

1 **Extended abstract from IGM webinar May 6, 2021**
Gender differences in COVID-19 pandemic around the world

The epidemiology of COVID-19: a focus on sex, gender and age

Jennifer M. Akerman¹, Paula A. Rochon^{1,2}

¹Women's College Research Institute, Women's College Hospital, Toronto, Canada; ²Department of Medicine and Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada; RTOERO Chair, Geriatric Medicine, University of Toronto, Toronto, Canada

As of June 2020, internationally reported data on COVID-19 shows there have been more than 173 million COVID-19 cases and close to 3.8 million deaths worldwide.¹ Often missing from these statistics are the demographics of who has COVID-19 infections; what is their sex, gender and age? Both sex (biological) and gender (socio-cultural) variables are critical for understanding the differential vulnerability, risk and outcomes of COVID-19. Further, sex and gender must be considered intersectionally with other key identity factors, such as age, to identify the differential impacts of COVID-19 for certain groups. These epidemiologic data must be collected and reported to inform effective and equitable interventions to improve COVID-19 outcomes. To illustrate this, we will draw upon COVID-19 data for older adults.

Sex, defined as male, female or intersex, refers to the biological attributes associated with physical features, chromosomes, hormones and reproductive anatomy.² Sex determines immunological and hormonal profiles that may be important in responding to infection.³ Early comparative research has shown a male bias in COVID-19 fatalities;⁴ a pathogenesis consistent with other viral infections, including severe acute respiratory (SARS) syndrome and Middle East respiratory syndrome.⁴ More recent data from the Government of Canada mirrors this pattern, with males experiencing higher fatality rates across all age groups (Table 1).⁵

The rate of confirmed COVID-19 deaths is also age dependent, with COVID-19 fatality increasing with

age.^{4,5} Notably, those 80 years and older accounted for 65.4% of all COVID-19 deaths, illustrating the disproportionate impact that COVID-19 has had on older adults. Yet, while the overall rate of COVID-19 deaths is higher in males than females among those 80 years and older (29.7% compared to 20.6%), the absolute number of cases in this age group is higher in females, with 9347 deaths compared to 7372 deaths in males.⁵ Research has shown that the prevalence of reported COVID-19 cases varies between males and females by Country and age group, with females having higher rates of acquiring COVID-19 in the younger and more advanced age groups.⁶ This suggests that social norms and cultural factors related to gender may influence risk of exposure and infection with SARS-CoV-2.

Gender, defined as the socially constructed roles, behaviours, expressions and identities that vary between sexes,² may influence disease prevalence between men and women in younger age groups in relation to cultural norms and gender roles that influence the risk of acquiring the virus, such as having an occupation in essential services. For example, women comprise the majority of personal care and health service support workers which places them at high risk of exposure to SARS-CoV-2.⁷ Individual risk-taking behaviours may also influence gender differences in rates of COVID-19 infection; men are more likely to engage in risky behaviours, such as smoking or drinking alcohol, which can predispose to chronic conditions later in life, negatively influencing COVID-19 outcomes.⁸ Higher numbers of

Table 1. Age and sex distribution of COVID-19 cases deceased in Canada as of June 4, 2021

Age group (years)	Number of deaths (%)	Male (% of cases)	Female (% of cases)
0-59	1380 (5.4%)	862 (0.15%)	518 (0.09%)
60-69	2317 (9.1%)	1478 (2.5%)	839 (1.6%)
70-79	5138 (20.1%)	3066 (10.5%)	2072 (7.0%)
80+	16,719 (65.4%)	7372 (29.7%)	9347 (20.6%)

Data table taken from ref 5. The table illustrates COVID-19 cases hospitalized, admitted to ICU, and deceased for which age and sex information were available.

