Supplemental material

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Table 1 Recruiting sites NHS region(s) and postcode districts where applicable

Site	NHS region(s)	Date of first recruit	Selected postcode districts						
Bradford	Yorkshire and Humber	31/3/2020	BD15	BD6					
Bristol	South West	9/4/2020	BS2	BS20	BS3	BS37	BS41	BS8	
Imperial	London	8/2/2021	SW1	SW3	NW6	NW8	W11	WC2	
Leeds	Yorkshire and Humber	5/6/2020	LS25	WF2					
Manchester	North West	12/6/2020	M1	M12	M20	M23	M25	M6	
Newcastle	North East	7/1/2021	NE3	NE12	NE13	NE20	NE23	NE28	
Nottingham*	Midlands	10/7/2020							
Oxford	South East East of England	15/10/2019	HP17	HP22	HP23	MK13	OX1	OX11	OX28
Plymouth*	South West	3/6/2020							
Sheffield	Yorkshire and Humber Midlands	20/4/2020	S14	S43					
Southampton	South East	12/4/2020	SO16	SO23	SO24	SO50	SO51	SO52	
St Georges London	London South East	26/3/2020	CR4	KT18	KT6	SM3	SW11	SW20	
West Suffolk	East of England	21/1/2021	CB8	CB9	CO10	IP14	IP24	IP28	

*recruitment not restricted by postcode district

Table 2 Sensitivity, specificity and thresholds of positivity for anti-SARS-CoV-2 IgG spike protein antibodies (RocheS) and anti-SARS-CoV-2 IgG nucleocapsid antibodies (RocheN) [13,14]

	RocheS	RocheN
Threshold of positivity	0·8U/ml	1·0 COI
Sensitivity	95·5% (95%CI 93·2-97·1)	83·9% (95% CI 74·8-90·7)
Specificity	100% (95% CI 99·1-100)	100% (95% CI 99·1-100)

COI – cut off index
U/ml - *units per millilitre*

Table 3 Summary of participants aged 0-18 years tested for COVID-19 with RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies and RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies assays

	Seroprevalence		Symptoms		Risk factor	
	RocheS	RocheN	RocheS	RocheN	RocheS	RocheN
Age group						
0-4 years	532 (21·5%)	529 (21·4%)	289 (21·6%)	287 (21·5%)	516 (21·4%)	513 (21·3%)
5-9 years	636 (25·7%)	636 (25·7%)	344 (25·7%)	344 (25·7%)	620 (25·7%)	620 (25·7%)
10-14 years	721 (29·1%)	721 (29·1%)	377 (28·2%)	377 (28·2%)	705 (29·2%)	705 (29·3%)
15-18 years	588 (23·7%)	589 (23·8%)	329 (24·6%)	329 (24·6%)	571 (23·7%)	572 (23·7%)
Sex						
Female	1230 (49·7%)	1230 (49·7%)	689 (51·5%)	688 (51·5%)	1198 (49·7%)	1198 (49·7%)
Male	1247 (50·3%)	1245 (50·3%)	650 (48·7%)	649 (48·5%)	1214 (50·3%)	1212 (50·3%)
NHS region						
East of England	171 (6·9%)	171 (6·9%)	96 (7·2%)	96 (7·2%)	156 (6·5%)	156 (6·5%)
London	289 (11·7%)	289 (11·7%)	181 (13·6%)	181 (13·5%)	287 (11·9%)	287 (11·9%)
Midlands	210 (8·5%)	211 (8·5%)	138 (10·3%)	138 (10·3%)	207 (8·6%)	208 (8·6%)

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North East and Yorkshire	419 (16·9%)	419 (16·9%)	232 (17·3%)	232 (17·4%)	410 (17·0%)	410 (17·0%)
North West	331 (13·4%)	331 (13·4%)	141 (10·5%)	141 (10·5%)	326 (13·5%)	326 (13·5%)
South East	633 (25·6%)	631 (25·5%)	260 (19·4%)	258 (19·3%)	607 (25·2%)	605 (25·1%)
South West	424 (17·1%)	423 (17·1%)	291 (21·7%)	291 (21·8%)	419 (17·4%)	418 (17·3%)
Time period						
Pre-pandemic (01 Oct 2019 - 31 Mar 2020)	125 (5·0%)	125 (5·1%)	32 (2·4%)	32 (2·4%)	125 (5·2%)	125 (5·2%)
First wave (01 Apr 2020 - 31 May 2020)	335 (13·5%)	335 (13·5%)	74 (5·5%)	74 (5·5%)	334 (13·8%)	334 (13·9%)
Post first wave (01 Jun 2020 - 31 Aug 2020)	516 (20·8%)	515 (20·8%)	111 (8·3%)	111 (8·3%)	507 (21·0%)	506 (21·0%)
Schools reopening and second wave (01 Sep 2020 - 31 Dec 2020)	464 (18·7%)	464 (18·7%)	298 (22·3%)	297 (22·2%)	456 (18·9%)	456 (18·9%)
Post second wave (01 Jan 2021 - 31 Mar 2021)	771 (31·1%)	770 (31·1%)	617 (46·1%)	616 (46·1%)	736 (30·5%)	735 (30·5%)
Emergence of delta variant (01 Apr 2021 - 30 Jun 2021)	266 (10·7%)	266 (10·7%)	207 (15·5%)	207 (15·5%)	254 (10·5%)	254 (10·5%)
Ethnicity						
White (White and White minorities)	1991 (80·4%)	1989 (80·4%)	1073 (80·1%)	1071 (80·1%)	1987 (82·4%)	1985 (82·4%)
Black (African, Caribbean, Other Black background)	51 (2·1%)	51 (2·1%)	29 (2·2%)	29 (2·2%)	51 (2·1%)	51 (2·1%)
Asian (Bangladeshi, Pakistani, Indian, Chinese, Arab, other Asian background and other ethnic group)	144 (5·8%)	144 (5·8%)	99 (7·4%)	99 (7·4%)	144 (6·0%)	144 (6·0%)
Multiple ethnic backgrounds	231 (9·3%)	231 (9·3%)	134 (10·0%)	134 (10·0%)	230 (9·5%)	230 (9·5%)
Not specified	60 (2·4%)	60 (2·4%)	4 (0·3%)	4 (0·3%)		

