmental component.



Human life-history

Humans are unique in exhibiting menopause, which may have evolved to allow women to avoid reproduction when the fitness costs begin to outweigh the benefits.

Data

Pre-industrial Finnish church records.

16,824 reproductive events from 3,663 women born 1709-1872.

Pedigree allows investigation of genetic basis of female life-history traits.



Aims

Determine genetic basis of:

- (1) reproductive rate (inter-birth interval; **IBI**)
- (2) offspring survival rate (**OSR**)
- (3) post-reproductive lifespan (**PRL**)

Quantify genetic associations between **IBI** and other traits, and how they vary with age and resources.

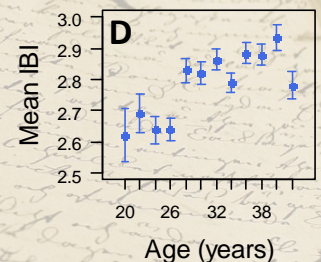
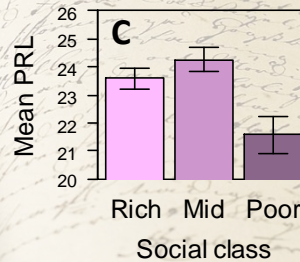
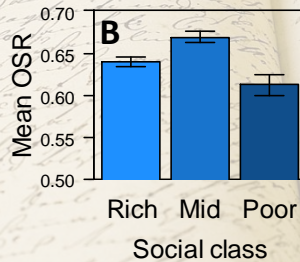
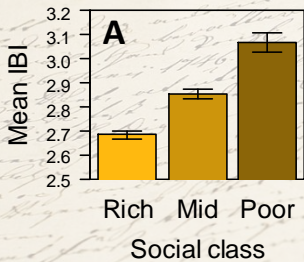
Predictions

Genetic variance for **IBI** increases with age.

Genetic trade-offs between **IBI** and OS/PRL should strengthen with age, especially where resources are limited.

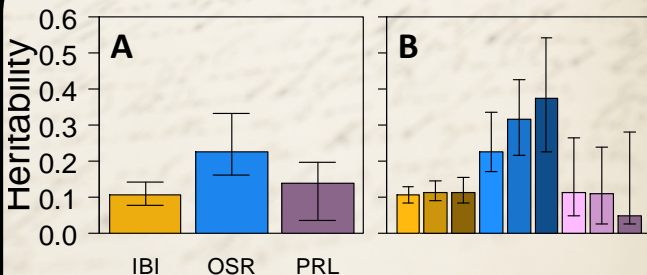


Life-history traits across environments and age



Social class in our population correlates with access to food, and is associated with variation in reproductive performance: Poor women have (A) longer inter-birth intervals; (B) lower offspring survival rate; (C) lower post-reproductive lifespan. In addition (D) older women have longer inter-birth intervals.

Genetic variance across environments and age



Animal models using MCMCglmm show significant additive genetic variance (V_a) for all three traits (A), and variable levels of V_a across the social classes (B)

Next

Correlations between age-specific IBI and (1) OSR and (2) PRL using multivariate model:

$$\begin{pmatrix} \text{IBI}(\text{young}) \\ \sigma(y,m) & \text{IBI}(\text{middle}) \\ \sigma(y,o) & \sigma(m,o) & \text{IBI}(\text{old}) \\ \sigma(y,OSR) & \sigma(m,OSR) & \sigma(o,OSR) & OSR \\ \sigma(y,PRL) & \sigma(m,PRL) & \sigma(o,PRL) & \sigma(OSR,PRL) & PRL \end{pmatrix}$$

Assess resulting matrices across social classes using **matrix comparison techniques**