COVID-19 Seroprevalence Report – August 19, 2020

Background

SARS-CoV-2 is a novel coronavirus first identified in Wuhan, Hubei province China in late 2019. It is responsible for a respiratory illness, coronavirus infection disease (COVID-19). Some people become extremely ill and can die from complications, while others experience mild symptoms or may not be aware of their infection at all. As of August 18th,2020 122,872 cases of COVID-19 have been reported in Canada, and 9,032 deaths. These statistics do not convey the true infection rate because some infections will not cause illness, others may not be severe enough for people to seek testing. Testing for SARS-CoV-2 antibodies is important to understand what proportion of the population have already been infected (the seroprevalence) and to monitor seroprevalence over the course of the pandemic. This information will improve mathematical models to predict the course of infection, inform public health policy and assist with evaluating the impacts the virus may have on the donor population and the blood system.

Blood donors are reasonably representative of healthy Canadians between the ages of 17 and about 60. There are people over 60 who donate blood, although there are fewer as age increases. There are blood collection sites in all large cities and many smaller urban centres in all provinces but people in rural areas may have less opportunity to donate. Blood donations are not collected in Yukon, the Northwest Territories or Nunavut. This report also does not include results from blood donations that were collected in Quebec. Hema-Quebec is conducting a separate study to determine the seroprevalence in donors in Quebec.

In partnership with the Canadian Immunity Task Force, Canadian Blood Services is testing samples left over from blood donations for SARS-CoV-2 antibodies. In this first report to the Canadian Immunity Task Force results from testing of blood donor samples collected between May 9 to June 18, 2020 are presented.

What did we do?

Blood samples

During every blood donation, several small tubes of blood are collected for infectious disease and other testing. An extra sample is taken, called the retention sample, in case extra testing is required. Only about 20% of these retention samples are needed for additional testing. For this seroprevalence study, plasma from the 80% of retention samples not needed for operational testing was aliquoted and frozen at -20°C or colder, starting on May 9, 2020.

SARS-CoV-2 antibody testing

All plasma samples were tested using a SARS-CoV-2 IgG assay (chemiluminescent microparticle immunoassay (CMIA)). Testing was conducted at Canadian Blood Services in Ottawa.

Data analysis

Because blood donors tend to live in areas close to a blood clinic there will be higher concentrations of donors in certain areas compared with the general population, and lower concentrations in other areas. In order to make inference to the general population, weighting factors were applied based on the donor's residential postal code [Forward Sortation Area], age group and sex. The seroprevalence was calculated as the number of positive samples divided by all samples tested. The weighted data were adjusted for sensitivity and specificity of the assay. Statistical comparisons between groups were carried out using logistic regression.

What did we find?

As shown in Table 1, of 37,737 samples tested slightly over half were from male donors and are from all age groups although there tend to be more from older age groups. Just over half of donations were from Ontario, the next highest numbers of donations were from Alberta and British Columbia. There were somewhat more donations tested from eastern Canada than Canadian Blood Services' usual collections because for logistic reasons samples from eastern Canada were stored starting about two weeks earlier than from the western provinces.

Table 2 shows the seroprevalence rates for all 9 provinces in which samples were tested and as a total value. The overall adjusted seroprevalence is 0.70%. The weighted percent positive was greater in females ($p<0.05$) but there were no significant differences between age groups (Figure 1).

Table 3 compares seroprevalence by province (See also Figure 2). The highest adjusted rate was in Ontario at 0.96% and the lowest in Newfoundland and Prince Edward Island. However, the numbers of samples in some provinces are small, hence wide confidence intervals. Using a logistic model with Ontario as the reference, Ontario was higher than British Columbia and Alberta ($p<0.01$).

Table 4 shows the seroprevalence in cities for which there was adequate sample size for a meaningful estimate. The percent positive in cities tended to correlate with the provincial estimate since the proportion of blood donations collected is greater in larger cities.

