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ENHANCED EPIDEMIOLOGICAL SUMMARY

Neighbourhood COVID-19 Incidence and Vaccination Rates, October 17, 2021 to December 4, 2021

Published: January 14, 2022

Purpose

To describe the relationship between neighbourhood-level SARS-CoV-2 incidence and COVID-19 vaccination rates, and other associated factors. A neighbourhood was defined by the Forward Sortation Area of residence (FSA).

Highlights

- We observed variation in neighbourhood SARS-CoV-2 incidence and COVID-19 vaccination coverage from October 17, 2021 to December 4, 2021.
- When comparing the highest incidence neighbourhoods to the lowest incidence neighbourhoods (Table 1, Figure 1), there was a 5.9-fold difference in SARS-CoV-2 infection, 7-fold difference in hospitalization, and 6.6-fold difference in mortality during this time period.
- From October 17, 2021 to December 4, 2021, weekly SARS-CoV-2 neighbourhoods with highest vaccination coverage had the lowest SARS-CoV-2 incidence (Figure 2 and Figure 3).
- Across neighbourhoods, for every 10% increase in vaccination coverage, there was a 32% decrease in the neighbourhood risk of SARS-CoV-2 incidence (Table 2), 57% decrease in SARS-CoV-2 the neighbourhood risk of hospitalizations, and a 65% decrease in the neighbourhood risk of mortality.

Data Sources

- SARS-CoV-2 infection data were based on information successfully extracted from the Public Health Case and Contact Management Solution (CCM) for all public health units (PHU) by PHO as of December 13, 2021.
- COVID-19 vaccination data were based on information successfully extracted from the Ontario Ministry of Heath's COVaxON application as of December 6, 2021.
- Population size by FSA were extracted from the Ontario Health Insurance Plan (OHIP) Registered Persons Database (RPDB) as of December 7, 2021.
- Census 2016 data were used for percentage of non-permanent residents and neighbourhood socio-demographic characteristics from aggregate dissemination area levels mapped to FSA.[2]

Methods

- COVID-19 vaccination coverage was calculated by applying weights for partially vaccinated (incomplete schedule, weight = 0.5) and fully vaccinated (completed schedule, weight = 1) divided by the total population for a given FSA. This differs from the vaccination coverage defined in the COVID-19 Vaccine Uptake and Program Impact in Ontario report. Individuals who have received more than two doses were also considered to be fully vaccinated.[3] These estimates are based on information captured in COVaxON on December 6, 2021, prior to the mass rollout of booster vaccinations.

- Case and vaccination records with missing or invalid FSA information were excluded.

- Because CCM captures COVID-19 information among non-residents, population denominators were adjusted to account for non-permanent residents in FSAs based on available Census information. Two FSAs with missing information for non-permanent residents were assumed to have zero non-permanent residents and were not adjusted.

- Four groups of incidence risk neighbourhoods were generated based on population-weighted quartiles of FSA-level incidence of SARS-CoV-2 infection captured in CCM. The groups were arranged from highest risk (1) to lowest risk (4). Weekly incidence of cases, hospitalizations, and mortality per 100,000 population were generated based on client information in CCM and RPDB population denominators. Vaccination coverage estimates and interquartile range (IQR) for each risk group were generated using the calculation described above and adjusted RPDB population denominators.

- To examine the relationship between SARS-CoV-2 incidence and COVID-19 vaccination at the FSA-level, risk ratios (RR) with 95% confidence intervals (95% CI) were calculated using a negative binomial regression model. For the outcome, the numerator was the count of SARS-CoV-2 cases from October 17, 2021 to December 4, 2021 in the FSA, while the denominator (considered as an offset) was the FSA population. The exposure of primary interest was the vaccination coverage from the week of October 17, 2021.

- Three models were employed to generate risk ratios:

    1. The unadjusted model that included just the FSA coverage variable to produce Ontario wide estimates.

    2. The health region model that added a categorical variable, corresponding to the six health regions, to the unadjusted model.

