RISK OF CARDIOVASCULAR DISEASE AMONG OSTEOARTHRITIS PATIENTS

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Agenda

Introduction

Data Challenge

- Data Cleaning
- Modeling
- Data Visualization

Economic Challenge

- Economic impact
- Fix and Variable Cost
- KPIs

Cardiovascular Disease

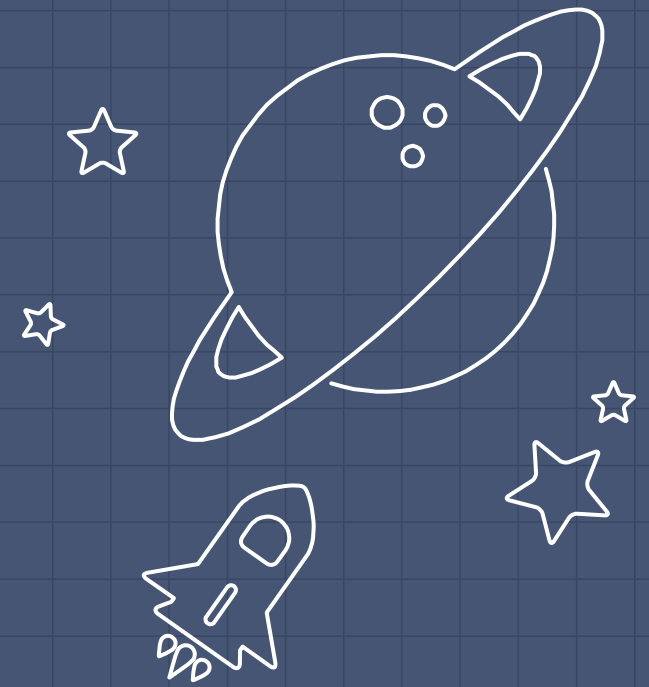
Cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke

Cardiovascular Disease is one of the leading causes of global mortality and morbidity and is responsible for an estimated **16.7 million** deaths worldwide.

Heart Disease in Canada

- It is the **second** leading cause of death among Canadian.
- Well over a million Canadians have heart disease and **50,000** new cases of heart failure are currently diagnosed each year.
- **600,000** Canadian are living with heart failure.

