

Neolithic Adaptations

Alan R. Rogers

April 14, 2023

Outline

- ▶ Lactase persistence
- ▶ Skin color
- ▶ Molecular archaeology

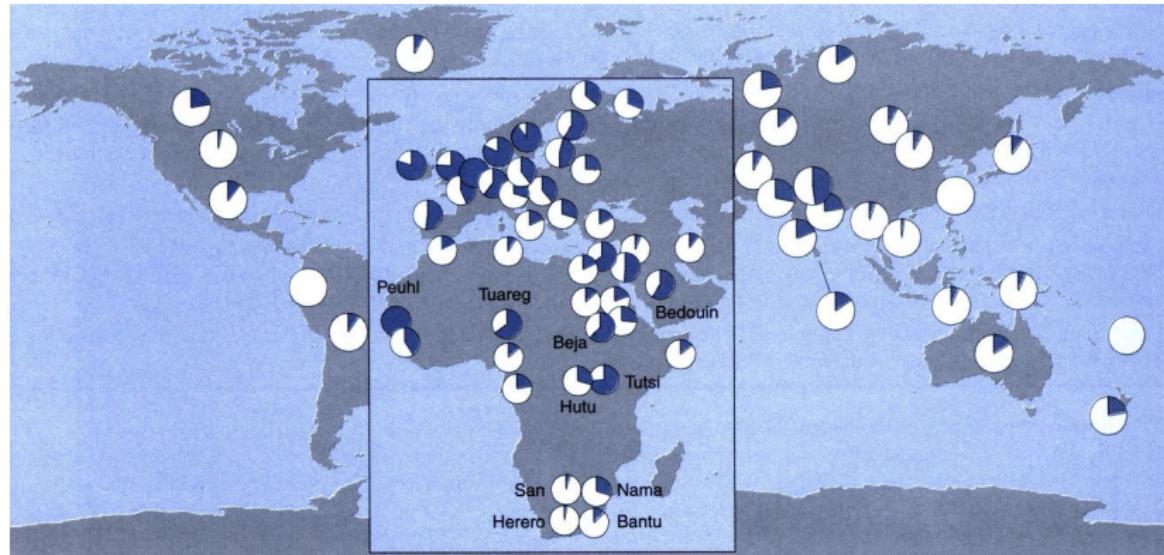
The trouble with fresh milk

- ▶ Contains the sugar *lactose*
- ▶ Digesting lactose requires the enzyme *lactase*
- ▶ Most humans don't produce it after age 5.
- ▶ Fresh milk gives them gas and diarrhea.
- ▶ 8000 years ago, all humans had this problem.

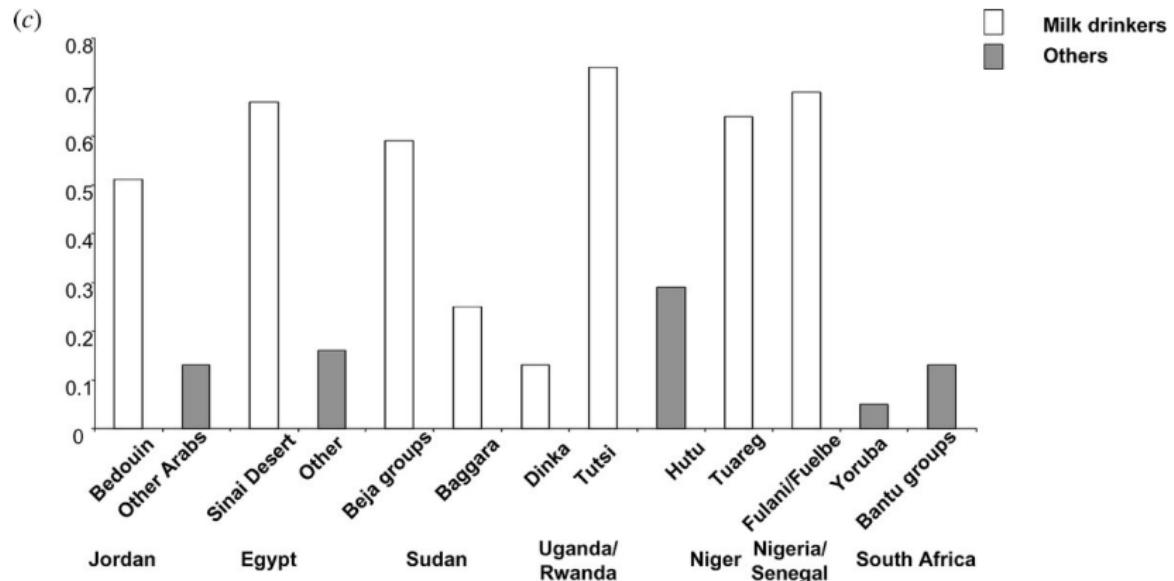
Lactase persistence

- ▶ Some modern humans produce lactase throughout life.
- ▶ Digest fresh milk as adults.
- ▶ Caused by mutation near lactase gene.
- ▶ When and where?

