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Sex-specific differences in COVID-19 testing, cases and outcomes: a population-wide study in Ontario, Canada

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Introduction

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) emerged in Wuhan,
China in late 2019 and spread globally resulting in the COVID-19 pandemic.[1] During the two
previous coronavirus epidemics, Severe Acute Respiratory Syndrome (SARS) and Middle East
Respiratory Syndrome (MERS), male sex was associated with worse clinical outcomes.[2] Though
there is limited sex-disaggregated COVID-19 incidence and outcome data, reports from
epidemics in Italy and China indicate that men may also be more affected.[1,3] It is unclear whether
these findings may be skewed because of unreported sex-based differences in SARS-CoV-2
testing and the age distributions of study populations.[4]

Methods

This population-wide cohort study included all residents of Ontario, Canada who received a
nasopharyngeal swab for SARS-CoV-2 between January 23, 2020 (date swab was performed for
first reported case of COVID-19 in Canada) and April 28, 2020. We excluded individuals with
unknown sex. Ontario is Canada's most populous province and is home to nearly 15 million
residents who receive universal access to medically necessary services including laboratory
testing for SARS-CoV-2 under a publicly funded provincial health insurance program. We
obtained data for this study from the Ontario Ministry of Health as part of the province's
emergency "modeling table", including deidentified line level data on all SARS-CoV-2 testing
via the Ontario Laboratories Information System (OLIS) and from the integrated Public Health
Information System (iPHIS) for all reported COVID-19 cases and related clinical outcomes.

We reported sex- and age-disaggregated data on SARS-CoV-2 testing, COVID-19 cases and related rates of hospitalization, intensive care unit (ICU) admission and death. We used census data from Statistics Canada to compare sex-based testing by age with the sex and age distribution of the Ontario population. Among laboratory confirmed COVID-19 cases, we used logistic regression to estimate sex-based odds ratios for hospitalization, ICU admission and death, adjusting for 10-year age intervals, with the level of statistical significance set at $\alpha = .05$. All analyses were performed using SAS statistical software, version 9.4 (SAS Institute Inc.). The study was approved by the Research Ethics Board of the University of Toronto.

Results

A total of 194,372 unique Ontario residents (122,205 women [62.9%] vs. 72,167 men [37.1%]) received testing for SARS-CoV-2 between January 23, 2020 and April 28, 2020 (Table 1). There were 141 individuals excluded because of unknown sex. With the exception of two age groups (ages 0-9 years and 70-79 years), men received less testing for SARS-CoV-2 than would be expected for their age-based representation in the Ontario population (Table 1).

Compared to women, men had a higher rate of laboratory-confirmed COVID-19 infection (6,546 men [9.1%] vs. 9,041 women [7.4%]), a finding consistent across all age groups (Table 1). Among all individuals with COVID-19 infection, men had higher rates of hospitalization (998 men [15.3%] vs. 798 women [8.9%]), ICU admission (294 men [4.5%] vs. 154 women [1.7%]), and death (477 men [7.3%] vs. 509 women [5.6%]) (Table 2). In age-adjusted analyses, male sex

was associated with a higher odds of hospitalization (adjusted odds ratio [aOR], 1.82, 95%

confidence interval [CI], 1.64-2.01, P<0.001), ICU admission (aOR, 2.39, 95% CI, 1.96-2.92,

P<0.001), and death (aOR, 1.75, 95% CI, 1.52-2.01, P<0.001) (Table 2).

Discussion

We found that while more women than men were tested for SARS-CoV-2, men had a

higher rate of laboratory-confirmed COVID-19 infection, hospitalization, ICU admission and

death. These findings were consistent even with age adjustment, suggesting that the observed

differences in outcomes between women and men were not explained by age or systematic

differences in testing by sex. Instead, they may be due to sex-based immunological or other

gendered differences, such as higher rates of smoking leading to cardiovascular disease.[5]

