From Cartilage Break-up to Broken Hearts: Estimating the Association between Osteoarthritis and Heart Disease among Canadian Adults

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Objectives

1. Estimate crude and adjusted measures of association between osteoarthritis (OA) and self-reported heart diseases (HD) within Canadian population between age 20 and 64
2. The effects of different levels of sex, province, marital status, and length of time in Canada on the relationship between OA and HD
3. Multiple imputation of missing income and its effect on the above relationships

Methods

Data Sources

- Public Use Microdata Files version of the Canadian Community Health Survey
- Combined three cycles of data from year 2000 to 2005 with standardized variable levels

Survey Weights

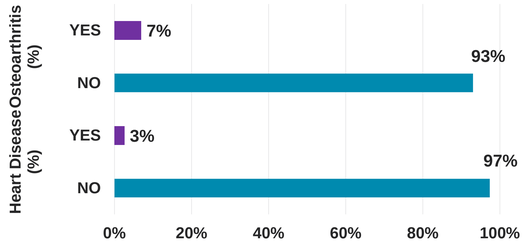
- Each weight is the number of sampling units with the same response reflecting at the population level

Weighted Logistic Model (svyglm) with Sandwich Variance Estimators

logit(P(Heart disease)) ~ Osteoarthritis + Confounders

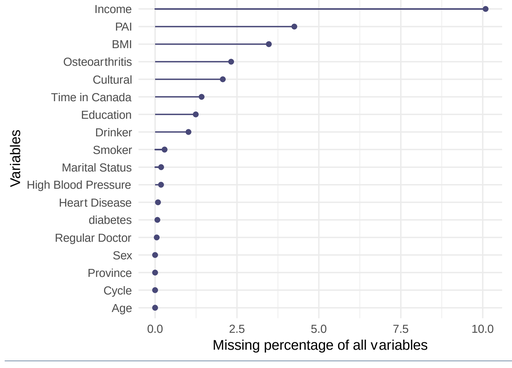
- All confounders were included in the model due to the specific attention to the association between OA and HD
- Province variable, uncollapsed, was included to adjust for any possible correlations in to regional sampling design

Low Prevalence of Osteoarthritis and Heart Disease

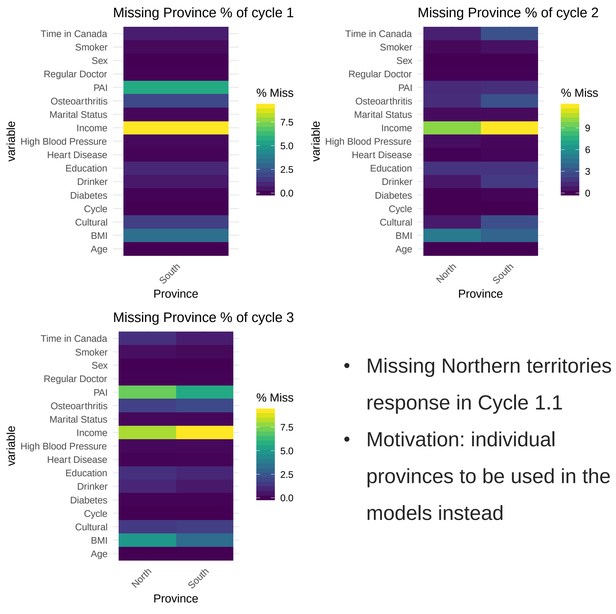


Missing Data Overview

- 12% missing income response

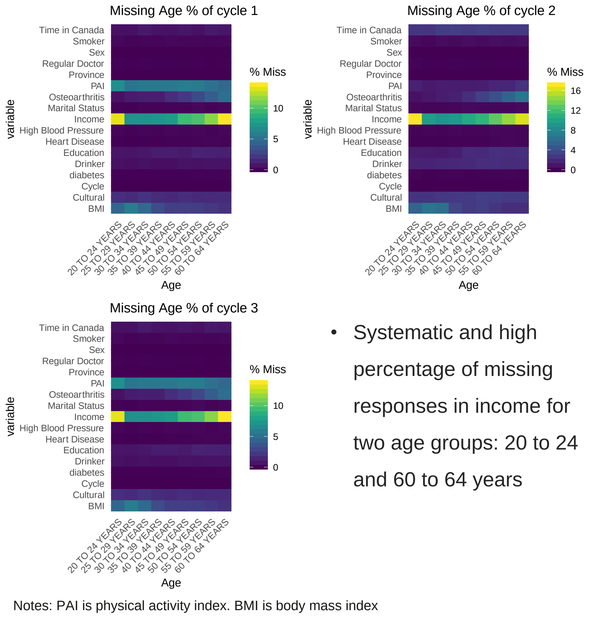


Missing Data Summaries by North/South and Cycle



- Missing Northern territories response in Cycle 1.1
- Motivation: individual provinces to be used in the models instead

Systematic Missing Pattern of Income by Age



- Systematic and high percentage of missing responses in income for two age groups: 20 to 24 and 60 to 64 years