Table 1. Number and percentage Canadian Blood Services donor samples tested

	Number Tested	Percentage
Sex		
Female	17,694	46.89
Male	20,043	53.11
Age		
17-24	3,581	9.49
25-39	10,781	28.57
40-59	14,147	37.49
60+	9,228	24.45
Province		
British Columbia	4,962	13.15
Alberta	5,644	14.96
Saskatchewan	1,387	3.68
Manitoba	1,753	4.65
Ontario	19,839	52.57
New Brunswick	1,477	3.91
Nova Scotia	1,610	4.27
Prince Edward Island	448	1.19
Newfoundland	617	1.64
Total	**37,737**	

Table 2. SARS-CoV-2 Seroprevalence by Sex and Age

	Unadjusted				Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Percent Positive	95% Confidence Interval
Sex						
Female	17,694	144	0.81	0.687, 0.957	0.81	0.667, 0.946
Male	20,043	131	0.65	0.547, 0.775	0.58	0.456, 0.705
Age						
17-24	3,581	30	0.84	0.566, 1.194	0.62	0.367, 0.873
25-39	10,781	76	0.70	0.556, 0.882	0.66	0.479, 0.849
40-59	14,147	103	0.73	0.595, 0.882	0.74	0.580, 0.906
60+	9,228	66	0.72	0.554, 0.909	0.70	0.524, 0.878
Total	**37,737**	**275**	**0.73**	**0.645, 0.820**	**0.70**	**0.603, 0.790**

Note: The adjusted estimate weighted data to the general population age, sex and location and adjusted for sensitivity and specificity of the assay

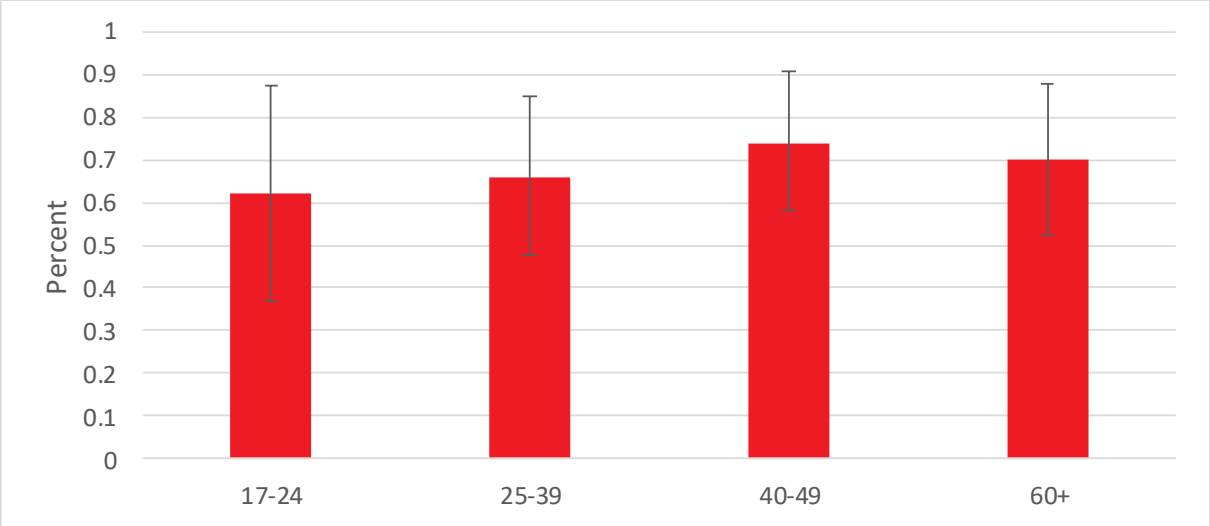

Figure 1. SARS-CoV-2 seroprevalence by age groups

Table 3. SARS-CoV-2 seroprevalence by province

	Unweighted				Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Percent Positive	95% Confidence Interval
British Columbia	4,962	29	0.58	0.392, 0.838	0.50	0.304, 0.694
Alberta	5,644	24	0.43	0.273, 0.632	0.37	0.182, 0.552
Saskatchewan	1,387	10	0.72	0.346, 1.322	0.46	0.067, 0.846
Manitoba	1,753	9	0.51	0.235, 0.972	0.56	0.160, 0.970
Ontario	19,839	189	0.95	0.822, 1.098	0.96	0.810, 1.113
New Brunswick	1,477	6	0.41	0.149, 0.882	0.26	0.000, 0.657
Nova Scotia	1,610	7	0.43	0.175, 0.894	0.36	0.000, 0.769
Prince Edward Island	448	0				
Newfoundland and Labrador	617	1	0.16	0.004, 0.900	0.29	0.000, 0.771
Total	**37,737**	**275**	**0.73**	**0.645, 0.820**	**0.70**	**0.603, 0.790**

