June 2022

Seroprevalence of antibodies to SARS-CoV-2 in children aged 1-12 years and adults aged 18+ years: results from National Serosurveillance Programme Collection Cycle 1

Key Points

Findings in children aged 1-12 years:

- Using residual serum collected between 19 December 2021 and 22 January 2022 from 170 children aged 1-12 years attending emergency department, medical outpatient clinics, general practice phlebotomy, and urgent care centres in Dublin:
    - The overall seroprevalence (S+) of SARS-CoV-2 was 38.4% (95% CI 31.3, 46.0), when adjusted for the sensitivity and specificity of the antibody test used.
    - Children aged 1-4 had an overall seroprevalence of 28.8% (95% CI 18.7, 41.6) and children aged 5-12 had an overall seroprevalence of 43.5% (95% CI 34.5, 53.0).
    - Paediatric quantitative antibody levels ranged from 0 to 975 BAU/ml, with a mean of 66 BAU/ml (standard deviation = 138 BAU/ml) and a median of 1.7 BAU/ml.
- During the period of sample collection, children aged under 5 years were not eligible for COVID-19 vaccination, and children aged 5-12 years became eligible approximately midway through the collection period.

(Ctd)

HSE Health Protection Surveillance Centre. Seroprevalence of antibodies to SARS-CoV-2, in adults, May 2022

Findings in adults aged 18+ years:

- Using residual serum/plasma specimens from general practice sources, and collected from seven clinical chemistry laboratories throughout Ireland between 30 January 2022 and 19 February 2022:
    - The overall seroprevalence (S+) of SARS-CoV-2 was 96.5% (95% CI 95.2-97.5), when adjusted for the sensitivity and specificity of the antibody test used.
    - Mean and median quantitative adult antibody levels were 2591 (SD = 2072) and 2081 BAU/ml respecitvely.
    - Serological results indicative of previous infection (S+N+) showed a seropositivity rate of 34.2% (95% CI 31.8, 36.8). This was highest in the 18-29 year age group at 51.0% (95% CI 44.7, 57.3), and lowest in the 70-79 age group at 13.8% (95% CI 8.8 ,1.1).
- National COVID-19 vaccination uptake rates show that adults aged 18-49 years had higher seroprevalence rates than vaccination uptake rates, however adults over 50 years had seroprevalence rates equal to or lower than vaccination rates.

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Background

The National Serosurveillance Programme (NSP) is led by the HPSC Seroepidemiology Unit (SEU), working in partnership with the University College Dublin (UCD) National Virus Reference Laboratory (NVRL) Serosurveillance Unit (SSU) and the acute-hospital Laboratory Surveillance Network (LSN). It is overseen by a national multi-disciplinary and multi-sectoral Steering Committee.

The NSP conducts systematic sampling of residual specimens from clinical chemistry laboratories within the LSN at regular intervals, with analysis for infectious disease antibodies at the UCD NVRL SSU. The SEU currently reports on the seroprevalence of SARS-CoV-2, and in the future will report on other infectious diseases of public health concern by age group, sex and region.

This report provides information on SARS-CoV-2 seroprevalence in children aged 1-12 years, and adults aged 18+ years.

Methods

Eight acute-hospital clinical chemistry laboratories participated in this cycle of testing for the National Serosurveillance Programme.

HPSC SEU provided a sampling frame to the participating laboratories, indicating quotas of specimens to be provided. Between 100 and 300 specimens were requested from each laboratory, depending on capacity for participation; the quota requested reflected the national population proportions by age group and sex in the general Irish population.

For paediatric specimens sourced from the clinical chemistry laboratory in Children's Health Ireland (CHI) at Temple Street, the residual sera specimens were sourced from:

- CHI at Temple Street Emergency Department, General Paediatric Medical Outpatient Clinic, and Phlebotomy Clinic
- CHI at Connolly Hospital Urgent Care Centre

In CHI at Temple Street, samples with a blood collection date between 19 December 2021 and 22 January 2022 were selected, as specimens are only regarded as residual 28 days following completion of the tests ordered.

Residual serum specimens were selected, aliquoted and submitted in anonymised batch format to the UCD NVRL SSU between 31 January 2022 and 18 February 2022. Each specimen was identifiable only through a unique, anonymised SEU ID number. In a separate process, demographic details including the SEU ID, date of specimen collection, sex, date of birth, and county of residence were sent by secure electronic means to HPSC SEU.

