Covid-19 vaccination in the province of Ontario: A geographical and socio-economical analysis

Appendix

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This document provides details on assessing the socio-economic information from the clean survey dataset, and how it compared to the Census Data for ontario. At the end, it also provides information about the corrections implemented into the data. The variables examined were: race/ethnicity, age groups, income, and population by Health Region. The computations are performed in the `clean_dataset.csv` file that was created at the end of the data cleaning process. Population-wide totals were obtained from the 2016, available in the Statistics Canada Website.

Race and Ethnicity

First, we explored how the race and ethnicity information from the dataset and how it compared to the data from the Census for Ontario. The following chunk creates a summary table for the Race variable.

Table A-1: Ethnic information from the clean dataset

race	observations	percentage
arab_middle_eastern	218	5.9%
black	306	8.3%
east_asian_pacific_islander	308	8.3%
indigenous	216	5.8%
latin_american	182	4.9%
mixed	324	8.7%
other	389	10.5%
south_asian	383	10.3%

white_caucasian	1383	37.3%

It is important to mention that the categories for race/ethnicity provided in the survey did not match the categories used in the Census. Therefore, we used a combination of sources to obtain estimates of racial/ethnic distribution that matched the categories from the survey.The data sources were:

- Fact sheet from the Provice of Ontario for Visible Minorities link: Used to obtain percentages for Arab, Black, East Asian/Pacific Islander (adding Chinese, Korean, and Japanese percentages), Latin American, Mixed (using the percentage for "multiple visible minority"), Other (obtained by adding the Southeast Asian, Filipino, West Asian, and Minority not identified elsewhere percentages), South Asian. *Accessed on January 05, 2022*
- Census Profile for Ontario link: Used to obtain percentage of Aboriginal population. *Accessed on January 05, 2022*
- Wikipedia entry for Ontario demographics link: To corroborate that the percentage of population reported as "European" in this website matched the percentage obtained for "White Caucasian" that was independently obtained by obtaining the difference in population proportion after subtracting the sum of Visible Minorities and Aboriginal Population percentages. The aggregated information can be found in in Table A-2, where the totals per race/ethnic category are presented.

Table A-2: Reference Data from the 2016 Census from Race/Ethnicity in Ontario

Ethnicity/Race	Percentage	Population totals
Arab	1.6%	212782
Black	4.7%	638346
East Asian/Pacific Islander	6.6%	886592
Indigenous	2.8%	376558
Latin American	1.5%	197020
Mixed	1.0%	130033
Other	5.2%	705333
South Asian	8.7%	1166361
White Caucasian	67.8%	9118079
Total	99.9%	13431105

Visible Minorities: 29.3% Not a Visible Minority: 70.7% (Aboriginal 2.8%, White Caucasian 67.8%)

It can be seen that there are differences in the distribution of each ethnicity between the Census data and the survey. For example, Arabs/Middle Easterner correspond to 5.9% of the

survey responses, but population-wise individuals that identify in this ethnic group correspond to 1.6% of the Ontario population.

Age Groups

According to the Census, the distribution of the different the age groups for the province of Ontario are as follows:

Table A-3: Age distributions from the 2016 Census for Ontario

Group age	Percentage	Population Totals
15-24	12.7%	1707959
25-34	12.9%	1734856
35-44	12.8%	1721407
45-54	14.9%	2003826
55-64	13.7%	1842444
65 and over	16.7%	2245898

To compare the survey data to the Census, the next chunk creates a barplot of the age groups in the survey. Here, it can be noticed that the age-group distribution from the survey data is different from the Census data.