IMD quintile						
Most deprived 1	357 (14·4%)	357 (14·4%)	179 (13·4%)	179 (13·4%)	352 (14·6%)	352 (14·6%)
2	337 (13·6%)	336 (13·6%)	178 (13·3%)	177 (13·2%)	328 (13·6%)	327 (13·6%)
3	461 (18·6%)	461 (18·6%)	247 (18·4%)	247 (18·5%)	446 (18·5%)	446 (18·5%)
4	535 (21·7%)	534 (21·6%)	289 (21·6%)	289 (21·6%)	518 (21·5%)	517 (21·5%)
Least deprived 5	782 (31·6%)	782 (31·6%)	441 (33·0%)	440 (32·9%)	768 (31·8%)	768 (31·9%)
Not specified	5 (0·2%)	5 (0·2%)	5 (0·4%)	5 (0·4%)		
IDACI quintile						
Most deprived 1	374 (15·1%)	374 (15·1%)	188 (14·0%)	188 (14·1%)	368 (15·3%)	368 (15·3%)
2	348 (14·0%)	347 (14·0%)	194 (14·5%)	193 (14·4%)	342 (14·2%)	341 (14·1%)
3	451 (18·2%)	451 (18·2%)	225 (16·8%)	225 (16·8%)	433 (18·0%)	433 (18·0%)
4	549 (22·2%)	541 (21·9%)	305 (22·8%)	305 (22·8%)	538 (22·3%)	537 (22·3%)
Least deprived 5	750 (30·3%)	750 (30·3%)	422 (31·5%)	421 (31·5%)	731 (30·3%)	731 (30·3%)
Not specified	5 (0·2%)	5 (0·2%)	5 (0·4%)	5 (0·4%)		
Urban/rural						
Urban	1984 (80·1%)	1982 (80·1%)	1076 (80·4%)	1075 (80·4%)	1933 (80·1%)	1931 (80·1%)
Rural	493 (19·9%)	493 (19·9%)	263 (19·6%)	262 (19·6%)	479 (19·9%)	479 (19·9%)
Member of family is a healthcare worker						
Yes	628 (25·4%)	627 (25·3%)	421 (31·5%)	421 (31·5%)	626 (26·0%)	625 (25·9%)
No	1269 (51·2%)	1268 (51·2%)	804 (60·0%)	802 (60·0%)	1262 (52·3%)	1261 (52·3%)
Not specified	580 (23·4%)	580 (23·4%)	114 (8·5%)	114 (8·5%)	524 (21·7%)	524 (21·7%)
Total	2477	2475	1339	1337	2412	2410

Table 4 Comparing regional populations (0-18 years) with the STORY sample (0-18 years olds) including vaccinated individuals

NHS region	East of England		London		Midlands		North East and Yorkshire		North West		South East		South West	
	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))	Region (0-18 years (%))	STORY sample (0-18 years (%))
White*	1146365·8 (82·4)	140 (88·6)	998497·8 (45·4)	199 (67·7)	852484·5 (75·4)	178 (84·8)	941658·8 (89·5)	361 (86·8)	1309834·6 (80·8)	235 (68·5)	1709830·1 (82·5)	531 (84·4)	1045274·7 (90·7)	393 (91·2)
Black**	46559·0 (3·3)	2 (1·3)	374912·9 (17·0)	19 (6·5)	37043·3 (3·3)	4 (1·9)	19364·3 (1·8)	7 (1·7)	36393·4 (2·2)	14 (4·1)	55537·4 (2·7)	4 (0·6)	18522·2 (1·6)	2 (0·5)
Asian***	111665·8 (8·0)	4 (2·5)	518125·2 (23·5)	30 (10·2)	169453·2 (15·0)	12 (5·7)	32584·5 (3·1)	17 (4·0)	190051·5 (11·7)	49 (14·3)	174174·6 (8·4)	28 (4·4)	36856·3 (3·2)	10 (2·3)
Multiple ethnic backgrounds	86007·6 (6·2)	12 (7·6)	310162·9 (14·1)	46 (15·6)	71616·5 (6·3)	16 (7·6)	58044·7 (5·5)	31 (7·5)	84851·4 (5·2)	45 (13·1)	131887·0 (6·4)	67 (10·6)	51275·7 (4·5)	26 (6·0)
total	1390598·2	158·0	2201698·7	294·0	1130597·5	210·0	1051652·4	416·0	1621130·9	343·0	2071429·2	630·0	1151928·9	431·0

*White including white minorities

**Black (African, Caribbean, Other Black background)

*** Asian (Bangladeshi, Chinese, Indian, Pakistani, Other Asian background)

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Table 5 Comparing children aged 0-15 years on IDACI and IMD by region as a measure of socioeconomic deprivation in children IMD and IDACI derived from postcode of participant, FASiii and Census 2011 home ownership and house size questions data were collected on the questionnaire

		Quintile				
		1	**2**	**3**	**4**	**5**
Overall	IMD	303	280	409	453	663
	Number (%) of families that own their own home in each IMD quintile	50·8	69·4	77·9	81·7	85·8
	Average number of rooms in home in each IMD quintile	5·6	6·1	6·6	7·0	7·3
	Average Number of bedrooms in home in each IMD quintile	2·9	3·2	3·5	3·6	3·8
	Mean FASiii score in each IMD quintile	6·5	7·7	8·7	8·9	9·5
	IDACI	315	304	481	476	632
	Number (%) of families that own their own home in each IDACI quintile	49·8	66·4	79·8	81·6	87·7
	Average number of rooms in home in each IDACI quintile	5·6	6·1	6·6	6·8	7·5
	Average Number of bedrooms in home in each IDACI quintile	2·9	3·2	3·5	3·6	3·8
	Mean FASiii score in each IDACI quintile	6·6	7·7	8·6	8·9	9·5
East of England	IMD	16	22	44	40	25
	Number (%) of families that own their own home in each IMD quintile	30·8	59·1	65·8	86·1	100·0
	Average number of rooms in home in each IMD quintile	5·8	6·6	6·8	7·4	7·8
	Average Number of bedrooms in home in each IMD quintile	2·9	3·5	3·3	3·9	3·7
	Mean FASiii score in each IMD quintile	6·4	7·6	7·8	9·3	9·7
	IDACI	24	22	30	40	31
	Number (%) of families that own their own home in each IDACI quintile	33·3	59·1	72·0	88·6	93·1
	Average number of rooms in home in each IDACI quintile	6·2	5·2	7·2	7·1	8·0
	Average Number of bedrooms in home in each IDACI quintile	3·0	3·4	3·8	3·5	3·8
	Mean FASiii score in each IDACI quintile	6·5	7·2	9·2	8·5	9·7
London	IMD	9	41	61	48	79
	Number (%) of families that own their own home in each IMD quintile	22·2	36·6	73·8	83·3	84·6
	Average number of rooms in home in each IMD quintile	4·8	5·1	5·9	6·7	6·8
	Average Number of bedrooms in home in each IMD quintile	2·3	2·9	3·2	3·5	3·8
	Mean FASiii score in each IMD quintile	5·8	7·5	8·5	9·3	9·7
	IDACI	18	55	35	61	69
	Number (%) of families that own their own home in each IDACI quintile	27·8	50·9	74·3	80·3	88·2
	Average number of rooms in home in each IDACI quintile	4·6	5·3	6·1	6·4	7·0
	Average Number of bedrooms in home in each IDACI quintile	2·5	2·9	3·3	3·6	3·9
	Mean FASiii score in each IDACI quintile	7·2	7·5	8·3	9·2	10·1
Midlands	IMD	17	30	34	30	44
	Number (%) of families that own their own home in each IMD quintile	58·8	67·9	84·8	86·7	95·3
	Average number of rooms in home in each IMD quintile	6·8	6·3	6·4	7·1	7·8
	Average Number of bedrooms in home in each IMD quintile	3·6	3·4	3·5	3·7	4·0
	Mean FASiii score in each IMD quintile	7·5	8·3	8·8	9·1	9·8
	IDACI	23	32	31	35	34
	Number (%) of families that own their own home in each IDACI quintile	52·2	75·9	83·9	91·2	97·1
	Average number of rooms in home in each IDACI quintile	6·6	6·4	6·3	7·3	7·9
	Average Number of bedrooms in home in each IDACI quintile	3·4	3·5	3·4	3·9	4·0
	Mean FASiii score in each IDACI quintile	7·7	8·5	8·7	9·5	9·7
North East and Yorkshire	IMD	88	59	61	57	89
	Number (%) of families that own their own home in each IMD quintile	58·8	82·5	81·7	91·1	88·6
	Average number of rooms in home in each IMD quintile	5·5	6·3	6·8	7·1	7·4

