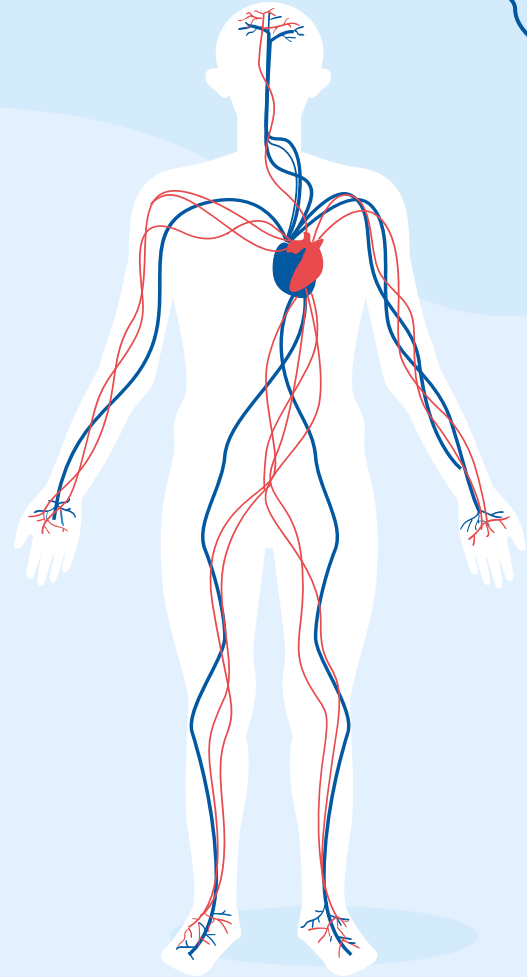


Sex Differences in Retinal Vascular Properties

With a focus on diabetes

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Project Goals:

- 1) Explore differences of IDPs of the retina between males and females
- 2) Study the association of IDPs with diabetes and other risk factors

About the Disease

Diabetes

2 types :

Type I

- No production of insulin because of no β cells in the pancreas (autoimmune disease).
- Multifactorial but with great genetic prevalence.
- Detectable in children and adolescents.

Type II

- Production of insulin that cannot be used, due to depletion of pancreatic β cells.
- Due to bad lifestyle (malnutrition, sedentarity, overweightness...)
- Detectable in adults (average = 45 years old)



Associated Diseases



**Cardiovascular
diseases**



Stroke



**Coronary artery
diseases**



Hypertension

And several other pathologies: Nephropathy, diabetic retinopathy, foot ulcers, gastroparesis

Factors That Increase Diabetes Risk



Weight

Being overweight or obese



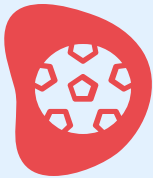
Fat Distribution

Storage of fat in the abdomen, rather than hips & thighs



Age

Risk increases with age



Inactivity

Risk increases with increasing inactivity



Family History

A parent or sibling having type 2 diabetes



Blood Lipid Levels

Low levels of "good" cholesterol
High levels of triglycerides

Diabetes in Men vs Women

Metabolic differences influence diabetes risk and the risk of vascular complications.

- Prevalence
- Proportion of vascular risk factors



Fundus Screening



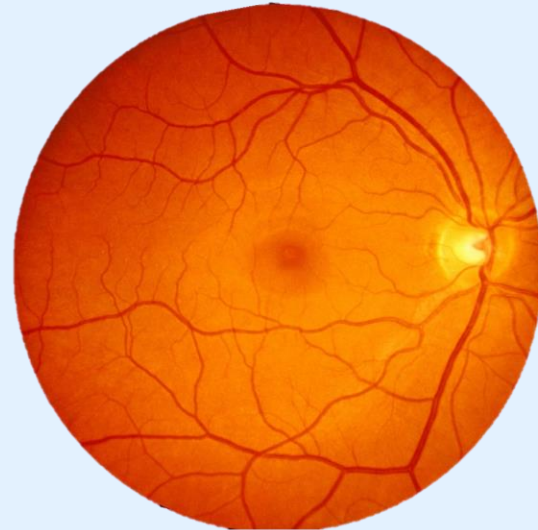
Inexpensive, accessible,
and timely



Could become an additional or
alternative screening method for
diabetes

Can be used to improve patient outcomes

- Early and accurate diagnosis
- Monitoring disease progression
- Generate treatment plans



UK Biobank Data

Retina images from 81,859 subjects (from different assessment centers)

- 38,200 men
- 43,659 women

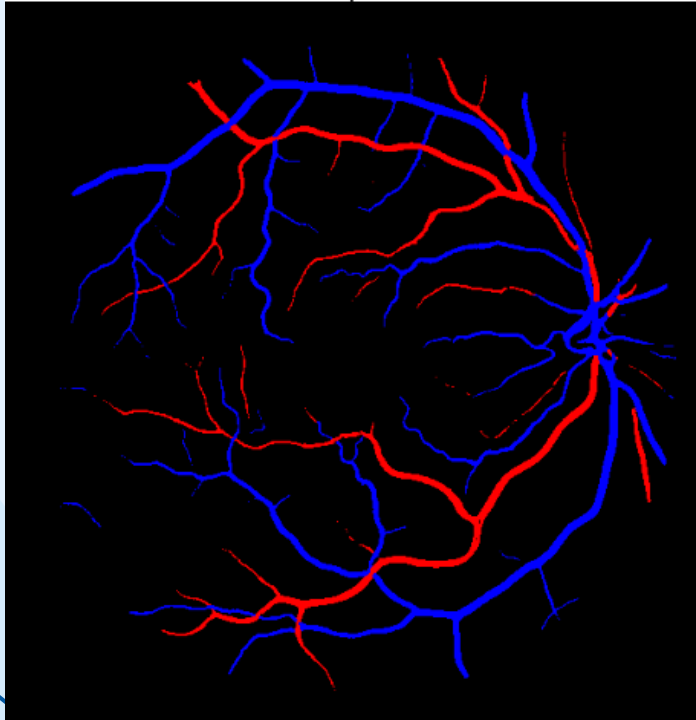
Used to extract vascular features from retinal images

- IDP = image derived phenotype
 - **17 IDPs** measured
 - Separately for veins and arteries
 - Also for any vessel type, in general
 - Ratios also calculated

biobank^{uk}



Image Derived Retinal Phenotypes



Examples:

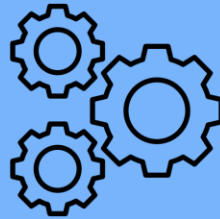
- Tortuosity
 - Vein, artery, and ratio
- Diameter
 - Veins and arteries
- Vascular density
 - Vein, artery, and total
- and many more...

