Heritability of BMI

In a search of a relevant phenotype for normalized weight, and what heritability says about it

Sofía Ortín Vela
sofia.ortinvela@unil.ch

Course: Biological problems that require math
DBC - Groupe du Prof. Bergmann

March 5, 2021

Introduction

Key words: *GWAS, phenotype, BMI, heritability, genes and pathways.*

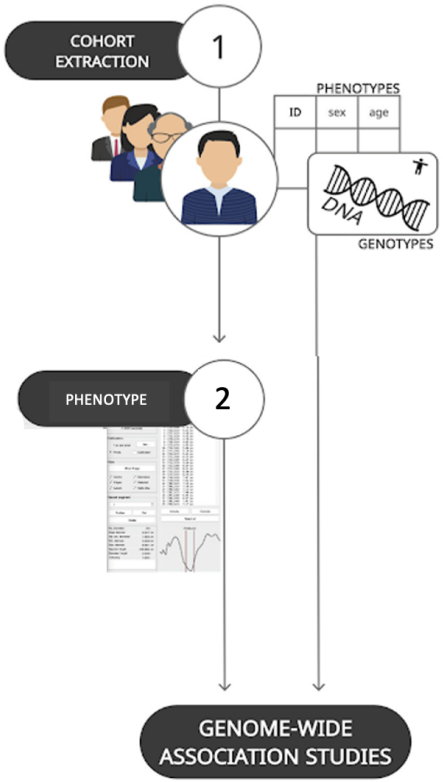


Figure: *Modified, Mattia Tomasoni*

Phenotype : Observable characteristics of traits of an organism. Ex: hair colour, diabetes, ...

This project: Phenotype based on height and weight

Introduction

Key words: *GWAS, phenotype, BMI, heritability, genes and pathways.*

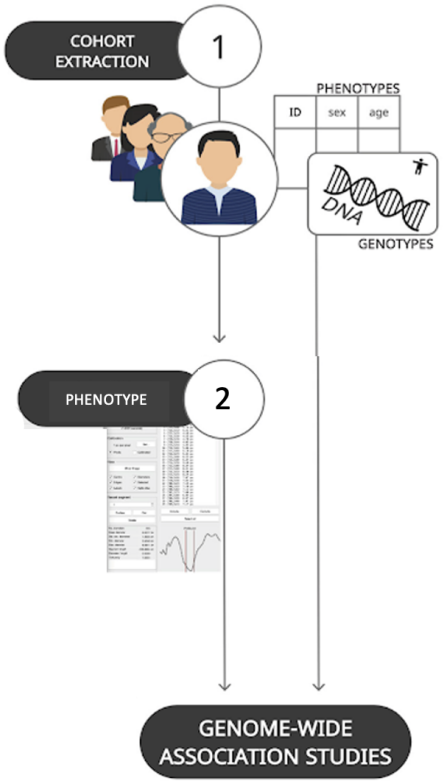


Figure: *Modified, Mattia Tomasoni*

Phenotype : Observable characteristics of traits of an organism. Ex: hair colour, diabetes, ...

This project: Phenotype based on height and weight

Introduction

Phenotype : Observable characteristics of traits of an organism. Ex: hair colour, diabetes, ...

This project: Phenotype based on height and weight

Body mass index (BMI) :