    3. The adjusted model that additionally adjusted for neighbourhood socio-demographic Census covariates (unsuitable housing, average dwelling size, and senior proportion) that were previously identified to be associated with SARS-CoV-2 incidence.[4]

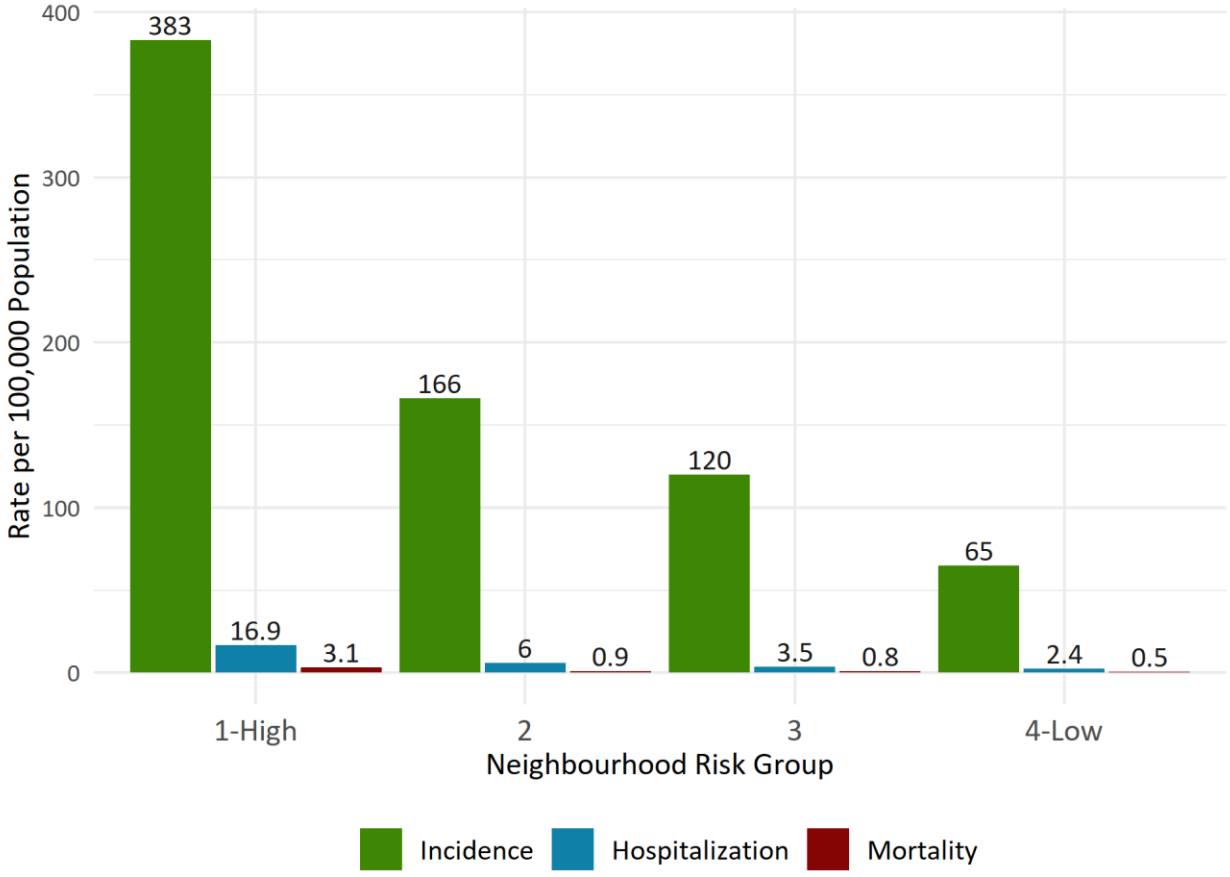
Results

Table 1: Demographic Characteristics and SARS-CoV-2 Incidence, Hospitalizations, Mortality, and Vaccination Coverage across Incidence Risk Neighbourhoods in Ontario, from October 17, 2021 to December 4, 2021