	Average Number of bedrooms in home in each IMD quintile	2·9	3·2	3·6	3·6	3·7
	Mean FASiii score in each IMD quintile	6·8	7·2	8·7	9·3	9·0
	IDACI	83	57	68	41	105
	Number (%) of families that own their own home in each IDACI quintile	60·0	73·2	83·3	87·5	92·3
	Average number of rooms in home in each IDACI quintile	5·6	6·3	6·8	6·7	7·4
	Average Number of bedrooms in home in each IDACI quintile	3·0	3·2	3·5	3·5	3·7
	Mean FASiii score in each IDACI quintile	6·7	7·3	8·6	8·8	9·1
North West	IMD	119	54	71	51	2
	Number (%) of families that own their own home in each IMD quintile	51·7	86·5	81·7	85·7	50·0
	Average number of rooms in home in each IMD quintile	5·7	6·5	7·3	7·8	8·0
	Average Number of bedrooms in home in each IMD quintile	2·9	3·4	3·9	4·2	4·5
	Mean FASiii score in each IMD quintile	6·5	8·4	9·0	8·7	9·5
	IDACI	116	27	50	41	63
	Number (%) of families that own their own home in each IDACI quintile	52·2	74·1	87·5	70·0	91·9
	Average number of rooms in home in each IDACI quintile	5·7	6·0	7·3	6·4	8·1
	Average Number of bedrooms in home in each IDACI quintile	3·0	3·2	3·7	3·7	4·3
	Mean FASiii score in each IDACI quintile	6·5	8·0	8·3	8·5	9·3
South East	IMD	23	40	81	112	293
	Number (%) of families that own their own home in each IMD quintile	27·3	63·2	73·7	76·9	80·4
	Average number of rooms in home in each IMD quintile	5·6	5·9	6·1	7·1	7·3
	Average Number of bedrooms in home in each IMD quintile	2·7	3·1	3·3	3·5	3·9
	Mean FASiii score in each IMD quintile	6·3	7·6	8·4	9·4	9·4
	IDACI	19	68	104	152	206
	Number (%) of families that own their own home in each IDACI quintile	23·5	65·7	72·6	77·7	82·5
	Average number of rooms in home in each IDACI quintile	5·3	6·1	6·5	7·0	7·5
	Average Number of bedrooms in home in each IDACI quintile	2·5	3·2	3·5	3·6	3·8
	Mean FASiii score in each IDACI quintile	5·5	8·0	8·7	9·2	9·6
South West	IMD	31	34	57	115	131
	Number (%) of families that own their own home in each IMD quintile	54·8	75·8	83·6	76·1	91·3
	Average number of rooms in home in each IMD quintile	5·1	5·8	6·9	6·4	7·3
	Average Number of bedrooms in home in each IMD quintile	2·8	3·4	3·5	3·5	3·8
	Mean FASiii score in each IMD quintile	6·1	7·5	8·5	8·2	9·5
	IDACI	32	43	63	106	124
	Number (%) of families that own their own home in each IDACI quintile	51·6	71·4	85·2	84·8	85·8
	Average number of rooms in home in each IDACI quintile	5·2	6·5	6·4	6·7	7·2
	Average Number of bedrooms in home in each IDACI quintile	2·9	3·3	3·3	3·7	3·7
	Mean FASiii score in each IDACI quintile	6·3	7·6	8·5	8·6	9·2

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Figure 1 A comparison of results by the RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies assay and RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies assay by age
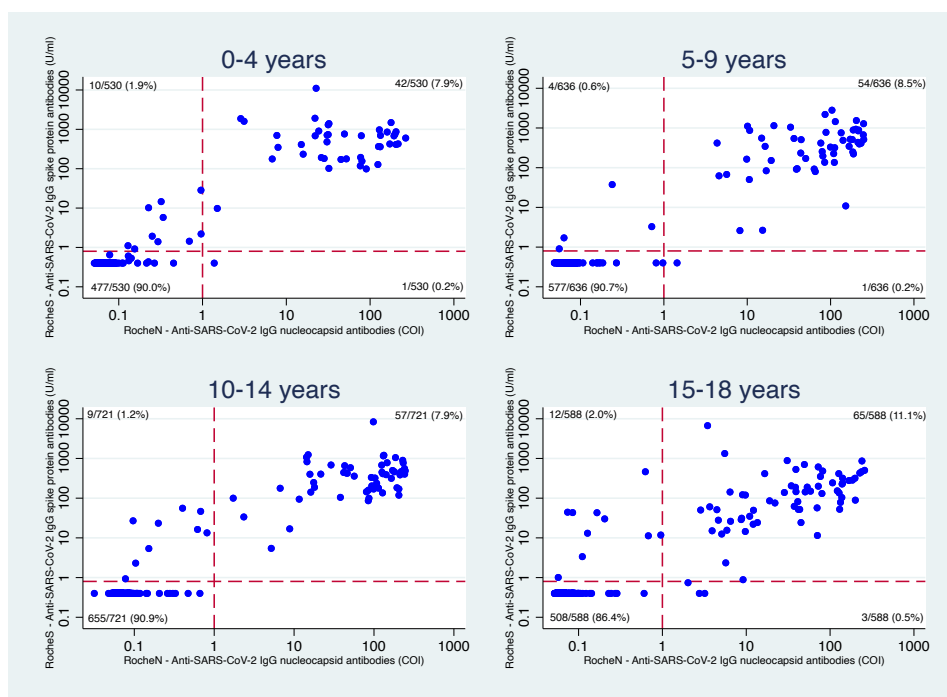
Assay positivity thresholds indicated as red dashed lines (0.8 U/ml for Spike and 1 COI for Nucleocapsid)
COI – cut off index, U/ml (units per millilitre)

