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Short Communication

National population prevalence of antibodies to SARS-CoV-2 among pregnant women in Scotland during the second wave of the COVID-19 pandemic: a prospective national serosurvey

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ABSTRACT

Objectives: This study aimed to determine SARS-CoV-2 seroprevalence among pregnant women in the Scottish population during the second wave of the COVID-19 pandemic.
Study design: Prospective national serosurvey.
Methods: We tested 13,428 residual samples retrieved from pregnant women participating in the first trimester combined ultrasound and biochemical screening for fetal trisomy across Scotland for SARS-CoV-2 antibodies over a 6-month period from November 2020 to April 2021. Seroprevalence estimates were adjusted for the sensitivity and specificity of the assays and weighted to reference populations.
Results: Seroprevalence rates in the antenatal samples significantly increased from 5.5% (95% confidence interval [CI] 4.7%–6.5%) in the 5-week period up to and including International Organization for Standardization (ISO) Week 51 (w/b Monday 14 December 2020) to 11.3% (95% CI 10.1%–12.6%) in the 5-week period up to and including ISO Week 14 (w/b Monday 5 April 2021). Increasing seroprevalence trends across the second wave were observed among all age groups.
Conclusions: By the end of the second wave of the COVID-19 pandemic, approximately one in 10 women tested around the end of the first trimester of pregnancy had antibodies to SARS-CoV-2, suggesting that the vast majority were still susceptible to COVID-19 as they progressed to the later stages of pregnancy, when risks from infection are elevated for both mother and baby.

Monitoring the exposure of pregnant women to SARS-CoV-2 infection is crucial, as they represent a population group vulnerable to COVID-19-related harms. COVID-19 in pregnancy is associated with increased risk of morbidity and mortality outcomes for both mother and baby.[1] Previous evidence from Scotland suggested that a small minority of pregnant women had been exposed to SARS-CoV-2 infection during the first wave.[2] In this study, our objective was to measure seroprevalence across the second wave of the pandemic using a national sample of pregnant women.

Seroprevalence of SARS-CoV-2 antibodies among pregnant women during the second wave

As part of the antenatal screening programme in Scotland, blood samples collected from pregnant women as part of the first

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trimester combined ultrasound and biochemical screening for fetal trisomy are sent to a single biochemistry laboratory for testing. Approximately 600 weekly samples were collected from all 14 health authorities across Scotland. From mid-November 2020, COVID-19 serology testing was undertaken on these samples. The results presented here cover the period between week commencing International Organization for Standardization (ISO) Week 47 (i.e. week beginning [w/b] 16 November 2020 to ISO Week 14 [w/b Monday 05 April 2021; i.e. up to and including 11 April 2021]) when 13,428 samples had been collected. Samples were anonymised before testing, and only age was attached to the result.

Antenatal samples were analysed using the Roche (Roche Elecsys Anti-SARS-CoV-2 N IgM/IgG) assay. The sensitivity and specificity of this assay are 92.3% (95% CI 85.4%–96.6%) and 100% (95% CI 98.7%–100.0%), respectively, as determined by a local evaluation. The assay detects antibodies to the nucleocapsid protein and therefore only measures antibodies resulting from infection and not vaccination. As described previously,[2] seroprevalence rates were adjusted for sensitivity and specificity of the assay[3] and weighted to the age structure of a reference population (maternities in Scotland 2019–2020). Five-weekly rolling seroprevalence estimates were calculated to smooth out week-to-week variation; these were plotted against the last week in each 5-week grouping (e.g. Weeks 47–51 in 2020 were plotted at Week 51). A non-parametric Mann–Kendall test was used to assess the change in seroprevalence trends over time.

Samples are processed and analysed anonymously for the purposes of public health surveillance only; therefore, the need for informed consent and ethical approval was waived. Public Health Scotland is registered under the General Data Protection Regulation and has an information security policy to safeguard the collection, processing and storage of confidential information. Approval for the COVID-19 serological surveillance work was given by the Head of Information Governance and Statistical Governance on 8 May 2020. The project was also endorsed by the Pregnancy & Newborn Screening Programme Board and the National Screening Oversight Board on 9 October 2020.

Rolling 5-weekly seroprevalence rates in the antenatal samples increased from 5.5% (95% confidence interval [CI] 4.7%–6.5%) up to and including ISO Week 51 (w/b Monday 14 December 2020) to 11.9% (95% CI 10.7%–13.2%) in the 5-week period up to and including ISO Week 14 (w/b Monday 5 April 2021; $t = 0.985$; $P \leq 0.001$; Table 1).

