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COVID-19 Seroprevalence Report

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August 25th, 2022

Report #24: July 2022 Survey

The advance of Omicron

Summary

July 2022

July 1 - July 31 2022 (n=31,275)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 100.00% (95% CI 100.00, 100.00%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September 2021, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February 2022 likely due to third vaccine dose administration. A slight increase in concentration in those over 60 was observed in May and June, consistent with a fourth dose, however this increase levelled off in July.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in July was 54.01% (95% CI 53.45, 54.56), higher than in June (50.7% (95% CI 50.15, 51.26)) $P < 0.0001$). There was a modest week-to-week change over July from 52.32% (95% CI 51.22, 53.42) to 52.70% (95% CI 51.62, 53.77) to 54.68% (95% CI 53.61, 55.74) to 56.51% (95% CI 55.35, 57.67).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (71.15% (95% CI 69.71, 72.59) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to June.
- Seroprevalence rates increased in July compared to June in all provinces except PEI, however the increase was only statistically significant in British Columbia, Ontario, New Brunswick and Newfoundland.
- Racialized groups have a higher seroprevalence rate (62.27% (95% CI 61.03, 63.51)) compared to white donors (52.01% (95% CI 51.37, 52.06)).

June 2022

June 1 - June 30 2022 (n=32,121)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 100.00% (95% CI 100.00, 100.00%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September 2021, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February 2022 likely due to third vaccine dose administration. An increase in concentration in those over 60 is observed in May and continued into June consistent with a fourth dose.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in June was 50.7% (95% CI 50.15, 51.26), higher than in May 2022 (46.32% (95% CI 45.77, 46.87) $P < 0.0001$). There was minimal week-to-week change over June from 50.47% (95% CI 49.32, 51.63) to 51.07% (95% CI 50.04, 52.10) to 50.26% (95% CI 49.25, 51.27) to 50.76% (95% CI 49.58, 51.94).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (66.29% (95% CI 64.81, 67.77) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to May.
- Seroprevalence rates increased in June compared to May in all provinces.
- Racialized groups have a higher seroprevalence rate (58.03% (95% CI 56.79, 59.27)) compared to white donors (49.01% (95% CI 48.38, 49.65)).

May 2022

May 1 - May 31 2022 (n=31,764)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 100.00% (95% CI 100.00, 100.00%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September 2021, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February 2022 likely due to third vaccine dose administration. An increase in concentration in those over 60 is observed in May.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in May 2022 was 46.32% (95% CI 45.77, 46.87), higher than April 2022 (36.71% (95% CI 36.16, 37.26), $P < 0.0001$). There was a gradual increase over May from 42.74% (95% CI 41.65, 43.84) to 46.11% (95% CI 45.00, 47.21) to 47.03% (95% CI 45.96, 48.10) to 48.96% (95% CI 47.87, 50.06) with the persistence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (64.47% (95% CI 62.96, 65.98) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to April.
- Seroprevalence rates increased in May compared to April in all provinces except PEI.
- Racialized groups have a higher seroprevalence rate (54.35% (95% CI 53.12, 55.58)) compared to white donors (44.31% (95% CI 43.67, 44.95)).
- Among repeat tested donors, new infections in unvaccinated donors have increased from June 2021 1.53% (95% CI 1.14, 2.00) to 9.12% (95% CI 8.24, 10.07) in January 2022 and 46.83% (95% CI 44.57, 49.10) in May 2022
- Potential breakthrough infections remained low from June 2021 to December 2021, but increased from 5.19% (95% CI 4.68, 5.74) in January 2022 to 31.02% (95% CI 30.17, 31.88) in May 2022.

April 2022

April 1 - April 30 2022 (n=29,787)

•**Humoral Immunity (Based on results from the Spike antibody assay):**

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 99.74% (95% CI 99.60, 99.88%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September 2021, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February 2022 likely due to third vaccine dose administration, but are now declining.

•**Natural Infections (Based on results from the Nucleocapsid antibody assay):**

- Seroprevalence (natural infection) in April 2022 was 36.71% (95% CI 36.16, 37.26), higher than March 2022 (28.70% (95% CI 28.15, 29.26), $P < 0.0001$). There was a gradual increase over April from 32.83% (95% CI 31.67, 33.98) to 35.54% (95% CI 34.47, 36.60) to 37.64% (95% CI 36.62, 38.65) to 40.04% (95% CI 38.90, 41.18) with the persistence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (55.37% (95% CI 53.76, 56.99) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to March.
- Seroprevalence rates increased in April compared to March in all provinces.
- Racialized groups have a higher seroprevalence rate (45.06% (95% CI 43.77, 46.34)) compared to white donors (34.78% (95% CI 34.15, 35.42)).
- Among repeat tested donors, new infections in unvaccinated donors have increased from June 2021 1.53% (95% CI 1.14, 2.00) to 9.12% (95% CI 8.24, 10.07) in January 2022 and 37.19% (95% CI 35.14, 39.28) in April 2022
- Potential breakthrough infections remained low from June 2021 to December 2021, but increased from 5.19% (95% CI 4.68, 5.74) in January 2022 to 21.99 (95% CI 21.19, 22.80) in April 2022.

March 2022

March 1 - March 31 2022 (n=26,026)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 99.57% (95% CI 99.42, 99.73%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February likely due to third vaccine dose administration, but were starting to decline in March.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in March 2022 was 28.70% (95% CI 28.15, 29.25), higher than February 2022 (23.68% (95% CI 23.18, 24.18)). ($P < 0.0001$). There was a gradual increase over the 31 day reporting period from 27.02% (95% CI 25.95, 28.09) to 27.54% (95% CI 26.47, 28.61) to 30.68% (95% CI 29.61, 31.75) to 29.52% (95% CI 28.34, 30.69) consistent with the persistence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (44.27% (95% CI 42.54, 46.01) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to February.
- Seroprevalence rates increased in March compared to February in all provinces with the exception of Prince Edward Island and Newfoundland and Labrador where sample sizes are smaller.
- Racialized groups have a higher seroprevalence rate (38.58% (95% CI 37.21, 39.95)) compared to white donors (26.27% (95% CI 25.65, 26.89)).
- Among repeat tested donors, new infections in unvaccinated donors have increased from June 1.53% (95% CI 1.14, 2.00) to 9.12% (95% CI 8.24, 10.07) in January and 29.49% (95% CI 27.57, 31.48) in March
- Potential breakthrough infections remained low from June to December, but increased from 5.19% (95% CI 4.68, 5.74) in January to 17.50 (95% CI 16.66, 18.37) in March.

February 2022

February 1 - February 28 2022 (n=28,616)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 99.60% (95% CI 99.45, 99.75%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by February likely due to third vaccine dose administration.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in February 2022 was 23.68% (95% CI 23.18, 24.18), higher than January 2022 (12.12% (95% CI 11.76, 12.48)). ($P < 0.0001$). There was a gradual increase over the 28 day reporting period from 21.39% (20.31, 22.48) to 23.43% (22.41, 24.45) to 23.68% (22.77, 24.58) to 25.25% (95% CI 24.30, 26.20) consistent with emergence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (36.27% (95% CI 34.68, 37.86%)) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to January.
- Seroprevalence rates increased in February compared to January in all provinces.
- Racialized groups have a higher seroprevalence rate (33.45% (95% CI 32.16, 34.73)) compared to white donors (21.17% (95% CI 20.62, 21.72%)).
- Among repeat tested donors, new infections in unvaccinated donors have increased from June 1.53% (1.14, 2.00) to 9.12% (95% CI 8.24, 10.07) in January, and more than doubled in February (23.71%, 95% CI 22.10, 25.37).
- Potential breakthrough infections remained low from June to December, but increased from 5.19% (95% CI 4.68, 5.74) in January to 15.56% (95% CI 14.72, 16.42) in February.

January 2022

January 1 - January 31 2022 (n=32,505)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 98.89% (95% CI 98.73, 99.06%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September, but gradually decreased. A peak in values followed by decline is expected after vaccination. Concentrations increased in all age groups by January likely due to third vaccine dose administration.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in January 2022 was 12.12% (95% CI 11.76, 12.48), higher than December 2021 at 6.39% (95% CI 6.01, 6.76) ($P < 0.001$). There was a gradual increase over the 31 day reporting period from 7.16% (6.62, 7.71) to 10.09% (9.46, 10.71) to 12.65% (11.84, 13.45) to 16.30% (95% CI 15.51, 17.09) consistent with emergence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (22.22% (95% CI 20.93, 23.51%)) compared to other age groups. However, the seroprevalence rate increased in all age groups compared to December.
- Seroprevalence rates increased in January compared to December in almost all provinces.
- Racialized groups have a higher seroprevalence rate (18.29% (95% CI 17.27, 19.32)) compared to white donors (10.73% (95% CI 10.34, 11.12%)).
- Among repeat tested donors, new infections in unvaccinated donors have increased from June 1.53% (1.14, 2.00) to 3.91% (3.11, 4.83%) in December and more than doubled in January to 9.012% (95% CI 8.24, 10.07).
- Potential breakthrough infections remained low from June to December, but increased from 0.74% (95% CI 0.48, 1.10) in December to 5.19% (95% CI 4.68, 5.74) in January.

December 2021

December 14 - December 30 2021 (n=16,816)

•**Humoral Immunity (Based on results from the Spike antibody assay):**

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 98.58% (95% CI 98.34, 98.82%) (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were high by September, but gradually decreased. A peak in values followed by decline is expected after vaccination. By December, concentrations increased in older age groups likely due to administration of third doses consistent with policies to vaccinate older age groups earlier.

•**Natural Infections (Based on results from the Nucleocapsid antibody assay):**

- Seroprevalence (natural infection) in December was 6.39% (95% CI 6.01, 6.76), higher than November at 5.08% (95% CI 4.58, 5.50) ($P < 0.001$). There was a gradual increase over the 17 day reporting period from 5.60% (5.03, 6.18) to 6.55% (5.95, 7.15) to 7.51% (6.63, 8.39) consistent with emergence of the Omicron variant.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (11.37% (95% CI 9.99, 12.75%)) compared to other age groups.
- Seroprevalence rates remained similar to November in most provinces, however, rates increased in December in Alberta (12.94% (95% CI 11.62, 14.27%), $P < 0.001$) and Ontario (5.43% (95% CI 4.94, 5.92%), $P < 0.001$) compared to November.
- Racialized groups have a higher seroprevalence rate (10.40% (95% CI 9.32, 11.48%)) compared to white donors (5.21% (95% CI 4.81, 5.61%)).
- Among repeat tested donors, new infections in unvaccinated donors have increased since June 1.53% (1.14, 2.00) to 3.91% (3.11, 4.83%) in December but vaccine breakthrough infections are low, 0.74% (0.48, 1.10%).

November 2021

November 13 - November 24 2021 (n=9,018)

•**Humoral Immunity (Based on results from the Spike antibody assay):**

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The (adjusted) proportion of blood donors with humoral immunity for SARS-CoV-2 was 98.52% (95% CI 98.18, 98.86%), slightly higher than October (based on results from the Spike antibody assay) ($P = 0.039$). This was predominantly driven by vaccination.
- Spike antibody concentrations were very high (>2500 U/mL) by July, but gradually decreasing in almost all age groups as the months progress with the greatest decrease in older age groups. A peak in values followed by decline is expected after vaccination. These results are consistent with policies to vaccinate older age groups earlier.

•**Natural Infections (Based on results from the Nucleocapsid antibody assay):**

- Seroprevalence (natural infection) in November was 5.08% (95% CI 4.58, 5.50), higher than October at 4.26% (95% CI 3.85, 4.68%) ($P = 0.014$).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (9.35% (95% CI 7.62, 11.07%)) compared to other age groups.
- Racialized groups have a higher seroprevalence rate (8.28% (95% CI 6.82, 9.74%)) compared to white donors (4.56% (95% CI 4.05, 5.07%)).
- Among repeat tested donors, new infections in unvaccinated donors have increased since June 1.53% (1.14, 2.00) to 3.19% (2.42, 4.13) in November but vaccine breakthrough infections are low, 0.6% (0.37, 0.93).

October 2021

October 14 - October 23 2021 (n=9,627)

•**Humoral Immunity (Based on results from the Spike antibody assay):**

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 98.01% (95% CI 97.65, 98.36%), slightly higher than September (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were very high (>2500 AU/mL) by July, but began to decrease in older individuals by September. In October values are still very high but gradually decreasing in all age groups. A peak in values followed by decline is expected after vaccination. These results are consistent with policies to vaccinate older age groups earlier.
- Similar to past reports, donors living in affluent neighbourhoods had higher seroprevalence rates, 99.25% (95% CI 98.72, 99.79%) compared to those living in the most materially deprived neighbourhoods, 97.13% (95% CI 95.64, 98.61%).
- Of 25,100 donors tested on 2 or more occasions since January 2021, the most common (55.2%) test profile was presumed unvaccinated to vaccinated (N negative S negative on their first tested donation and N negative S positive on their last tested donation). There were 15 presumed breakthrough infections (donors who were N negative S positive on their first tested donation and N positive S positive on their last tested donation).

•**Natural Infections (Based on results from the Nucleocapsid antibody assay):**

- Seroprevalence (natural infection) in October was 4.26% (95% CI 3.85, 4.68%) similar to September, 2021 at 4.38% (95% CI 3.96, 4.81%).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (7.50% (95% CI 5.98, 9.01%)) compared to other age groups.
- Racialized groups have a higher seroprevalence rate (6.18% (95% CI 4.92, 7.45%)) compared to white donors (3.85% (95% CI 3.40, 4.31%)).

September 2021

September 14 - September 24 2021 (n=9,363)

•**Humoral Immunity (Based on results from the Spike antibody assay):**

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 97.03% (95% CI 96.62, 97.44%), slightly higher than August (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Spike antibody concentrations were very high (>2500 AU/mL) by July, but are beginning to decrease in older individuals by September. A peak in values followed by decline is expected after vaccination. These results are consistent with policies to vaccinate older age groups earlier.
- Similar to past reports, donors living in affluent neighbourhoods had higher seroprevalence rates, 97.56% (95% CI 96.83, 98.28%) compared to those living in the most materially deprived neighbourhoods, 94.72% (95% CI 92.93, 96.51%).
- Of 21,727 donors tested on 2 or more occasions since January 2021, the most common (54.0%) test profile was presumed unvaccinated to vaccinated (N negative S negative on their first tested donation and N negative S positive on their last tested donation). There were 12 presumed breakthrough infections (donors who were N negative S positive on their first tested donation and N positive S positive on their last tested donation).

•**Natural Infections (Based on results from the Nucleocapsid antibody assay):**

- Seroprevalence (natural infection) in September was 4.38% (95% CI 3.96, 4.81%) similar to August, 2021 at 4.43% (95% CI 3.99, 4.86%).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (8.70% (95% CI 7.06, 10.34%) compared to other age groups. Rates in the 60+ age group increased significantly in September (2.78% (95% CI 2.13, 3.43%)) compared to August (1.61% (95% CI 1.09, 2.12%)) while other age groups did not change.
- Racialized groups have a higher seroprevalence rate (7.61% (95% CI 6.24, 8.97%)) compared to white donors (3.65% (95% CI 3.20, 4.10%)).

August 2021

August 15 - August 26 2021 (n=9,109)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 96.09% (95% CI 95.63, 96.54) slightly up from July (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Median spike antibody concentrations increased in July compared to previous months ($P < 0.001$) but increased even further in August ($P < 0.001$).
- Similar to past reports, donors living in affluent neighbourhoods had higher seroprevalence rates, 98.25% (95% CI 97.56, 98.95%) compared to those living in the most materially deprived neighbourhoods, 93.41% (95% CI 91.45, 95.37%).
- Of 17,762 donors tested on 2 or more occasions since January 2021, the most common (52.9%) test profile was presumed unvaccinated to vaccinated (N negative S negative on their first tested donation and N negative S positive on their last tested donation). There were 11 presumed breakthrough infections (donors who were N negative S positive on their first tested donation and N positive S positive on their last tested donation).

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in August was 4.43% (95% CI 3.99, 4.86%) similar to July, 2021 at 4.08% (95% CI 3.65, 4.51%).
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (8.44% (95% CI 6.80, 10.09%)) compared to other age groups. Rates in this age group were highest in Manitoba at 24.95% (95% CI 13.53, 36.37%).
- Racialized groups have a higher seroprevalence rate (11.14% (95% CI 9.14, 13.15%)) compared to white donors (3.30% (95% CI 2.86, 3.74%)). Natural infection rates in racialized donors also increased significantly compared to July. Compared to previous reports, the gap between those in materially deprived vs. affluent neighbourhoods has begun to widen likely due to the 4th wave, 7.85% (95% CI 5.87, 9.83%) vs 3.27% (95% CI 2.52, 4.02%).

July 2021

July 14 - July 23 2021 (n=8,457)

•Humoral Immunity (Based on results from the Spike antibody assay):

- Spike antibody results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Nucleocapsid and Spike antibody positive results together likely have been infected and may or may not have been vaccinated.
- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 94.69% (95% CI 94.16, 95.22) a significant increase from June (based on results from the Spike antibody assay). This was predominantly driven by vaccination.
- Median Spike antibody concentrations increased in June compared to previous months ($P < 0.001$) but increased more in July ($P < 0.001$).
- The seroprevalence of white donors (95.04% (95% CI 94.44, 95.64%)) was not different from racialized groups (93.82% (95% CI 92.48, 95.15%)), this gap has closed compared to earlier surveys. Similar to past reports, donors living in affluent neighbourhoods had higher seroprevalence rates, 96.72% (95% CI 95.82, 97.61%) compared to those living in the most materially deprived neighbourhoods, 92.94% (95% CI 90.89, 95.00%).
- Of 14, 201 donors tested on 2 or more occasions since January 2021 the most common (51.2%) test profile was N negative S negative on their first tested donation and N negative S positive on their last tested donation, most likely due to vaccination. There were 5 donors who were N negative S positive on their first tested donation and N positive S positive on their last tested donation, potentially breakthrough infections.

•Natural Infections (Based on results from the Nucleocapsid antibody assay):

- Seroprevalence (natural infection) in July was 4.08% (95% CI 3.65, 4.51%), decreased from June, 2021.
- Natural seroprevalence in most provinces except Alberta plateaued, likely due to widescale vaccination and social restrictions.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (6.71% (95% CI 5.17, 8.25%)) compared to other age groups, however, this number has decreased since June, 2021.
- Rates in this age group were highest in Alberta at 11.88% (95% CI 6.80, 16.97%) and British Columbia at 9.91% (95% CI 5.44, 14.37%). Since June, 2021 these rates have decreased or stayed very similar in almost every province with the exception of British Columbia where they have increased.
- Racialized groups had a higher seroprevalence rate (7.29% (95% CI 5.95, 8.63%)) compared to white donors (3.33% (95% CI 2.87, 3.78%)). Compared to previous reports, the gap between those in materially deprived vs. affluent neighbourhoods is closing, 4.62% (95% CI 3.03, 6.22%) vs 3.87% (95% CI 3.02, 4.71%). However, those living in more socially deprived settings (had lower social contact) had lower seroprevalence rates compared to those that were least deprived, 3.35% (95% CI 2.39, 4.30%) vs. 5.63% (95% CI 4.47, 6.80%).

June 2021

June 14 - June 29 2021 (n=16,884)

•**Humoral Immunity (Based on results from the Roche S assay):**

- Roche S results indicate a SARS-CoV-2 humoral response to vaccination or natural infection. Because people are advised to be vaccinated irrespective of past infection, those with Roche N and S positive results together likely have been infected and may or may not have been vaccinated.
- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 90.78% (95% CI 90.32, 91.25) a significant increase from May (based on results from the Roche S assay). This was predominantly driven by vaccination.
- The proportion of blood donors with presumed vaccine-induced humoral immunity to SARS-CoV-2 was 86.05% (95% CI 85.50, 86.59%), a significant increase from May (based on results from the Roche S-only assay).
- White donors did not have different seroprevalence rates (Roche S, primarily vaccine-induced) (90.81% (95% CI 90.25, 91.35%)) compared to other racialized groups (91.37% (95% CI 90.27, 92.47%)), this gap has closed compared to previous surveys. However, white donors had higher seroprevalence rates (Roche S-only, presumed vaccine induced) (86.87% (95% CI 86.26, 87.49%)), compared to other racialized groups (83.14% (95% CI 81.72, 84.56%)) with a decreased difference between these two groups compared to May. Similarly, donors living in affluent neighbourhoods had higher seroprevalence rates (Roche S, primarily vaccine-induced), 93.68% (95% CI 92.90, 94.46%) compared to those living in the most materially deprived neighbourhoods, 88.33% (95% CI 86.60, 90.06%).