Table 6 SARS-CoV-2 seroprevalence (RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies and RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies) by age group and time period October 2019 to June 2021 in England, adjusted for age, region and ethnicity
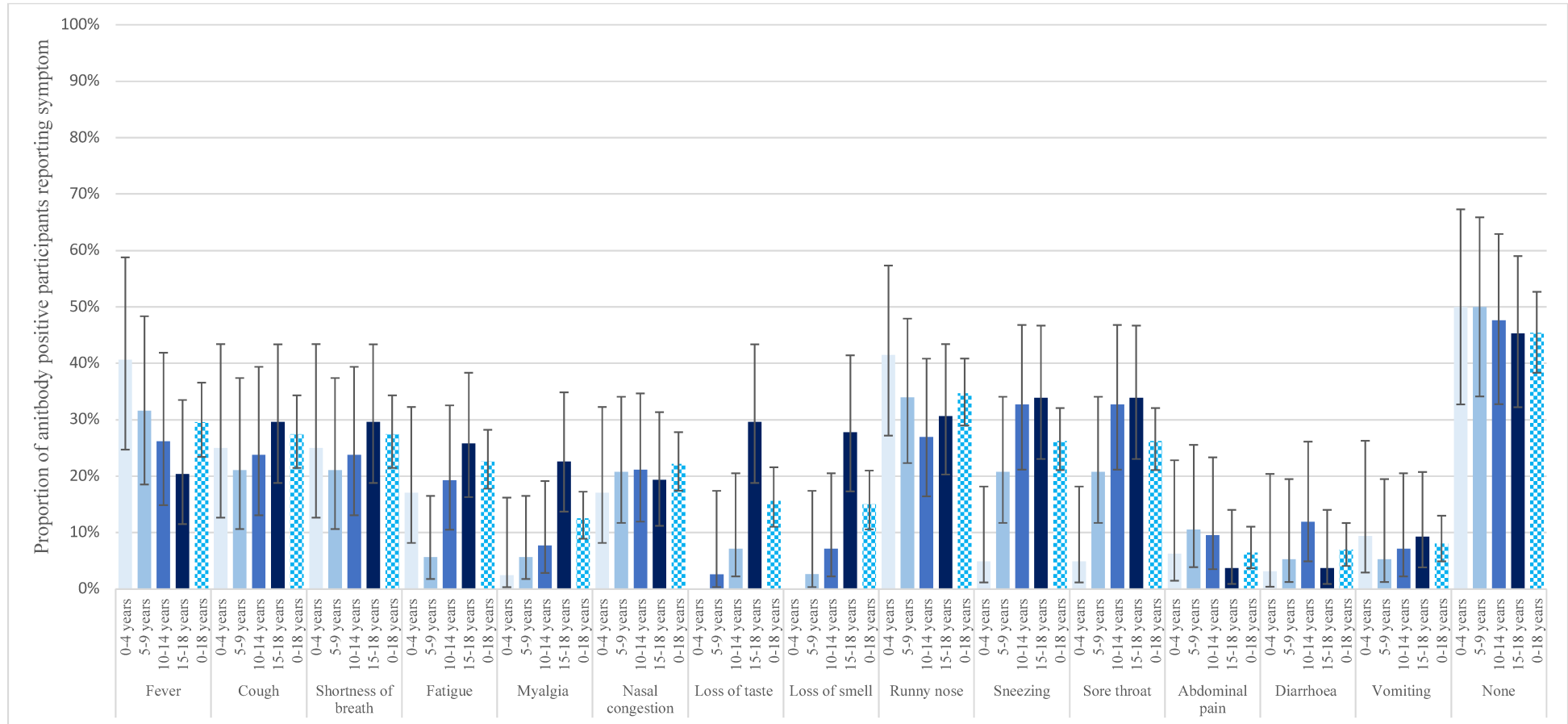
	RocheS			RocheN		
Period	**N**	**Crude rate**	**Adjusted rate**	**N**	**Crude rate**	**Adjusted rate**
Pre-pandemic (Oct 19 - Mar 20)	125	0·0%	0·0%	125	0·0%	0·0%
First wave (Apr 20 - May 20)	335	3·9%	2·2% (0·9%-3·4%)	335	3·6%	1·8% (0·8%-2·8%)
Post first wave (Jun 20 - Aug 20)	516	3·9%	5·2% (3·2%-7·2%)	515	3·7%	5·1% (3·1%-7·2%)
Schools reopening and second wave (Sep 20 - Dec 20)	464	6·9%	7·1% (5·5%-8·6%)	464	6·0%	7·3% (5·5%-9·1%)
Post second wave (Jan 21 - Mar 21)	771	17·5%	17·6% (14·4%-20·9%)	770	15·2%	16·2% (12·9%-19·4%)
Emergence of delta variant (Apr 21 - Jun 21)	266	19·9%	19·9% (16·1%-23·7%)	266	17·7%	16·8% (13·1%-20·6%)

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Table 7 SARS-CoV-2 seroprevalence (RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies and RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies) by age group and time period October 2019 to June 2021 in England, adjusted for NHS region and ethnicity

		RocheS			RocheN		
		N	Crude	Adjusted	N	Crude	Adjusted
0-4 years	**Pre-pandemic (Oct 19 - Mar 20)**	25	0·0%	0·0%	25	0·0%	0·0%
	First wave (Apr 20-May 20)	62	1·6%	0·7% (0·0%-2·1%)	62	1·6%	0·7% (0·0%-2·1%)
	Post first wave (Jun 20 - Aug 20)	64	4·7%	4·7% (0·0%-10·2%)	63	4·8%	4·7% (0·0%-10·3%)
	Schools reopening and second wave (Sep 20 - Dec 20)	77	5·2%	5·3% (2·2%-8·4%)	76	6·6%	6·2% (2·7%-9·8%)
	Post second wave (Jan 21 -Mar 21)	200	13·5%	13·0% (6·7%-19·3%)	199	10·1%	11·7% (5·5%-18·0%)
	Emergence of delta variant (Apr 21 - Jun 21)	104	16·3%	13·9% (4·5%-23·2%)	104	13·5%	12·2% (3·1%-21·4%)
5-9 years	**Pre-pandemic (Oct 19 - Mar 20)**	31	0·0%	0·0%	31	0·0%	0·0%
	First wave (Apr 20-May 20)	83	3·6%	2·5% (0·0%-5·0%)	83	3·6%	2·5% (0·0%-5·0%)
	Post first wave (Jun 20 - Aug 20)	144	4·9%	9·5% (8·2%-10·9%)	144	3·5%	8·9% (7·9%-10·0%)
	Schools reopening and second wave (Sep 20 - Dec 20)	119	3·4%	1·8% (0·0%-3·5%)	119	3·4%	3·6% (0·0%-7·3%)
	Post second wave (Jan 21 -Mar 21)	187	15·0%	17·8% (11·5%-24·1%)	187	15·0%	17·8% (11·5%-24·1%)
	Emergence of delta variant (Apr 21 - Jun 21)	72	22·2%	18·9% (15·5%-22·3%)	72	20·8%	18·5% (15·2%-21·9%)
10-14 years	**Pre-pandemic (Oct 19 - Mar 20)**	41	0·0%	0·0%	41	0·0%	0·0%
	First wave (Apr 20-May 20)	108	3·7%	3·2% (0·0%-6·5%)	108	2·8%	1·7% (0·0%-3·5%)
	Post first wave (Jun 20 - Aug 20)	174	2·3%	0·9% (0·0%-1·8%)	174	2·3%	0·9% (0·0%-1·8%)
	Schools reopening and second wave (Sep 20 - Dec 20)	152	5·3%	2·5% (0·6%-4·4%)	152	5·3%	2·5% (0·6%-4·4%)
	Post second wave (Jan 21 -Mar 21)	195	21·5%	20·6% (13·6%-27·6%)	195	17·9%	18·1% (11·3%-24·9%)
	Emergence of delta variant (Apr 21 - Jun 21)	51	15·7%	17·6% (9·7%-25·5%)	51	13·7%	16·6% (8·9%-24·3%)
15-18 years	**Pre-pandemic (Oct 19 - Mar 20)**	28	0·0%	0·0%	28	0·0%	0·0%
	First wave (Apr 20-May 20)	82	6·1%	2·5% (0·5%-4·5%)	82	6·1%	2·5% (0·5%-4·5%)
	Post first wave (Jun 20 - Aug 20)	134	4·5%	4·6% (0·5%-8·7%)	134	5·2%	5·1% (1·0%-9·3%)
	Schools reopening and second wave (Sep 20 - Dec 20)	116	13·8%	23·2% (17·4%-29·0%)	117	9·4%	20·7% (15·3%-26·0%)
	Post second wave (Jan 21 -Mar 21)	189	20·1%	19·5% (13·8%-25·1%)	189	18·0%	17·0% (11·5%-22·4%)
	Emergence of delta variant (Apr 21 - Jun 21)	39	30·8%	32·7% (23·6%-41·8%)	39	28·2%	21·2% (12·1%-30·4%)