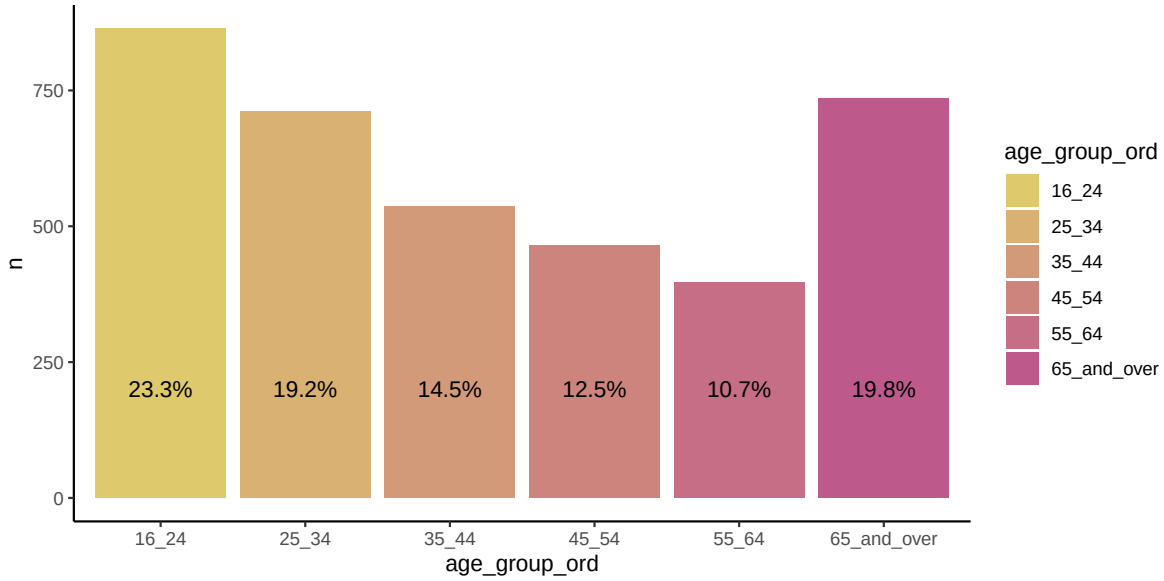

Figure A-1: Age group distributions from the dataset

Income

Survey respondents answered the question "What is your household annual income?". To compare the distribution of responses to this question from the survey and the Census data, we used the "Household total income groups in 2015 for private households" from the Census data (available in the Census Data for Ontario website link).

Table A-4: Income percentages from the 2016 Census for Ontario

Household income range (CAD)	Percentage	Population Totals
< 15,000	5.7%	294643
15,000 - 24,999	7.5%	387688
25,000 - 39,999	11.6%	599624
40,000- 59,999	15.4%	796052
60,000 - 89,999	19.5%	1007988
>90,000	40.3%	2083176

One difference that is noticeable is that the brackets for income in the census data are different than the brackets used in the survey. The census does CAD 4,999 brackets (e.g., CAD 5,000- CAD 9,9999) up to CAD 49,999, followed by CAD 9,999 brackets up to CAD 99,999. After that, the brackets increase to CAD 24,999, and therefore, it is not possible to obtain percentages for the 90,000-109,999 and >110,000 brackets from the survey.

Therefore, in the following code chunk, we created an additional category for income in the dataset that matched the information from the Census, and barplots to visualize the proportion of each income bracket in the dataset.

We identified differences again between the survey data and the Census data. For example, the <15,000 bracket accounts for about 24% of the responses, a much higher rate than the proportion from the Census (5.7%). The other brackets were different as well from the Census data.

Health Regions Population

Finally, we obtained population totals for each of the Health Regions included in the dataset from the Ontario Health Business Plan for 2022-2023 (available here). The population totals are presented in Table A-5.