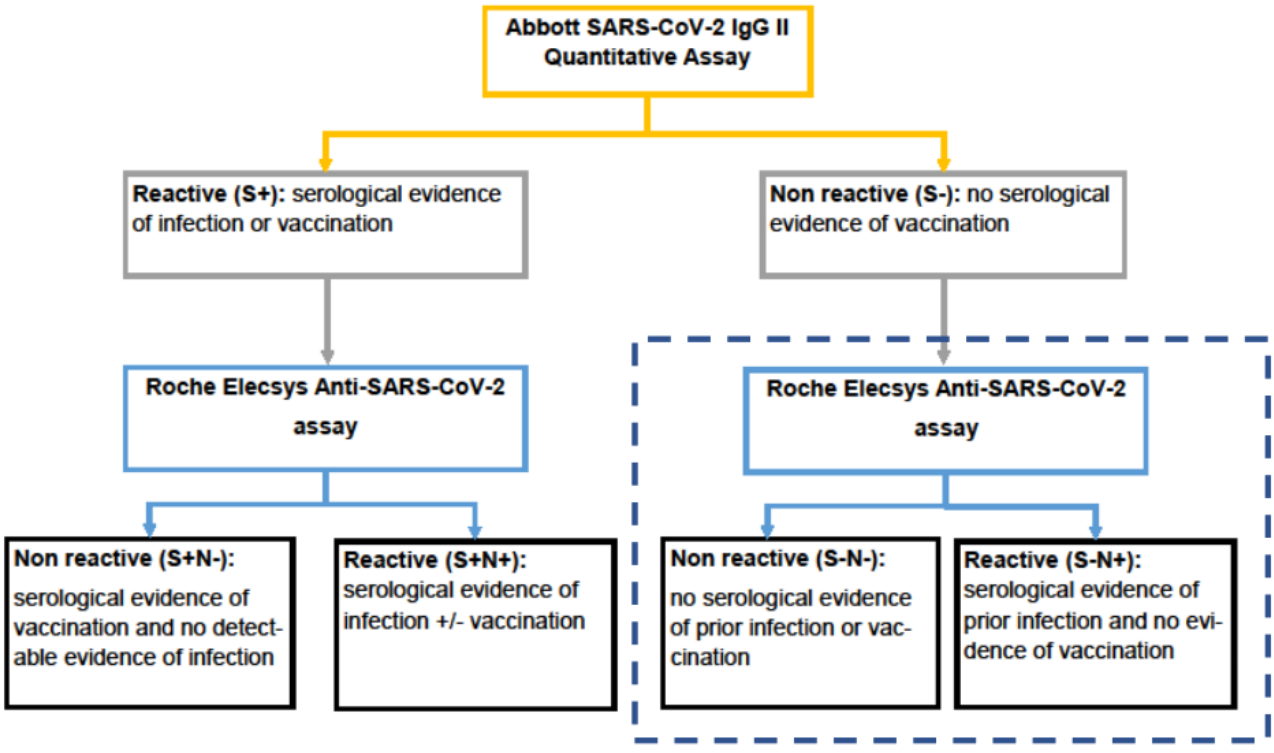
For adult specimens sourced from the remaining seven acute-hospital clinical chemistry laboratories, residual sera from general practice with blood collection dates between 30 January and 19 February 2022 were collected. Anonymisation and submission of samples followed the same process as paediatric specimens.

Antibodies to SARS-CoV-2 were detected using the Abbott SARS-CoV-2 IgG II Quantitative Assay, which detects antibodies to SARS-CoV-2 spike (S) protein (anti-S). Results were reported in

Aribitrary Units (AU)/mL. Specimens with a result ≥50.0 arbitrary units per millilitre (AU/mL) are considered positive or reactive (S+). These were converted to the WHO international standard Binding Antibody Units (BAU)/mL using the formula BAU= AU/mL*0.142, prior to analysis. The Abbott SARS-CoV-2 IgG II Quantitative Assay has a manufacturer's stated Positive Percent Agreement (PPA) of 98.75% (93.25, 99.94) at ≥ 15 days post PCR diagnosis, and a Negative Percent Agreement (NPA) of 99.55% (99.15, 99.76).

All specimens were then tested on the Elecsys Roche Qualitative Assay which qualitatively detects antibodies to SARS-CoV-2 nucleocapsid (N) protein (anti-N). Vaccines currently approved for use in Ireland target the S protein, and it is not expected that individuals will produce an immunological response to N proteins following vaccination. As such, anti-N reactivity was used to determine antibody responses due to natural infection, and specimens with a cut-off index (COI) of ≥ 1.0 were considered positive (S+N+). The Roche Elecsys Anti-SARS-CoV-2 assay has a manufacturer's stated sensitivity of 99.5% (97.0-100) at ≥ 14 days post PCR diagnosis, and a clinical specificity of 99.80% (99.69, 99.88). Figure 1 illustrates this testing algorithm via the Abbott and Roche platforms. The dashed box indicates additional testing that does not form part of the WHO suggested testing algorithm. (1) Due to the small number of S-N+ specimens identified (n=10), further analysis of this group was not conducted. Details of these specimens can be found in Appendix table 1a.

Figure 1. Surveillance testing algorithm



Descriptive statistics were used to explore the data with data management and analysis carried out using R version 4.1.2. A non-parametric method, LOESS regression was applied to estimate the conditional mean function and 95% confidence interval for quantitiative antibody levels by year of age.

Seroprevalence is presented by age group, sex, county of residence, and target antigen (anti-S, anti-N). The seroprevalence was adjusted for the misclassification or imperfect sensitivity and specificity in the application of the diagnostic testing using the Rogan Gladen-estimator (see Technical Notes for further details). Unless stated otherwise, adjusted results are presented. Quantitative IgG Antibodies in BAU/mL are presented by age group and sex.

Denominator population profiles were taken from CSO 2021 population estimates provided by the HSE National Health Intelligence Unit ('April 2021/H1')**.** Data were aggregated into the following age groups for analysis: 1-4 years, 5-12 years, 18-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, 70-79 years, and 80+ years. As seroprevalence is a core surveillance activity, for which the HPSC is legally mandated, no individual patient consent was required.

Vaccination uptake data by sex and age group were obtained from HPSC and extracted from Ireland's national COVID-19 immunisation system, COVAX. These data were aggregated into the following age groups for the analysis: 18-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, 70-79 years, and 80+ years. Vaccinated persons were collated from COVAX data through midnight 5 January 2022 to provide an approximate 14-day window for comparison with LSN sample data, allowing for development of antibody response to vaccination.

Results

Due to differing sample collection periods for children aged 1-12 years and adults aged 18+ years, results are presented separately for each group.

Children aged 1-12 years

Demographic characteristics

In all, 170 paediatric residual sera specimens were provided for analysis: 86 males, and 84 females. Demographic characteristics of specimens are outlined in Table 1.