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Table 8 SARS-CoV-2 seroprevalence (RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies and RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies) by region and time period October 2019 to June 2021 in England, adjusted for age and ethnicity·

		RocheS			RocheN		
		N	Crude	Adjusted	N	Crude	Adjusted
Pre-pandemic (Oct 19 - Mar 20)	**East of England**	21	0·0%	0·0%	21	0·0%	0·0%
	London	10	0·0%	0·0%	10	0·0%	0·0%
	Midlands	0	0·0%	0·0%	0	0·0%	0·0%
	North East & Yorkshire	2	0·0%	0·0%	2	0·0%	0·0%
	North West	0	0·0%	0·0%	0	0·0%	0·0%
	South East	92	0·0%	0·0%	92	0·0%	0·0%
	South West	0	0·0%	0·0%	0	0·0%	0·0%
First wave (Apr 20 - May 20)	**East of England**	16	6·3%	3·3% (0·0%-9·3%)	16	6·3%	0·0%
	London	55	12·7%	10·2% (3·0%-17·3%)	55	12·7%	10·2% (3·0%-17·3%)
	Midlands	27	0·0%	0·0%	27	0·0%	0·0%
	North East & Yorkshire	64	3·1%	3·8% (0·0%-8·4%)	64	3·1%	3·8% (0·0%-8·4%)
	North West	0	0·0%	0·0%	0	0·0%	0·0%
	South East	134	2·2%	1·5% (0·0%-3·1%)	133	2·3%	1·5% (0·0%-3·1%)
	South West	39	0·0%	0·0%	39	0·0%	0·0%
Post first wave (Jun 20- Aug 20)	**East of England**	9	0·0%	0·0%	9	0·0%	0·0%
	London	14	21·4%	33·9% (18·7%-49·1%)	14	21·4%	33·9% (18·7%-49·1%)
	Midlands	46	2·2%	0·9% (0·0%-2·7%)	46	2·2%	0·9% (0·0%-2·7%)
	North East & Yorkshire	73	0·0%	0·0%	73	0·0%	0·0%
	North West	127	6·3%	5·8% (1·9%-9·7%)	125	6·4%	5·9% (2·0%-9·8%)
	South East	97	0·0%	0·0%	94	0·0%	0·0%
	South West	39	0·0%	0·0%	39	0·0%	0·0%
Schools reopening and second wave (Sep 20- Dec 20)	**East of England**	11	0·0%	0·0%	11	0·0%	0·0%
	London	12	16·7%	8·4% (2·0%-14·7%)	12	16·7%	8·4% (2·0%-14·7%)
	Midlands	77	6·5%	2·6% (0·1%-5·0%)	75	5·3%	5·2% (0·1%-10·3%)
	North East & Yorkshire	62	11·3%	11·6% (5·7%-17·4%)	61	9·8%	10·5% (5·0%-16·0%)
	North West	61	11·5%	15·1% (9·5%-20·7%)	61	11·5%	15·4% (9·3%-21·4%)
	South East	127	3·9%	3·8% (0·7%-6·9%)	122	4·1%	3·0% (0·2%-5·8%)
	South West	114	5·3%	5·1% (0·0%-10·2%)	114	5·3%	4·6% (0·0%-9·6%)
Post second wave (Jan 21 - Mar 21)	**East of England**	88	9·1%	13·2% (8·9%-17·5%)	76	10·5%	11·2% (7·7%-14·8%)
	London	115	26·1%	24·1% (15·1%-33·1%)	115	26·1%	22·8% (13·9%-31·8%)
	Midlands	49	14·3%	15·5% (5·4%-25·6%)	48	14·6%	15·5% (5·4%-25·6%)
	North East & Yorkshire	193	16·1%	14·8% (9·9%-19·7%)	187	16·6%	12·4% (7·7%-17·0%)
	North West	116	28·4%	26·8% (18·0%-35·7%)	115	27·8%	24·0% (15·4%-32·6%)
	South East	120	10·8%	11·5% (5·3%-17·8%)	109	11·0%	11·6% (5·3%-17·9%)
	South West	90	14·4%	18·5% (10·8%-26·2%)	89	14·6%	16·4% (9·1%-23·7%)
	East of England	26	7·7%	2·0% (0·0%-5·8%)	23	4·3%	2·0% (0·0%-5·8%)

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Emergence of delta variant (Apr 21 - Jun 21)	**London**	83	24·1%	25·8% (13·8%-37·8%)	83	24·1%	20·6% (9·7%-31·5%)
	Midlands	11	18·2%	11·3% (0·7%-21·9%)	11	18·2%	11·3% (0·7%-21·9%)
	North East & Yorkshire	25	24·0%	23·7% (20·3%-27·0%)	25	24·0%	7·8% (4·8%-10·9%)
	North West	27	40·7%	51·9% (33·4%-70·5%)	26	42·3%	51·9% (33·4%-70·5%)
	South East	63	11·1%	6·0% (0·1%-11·9%)	57	10·5%	5·6% (0·0%-11·5%)
	South West	31	16·1%	26·6% (22·0%-31·2%)	31	16·1%	28·9% (23·3%-34·6%)