Distribution of lactase persistence (dark blue)



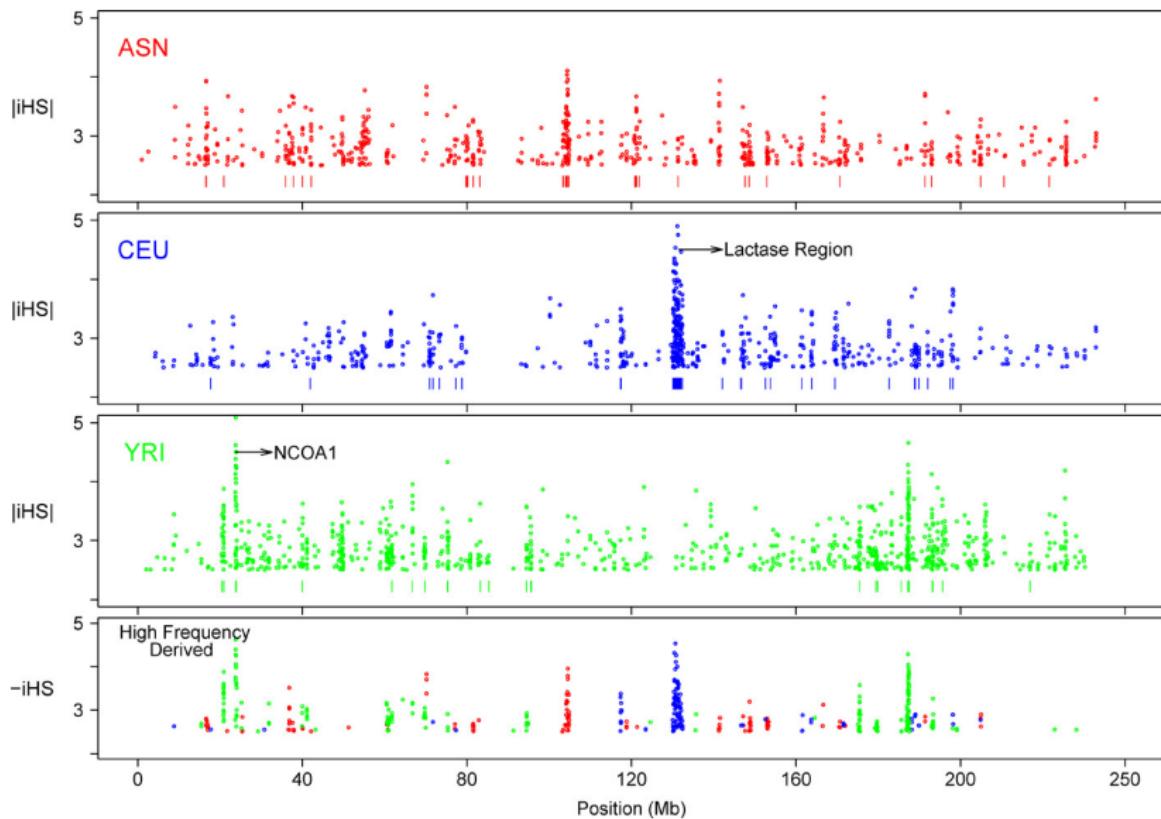
Within countries, lactase persistence more common in populations that drink milk