Table 1. Demographic characteristics of paediatric residual specimens, 19 December 2021 – 22 January 2022

Characteristic		Number	Percent
Sex	Male	86	49.0
	Female	84	51.0
Age	Median age (years)	6	-
	Mean age (years)	6.3	-
	Age range (years)	1-12	-
	1-4	59	34.7
	5-12	111	65.3
County of residence	Dublin	139	82.0
	Meath	12	7.0
	Other	19	11.0
Total		**170**	**100.0**

Overall seroprevalence results

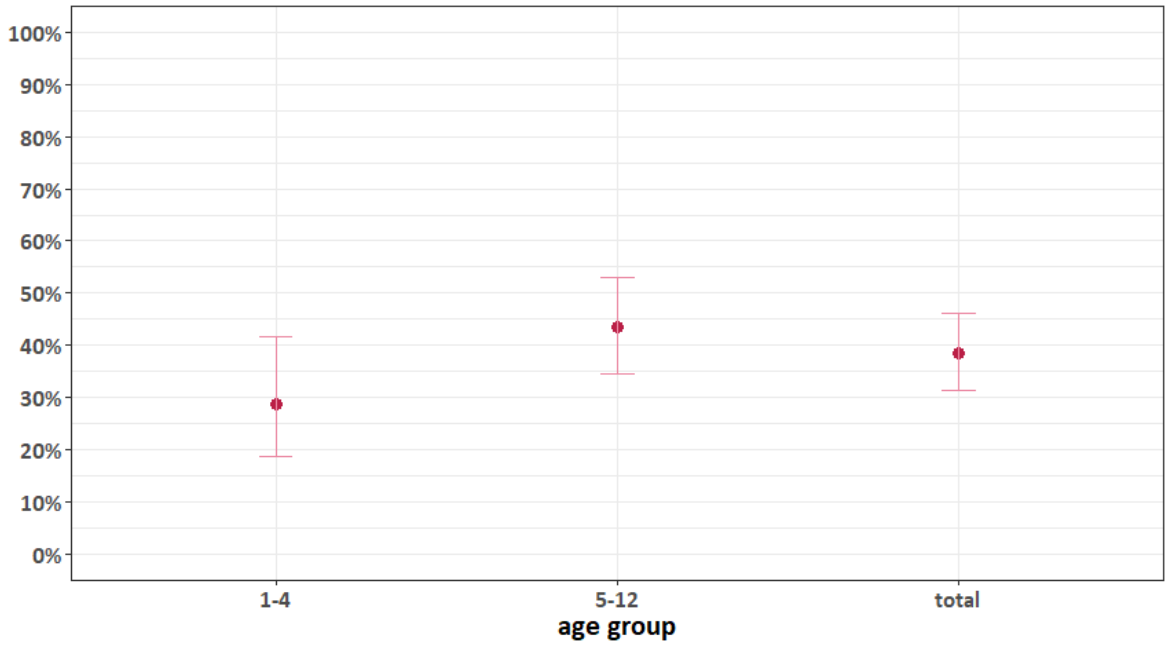
The adjusted overall seropositivity rate was 38.4% (95% CI 31.3, 46.0). Adjustment had a small effect, increasing estimates of seropositivity by less than 1%. Seropositivity was 28.8% and 43.5% for 1-4 years and 5-12 years respectively, with a wide confidence interval in those aged 1-4 years due to smaller numbers in this group (table 2 and figure 2). Seropositivity by sex was similar, at 40.7% for females and 36.2% for males, with overlapping confidence intervals.

Table 2. Unadjusted and adjusted paediatric seropositivity overall and by age group and sex,

19 December 2021 – 22 January 2022

Characteristic		Number seropositive	Unadjusted Percent	95% Confidence interval		Adjusted Percent	95% Confidence interval	
Age group (years)	1-4	17	28.8	18.8	41.4	**28.8**	**18.7**	**41.6**
	5-12	48	43.2	34.4	52.5	**43.5**	**34.5**	**53.0**
Sex	F	34	40.5	30.6	51.2	**40.7**	**30.7**	**51.6**
	M	31	36.0	26.7	46.6	**36.2**	**26.7**	**46.9**
Total		**65**	**38.2**	**31.3**	**45.7**	**38.4**	**31.3**	**46.0**

Figure 2. Adjusted overall seropositivity (S+) with 95% confidence intervals by age group and overall, 19 December 2021 – 22 January 2022



Quantitative antibody levels

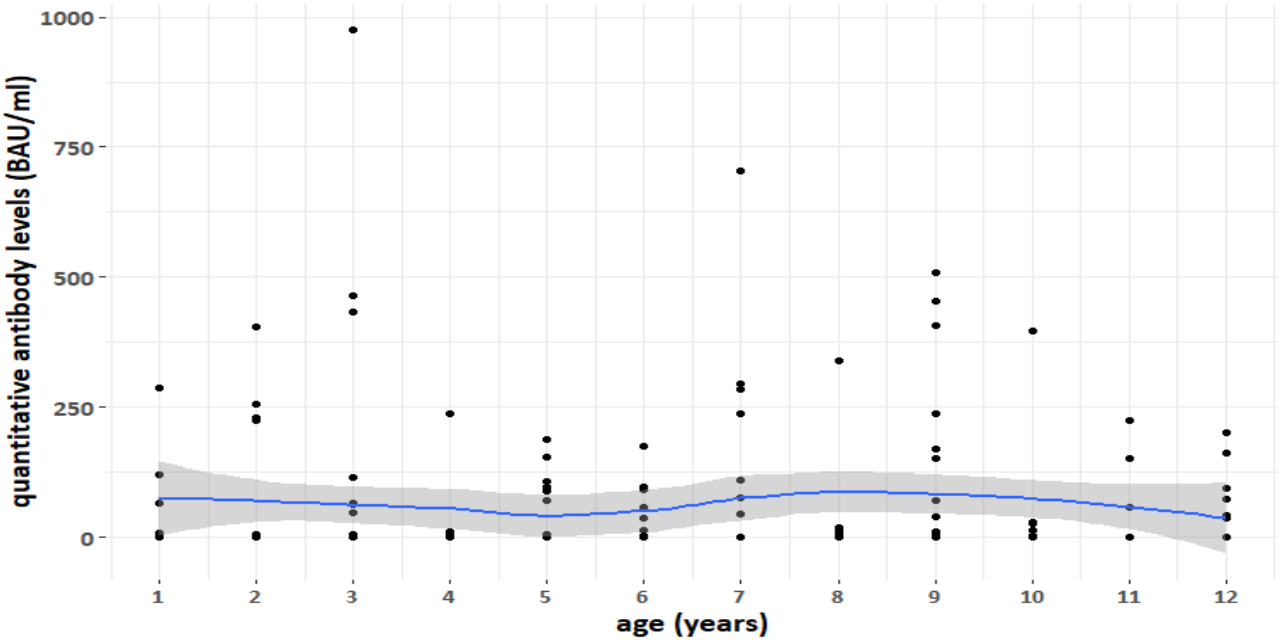
Mean quantitative antibody levels remained approximately stable across each year of age (table 3 and figure 3). While the mean antibody level across all ages (1-12 years) is 65.0 BAU/ml (SD= 133.2), the median is 1.72 BAU/ml indicating that most children had antibody levels below the positivity threshold of 7.14 BAU/ml.