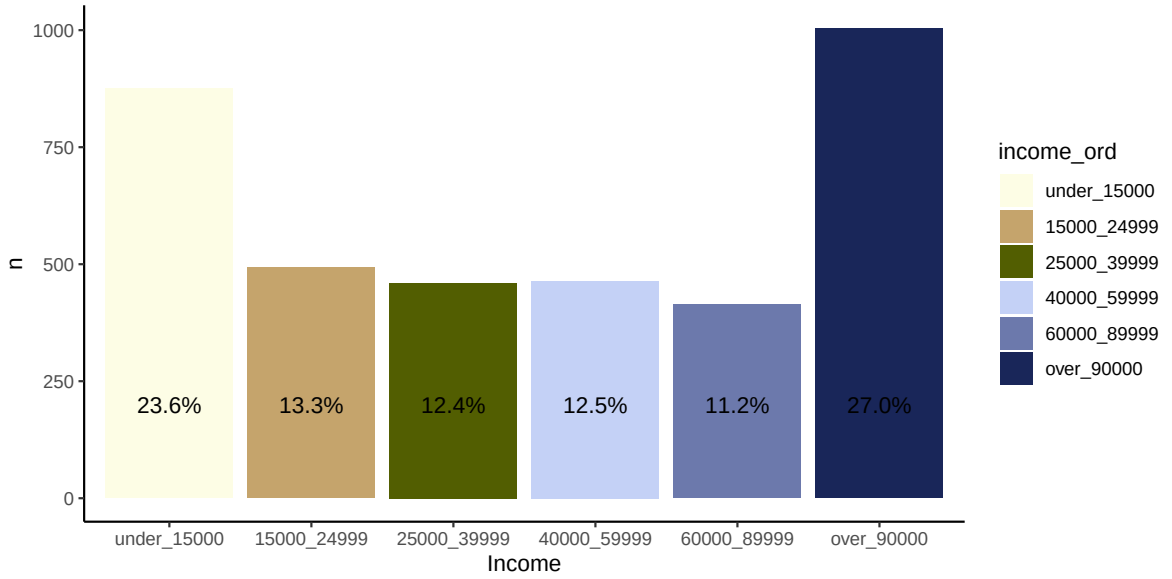

Figure A-2: Income bracket distribution in the dataset

Table A-5: Population Totals for the Health Regions in Ontario

Health Region	Population Totals
North East	232299
North West	557000
West	4095589
East	3742520
Central	5032410
Toronto	1440644

Note that as indicated in the paper, we excluded observations from the North East and North West Health Regions, and therefore, the population totals for these areas were not used in the final analysis.

Corrections

We used the iterative proportional fitting procedure (*raking*) in order to account for the differences in income, age groups, race/ethnicity and the population from the Health Regions. Details of the implementation can be found in the R Script `raking_logistic_regression.R` in the `code` directory.

Interactions from the Regression Model

The plots below show the interactions for Race and Income and Race and Health Region based on the regression model presented in the main paper.