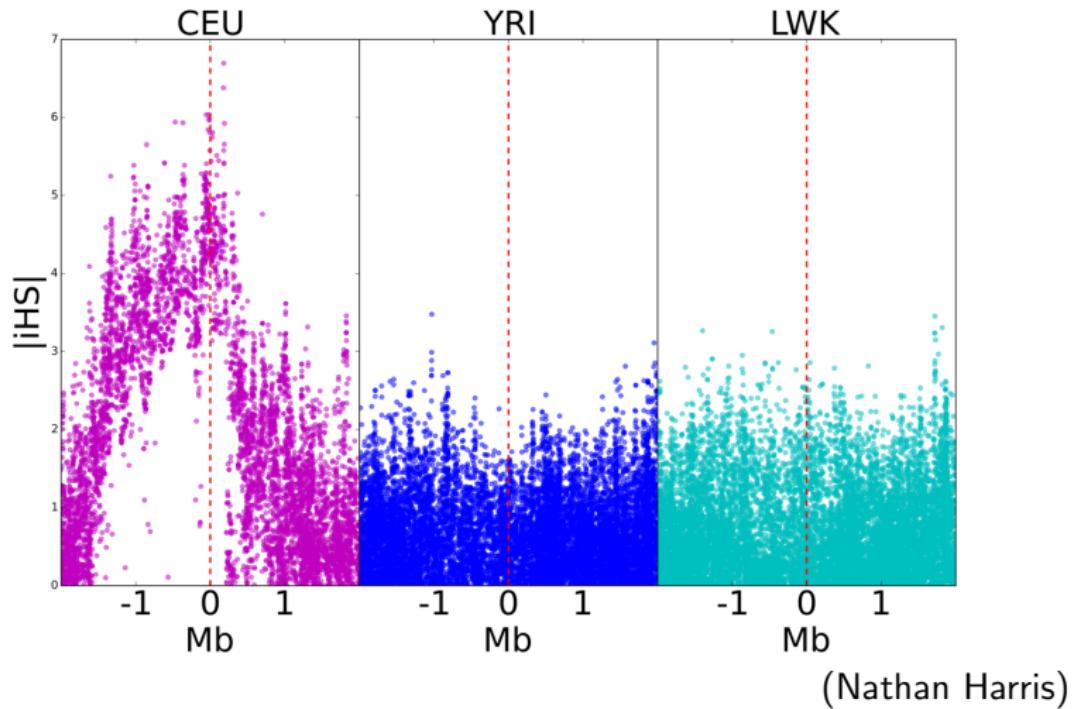
Evidence for a selective sweep

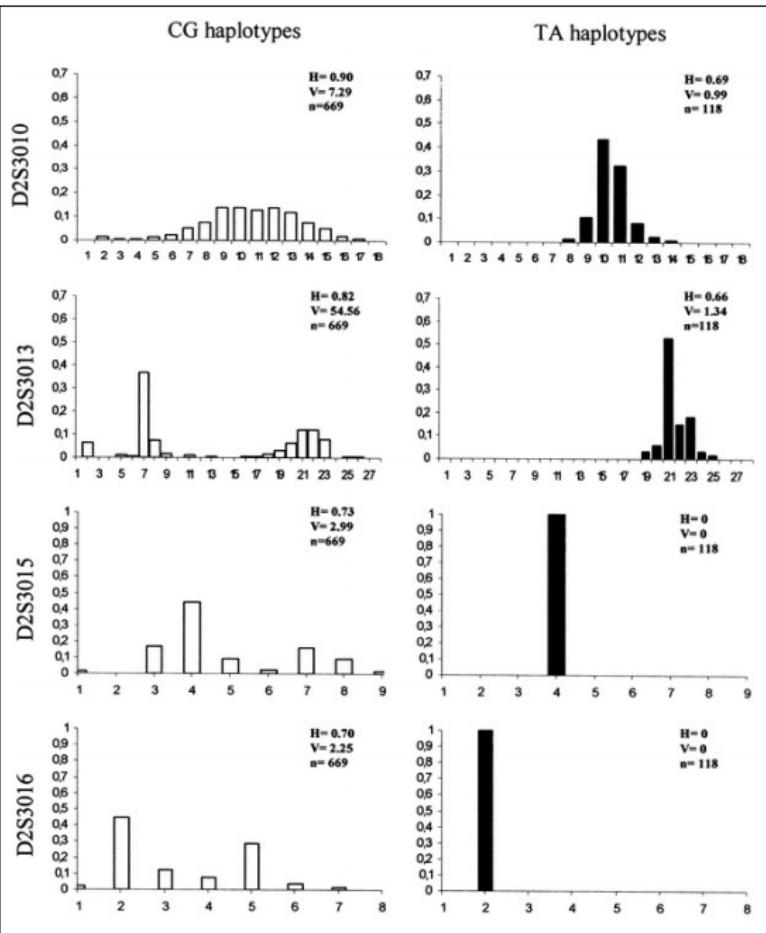
- ▶ In Europeans, persistence allele surrounded by a million bases of LD.
- ▶ Indicates strong selection.
- ▶ Statistical tests reject the drift hypothesis (Bersaglieri et al 2004)
- ▶ Increasing for ~10,000 years (Coelho et al 2005).

LD surrounds lactase gene in Europe



Huge block of LD around lactase allele in Europe





- ▶ Rows are different STRs
- ▶ Lactase persistence allele: haplotype TA.
- ▶ Has reduced SNP variation,
- ▶ Indicates recent origin.
- ▶ Age: 7,450 or 12,300 years (depending on assumptions)

Outline

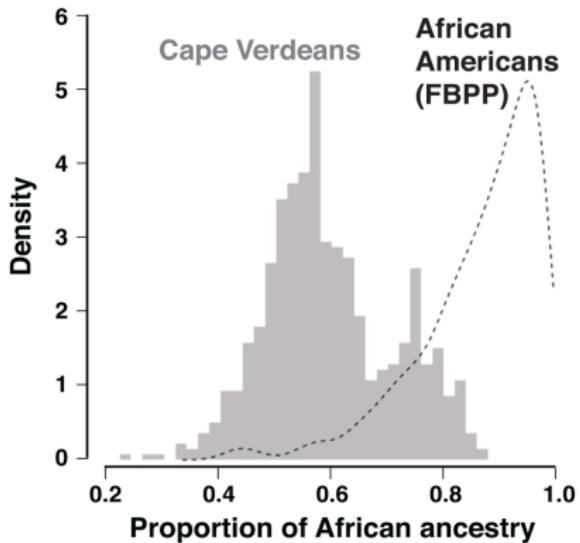
- Lactase persistence
- ▶ Skin color
- ▶ Molecular archaeology



Cape Verde Islands

A good place to study genetic variation in skin color.