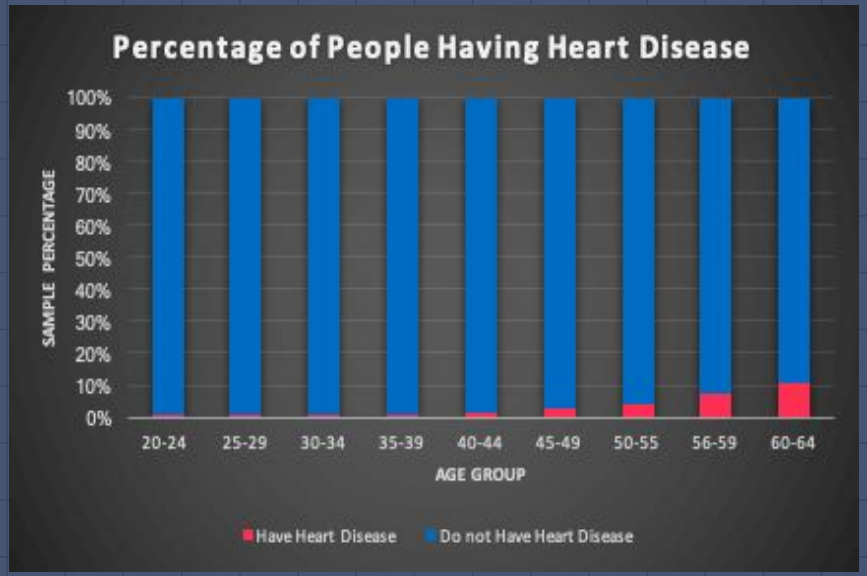
Data Challenge

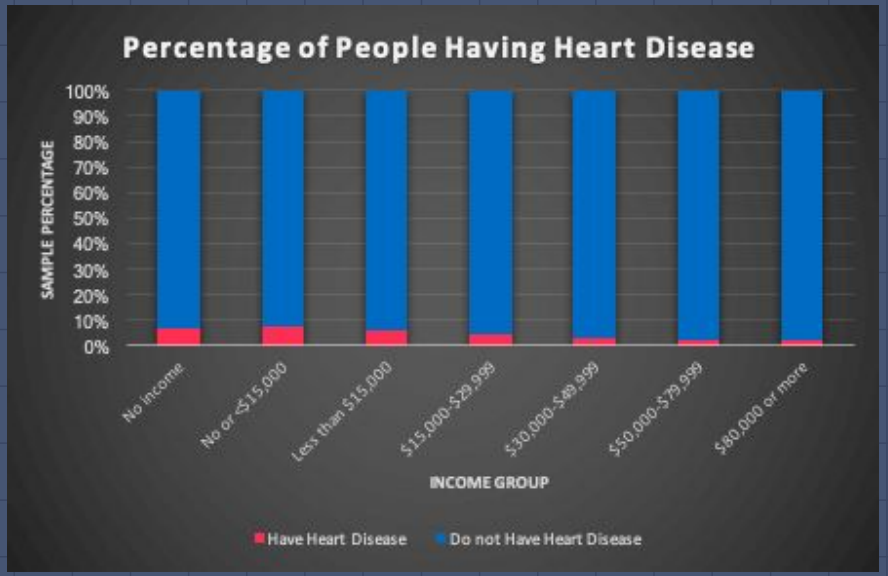


Mindmap

- Select necessary variables
- Delete the missing values
- Plot the histogram for each variables
- Reclassify each variables into two categories
- Create dummy variables
- Using linear regression model
- Select the variables with highest significance

Reclassify Data





- People aged above 50 are more likely to get heart disease. → Reclassify to Age and Young at age of 50
- People overweight are more likely to get heart disease. → Reclassify between healthy and overweight.

OLS Regression

- People who has osteoarthritis are more likely to get heart disease.
- Based on t-test, exposuring to osteoarthritis is a significant variable to heart disease.
- But the R Square is extremely low which mean

OLS Regression Results

Dep. Variable:	Has_heart_disease	R-squared:	0.009
Model:	OLS	Adj. R-squared:	0.009
Method:	Least Squares	F-statistic:	645.1
Date:	Thu, 07 Nov 2019	Prob (F-statistic):	1.11e-141
Time:	18:27:11	Log-Likelihood:	24551.
No. Observations:	71426	AIC:	-4.910e+04
Df Residuals:	71424	BIC:	-4.908e+04
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.9180	0.002	433.071	0.000	0.914	0.922
Kind_of_arthritis	0.0565	0.002	25.399	0.000	0.052	0.061

OLS Regression

OLS Regression Results

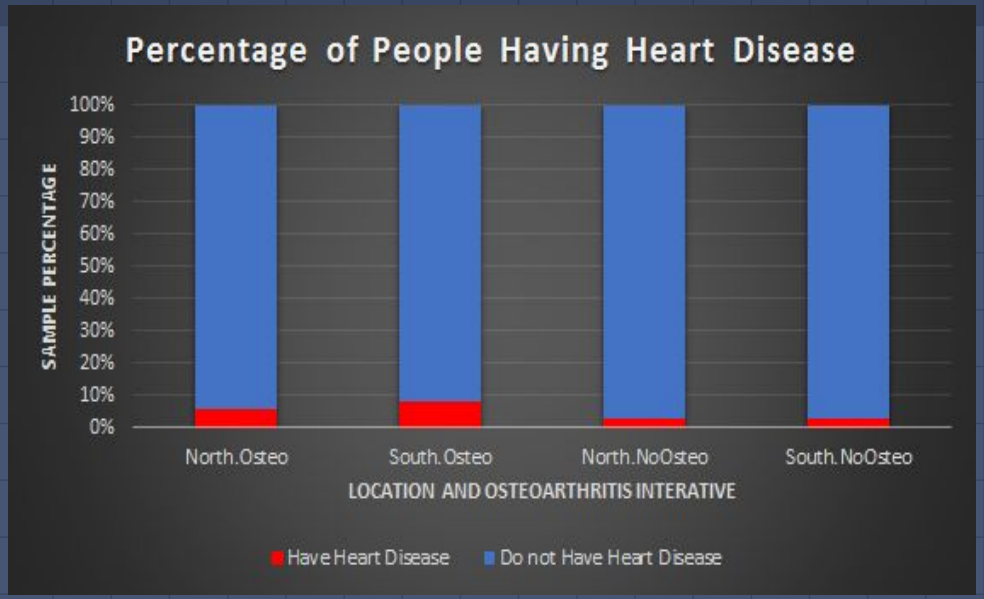
Dep. Variable:	Has_heart_disease	R-squared:	0.056
Model:	OLS	Adj. R-squared:	0.056
Method:	Least Squares	F-statistic:	284.6
Date:	Thu, 07 Nov 2019	Prob (F-statistic):	0.00
Time:	13:43:21	Log-Likelihood:	26303.
No. Observations:	71426	AIC:	-5.257e+04
Df Residuals:	71410	BIC:	-5.243e+04
Df Model:	15		
Covariance Type:	nonrobust		