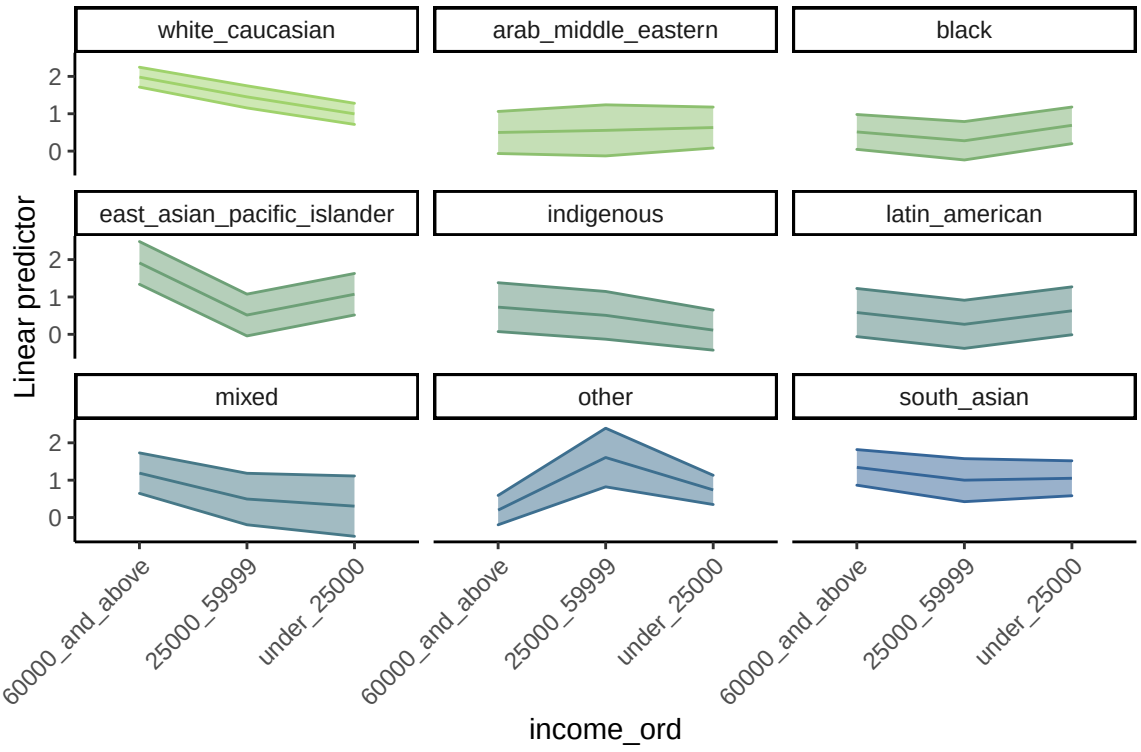

Figure A-3: Interaction plot between Race and Income

Socio-economic Information from the Survey Data

The tables below present summaries of information from the Fields survey (from the clean dataset analyzed in the main paper), showing responses by White/Caucasian individuals by Health Region and proportion of answers by LHIN in the West Health Region.

Table A-6: Reported Vaccination Status from the Survey for White/Caucasian Individuals by Health Region

Characteristic	**no**, N = 233	**yes**, N = 1,080
Health_Region		

Characteristic	**no**, N = 233	**yes**, N = 1,080
Toronto	85 (21%)	321 (79%)
West	69 (17%)	329 (83%)
East	41 (15%)	236 (85%)
Central	38 (16%)	194 (84%)

Table A-7: Proportion of answers by LHIN (West Health Region)

Characteristic	**N = 839**
LHIN	
Hamilton Niagara Haldimand Brant (Hnhb)	271 (32%)
Waterloo Wellington	227 (27%)
South West	187 (22%)
Erie St. Clair	154 (18%)

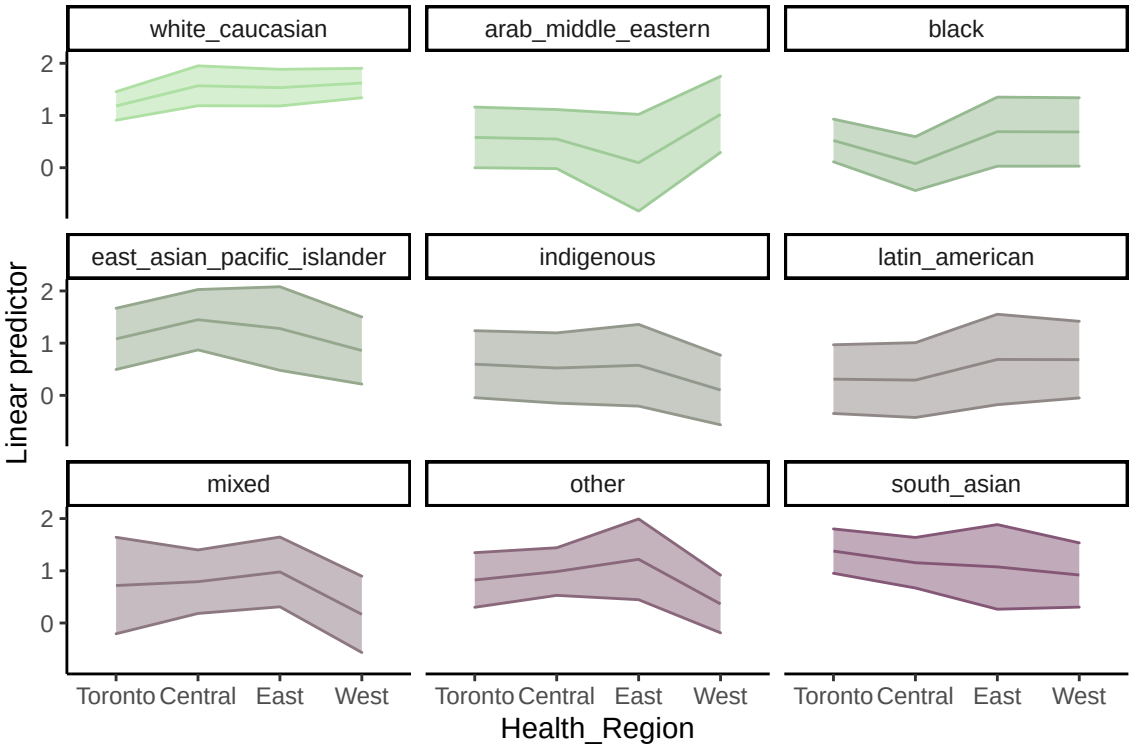

Figure A-4: Interaction plot between Race and Health Region