Analyzing the Impact of the COVID-19 Pandemic on Gender-Based Salary Disparities in Ontario, Canada

October 19, 2023

1 Introduction

The COVID-19 pandemic has heightened awareness of gender disparities, exposing complex interactions between health and income inequalities. In this study, we explore the relationship between changes in gender-based disparities of COVID-19 cases and gender-based salary gaps in Ontario, Canada. We examine the changes in confirmed COVID-19 cases for males and females in Ontario cities for 2020 and 2022, then we examine the gender-based salary gap for 2019 and 2021. Additionally, we analyze the statistical correlation between these variables, while controlling for population variations. Data visualizations complement our analyses. Our initial findings suggest contrasting trends that require further investigation. Recognizing limitations, such as potential biases and data availability, our study aims to contribute to a general understanding of gender salary inequality affected by the COVID-19 pandemic in Ontario.

2 Data Source

Our primary data sources, provided by the Government of Canada, include the "Confirmed positive cases of COVID-19 in Ontario - Data Dictionary" (2020-2023) detailing COVID-19 cases by gender and city. Additionally, the "Labour income profile of tax filers by sex" (2019-2021) provides median income data. We also use population data from "Population and dwelling counts: Canada and population centers" (2021). (Government of Canada, ope, Government of Canada [2022], Government of Canada [2023])

3 Methodology

We first examine the change of difference in confirmed positive COVID-19 cases reported for males and females in Ontario cities for the years 2020 and 2022. We calculate this difference for each city using the formula:

$$\Delta_{c,cases} = \text{Cases}_{\text{Male},2022,c} - \text{Cases}_{\text{Female},2022,c} - (\text{Cases}_{\text{Male},2020,c} - \text{Cases}_{\text{Female},2020,c})$$

Where $\Delta_{c,cases}$ represents the change in difference of confirmed cases between males and females for city c, and $\text{Cases}_{\text{Male/Female},Year,c}$ represents the confirmed cases for males/females in the respective years for city c. If assume $\text{Cases}_{\text{Male}}, 2022, c = \text{Cases}_{\text{Male}}, 2020, c$, then a negative $\Delta_{c,cases}$ indicates an increase female positive cases from 2020 to 2022 which means an increase of gender inequality and vice versa.

In addition, we also analyze changes in the gender-based salary gap by considering the difference in median income between males and females for Ontario cities in 2019 and 2021. To calculate this difference for each city, we use the following formula:

$$\Delta_{c,income} = \text{Income}_{\text{Male},2021,c} - \text{Income}_{\text{Female},2021,c} - (\text{Income}_{\text{Male},2019,c} - \text{Income}_{\text{Female},2019,c})$$

Where $\Delta_{c,income}$ represents the change in gender-based median salary gap city c, and $\text{income}_{\text{Male/Female},Year,c}$ represents the median income for males/females in the respective years for city c. If assume $\text{Income}_{\text{Male}}, 2021, c = \text{Income}_{\text{Male}}, 2019, c$, then a negative $\Delta_{c,cases}$ indicates an increase female salary from 2019 to 2021, which means a decrease of gender inequality and vice versa.

Then We will examine the relationship between changes in COVID-19 case differences and income differences (gender-based salary gaps) with controlling for population of that city in 2021 variations.

$$\Delta_{Income} = \beta_0 + \beta_1 \Delta_{Cases} + \beta_2 Pupulation_{2021} + \epsilon \tag{1}$$

Where:

Δ_{Income} is the dependent variable
Δ_{Cases} is the first independent variable
$Pupulation_{2021}$ is the control variable
β_0 is the intercept coefficient
β_1 is the coefficient for Δ_{Cases}
β_2 is the coefficient for $Pupulation_{2021}$
ϵ is the error term