At baseline, seroprevalence rates were lowest in the youngest (up to 19 years: 2.9%) and oldest age groups (≥40 years: 2.5%). By the end of the study period, seroprevalence rates were slightly, but not significantly, higher in younger age groups (up to 19 years: 13.5%; 20–29 years: 13.7%) when compared with older age groups (30–39 years: 10.5%; ≥40 years: 10.1%). There were significant increases observed in seroprevalence trends across all age groups during the study period: up to 19 years ($t = 0.706$, $P \leq 0.001$); 20–29 years ($t = 0.824$, $P \leq 0.001$); 30–39 years ($t = 0.917$, $P \leq 0.001$); and ≥40 years ($t = 0.48$, $P \leq 0.001$).

Discussion

Our findings highlight how population exposure to SARS-CoV-2 in Scotland among pregnant women increased across the second wave of the pandemic. Our estimate of 11.3% seroprevalence at the beginning of April 2021 suggests that the majority of pregnant women in Scotland had still not been exposed to SARS-CoV-2 towards the end of their first trimester despite consistently increasing trends across the second wave. This potentially leaves a sizeable proportion of women still susceptible to COVID as they progress to the later stages of pregnancy, when risks from infection are likely higher for both mother and baby.[4] To our knowledge, this is one of the first studies to present national seroprevalence rates among pregnant women and to present data covering the second wave. Previous studies have focused on the first wave of the pandemic and/or on local populations.[5,6]

Our results are consistent with other population-level data sources from Scotland, illustrating an increase in seroprevalence across the second wave of the pandemic, including primary care patients.[2] Seroprevalence rates of 5.5% at the beginning of our study period are higher than what we observed in a previous study of antenatal seroprevalence during the first wave of the pandemic, which reached a peak of 2.8% (95% CI 2.2%–3.5%) in ISO Week 20.[2] Seroprevalence significantly increased across the second wave and more than doubled between November 2020 and April 2021. This occurred despite increases in the proportion of the total population who had been vaccinated between the beginning and end of the second wave, which should have reduced the likelihood of transmission as the pool of susceptible people shrank. However, seroprevalence amongst pregnant women increased nevertheless, indicating that the collective immunity (either from vaccination or previous exposure to the virus) was insufficient.

Table 1
Scotland antenatal SARS-CoV-2 seroprevalence (95% CI) overall and by age-group, November 2020 to April 2021.

Week commencing	ISO weeks combined	No. tested	Overall	Age group			
				0–19	20–29	30–39	40+
16 November 2020	47–51	2821	5.5% (4.7%, 6.5%)	2.9% (0.1%, 7.5%)	7.2% (5.7%, 8.9%)	4.6% (3.5%, 5.8%)	2.5% (0.1%, 6.6%)
23 November 2020	48–52	3151	5.8% (4.9%, 6.7%)	2.8% (0.1%, 7.3%)	8.1% (6.5%, 9.7%)	4.5% (3.4%, 5.6%)	2.2% (0.1%, 5.8%)
30 November 2020	49–53	3052	5.8% (4.9%, 6.8%)	4.4% (0.1%, 10.1%)	7.9% (6.4%, 9.7%)	4.4% (3.4%, 5.6%)	3.7% (0.1%, 8.7%)
7 December 2020	50–1	3122	6.3% (5.4%, 7.3%)	4.6% (0.1%, 10.8%)	8.3% (6.7%, 10%)	5% (3.9%, 6.1%)	5.8% (1.2%, 11.5%)
14 December 2020	51–2	3214	6.8% (5.9%, 7.7%)	6.3% (1.5%, 12.9%)	7.9% (6.3%, 9.6%)	6.1% (5%, 7.4%)	4.7% (1.1%, 9.5%)
21 December 2020	52–3	3189	7.1% (6.2%, 8.1%)	4.7% (0.1%, 11.1%)	8.5% (6.9%, 10.2%)	6.4% (5.2%, 7.7%)	4.5% (1.1%, 9.3%)
28 December 2020	53–4	3279	7.1% (6.2%, 8.1%)	7.5% (1.6%, 14.9%)	7.8% (6.3%, 9.5%)	6.7% (5.5%, 8%)	6.2% (2%, 11.6%)
4 January 2021	1–5	3478	7.5% (6.6%, 8.5%)	8% (1.6%, 15.8%)	8.1% (6.5%, 9.7%)	7.2% (5.9%, 8.5%)	5.7% (1.9%, 10.7%)
11 January 2021	2–6	3446	8.1% (7.1%, 9.1%)	10.1% (4.2%, 17.8%)	9.2% (7.6%, 11%)	7.4% (6.2%, 8.8%)	3.7% (0.9%, 8.3%)
18 January 2021	3–7	3397	8.1% (7.1%, 9.1%)	10.3% (3.9%, 18.1%)	9.6% (7.9%, 11.3%)	7.1% (5.9%, 8.4%)	3.8% (0.9%, 8.2%)
25 January 2021	4–8	3402	8.6% (7.5%, 9.6%)	14.7% (6.8%, 23.6%)	9.8% (8.1%, 11.6%)	7.5% (6.2%, 8.9%)	5.1% (1.1%, 10.1%)
1 February 2021	5–9	3387	9.1% (8.1%, 10.2%)	11.9% (5.2%, 19.8%)	10.1% (8.4%, 11.9%)	8.6% (7.2%, 10.1%)	4.1% (1.1%, 8.7%)
8 February 2021	6–10	3355	9.6% (8.5%, 10.7%)	10.1% (3.8%, 17.4%)	11% (9.2%, 12.9%)	8.9% (7.5%, 10.4%)	4.1% (1.1%, 8.5%)
15 February 2021	7–11	3398	10.3% (9.2%, 11.5%)	10.2% (3.9%, 17.8%)	11.2% (9.5%, 13.1%)	10% (8.5%, 11.6%)	4.8% (1.1%, 9.7%)
22 February 2021	8–12	3423	10.9% (9.8%, 12.1%)	9.8% (4.1%, 17.6%)	12% (10.3%, 14.1%)	10.4% (8.9%, 12.1%)	6.4% (2.6%, 11.6%)
1 March 2021	9–13	3359	11.3% (10.1%, 12.6%)	10.2% (4.3%, 17.9%)	12.6% (10.7%, 14.7%)	10.6% (9%, 12.3%)	7.5% (2.8%, 13.1%)
8 March 2021	10–14	3342	11.9% (10.7%, 13.2%)	13.5% (6.1%, 22.8%)	13.7% (11.7%, 15.9%)	10.5% (9%, 12.2%)	10.1% (4.8%, 16.3%)
			$t = 0.985$, $P = 0.00022$	$t = 0.706$, $P = 0.0009$	$t = 0.824$, $P = 0.00004$	$t = 0.917$, $P = 0.0000035$	$t = 0.480$, $P = 0.009$