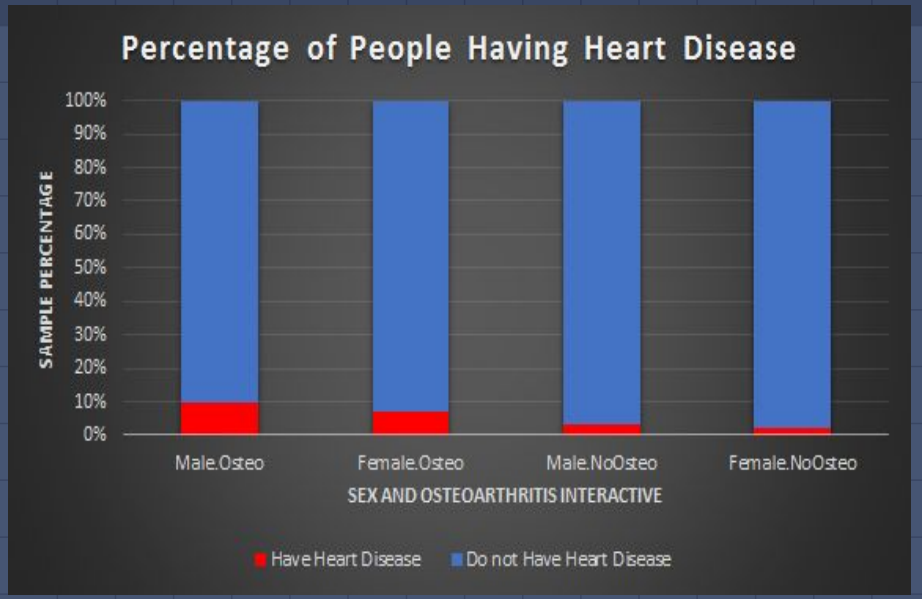
	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.8435	0.006	135.135	0.000	0.831	0.856
Kind_of_arthritis	0.0305	0.002	13.469	0.000	0.026	0.035
Age	-0.0192	0.001	-14.078	0.000	-0.022	-0.017
Sex	-0.0162	0.001	-12.373	0.000	-0.019	-0.014
Length_of_time_in_Canada	0.0034	0.004	0.870	0.384	-0.004	0.011
Education	-0.0105	0.002	-5.720	0.000	-0.014	-0.007
household_income	-0.0186	0.002	-11.269	0.000	-0.022	-0.015
BMI	0.0019	0.001	1.437	0.151	-0.001	0.004
Physical_activity	-0.0036	0.001	-2.829	0.005	-0.006	-0.001
smoker	-0.0088	0.001	-6.775	0.000	-0.011	-0.006
drinker	-0.0123	0.002	-6.022	0.000	-0.016	-0.008
Has_high_blood_pressure	0.0715	0.002	34.622	0.000	0.067	0.076
Has_diabetes	0.0729	0.003	21.431	0.000	0.066	0.080
Province	-0.0019	0.004	-0.437	0.662	-0.010	0.006
ethnicity	-0.0058	0.002	-2.586	0.010	-0.010	-0.001
Has_a_regular_medical_doctor	0.0127	0.002	7.300	0.000	0.009	0.016

Drop:

- BMI
- Province
- Ethnicity
- Immigration

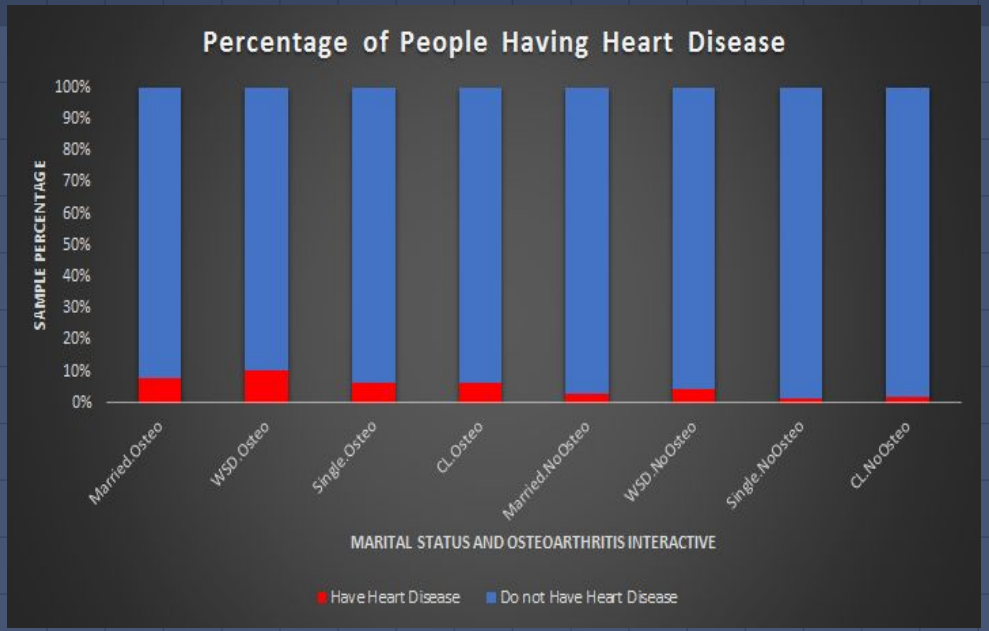
Variation in relationship

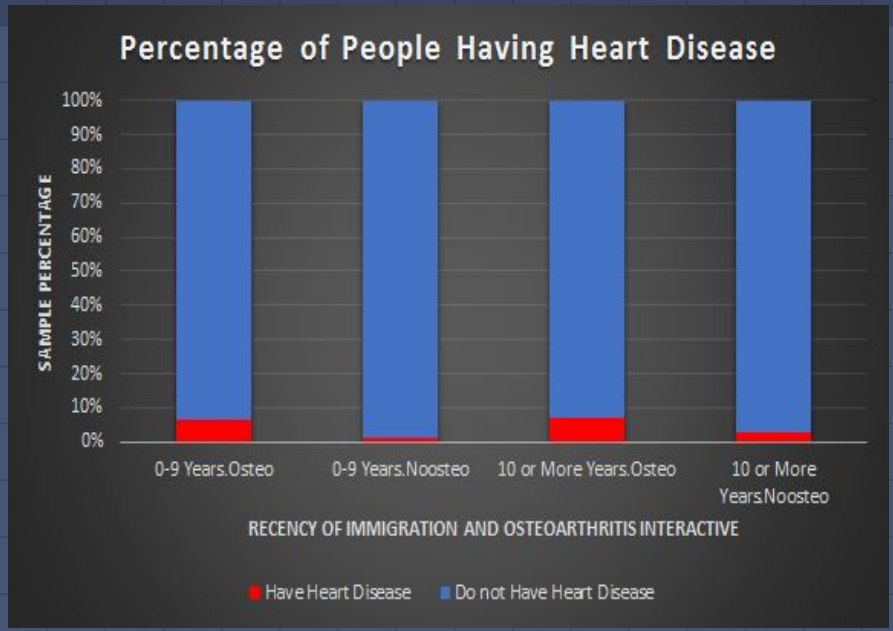




- In general, the percentage of people with osteoarthritis having heart disease is higher than that of people without osteoarthritis having heart disease, in both north and south.
- Additionally, the relationship between osteoarthritis and heart disease for male is stronger than that of female.