4 Data Visualization

4.1 COVID-19 Positive Cases Reported by Gender in Ontario

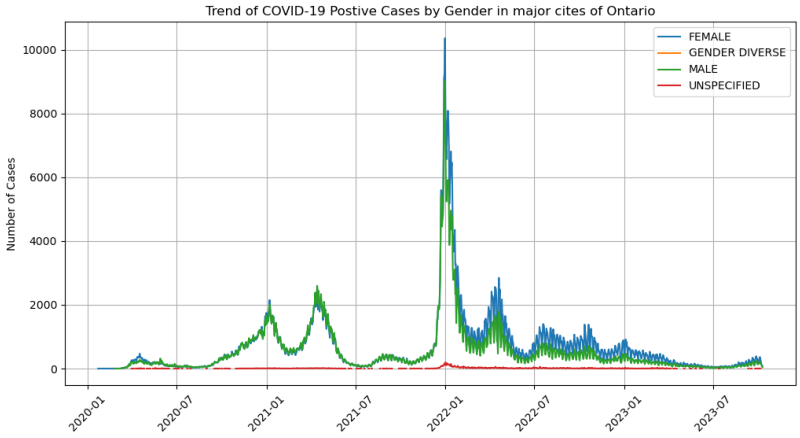


Figure 1: Trend of COVID-19 Positive Cases report By Gender in Ontario. (ope)

Figure 1 illustrates the COVID-19 positive case trends by gender in Ontario over three years. The data is from the Government of Canada. In 2020 and 2021, both genders experienced similar patterns with peaks in January and March 2021. However, towards the end of 2021, there was a significant surge in cases. Subsequently, the trend shows more positive cases among females than males. This data underscores the evolving nature of the pandemic, emphasizing the need for gender-specific strategies in Ontario's response.

