Public Health England

Protecting and improving the nation's health

Serological Surveillance: Summary report 3
PHE Surveillance Cell

6 May 2020

Background

Control of COVID-19 requires the ability to detect asymptomatic and mild infections, that would not present to healthcare and would otherwise remain undetected through existing surveillance systems. This is important to determine the true number of infections within the general population to understand transmission, to inform control measures such as social distancing and school closures and to provide a denominator for the estimation of severity measures such as infection fatality and infection hospitalisation ratios.

Enhanced Sero-surveillance

A number of serological collections have been established with the aim to provide an age-stratified geographically representative sample across England over time. These have been derived from a number of sources including: 1) existing opportunistic collection of residual samples of all ages from PHE's Sero-Epidemiology Unit (SEU) and 2) samples from patients aged 10 years and over attending participating practices in the RCGP Research and Surveillance Centre network, 3) an existing NIHR funded paediatric study (What's the STORY) to collect sera from health children and adolescents <25 years in England, as well as a range of new collections among 4) healthy blood donors, supplied by the NHS Blood and Transplant (NHS BT), instigated by the Wellcome Trust, 5) paediatric patients seen at Great Ormond Street Hospital (GOSH), 6) a PHE longitudinal study (ESCAPE) among PHE /NHS staff, and 7) paediatric sera from non-specialist paediatric centres, among others.

Approximately 1000 samples per week are being provided by NHSBT from different geographic regions, and 100 samples per week are being collected from GOSH patients residing in London and the South East.

The results from the testing of NHSBT and GOSH samples undertaken to date, are summarised in this report. Samples from other sources continue to be being collected and analysed and will be presented in subsequent reports. All results presented in this summary report are based on samples using the commercial Euroimmun IgG ELISA.

Results

Seroprevalence estimates presented here are based on adult samples from NHSBT (n= 7427) and paediatric samples obtained from GOSH (n=359).

As with last week's report, the NHSBT results include two sets of data from London collected two weeks apart (week 13 (n=757), and weeks 15-16 (n=1085)), two sets of data from the Midlands (week 14, n=916, week 17, n=938), North-East region (week 16, n=1016) ,North-West region (week 16 - 17, n=936), South-West region (week 17, n = 773) and Wales (week 17, n = 1006).

The GOSH samples comprised a total of 359 samples of children aged 1 – 19 years; 154 from late March and 205 from early April. Another 111 results from children sampled in April are included in this report. Results among infants (<1y of age) are not included in the paediatric analysis, as may likely reflect maternal antibodies.

The analysis of seroprevalence was adjusted for the sensitivity and sensitivity of the EuroImmun, based on sensitivity of 72/101 (71.3%) and specificity of 777/786 (98.9%) and uncertainty using a Bayesian approach. The sensitivity estimates have been updated from last week's report, which stood at 64% (44/69), after further convalescent sera was tested last week, including on patients in their second month post infection.

Table 1 summarises the main results by collection and chronological order of sampling.

Table 1: Summary of the Prevalence Estimates by Collection and Chronological order of Sampling, using the Euroimmun Assay

Region	Date range	Week of collection	#pos	#ind	#neg	Total	% pos (95% CI)	Adjusted prevalence (95% CrI)*
GOSH**								
London & SE	6-28 Mar	11-13	13	7	150	170	7.6% (4.1% - 12.7%)	8.9% (3.7% - 15.9%)
London & SE	1-15 Apr	14-16	25	6	182	213	11.7% (7.7% - 16.8%)	14.8% (8.9% - 22.6%)
NHSBT								
London	26-27 Mar	13	22	11	724	757	2.9% (1.8% - 4.4%)	1.8% (0% - 4.1%)
Midlands	2-3 Apr	14	25	13	878	916	2.7% (1.8% - 4%)	1.5% (0% - 3.7%)
London	9-13 Apr	15	107	15	963	1085	9.9% (8.2% - 11.8%)	11.9% (8.9% - 15.4%)
NE	14-16 Apr	16	46	12	958	1016	4.5% (3.3% - 6%)	4.2% (1.9% - 6.6%)
NW	15-20 Apr	16-17	55	11	870	936	5.9% (4.5% - 7.6%)	6.1% (3.6% - 9.1%)
Midlands	23-24 Apr	17	58	7	873	938	6.2% (4.7% - 7.9%)	6.6% (4% - 9.5%)
SW	24-26 Apr	17	38	7	728	773	4.9% (3.5% - 6.7%)	4.8% (2.2% - 7.5%)
Wales		17	34	4	968	1006	3.4% (2.4% - 4.7%)	2.5% (0.3% - 4.9%)