Figure 2 Summary of symptoms reported by seropositive participants on RocheN Anti-SARS-CoV nucleocapsid antibodies assay by age group· Error bars show 95% confidence intervals
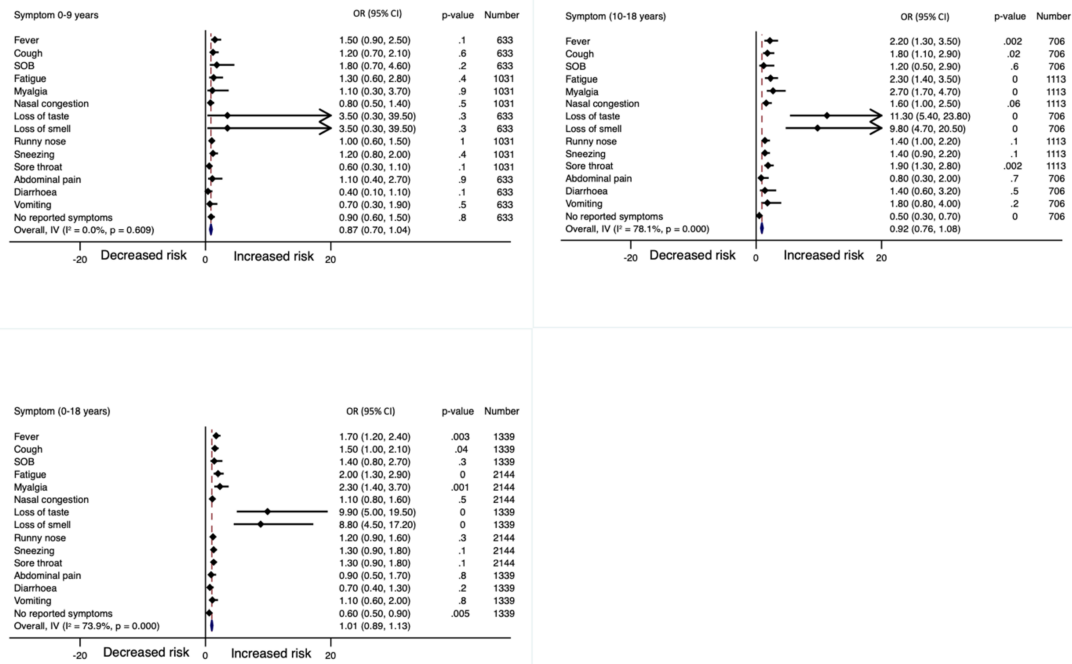
Figure 3a Univariate analysis of symptoms by age band (RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies)
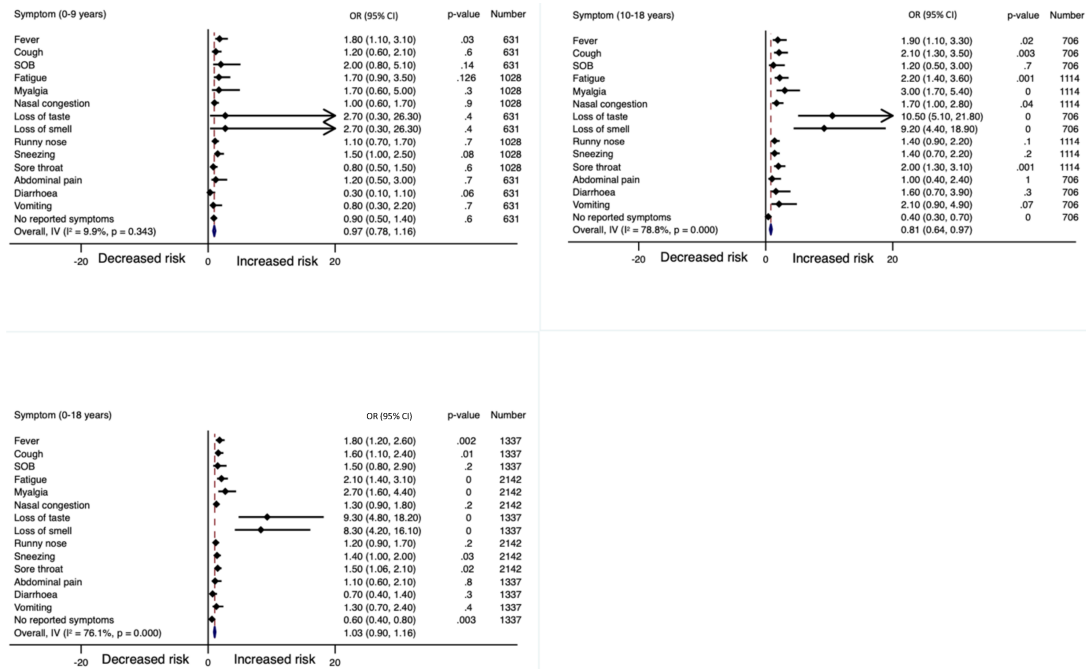
Figure 3b Univariate analysis of symptoms by age band (RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies)

Table 9a Logistic regression models to determine symptoms associated with positivity the RocheS - Anti-SARS-CoV-2 IgG spike protein antibodies assay results. Symptoms with the highest p-value were sequentially excluded and model Akaike Information Criterion (AIC) values were compared until a model with the lowest AIC value had been reached. Separate models created for 0-9 years and 10-18 years.

RocheS	**OR (95% CI)**	**p-value**
Age group: 0-9 years (N=663 observations)		
Male	1·0 (0·6-1·7)	0·89
Fever	1·7 (1·0-2·9)	0·05
Gastrointestinal symptoms	0·6 (0·3-1·1)	0·09
Age group: 10-18 years (N=873 observations)		
Male	0·9 (0·6-1·3)	0·57
Fever	1·6 (1·0-2·7)	0·05
Loss of taste and smell	9·2 (5·1-16·3)	<0·001

OR: odds ratio

Table 9b Logistic regression models to determine symptoms associated with positivity the RocheN - Anti-SARS-CoV-2 IgG nucleocapsid antibodies assay results· Symptoms with the highest p-value were sequentially excluded and model Akaike Information Criterion (AIC) values were compared until a model with the lowest AIC value had been reached· Separate models created for 0-9 years and 10-18 years

RocheN	**OR (95% CI)**	**p-value**
Age group: 0-9 years (N=631 observations)		
Male	1·1 (0·6-1·8)	0·80
Fever	2·1 (1·2-3·6)	0·009
Gastrointestinal symptoms	0·5 (0·3-1·1)	0.09
Age group: 10-18 years (N=873 observations)		
Male	0·9 (0·6-1·4)	0·65
Cough	1·6 (1·0-2·6)	0·07
Loss of taste or smell	8·0 (4·5-14·4)	<0·001

OR: odds ratio

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Table 10 A univariate and multivariable logistic regression models to establish risk of SARS-CoV-2 seropositivity on Roche Elecsys Anti-SARS-CoV-2 serological assays for the detection of anti-SARS-CoV-2 IgG nucleocapsid antibodies (RocheN) in children aged 0-18 years·