4.2 COVID-19 Positive Cases Reported by Gender Separate with Cites

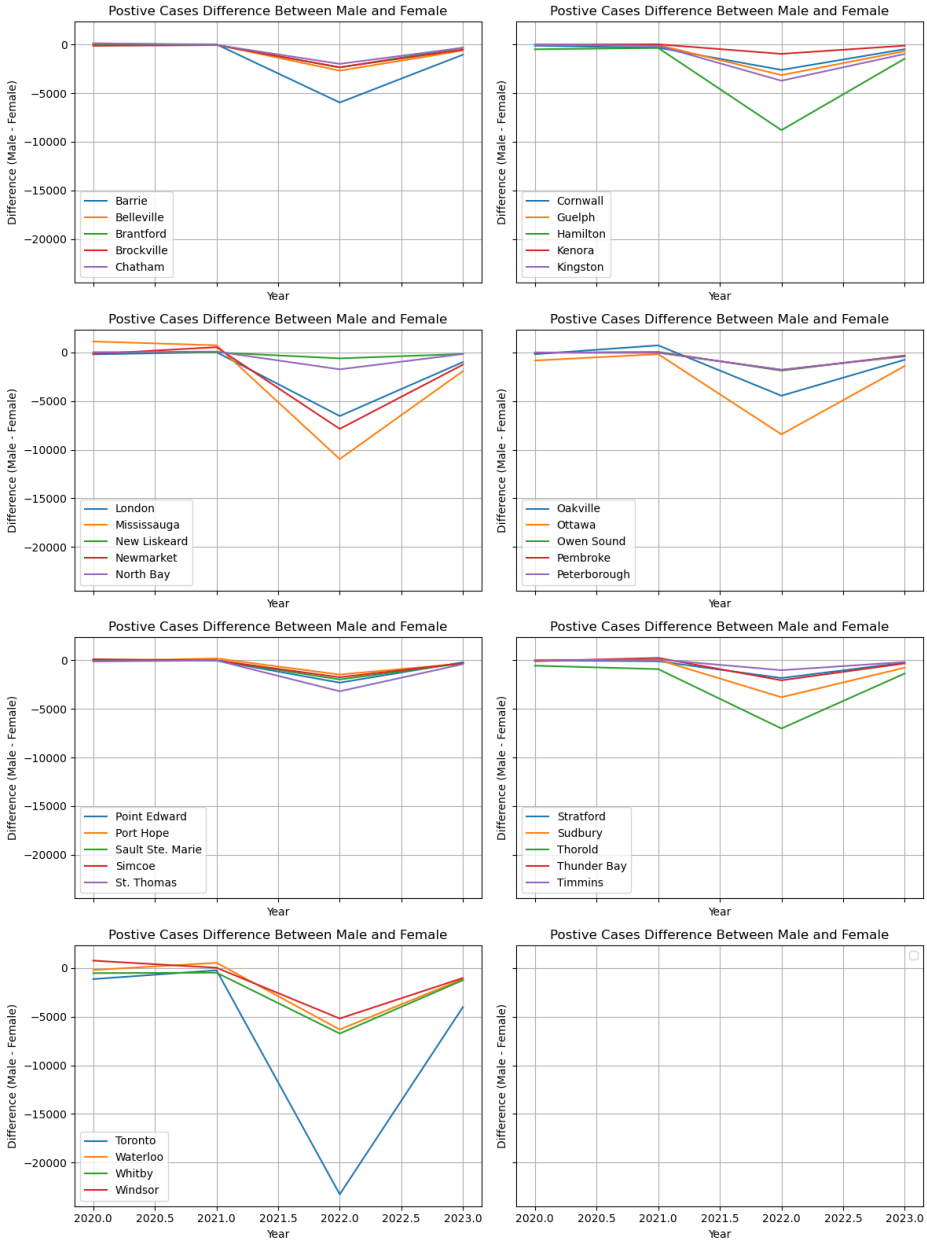


Figure 2: Trend of COVID-19 Positive Cases report By Gender in Ontario. (ope)

Figure 2 illustrates the changing gender disparity in COVID-19-positive cases across Ontario cities from 2020 to 2023. Initially, the gap remains stable, but in 2022, a significant and widespread increase in female-positive cases is observed. Notably, in Toronto in 2022, females reported nearly 22,500 more positive cases than males. Indeed, these trends somewhat reflect an inequality in the impact of the pandemic on males and females.

4.3 Change of median income gap versus change of positive cases reported gap

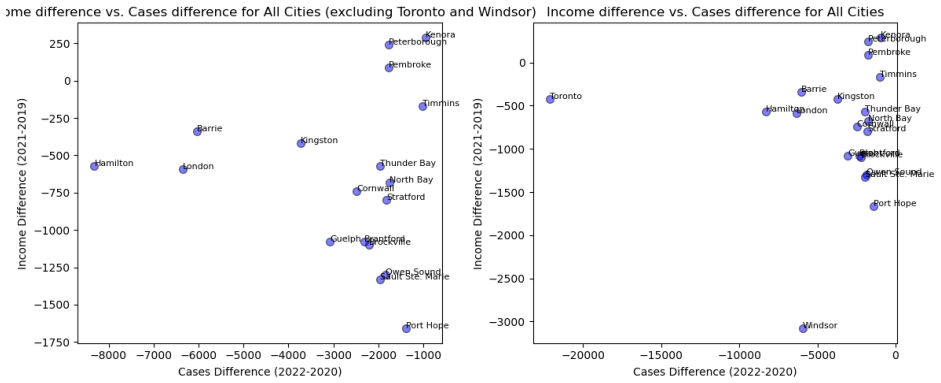


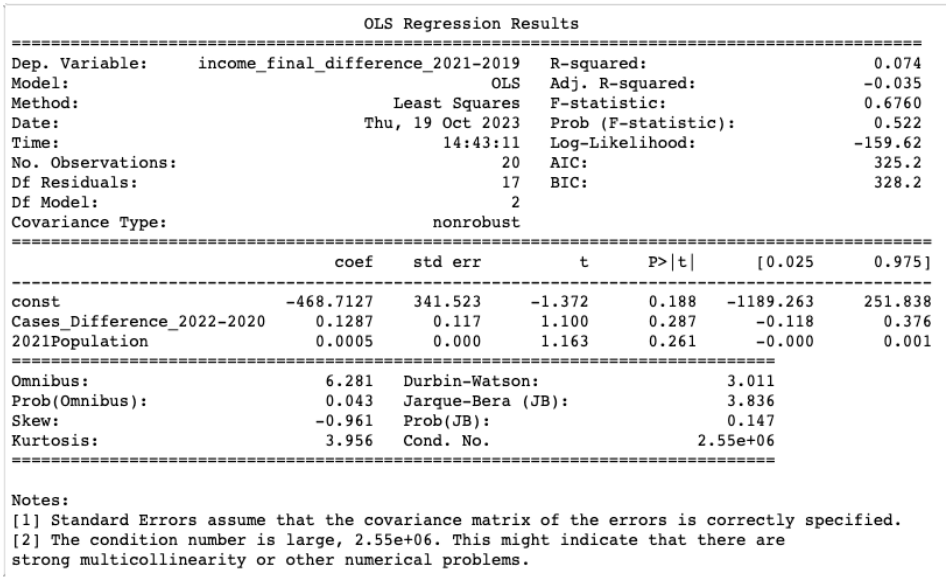
Figure 3: The change of median income gap between males and females from 2019 to 2021($\Delta_{c,income}$) versus the change of positive cases difference between males and females from 2020 and 2022 ($\Delta_{c,Cases}$)(ope, Government of Canada [2022])

The data presents a complex relationship with no consistent trend observed across cities. Notably, two cities, Toronto and Windsor, stand out as outliers. In Toronto, a significant increase in the gap of positive cases reported between males and females from 2020 to 2022 is evident, with a substantial rise of approximately 22,500. ($\Delta_{c,Cases}$ = -22,500) This suggests a considerable increase in the number of positive cases among females compared to 2020, assuming male cases remained constant. However, ($\Delta_{c,income}$ = -500) for Toronto implies indicates a slight improvement in gender salary inequality in Toronto from 2019 to 2021.