•**Natural Infections (Based on results from the Roche N assay):**

- Seroprevalence (natural infection) in June was 4.5% (95% CI 4.19, 4.83%), increased from May, 2021.
- Natural infections in most provinces except Alberta plateaued, likely due to widescale vaccination.
- Consistent with previous surveys, donors aged 17-24 years old had the highest seroprevalence rate (9.3% (95% CI 8.04, 10.57%)) compared to other age groups.
- Rates in this age group were highest in Alberta at 17.53% (95% CI 13.23, 21.82%), Saskatchewan at 14.26% (95% CI 6.66, 21.87%), and Manitoba at 15.56% (95% CI 8.46, 22.65%).
- Racialized groups had a higher seroprevalence rate (7.95% (95% CI 6.95, 8.95%)) compared to white donors (3.72% (95% CI 3.38, 4.06%)). Those living in materially deprived vs. affluent neighbourhoods had a higher rate of natural infections, 6.95% (95% CI 5.62, 8.27%) vs 4.26% (95% CI 3.66, 4.87%).

May 2021

May 22 -June 4 2021 (n=17,001)

- The proportion of blood donors with humoral immunity for SARS-CoV-2 was 63.9% (95% CI 63.2, 64.6) a significant increase from April (based on results from the Roche S assay). This was predominantly driven by vaccination.

• **Vaccine-Induced Humoral Immunity (Reactive to Roche S-only):**

- The proportion of blood donors with vaccine-induced humoral immunity to SARS-CoV-2 was 59.8% (95% CI 59.1, 60.6), a significant increase from April.
- White donors had higher seroprevalence rates (vaccine-induced) (61.8% (95% CI 60.9, 62.7) compared to other racialized groups (48.9% (95% CI 47.1, 50.7%). Similarly, donors living in affluent neighbourhoods also had higher seroprevalence rates 64.8% (95% CI 63.4, 66.2%) compared to those living in the most materially deprived neighbourhoods, 56.6% (95% CI 54.0, 59.1%).

• **Natural Infections (Based on results from the Roche N assay):**

- Seroprevalence (natural infection) in May was 4.0% (95% CI 3.7, 4.3), increased from April, 2021.
- Natural infections in most provinces except Ontario and Alberta plateaued, likely due to widescale vaccination.
- Consistent with previous surveys donors aged 17-24 years old had the highest seroprevalence rate (7.0% (95% CI 5.9, 8.1)) compared to other age groups.
- Rates in this age group were highest in Alberta 12.7% (95% CI 9.0, 16.4) and Manitoba 11.3% (95% CI 5.2, 17.4).
- Racialized groups had a higher seroprevalence rate (7.4% (95% CI 6.5, 8.3)) compared to white donors (3.3% (95% CI 2.9, 3.6)). Those living in materially deprived vs. affluent neighbourhoods had a higher rate of natural infections 5.7% (95% CI 4.5, 6.8) vs 3.1% (95% CI 2.6, 3.6).

April 2021

April 13-April 30 2021 (n=16,931)

- The proportion of blood donors with humoral immunity to SARS-CoV-2 was 26.9% (95% CI 26.2, 27.6) a significant increase from March (based on results from the Roche S assay). This was predominantly driven by vaccination.

- **Vaccine-Induced Humoral Immunity (Reactive to Roche S-only):**

- The proportion of blood donors with vaccine-induced humoral immunity to SARS-CoV-2 was 23.6% (95% CI 23.0, 24.3), a significant increase from March.
- Vaccine inequity emerged in April 2021.
- White donors had higher seroprevalence rates (vaccine-induced) (25.0% (95% CI 24.3, 25.8) compared to other racialized groups (17.9% (95% CI 16.5, 19.3%)). Similarly, donors living in affluent neighbourhoods also had higher seroprevalence rates 26.9% (95% CI 25.6, 28.2%) compared to those living in the most materially deprived neighbourhoods, 20.9% (95% CI 18.8, 23.0%).

- **Natural Infections (Based on results from the Roche N assay):**

- Seroprevalence (natural infection) in April was 3.2% (95% CI 3.0, 3.5), similar to March 2021.
- Natural infections in most provinces except Ontario decreased or plateaued, likely due to widescale vaccination.
- Consistent with previous surveys donors aged 17-24 years old had the highest seroprevalence rate (5.4% (95% CI 4.4, 6.3)) compared to other age groups.
- Rates in this age group were significantly higher in Alberta 8.9% (95% CI 5.7, 12.0) and Manitoba 15.0% (95% CI 7.9, 22.0) compared to the full sample.
- Racialized groups had a higher seroprevalence rate (5.3% (95% CI 4.4, 6.1)) compared to white donors (2.8 (95% CI 2.5, 3.1)). Those living in materially deprived vs. affluent neighbourhoods had a higher rate of natural infections 4.6% (95% CI 3.5, 5.7) vs 2.7% (95% CI 2.2, 3.2).

March 2021

February 27-March 13, 2021 (n=16,873)

- Serological testing using the Roche nucleocapsid (N) and the Roche spike (S) total antibody assays allows us to monitor trends in natural infection transmission and vaccine-induced seropositivity.
- Overall, as of March 2021 adjusted seroprevalence by the Roche S assay (proxy for humoral immunity, vaccine or natural infection immunity) was 9.9% (95% CI 9.4, 10.3). The fraction of the population naturally exposed as opposed to developing immunity post-vaccination varied across Canada.
- Adjusted seroprevalence by the Roche S assay alone (N negative, proxy for vaccine-induced immunity) was 6.8% (95% 6.4, 7.16) a significant increase from January.
- Using self-reported vaccine history the Roche S assay alone had a sensitivity of 96.1% to identify vaccination (after 2 weeks)
- Despite broader access to COVID-19 vaccines, seroprevalence by the Roche N assay (proxy for natural infections) continued to increase from January (2.2% (95% 2.1, 2.4) to March (3.3% (95% CI 3.0, 3.5))
- Consistent with previous surveys, donors aged 17-24 years old demonstrated the highest seroprevalence rate (natural infection immunity) 6.37% (5.31, 7.44) compared to other age groups. Rates in this age group were significantly higher in Alberta 14.7% (95% CI 10.8, 18.6) and Manitoba 20.8% (95% CI 12.3, 28.0) than for the full sample.
- The disparities in natural infection immunity seroprevalence rates between racialized groups and white donors and those living in materially deprived vs. affluent neighbourhoods narrowed for the first time since November 2020 when disparities began to widen.

January 2021 (Roche)

January 1-27, 2021 (n=33,400 Roche)

- In order to evaluate seroprevalence in the vaccine era, residual blood is now tested using the Roche Elecsys® Anti-SARS-CoV-2 Spike (S) (semi-quantitative) and N (qualitative) assays. All vaccines will produce antibodies to S but not N, and natural infection will usually produce antibodies to S and N.
- In January 2021, seroprevalence estimates were higher by the Roche S assay (2.78% (95% CI 2.58, 2.97%) compared to either nucleocapsid assays. Seroprevalence by the Roche N assay was 2.24% (95% CI 2.08, 2.41) comparable to the Abbott N (1.99% (95% CI 1.84, 2.15)).
- **New:** 511 (1.5%) of donors self-reported vaccination against COVID-19 in the last 3 months in January 2021.

January 2021

January 1-27, 2021 (n=34,921)

- Seroprevalence in January was 1.99% (95% CI 1.84, 2.15)
- Across Canada seroprevalence remained the highest in Manitoba (3.92% (95% CI 2.92, 4.93)) and lowest in PEI (0%)
- Seroprevalence increased significantly in Ontario (1.16% vs 1.82%) and in Alberta (2.12% to 3.41%) from December 2020 until January 2021
- Consistent with previous surveys, donors aged 17-24 years old the highest seroprevalence rate (3.45% (95% CI 2.87, 4.02)).
- Disparities by socioeconomic status and racialized groups widened. Donors living in the most materially deprived neighbourhoods were nearly 4-times more likely to be positive than those living in affluent neighbourhoods (4.04% compared with 1.17%) . Racialized groups of donors were two time more likely to be positive than self identified white donors (3.37% compared to 1.66%)
- Detailed comparison with the previous survey (December 2020) is included.

December 2020

December 10-23, 2020 (n=16,961)

- Seroprevalence in December was 1.37% (95% CI 1.18, 1.56)
- Regional variation: Across Canada seroprevalence remained the highest in Manitoba (3.02% (95% CI 1.75, 4.29) however this was a significant decrease from the last report.
- Donors aged 17-24 years old remained the age group with the highest seroprevalence (2.75% (95% CI 2.01, 3.49))
- Disparities by socioeconomic status widened, donors living in the most materially deprived neighbourhoods were 3-times more likely to be positive than those living in affluent neighbourhoods (2.2% compared with 0.72%)
- **New:** Longitudinal data on repeat donors illustrating waning S/co ratios over time

November 2020

November 7-25, 2020 (n=17,049)

- Seroprevalence in November was 1.51% (95% CI 1.31, 1.71)
- Regional variation: Seroprevalence increased mostly in Western Canada. Highest rates were observed in the Prairies; Manitoba's rate increased to 8.56% (95% CI 6.51, 10.62) and Saskatchewan's rate increased to 4.2% (95% CI 2.3, 5.8). There was a slight decrease in Ontario to 0.77% (95% CI 0.56, 0.97%) and PEI remained at 0.
- Donors aged 17-24 years old had the highest seroprevalence rates 2.97% (95% CI 2.20, 3.37%) while donors 40-59 years old 1.09% (95% CI 0.80, 1.38%) had the lowest rates.
- New: Revised time series (Additional data from the correlates of immunity study from April until Aug 31, 2020 are included in this report)
- Comparison of Wave 1 (May-July) to November 2020

October 2020

October 12-31, 2020 (n=16,811)

- Seroprevalence increased significantly in October to 0.88% (95% CI 0.73, 1.04) (p=0.04).
- Regional variation: Manitoba's seroprevalence rate increased to 2.96% (95% CI 1.70, 4.23), the highest in Canada. Ontario remained stable at 0.87% (0.65, 1.08)
- New: Heat maps to illustrate inter-provincial variation (by economic regions)
- Disparities widen: Donors that self-identified as white (0.75%; 95% CI 0.61, 0.92) had significantly lower seroprevalence compared to other racialized groups (1.82%; 95% CI 1.21, 2.62)

Wave 1

May 9, 2020- July 21, 2020 (n=74,642)

- Seroprevalence was estimated at 0.70% (95% CI 0.63, 0.77)
- Regional variation: Ontario, 0.88% (95% CI 0.78, 0.99) had the highest seroprevalence, very low seroprevalence in Atlantic provinces.
- Disparities: Donors that self-identified as white (0.66%; 95% CI 0.59, 0.74) had lower seroprevalence compared to racialized groups (1.09%; 95% CI 0.84, 1.34)

Introduction

SARS-CoV-2 is responsible for the respiratory illness, coronavirus infection disease 2019 (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. Early in the pandemic (by late March 2020) strict physical distancing measures were implemented. As a result, the first wave of the epidemic in Canada peaked by the end of April 2020 and plateaued during the summer. A resurgence of cases began in late September 2020, peaking in January 2021 (the second wave). This was followed by a third wave that emerged in many regions across Canada in March 2021, which then subsided in late April. A fourth wave of this epidemic began in early August 2021 and subsided by the end of October. In mid-December 2021, a fifth wave began and subsided somewhat over January with a sixth wave in March/April and a seventh in July. As of July 30, 2022, 4,084,719 cases of COVID-19 had been reported in Canada.

Beginning in January 2021, Alpha (B.1.1.7) began to establish itself as the primary variant of concern (VOC). In late June 2021, Delta (B.1.617.2) was transitioning to be the primary VOC. In mid-December 2021, a new more contagious VOC, Omicron (B.1.1.529) began to establish itself as a primary VOC followed by subvariants. Peak timepoints when each VOC became dominant varied between provinces. By late December 2021 public health testing facilities were overwhelmed and restrictions on testing were implemented in many jurisdictions. Because many people with symptoms were not being tested, as well as those infected but without symptoms, the reported cases underestimate the infection rate. Surveillance studies that monitor SARS-CoV-2 antibodies are important to understand what proportion of the population have detectable antibodies (the seroprevalence) and to monitor trajectories over the course of the pandemic. This information improves mathematical models to predict the course of infection and informs public health policies.

Antibody concentrations typically peak within a month of vaccination and then gradually decrease. Antibody concentrations can be much higher after a subsequent dose of vaccine, or when an infection occurs pre- or post-vaccination. More than 86% of the eligible (5 and older) population had received two doses as of the end of July, 2022. Starting in November 2021, some Canadians became eligible for a third dose with 59% of the eligible population (18 and older) having received a third dose by the end of July, 2022. A fourth dose was encouraged in risk groups and older individuals. Monitoring spike (vaccine) antibody concentrations and the proportion of people with Omicron variant infection provides data for mathematical models to estimate the status of humoral immunity.

In partnership with the COVID-19 Immunity Task Force, Canadian Blood Services is testing residual blood for SARS-CoV-2 antibodies from blood donors. This report tracks SARS-CoV-2 seroprevalence distinguishing natural and likely vaccine induced humoral immunity. We present seroprevalence rates based on two Roche total Ig- assays that detect Spike (S) and Nucleocapsid (N) antibodies and monitor the concentration of S antibodies. We assess temporal changes and evaluate differences by geographical regions, age groups, racialized groups, and socioeconomic status.

Methods

Population

Canadian Blood Services has blood collection sites in all large cities and many smaller urban centres in all provinces except Quebec. People in rural areas may have less opportunity to donate and donations are not collected in the northern territories. Blood donors are reasonably representative of healthy Canadians between the ages of 17 and about 60.

Blood donor eligibility

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. Donors are deferred if they have been in contact with someone who was infected or if they have had the infection for 2 weeks after symptoms disappear (3 weeks if hospitalized). Donors also have their temperature and their hemoglobin level checked before they can donate.

Blood samples

Just before a donor gives their blood donation, several small tubes of blood are collected for infectious disease screening. An extra sample is taken, known as the retention sample, in case extra testing is required (80% of these retention samples are not needed for operational testing). For this study retention samples were aliquoted and frozen at -20°C or colder, starting on May 9, 2020.

Periodicity

All retention samples were tested for SARS-CoV-2 antibodies until July 21, 2020 (Wave 1). From August 2020 until December 2020, only samples from approximately the last two weeks of each month were tested (except samples from August and September which were stored but not tested). In January 2021 a larger sample was tested and in February samples were stored but not tested. As of March, testing of approximately 2 weeks per month resumed. Beginning in July 2021 the sample size was reduced to include about 300 samples per age/region grouping plus extra repeat tested donors. In December 2021 samples from 2 weeks were tested without sorting in order to be able to report more quickly, and as of January 2022 samples from all weeks of the month were tested. Seroprevalence estimates also include an additional 1,500 residual blood tests from the correlates of immunity study from April 2020 to January 2021. These were tested on a battery of assays (orthogonal testing) including the Abbott IgG Assay.

COVID-19 Seroprevalence Report
July 2022 Survey

		2020											
		March			April			May			June		
		July			August			September			October		
		November			December								
Seroprevalence ¹								14,541		51,963	21,594		
Correlates of Immunity Study ²												16,811	17,049
													16,961
		2021											
		January			February			March			April		
		May			June			July			August		
		September			October			November			December		
Seroprevalence ¹		34,921				16,873		16,931		17,001		16,884	8,457
Correlates of Immunity Study ²												9,109	9,363
												9,627	9,018
													16,816
		2022											
		January			February			March			April		
		May			June			July					
Seroprevalence ¹			32,505		28,616		26,027		29,787		31,764		32,121
Orthogonal Testing ²													31,275

¹ Samples tested with the **Abbott SARS-CoV-2 IgG Assay until January 2021** (residual blood from August 2020, September 2020 and February 2021 are aliquoted but have not been tested). As of January 2021, all samples were tested using the Roche Elecsys® Anti-SARS-CoV-2 assays (S and N).

² Orthogonal Testing (PI: S. Drews (CIHR 2020) sampling 1,500 samples per month until and including January 2021 (Abbott tested); this study is known as the "Correlates of Immunity Study"

SARS-CoV-2 antibody testing

Two assays were used. The Roche Elecsys® Anti-SARS-CoV-2 spike semi-quantitative immunoassay detects total antibodies (including IgA, IgM and IgG) to the SARS-CoV-2 spike (S) protein (**Spike antibody**). The Elecsys® Anti-SARS-CoV-2 qualitative immunoassay detects total antibodies (including IgA, IgM and IgG) to SARS-CoV-2 using a recombinant protein, nucleocapsid (N) antigen (**Nucleocapsid antibody**). At a concentration of ≥ 0.8 U/mL, the Spike antibody assay was assumed to have sensitivity of 98.8% and specificity of 99.6%. At a concentration of ≥ 1.0 U/mL, the Nucleocapsid antibody assay was assumed to have sensitivity of 99.5% and specificity of 99.8%¹. All testing was conducted at Canadian Blood Services laboratories in Ottawa.

Samples from January to August were tested neat and at a 1:10 dilution for Spike antibody, however, by June many samples were above the maximum detection level when diluted. From September onwards samples were tested up to a 1:400 dilution.

Serological testing using the Nucleocapsid, and Spike antibody assay allows trends in natural infection transmission and vaccine-induced seropositivity to be monitored². In this report the dual terms Spike antibody/ humoral immunity (by vaccine or natural infection) and Nucleocapsid antibody/ proxy for natural infection will be used interchangeably. This is to ease interpretation for readers, with the caveat that these interpretations do not reflect the complexity of adaptive immunity.

Ethical issues

All data were de-identified by the information technology team at Canadian Blood Services by providing a random identification number. Demographic variables and vaccination history were extracted from the Canadian Blood Services donor database (e.g., donation date, birth year, sex, racialized groups, Forward Sortation Area of residential postal code) and linked to the test

data. In the donor pamphlet “What you must know to donate blood” which donors must read before each donation, and in the pamphlet entitled “What happens to your blood donation?” donors were informed that their blood will be tested for routine infectious disease markers and other tests as required. Information about the study was made available on the website in late June 2020 prior to commencing testing. 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 Board.

Data management and analysis

De-identified demographic data were analysed by the Canadian Blood Services Epidemiology & Surveillance Department. Socioeconomic status was estimated by quintiles of the Pampalon Material and Social Deprivation Indices (MSDI). MSDI was derived from 2016 Statistics Canada census, aggregated from postal codes to the dissemination area (DA) level (the smallest geographic unit available in the Canadian census, consisting of 400–700 persons). 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. To make inference to the general population, weighting factors were applied based on the donor’s residential Forward Sortation Area (FSA), age group and sex. Data were weighted based on Statistics Canada data (catalogue # 98-400-X2016008). For FSAs with few donors, several FSAs were combined, generally to include at least 500 donors. For data with no FSA recorded or if not in a province where blood is collected (0.2% of samples) weighting was based on FSA of the blood centre.

The seroprevalence was calculated as the number of positive samples divided by all samples tested. Ninety-five percent confidence intervals were calculated based on the Exact method. The adjusted seroprevalence and confidence intervals present the weighted data adjusted for sensitivity and specificity of the assay using the Rogan-Gladen equation³. SARS-CoV-2 seroprevalence was stratified by geography (regions, province and selected metropolitan cities), sex, age groups, self-reported ethnicity, and social and material deprivation indices.

Temporal trends by monthly intervals were evaluated by demographic variables. Statistical comparisons between groups were carried out using logistic regression.

Donors who donated more than once since testing began with the Roche assay in January 2021 and whose samples were selected for seroprevalence testing (at least two samples tested per donor) were included in a separate dataset for analysis and are referred to as “repeat donors”. At monthly intervals, beginning with June 2021, donations from repeat donors were evaluated for potential incident infections. If a donor was S positive and N negative on their previous donation (presumed vaccinated) before the month being observed and then was S positive N positive on their following donation in the corresponding month, this was considered a potential incident breakthrough infection. Percent incidence for each month was calculated by dividing the number of new incident infections (S positive N positive) in that month by the total number of donors who tested S positive N negative on their previous donation prior to the corresponding month. This same approach was used to evaluate incident cases among donors who were S

negative and N negative (presumed unvaccinated) on their previous donation who then were S positive N positive on their following donation in the corresponding month.

Results

Between July 1 and July 31, 2022, a total of 31,275 unique donors were tested for SARS-CoV-2 antibodies.