**adjusted based on sensitivity of 72/101 (71.3%) and specificity of 777/786 (98.9%) - uncertainty of these estimates incorporated into the adjustment using Bayesian analysis (median and 95% credible interval)*

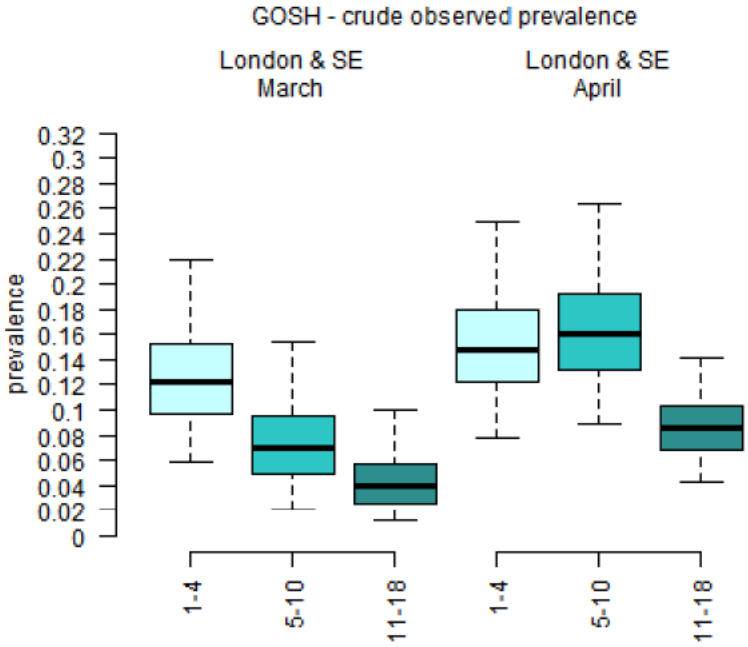
***Analysis for GOSH excludes ages <1*

Great Ormond Street Hospital

Figure 1 and Table 2 show the observed and adjusted prevalence estimates by age group, in March and April. The analysis by age group shows a marked increase in the overall prevalence between the two time points, and a higher prevalence in children <10 years compared to 11 – 18 year olds.

The prevalence in children <10 years of age needs to be interpreted with caution, as unlike in children >10 years and in adults, the distribution of positive results is very close to the cut-off value, suggesting that a better understanding of assay performance is needed to interpret the prevalence age trends in the paediatric population.

Figure 1: *Observed Prevalence by Age Group, GOSH data.*



Details about the prevalence estimates are provided in Table 2, including adjusted estimates.

Table 2: Observed and adjusted seroprevalence by age group, GOSH

Region	Date range	Week of collection	Age group	#pos	#ind	#neg	Total	% pos (95% CI)	Adjusted prevalence (95% CrI)*
London & SE	6-28 Mar	11-13	1-4	8	3	43	54	14.8% (6.6% - 27.1%)	15.5% (6.5% - 29.6%)
			5-10	3	3	36	42	7.1% (1.5% - 19.5%)	8.2% (0.9% - 20.1%)
			11-18	2	1	70	73	2.7% (0.3% - 9.5%)	3.9% (0% - 12.5%)
London & SE	1-15 Apr	14-16	1-4	8	3	38	49	16.3% (7.3% - 29.7%)	19.3% (9.2% - 34.1%)
			5-10	9	0	41	50	18% (8.6% - 31.4%)	21% (10.5% - 36.2%)
			11-18	8	3	101	112	7.1% (3.1% - 13.6%)	10.3% (4.1% - 18.7%)

NHSBT data

Table 1 shows that in London (week 15), North West and North East (week 16), and the Midlands (week 17) the prevalence is well above baseline, with a marked prevalence increase in London between week 15 and week 13 (observed difference of 7% (95% CI: 4.8% - 9.1%)) and in the Midlands between weeks 14 and 17 (observed difference of 3.5% (95% CI: 1.6% - 5.3%)). In contrast, the prevalence in Wales in week 17 remains low, closer to the baseline and to estimates from London and the Midlands 3 – 4 weeks earlier.

The observed prevalence estimates by ~10 year age bands is shown in **Figure 2** and summarised in **Table 3** (which includes both crude and adjusted figures). It shows a higher prevalence among younger adults in all areas where the prevalence is well above baseline, disproportionally so in the North West in week 16. In the Midlands, week 17 estimates show a higher prevalence in young adults, but also in older adults (60+years), albeit with wide uncertainty.

Age-specific estimates for Wales could not be provided as the demographic data were not yet available, but will be provided in next week's report.

Please note that about 1-2% of the samples come without demographic data, and hence prevalence estimates in this report are based on the 98-99% sets with available data.