Why Cape Verde is ideal



Population is close to a 50:50 mixture of African and European ancestry.

Lots of variation at loci that differ between the continents.

African Americans (dotted lines) are much more African.

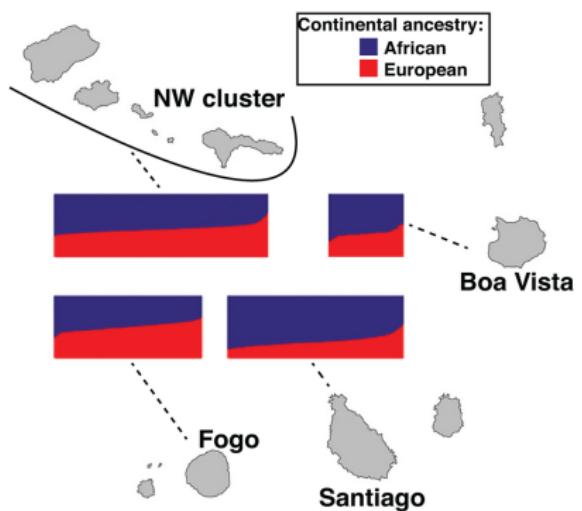


“

*We recognize the effort the country
has made to support us, so we will do
our best to repay our country.*

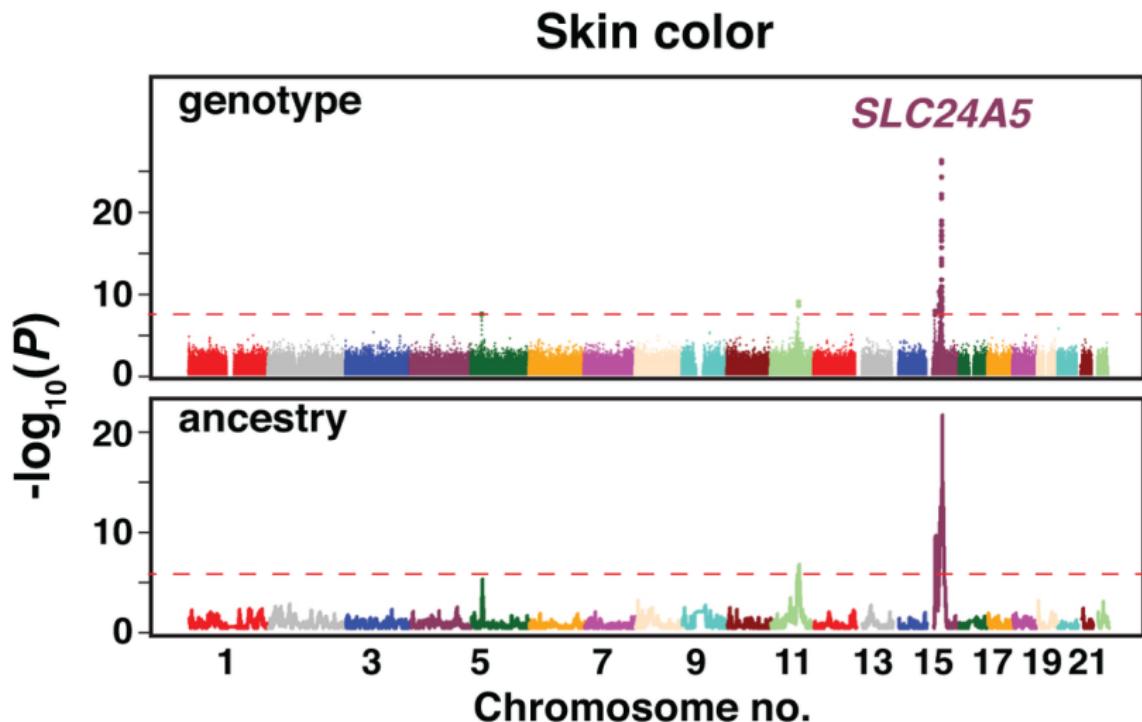
”