Table 1 compares adjusted seroprevalence rates by different assays (**Nucleocapsid and Spike antibody**) by sociodemographic variables for all Canadian provinces (except Quebec and territories). Overall adjusted seroprevalence by Spike antibody (a proxy of humoral immunity) was 100.00% (95% CI 100.00, 100.00%). The adjusted seroprevalence by Nucleocapsid antibody (proxy for natural infection) was 54.01% (95% CI 53.45, 54.56) (please refer to points of interpretation). There was a slight increase over the 30-day reporting period from 52.32% (95% CI 51.22, 53.42) to 52.70% (95% CI 51.62, 53.77) to 54.68% (95% CI 53.61, 55.74) to 56.51% (95% CI 55.35, 57.67).

Figure 1 illustrates temporal trends of SARS-CoV-2 seroprevalence from April 4, 2020, until July 31, 2022, by monthly intervals. The discontinuation of the line in January 2021 represents the transition from the Abbott assay to the Roche assay. The largest increase in seroprevalence was seen in the Roche S assay, from early-March 2021 onwards, mirroring wider first and second dose vaccine roll out. Figure 2 (A-E) stratifies seroprevalence by regions. Much of the humoral immunity was induced by vaccines (compared to natural infections) across the country. The largest increase in seroprevalence using Roche N began in February 2022, and has continued to increase consistent with the Omicron variant wave. Appendix Tables A1.1-A1.6 compare seroprevalence rates by sex, age groups and material deprivation in different regions.

Table 2 compares temporal changes in seroprevalence rates by natural infection (**Nucleocapsid antibody** between June 2022 and July 2022). Overall, the seroprevalence rate for natural infections was higher in July (54.01% (95% CI 53.45, 54.56) compared to June (50.70% (95% CI 50.15, 51.26) ($P < 0.0001$)), and natural infections increased compared to the previous month across all demographics. Donors aged 17-24 years old continued to have the highest seroprevalence rate at 71.15% (95% CI 69.71, 72.59) compared to other age groups.

After vaccination an increase in antibody concentration followed by gradual decline is expected. From September 2021 to July 2022 dilution of high concentration spike antibody samples permitted measurement of antibody concentrations as high as 100,000 U/mL. Figure 3 illustrates distributions of log transformed S antibody concentrations by age group from September to July.

From June to October 2021 the percentage of incident breakthrough infections were rare and varied by month with no clear trend (See Table 3). There was a small increase over November and December which increased from January and in July was 31.76% (95% CI 30.91, 32.63). Table 4 shows the percentage of incident cases by month in likely unvaccinated donors. Since June 2021 the percentage slowly increased to 3.91% (95% CI 3.11, 4.83) by December 2021 then increased much higher to 52.70% (95% CI 50.09, 55.30) by July 2022.

Figure 4 shows regional weekly trends since December 2021 for Nucleocapsid by age group. Figures 5A-H illustrate temporal trends of seroprevalence by Nucleocapsid and Spike antibody results by sociodemographic variables (ethnicity, age, material deprivation, and social deprivation) from January 2021 to July 2022. Differences in natural infections between white and racialized groups were seen from January 2021 to July 2022 with racialized groups having higher natural infection rates. Other sociodemographic variables had significant differences at various months corresponding to the vaccine roll out across Canada with evident trends in certain groups having increased Spike and/or Nucleocapsid antibodies compared to others. Tables A 1.1 to A 1.6 show selected demographic results for July by region (Nucleocapsid and Spike), and additional weekly breakdown of Nucleocapsid results are shown in Tables A 2.1 and A 2.2

Conclusion

As of July 2022, adjusted seroprevalence by the Spike antibody assay (proxy for humoral immunity) was 100.00% (95% CI 100.00, 100.00). While humoral immunity has been largely driven by vaccination, the fraction of the population naturally exposed (with hybrid immunity) has increase sharply since December consistent with the arrival of the Omicron variant and subsequent subvariants.

Points for Interpretation

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. For example, the Nucleocapsid antibody assay unweighted SARS-CoV-2 seroprevalence for the full sample was 53.11% (95% CI 52.55, 53.66), and after weighting factors applied it was 53.83% (95% CI 53.27, 54.38), then after the weighted seroprevalence was adjusted for sensitivity and specificity, 54.01% (95% 53.45, 54.56). Using the Spike antibody assay, the unweighted SARS-CoV-2 seroprevalence for the full sample was 99.17% (95% CI 99.06, 99.27), and after weighting factors applied it was 99.20% (95% CI 99.10, 99.30), then after the weighted seroprevalence was adjusted for sensitivity and specificity, 100% (95% CI 100.00, 100.00).

3. The sensitivity and specificity of the Roche assays 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.
4. Different seroprevalence rates by the assays reflect different isotypes being measured. The Roche assay identifies IgA, IgG and IgM antibodies. The Abbott assay measured IgG. Detection of Nucleocapsid antibodies is likely a marker of natural infection while Spike antibodies can be induced by either natural infection or by vaccines.
5. Seroprevalence results reflect measurement of humoral immunity. The exact mechanisms of protective immunity against SARS-CoV-2 remains unknown. The protection at particular levels of Spike antibody is unknown. Quantitative results from the Spike antibody assay will be valuable to inform policy regarding booster shots as the science evolves.
6. As of September 2021, the dilution for higher concentration (>250 U/mL) was increased from 1:10 to 1:400. This allows antibody concentration to be measured as high as 100,000 U/mL rather than 2,500 U/mL. It is possible that values between 160 and 320 U/mL may be less accurate because they are at the lower end of sensitivity of the assay.
7. SARS-CoV-2 antibody signals wane over time.
8. Spike antibodies reflect SARS-CoV-2 humoral response. Many Spike antibody positive results are related to vaccination. However, Spike antibody positives are also due to natural infection (with or without N antibodies). Donors with both Spike and Nucleocapsid antibodies are assumed to have had a natural infection; however, they may have also been vaccinated before or after the infection.

Due to a variety of biological factors, 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). In July the two most common positive antibody profiles were positive on Spike antibody/negative on Nucleocapsid antibody (46.2%) and positive on Spike antibody/positive on Nucleocapsid antibody (52.9%) (see below).

Diagnostic phenotypes in July 2022 (unadjusted)

	Nucleocapsid Antibody	Spike Antibody	Total N (%)
	Negative	Negative	205 (0.70)
	Negative	Positive	14,461 (46.2)
	Positive	Negative	55 (0.2)
	Positive	Positive	16,554 (52.9%)
Total			31,275

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

Table 1. Comparing SARS-CoV-2 seroprevalence by sociodemographic variables by Nucleocapsid and Spike antibody results in July 2022

Nucleocapsid Antibody Results					Spike Antibody Results			
(proxy for natural infection)					(proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	13,225	7,011	52.77	52.00, 53.55	13,225	13,139	100.00	100.00, 100.00
Male	18,050	9,598	55.31	54.52, 56.11	18,050	17,876	100.00	100.00, 100.00
Age								
17-24	2,189	1,545	71.15	69.71, 72.59	2,189	2,186	100.00	100.00, 100.00
25-39	8,287	5,186	63.40	62.31, 64.49	8,287	8,225	100.00	100.00, 100.00
40-59	11,754	6,428	54.63	53.69, 55.57	11,754	11,653	100.00	100.00, 100.00
60+	9,045	3,450	37.57	36.56, 38.59	9,045	8,951	100.00	99.82, 100.00
Province								
British Columbia	4,670	2,523	55.19	53.87, 56.52	4,670	4,630	100.00	100.00, 100.00
Alberta	5,637	3,426	62.32	60.91, 63.73	5,637	5,593	100.00	100.00, 100.00
Saskatchewan	1,392	758	57.09	54.28, 59.90	1,392	1,381	100.00	99.53, 100.00
Manitoba	1,564	868	56.95	54.33, 59.56	1,564	1,549	100.00	99.59, 100.00
Ontario	14,936	7,596	51.68	50.89, 52.46	14,936	14,804	100.00	100.00, 100.00
New Brunswick	856	412	49.60	46.27, 52.93	856	850	100.00	99.75, 100.00
Nova Scotia	1,504	663	43.73	40.77, 46.70	1,504	1,496	100.00	99.97, 100.00
Prince Edward Island	304	147	48.95	41.28, 56.62	304	302	99.44	97.45, 100.00
Newfoundland	412	216	54.29	50.30, 58.28	412	410	100.00	99.89, 100.00
Metro area								
Vancouver	2,501	1,448	58.34	56.60, 60.08	2,501	2,484	100.00	100.00, 100.00
Calgary	2,178	1,357	63.64	61.17, 66.10	2,178	2,169	100.00	100.00, 100.00
Edmonton	1,781	1,025	58.26	55.91, 60.60	1,781	1,768	100.00	99.97, 100.00
Ottawa	1,472	644	44.13	41.12, 47.13	1,472	1,464	100.00	100.00, 100.00
Toronto	4,819	2,629	54.37	53.16, 55.57	4,819	4,781	100.00	100.00, 100.00
Winnipeg	1,016	542	54.42	51.05, 57.78	1,016	1,008	100.00	99.54, 100.00

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Ethnicity ^{1,2}								
White	23,718	12,207	52.01	51.37, 52.66	23,718	23,516	100.00	100.00, 100.00
Indigenous	427	249	61.06	56.46, 65.65	427	423	100.00	99.00, 100.00
Asian	1,650	875	52.98	50.69, 55.27	1,650	1,646	100.00	100.00, 100.00
Other racialized groups	3,472	2,249	67.11	65.57, 68.64	3,472	3,446	100.00	100.00, 100.00
Social Deprivation ³								
1 (least deprived)	5,910	3,246	55.61	54.34, 56.89	5,910	5,878	100.00	100.00, 100.00
2	5,819	3,060	53.99	52.70, 55.29	5,819	5,764	100.00	100.00, 100.00
3	5,433	2,811	52.98	51.65, 54.31	5,433	5,388	100.00	100.00, 100.00
4	5,068	2,706	54.52	53.14, 55.90	5,068	5,025	100.00	100.00, 100.00
5 (most deprived)	5,315	2,700	50.99	49.64, 52.34	5,315	5,263	100.00	99.95, 100.00
Material Deprivation ³								
1 (least deprived)	7,944	4,170	53.34	52.22, 54.45	7,944	7,903	100.00	100.00, 100.00
2	6,779	3,656	54.65	53.45, 55.86	6,779	6,731	100.00	100.00, 100.00
3	5,798	2,976	51.93	50.63, 53.23	5,798	5,740	100.00	99.95, 100.00
4	4,454	2,271	52.37	50.92, 53.83	4,454	4,405	100.00	99.73, 100.00
5 (most deprived)	2,570	1,450	57.88	56.02, 59.73	2,570	2,539	99.95	99.53, 100.00
Total	31,275	16,609	54.01	53.45, 54.56	31,275	31,015	100.00	100.00, 100.00

¹ Self reported ethnicity was missing for 2,008 (6.4%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 52.59% (95% CI 50.40, 54.79); and Spike antibody was 99.80% (95% CI 98.28, 100.00).

² Combining all racialized groups together resulted in adjusted SARS-CoV-2 seroprevalence of 62.27% (95% CI 61.03, 63.51) by the Nucleocapsid antibody assay, and 100.00% (95% CI 100.00, 100.00) by Spike antibody.

³ Postal Codes were missing for 3,730 (11.9%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 56.65% (95% CI 55.04, 58.26) and Spike antibody was 100.00% (95% CI 99.87, 100.00).

Table 2. Changes in SARS-CoV-2 seroprevalence by **Nucleocapsid Antibody assay (proxy for natural infection)** by sociodemographic variables between June and July 2022

June 2022 (crude)			June 2022 (adjusted)		July 2022 (crude)		July 2022 (adjusted)		
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	P- Value*
Sex									
Female	14,493	7,289	49.61	48.85, 50.38	13,225	7,011	52.77	52.00, 53.55	<0.0001
Male	17,628	8,793	51.86	51.07, 52.65	18,050	9,598	55.31	54.52, 56.11	<0.0001
Age									
17-24	2,354	1,569	66.29	64.81, 67.77	2,189	1,545	71.15	69.71, 72.59	<0.0001
25-39	8,162	4,908	60.62	59.53, 61.71	8,287	5,186	63.40	62.31, 64.49	0.0004
40-59	12,169	6,340	51.99	51.06, 52.92	11,754	6,428	54.63	53.69, 55.57	0.0001
60+	9,436	3,265	33.73	32.75, 34.71	9,045	3,450	37.57	36.56, 38.59	<0.0001
Province									
British Columbia	5,202	2,527	50.54	49.23, 51.86	4,670	2,523	55.19	53.87, 56.52	<0.0001
Alberta	6,415	3,771	60.86	59.45, 62.26	5,637	3,426	62.32	60.91, 63.73	0.1503
Saskatchewan	1,555	822	55.45	52.66, 58.23	1,392	758	57.09	54.28, 59.90	0.4167
Manitoba	1,730	947	56.27	53.70, 58.85	1,564	868	56.95	54.33, 59.56	0.7186
Ontario	14,562	6,887	48.14	47.37, 48.92	14,936	7,596	51.68	50.89, 52.46	<0.0001
New Brunswick	804	348	44.53	41.27, 47.80	856	412	49.60	46.27, 52.93	0.0333
Nova Scotia	1,276	506	41.49	38.58, 44.40	1,504	663	43.73	40.77, 46.70	0.2895
Prince Edward Island	192	91	49.24	41.66, 56.82	304	147	48.95	41.28, 56.62	0.9578
Newfoundland	385	183	45.72	41.78, 49.66	412	216	54.29	50.30, 58.28	0.0028
Metro area									
Vancouver	2,743	1,457	53.68	51.96, 55.39	2,501	1,448	58.34	56.60, 60.08	0.0002
Calgary	2,390	1,392	59.57	57.06, 62.08	2,178	1,357	63.64	61.17, 66.10	0.0236
Edmonton	1,995	1,103	57.70	55.25, 60.16	1,781	1,025	58.26	55.91, 60.60	0.7491

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Ottawa	1,588	627	39.87	36.97, 42.78	1,472	644	44.13	41.12, 47.13	0.0463
Toronto	4,499	2,264	50.37	49.17, 51.56	4,819	2,629	54.37	53.16, 55.57	<0.0001
Winnipeg	1,096	570	52.85	49.46, 56.24	1,016	542	54.42	51.05, 57.78	0.5201
Ethnicity^{1,2}									
White	24,321	11,789	49.01	48.38, 49.65	23,718	12,207	52.01	51.37, 52.66	<0.0001
Indigenous	403	223	56.54	51.62, 61.45	427	249	61.06	56.46, 65.65	0.1878
Asian	1,708	877	49.93	47.69, 52.16	1,650	875	52.98	50.69, 55.27	0.0614
Other racialized groups	3,470	2,111	62.32	60.78, 63.87	3,472	2,249	67.11	65.57, 68.64	<0.0001
Social Deprivation³									
1 (least deprived)	6,055	3,156	52.46	51.19, 53.73	5,910	3,246	55.61	54.34, 56.89	0.0006
2	6,097	2,971	49.43	48.16, 50.71	5,819	3,060	53.99	52.70, 55.29	<0.0001
3	5,661	2,804	50.55	49.24, 51.87	5,433	2,811	52.98	51.65, 54.31	0.0109
4	5,108	2,507	49.61	48.23, 50.98	5,068	2,706	54.52	53.14, 55.90	<0.0001
5 (most deprived)	5,165	2,474	48.56	47.18, 49.93	5,315	2,700	50.99	49.64, 52.34	0.0132
Material Deprivation³									
1 (least deprived)	8,219	3,999	48.53	47.42, 49.64	7,944	4,170	53.34	52.22, 54.45	<0.0001
2	6,919	3,349	49.46	48.26, 50.66	6,779	3,656	54.65	53.45, 55.86	<0.0001
3	5,957	2,920	49.72	48.43, 51.00	5,798	2,976	51.93	50.63, 53.23	0.0175
4	4,446	2,278	51.95	50.51, 53.40	4,454	2,271	52.37	50.92, 53.83	0.688
5 (most deprived)	2,545	1,366	54.62	52.77, 56.48	2,570	1,450	57.88	56.02, 59.73	0.0152
Total	32,121	16,082	50.70	50.15, 51.26	31,275	16,609	54.01	53.45, 54.56	<0.0001

*P-value reflects the difference between June and July results.

¹ In June, self reported ethnicity was missing for 2,219 (6.9%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 48.37% (95% CI 46.24, 50.50). In July, self reported ethnicity was missing for 2,008 (6.4%) donors. Adjusted seroprevalence by the Nucleocapsid antibody assay was 52.59% (95% CI 50.40, 54.79).

² In June, combining all racialized groups together resulted in adjusted SARS-CoV-2 seroprevalence of 58.03% (95% CI 56.79, 59.27) by the Nucleocapsid antibody assay. In July, combining all racialized groups together resulted in adjusted SARS-CoV-2 seroprevalence of 62.27% (95% CI 61.03, 63.51) by the Nucleocapsid antibody assay.

³ In June, Postal Codes were missing for 4,035 (12.6%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 54.29% (95% CI 52.75, 55.82). In July, Postal Codes were missing for 3,730 (11.9%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 56.65% (95% CI 55.04, 58.26).

Table 3. SARS-CoV-2 incidence among anti-S positive donors by month from June 2021 – July 2022.

Month	Total donors tested	Repeat Donors	Previous S positive, N negative	S Positive, N Positive		
				N	%	95% CI
Jun	16,884	4,452	929	2	0.22	0.03, 0.78
Jul	8,457	2,853	1,054	5	0.47	0.15, 1.10
Aug	9,109	5,400	2,719	8	0.29	0.13, 0.58
Sep	9,363	5,728	2,915	3	0.10	0.02, 0.30
Oct	9,627	5,898	3,313	12	0.36	0.19, 0.63
Nov	9,018	5,290	3,318	20	0.60	0.37, 0.93
Dec	16,817	5,560	3,241	24	0.74	0.48, 1.10
Jan	32,505	11,296	6,973	362	5.19	4.68, 5.74
Feb	28,616	10,200	7,065	1,099	15.56	14.72, 16.42
Mar	26,056	10,650	7,753	1,359	17.53	16.69, 18.39
Apr	29,786	14,128	10,365	2,279	21.99	21.19, 22.80
May	31,764	15,665	11,344	3,519	31.02	30.17, 31.88
Jun	32,121	16,134	11,075	3,565	32.19	31.32, 33.07
Jul	31,275	17,142	11,264	3,578	31.76	30.91, 32.63

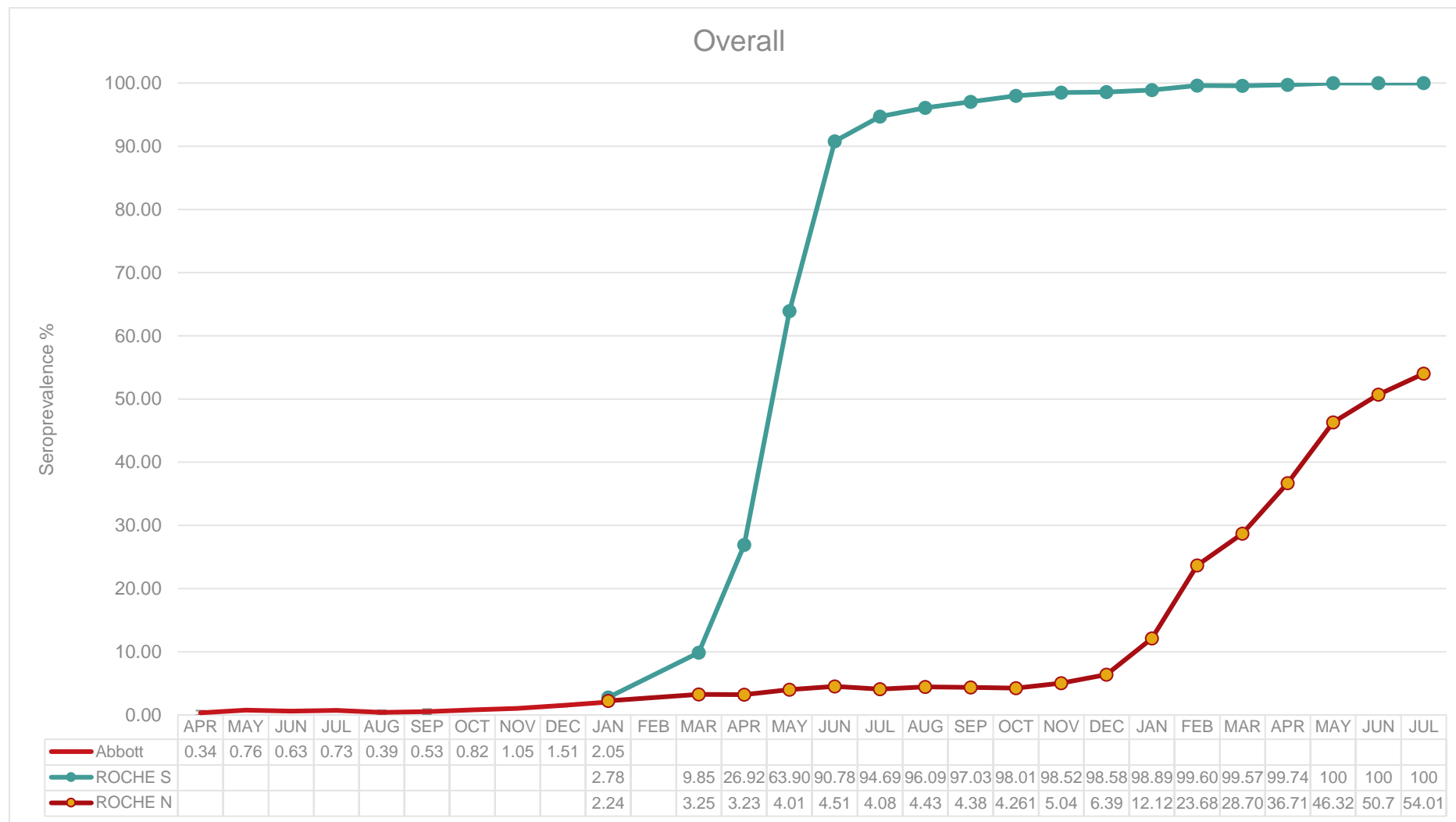
Note: A donation was considered a potential breakthrough incident infection if donors tested S positive and N negative on their previous donation and then tested S positive and N positive on their following donation.

