Genetics of Athletic Ability:
Is athletic performance encoded in your DNA?

Heather Landry
DayCon 2016
What contributes to athletic ability?
Roadmap

1. What is genetics?

2. Is athletic ability inherited?

3. Which genes influence athletic ability?
Every cell has the same DNA sequence

Adapted from the National Human Genome Research Institute
DNA guides protein production

DNA → Gene → RNA → Protein → Function
DNA changes influence protein function

DNA

RNA

protein

red blood cell

Red blood cells: adapted from Bruce Blaus via Wikimedia Commons
Questions?
DNA gets inherited from parents to children

Image adapted from Thomas Shafee via Wikimedia commons
Twins can be used to understand whether athletic ability is inherited.
Identical twins have identical DNA

Identical twins

Sperm
Egg

Fraternal twins
Identical twins have similar athletic traits

Data extracted from Klissouras et al., 1971; VO$_2$ max test: THWZ via wikimedia commons
Questions?
It is challenging to find the genes responsible for athletic ability.
Humans have been around for a long time

Campbell and Tishkoff, 2010

Thousands of years ago

Africa

Middle East / Europe

Australia / Melanesia

Asia

Americas
Human population growth is very recent

Graph: El T via census.gov
alpha-actinin 3 (ACTN3)

Interacts with actin to help coordinate muscle contractions in fast twitch muscle fibers.

slow twitch  

Muscle fiber  

fast twitch
A common mutation in **ACTN3**

- There is a mutation in the *ACTN3* gene that is very common in the human population.
- This mutation causes complete loss of protein function.
ACTN3 is more commonly mutated in endurance athletes versus sprinters
erythropoietin receptor \((EPOR)\)

Signals the production of red blood cells
Eero Mäntyranta

- Finish cross-country skier who had a mutation in the *EPOR* gene that increased his red blood cell numbers.

- More red blood cells increases hemoglobin levels, oxygen intake, and endurance.

- Eero won 7 medals in 4 Winter Olympics.
Conclusions

- Athletic ability can be an inherited trait.

- Both common variants (e.g. mutation in \textit{ACTN3}) and rare variants (e.g. mutation in \textit{EPOR}) can influence athletic ability.

- Many genes often work in combination and other elements (e.g. nutrition or environment) can contribute to athletic ability.
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