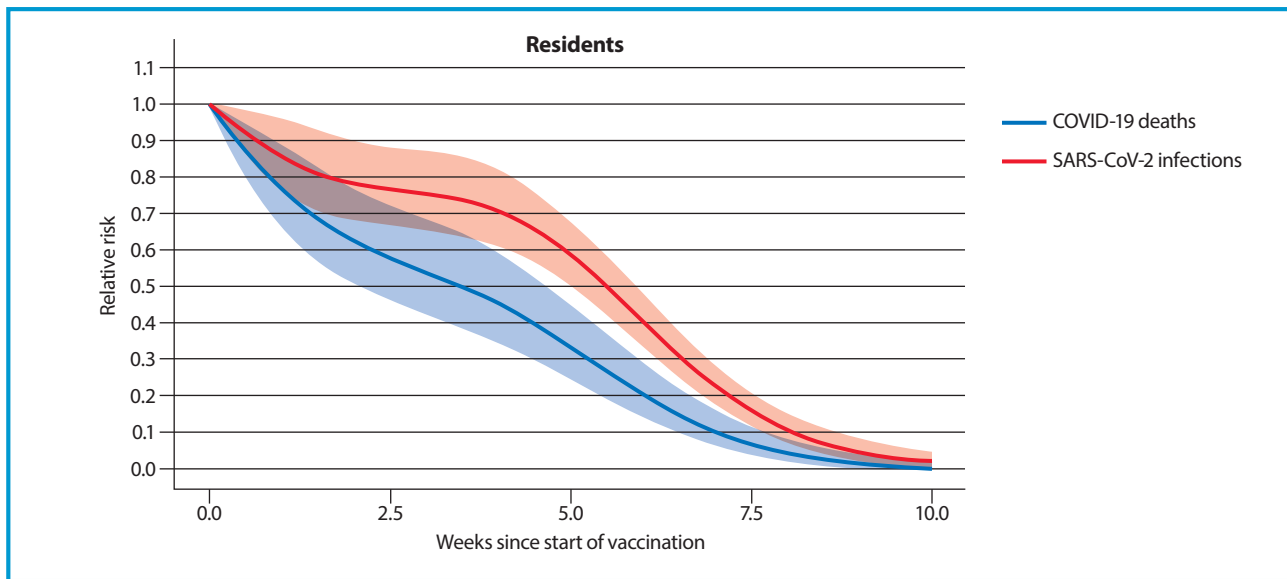


Figure 1. Relative risk of SARS-CoV-2 infections and COVID-19 deaths in long-term care residents in Ontario, Canada.¹² This line graph illustrates the relative risk of SARS-CoV-2 infections among long-term care residents as compared with statistical unvaccinated control populations. The estimated infections in statistical unvaccinated control populations were modelled based on fitted slopes of the epidemic curves of SARS-CoV-2 infections in long-term care residents compared to community-dwelling individuals aged ≥ 70 years.

confirmed cases among women in the oldest age group may be explained by their overrepresentation in long-term care (LTC) and nursing homes.⁶ Thus, while findings suggest biological sex contributes to male-biased death due to COVID-19, with older adults at highest risk of fatality, disaggregating data by sex and age make visible important patterns of difference between men and women that require consideration of gender-related sociocultural influences.

It is important to consider operationalizing an intersectional sex- and gender-based analysis (SGBA+) lens when collecting epidemiologic data. As an analytical framework, SGBA+ provides a prism through which to examine the effects of COVID-19 between and within groups of men, women and gender diverse people by systematically evaluating differences associated with sex and gender, and their interaction with other critical factors, such as age, race, socioeconomic status, and geography.⁹ SGBA+ also involves the consideration of structures of power and how systems of privilege and oppression shape a person's lived experience of health and illness. The importance of an intersectional approach is illustrated in the distribution of COVID-19 risk in LTC: a crisis at the intersection of sex, gender, age and setting of care, with older women living in LTC at highest risk of death.

LTC was the epicenter of the COVID-19 pandemic in Canada in 2020. More than half of Canada's LTC residents are 85 years or older, and more than 70% are women.¹⁰ While Canada's overall COVID-19 mortality rate is low, Canada had the highest proportion of CO-

VID-19- related deaths occurring in LTC of 16 OECD Countries as of May 25th, 2020.¹¹ Despite only about 7% of Canada's population living in LTC, retirement homes or other congregate care settings, earlier in the pandemic they accounted for 81% of all COVID-19 deaths.¹¹ This is one of the greatest tragedies of the pandemic.

Due to their high risk of poor outcomes following COVID-19, older adults in LTC were the first group prioritized to receive COVID-19 vaccinations in Ontario, Canada's largest province. Figure 1 illustrates the effectiveness of Ontario's vaccination strategy efforts tailored to older adults to reduce the relative risk of COVID-19 infections and deaths. Within 8 weeks of starting vaccination in the province of Ontario, 92% of residents were vaccinated, leading to an 89% relative reduction in the risk of SARS-CoV2 infections, and a 96% risk reduction of COVID-19 deaths.¹²

Despite older adults being among those most at risk for COVID-19 deaths globally, data on older people and LTC are difficult to find. As identified by Rochon and colleagues, only three of the ten Countries with the most COVID-19 cases in April 2020 reported their cases and deaths disaggregated by sex and age.⁶ Not one of those three Countries did this for LTC homes. The availability and comparability of Country-specific, sex-disaggregated data on COVID-19 cases and deaths for older adults is highly variable due to the lack of international reporting standards. As a result, older women, the majority of older adults and LTC residents have remained largely invisible in internationally reported

data despite this group accounting for the most deaths from COVID-19.