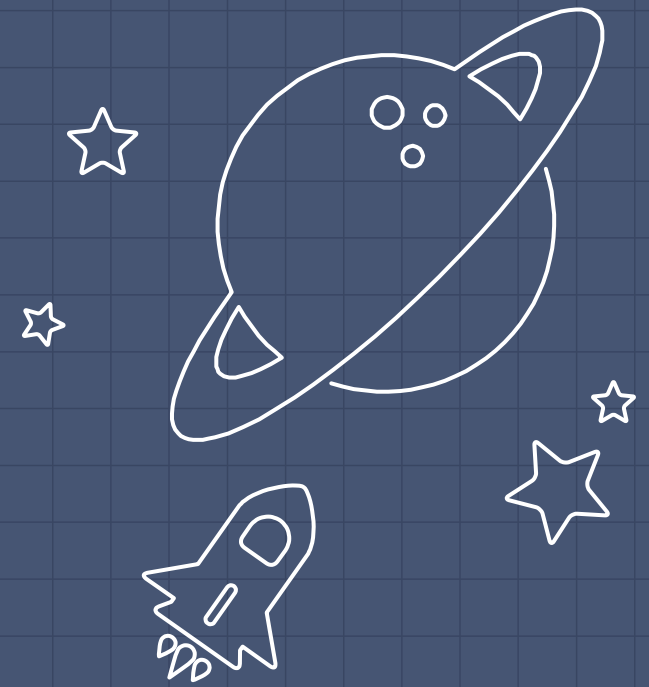
Variation in relationship



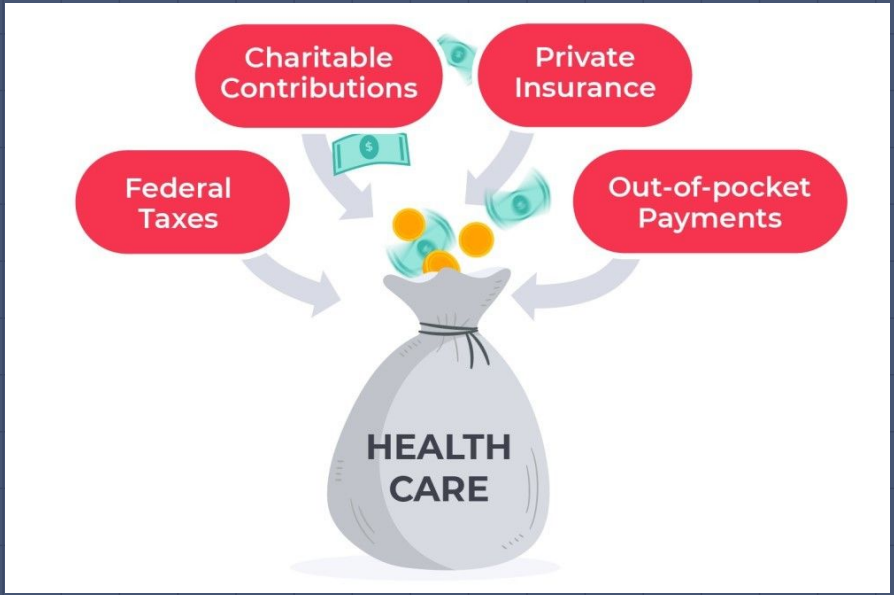


- In general, the percentage of people with osteoarthritis having heart disease is higher than that of people without osteoarthritis having heart disease, no matter if they are married, single, being widow/seperated/divided, or sharing a common-law relationship.

Economic Challenge



Economic Impact of cardiovascular disease in Canada



Health care in Canada is funded at both the provincial and federal levels. The financing of health care is provided via taxation both from personal and corporate income taxes. Additional funds from other financial sources like sales tax and lottery proceeds are also used by some provinces.

Economic Impact

Total cost of Cardiovascular Disease in 2017 is **approximately $ 12.626 million**

Direct:

- Cost of hospitalizations (eg. drug, physician care, hospital, etc.)
- Cost of consulting outside of the hospital system
- Tax Burden

Indirect:

- Workforce Impact (eg. stress, emotion, early retirement etc.)
- Mortality or disability cost
- Morbidity cost