Characteristics	Risk Group 1 (High)	Risk Group 2	Risk Group 3	Risk Group 4 (Low)
Number of FSAs	145	124	106	134
Demographic Factors				
Average Dwelling Size	2.47	2.54	2.55	2.6
Senior (%)	18.6	17	16.2	17.3
Unsuitable Housing (%)	3.45	5.67	6.89	6.11
COVID-19 Measures				
Infection per 100,000 residents	383	166	120	65
Hospitalization per 100,000 residents	16.9	6.0	3.4	2.4
Mortality per 100,000 residents	3.15	0.94	0.84	0.48
Vaccination Coverage (%, [IQR])	71.1 (68.7-73.8)	72.4 (69.9-74.6)	72.8 (70.8-74.8)	72.9 (70.0-75.9)

IQR – interquartile range
Data Sources: CCM, COVaxON, RPDB, Census

Figure 1: SARS-CoV-2 Incidence, Hospitalizations, Mortality across Incidence Risk Neighbourhood Groups (1-High, 4-Low) from October 17, 2021 to December 4, 2021



Data Sources: CCM and RPDB

Table 2: Association Between Neighbourhood Vaccine Coverage and SARS-CoV-2 Incidence (n=482 FSAs) from October 17, 2021 to December 4, 2021

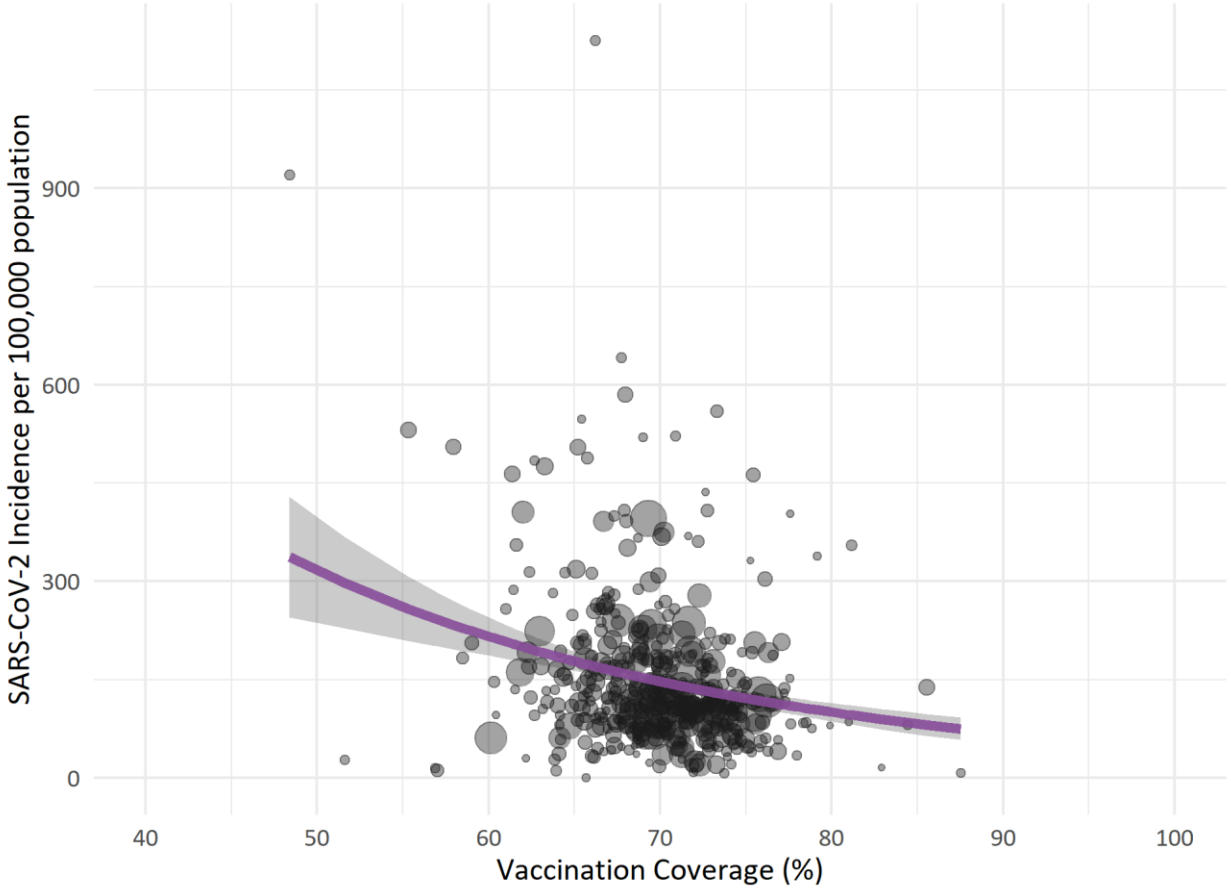
Model	Infection (RR [95% CI]*)	Hospitalization (RR [95% CI]*)	Mortality (RR [95% CI]*)
Ontario			
Vaccination Coverage (per 10% increase)	0.68 (0.60-0.77)	0.43 (0.35-0.52)	0.35 (0.24-0.49)
Health Region**			
Vaccination Coverage (per 10% increase)	0.74 (0.63-0.79)	0.43 (0.36-0.53)	0.35 (0.24-0.49)
Adjusted†			
Vaccination Coverage (per 10% increase)	0.69 (0.61-0.77)	0.42 (0.34-0.52)	0.33 (0.23-0.48)
% Average Dwelling Size (per 1% increase)	1.00 (0.98-1.01)	0.99 (0.97-1.02)	0.98 (0.94-1.03)
% Senior (per 1% increase)	1.00 (0.99-1.00)	1.00 (1.00-1.01)	1.00 (0.99-1.01)
% Unsuitable Housing (per 1% increase)	1.00 (0.99-1.01)	1.00 (0.99-1.00)	0.99 (0.99-1.00)