Note: The adjusted estimate weighted data to the general population age, sex and location and adjusted for sensitivity and specificity of the assay

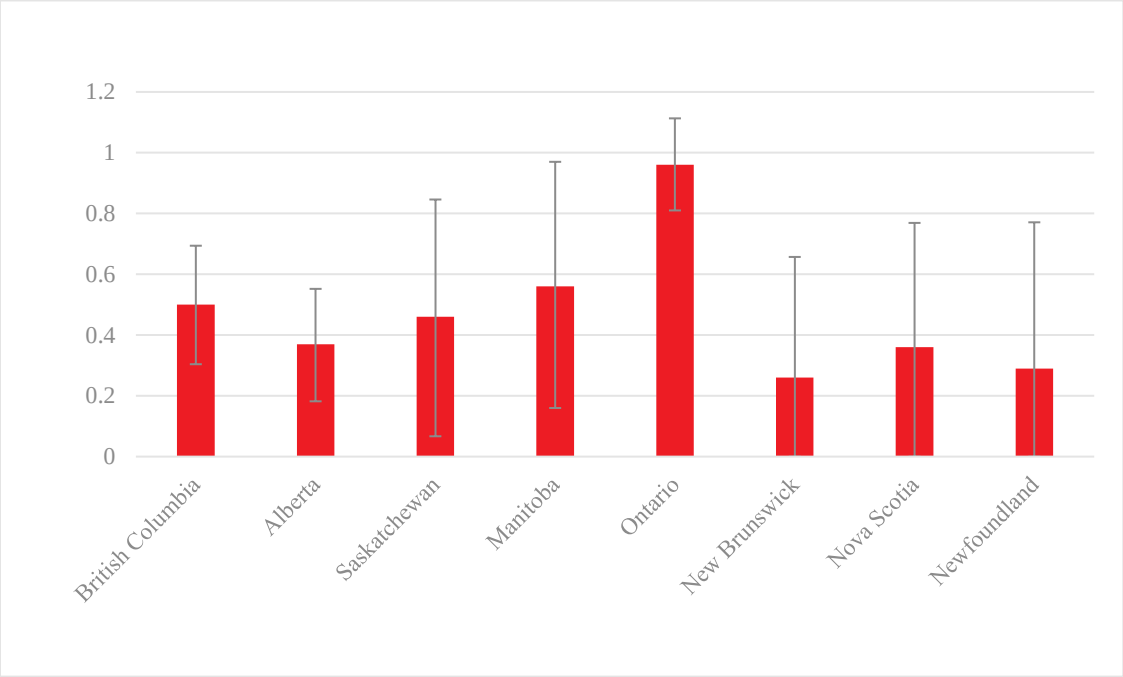

Figure 2. SARS-CoV-2 seroprevalence by province

Table 4. SARS-CoV-2 seroprevalence in selected cities

	Unweighted				Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Percent Positive	95% Confidence Interval
Vancouver	2,873	20	0.70	0.426, 1.073	0.60	0.328, 0.865
Calgary	2,069	10	0.48	0.232, 0.887	0.43	0.089, 0.772
Edmonton	2,043	8	0.39	0.169, 0.770	0.38	0.057, 0.704
Ottawa	1,975	18	0.91	0.541, 1.437	1.29	0.735, 1.836
Toronto	6,597	71	1.08	0.841, 1.356	1.07	0.827, 1.304

Note: Cities were selected on the basis of having sufficient sample size

Conclusion

The seroprevalence of SARS-CoV-2 was low in Canadian Blood Services donors during May 9 to June 18, 2020 (less than 1%). It was slightly higher in Ontario compared with other provinces. There was slightly higher seroprevalence among females compared with males, but no difference between age groups. While the donation selection criteria ensure blood donors are healthy, caution should be exercised in extrapolating findings to all healthy adult Canadians because blood donors self-select to be blood donors, because in some areas access to a donation clinic may be limited and because there are fewer elderly donors.