Figure 2: *Observed Prevalence by Age Group and Collection, NHSBT data*

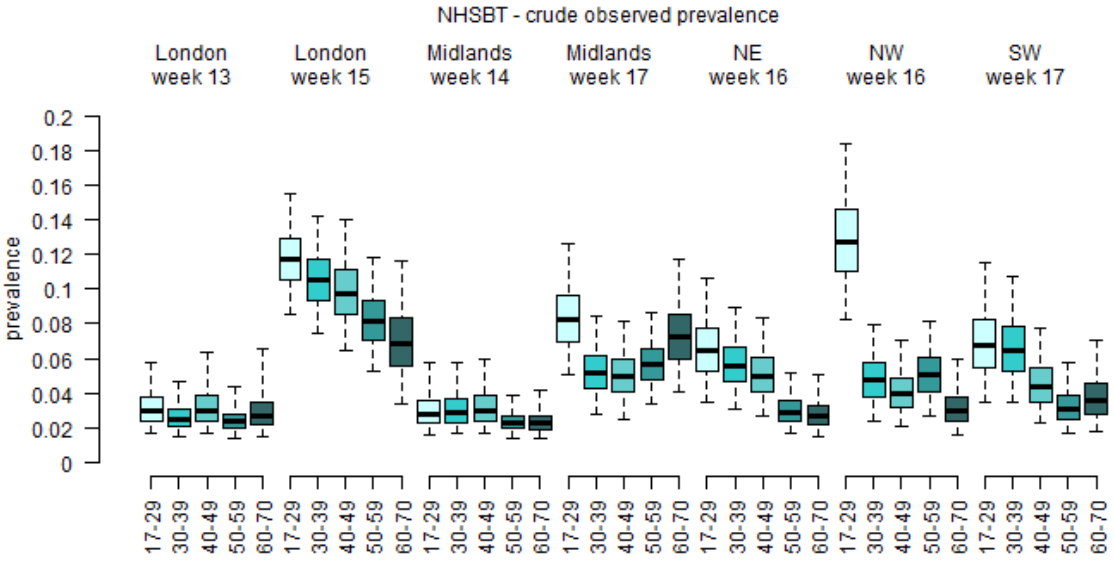


Table 3: Observed and adjusted seroprevalence by age group, NHSBT

Region	Date range	Week of collection	Age group	#pos	#ind	#neg	Total	% pos (95% CI)	adjusted prevalence (95% CrI)*
London	26-27 Mar	13	17-29	7	4	182	193	3.6% (1.5% - 7.3%)	1.6% (0% - 6%)
			30-39	5	3	188	196	2.6% (0.8% - 5.9%)	0.7% (0% - 4.5%)
			40-49	5	1	130	136	3.7% (1.2% - 8.4%)	1.5% (0% - 6.7%)
			50-59	3	1	159	163	1.8% (0.4% - 5.3%)	0.5% (0% - 3.8%)
			60-70	2	2	65	69	2.9% (0.4% - 10.1%)	1% (0% - 7.1%)
Midlands	2-3 Apr	14	17-29	5	2	141	148	3.4% (1.1% - 7.7%)	1.2% (0% - 6%)
			30-39	6	4	161	171	3.5% (1.3% - 7.5%)	1.3% (0% - 6.1%)
			40-49	7	2	176	185	3.8% (1.5% - 7.6%)	1.6% (0% - 6.3%)
			50-59	5	1	257	263	1.9% (0.6% - 4.4%)	0.4% (0% - 3.1%)
			60-70	2	4	141	147	1.4% (0.2% - 4.8%)	0.3% (0% - 3.5%)
London	9-13 Apr	15-16	17-29	35	5	246	286	12.2% (8.7% - 16.6%)	14.4% (9.4% - 20.6%)
			30-39	30	8	241	279	10.8% (7.4% - 15%)	12.6% (7.9% - 18.6%)
			40-49	19	0	173	192	9.9% (6.1% - 15%)	11.5% (6.5% - 18.3%)
			50-59	17	1	199	217	7.8% (4.6% - 12.2%)	9.3% (4.7% - 15.1%)
			60-70	6	1	104	111	5.4% (2% - 11.4%)	7.4% (2% - 14.7%)
NE	14-16 Apr	16	17-29	12	4	148	164	7.3% (3.8% - 12.4%)	6.7% (2.1% - 13.1%)
			30-39	13	2	198	213	6.1% (3.3% - 10.2%)	5.4% (1.5% - 10.7%)
			40-49	11	3	189	203	5.4% (2.7% - 9.5%)	4.6% (0.7% - 9.8%)
			50-59	7	0	258	265	2.6% (1.1% - 5.4%)	1.4% (0% - 5.1%)
			60-70	3	3	165	171	1.8% (0.4% - 5%)	1% (0% - 4.8%)
NW	15-20 Apr	16-17	17-29	22	5	128	155	14.2% (9.1% - 20.7%)	15.8% (9.1% - 24.9%)
			30-39	10	2	194	206	4.9% (2.4% - 8.7%)	4.2% (0.4% - 9.2%)
			40-49	8	1	192	201	4% (1.7% - 7.7%)	3.1% (0% - 7.9%)
			50-59	12	2	218	232	5.2% (2.7% - 8.9%)	4.6% (0.8% - 9.6%)
			60-70	3	1	138	142	2.1% (0.4% - 6%)	1.5% (0% - 6.2%)