Table 4. SARS-CoV-2 incidence among anti-S negative donors by month from June 2021 – July 2022.

Month	Total donors tested	Repeat Donors	Previous S negative, N negative	S Positive, N Positive		
				N	%	95% CI
Jun	16,884	4,452	3,409	52	1.53	1.14, 2.00
Jul	8,457	2,853	1,697	24	1.41	0.91, 2.10
Aug	9,109	5,400	2,487	29	1.17	0.78, 1.67
Sep	9,363	5,728	2,628	53	2.02	1.51, 2.63
Oct	9,627	5,898	2,385	61	2.56	1.96, 3.27
Nov	9,018	5,290	1,754	56	3.19	2.42, 4.13
Dec	16,817	5,560	2,073	81	3.91	3.11, 4.83
Jan	32,505	11,296	3,924	358	9.12	8.24, 10.07
Feb	28,616	10,200	2,666	632	23.71	22.10, 25.37
Mar	26,056	10,650	2,138	630	29.47	27.54, 31.45
Apr	29,786	14,128	2,143	797	37.19	35.14, 39.28
May	31,764	15,665	1,907	893	46.83	44.57, 49.10
Jun	32,121	16,134	1,784	934	52.35	50.01, 54.69
Jul	31,275	17,142	1,446	762	52.70	50.09, 55.30

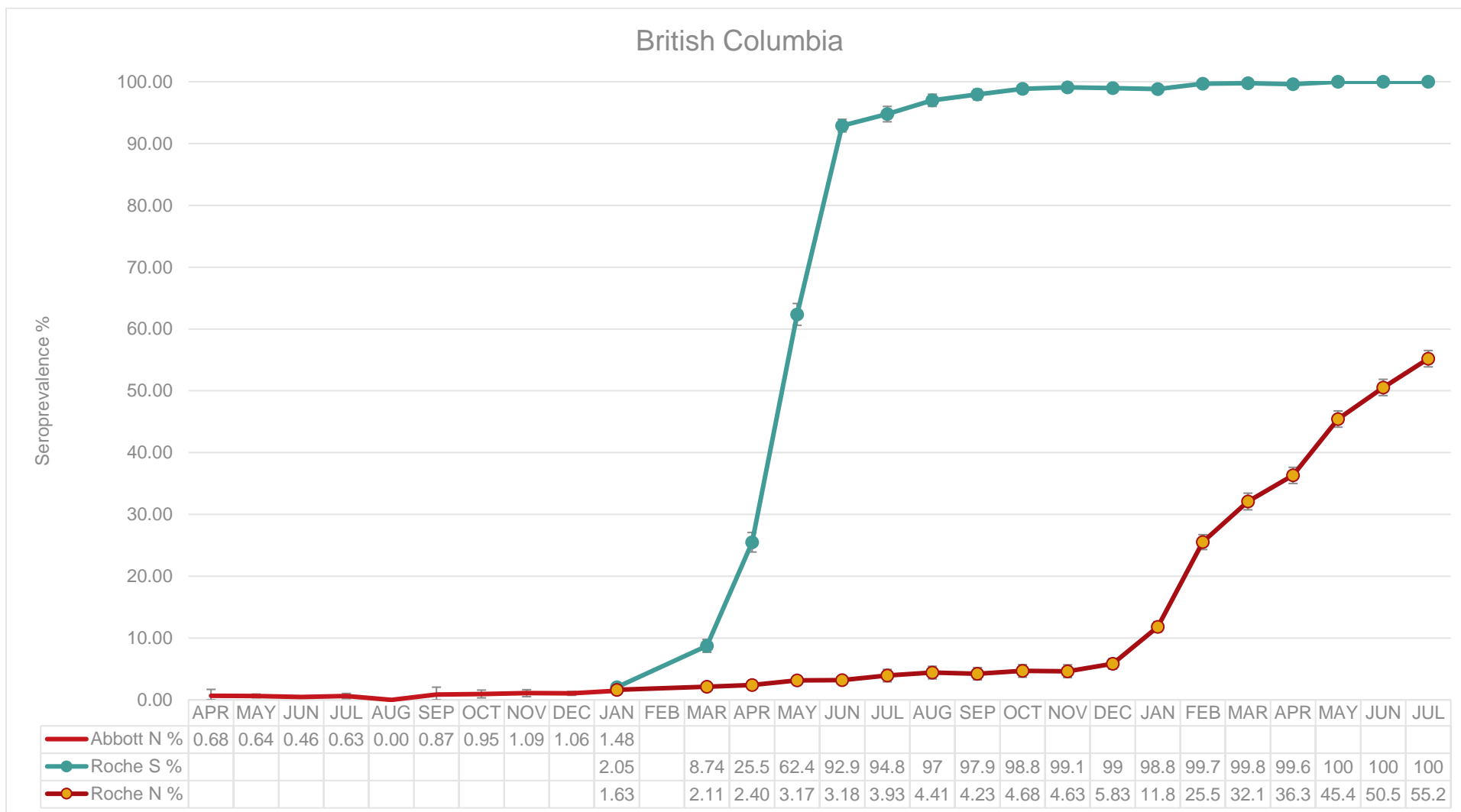
Note: A donation was considered a potential incident infection if donors tested S negative and N negative on their previous donation and then tested S positive and N positive on their following donation.

Figure 1. Overall temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from April 2020 - July 2022 (comparing results from Abbott N (until January 2021) followed by seroprevalence estimated by Roche N and Roche S results).

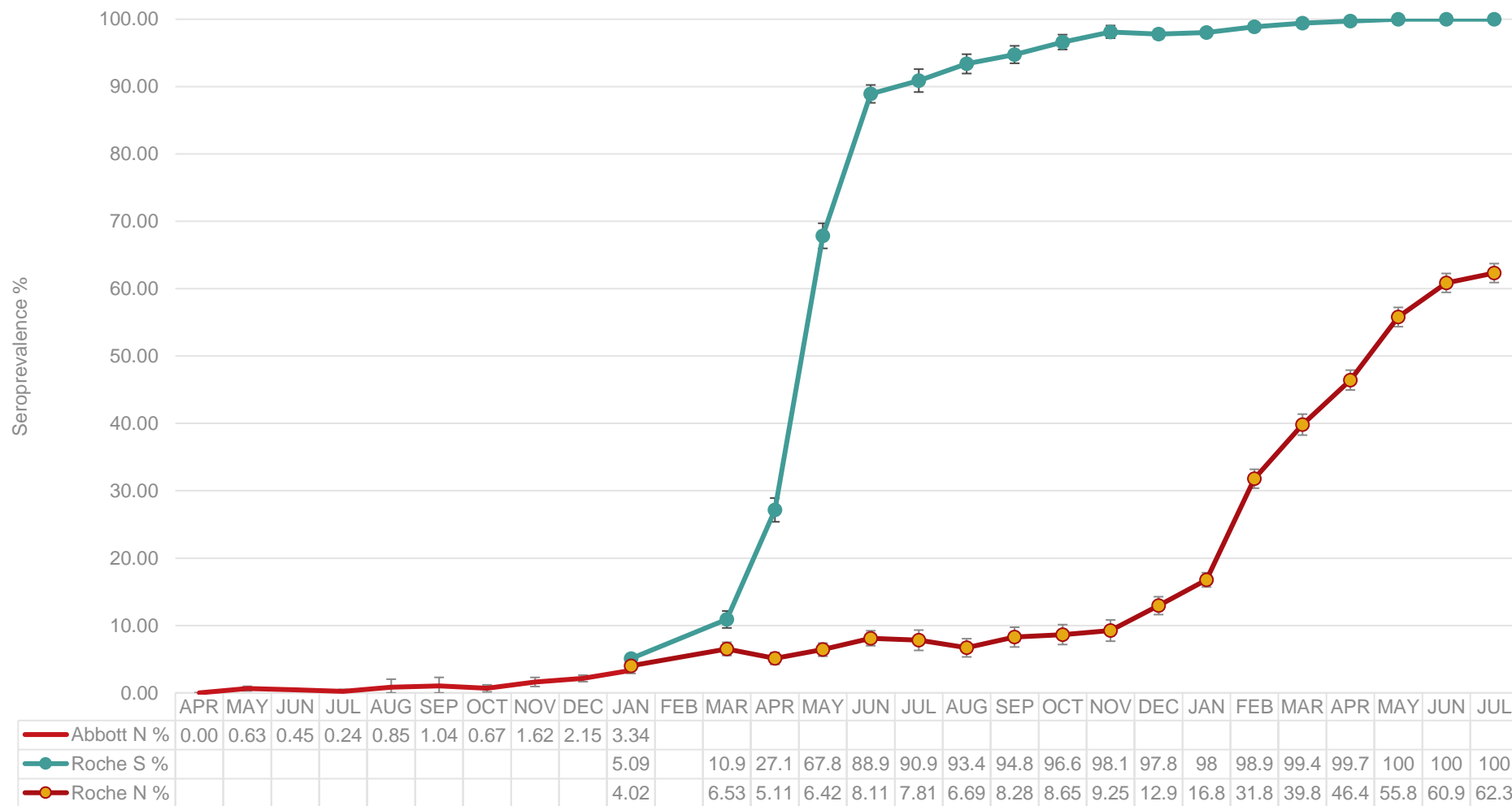


Notes: SARS-CoV-2 seroprevalence rates (95% CI), that have been weighted and adjusted for test characteristics. Data from the CIHR funded study (Correlates of Immunity) from April 9, 2020-January 31, 2021, have been included.

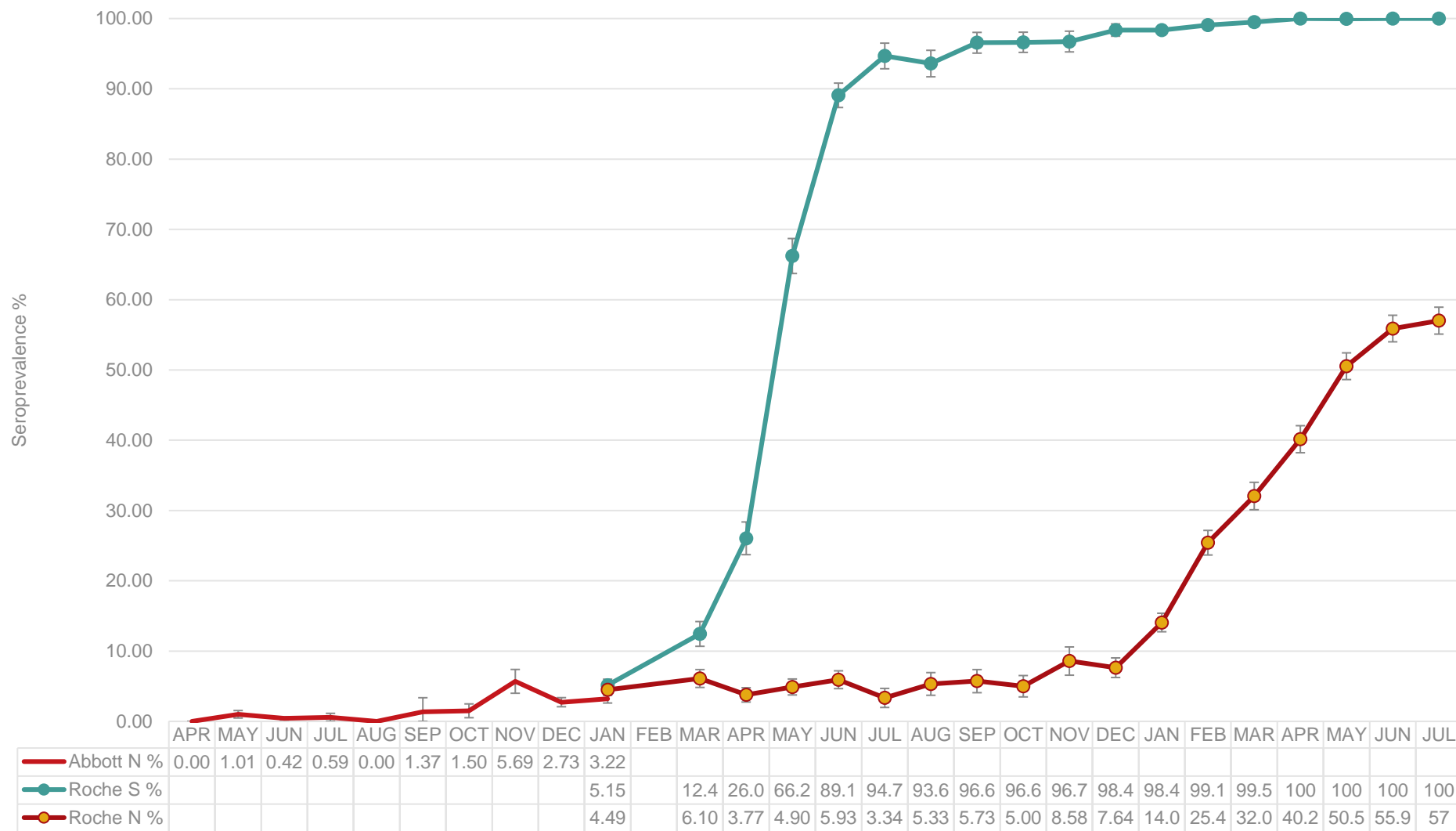
Figure 2. Regional temporal trends of SARS-CoV-2 seroprevalence monthly from April 2020 - July 2022 (by Abbott N, Roche N and Roche S assays)



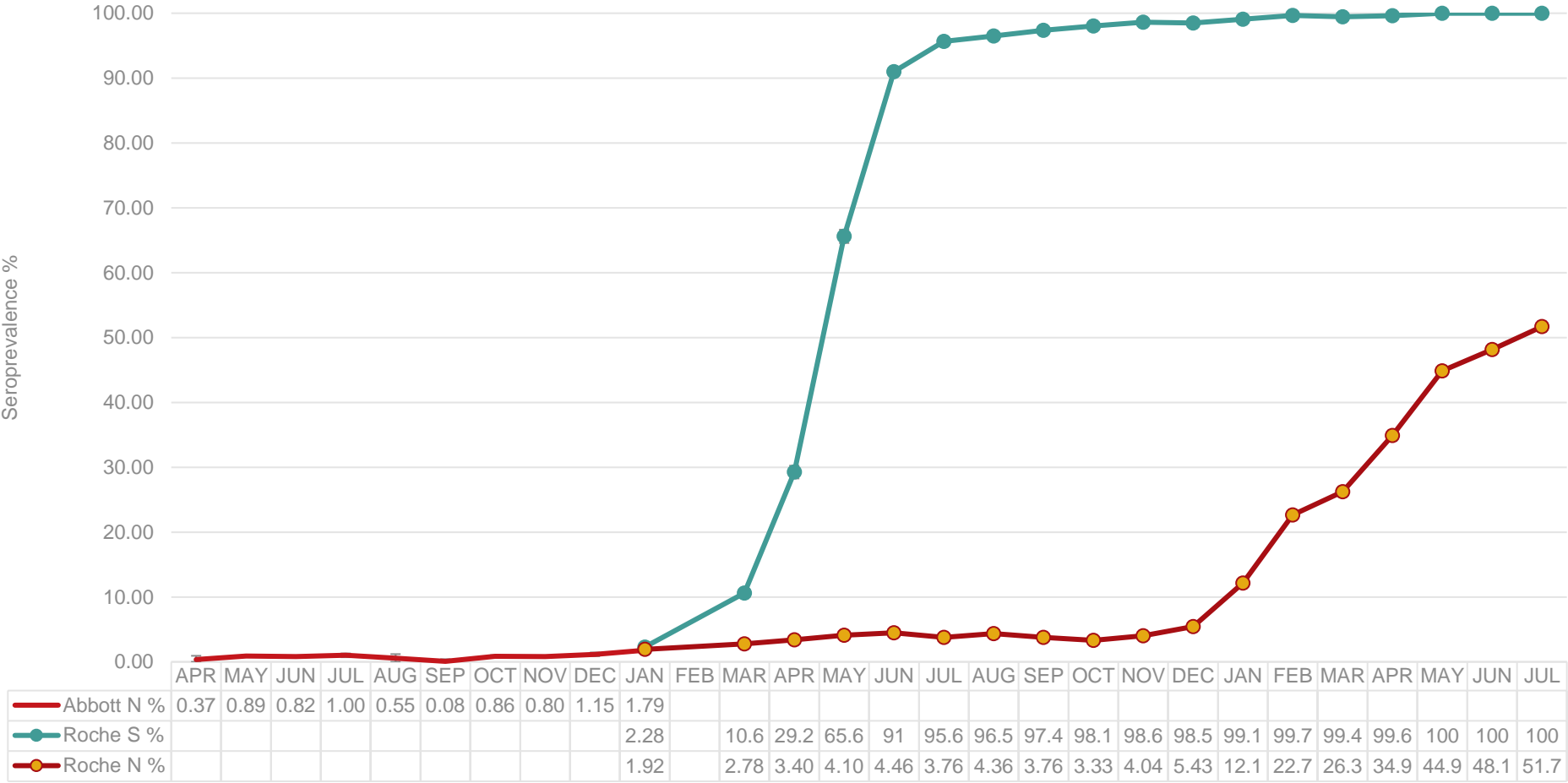
Alberta



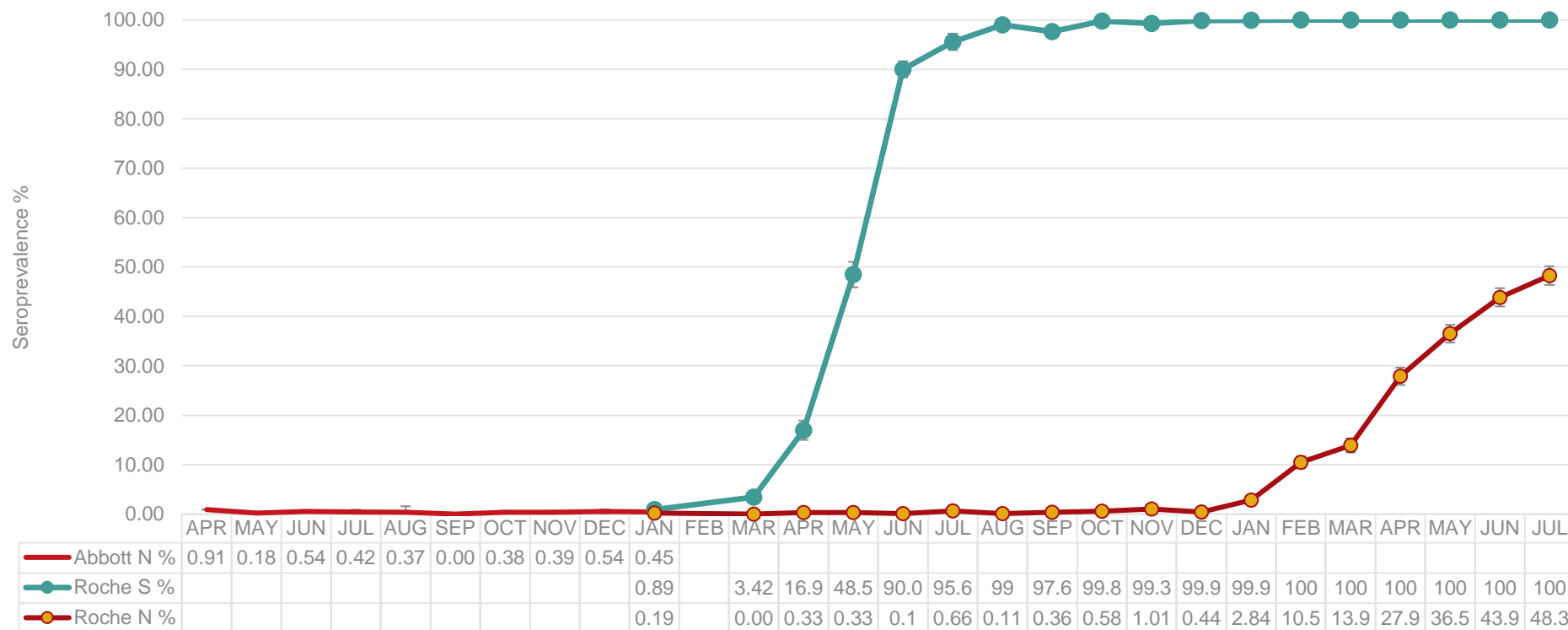
Prairies



Ontario



Atlantic



Note: SARS-CoV-2 seroprevalence rates (95% CI), that have been weighted and adjusted for test characteristics. Data from the CIHR funded study (Correlates of Immunity) from April 9, 2020-January 31, 2021, have been included.