Genome-wide association study (GWAS) of skin color

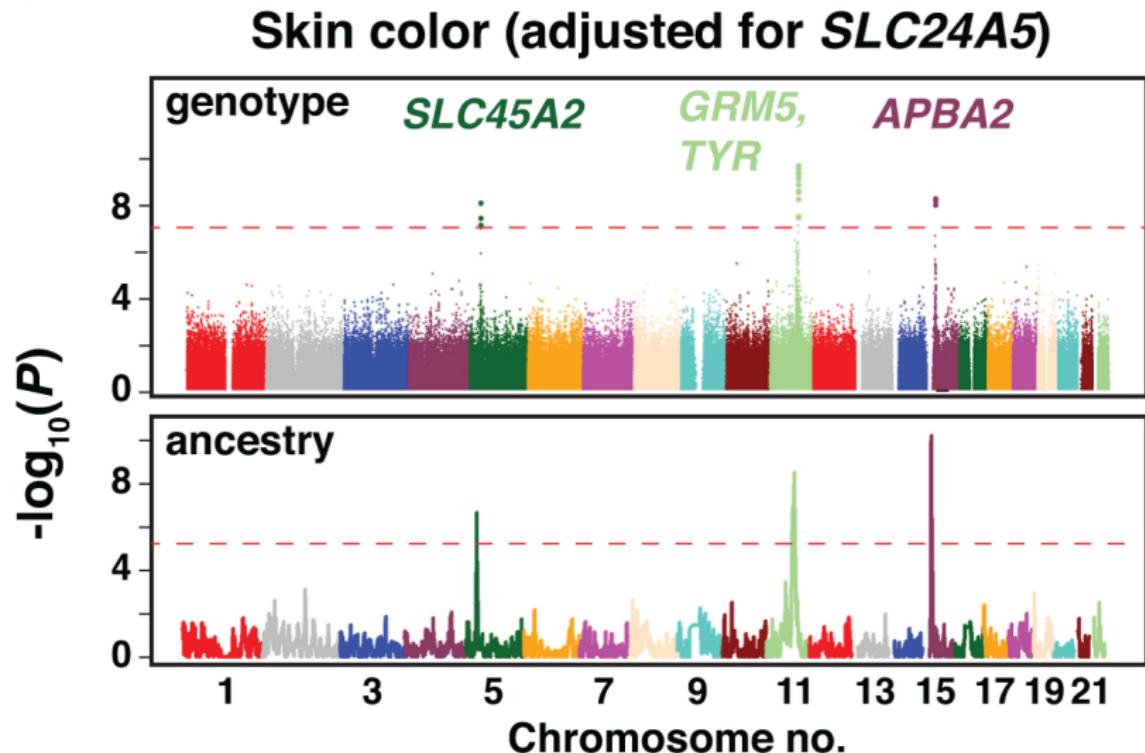


- ▶ GWAS: look for loci associated with skin color
- ▶ Beleza et al (2013).