Methods

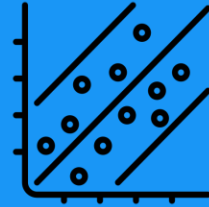
Used various statistical methods:



1) Explorative statistics



2) Correlation analysis



3) Regression analysis

- Logistic regression
- Linear regression

Covariates Used

BMI

Body Mass Index

$$\frac{\text{weight}}{\text{height}^2}$$

LDL

Low Density Lipoprotein
"Bad cholesterol"



HDL

High density Lipoprotein
"Good cholesterol"

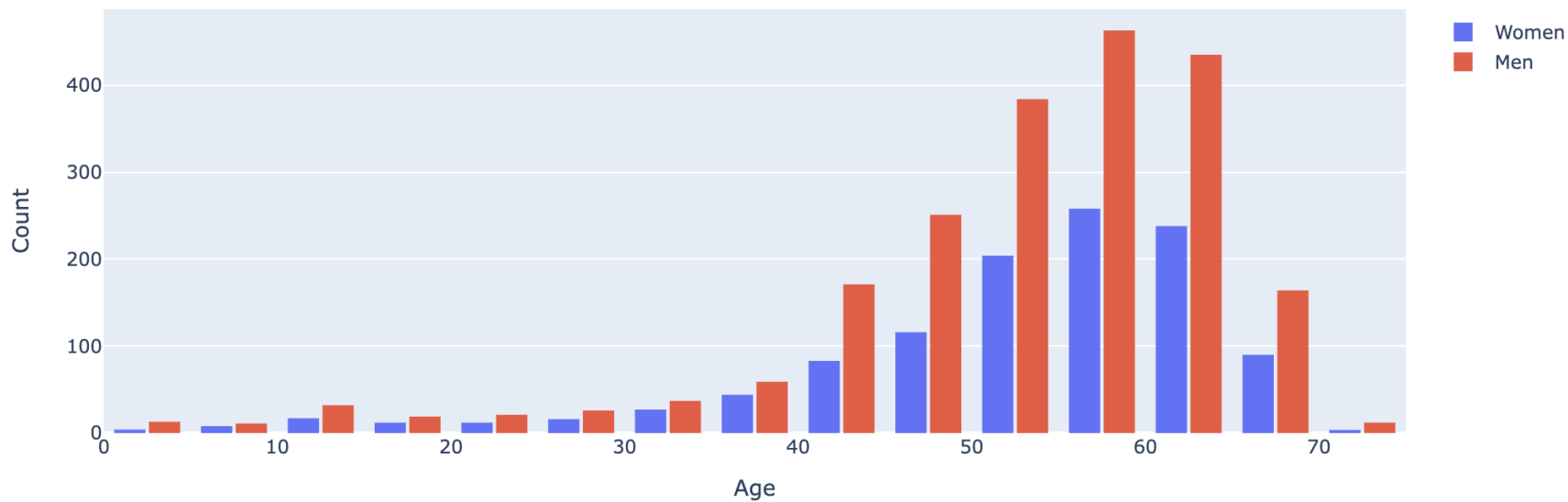
Triglycerides

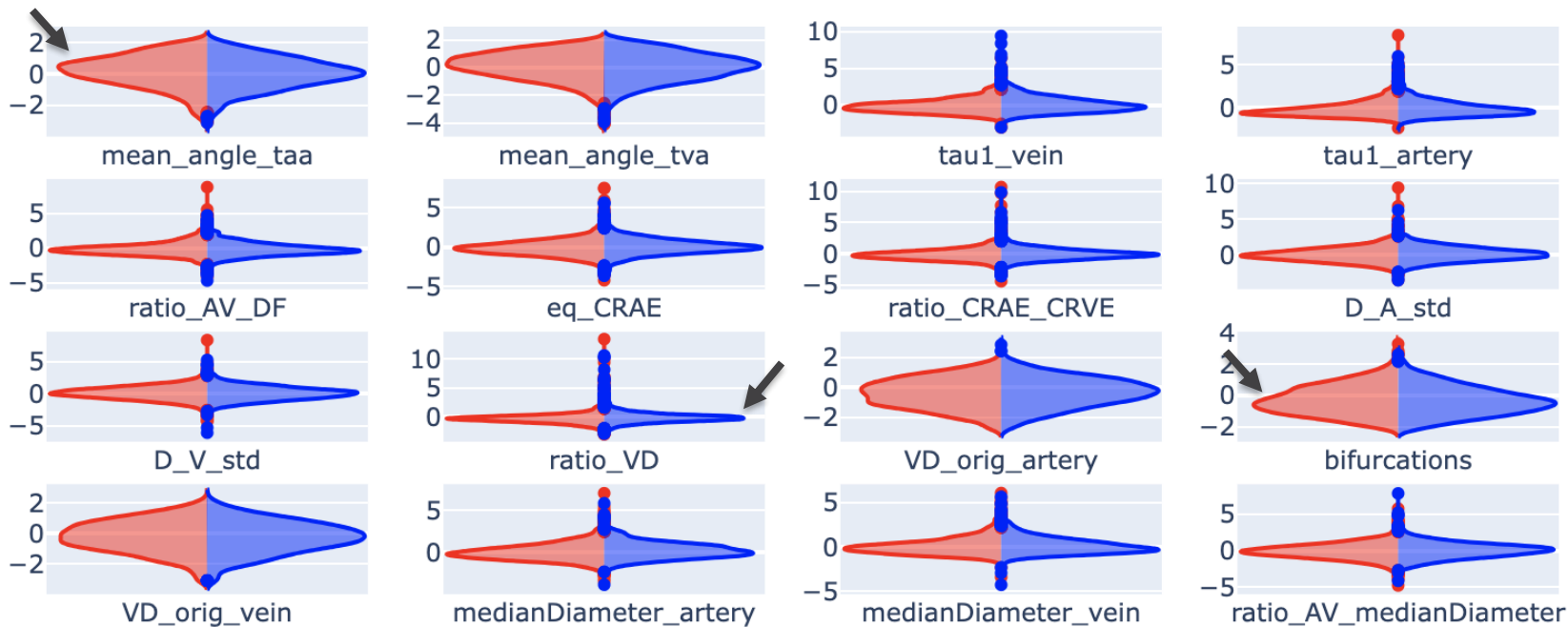
Source of ATP through the
release of fatty acids