COVID-19 has made visible inequities in our health systems and societies. Identifying these inequities requires collecting and reporting epidemiologic data by sex, gender and age, and considering their intersections to allow patterns to emerge that are important for understanding the biological and social circumstances that contribute to COVID-19 vulnerability, risk and outcomes.⁶ Operationalizing an intersectional SGBA+ lens in health research is critical for identifying disproportionate impacts of pandemics, as illustrated by disproportionate burden of COVID-19 on older adults. To support continued investigation of exposure and vulnerability of COVID-19, we encourage researchers across the health sector internationally to commit to including, at a minimum, sex, gender and age data in their COVID-19 research.

Keywords. COVID-19, epidemiology, sex, gender, age.

References

1. World Health Organization [Internet]. COVID-19 dashboard. Geneva: WHO; c. 2020 [cited 6 May 2021]. Available from: <https://covid19.who.int/>
2. Canadian Institutes of Health Research [Internet]. How to integrate sex and gender into research. Ottawa: The Government of Canada; c2019 [cited 2021 Jun 1]. Available from: <https://cihr-irsc.gc.ca/e/50836.html>
3. World Health Organization [Internet]. Addressing sex and gender in epidemic-prone infectious diseases. Geneva: WHO; c.2007 [cited 1 Jun 2021]. Available from: <https://www.who.int/csr/resources/publications/SexGenderInfectDis.pdf>
4. Scully EP, Haverfield J, Ursin RL, Tannenbaum C, Klein S. Considering how biological sex impacts immune responses and COVID-19 outcomes. *Nat Rev Immunol*. 2020;20:442-7.
5. Government of Canada [Internet]. COVID-19 daily epidemiology update. c2020- [cited 30 April 2021]. Available from: https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html?stat=num&measure=total_last7&map=pt#a2
6. Rochon PA, Wu W, Giannakeas V, Stall NM. The missing pieces of the COVID-19 puzzle. *JAGS*. 2020;68:1671-3.
7. Tadri C, Gisinger T, Kautzky-Willer A, Kublickiene K, Herrero MT, Raparelli V, et al. The influence of sex and gender domains on COVID-19 cases and mortality. *CMAJ*. 2020;192(36):E1041-E1045.
8. Mauvais-Jarvis F, Merz NB, Barnes PJ, Brinton RD, Carrero J, DeMeo DL, et al. Sex and gender: modifiers of health, disease, and medicine. *Lancet*. 2020;396:565-82.
9. Hankivsky O, Kapilashrami A. Beyond sex and gender analysis: an intersectional view of the COVID-19 pandemic outbreak and response. University of Melbourne [Internet]; 2020 [cited 1 Jun 2021]. Available from: https://mspgh.unimelb.edu.au/_data/assets/pdf_file/0011/3334889/Policy-brief_v3.pdf
10. Statistics Canada [Internet]. 2016 census of population, type of collective dwelling, age and sex for the population in collective dwellings of Canada. Available from: <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/dt-dt/Rp-eng.cfm?TABID=2&Lang=E&APATH=3&DETAIL=0&DIM=0&FL=A&FREE=0&GC=0&GID=1234492&GK=0&GRP=1&PID=109537&PRID=10&PTYPE=109445&S=0&SHOWALL=0&SUB=0&Temporal=2016&THEME=116&VID=0&VNAMEE=&VNAMEF=&D1=0&D2=0&D3=0&D4=0&D5=0&D6=0>
11. Canadian Institute for Health Information [Internet]. Pandemic experience in the long-term care sector: how does Canada compare with other countries? Ottawa: CIHI; c.2020 [cited 1 Jun 2021]. Available from: <https://www.cihi.ca/sites/default/files/document/covid-19-rapid-response-long-term-care-snapshot-en.pdf>
12. Brown KA, Stall NM, Vanniyasingam T, Buchan SA, Daneman N, Hillmer MP, et al. Early impact of Ontario's COVID-19 vaccine rollout on long-term care home residents and health care workers. [Internet]. 2021 [cited 1 Jun 2021]. Available from: <https://doi.org/10.47326/ocsat.2021.02.13.1.0>

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Correspondence to:

Paula A. Rochon
Women's Age Lab
Women's College Research Institute
Women's College Hospital
76 Grenville street, Toronto
ON M5S 1B2, Canada
email: paula.rochon@wchospital.ca