Figure 3. Distributions of log transformed Spike antibody concentration results (U/mL) (grey circle represents the median and the bar represents the IQR) in spike antibody seropositive donations from September 2021 to July 2022 stratified by age group.

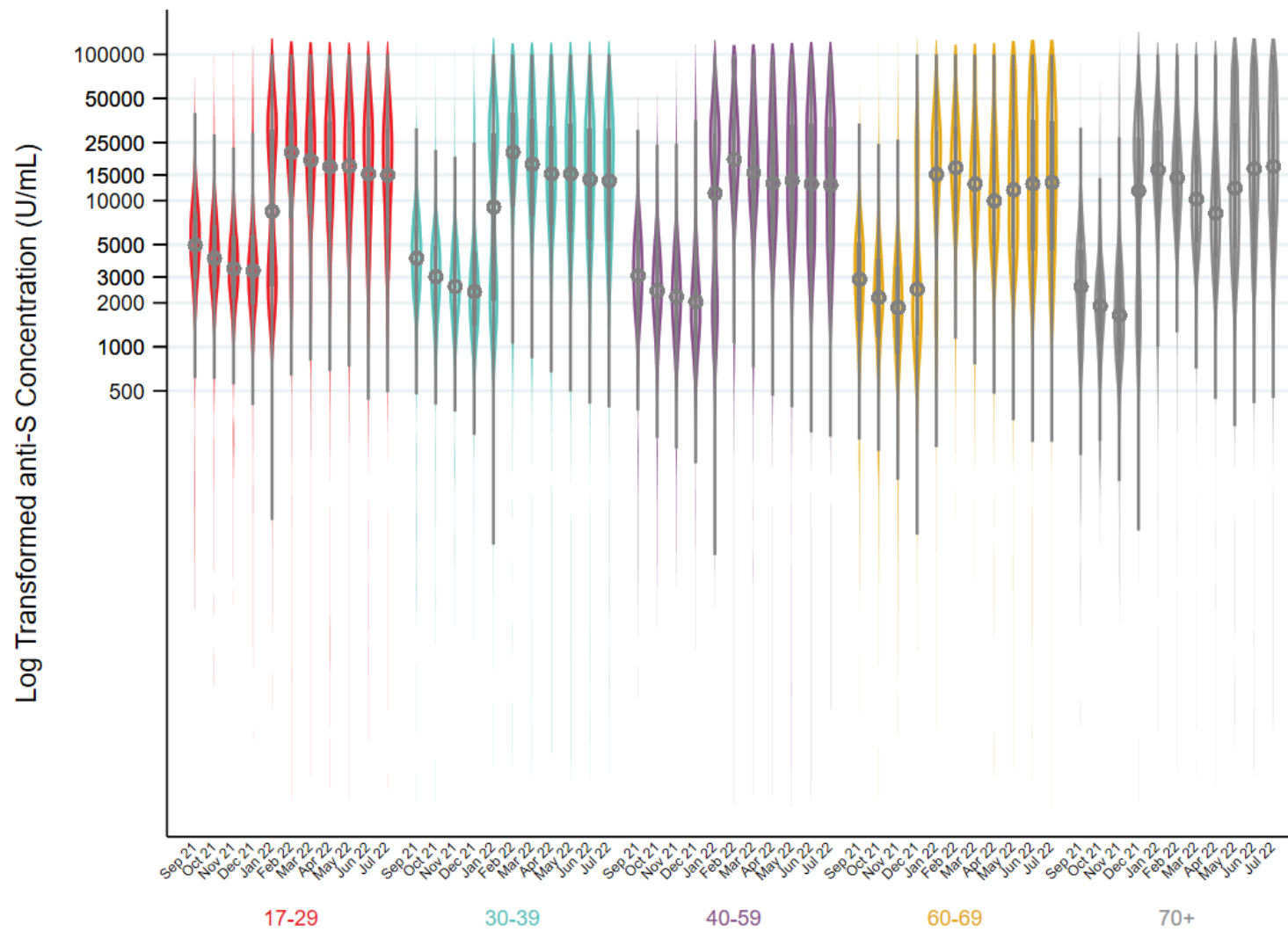
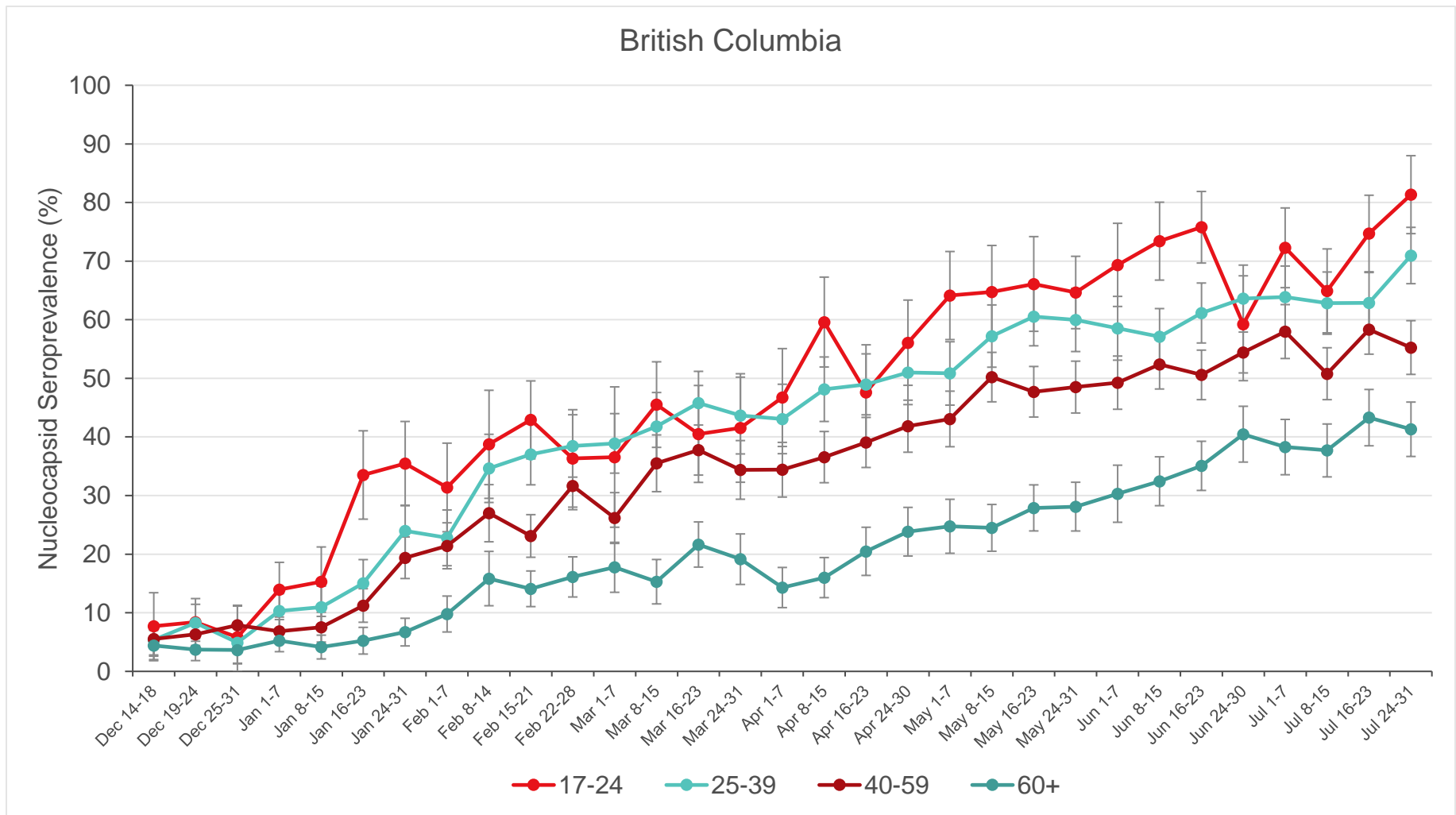
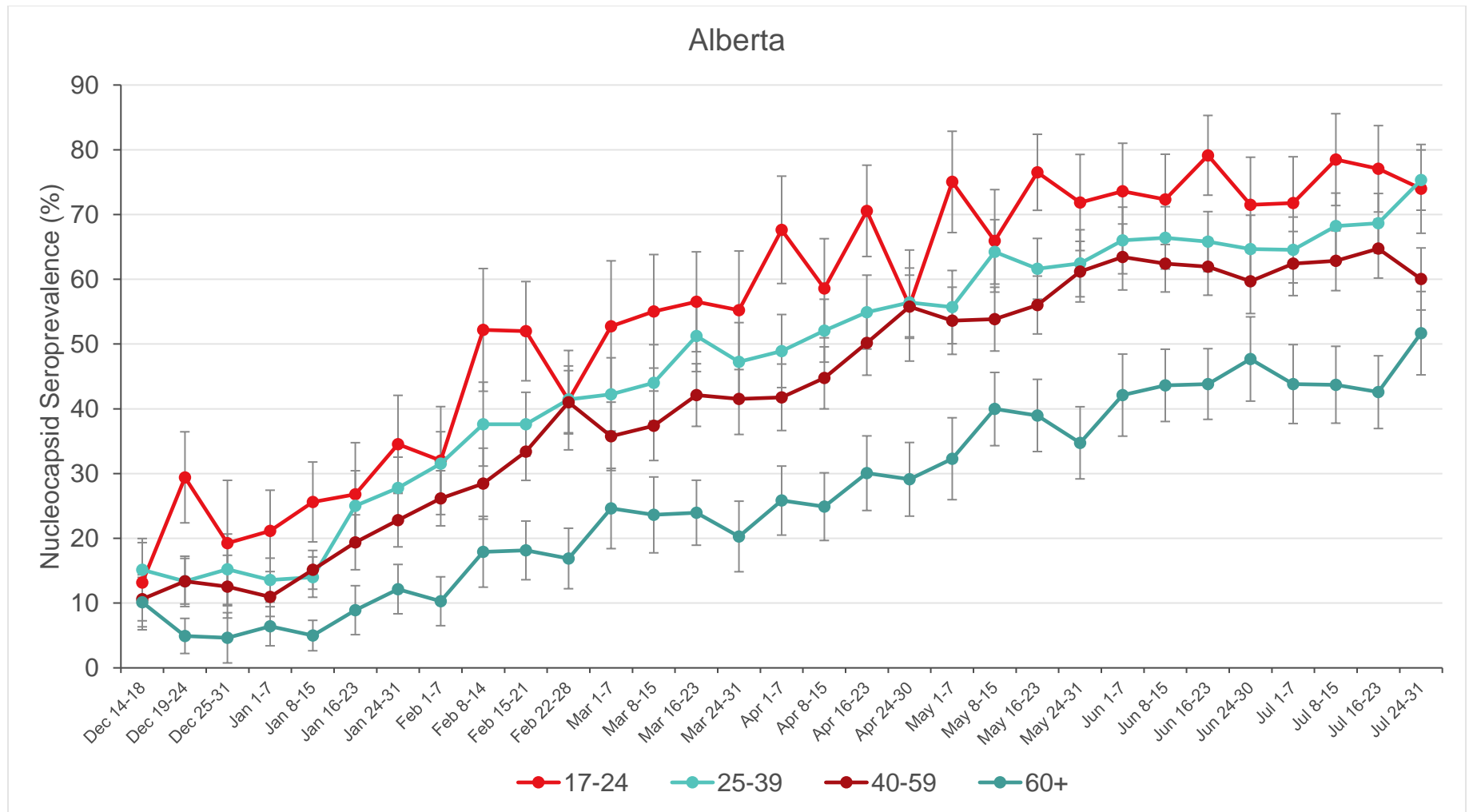
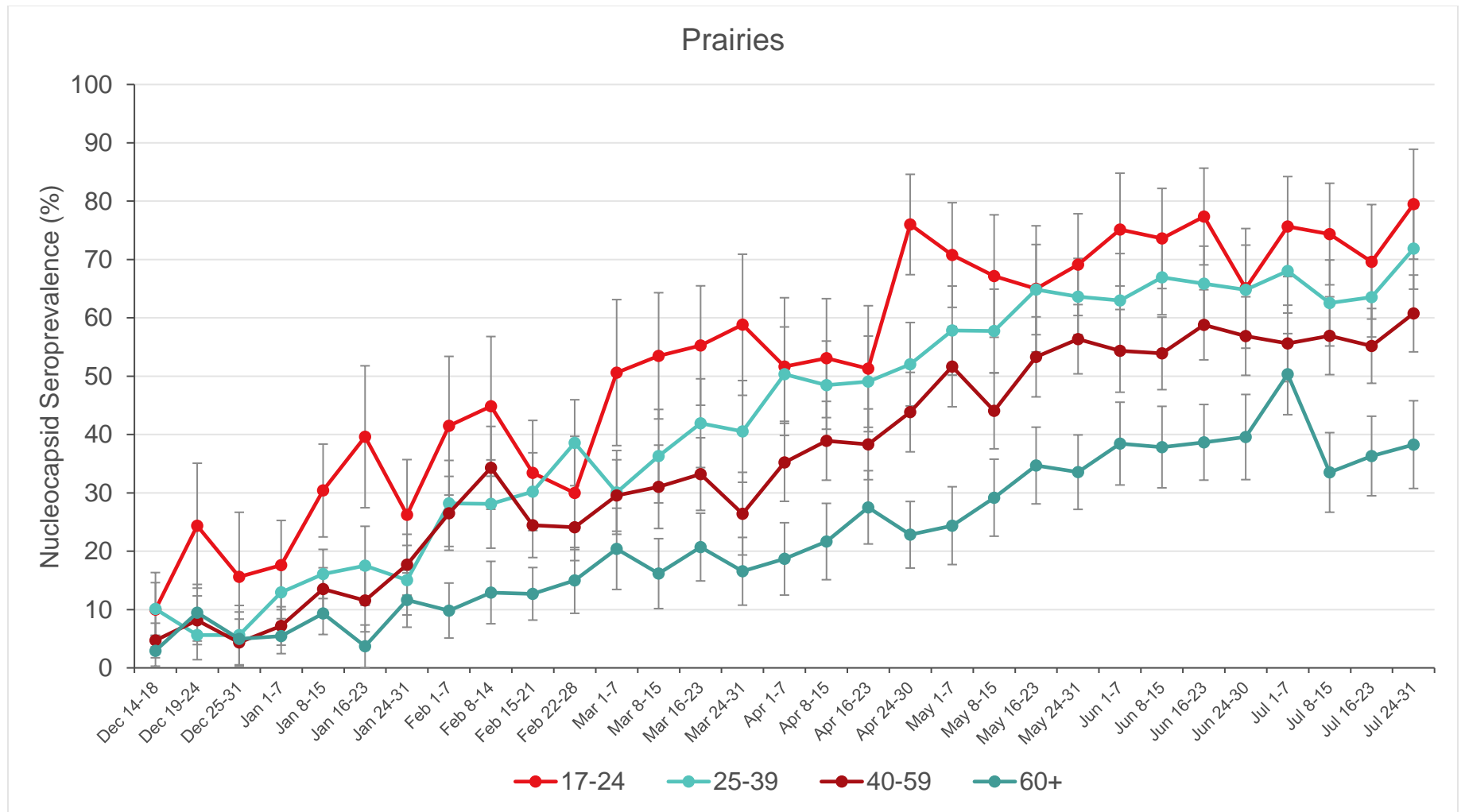
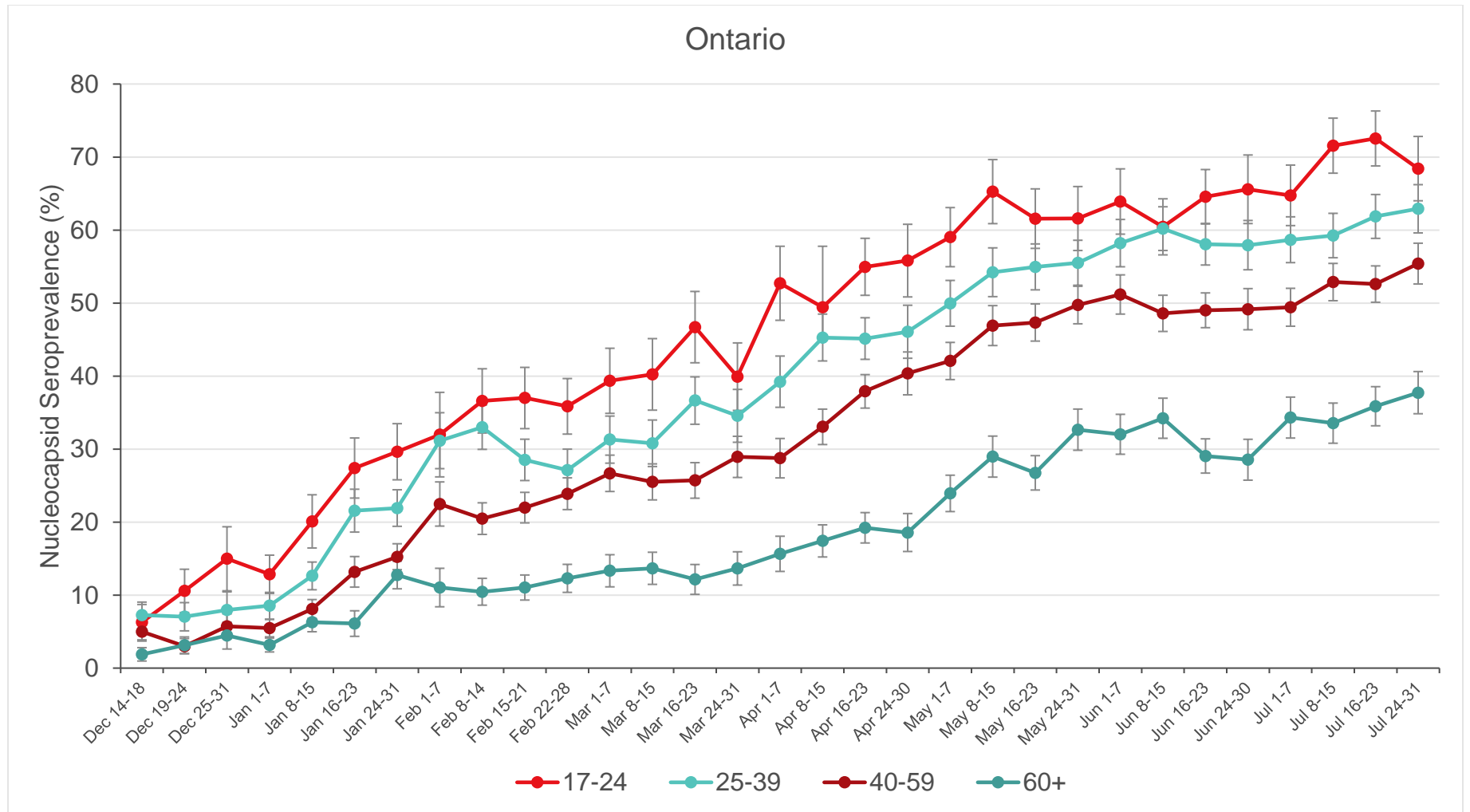