Initial Findings

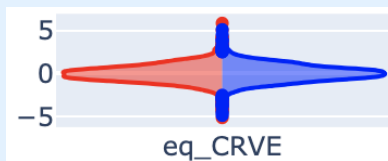
- Larger proportion of men with diabetes than women
- Similar distribution of age at diagnosis for men and women
- Differences in the 17 traits between men and women
- Differences in correlation between men and women

Age of diabetes by sex

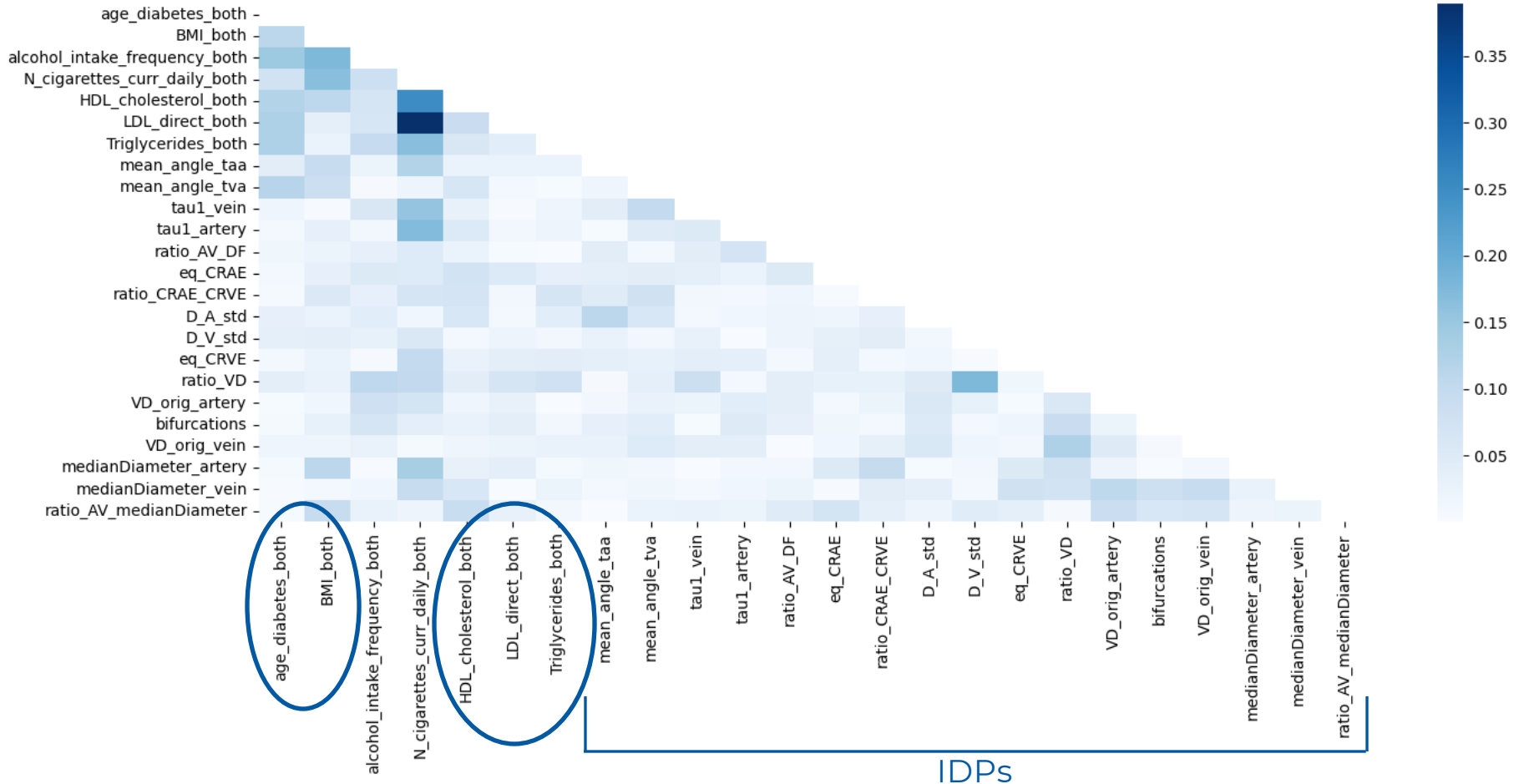


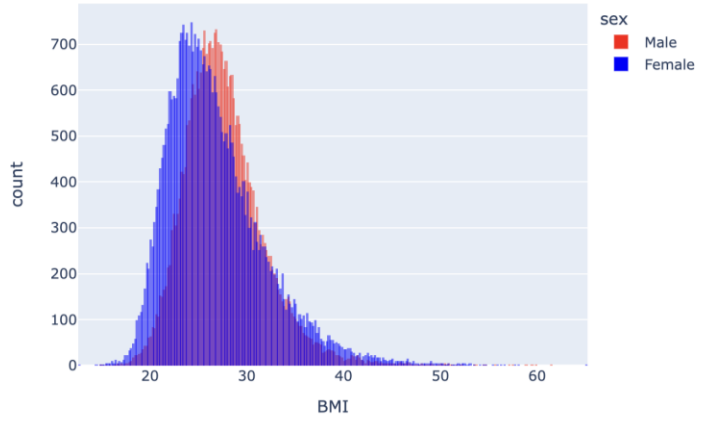