Table 3. Summary of quantitiative antibody levels* in children aged 1-12 years, 19 December 2021 – 22 January 2022

Characteristic		N	Mean	Standard Deviation	Median	IQR	Minimum	Maximum
Age	1-4	59	68.8	165.5	0.9	30	0	975
	5-12	111	63.9	121.9	2.1	75	0	704
Sex	M	86	64.0	133.1	1.9	54	0	704
	F	84	67.2	143.9	1.3	74	0	975
Total		**170**	**65.9**	**133.2**	**1.72**	**66**	**0**	**975**

*units are BAU/ml

Figure 3. Distribution of paediatric quantitative antibody levels by year of age and fitted conditional means, 19 December 2021 – 22 January 2022



Note: Non-parametric method (LOESS regression) was applied to estimate the conditional mean function (blue line). The grey shaded area indicates the 95% confidence interval around the estimates.

S+N+ results indicating previous infection

Children aged 5-12 years had a seroprevalence rate indicating previous infection (S+N+) of 37.9% (95% CI 29.4, 47.3). As children aged 1-4 years of age were ineligible for vaccination during the collection period, overall seropositivity (S+) is indicative of previous SARS-CoV-2 infection in this age cohort (table 4).

Table 4. Paediatric seropositivity overall and indicating natural infection, by age group, 19 December 2021 - 22 January 2022

Age Group	S+ prevalence estimate	95% Confidence interval		S+N+ prevalence estimate	95% Confidence interval	
1-4	28.8	18.7	41.6			
5-12	43.5	34.5	53.0	37.9	29.4	47.3
Total	**38.4**	**31.3**	**46.0**			

Comparison with vaccination uptake

During the four-week period of the specimen collection, vaccination was not recommended for children in the 1-4 years age group. Vaccination in children over 5 years of age began on 3 January 2022 for high risk patients, and 8 January 2022 for all children over age 5. While it is possible that overall seropositivity (S+) may capture some of these vaccinated cases, the number of children in the general population over 5 years of age who had received at least one dose of vaccine with a

sufficient lead in time to have developed antibodies during the collection period was small (n=50 by 9 January), and therefore further comparison with vaccination uptake in children 5-12 years of age is not shown. Please see appendix table 2a for further detail on vaccination uptake in children aged 0-12 during this period.

Adults aged 18+ years

Demographic characteristics

In all, 1,410 adult residual sera specimens were provided for analysis: 675 males, and 735 females. Demographic characteristics of these specimens are outlined in table 5.

Table 5. Demographic characteristics of adult residual specimens, 30 January 2022 to 19 February 2022

Characteristic		Number	Percent
Sex	Male	675	52.1
	Female	735	47.9
Age	Median age (years)	46.0	-
	Mean age (years)	47.3	-
	Age range (years)	18-95	-
	18-29	242	17.2
	30-39	286	20.3
	40-49	275	19.5
	50-59	252	17.9
	60-69	177	12.6
	70-79	122	8.7
	80+	56	4.0
County of residence	Clare	28	2.0
	Cork	198	14.0
	Donegal	100	7.1
	Dublin	828	58.7
	Galway	79	5.6
	Limerick	52	3.7
	Mayo	18	1.3
	Tipperary	18	1.3
	Wicklow	72	5.1
	Other	17	1.2
Total		**1,410**	**100.0**