Technical issues

1. Blood donors are a healthy sub-set of the adult Canadian population. Important points to keep in mind with regard to representativeness of the sample are:
   - blood donors self-select to donate blood therefore those who choose not to donate blood for whatever reason are not included in the sample.
   - Blood donations are collected from people aged 17 years and older, however there are relatively few donations from elderly donors.
   - Blood donations are collected in larger cities and many smaller urban areas, but people in rural areas may be under-represented. Canadian Blood Services does not collect blood in the northern territories or the province of Quebec.
2. Data were weighted for age, sex and location to more closely reflect the Canadian population. However, weighting of the data had only a modest impact on the seroprevalence estimate. For example, the unweighted seroprevalence for the full sample was 0.73%, and after weighting factors applied it was 0.75%, then after the weighted seroprevalence was adjusted for sensitivity and specificity, 0.70%.
3. Test kits for the SARS-CoV-2 IgG assay (chemiluminescent microparticle immunoassay (CMIA), Abbott Laboratories) were provided by the Government of Canada. The sensitivity and specificity of the assay were obtained from a report from the United Kingdom [92.7% (90.2-94.8%) sensitivity and 99.9% (99.4 – 100%) specificity (1)]. The manufacturer indicates higher sensitivity and a second more recently released report form Denmark

indicates it may be slightly lower. Results were adjusted using the Rogan-Gladen equation (2).

4. The sensitivity and specificity of the assay are very good, but it is still possible that some true positives may be missed, and some positive results may be false. Confirmatory testing has not been performed. The seroprevalence was adjusted for sensitivity and specificity using a well-established mathematical formula. The assay used by Canadian Blood Services detects IgG antibodies to the SARS-CoV-2 nucleocapsid protein. IgG develops during infection but may not be present early in the course of infection. Donors are deferred if they have recent COVID-19 infection, but asymptomatic early stage infections may not be detected. In some rare cases, donors may have variable antibody responses to different binding sites on the SARS-CoV-2 virus (e.g. Spike, receptor binding domain of Spike, nucleocapsid protein).

5. The adjusted percent positive was statistically higher in females compared with males, but a spurious finding cannot be ruled out with a single sample.

6. Before each donation blood donors must answer screening questions to ensure that they are in good health and do not have risk factors for infections that may be transmitted to blood recipients. There is no evidence that SARS-CoV-2 can be transmitted through blood transfusion, but it is important to ensure other donors and staff are safe while in the blood clinic. Donors are asked if they have had COVID-19 or been in contact with someone who has. They are deferred from donation for 2 weeks if they have been in contact with someone who was infected, and if they have had the infection deferral is for two weeks after symptoms disappear. Donors also have their temperature checked before they enter the clinic.

7. All donor data were de-identified. Donors were not informed of their results because confirmatory/supplemental testing was not carried out. This study was approved by the Canadian Blood Services Research Ethics committee.

8. Disclaimer: Canadian Blood Services is providing this report of the study results on an "as is" basis and makes no representations or warranties, express or implied, including with regards to the accuracy, reliability or validity of the information or its fitness for a particular purpose. The use of this report and/or any study results is the responsibility of the user. Canadian Blood Services assumes no liability resulting from any such use. This report may not be reproduced without permission from Canadian Blood Services.

1. The National SARS-CoV-2 Serologic Assay Evaluation Group. Head-to-head benchmark evaluation of the sensitivity and specificity of five immunoassays for SARS-CoV-2 serology on >1500 samples. Available at: https://doi.org/10.6084/m9.figshare.12593288.v1.

2. Lang Z, Reiczigel J. Confidence limits for prevalence of disease adjusted for estimated sensitivity and specificity. Preventive Veterinary Medicine. 2014:113;13-22.