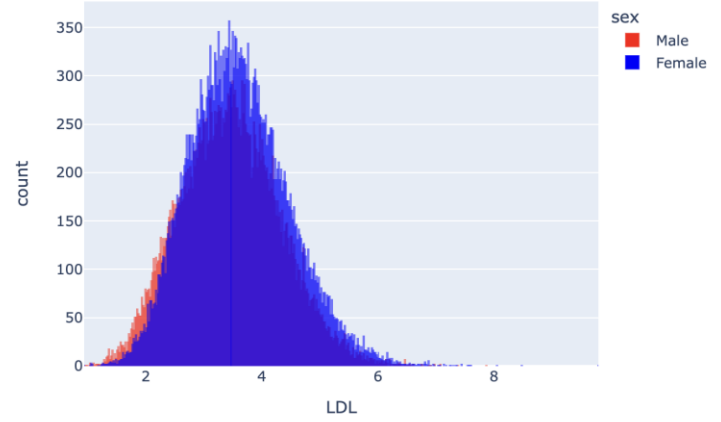
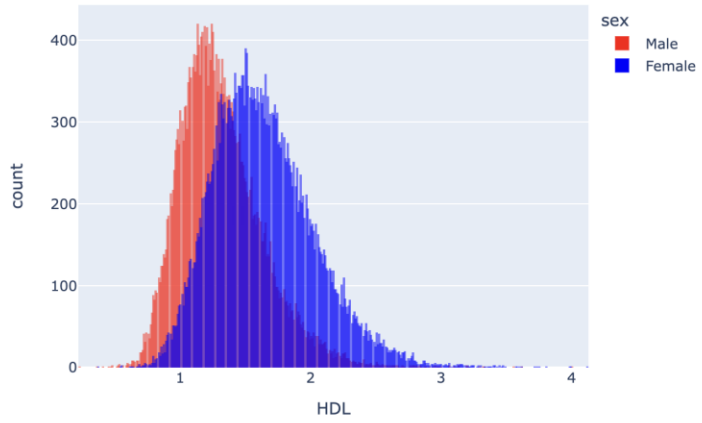
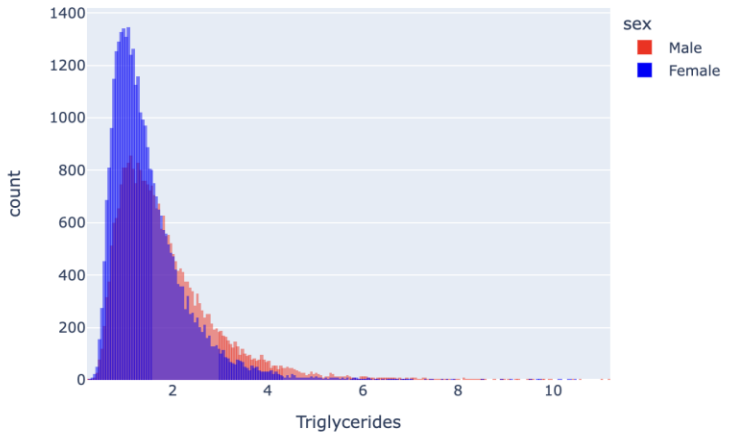


■ Women
■ Men



Correlation differences between sex



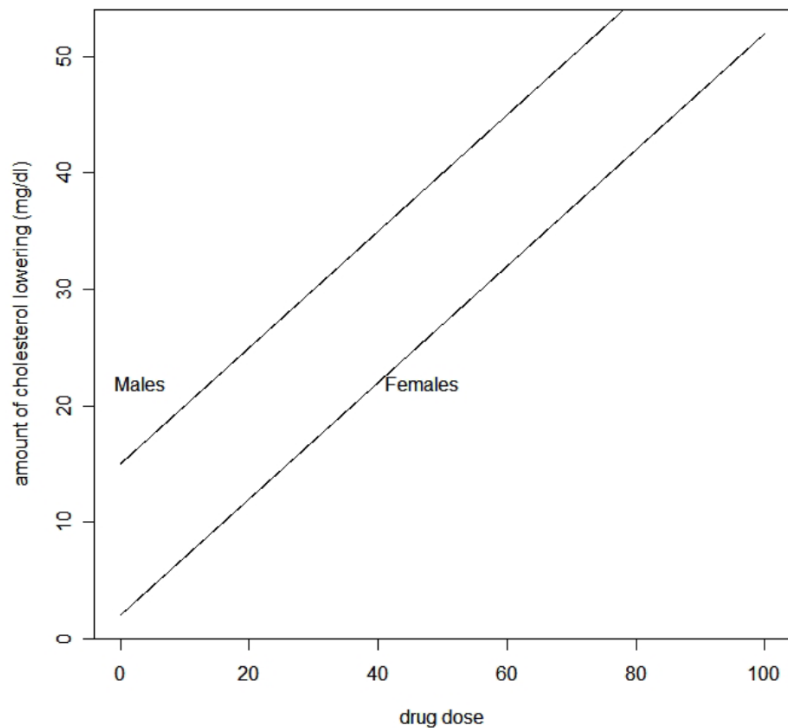


Results

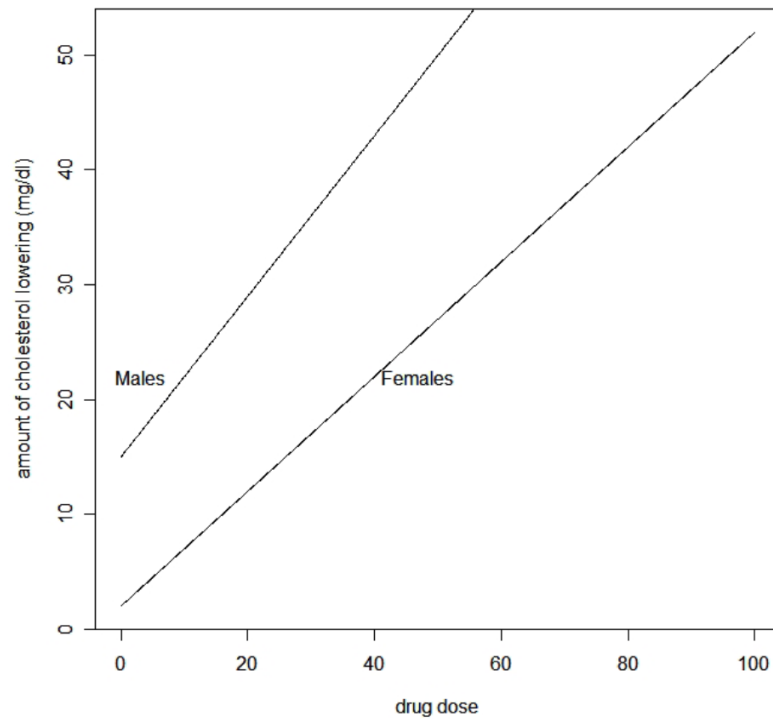
Differences in the IDPs between sex

-> Does this difference have any impact with the correlation to diabetes and associated risk factors?