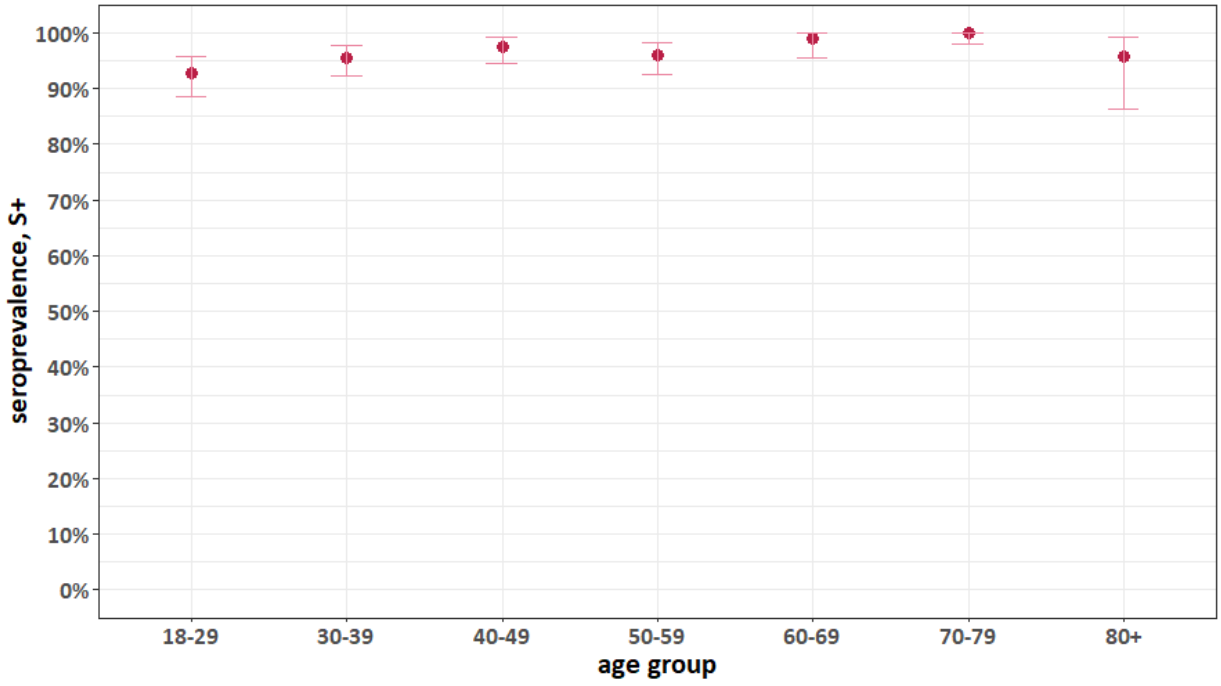
Overall seroprevalence results

The adjusted overall seropositivity rate (S+) was 96.5% (95% CI 95.2, 97.5). Adjustment had a small effect, increasing estimates of seropositivity by approximately 1%. Seropositivity varied by age, as shown in table 6 and figure 4. The 18-29 year age group had the lowest seropositivity (92.8%, 95% CI 88.6, 95.7) and the 70-79 year age group had the highest seropositivity (100.0%, 95% CI 98.1, 100.0). Seropositivity by sex was similar, at 95.5% for females and 97.4% for males.

Table 6. Unadjusted and adjusted overall adult seropositivity (S+) by age group and sex, 30 January 2022 to 19 February 2022

Characteristic		Number seropositive	Unadjusted Percent	95% Confidence interval		Adjusted Percent	95% Confidence interval	
Sex	Male	650	96.3	94.6	96.3	**97.4**	**95.7**	**98.6**
	Female	694	94.4	92.5	94.4	**95.5**	**93.6**	**97.7**
Age	18-29	222	91.7	87.6	94.6	**92.8**	**88.6**	**95.7**
	30-39	270	94.4	91.1	96.5	**95.5**	**92.2**	**97.7**
	40-49	265	96.4	93.4	98.0	**97.5**	**94.5**	**99.2**
	50-59	239	94.8	91.4	97.0	**96.0**	**92.4**	**98.1**
	60-69	173	97.7	94.3	99.1	**98.9**	**95.4**	**100.0**
	70-79	122	100.0	96.9	100.0	**100.0**	**98.1**	**100.0**
	80+	53	94.6	85.4	98.2	**95.8**	**86.4**	**99.3**
Total		**1,344**	**95.3**	**94.1**	**96.3**	**96.5**	**95.2**	**97.5**

Figure 4. Adjusted adult seropositivity with 95% confidence intervals by age group, 30 January 2022 to 19 February 2022



Quantitative antibody levels

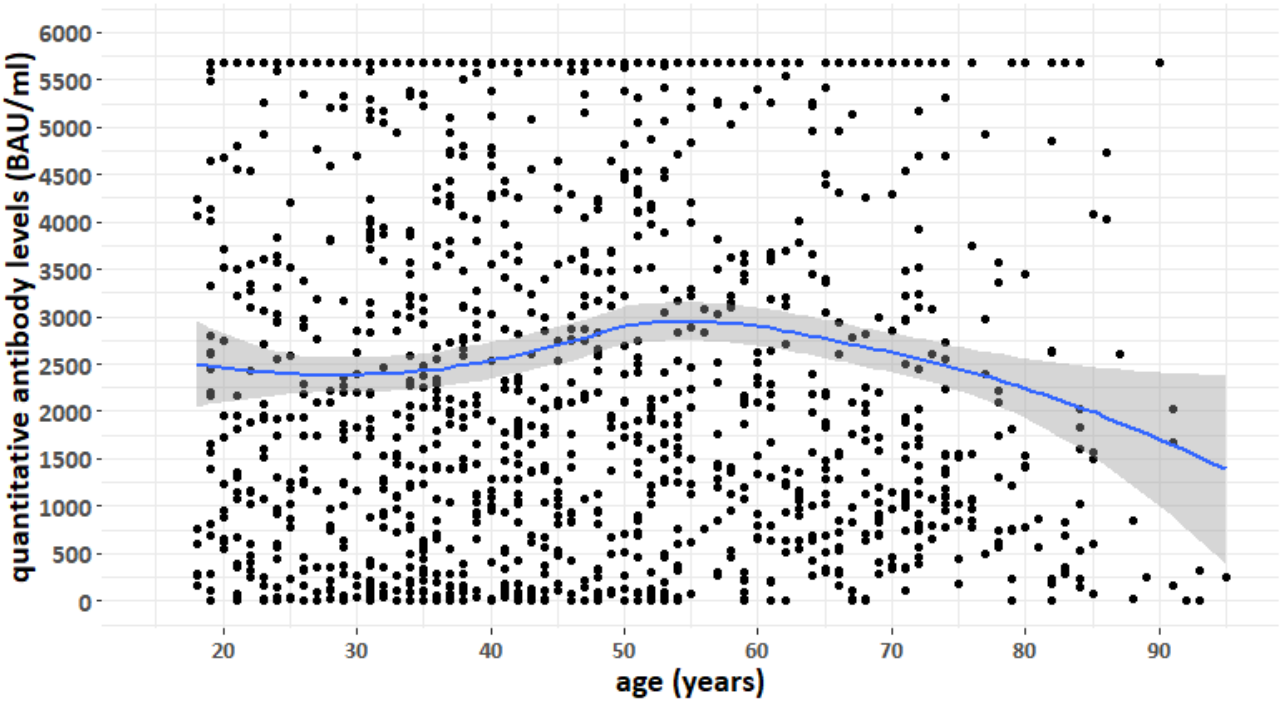
The distribution of mean quantitative antibody levels by year of age and the overall trend are shown in table 7 and figure 5, showing declining mean antibody levels in the 60+ age groups.