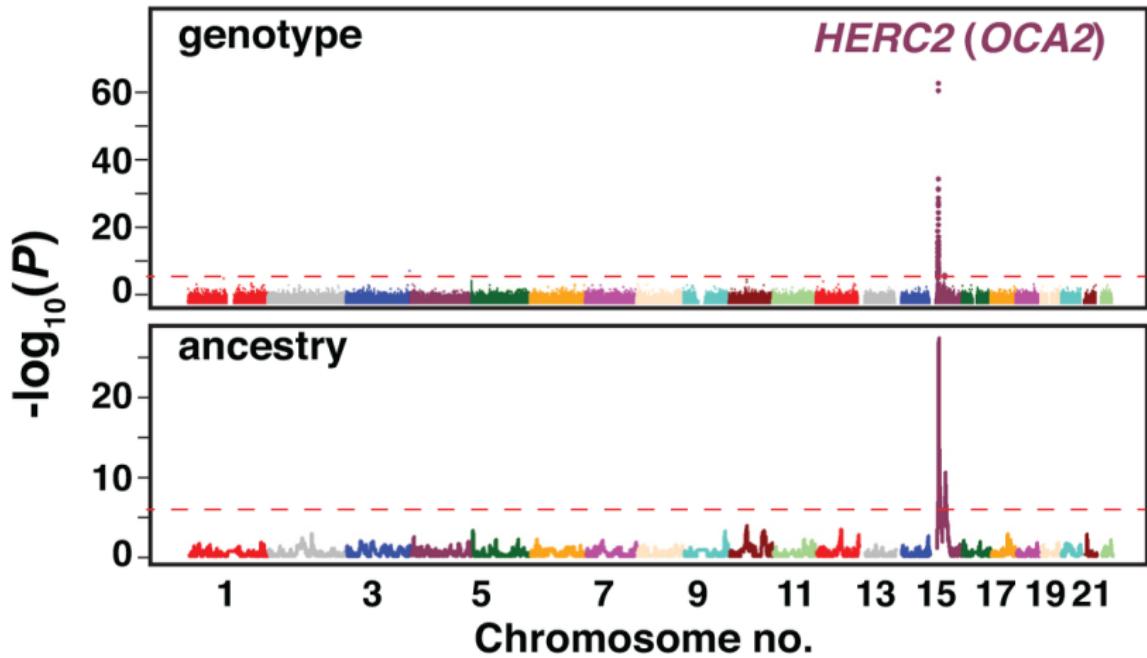
Locus SLC24A5 affects skin color



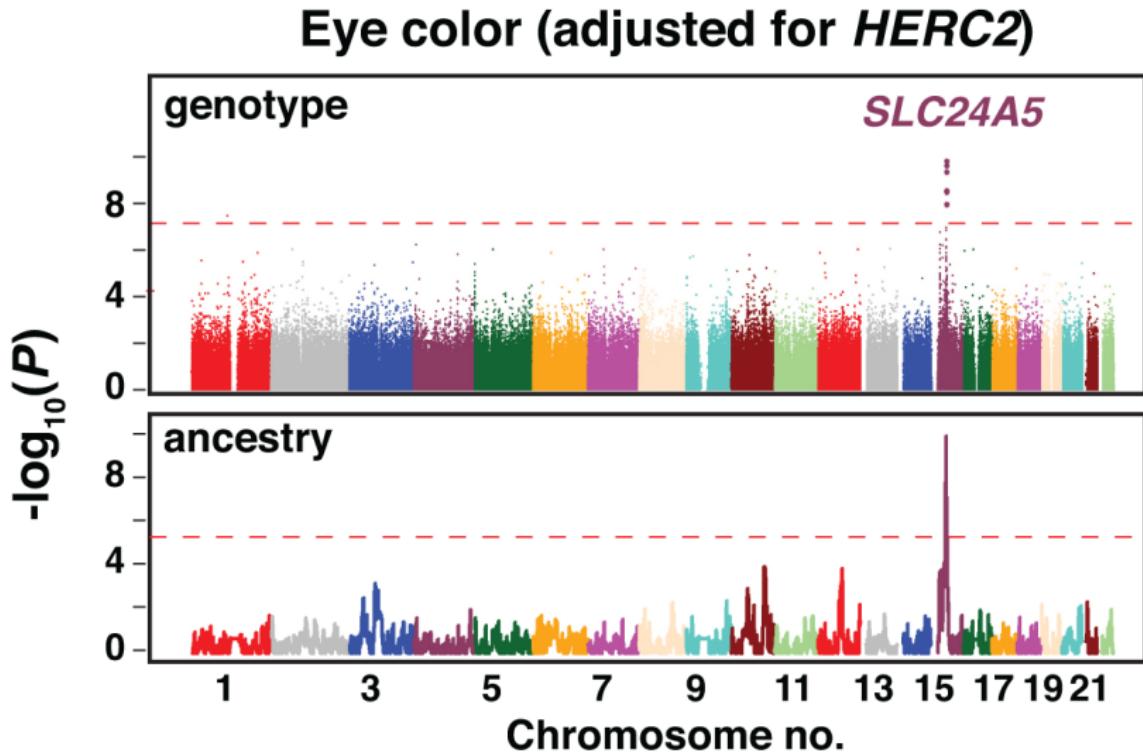
3 other loci pop out after adjusting for *SLC24A5*



Locus HERC2 affects eye color



SLC24A5 affects eyes as well as skin



Outline

- Lactase persistence
- Skin color
- ▶ Molecular archaeology

Postglacial History of Europe

- 12 kya Warm Post-glacial climate. Europe inhabited by Mesolithic foragers.
- 7 kya Neolithic: farmers expand into Europe from Middle East and Anatolia, largely replacing foragers.
- 5 kya Pastoralists invade Europe from Russia and Ukraine, largely replacing early Neolithic peoples (especially the males).