The study is limited to a single region and could not control for underlying differences in

sociodemographic characteristics and comorbidities between women and men. We also could not

identify healthcare workers—the majority of whom are women—which could explain some of

the sex-based differences in SARS-CoV-2 testing. With the majority of regional health systems

failing to report fully sex-disaggregated data on COVID-19, our study highlights how sex-

specific reporting can guide a more gender-responsive approach to the global pandemic.[2,5] In

particular, our findings can inform pathways for COVID-19 care, including targeting older men

as a particularly at risk group who may benefit from intensified prevention and earlier

intervention.[2]

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Table 1: Sex- and age-disaggregated SARS-CoV-2 testing and positivity in Ontario, Canada (January 23-April 28, 2020)

Age (years)	SARS-CoV-2 Testing (n = 194,372)		Percentage of men in Ontario (2019)*	Test Positivity (n = 15,587)	
	Women	Men		Women	Men
All ages, n (%)	122,202 (62.9%)	72,167 (37.1%)	49.4%	9,041 (7.4%)	6,546 (9.1%)
0-9, n (%)	1,895 (45.2%)	2,298 (54.8%)	51.1%	41 (2.2%)	53 (2.3%)
10-19, n (%)	2,257 (56.5%)	1,741 (43.5%)	51.1%	146 (6.5%)	122 (7.0%)
20-29, n (%)	14,682 (66.0%)	7,554 (34.0%)	51.9%	998 (6.8%)	727 (9.6%)
30-39, n (%)	19,432 (65.4%)	10,277 (34.6%)	49.9%	1,048 (5.4%)	798 (7.8%)
40-49, n (%)	19,820 (68.2%)	9,244 (31.8%)	48.7%	1,213 (6.1%)	885 (9.6%)
50-59, n (%)	21,175 (65.2%)	11,307 (34.8%)	49.6%	1,513 (7.1%)	1,094 (9.7%)
60-69, n (%)	13,829 (56.9%)	10,479 (43.1%)	48.3%	1,034 (7.5%)	1,003 (9.6%)
70-79, n (%)	9,037 (51.4%)	8,555 (48.6%)	46.6%	699 (7.7%)	724 (8.5%)
≥80, n (%)	20,078 (65.2%)	10,712 (34.8%)	40.0%	2,349 (11.7%)	1,140 (10.6%)

*Census-data from Statistics Canada (Statistics Canada. Table 17-10-0005-01 Population estimates on July 1st, by age and sex. https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1710000501).

Table 2: Sex- and age-disaggregated COVID-19 clinical outcomes in Ontario, Canada (January 23-April 28, 2020)

	Women	Men	aOR (95% CI) Men vs. Women	P-Value
All ages	n = 9,041	n = 6,546		
Hospitalization	798 (8.9%)	998 (15.3%)	1.82 (1.64-2.01)	<0.001
ICU admission	154 (1.7%)	294 (4.5%)	2.39 (1.96-2.92)	<0.001
Death	509 (5.6%)	477 (7.3%)	1.75 (1.52-2.01)	<0.001
Age 0-59 years	n = 4,959	n = 3,679		
Hospitalization	251 (5.1%)	359 (9.8%)	2.09 (1.76-2.47)	<0.001
ICU admission	54 (1.1%)	122 (3.3%)	3.21 (2.32-4.44)	<0.001
Death	19 (0.4%)	33 (0.9%)	2.41 (1.37-4.24)	0.002
Age 60-79 years	n = 1,733	n = 1,727		
Hospitalization	181 (17.0%)	414 (24.0%)	1.54 (1.30-1.82)	<0.001
ICU admission	75 (4.3%)	152 (8.8%)	2.13 (1.60-2.83)	<0.001
Death	97 (5.6%)	166 (9.6%)	1.79 (1.37-2.32)	<0.001
Age ≥80 years	n = 2,349	n = 1,140		
Hospitalization	253 (10.8%)	225 (19.7%)	1.89 (1.55-2.30)	<0.001
ICU admission	25 (1.1%)	20 (1.8%)	1.39 (0.76-2.52)	0.28
Death	393 (16.7%)	278 (24.4%)	1.68 (1.41-2.00)	<0.001

aOR = adjusted odds ratio; CI = confidence interval; ICU = intensive care unit