$$BMI = \frac{weight(kg)}{height^2(m^2)}$$

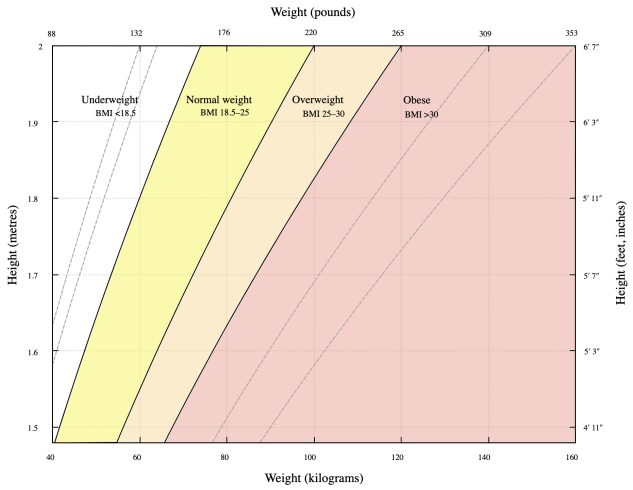


Figure: *By amfucla using gnuplot and inkscape*

Introduction

Phenotype : Observable characteristics of traits of an organism. Ex: hair colour, diabetes, ...

This project: Phenotype based on height and weight

Body mass index (BMI) :

$$BMI = \frac{weight(kg)}{height^2(m^2)}$$

But ... Why squared?

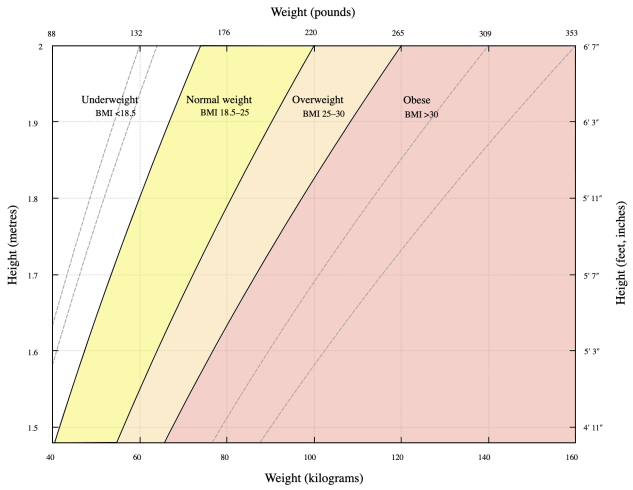


Figure: *By amfucla using gnuplot and inkscape*

Other measures: **Ponderal index (PI)**

$$PI = \frac{weight(kg)}{height^3(m^3)}$$

Mainly used to assess the pattern of fetal growth

$$\frac{weight}{height^{INDEX}}$$

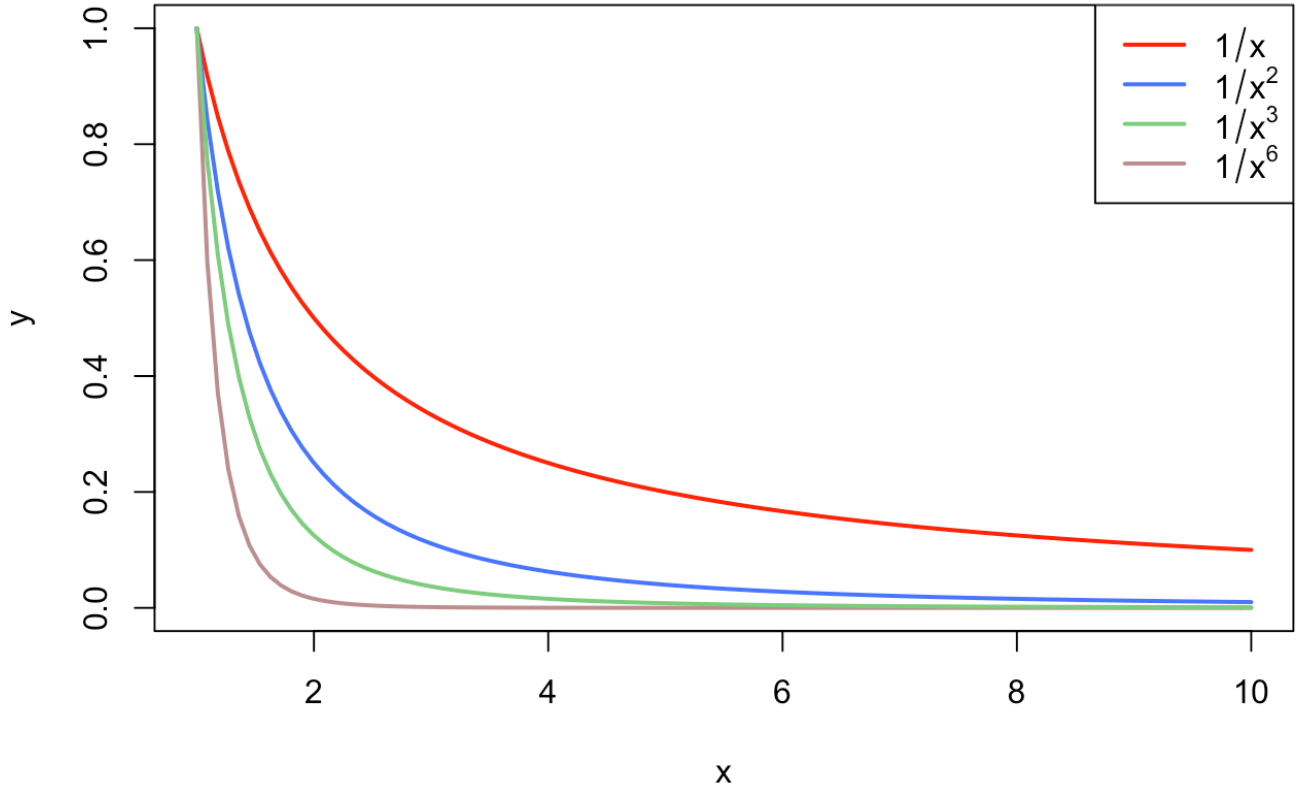
Is the denominator's index that important?