Table 7. Summary of quantitiative antibody levels* in adults 18 years and older, 30 January 2022 to 19 February 2022

Characteristic		N	Mean	Standard Deviation	Median	IQR	Minimum	Maximum
Sex	M	675	2,706	2,086	2,222	4,390	0.0	5,680
	F	735	2,486	2,055	1,940	3,692	0.0	5,680
Age	18-29	242	2,343	2,071	1,849	3,657	0.2	5,680
	30-39	286	2,471	2,029	2,073	3,610	0.0	5,680
	40-49	275	2,657	2,077	2,238	3,806	0.1	5,680
	50-59	252	3,058	2,136	2,836	4,481	0.0	5,680
	60-69	177	2,564	2,021	1,877	4,089	0.2	5,680
	70-79	122	2,427	1,918	1,591	2,769	9.5	5,680
	80+	56	2,305	2,206	1,516	4,450	0.3	5,680
Total		**1,410**	**2,592**	**2,072**	**2,081**	**3,976**	**0**	**5,680**

*units are BAU/ml

Figure 5. Distribution of quantitative antibody levels by year of age and fitted conditional means, 30 January 2022 to 19 February 2022



Note: Non-parametric method (LOESS regression) was applied to estimate the conditional mean function (blue line). The grey shaded area indicates the 95% confidence interval around the estimates.

The mean quantitative antibody level for 18-29 year olds was 2,343 BAU/ml, and increased until age 55, then began to decrease consistently. The 50-59 year age group had the highest mean antibody levels overall at 3,058 BAU/ml, and while men had a higher mean antibody level (2,706 BAU/ml) than women (2,486 BAU/ml) there was high variance around these estimates (table 7).

S+N+ results indicating previous infection

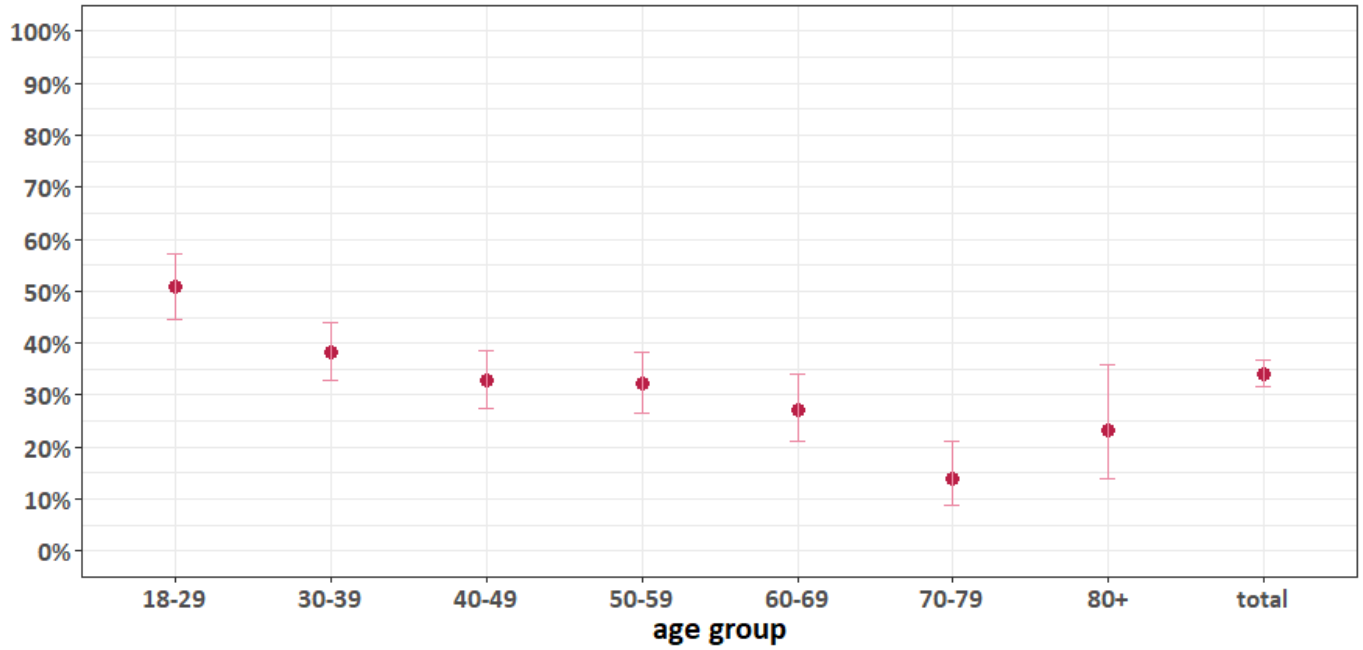
The proportion of adult specimens with serological evidence of previous infection (S+N+) was 34.2% (95% CI 31.7, 36.7). Seropositivity indicating previous infection (S+N+) declined with increasing age

(Table 8, Figure 6) from the 18-29 age group to the 70-79 year age group, with a slight increase in the 80 year age group. There was no significant difference for this measure between genders at the 5% level.

Table 8. Adult seropositivity indicating natural infection (S+N+) overall and by age group, 30 January 2022 - 19 February 2022

Age Group	Sample prevalence estimate	Lower 95% CI	Upper 95% CI
18-29	**51.0%**	44.7	57.3
30-39	**38.2%**	32.7	44.0
40-49	**32.8%**	27.4	38.5
50-59	**32.2%**	26.7	38.2
60-69	**27.1%**	21.1	34.1
70-79	**13.8%**	8.8	21.1
80+	**23.2%**	14.0	35.8
Total	**34.2%**	**31.7**	**36.7**