La Braña, a 7000-y-old Mesolithic European



Mesolithic Europeans: dark skin & blue eyes



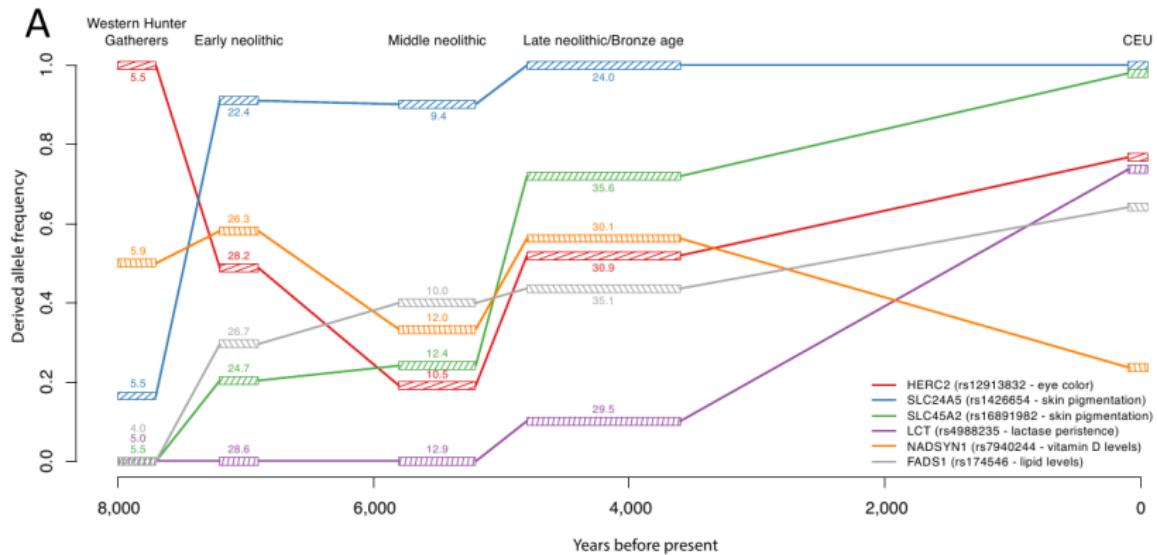
Dark skin: Ancestral (dark-skin) allele at SLC45A2, SLC24A5, MC1R, TYR and KITLG. Derived (light-skin) alleles at TYRP1, ASIP and IRF4.

Blue eyes: Derived (blue-eye) allele at HERC2.

Study of Mathieson et al 2015

- ▶ DNA from 83 ancient Europeans.
- ▶ Track changes in allele frequencies over time.

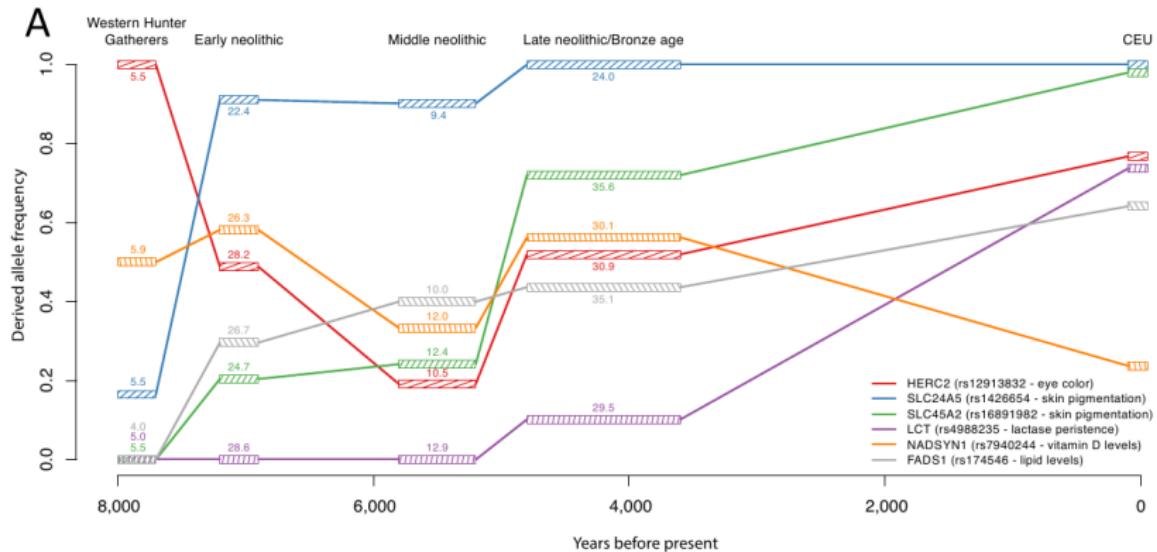
History of evolution in Europe



Eye color Blue eyes early; brown with Neolithic; blue comes back 4 kya.

Skin color Dark early; lighter with Neolithic; lighter still 4 kya.

History of evolution in Europe



Lactase persistence begins in Europe around 4000 BP.