	Univariate		IMD* deprivation quintiles		Multivariable IDACI** deprivation quintiles		IMD and incl· HCW[‡]	
Number of participants in model			2285		2285		1886	
	Odds ratio (95%CI)	**LR test (p value)**	**Odds ratio (95% CI)**	**LR test‡ (p value)**	**Odds ratio (95% CI)**	**LR test (p value)**	**Odds ratio (95% CI)**	**LR test (p value)**
Age group								
0-4 years	1·0 (0·7-1·6)	0·1	0·8 (0·5-1·3)	0·02	0·8 (0·1-1·3)	0·02	0·8 (0·5-1·3)	0·07
5-9 years	1·1 (0·7-1·6)		1·1 (0·7-1·7)		1·1 (0·7-1·7)		1·1 (0·7-1·6)	
10-14 years	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
15-18 years	1·5 (1·1-2·2)		1·6 (1·1-2·4)		1·6 (1·1-2·4)		1·5 (1·0-2·2)	
Sex								
Female	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
Male	0·9 (0·7-1·2)	0·7	1·0 (0·7-1·3)	0·9	1·0 (0·7-1·3)	0·9	1·0 (0·7-1·3)	0·9
NHS region								
East of England	1·1 (0·5-2·6)	<0·001	0·8 (0·3-2·0)	<0·001	0·8 (0·3-2·0)	0·001	0·9 (0·3-2·2)	0·001
London	5·5 (3·3-8·9)		2·7 (1·6-4·7)		2·6 (1·5-4·4)		2·7 (1·5-4·8)	
Midlands	1·7 (0·8-3·2)		1·3 (0·6-2·6)		1·2 (0·6-2·5)		1·2 (0·6-2·6)	
North East and Yorkshire	2·3 (1·3-3·8)		1·5 (0·9-2·7)		1·5 (0·8-2·6)		1·5 (0·8-2·7)	
North West	4·5 (2·8-7·4)		2·7 (1·5-4·9)		2·6 (1·5-4·6)		2·7 (1·4-4·9)	
South East	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
South West	1·7 (0·9-3·0)		1·5 (0·8-2·7)		1·5 (0·8-2·7)		1·5 (0·8-2·7)	
Time period								
Pre-pandemic (01 Oct 2019 - 31 Mar 2020)		<0·001		<0·001		<0·001		<0·001
First wave (01 Apr 2020 - 31 May 2020)	0·2 (0·1-0·4)		0·2 (0·1-0·5)		0·2 (0·1-0·5)			
Post first wave (01 Jun 2020 - 31 Aug 2020)	0·2 (0·1-0·4)	<0·001	0·2 (0·1-0·3)		0·2 (0·1-0·3)		0·2 (0·1-0·3)	
Schools reopening and second wave (01 Sep 2020 - 31 Dec 2020)	0·4 (0·2-0·6)	<0·001	0·4 (0·3-0·6)		0·4 (0·2-0·6)		0·4 (0·3-0·6)	
Post second wave (01 Jan 2021 - 31 Mar 2021)	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
Emergence of delta variant (01 Apr 2021 - 30 Jun 2021)	1·2 (0·8-1·7)	0·3	1·0 (0·7-1·6)		1·0 (0·7-1·6)		1·0 (0·7-1·6)	
Ethnicity								
White	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
Minority ethnic group [††]	2·5 (1·9-3·5)	<0·001	1·5 (1·0-2·1)	0·04	1·5 (1·0-2·1)	0·04	1·4 (1·0-2·1)	0·06
IMD deprivation quintile								

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Risk factor		OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Most deprived 1		2·8 (1·8-4·2)	0·002	1·5 (0·9-2·4)	0·02			1·7 (1·0-2·9)	0·009
	2	1·4 (0·9-2·3)		0·7 (0·4-1·2)				0·7 (0·4-1·2)	
	3	1·5 (1·0-2·3)		0·9 (0·6-1·5)				1·0 (0·6-1·7)	
	4	1·7 (1·1-2·5)		1·4 (0·9-2·2)				1·5 (0·9-2·4)	
Least deprived 5		1 (ref)		1 (ref)				1 (ref)	
IDACI deprivation quintile									
Most deprived 1		2·0 (1·3-2·9)	<0·001			1·2 (0·7-1·8)	0·04		
	2	1·0 (0·6-1·6)				0·6 (0·4-1·0)			
	3	0·8 (0·5-1·3)				0·6 (0·4-1·0)			
	4	1·0 (0·7-1·5)				1·0 (0·6-1·5)			
Least deprived 5		1 (ref)				1 (ref)			
Urban/rural									
Rural		0·2 (0·1-0·4)	<0·001	0·4 (0·2-0·8)	0·002	0·4 (0·2-0·7)	<0·001	0·5 (0·2-0·9)	0·009
Urban		1 (ref)		1 (ref)		1 (ref)		1 (ref)	
HCW [†]									
No		1 (ref)						1 (ref)	
Yes		1·5 (1·1-2·0)	0·003					1·7 (1·3-2·4)	<0·001

*IMD Index of Multiple Deprivation

**IDACI Income Deprivation Affecting Children Index (IDACI) measures the proportion of all children aged 0 to 15 living in income deprived families

†,fewer results available for this analysis due to incomplete data in HCW (healthcare worker) field (see Table 2)

††,Minority ethnic group includes all minority groups apart from white minorities·

‡Likelihood ratio for each risk factor calculated with overall p value displayed

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Appendix 1 Questionnaire used in What's the STORY? (Serum Testing Of Representative Youngsters)

Participant Number: |__|__| |__|__|

Most of the questions below are taken from the UK census. They are included here to check how well the participants taking part in this study match those of the general population in your area. These data will be stored securely by your site and analysed anonymously in accordance with General Data Protection Regulation (GDPR).

Today's date: _ _ / _ _ _ / _ _ _ _

Q1. What is your child's date of birth? (month and year only)

Q2. What was their birth gender?   male   female

Q3. Which country was your child born in?

Q4. How many years has your child lived in the UK?

Q5. Which country were you (the Parent/Guardian) born in?

Q6. How many years have you (the Parent/Guardian) lived in the UK?

Q7. In which country/countries did your child (the participant) receive their vaccinations?

UK Other

Q8. Does your child attend a childcare setting? **(This question is for under 5 year olds only)**

Yes no

If Yes which setting? Nursery   Childminder   Nanny   Other   Please specify _____

If the answer is yes to Q8. please indicate how many hours a week?

1-4 hours	4-8 hours	8-12 hours
12-20 hours	21-30 hours	30 + hours

The following questions is for school aged children

Q9. Is your child enrolled in full time education?

    Yes No

Q10. If yes to Q9, which setting are they being educated in?

    Primary school

    Middle school

    Secondary school

    College

    Homeschooling

    Other   please specify

Q11. If in full time education please provide the name of the institution_____

    or N/A   (if N/A please move to question 14)

Q12. If enrolled at an institution, is it open? Yes no (if no please move to question 14)

Q13. If your child's institution is open are they attending? Yes no N/A

Q14. Who is your child's GP? _____

Q15. Name and address of surgery _____

Q16. Has your child had any symptoms such as those listed below since February 2020?

    Fever

    Dry Cough

    Shortness of breath

    Fatigue

    Myalgia (muscle aches)

    Nasal congestion

    Loss of sense of taste

    Loss of sense of smell

    Runny nose

    Sneezing

Sore throat

Abdominal pain or cramps (not including menstrual cramps)

Diarrhoea

Vomiting

Other Please specify_____

None of the above

Q17. If yes to any of the symptoms in question 16, when was the **start** of their most recent episode of symptoms? DD/MM/2020 N/A

Q18. Has your child ever been tested for COVID-19? (throat and/or nose swab specifically for COVID-19) Yes No

Q19. Has the result of your child's throat and/or nose swab for COVID-19 been positive? Yes No N/A

Q20. What was the date of the test? DD/MM/YYYY N/A

Q21. Has your child ever been tested for COVID-19 antibodies (blood test/saliva test)? Yes No

Q22. If yes to Q21, has the result of your child's antibody testing been positive?