Effect of sex, no interaction



Effect of sex, with interaction



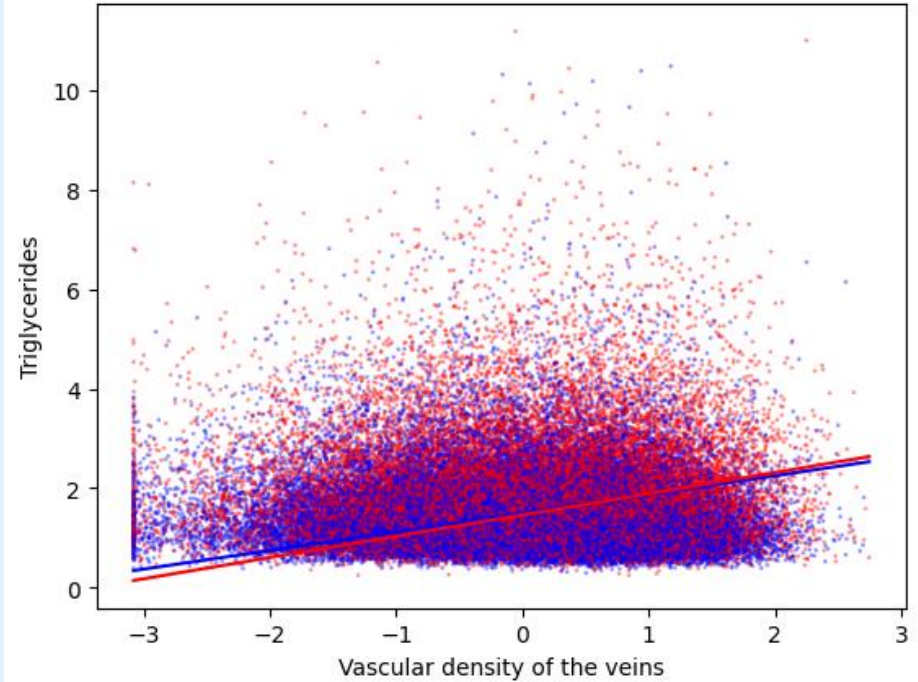
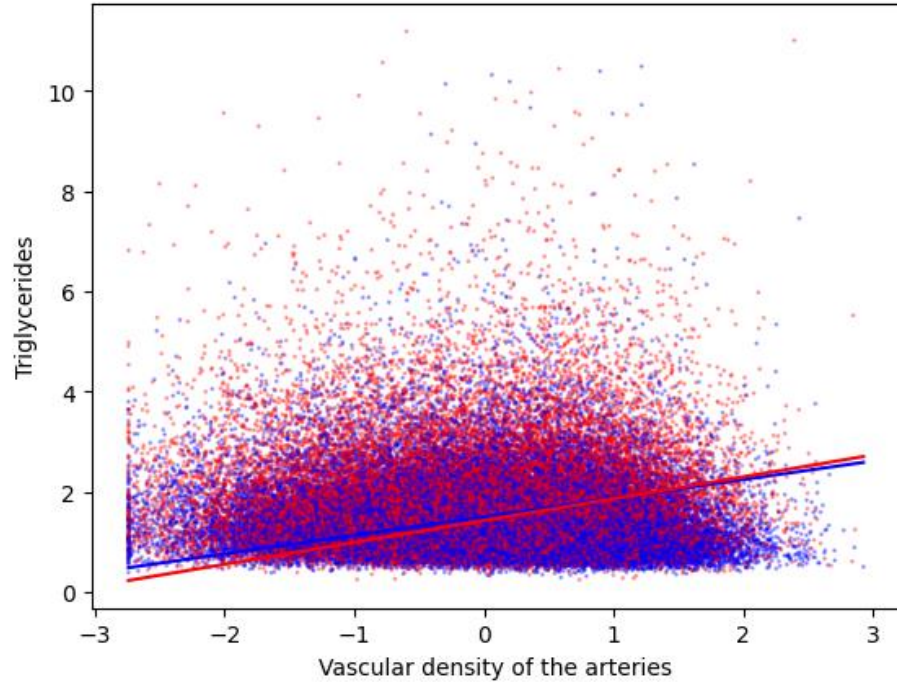
Risk factor ~ IDP + sex + IDP*sex + confounding factors (age, assessment centers, spherical, and cylindrical power)

Associated risk factors studied:

- Triglycerides
- LDL
- HDL
- BMI

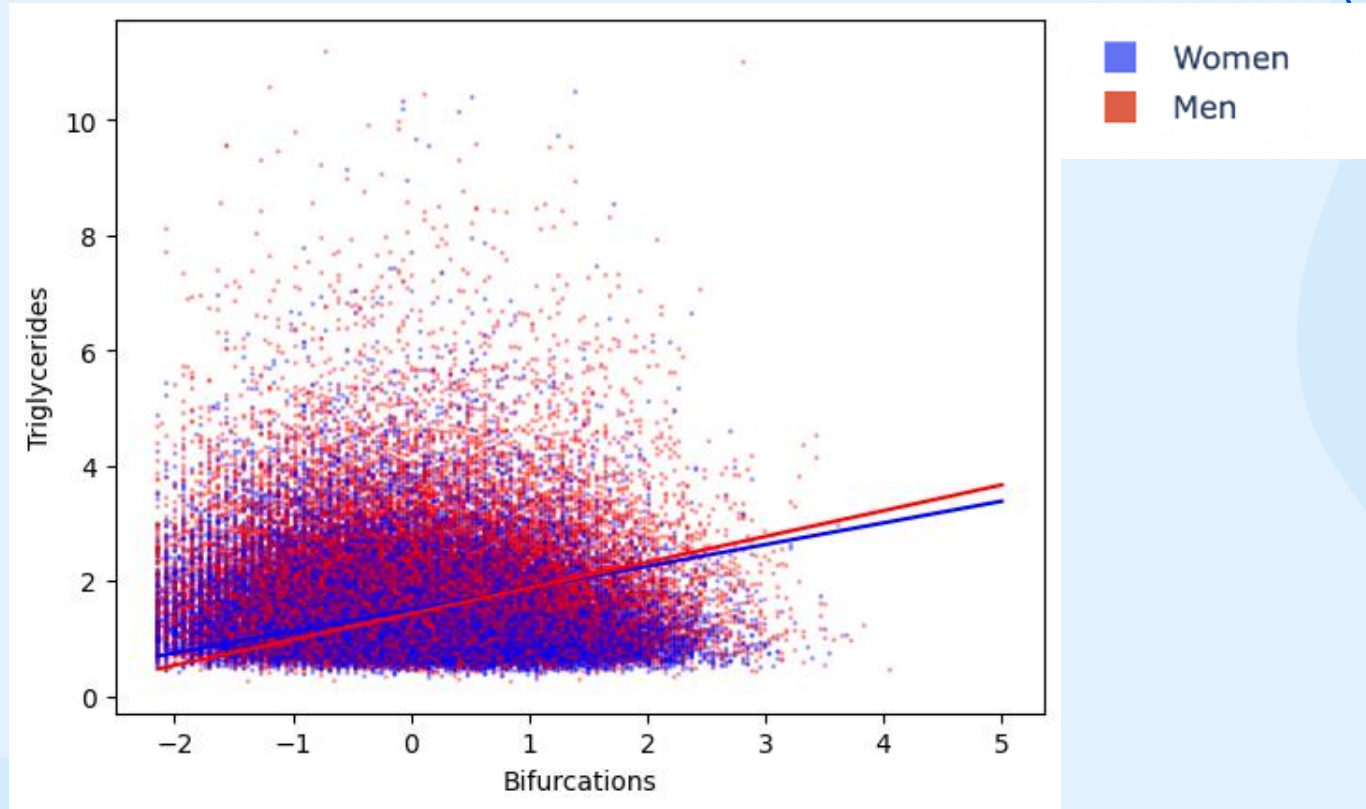
-> «Ordinary Least Square» model

Triglycerides

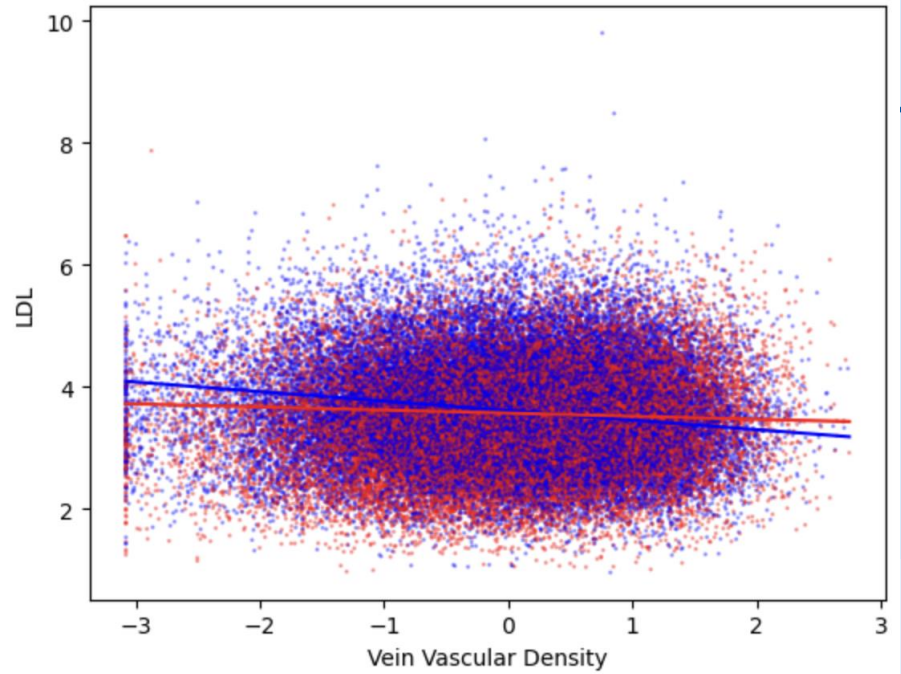
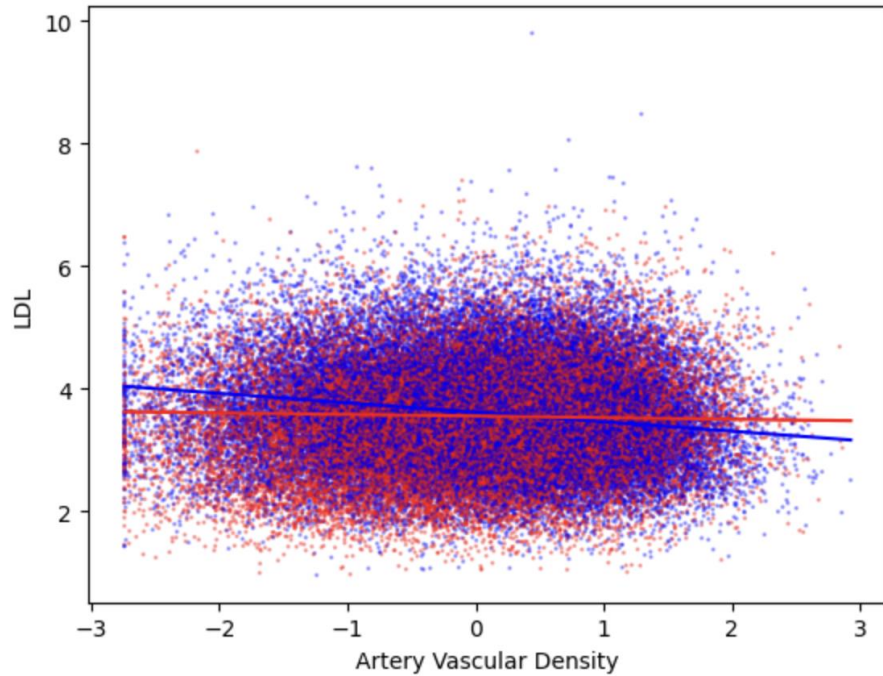