Our study also has limitations. First, seroprevalence has the potential to underestimate overall population exposure because of waning antibody levels over time and the lack of seroconversion among some individuals, possibly resulting from the role of other unmeasured immune responses in neutralising infection (e.g. cellular immunity). Second, there is uncertainty in the sensitivity and specificity of the assays and with regard to the representativeness of our samples in relation to the general Scottish population. To address this, we weighted the data to standard reference populations to account for any oversampling according to age. Third, the Roche assay used to test the blood samples for our study detects antibodies to the nucleocapsid protein and will therefore only reflect antibodies generated through previous infection rather than via vaccination. As a result, our study is likely to overestimate overall susceptibility to infection. However, uptake of the vaccine among pregnant women in Scotland was low during the study period.[7] Fourth, using samples sent for the first trimester screening for fetal trisomy may also have introduced bias into our results. Uptake of first trimester screening in Scotland ranges between 60% and 65% of pregnant women,[8,9] with variation in uptake likely to reflect demographic and cultural influences on individual choice to partake in the screening programme. Our study has demonstrated the utility of using samples sent for fetal trisomy for public health surveillance, which could equally be useful in future for managing any related pandemic. The seroprevalence rates from antenatal samples are consistently lower than those from general population samples in Scotland, which is likely, in part, to be explained by pregnant women and women trying to conceive taking extra precautions to avoid infection in the context of the ongoing COVID-19 pandemic.[10]

At the end of the second wave of the COVID-19 pandemic, approximately one in 10 women tested around the end of the first trimester of pregnancy had antibodies to SARS-CoV-2, suggesting that the vast majority were still susceptible to infection as they progress through pregnancy and risk of COVID-19-related harm to mother and baby increases. However, seroprevalence may underestimate overall population exposure because of waning antibody levels among those who were infected earlier in the pandemic. Our findings highlight that prevention initiatives alone are insufficient to prevent transmission among pregnant women in Scotland and that ensuring high vaccination uptake will be critical to reducing risks among this population moving forward.

Author statements

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Ethical approval

Samples are processed and analysed anonymously for the purposes of public health surveillance only; therefore, the need for informed consent and ethical approval was waived. Public Health Scotland is registered under the General Data Protection Regulation and has an information security policy to safeguard the collection, processing and storage of confidential information. Approval for the COVID-19 serological surveillance work was given by the Head of Information Governance and Statistical Governance on 8 May 2020. The project was also endorsed by the Pregnancy & Newborn Screening Programme Board and the National Screening Oversight Board on 9 October 2020.

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Competing interests

None declared.

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