Region	Date range	Week of collection	Age group	#pos	#ind	#neg	Total	% pos (95% CI)	adjusted prevalence (95% CrI)*
Midlands	23-24 Apr	17	17-29	15	2	148	165	9.1% (5.2% - 14.6%)	9.3% (4.4% - 16.2%)
			30-39	9	3	172	184	4.9% (2.3% - 9.1%)	4.8% (0.9% - 9.9%)
			40-49	10	1	204	215	4.7% (2.3% - 8.4%)	4.5% (0% - 9.5%)
			50-59	13	1	220	234	5.6% (3% - 9.3%)	5.5% (1.8% - 10.3%)
			60-70	11	0	129	140	7.9% (4% - 13.6%)	7.8% (3% - 14.7%)
SW	24-26 Apr	17	17-29	10	3	115	128	7.8% (3.8% - 13.9%)	7.2% (2% - 14.5%)
			30-39	11	1	138	150	7.3% (3.7% - 12.7%)	6.8% (2.1% - 13.2%)
			40-49	8	1	167	176	4.5% (2% - 8.8%)	3.7% (0.1% - 8.9%)
			50-59	5	1	188	194	2.6% (0.8% - 5.9%)	1.8% (0% - 5.9%)
			60-70	4	1	120	125	3.2% (0.9% - 8%)	2.5% (0% - 7.7%)

Comments

This week's report provides more detailed analyses on the seroprevalence by age group and geographic area and includes results from donor samples from the second collection in the Midlands, and first estimates for the South West and for Wales.

The estimates among adults show a steady decline in prevalence across adult age groups, with the highest prevalence found among adolescents and young adults in the 17-24 year old age group. . This may reflect differences in behaviour and mixing patterns in the young adult age group, but repeated data in the same regions in the coming weeks would be required to better understand whether differences by age group may also relate to differences in adhering to physical distancing rules under lockdown. A high prevalence in young children, young adults (and in some places, a suggestion that the prevalence is higher among healthy >60 year olds) may reflect intergenerational mixing patterns. Obtaining more data in paediatric age groups and adolescents/young adults (he 15-25 year olds) would be important. Samples from What's the Story study, with healthy children and adolescents up to the age of 25, should provide more insight.

Having repeated data within similar regions, and more than two time points, is important to better understand transmission dynamics. The sizeable increase seen in London and in the Midlands over a two and three week period respectively is important to understand dynamics, and having a third data point in the coming week(s) would be important.

The age trend among young children need to be interpreted with caution, both because of challenges in generalising from a very specific paediatric population seen at GOSH, as well as uncertainty around assay performance in those age groups. The lack of specific validation data on paediatric samples also requires caution when interpreting adjusted estimates in that age group .

Recommendations

1. PHE continues to collect samples for assay evaluation including later convalescent samples from cases and additional sample sets to better establish specificity, including among paediatric age groups.

2. PHE continues to investigate alternative commercial assays. Results generated using the EuroImmun assay should be used with caution for modelling until more information is available on the antibody dynamics using this test or a more accurate assay is available. Parallel testing of some sample sets with the in-house assays will allow better adjustments to be made to future results.

3. Additional evaluation of other PHE assays under development continues, and will be used to retest some of the above samples sets (or equivalents) to confirm the initial findings. Further development may include development of assays suitable for oral fluid. Assays targeting different antigens or antibody classes may be key for vaccine evaluation, and may have different antibody dynamics which can be used to inform seroprevalence in this rapidly changing situation.

4. More representative samples from young children and adolescents are being sourced urgently. Testing of precious low volume samples (such as those from children) should proceed with caution, ideally using the most accurate assays.

5. Now that NHSBT have targeted most regions as baseline repeat sampling at intervals of at least two weeks, as the change in prevalence will enable, in concert with other surveillance data, us to better understand both transmission and antibody dynamics.

6. PHE continue to work with other groups in the NHS and academia to increase the pool of information on the range of assays available to select the best choice of tests for current and future sero-epidemiology studies.