■ Women
■ Men

Triglycerides

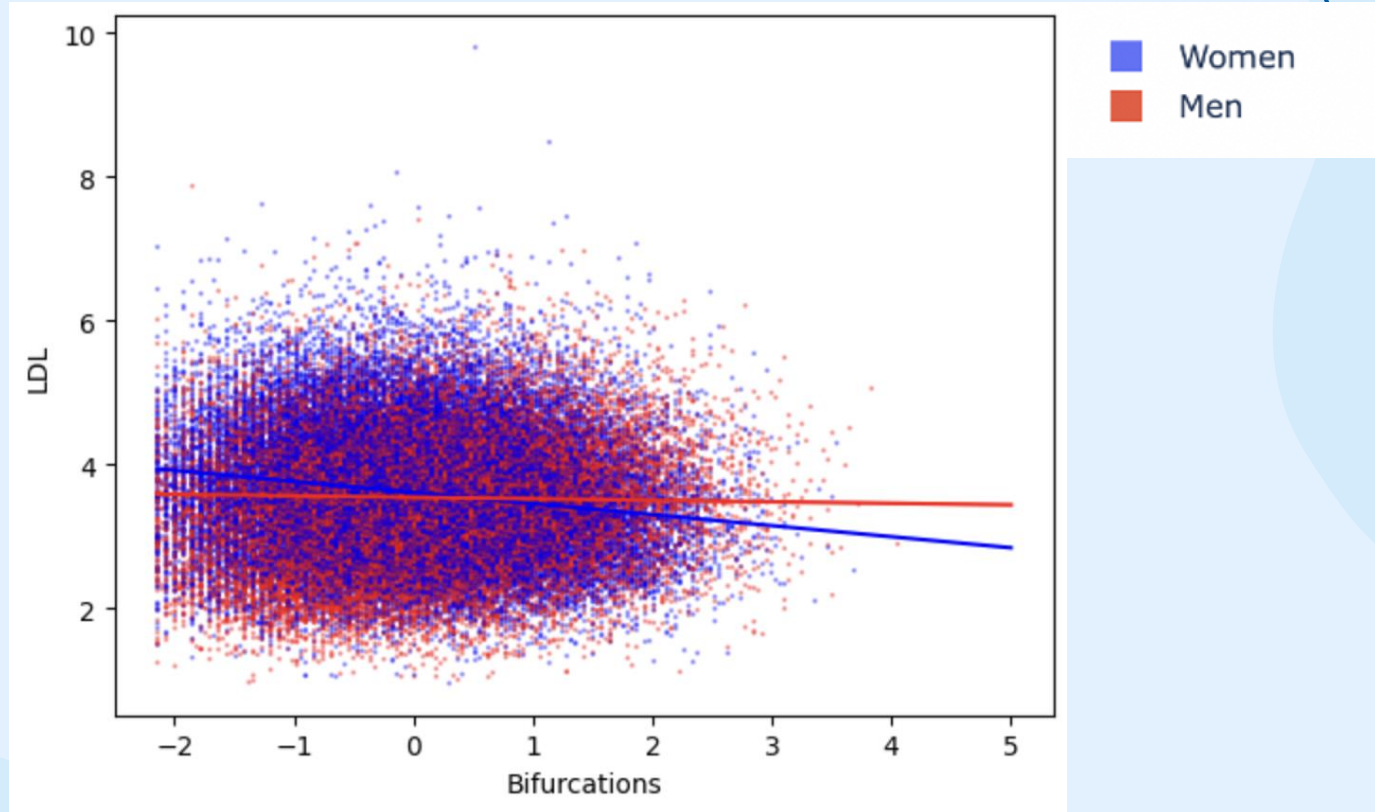


Low Density Lipoprotein



■ Women
■ Men

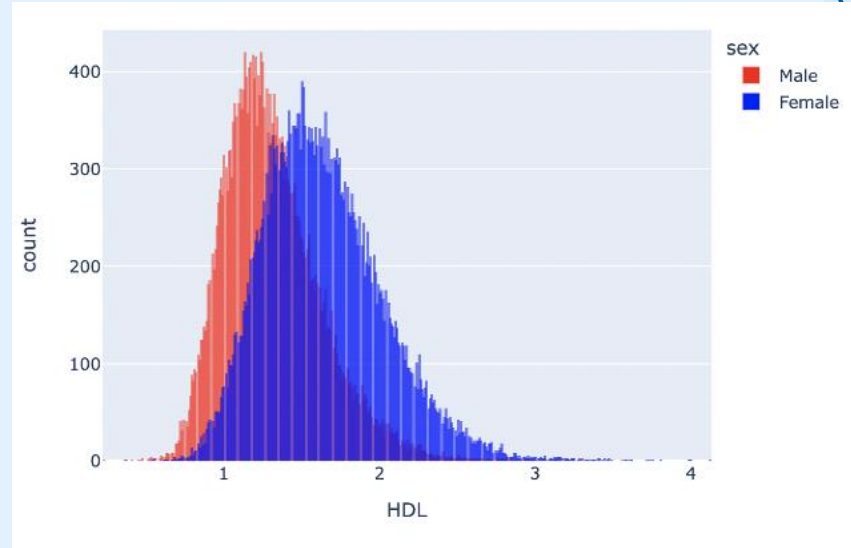
Low Density Lipoprotein



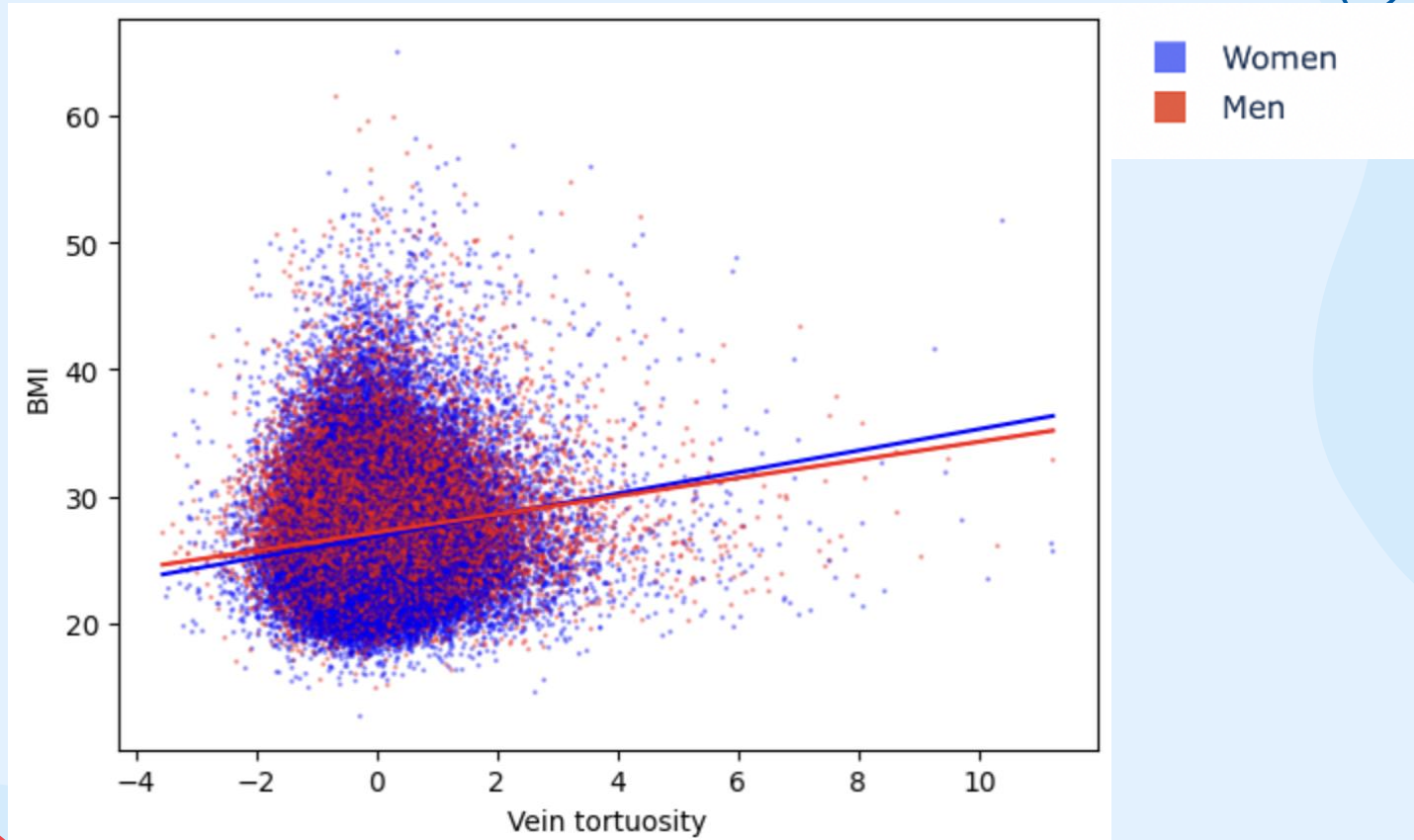
High Density Lipoprotein

Confounding factors: age, assessment centers, spherical, and cylindrical power

-> Assessment center has a significant impact...



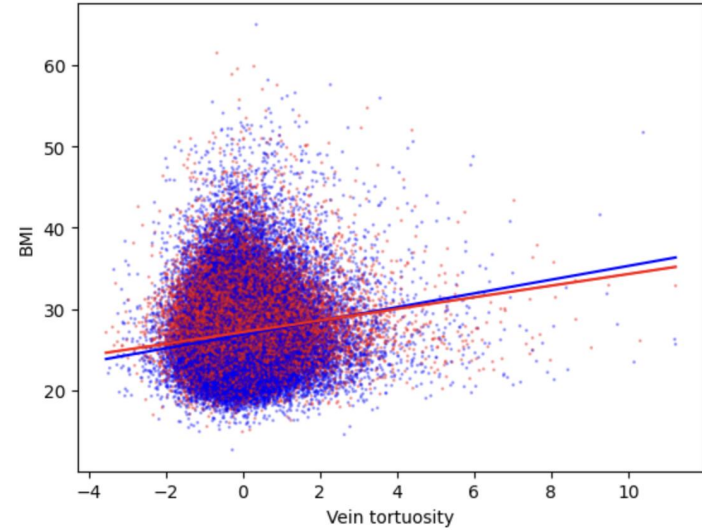
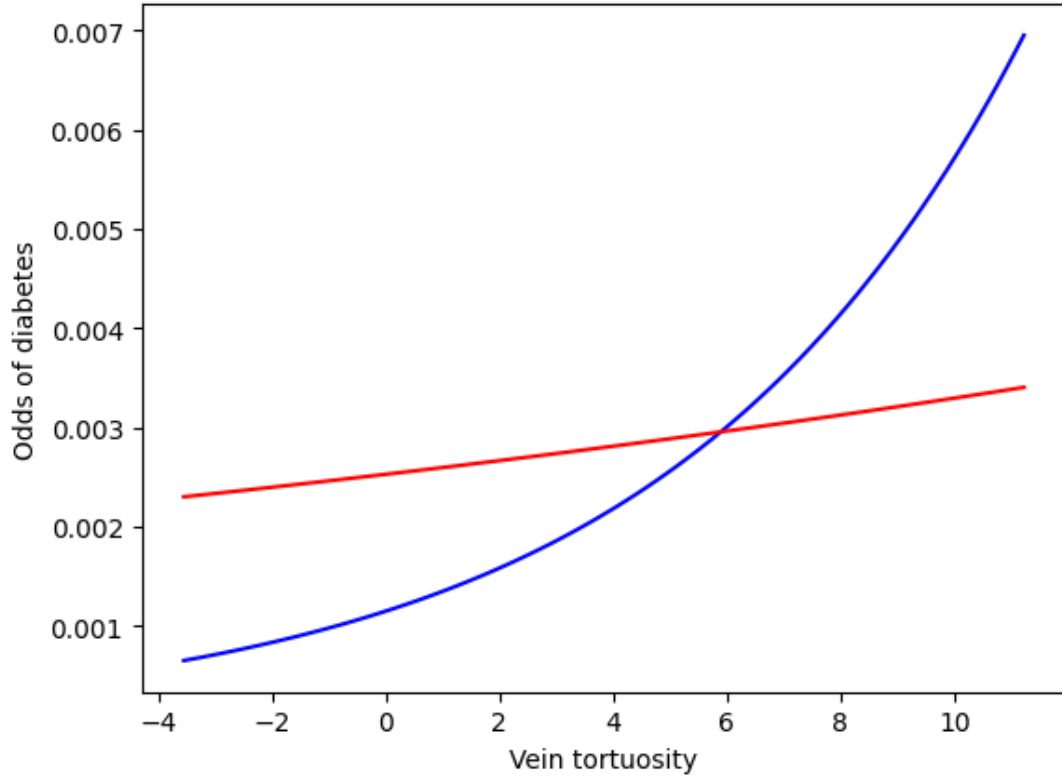
BMI



Diabetes ~ IDP + sex + IDP*sex + confounding factors (age, assessment centers, spherical, and cylindrical power)

-> Logistical model

Diabetes



Project Takeaways

- There are several differences in diabetes between men and women
 - Age of diagnosis
 - Number of cases
 - Significance of the 17 traits
- There are interaction between the IDPs and sex for most of the risk factors and diabetes

Project Challenges

- Statistical analysis
 - >>> Consideration of variables, binary vs continuous
- Obtaining results taking all variables into account (diabetes, sexes, IDPs, other covariates...) and create something consistent
- Significant differences between all assessment center in some cases
- Samples with different sizes => Some of them are too small (background noise, less statistical power...)

Project Challenges

If we had more time...

- Look at confounding factors
 - i.e. smoking and alcohol
 - Right, left, and both eyes separately
 - Splitting the data into age categories