For Windsor, a $\Delta_{c,income}$ of -3000 indicates a decrease in the gender-based salary gap from 2019 to 2021, signifying a great improvement in salary inequality between males and females in 2021. Simultaneously, a $\Delta_{c,Cases}$ of -6000 reveals an increase in the gender disparity of positive COVID-19 cases from 2020 to 2022, suggesting a bigger gap in the number of reported COVID-19 cases between genders in 2022 compared to 2020.

Most cities in Ontario have a negative $\Delta_{c,Cases}$ and $\Delta_{c,Income}$, this indicates that gender wage gaps are closing in many Ontario cities, but the gender gap in COVID-19-positive reports widens.

5 Regression Results



OLS Regression Results

Dep. Variable:	income_final_difference_2021-2019	R-squared:	0.074
Model:	OLS	Adj. R-squared:	-0.035
Method:	Least Squares	F-statistic:	0.6760
Date:	Thu, 19 Oct 2023	Prob (F-statistic):	0.522
Time:	14:43:11	Log-Likelihood:	-159.62
No. Observations:	20	AIC:	325.2
Df Residuals:	17	BIC:	328.2
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-468.7127	341.523	-1.372	0.188	-1189.263	251.838
Cases_Difference_2022-2020	0.1287	0.117	1.100	0.287	-0.118	0.376
2021Population	0.0005	0.000	1.163	0.261	-0.000	0.001

Omnibus:	6.281	Durbin-Watson:	3.011
Prob(Omnibus):	0.043	Jarque-Bera (JB):	3.836
Skew:	-0.961	Prob(JB):	0.147
Kurtosis:	3.956	Cond. No.	2.55e+06

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.55e+06. This might indicate that there are
strong multicollinearity or other numerical problems.

Figure 4: Regression Result for The change of median income gap between males and females from 2019 to 2021 versus the change of positive cases difference between males and females from 2020 and 2022 with control city population.(ope, Government of Canada [2022], Government of Canada [2023])

We can see not surprisingly that the R-squared value is 0.074, indicating that the model explains only 7.4% of the variation in the dependent variable as the scatter plot does reflect a significant trend even though we control the population in each city. The coefficient for $\Delta_{c,cases}$ is 0.1287, but the p-value is 0.287, which is greater than the typical significance level of 0.05. This suggests that the change in COVID-19 case differences between 2020 and 2022 is not statistically significant in explaining the change in the salary gap.

6 Conclusion

In our analysis, we explored the dynamics of gender-based disparities in Ontario, focusing on COVID-19-positive cases and median salary gaps. The scatter plots revealed contrasting trends in the years 2020 to 2022, with most cities experiencing an exacerbation of gender inequality in COVID-19-positive cases but showing an improvement in gender-based salary gaps. However, our regression analysis demonstrated that these two trends were not statistically correlated.

These results highlight the complexity of understanding the relationship between gender disparities in health and income. It suggests that while there may be observable trends in certain aspects, such as COVID-19 cases and income gaps, these trends may not be directly linked, or other factors might be influencing the outcomes.

7 Limitation

Several limitations need to be acknowledged in our analysis. First, we used median salary data, which may not fully represent the entire income distribution and could overlook variations within gender groups. Additionally, population differences among cities can introduce biases, and the presence of outliers like Toronto in the scatter plot demonstrates the need for more in-depth investigations.

Another limitation is the use of salary data up to 2021 due to the unavailability of more recent data. This older data might not fully reflect the current relationship between gender and income. Future research with access to more recent and detailed data, as well as the inclusion of additional variables, could provide a more comprehensive understanding of the dynamics of gender disparities in Ontario.

References

Confirmed positive cases of covid-19 in ontario - data dictionary. Open Government Portal. URL https://open.canada.ca/data/en/dataset/f4112442-bdc8-45d2-be3c-12efae72fb27.

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