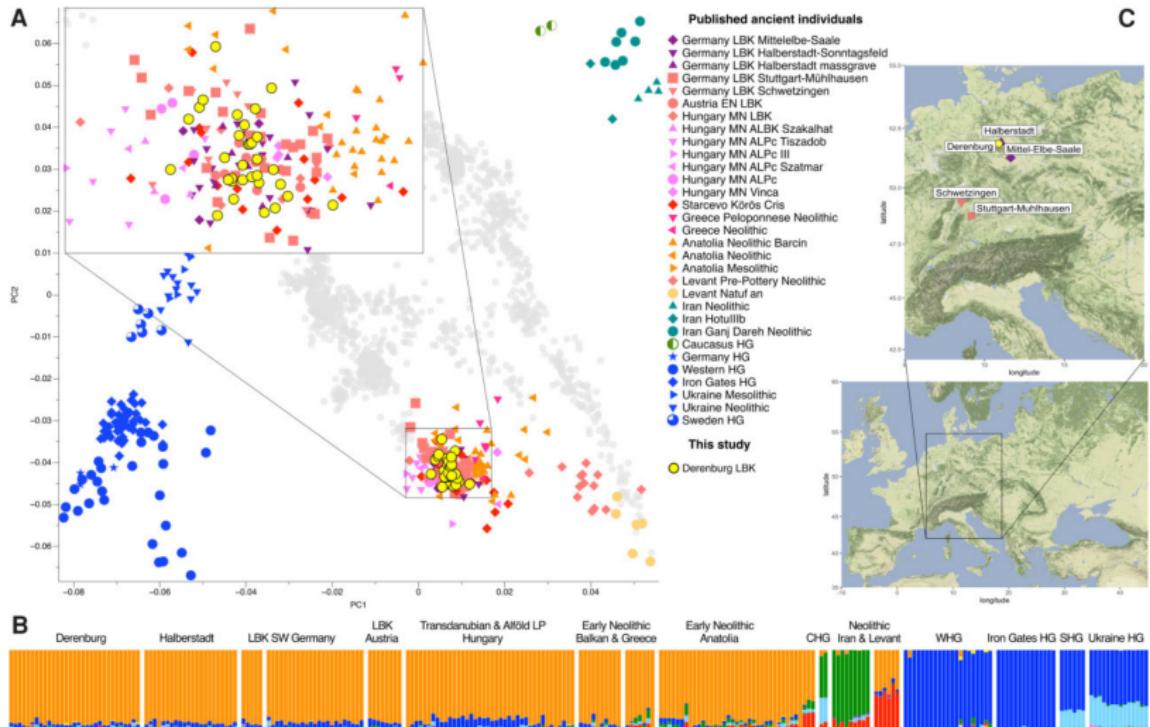
Comparing Neolithic Europeans with their Anatolian Ancestors

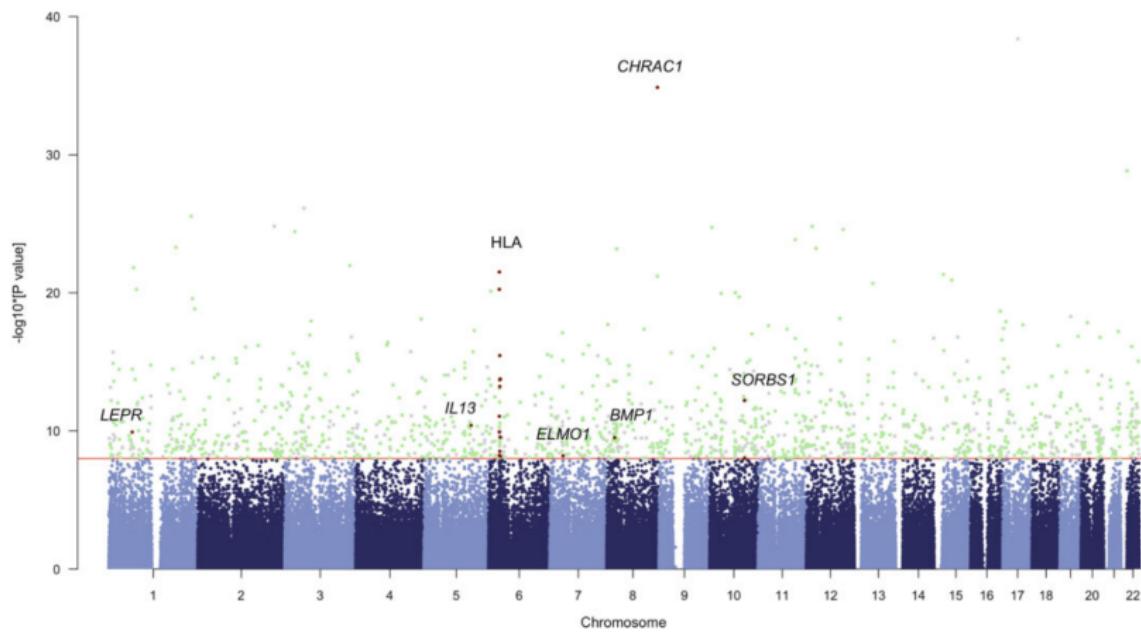
The Neolithic begins in the Middle East and Anatolia (modern Turkey) about 7000 ya.

One axis of spread went north into the Danube basin and then west into Germany and France.

Early farmers of this northern region: the “Linearbandkeramik (LBK) culture”.

Childebayeva et al (2022) compared LBK farmers earlier Anatolian farmers.





Summary

- ▶ Mesolithic foragers were dark, with blue eyes; lactose intolerant.
- ▶ Neolithic brought lighter skin and dark eyes; still lactose intolerant.
- ▶ Indo-Europeans brought lighter skin, blue eyes, maybe lactase persistence.
- ▶ Frequency of lactase persistence increases after 4 kya.