Figure 4. Regional temporal trends of SARS-CoV-2 Nucleocapsid (infection) seroprevalence by age group weekly from December 2021 - July 2022









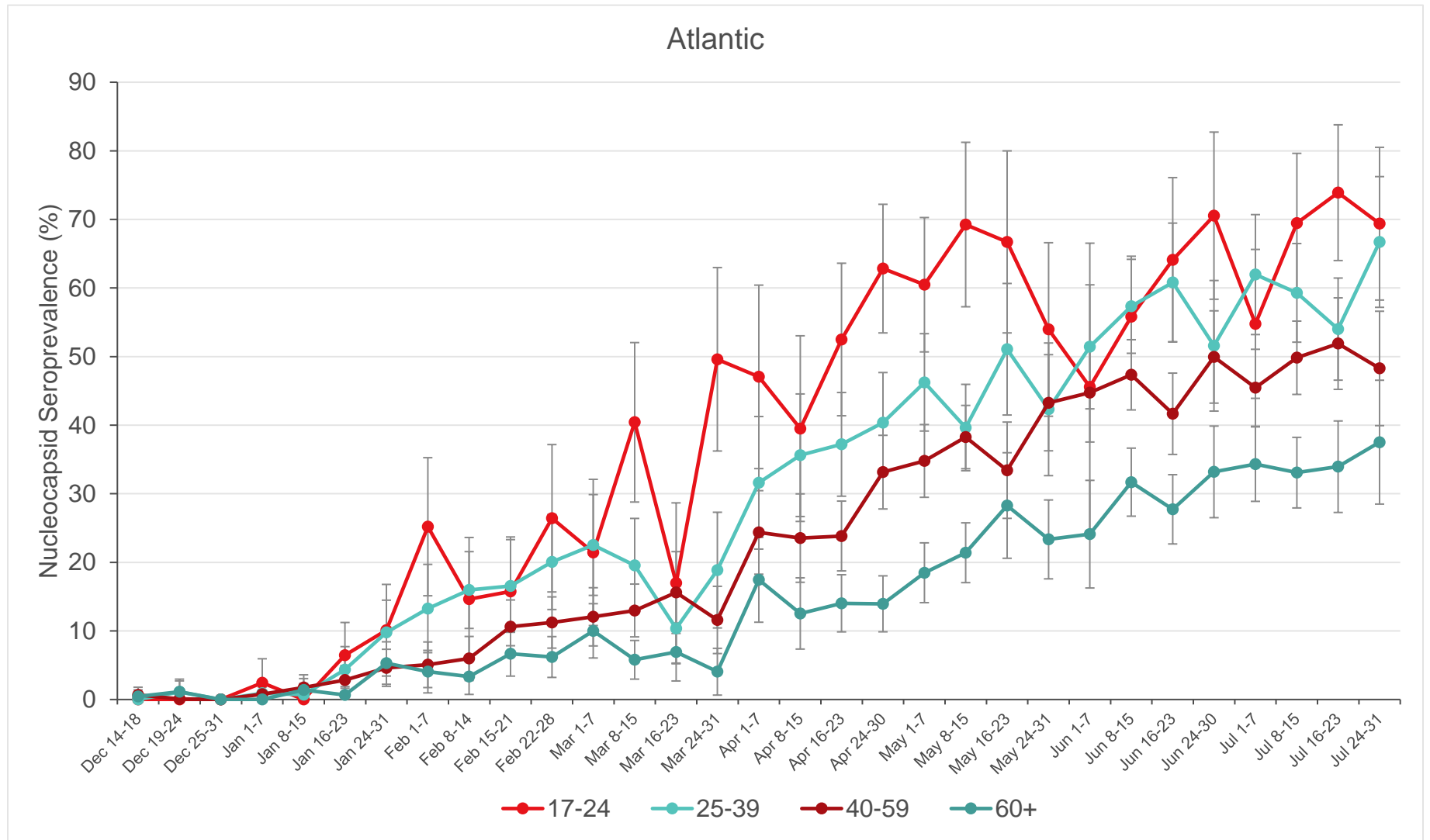


Figure 5A. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Nucleocapsid antibody results by ethnicity.

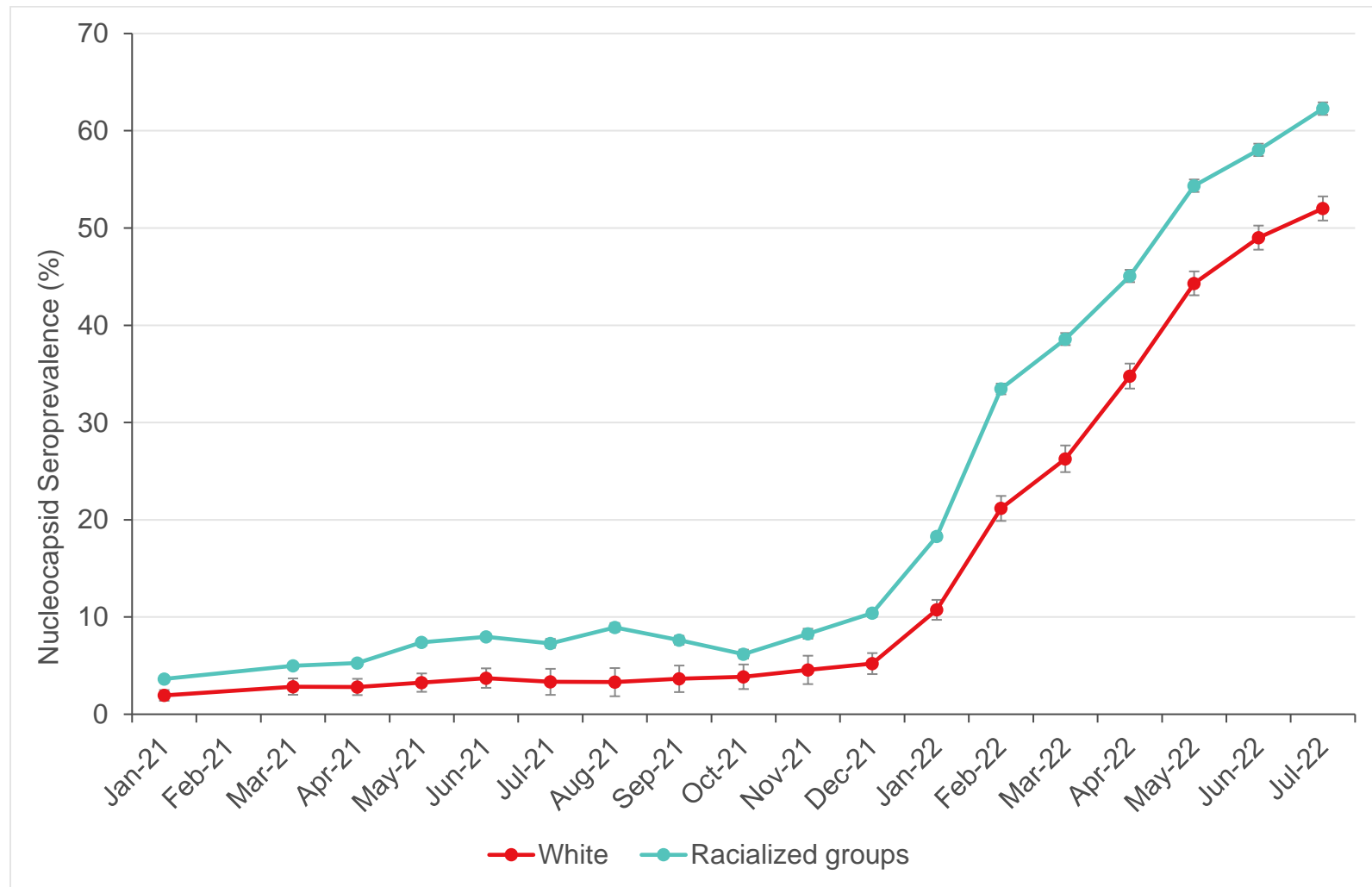


Figure 5B. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Spike antibody results by ethnicity.

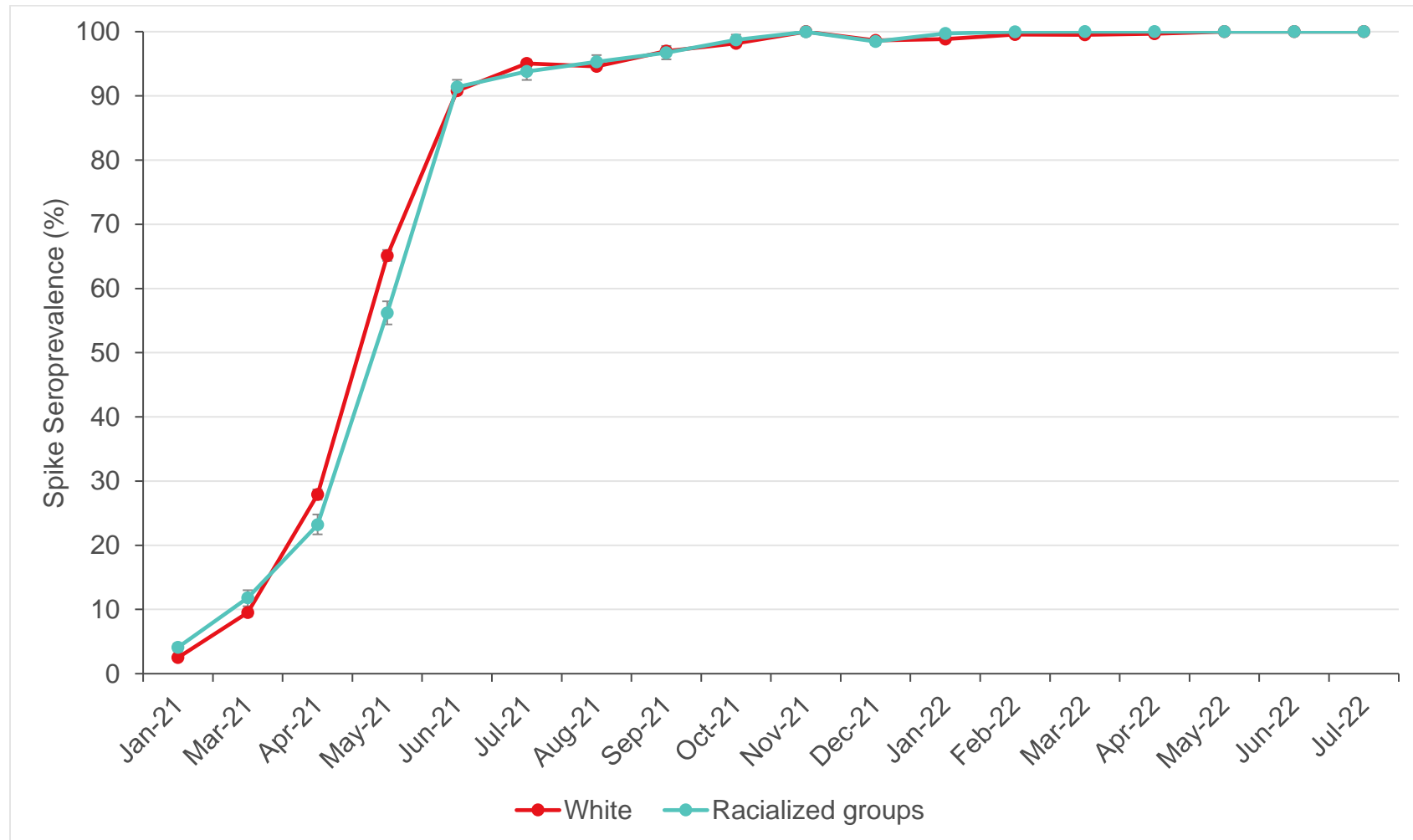


Figure 5C. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Nucleocapsid antibody results by age group.

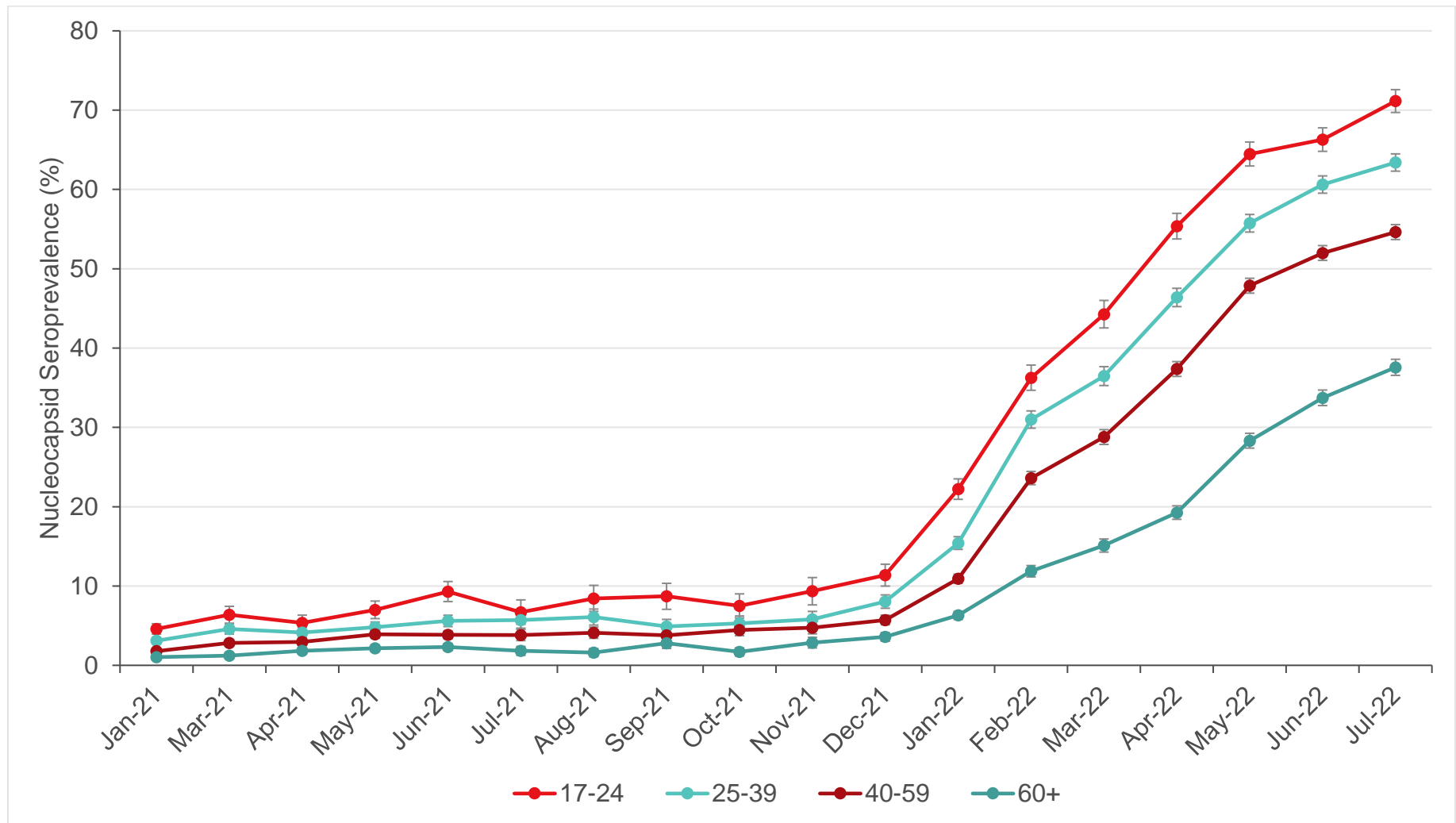


Figure 5D. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Spike antibody results by age group.

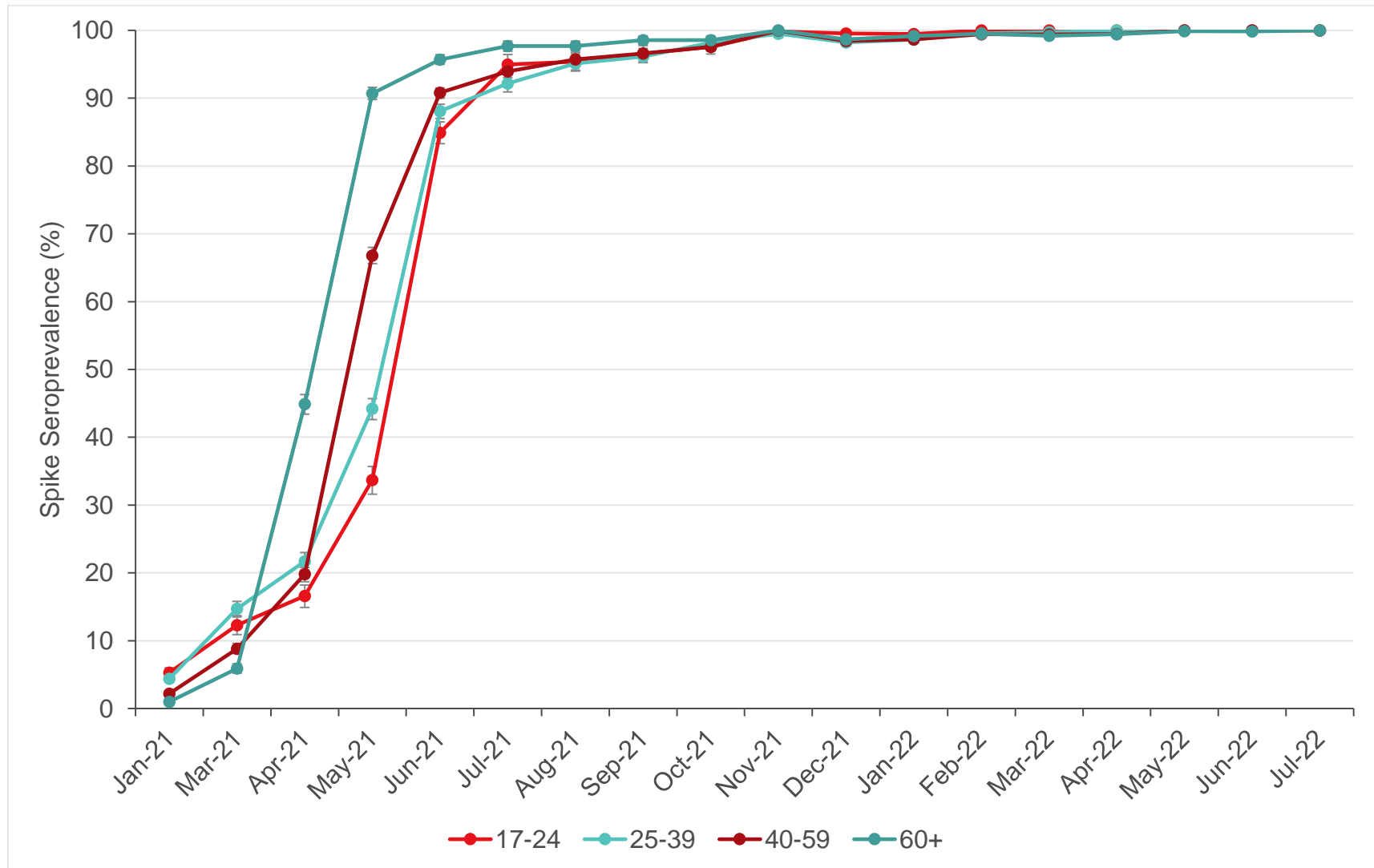


Figure 5E. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Nucleocapsid antibody results by material deprivation level (1 = least deprived and 5 = most deprived).