Notes: PAI is physical activity index. BMI is body mass index

Missing Income Imputation

- Assumption: Missing at random (MAR)
- Multivariate Imputation (MI) by Chained Equations (MICE) using ordered logit model (**polr**);
- Total 5 imputations x 10 iterations
- Averaged estimates by Rubin's rules (**pool**)

Results

Univariate Analysis

- Odds Ratio, HD risk by OA : 3.6*** [3.26, 4.01]
- Population Attributable Fraction (**PAF**): **15.4%**

Multivariate Analysis

A. Original Case Analysis

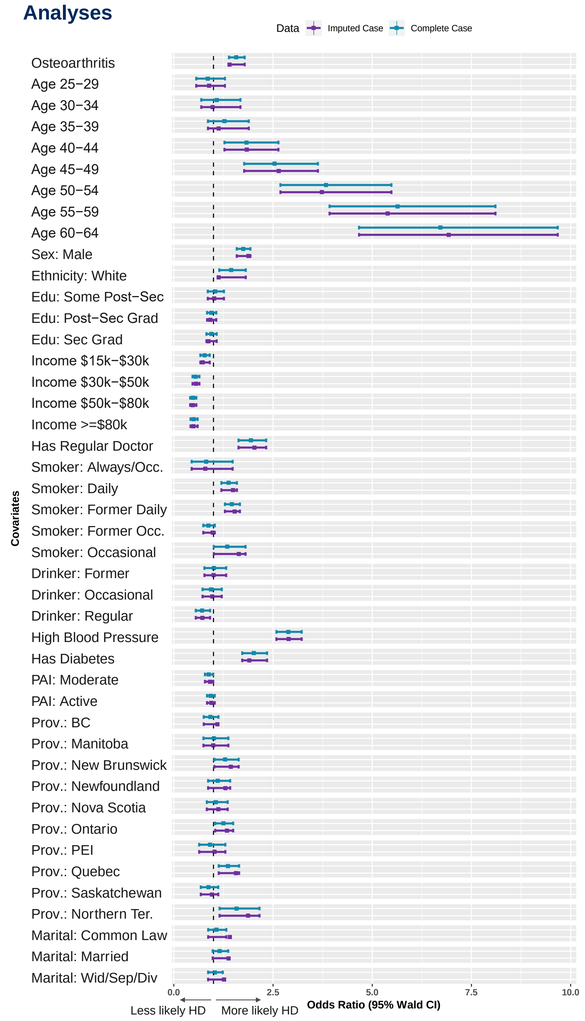
- OR, HD risk by OA: 1.6*** [1.39,1.79]
- **Adjusted PAF: 3.4%**

B. Imputed Case Analysis

- OR, HD risk by OA : 1.4*** [1.31,1.51]
- **Adjusted PAF: 2.7%**

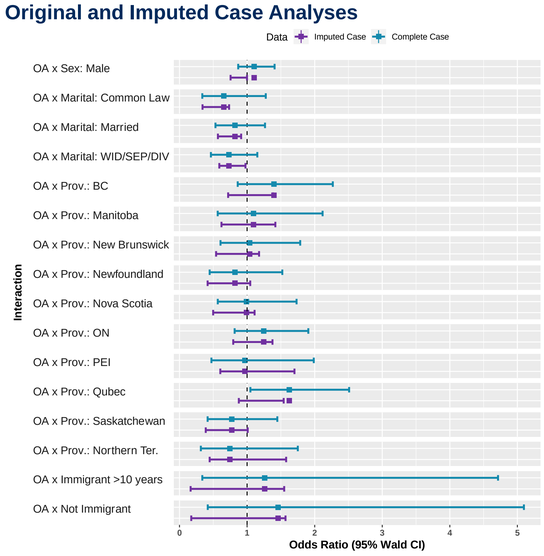
Note: *** indicates p-value < 0.001

Forest Plot of Heart Disease in Original and Imputed Case Analyses



Note: Only confounders with p-value less than 0.05 were shown in the above plot.

Forest Plot of Heart Disease for Interaction Effects in Original and Imputed Case Analyses



Discussions/Limitations

- Bootstrap weights would have accounted for the correlations induced by the sampling design
- Lack of necessary design information or original data to construct bootstrap weights or do any data resampling → sandwich standard error (SE) estimators are still underestimated
- If data were missing not at random, the maximum likelihood estimators and the imputation method are not generalizable to the true population
- Measurement error of survey responses may not be completely at random (questions wording, etc.)
- Smaller sample size of Northern data (0.2% of sample) made detecting its effect on the relationship of interest more difficult → a new study with focused samples will be needed
- Potential unaccounted confounders might affect the size or even the direction of the association of interest in observational studies
- The methods used are applicable and robust to many survey data problems, and the MI approach is robust for missing data problems from many sources
- A strong association between OA and HD was seen in this population even following controlling for confounders

Acknowledgement

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