$$\frac{weight}{height^{INDEX}}$$

Is the denominator's index that important?

$$\frac{weight}{height^{INDEX}}$$

Is the denominator's index that important?



Objectives

First step: Define our phenotype(s)

We will find new indices:

$$HWI = \frac{weight(kg)}{height^{\gamma}(m^{\gamma})}$$

Where γ ranges from 2 to 3

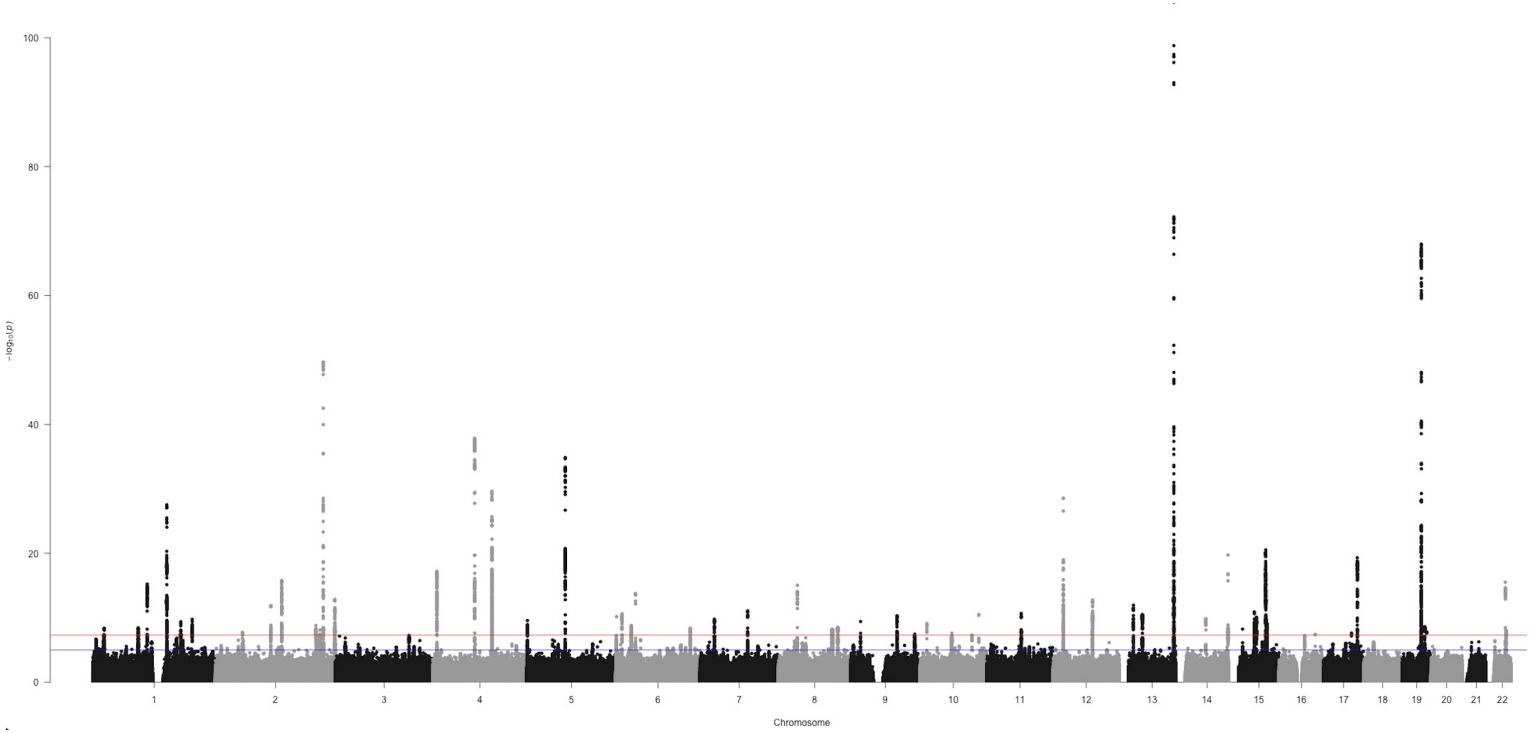
Particularly, HWI($\gamma = 2$) = BMI and HWI($\gamma = 3$)=PI