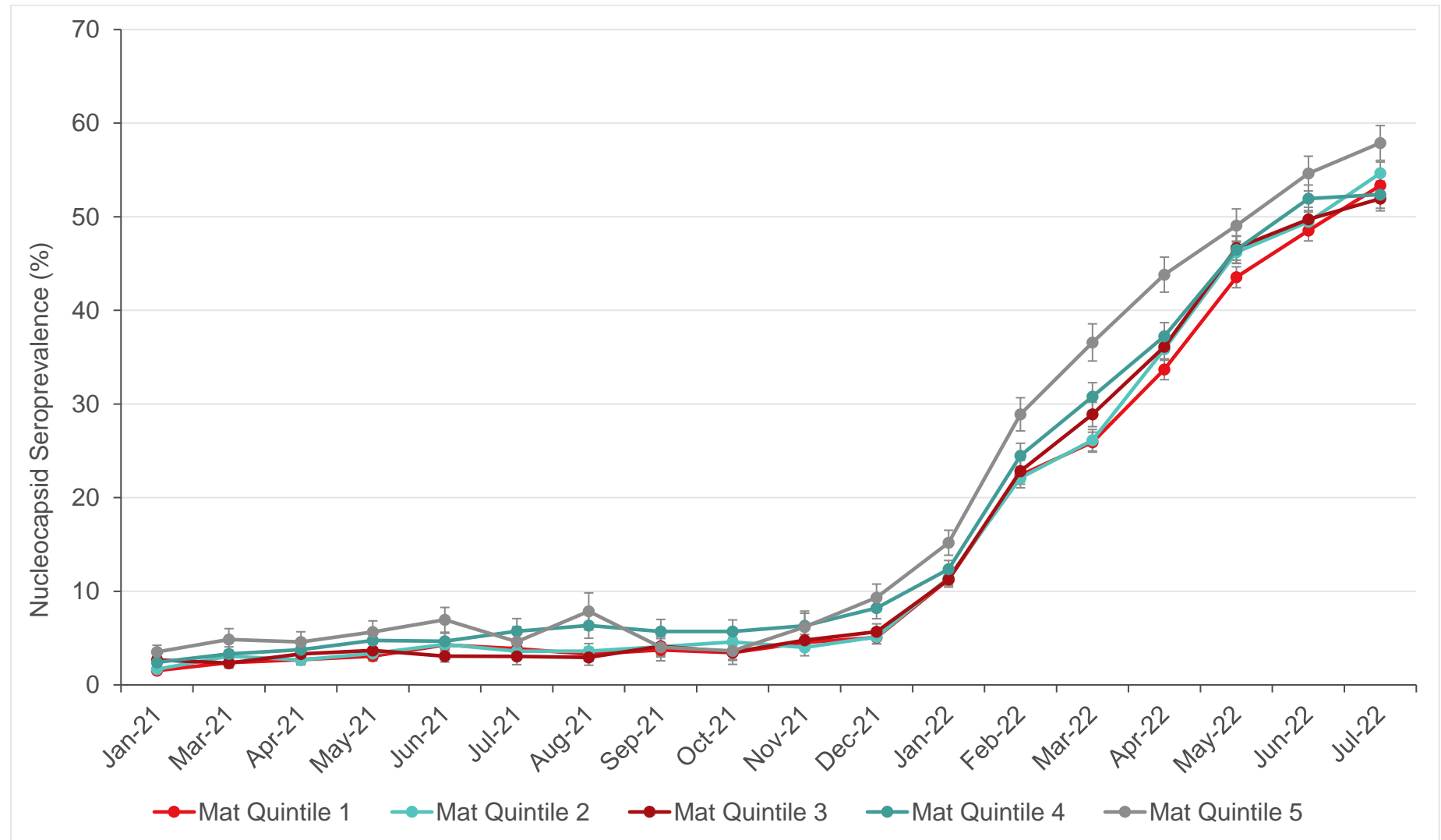


Figure 5F. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Spike antibody results by material deprivation level (1 = least deprived and 5 = most deprived).

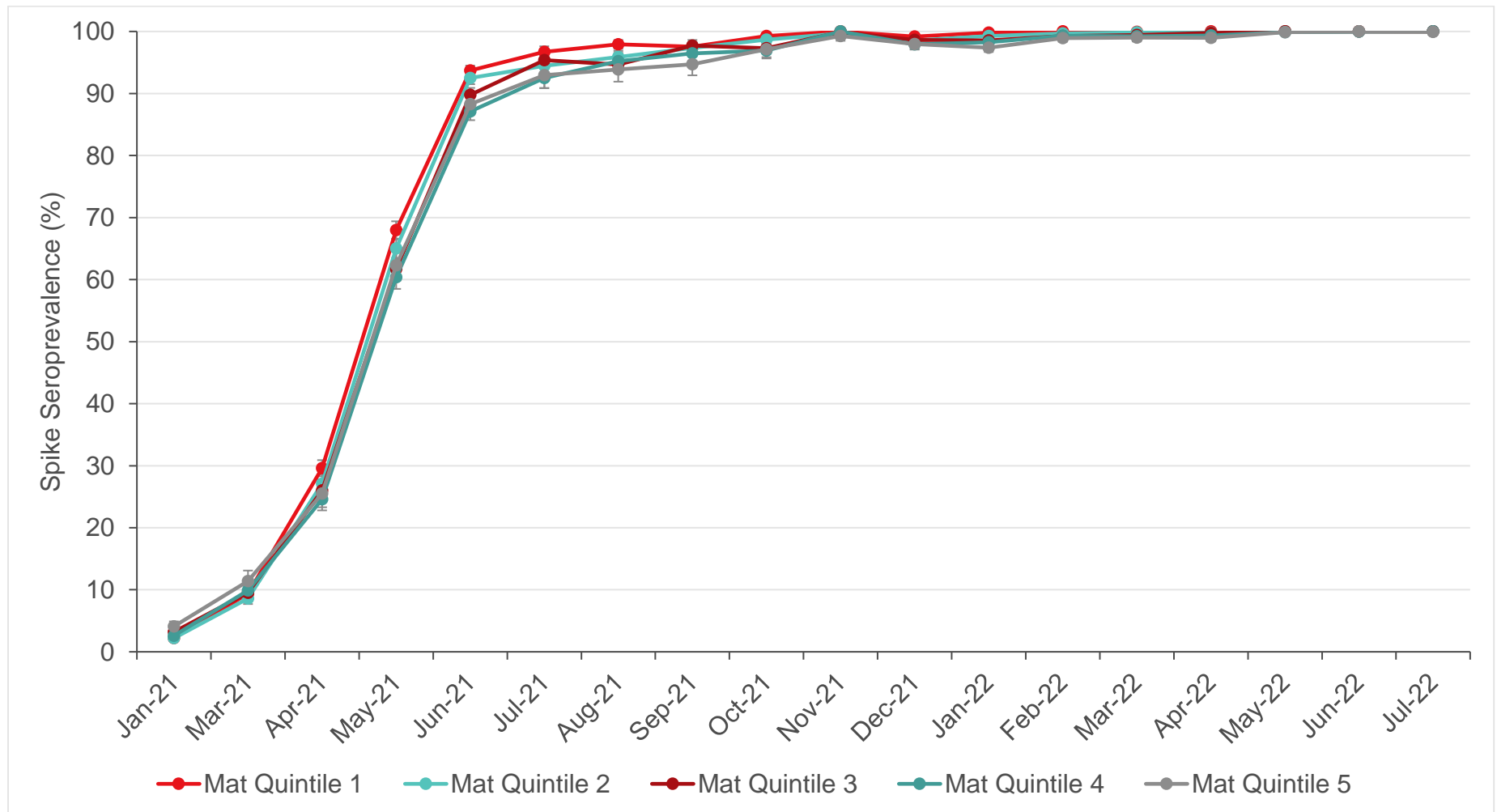


Figure 5G. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Nucleocapsid antibody results by social deprivation level (1 = least deprived and 5 = most deprived).

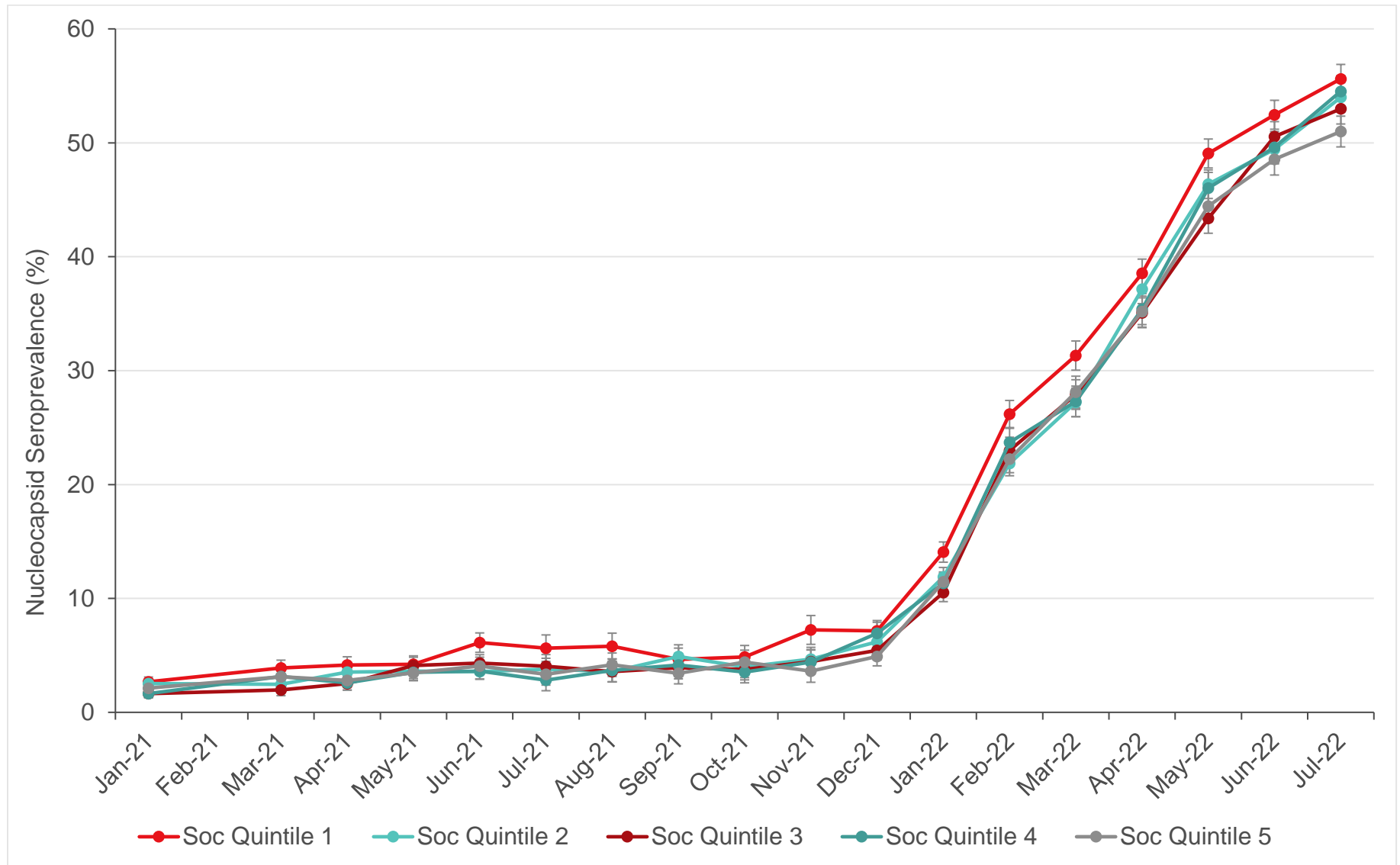


Figure 5H. Temporal trends of SARS-CoV-2 seroprevalence by monthly intervals from January 2021 - July 2022 estimated by Spike antibody results by social deprivation level (1 = least deprived and 5 = most deprived).

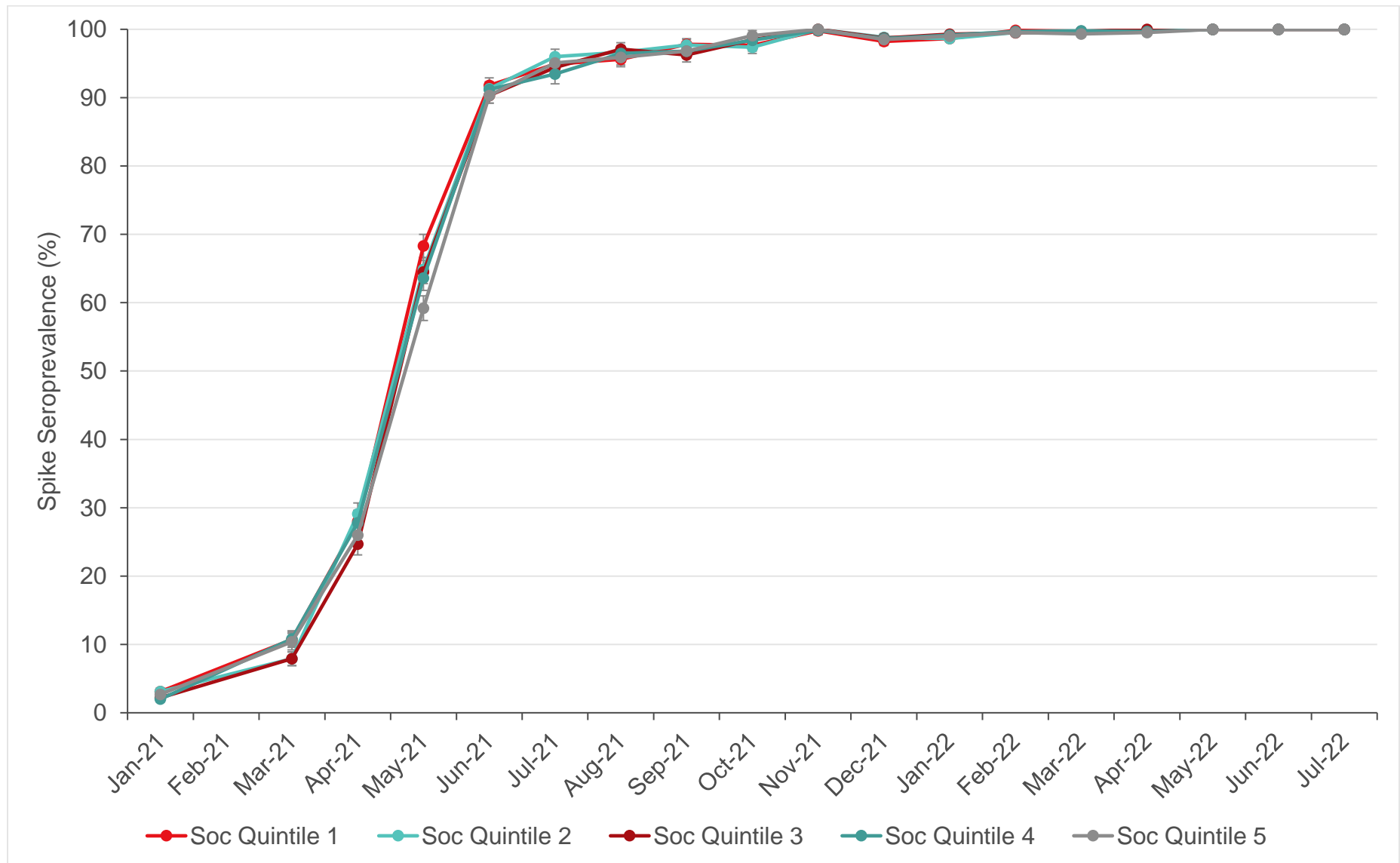


Table A1.1 British Columbia SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike results in July 2022

	Nucleocapsid Antibody Results (proxy for natural infection)				Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	2,035	1,089	53.98	52.13, 55.83	2,035	2,013	99.97	99.56, 100.00
Male	2,635	1,434	56.49	54.59, 58.38	2,635	2,617	100.00	100.00, 100.00
Age								
17-24	269	195	73.44	69.98, 76.91	269	268	100.00	99.97, 100.00
25-39	1,297	838	65.03	62.41, 67.64	1,297	1,292	100.00	100.00, 100.00
40-59	1,627	901	55.74	53.49, 58.00	1,627	1,609	99.95	99.44, 100.00
60+	1,477	589	39.96	37.60, 42.33	1,477	1,461	99.95	99.41, 100.00
Material Deprivation¹								
1 (least)	1,155	634	56.57	53.95, 59.19	1,155	1,148	100.00	99.97, 100.00
2	1,098	590	54.45	51.72, 57.19	1,098	1,092	100.00	99.96, 100.00
3	873	467	54.70	51.61, 57.79	873	866	100.00	99.86, 100.00
4	646	330	51.92	48.29, 55.55	646	636	99.57	98.65, 100.00
5 (most)	313	186	61.83	56.92, 66.75	313	311	99.72	98.50, 100.00
Total	4,670	2,523	55.19	53.87, 56.52	4,670	4,630	100.00	100.00, 100.00

¹Postal codes were missing for 585 (12.5%) of donors which could not be included in the quintiles of Material Deprivation; 316/585 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 54.36% (95% CI 50.58, 58.13); and 577/585 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 99.61% (95% CI 98.66, 100.00).^{*}

Table A1.2 Alberta SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike antibody results in July 2022

	Nucleocapsid Antibody Results (proxy for natural infection)				Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	2,378	1,451	61.37	59.37, 63.38	2,378	2,366	100.00	100.00, 100.00
Male	3,259	1,975	63.27	61.28, 65.26	3,259	3,227	100.00	99.65, 100.00
Age								
17-24	419	313	75.13	71.60, 78.66	419	419	100.00	100.00, 100.00
25-39	1,588	1,092	69.44	66.98, 71.90	1,588	1,578	100.00	99.96, 100.00
40-59	2,098	1,319	62.62	60.23, 65.01	2,098	2,083	100.00	99.80, 100.00
60+	1,532	702	45.21	42.17, 48.26	1,532	1,513	99.94	99.25, 100.00
Material Deprivation¹								
1 (least)	2,121	1,269	60.96	58.59, 63.32	2,121	2,113	100.00	100.00, 100.00
2	1,149	693	61.68	58.55, 64.81	1,149	1,137	99.92	99.19, 100.00
3	814	489	62.14	58.49, 65.78	814	808	100.00	99.59, 100.00
4	441	260	62.54	57.66, 67.43	441	436	99.68	98.45, 100.00
5 (most)	252	168	65.24	58.89, 71.60	252	248	99.80	98.22, 100.00
Total	5,637	3,426	62.32	60.91, 63.73	5,637	5,593	100.00	100.00, 100.00

¹Postal codes were missing for 860 (15.3%) of donors which could not be included in the quintiles of Material Deprivation; 547/860 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 63.85% (95% CI 60.61, 67.09); 851/860 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 100% (95% CI 99.18, 100.00).

Table A1.3 Saskatchewan SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike antibody results in July 2022

	Nucleocapsid Antibody Results (proxy for natural infection)				Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	547	304	57.02	53.07, 60.96	547	541	99.95	99.06, 100.00
Male	845	454	57.16	53.16, 61.16	845	840	100.00	99.51, 100.00
Age								
17-24	119	88	75.36	68.52, 82.19	119	119	99.99	98.28, 100.00
25-39	346	223	65.98	60.75, 71.20	346	345	100.00	99.31, 100.00
40-59	517	290	57.23	52.32, 62.14	517	512	99.96	98.86, 100.00
60+	410	157	40.01	34.74, 45.27	410	405	99.58	98.22, 100.00
Material Deprivation¹								
1 (least)	441	227	53.89	48.60, 59.19	441	439	100.00	99.35, 100.00
2	332	183	58.53	52.81, 64.25	332	330	99.74	98.35, 100.00
3	207	119	59.24	52.18, 66.31	207	204	99.25	97.26, 100.00
4	125	69	56.38	47.79, 64.98	125	123	99.46	97.18, 100.00
5 (most)	70	35	53.27	41.11, 65.43	70	69	99.98	97.28, 100.00
Total	1,392	758	57.09	54.28, 59.90	1,392	1,381	100.00	99.53, 100.00

¹Postal codes were missing for 217(15.6%) of donors which could not be included in the quintiles of Material Deprivation 125/217 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 60.32% (95% CI 53.35, 67.29); 216/217 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 99.65% (95% CI 97.90, 100.00).