* RR – risk ratio. CI – confidence intervals.

** Adjusted for six health regions – Toronto, Central East, Central West, Eastern, Northern, and South West.

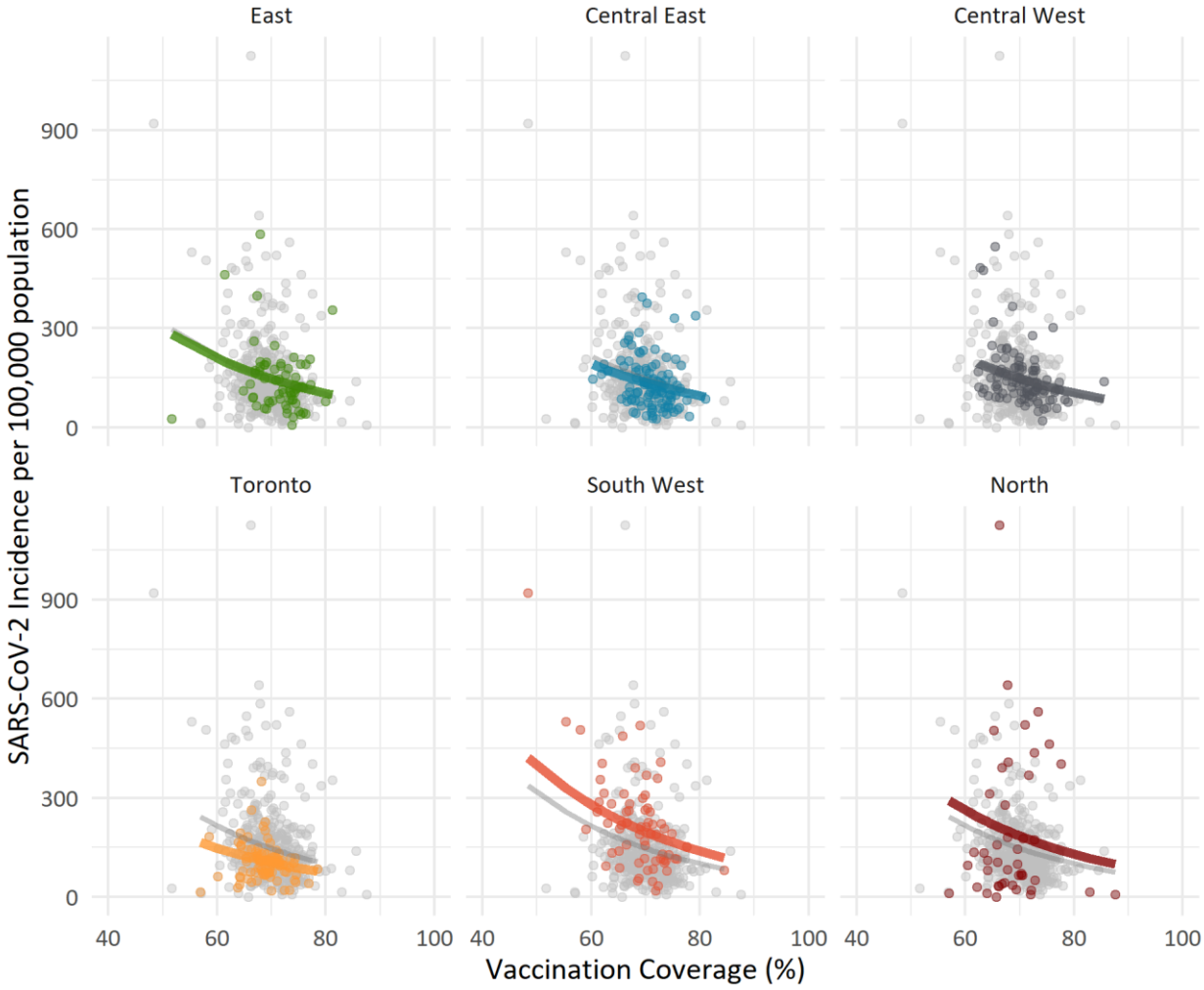
† Adjusted for health region and the following Census covariates: 1) unsuitable housing (whether there are enough bedrooms for the size and composition of the household), 2) average dwelling size (total area of living quarters), and 3) senior (proportion aged over 65 years). None of the Census covariates were significantly associated with neighbourhood level incidence.

Figure 2: Cumulative FSA level SARS-CoV-2 Infection Incidence per 100,000 from October 17, 2021 to December 4, 2021, and the Association with FSA level Vaccination Coverage in Ontario



Note: The size of points is proportional to population of individual FSAs. The blue line represents model fit for Ontario-wide relationship between SARS-CoV-2 incidence and vaccination coverage. The shaded region represents the 95% confidence intervals for the model fit.
Data Sources: CCM, COVaxON, and RPDB

Figure 3: Cumulative FSA level SARS-CoV-2 Infection Incidence per 100,000 Between October 17, 2021 and December 4, 2021, and the Association with FSA level Vaccination Coverage by Health Region in Ontario



Note: The grey points represent all FSAs in Ontario while coloured points represent FSAs in each health region. The grey line represents model fit for the Ontario-wide relationship between SARS-CoV-2 incidence and vaccination coverage. Coloured lines represent model fit for the health region-level relationship between SARS-CoV-2 incidence and vaccination coverage.
Data Sources: CCM, COVaxON, and RPDB