Example:
If we decide to use the values: $\gamma = 2.33$, $\gamma = 2.5$, $\gamma = 2.718 \Rightarrow$ 3 phenotypes:

- HWI(2.33) = weight / height$^{2.33}$
- HWI(2.5) = weight / height$^{2.5}$
- and HWI(2.718) = weight / height$^{2.718}$

Second step:

We will perform GWAS with HWI as a phenotype for different choices of γ

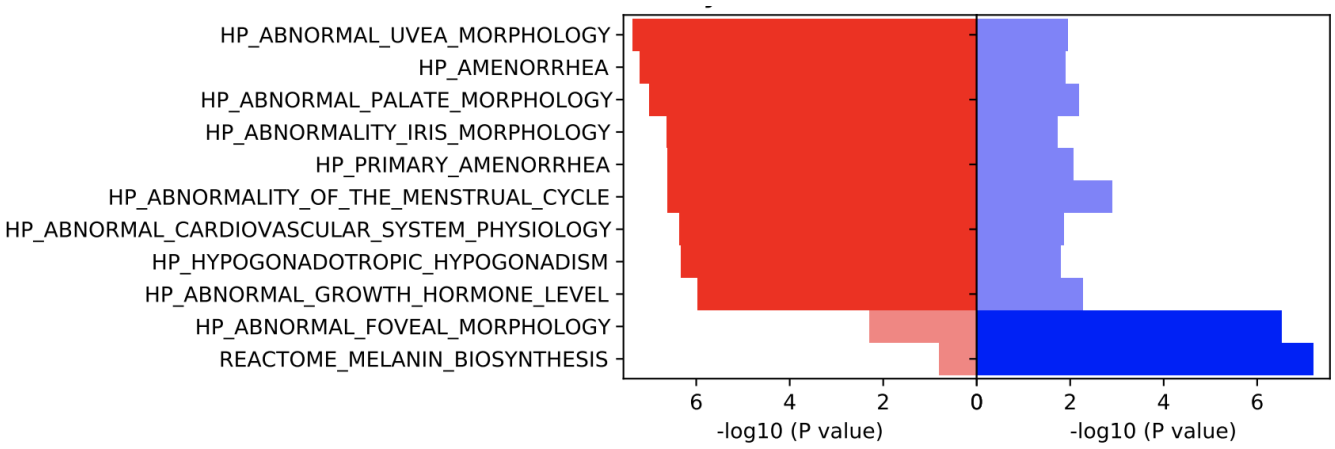


Third step:

We will obtain the:

- Heritability ($h^2 = V_A/V_P$)
- Genes and Pathways associated

To see how γ choice's affects these parameters



What you will learn in this course

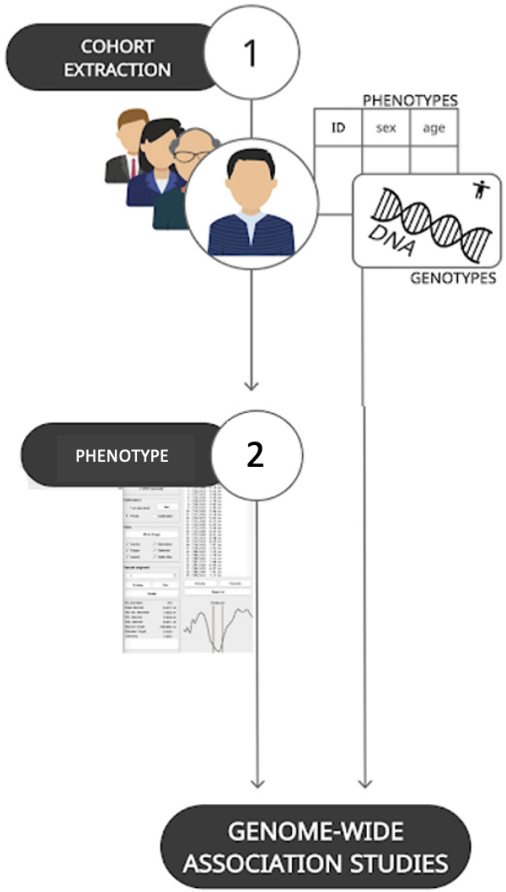


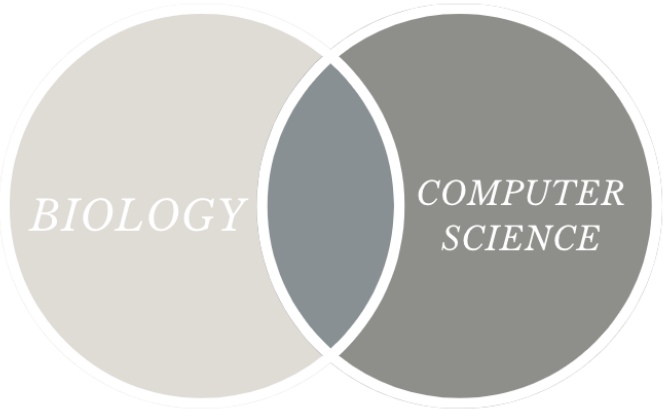
Figure: *Modified, Mattia Tomasoni*

- How to face a real project, facing troubles of not prepared experiments
- How to use basics mathematical concepts in favor of your biological knowledge
- How to choose a potentially relevant phenotype

$$HWI = weight / height^{\gamma}$$

- How to realize a GWAS, Manhattan plots, QQplots, etc
- How to compute heritability (h^2)

What you will learn in this course



- How to face a real project, facing troubles of not prepared experiments
- How to use basics mathematical concepts in favor of your biological knowledge
- How to choose a potentially relevant phenotype

$$HWI = weight / height^{\gamma}$$

- How to realize a GWAS, Manhattan plots, QQplots, etc
- How to compute heritability (h^2)

a) Improve your programming skills
b) Focus in analysing the biology that computer sciences bring to you

email: sofia.ortinvela@unil.ch