Realistic Approach

Early stage

- Onset diagnosis
- Awareness Campaign

In Hospital

- Surgery
- Supportive device and drugs

After discharge from hospital

- Specialized Clinics
- Counseling

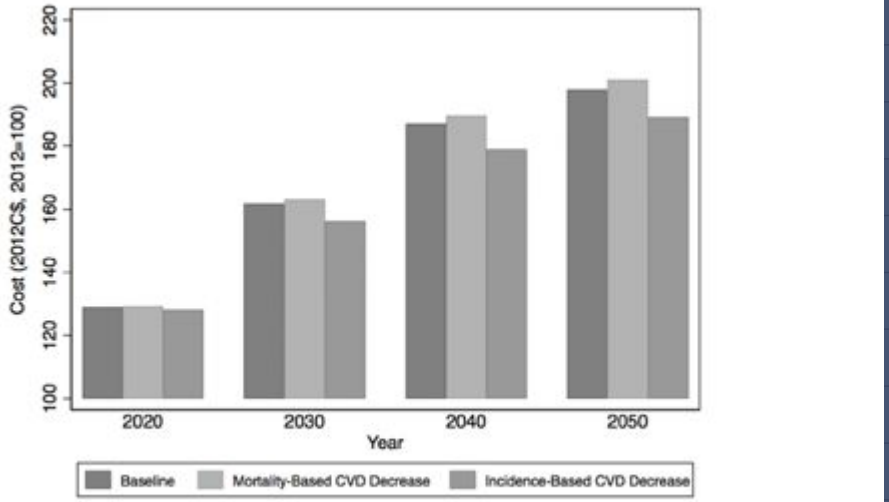


Fig 1. Cost of hospitalizations for Quebec, Canada, 2012 to 2050 (2012C$, 2012 = 100). Notes: Aggregate cost is normalized to 100 in the base year (2012) in the baseline scenario.

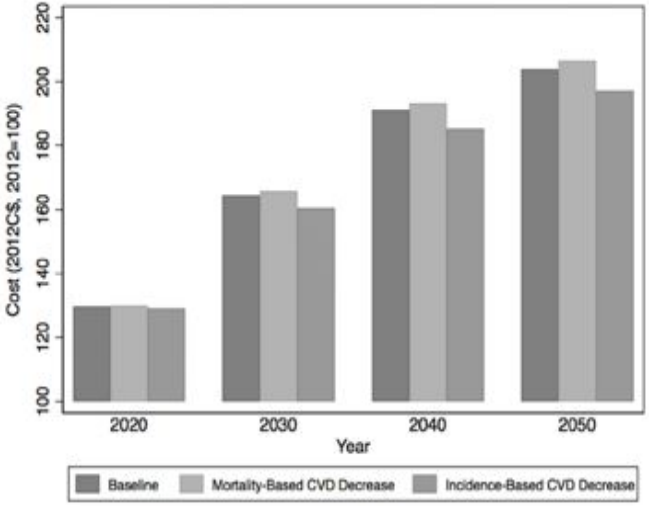


Fig 2. Cost of consultations with a physician (generalist or specialist) for Quebec, Canada, 2012 to 2050 (2012C$, 2012 = 100). Notes: Aggregate cost is normalized to 100 in the base year (2012) in the baseline scenario.

Cost

Fixed

- Hospitalizations & Associated Costs (equipments, utility, admission cost, ect.)
- Emergency room cost
- Health care cost

Variable

- Treatment cost (drug, supplies, etc.)
- Heart disease specialist cost
- Readmission cost

KPIS of Economic Cost

- Blood Pressure
- Diabetes
- Income
- Education

Conclusions

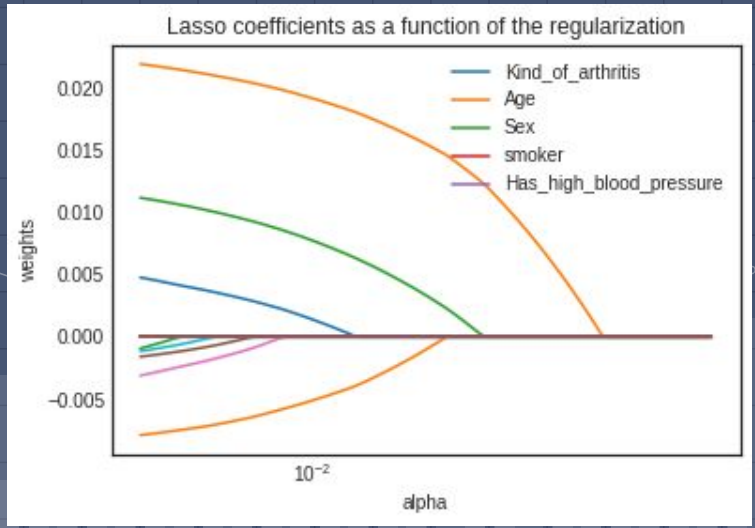
Uncontrollable Parameters:

- Age
- Gender

Controllable Parameters:

- Control Blood Pressure
- Don’t Smoke
- Regular Visit to Doctor

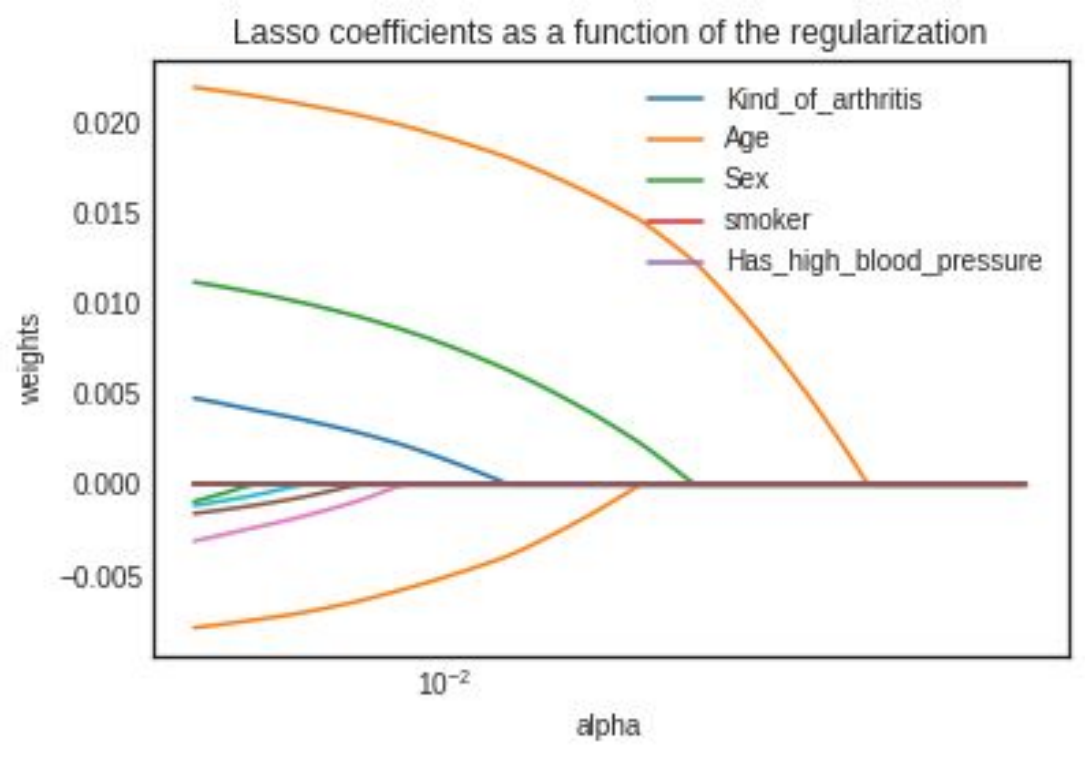
Lasso Regression



Limitations

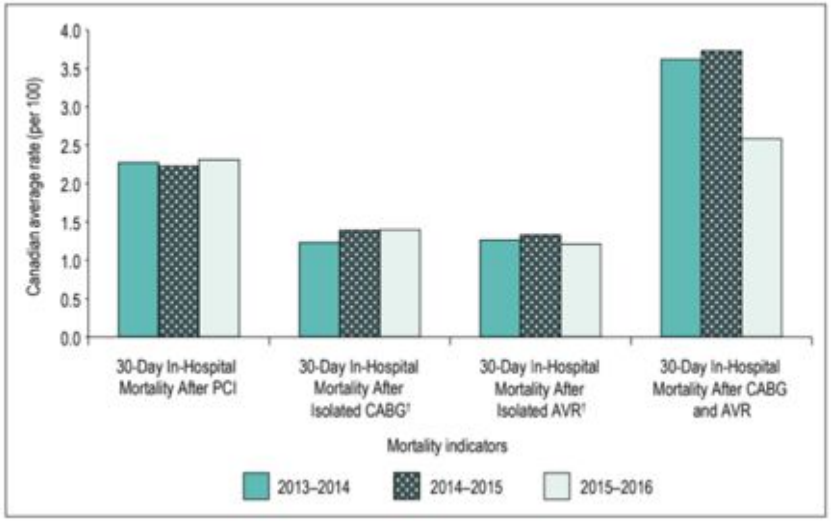
- Data
- Method

Additional Information



Additional Graphs

Canadian average mortality* rates by indicator and fiscal year, 2013–2014 to 2015–2016



Notes

Canadian average readmission rates by indicator and fiscal year, 2013–2014 to 2015–2016