Table A1.4 Manitoba SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike antibody results in July 2022

	Nucleocapsid Antibody Results (proxy for natural infection)				Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	689	389	56.16	52.50, 59.82	689	686	100.00	99.77, 100.00
Male	875	479	57.77	54.04, 61.50	875	863	99.84	98.96, 100.00
Age								
17-24	145	108	73.77	67.45, 80.09	145	144	99.40	97.51, 100.00
25-39	400	263	66.63	61.66, 71.59	400	398	100.00	99.18, 100.00
40-59	560	316	56.76	52.24, 61.28	560	556	100.00	99.11, 100.00
60+	459	181	40.11	35.20, 45.02	459	451	99.53	98.23, 100.00
Material Deprivation¹								
1 (least)	327	166	51.28	45.29, 57.27	327	325	99.97	98.65, 100.00
2	306	179	60.28	54.44, 66.11	306	306	100.00	99.52, 100.00
3	351	194	56.65	51.18, 62.12	351	344	99.37	97.88, 100.00
4	243	129	52.94	46.42, 59.46	243	242	100.00	98.72, 100.00
5 (most)	110	60	56.35	46.51, 66.19	110	107	97.61	93.90, 100.00
Total	1,564	868	56.95	54.33, 59.56	1,564	1,549	100.00	99.59, 100.00

¹Postal codes were missing for 227 (14.5%) of donors which could not be included in the quintiles of Material Deprivation; 140/227 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 65.18% (95% CI 58.61, 71.74); 225/227 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 99.57% (95% CI 97.84, 100.00).

Table A1.5 Ontario SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike antibody results in July 2022

Nucleocapsid Antibody Results (proxy for natural infection)					Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	6,209	3,118	49.90	48.81, 50.99	6,209	6,171	100.00	100.00, 100.00
Male	8,727	4,478	53.59	52.46, 54.72	8,727	8,633	100.00	99.96, 100.00
Age								
17-24	1,051	719	69.41	67.38, 71.44	1,051	1,050	100.00	100.00, 100.00
25-39	4,002	2,384	60.67	59.09, 62.25	4,002	3,961	100.00	99.98, 100.00
40-59	5,755	3,022	52.54	51.22, 53.86	5,755	5,708	100.00	100.00, 100.00
60+	4,128	1,471	35.17	33.76, 36.58	4,128	4,085	99.99	99.67, 100.00
Material Deprivation¹								
1 (least)	3,413	1,632	49.04	47.43, 50.65	3,413	3,392	100.00	100.00, 100.00
2	3,212	1,684	53.05	51.33, 54.77	3,212	3,186	100.00	100.00, 100.00
3	2,957	1,433	48.17	46.37, 49.97	2,957	2,923	99.99	99.59, 100.00
4	2,368	1,211	52.38	50.42, 54.34	2,368	2,345	100.00	99.73, 100.00
5 (most)	1,410	805	58.94	56.49, 61.40	1,410	1,395	100.00	99.52, 100.00
Total	14,936	7,596	51.68	50.89, 52.46	14,936	14,804	100.00	100.00, 100.00

¹Postal codes were missing for 1,576 (10.6%) of donors which could not be included in the quintiles of Material Deprivation; 831/1576 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 53.33% (95% CI 50.93, 55.74); 1563/1576 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 10.00% (95% CI 99.83, 100.00).

Table A1.6 Atlantic Provinces SARS-CoV-2 seroprevalence, Nucleocapsid vs. Spike antibody results in July 2022

	Nucleocapsid Antibody Results (proxy for natural infection)				Spike Antibody Results (proxy for humoral immunity by either natural infection or vaccination)			
	Crude		Adjusted		Crude		Adjusted	
	Number Tested	Number Positive	Percent Positive	95% Confidence Interval	Number Tested	Number Positive	Percent Positive	95% Confidence Interval
Sex								
Female	1,367	660	49.46	46.84, 52.07	1,367	1,362	100.00	100.00, 100.00
Male	1,709	778	46.99	44.28, 49.70	1,709	1,696	100.00	99.75, 100.00
Age								
17-24	186	122	66.28	60.88, 71.69	186	186	100.00	99.66, 100.00
25-39	654	386	59.50	55.40, 63.61	654	651	100.00	99.51, 100.00
40-59	1,197	580	49.27	46.12, 52.43	1,197	1,185	100.00	99.36, 100.00
60+	1,039	350	34.32	31.21, 37.43	1,039	1,036	100.00	100.00, 100.00
Material Deprivation¹								
1 (least)	487	242	51.75	46.91, 56.58	487	486	100.00	99.93, 100.00
2	682	327	48.00	43.86, 52.14	682	680	100.00	100.00, 100.00
3	596	274	49.20	44.91, 53.49	596	595	100.00	100.00, 100.00
4	631	272	44.99	40.89, 49.09	631	623	99.98	99.08, 100.00
5 (most)	415	196	47.70	42.93, 52.47	415	409	99.95	98.88, 100.00
Total	3,076	1,438	48.27	46.38, 50.15	3,076	3,058	100.00	100.00, 100.00

¹Postal codes were missing for 265 (8.6%) of donors which could not be included in the quintiles of Material Deprivation; 127/265 were positive by the Nucleocapsid antibody, adjusted SARS-CoV-2 seroprevalence among missing postal codes was 49.68% (95% CI 43.19, 56.17); 265/265 were positive by the Spike antibody, adjusted SARS-CoV-2 seroprevalence was 100% (95% CI 99.21, 100.00).

Table A2.1. Weekly SARS-CoV-2 seroprevalence by sociodemographic variables by Nucleocapsid results in July 2022

	July 1-7			July 8-15			July 16-23			July 24-31		
	Crude	Adjusted		Crude	Adjusted		Crude	Adjusted		Crude	Adjusted	
	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI
Sex												
Female	3,386 (1,750)	51.32	49.80, 52.85	3,449 (1,785)	52.26	50.74, 53.77	3,558 (1,882)	52.26	50.76, 53.76	2,975 (1,651)	55.22	53.62, 56.83
Male	4,656 (2,378)	53.41	51.82, 55.00	5,004 (2,563)	53.15	51.62, 54.68	5,023 (2,727)	57.16	55.65, 58.67	4,048 (2,264)	57.92	56.25, 59.59
Age												
17-24	573 (387)	67.31	64.41, 70.21	575 (413)	71.44	68.67, 74.20	573 (410)	73.44	70.73, 76.15	486 (347)	72.45	69.45, 75.44
25-39	2,071 (1,258)	61.61	59.41, 63.80	2,181 (1,317)	61.56	59.42, 63.70	2,278 (1,415)	62.80	60.73, 64.87	1,876 (1,267)	67.88	65.69, 70.07
40-59	2,991 (1,566)	52.60	50.73, 54.46	3,180 (1,707)	53.91	52.10, 55.71	3,226 (1,807)	55.54	53.74, 57.33	2,614 (1,472)	56.21	54.23, 58.19
60+	2,407 (917)	37.52	35.52, 39.51	2,517 (911)	35.43	33.49, 37.36	2,504 (977)	37.91	35.94, 39.89	2,047 (829)	40.13	37.99, 42.27
Province												
British Columbia	1,127 (603)	55.16	52.49, 57.83	1,210 (614)	51.12	48.52, 53.72	1,252 (695)	57.08	54.52, 59.63	1,201 (673)	57.38	54.75, 60.00
Alberta	1,445 (839)	60.10	57.23, 62.97	1,495 (891)	61.68	58.86, 64.50	1,605 (974)	62.24	59.57, 64.90	1,399 (888)	64.80	62.01, 67.60
Saskatchewan	368 (211)	61.20	55.87, 66.53	352 (188)	57.33	51.69, 62.97	369 (184)	51.18	45.75, 56.62	320 (183)	59.21	53.49, 64.93
Manitoba	381 (217)	58.71	53.59, 63.82	400 (200)	51.99	46.85, 57.13	420 (233)	56.59	51.56, 61.61	367 (218)	60.70	55.36, 66.04
Ontario	3,794 (1,859)	49.42	47.86, 50.97	3,950 (1,980)	51.64	50.12, 53.16	4,177 (2,161)	52.50	51.01, 53.99	3,249 (1,706)	53.34	51.70, 54.98
New Brunswick	357 (163)	47.01	41.80, 52.21	202 (95)	48.00	41.06, 54.94	203 (105)	52.59	45.97, 59.21	112 (54)	52.68	43.75, 61.61
Nova Scotia	423 (163)	38.07	32.58, 43.55	517 (212)	41.45	36.32, 46.58	380 (177)	47.55	41.49, 53.61	281 (140)	49.76	42.61, 56.90
Prince Edward Island	80 (38)	48.28	32.49, 64.07	124 (61)	48.87	36.59, 61.16	78 (33)	46.21	31.24, 61.17	45 (24)	53.29	32.87, 73.71
Newfoundland	67 (35)	55.27	45.64, 64.90	203 (107)	54.09	48.44, 59.73	97 (47)	50.37	41.94, 58.80	49 (29)	61.50	50.65, 72.34
Metro area												

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Vancouver	646 (360)	56.76	53.33, 60.18	579 (313)	54.35	50.74, 57.97	669 (399)	60.73	57.43, 64.04	638 (394)	61.22	57.82, 64.62
Calgary	476 (285)	60.25	54.82, 65.68	624 (388)	64.71	60.07, 69.35	594 (366)	63.82	59.01, 68.62	605 (383)	64.54	59.80, 69.28
Edmonton	420 (224)	54.96	49.89, 60.03	437 (237)	56.01	51.02, 61.00	573 (335)	58.51	54.35, 62.67	458 (278)	60.93	56.45, 65.42
Ottawa	345 (137)	41.61	35.52, 47.69	456 (188)	41.47	36.15, 46.79	371 (174)	45.68	39.61, 51.76	324 (156)	49.01	42.70, 55.33
Toronto	1,328 (700)	51.39	49.12, 53.67	1,289 (687)	54.33	52.01, 56.66	1,186 (651)	54.89	52.48, 57.31	1,048 (605)	57.30	54.81, 59.79
Winnipeg	212 (105)	50.59	43.42, 57.77	253 (119)	48.10	41.47, 54.74	275 (158)	59.37	53.04, 65.70	278 (160)	58.38	51.97, 64.79
Ethnicity¹												
White	6,092 (3,020)	50.43	49.14, 51.71	6,466 (3,242)	51.08	49.84, 52.32	6,588 (3,436)	52.67	51.44, 53.90	5,289 (2,848)	54.09	52.73, 55.44
Indigenous	92 (51)	58.96	49.23, 68.69	123 (73)	61.91	53.64, 70.19	117 (66)	56.08	46.89, 65.26	104 (61)	62.52	53.23, 71.80
Asian	417 (223)	50.91	46.47, 55.35	427 (220)	53.02	48.43, 57.61	416 (215)	52.44	47.86, 57.03	408 (226)	55.60	51.08, 60.11
Other racialized groups	908 (575)	65.18	62.16, 68.20	920 (570)	64.05	61.03, 67.07	907 (589)	68.47	65.47, 71.47	801 (548)	71.08	68.03, 74.13
Social Deprivation²												
1 (least deprived)	1,585 (877)	57.02	54.54, 59.50	1,587 (855)	54.06	51.61, 56.52	1,615 (869)	55.21	52.78, 57.64	1,275 (716)	55.97	53.23, 58.70
2	1,466 (733)	50.80	48.22, 53.38	1,588 (839)	54.80	52.31, 57.29	1,563 (820)	54.28	51.77, 56.79	1,340 (738)	56.47	53.82, 59.11
3	1,425 (705)	50.23	47.62, 52.84	1,416 (718)	52.96	50.33, 55.60	1,513 (813)	54.87	52.37, 57.37	1,242 (654)	54.11	51.36, 56.86
4	1,308 (652)	50.81	48.10, 53.51	1,335 (716)	55.47	52.76, 58.17	1,456 (768)	53.49	50.87, 56.11	1,115 (640)	58.57	55.70, 61.44
5 (most deprived)	1,347 (642)	49.27	46.59, 51.95	1,498 (709)	47.99	45.46, 50.51	1,426 (760)	52.87	50.23, 55.50	1,184 (649)	53.81	50.96, 56.67
Material Deprivation²												
1 (least deprived)	1,857 (917)	50.65	48.36, 52.93	2,175 (1,140)	53.44	51.31, 55.57	2,248 (1,184)	54.19	52.10, 56.29	1,916 (1,042)	54.11	51.83, 56.40
2	1,763 (919)	53.06	50.70, 55.43	1,819 (982)	55.18	52.85, 57.51	1,886 (1,018)	54.09	51.80, 56.38	1,498 (846)	57.35	54.81, 59.89
3	1,580 (792)	50.89	48.38, 53.39	1,600 (785)	49.94	47.45, 52.43	1,582 (822)	52.75	50.26, 55.24	1,172 (636)	54.64	51.80, 57.48
4	1,252 (611)	49.79	47.00, 52.57	1,077 (520)	50.78	47.83, 53.74	1,233 (647)	53.62	50.84, 56.41	1,006 (535)	54.79	51.80, 57.77
5 (most deprived)	679 (370)	56.78	53.12, 60.43	753 (410)	56.18	52.72, 59.63	624 (359)	58.97	55.18, 62.75	564 (338)	60.64	56.83, 64.44
Total	8,042 (4,128)	52.32	51.22, 53.42	8,453 (4,348)	52.70	51.62, 53.77	8,581 (4,609)	54.68	53.61, 55.74	7,023 (3,915)	56.51	55.35, 57.67

¹ In Week 1, self reported ethnicity was missing for 533 (6.6%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 49.99% (95% CI 45.76, 54.22).
 In Week 2, self reported ethnicity was missing for 517 (6.1%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 48.15% (95% CI 43.86, 52.44).
 In Week 3, self reported ethnicity was missing for 553 (6.4%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 56.34% (95% CI 52.12, 60.58).
 In Week 4, self reported ethnicity was missing for 421 (6.0%) donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 56.37% (95% CI 51.65, 61.10).

² In Week 1, postal codes were missing for 911 (11.3%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 56.88% (95% CI 53.61, 60.15).
 In Week 2, postal codes were missing for 1029 (12.2%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 50.43% (95% CI 47.33, 53.52).
 In Week 3, postal codes were missing for 1008 (11.7%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 58.39% (95% CI 55.29, 61.50).
 In Week 4, postal codes were missing for 867 (12.3%) of donors; Adjusted seroprevalence by the Nucleocapsid antibody assay was 61.72% (95% CI 58.50, 64.94).

Table A2.2. Weekly SARS-CoV-2 seroprevalence by province and age group by Nucleocapsid results in July 2022

	July 1-7			July 8-15			July 16-23			July 24-31		
	Adjusted			Adjusted			Adjusted			Adjusted		
	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI	N Tested (N Positive)	Percent Positive	95% CI
British Columbia												
17-24	68 (48)	72.27	65.47, 79.07	72 (47)	64.92	57.76, 72.08	72 (51)	74.71	68.18, 81.24	60 (49)	81.34	74.69, 87.99
25-39	316 (203)	63.86	58.55, 69.16	317 (197)	62.83	57.52, 68.14	336 (210)	62.87	57.68, 68.05	351 (246)	70.95	66.15, 75.76
40-59	386 (219)	57.98	53.38, 62.58	424 (216)	50.79	46.36, 55.22	460 (267)	58.32	54.12, 62.52	398 (219)	55.26	50.67, 59.84
60+	357 (133)	38.27	33.55, 42.99	397 (154)	37.70	33.18, 42.21	384 (167)	43.30	38.49, 48.10	392 (159)	41.31	36.67, 45.95
Total	1,127 (603)	55.16	52.49, 57.83	1,210 (614)	51.12	48.52, 53.72	1,252 (695)	57.08	54.52, 59.63	1,201 (673)	57.37	54.75, 60.00
Alberta												
17-24	110 (76)	71.76	64.60, 78.92	95 (75)	78.48	71.39, 85.57	113 (87)	77.06	70.39, 83.73	110 (81)	73.97	67.11, 80.82
25-39	403 (260)	64.53	59.44, 69.61	389 (260)	68.23	63.14, 73.31	464 (315)	68.64	64.03, 73.25	384 (287)	75.32	70.67, 79.97
40-59	514 (318)	62.43	57.48, 67.38	566 (355)	62.87	58.25, 67.49	568 (372)	64.73	60.19, 69.27	530 (321)	60.05	55.26, 64.84
60+	418 (185)	43.82	37.73, 49.91	445 (201)	43.71	37.78, 49.65	460 (200)	42.58	36.96, 48.19	375 (199)	51.68	45.24, 58.11
Total	1,445 (839)	60.10	57.23, 62.97	1,495 (891)	61.68	58.86, 64.50	1,605 (974)	62.24	59.57, 64.90	1,399 (888)	64.80	62.01, 67.60
Saskatchewan												
17-24	31 (24)	78.19	65.41, 90.97	30 (22)	76.23	62.70, 89.76	31 (22)	71.21	57.32, 85.10	29 (22)	77.07	63.68, 90.46
25-39	82 (54)	70.95	60.62, 81.28	90 (52)	61.26	50.78, 71.74	96 (56)	56.85	46.76, 66.94	79 (62)	77.89	68.41, 87.37
40-59	138 (75)	56.20	46.90, 65.51	124 (75)	61.17	51.26, 71.08	136 (69)	51.05	41.40, 60.70	122 (74)	62.07	52.34, 71.80
60+	117 (58)	52.25	42.33, 62.17	108 (39)	39.89	29.21, 50.56	106 (37)	35.99	25.96, 46.03	90 (25)	28.13	17.99, 38.27
Total	368 (211)	61.20	55.87, 66.53	352 (188)	57.33	51.69, 62.97	369 (184)	51.18	45.75, 56.62	320 (183)	59.21	53.49, 64.93
Manitoba												

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17-24	43 (32)	73.81	62.31, 85.31	46 (34)	74.23	61.45, 87.01	33 (23)	68.10	54.26, 81.94	23 (19)	82.25	69.16, 95.34
25-39	96 (62)	65.52	55.49, 75.55	91 (57)	62.88	52.87, 72.89	110 (76)	69.81	60.74, 78.88	103 (68)	66.77	56.93, 76.61
40-59	124 (68)	55.04	45.82, 64.26	136 (74)	54.59	46.16, 63.02	155 (89)	58.53	49.99, 67.06	145 (85)	59.67	50.74, 68.61
60+	118 (55)	48.52	38.79, 58.24	127 (35)	27.55	19.73, 35.38	122 (45)	36.60	27.30, 45.89	96 (46)	47.32	36.69, 57.95
Total	381 (217)	58.71	53.59, 63.82	400 (200)	51.99	46.85, 57.13	420 (233)	56.59	51.56, 61.61	367 (218)	60.70	55.36, 66.04
Ontario												
17-24	273 (181)	64.75	60.61, 68.90	282 (201)	71.56	67.79, 75.33	274 (192)	72.55	68.78, 76.31	224 (147)	68.41	64.01, 72.82
25-39	1,029 (594)	58.67	55.54, 61.81	1,081 (627)	59.25	56.21, 62.29	1,079 (650)	61.86	58.86, 64.87	842 (527)	62.92	59.61, 66.22
40-59	1,446 (715)	49.43	46.83, 52.02	1,523 (791)	52.87	50.32, 55.43	1,634 (873)	52.60	50.11, 55.09	1,232 (683)	55.40	52.61, 58.20
60+	1,046 (369)	34.31	31.51, 37.12	1,064 (361)	33.55	30.80, 36.30	1,190 (446)	35.87	33.19, 38.55	951 (349)	37.73	34.84, 40.62
Total	3,794 (1,859)	49.42	47.86, 50.97	3,950 (1,980)	51.64	50.12, 53.16	4,177 (2,161)	52.50	51.01, 53.99	3,249 (1,706)	53.34	51.70, 54.98
Atlantic Canada												
17-24	48 (26)	54.76	43.91, 65.62	50 (34)	69.47	59.31, 79.63	50 (35)	73.90	64.00, 83.79	40 (29)	69.37	58.24, 80.51
25-39	145 (85)	61.96	53.21, 70.70	213 (124)	59.29	52.10, 66.48	193 (108)	54.01	46.56, 61.45	117 (77)	66.71	57.18, 76.24
40-59	383 (171)	45.45	39.84, 51.06	407 (196)	49.83	44.48, 55.17	273 (137)	51.89	45.22, 58.56	187 (90)	48.27	39.93, 56.61
60+	351 (117)	34.32	28.89, 39.75	376 (121)	33.08	27.93, 38.22	242 (82)	33.94	27.27, 40.61	143 (51)	37.52	28.49, 46.55
Total	927 (399)	44.75	41.30, 48.21	1,046 (475)	47.52	44.29, 50.75	758 (362)	49.72	45.90, 53.54	487 (247)	53.04	48.20, 57.88
Overall Total	8,042 (4,128)	52.32	51.22, 53.42	8,453 (4,348)	52.70	51.62, 53.77	8,581 (4,609)	54.68	53.61, 55.74	7,023 (3,915)	56.51	55.35, 57.67