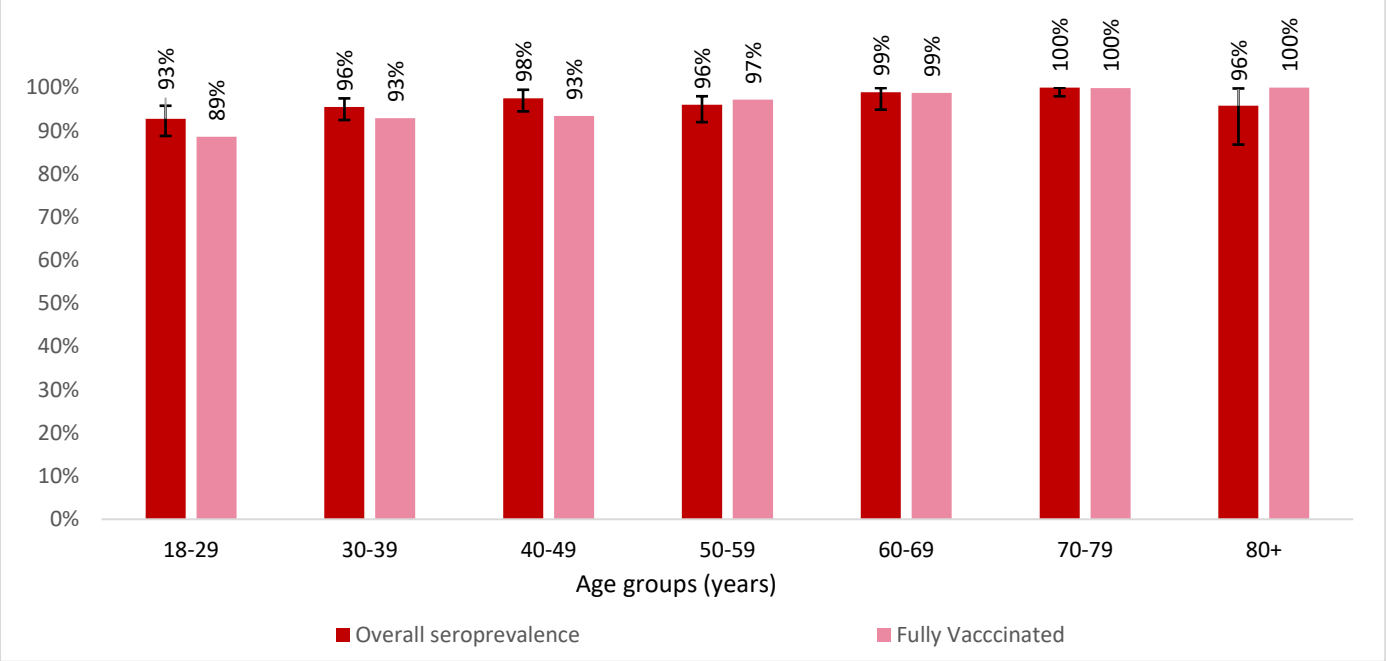
Figure 6: Adult seropositivity indicating natural infection (S+N+) by age-group, 30 January 2022 to 19 February 2022



Comparison with vaccination uptake

The HSE's COVID-19 vaccination programme (COVAX) commenced December 2020. An ecological comparison of overall adjusted seroprevalence from the first NSP collection cycle and vaccination uptake in Ireland stratified by age cohort is shown in figure 7. COVAX figures are collated 14 days in arrears of serosurveillance data to allow for the development of anti-S (S+) antibodies. The presence of anti-S (S+) antibodies is used as a proxy for vaccination to allow comparison of vaccination rates with serosurveillance data. By the end of the serosurveillance collection period, adults aged 18-49 years had higher seropositive rates than vaccination uptake rates, and adults aged 50 years and older had seropositive rates equal to or lower than vaccination rates.

Figure 7. Age stratified overall adult seropositivity rates (S+) and vaccination uptake*, 30 January 2022 to 19 February 2022



*Data source: HPSC COVID-19 Vaccination Uptake in Ireland Weekly Report, 05/01/2022 (2). Fully vaccinated refers to individuals on a two-dose vaccination plan who have received their first and second doses, and individuals on a single dose vaccine plan who have received a vaccination. Secondary course vaccinated/booster dose refers to individuals who have completed a primary course (fully vaccinated) and have received a booster dose, while primary course vaccinated/third dose refers to immunocompromised individuals who have received two doses initially and require an additional third dose as part of their primary course treatment.

Discussion

Information on population seroprevalence is critical to inform proactive, targeted public health interventions and vaccination policy. It complements data from other surveillance systems, and can be used to estimate the true proportion of the population that remain susceptible to infection. Surveillance of residual serum/plasma from general practice can be used to approximate community prevalence, and is logistically more feasible to achieve and less costly than community surveys.

Children over age 5 determined to be at risk of severe COVID-19 disease or living with someone at higher risk from COVID-19 became eligible for vaccination from 03 January 2022; all children over age 5 became eligible for primary vaccination from 08 January 2022. It is estimated that antibodies are generated approximately 14 days after vaccination. Given that the number of 5-12 year olds in the general population who had received the first dose of vaccine by the 9th of January was only 50 (appendix table 2a), the paediatric results for specimens aged 1-12 years during this sample collection period predominantly reflect the prevalence of natural infections among this group. The 1-4 years age group had a lower seroprevalence (28.8%) than the 5-12 year age group (43.5%), possibly due to increased socialisation among older aged children in school and public settings. There was no evidence of a gender difference in paediatric seropositivity.

The adult specimens aged over 18 years demonstrated a high overall seropositivity of 96.5% (95% CI 95.2, 97.5), with small variances by age group. The 18-29 year age group had both the lowest overall seropositivity (92.8%, 95% CI 88.6, 95.7) and lowest vaccination uptake rates (93%), but the highest rates of serological evidence of previous natural infection in the adult sample (51.0%, 95%

CI 44.7, 57.3). There was a steady decline in S+N+ seropositivity with increasing age groups, with 70-79 years having the lowest serological evidence of previous natural infection at 13.8% (95% CI 8.8, 21.1). Similar to the paediatric sample, there was no evidence of a gender difference in seropositivity among adults.

Serosurveillance provides valuable information on the proportion of the population that has been exposed to SARS-CoV-2, as it includes asymptomatic and unreported infections that generally remain undetected using case-based surveillance systems. In addition, serosurveillance is independent of changes in testing policy that affect the comprehensiveness of surveillance data being collected. The use of serosurveillance methods in tandem with traditional case based surveillance may assist in providing knowledge on the burden of COVID-19 in the community.