Technical Notes/Limitations

- The PHUs were categorized into regions as follows:
    - Toronto: Toronto Public Health
    - Central East: Durham Region Health Department, Haliburton, Kawartha, Pine Ridge District Health Unit, Peel Public Health, Peterborough Public Health, Simcoe Muskoka District Health Unit, and York Region Public Health
    - Central West: Brant County Health Unit, City of Hamilton Public Health Services, Haldimand-Norfolk Health Unit, Halton Region Public Health, Niagara Region Public Health, Region of Waterloo Public Health and Emergency Services, and Wellington-Dufferin-Guelph Public Health
    - Eastern: Ottawa Public Health, Eastern Ontario Health Unit, Hastings Prince Edward Public Health, Kingston, Frontenac and Lennox & Addington Public Health, Leeds, Grenville & Lanark District Health Unit, and Renfrew County and District Health Unit
    - Northern (North West and North East merged): Northwestern Health Unit, Thunder Bay District Health Unit, Algoma Public Health, North Bay Parry Sound District Health Unit, Porcupine Health Unit, Public Health Sudbury & Districts, and Timiskaming Health Unit
    - South West: Chatham-Kent Public Health, Grey Bruce Health Unit, Huron Perth Public Health, Lambton Public Health, Middlesex-London Health Unit, Southwestern Public Health, and Windsor-Essex County Health Unit
- CCM is a dynamic disease reporting system, which allows ongoing updates to data previously entered. As a result, data extracted from CCM represent a snapshot at the time of extraction and may differ from previous or subsequent reports.
- The data only represent cases reported to public health units and recorded in CCM. As a result, all counts will be subject to varying degrees of underreporting due to a variety of factors, such as disease awareness and medical care seeking behaviours, which may depend on severity of illness, clinical practice, changes in laboratory testing, and reporting behaviours.
- Population estimates from RPDB contain information on persons registered under the Ontario Health Insurance Plan (OHIP) and who are eligible for the Ontario Drug Program.
    - Chung H, Fung K, Ishiguro L, Paterson M, et al. Characteristics of COVID-19 diagnostic test recipients, Applied Health Research Questions (AHRQ) # 2021 0950 080 000. Toronto: Institute for Clinical Evaluative Sciences; 2020.[1]
    - This work is supported by the Applied Health Research Questions (AHRQ) Portfolio at ICES, which is funded by the Ontario Ministry of Health. For more information on AHRQ and how to submit a request, please visit www.ices.on.ca/DAS/AHRQ. This work is also supported by the Ontario Health Data Platform (OHDP), a Province of Ontario initiative to support Ontario's ongoing response to COVID-19 and its related impacts. Parts of this material are based on data and information compiled and provided by Ontario Ministry of Health. The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of ICES, the OHDP or the funding or data sources; no endorsement is intended or should be inferred.

- Immunity acquired from infection was not accounted for in this analysis.
- FSAs with populations of less than 5000 persons (n=27) were excluded due to unstable vaccination coverage estimates that may be driven by recent population changes.

References

1. Chung H, Fung K, Ishiguro L, Paterson M, Bronskill S, Kwong J, et al. Characteristics of COVID-19 diagnostic test recipients, Applied Health Research Questions (AHRQ) # 2021 0950 080 000. Toronto, ON: Institute for Clinical Evaluative Sciences; 2020.

2. Statistics Canada. Dictionary, census of population, 2016 [Internet]. Ottawa, ON: Statistics Canada; 2017 [modified 2019 Jan 3; cited 2021 Nov 10]. Available from: https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/az1-eng.cfm?topic=az1

3. Ontario. Ministry of Health. COVID-19 vaccine third dose recommendations: version 3.0 [Internet]. Toronto, ON: Queen's Printer Ontario; 2021 [cited 2021 Nov 11]. Available from: https://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/vaccine/COVID-19_vaccine_third_dose_recommendations.pdf

4. Van Ingen T, Akingbola S, Brown KA, Daneman N, Buchan SA, Smith BT. Neighbourhood-level risk factors of COVID-19 incidence and mortality. medRxiv 21250618 [Preprint]. 2021 Jan 31 [cited 2022 Jan 7]. Available from: https://doi.org/10.1101/2021.01.27.21250618

Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Neighbourhood COVID-19 incidence and vaccination rates, October 17, 2021 to December 4, 2021. Toronto, ON: Queen's Printer for Ontario; 2022.

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