Q23. Yes No N/A

Q24. What was the date of the antibody test? DD/MM/YYYY N/A

The following questions refer to any household contacts. A household contact is defined as a person who stays overnight in the same residence the participant.

Q25. Has anyone in your child's household(s) had a new loss of taste or smell since February 2020? Yes No

Q26. If yes to question 26, how many people in your child's household been affected? …………..

Q27. If yes to question 26 when was the *start* of their symptoms? DD/MM/2020

Q28. If yes to question 26, how old are they?

Q29. Has anyone in your child's household had any symptoms listed below since February 2020?

Fever

Dry cough

Shortness of breath

Muscle aches

Feeling tired

Loss of appetite

Abdominal pain or cramps (not including menstrual cramps)

Diarrhoea

Vomiting

Other Please specify_____

None of the above

Q30. If yes to question 28, how many people in your child's household been affected? …………..

Q31. If yes to any symptoms in question 28, when was the start of their most recent episode of symptoms? DD/MM/ YYYY If yes to any symptoms in question 28, how old are they?

Q32. If yes to any symptoms in question 28 have they ever been tested for COVID-19? (throat and/or nose swab specifically for COVID-19) Yes No

Q33. If yes to any symptoms in question 28 have they ever been diagnosed with laboratory confirmed throat and/or nose swab for COVID-19? Yes No

Q34. If yes to question 33, when was their positive test? DD/MM/ YYYY Has the individual in question ever been tested for COVID-19 antibodies (blood test/saliva test)? Yes No N/A

Q35. If yes to Q35, has the result of the individual's antibody testing been positive?

Q36. Yes No N/A

Q37. What was the date of the antibody test? DD/MM/ YYYY N/A

Q38. Has anyone in the household without symptoms been tested for COVID-19? (throat and/or nose swab specifically for COVID-19) Yes No

Q39. If yes to Q38 was it positive? Yes No

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Q40.　　　What was the date of the test? DD/MM/ YYYY N/A

Q41.　Has anyone in the household without symptoms been tested for COVID-19 antibodies (blood test/saliva test)? Yes No N/A

Q42.　If yes to Q40 was it positive? Yes No

Q43.　　　What was the date of the antibody test? DD/MM/ YYYY N/A

Q44.　Which of the following best describes **your child? (the participant)**

White

English/Welsh/Scottish/Northern Irish/ British

Irish

Gypsy or Irish Traveller

Other White background please specify ………………

Mixed/ multiple ethnic groups

White and Black Caribbean

White and Black African

White and Asian

Any other mixed/ multiple ethnic background please specify

Asian/ Asian British

Indian

Pakistani

Bangladeshi

Chinese

Any other Asian background please specify

Black/ African/ Caribbean/Black British

African

Caribbean

Any other Black/ African/ Caribbean background please specify

Other ethnic group

Arab

Any other ethnic group please specify What is **your child's** (the participant) religion? (This question is optional)

No religion

Christian (including Church of England, Catholic, Protestant and all other Christian denominations)
Buddhist
Hindu
Jewish
Muslim
Sikh
Other please specify
Prefer not to say

Please complete questions 46 -59 for the main household in which your child lives?

Q45.　How many adults (16+ years old)?

19

Q46. How many children (under the age of 16)?

Q47. How would you describe the main household?

A whole house or bungalow that is:

Detached

Semidetached

Terraced (including end-terrace)

A flat, maisonette or apartment that is:

In a purpose built block of flats or tenement

Part of a converted or shared house (including bedsits)

In a commercial building (for example, in an office building, hotel, or over a shop)

A mobile or temporary structure

A caravan or other mobile or temporary structure

Q48. Is this household's accommodation self-contained?

This means that all the rooms, including the kitchen, bathroom and toilet, are behind a door that only this household can use:

Yes, all the rooms are behind a door that only this household can use

No

Q49. How many rooms are available for use only by this household?

Do **NOT** count

Bathrooms

Toilets

Halls or landing

Rooms that can only be used for storage such as cupboards

Count all other rooms e.g.

Kitchens

Living rooms

Utility rooms

Bedrooms

Studies

Conservatories

If two rooms have been converted into one, count them as one room

Number of rooms …………………………………

How many of these rooms are bedrooms?Include all rooms built or converted for use as bedrooms even if they are not currently used as bedrooms

Number of rooms…………………………………………………………………..

Q50. Which of the following best describes your child's household's current accommodation?

Own you own home outright

Own your home with a mortgage

Renting from the council

Renting from a housing association

Renting from a private landlord

In shared accommodation with a housing association

Living with relatives

In housing tied to your job

Lodging within another household

Other Please specify

Q51. Your employment – Parent or Guardian to answer (please select only one as your main form of employment)

Working full time

Working part time

Unemployed

Retired

In full time or further education

Claiming Job Seekers Allowance

Incapacity Benefit

Other

Q52. Does anyone in the household work in either social care or health care?

Yes

No

Thinking about your child's immediate family (parents and siblings in the same household) please can you tell us the following?

Q53. Does your family own a car, van or truck (include company cars or vans available for private use)?

None

One

Two

Three

Four or more

Q54. Does your child have their own bedroom to themselves?

No

Yes

Q55. How many computers does your family own? (including laptops and tablets, not including games consoles and smartphones)

None

One

Two

More than two

Q56. How many bathrooms (room with a bath/shower or both) are in your home?

None

One

Two

More than two

Q57. Does your family have a dishwasher at home?

No

Yes

Q58. How many times did you travel out of the UK for a holiday/vacation last year either alone or with friends/family (in the 12 months preceding lockdown for COVID-19)?

Not at all

Once

Twice

More than Twice

Table 10 STORY research team

Name	Research Group
K. Bell	Newcastle NHS Trust
C. Kennedy	Newcastle NHS Trust
A. Bell	Newcastle NHS Trust
C. L. Coates	Newcastle NHS Trust
S. Crulley	Newcastle NHS Trust
A. Davies	Newcastle NHS Trust

S. King	Newcastle NHS Trust
D.T.J. Metcalfe	Newcastle NHS Trust
C. Reigan	Newcastle NHS Trust
D.T.J. Fabian	Newcastle NHS Trust
R.A. Sarjeant	Newcastle NHS Trust
C. Smith	Newcastle NHS Trust
L.B. Baxter	Newcastle NHS Trust
E. Thompson	Newcastle NHS Trust
R. Wane	Bradford Children's Research Team
R. Swingler	Bradford Children's Research Team
C. Bass-Woodcock	Bradford Children's Research Team
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J. McEwan	Oxford Vaccine Group
H. Roberts	Oxford Vaccine Group
K. O'Brien	Oxford Vaccine Group
A. Yao	Oxford Vaccine Group
H. Trari Belhadef	Oxford Vaccine Group
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I. Mayor	Royal Manchester Children's Hospital
K. Wilkins	Royal Manchester Children's Hospital
S. Williams	Royal Manchester Children's Hospital
S. Akter	Royal Manchester Children's Hospital
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H. Dalgleish	Royal Manchester Children's Hospital
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