Limitations

Independent evaluations of test performance were not carried out; sensitivity and specificity rates were as reported by the manufacturers, Abbott and Roche.

The information collected is a simple dataset, including data readily available within the laboratory information management systems. No information was available on vaccination status, history of COVID-19 infection, or underlying conditions of the individuals from whom the specimens were sourced. Information on fully vaccinated and boosted individuals by age group in the whole population, available from COVAX, was used for comparison.

There are challenges with identifiying residual sera specimens sourced from general practice in paediatric populations. In order to obtain sufficient specimens, we included specimens from the Emergency Department and general paediatrics medical outpatients as well as from general practice. Similar strategies have been used in the USA (3,4) and Israel (5). The findings should be reviewed in this light, as this population may have been attending emergency/urgent services due to COVID-19 related symptoms, and may therefore present with higher seropositivity rates than the general population. Due to the small sample size and the predominance of specimens from a single county, paediatric specimen results may not be representative of, or generalisable to, the general paediatric population. Similarly, adult specimens are overrepresented in certain counties, which limits generalisation of results to the general population.

The test sensitivity was measured as its ability to detect antibodies 14 days or longer following infection or vaccination; antibodies might not have been detected in specimens from persons tested earlier than this time period post infection or vaccination. While the majority of SARS-CoV-2-infected or vaccinated individuals seroconvert following SARS-CoV-2 infection or vaccination, antibodies are not generated in a small minority of cases.

Work is ongoing to better understand what antibody levels mean in terms of protection against COVID-19. Current thinking is that there is no threshold antibody level that offers complete protection against infection, but instead that higher antibody levels are likely to be associated with lower probability of infection.

Serological tests target specific SARS-CoV-2-induced antibodies. However, results only provide a partial picture of the immune response against the virus. They may not reflect immune protection at the site of infection (i.e. respiratory tract), or T-cell mediated responses. The induction of SARS-CoV-2-specific memory T-cells is important for long-term protection and play a vital role in virus

clearance. T-cells may be maintained even if there are not measurable levels of serum antibodies. This limits the reliance on antibody levels alone as a proxy for the existence and duration of immunity.

Public health implications

As part of the HPSC's ongoing remit to protect the health of the Irish people as the national centre for surveillance of communicable diseases, the National Serosurveillance Programme facilitates identification of changes in SARS CoV 2 seroprevelance at a community level.

Seroprevalence data generated by the NSP and participating partners helps to identify variance in population immunity in an attempt to inform public health measures. Seroprevalence data also aids in ongoing epidemiological models being used to project scenarios for the trajectory of the disease and to monitor transmission trends.

Appendix

Table 1a. Quantitative anti-S and anti-N results of S-N+ specimens (N= 10)

Age (years)	Sex	Abbott BAU/ml	Roche cutoff index (COI)
5	F	0.48	2.13
5	F	6.99	11.1
29	F	1.08	5.88
29	F	4.79	23.4
29	F	4.63	1.32
38	F	5.35	3.82
37	F	6.22	87.7
51	F	0.738	10.5
44	M	6.18	1.21
24	F	6.33	40.8

Table 2a. Paediatric vaccination status in COVAX as of 09/01/2022

Characteristic		Partially Vaccinated Only	Fully Vaccinated Only	No. Additional/Booster Doses	No. Immunocompromised Doses
Age group (years)	0-4	3	4	74	0
	5-9	21	2	7	1
	10-11	11	9	3	1
	12-15	9665	193756	1963	109

* Partially Vaccinated Only refers to people on a two-dose vaccine plan who have received the 1st dose only and not their 2nd dose; Fully Vaccinated Only refers to people on a two-dose plan who have received their 1st & 2nd doses + the number of people on a single dose vaccine plan who have received a vaccination; Additional/Booster Doses are the number of people who have completed a primary course (fully vaccinated) and have received a booster dose; Immunocompromised Doses are individuals in receipt of two doses initially and who require an additional third dose as part of primary course treatment.

Technical notes

1. Population Data

Population data were taken from the Central Statistics Office population estimates of 2021 provided by the HSE-National Health Intelligence Unit ('April 2021/H1'). Data were aggregated into the following age groups for analysis: 1-4 years, 5-12 years, 18-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, 70-79 years, and 80+ years.

2. Adjustments for sensitivity and specificity of the test

The seroprevalence was adjusted for the misclassification or imperfect sensitivity (the proportion of true positives that have been correctly identified) and specificity (the proportion of true negatives that have been correctly identified) in the application of the diagnostic testing. If the sensitivity and specificity of a test is known, we can get an approximately unbiased estimate of the true prevalence using the Rogan Gladen-estimator (6)

Thus the adjusted prevalence is estimated by:

$$prev_{adj} = \frac{prev + Sp - 1}{\mathrm{Se} + \mathrm{Sp} - 1}$$

Where $prev$ is the unadjusted seroprevalence, Sp is the specificity of the test and Se is the sensitivity of the test.

The associated confidence interval is similarly adjusted. The confidence interval is approximate because it assumes that the values of the sensitivity and specificity are known rather than estimated. If they are only estimates, then this can be taken into account using the estimates given in Greiner & Gardner (7). In this report we assume the sensitivity of the Abbott Architect SARS-CoV-2 IgG Assay is 98.81% (95% CI 93.56, 99.94) and specificity is 99.55% (95% CI 99.15, 99.76) as reported in (8).

3. Definition of Epidemiological week

Epidemiological weeks are as outlined on the HPSC website.

4. Vaccination Uptake Data

Vaccination uptake data by sex and age group were obtained from HPSC and extracted from Ireland's national COVID-19 immunisation system, COVAX. These data were aggregated into the following age groups for the analysis: 18-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, 70-79 years, and 80+ years. Vaccinated persons were collated from COVAX data through to midnight 05 January 2022 to provide an approximate 14-day window for comparison with seroprevalence data, allowing for development of antibody response to vaccination.

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For further information on the National Serosurveillance Programme see here

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