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Supplementary information

Antibody responses and correlates of protection in the general population after two doses of the ChAdOx1 or BNT162b2 vaccines

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Supplementary information for

Antibody responses and correlates of protection in the general population after two doses of the ChAdOx1 or BNT162b2 vaccines

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Contents

Supplementary Tables

	ChAdOx1 two dose no prior infection (N=121,322)	BNT162b2 two dose no prior infection (N=79,693)	ChAdOx1 two dose prior infection (N=12,066)	BNT162b2 two dose prior infection (N=9,412)	Total (N=222,493)	p value
Percentage (%)	54.5	35.8	5.4	4.2	100	
Dosing interval (days)						
Median	76	71	76	65	74	
Q1, Q3	68, 78	58, 77	66, 78	56, 76	64, 78	
Age (years)						< 0.001
Median	58	56	53	37	57	
Q1, Q3	48, 67	36, 70	45, 62	29, 57	43, 68	
Sex						< 0.001
Female	64,470 (53.1%)	44,717 (56.1%)	6,477 (53.7%)	5,202 (55.3%)	120,866 (54.3%)	
Male	56,852 (46.9%)	34,976 (43.9%)	5,589 (46.3%)	4,210 (44.7%)	101,627 (45.7%)	
Ethnicity						< 0.001
Non-white	5,698 (4.7%)	4,858 (6.1%)	932 (7.7%)	1,107 (11.8%)	12,595 (5.7%)	
White	115,624 (95.3%)	74,835 (93.9%)	11,134 (92.3%)	8,305 (88.2%)	209,898 (94.3%)	
Household size						< 0.001
1	22,809 (18.8%)	15,069 (18.9%)	1,928 (16.0%)	1,291 (13.7%)	41,097 (18.5%)	
2	59,704 (49.2%)	39,965 (50.1%)	5,065 (42.0%)	3,890 (41.3%)	108,624 (48.8%)	
3	18,176 (15.0%)	11,691 (14.7%)	2,167 (18.0%)	1,859 (19.8%)	33,893 (15.2%)	
4	15,215 (12.5%)	9,143 (11.5%)	2,075 (17.2%)	1,593 (16.9%)	28,026 (12.6%)	
5+	5,418 (4.5%)	3,825 (4.8%)	831 (6.9%)	779 (8.3%)	10,853 (4.9%)	
Deprivation percentile						< 0.001
Median	64	62	60	56	62	
Q1, Q3	40, 83	38, 82	35, 81	32, 78	39, 82	
Report working in patient facing healthcare						< 0.001
No	119,937 (98.9%)	74,840 (93.9%)	11,805 (97.8%)	8,840 (93.9%)	215,422 (96.8%)	
Yes	1,385 (1.1%)	4,853 (6.1%)	261 (2.2%)	572 (6.1%)	7,071 (3.2%)	
Report having a long-term health condition						< 0.001
No	87,034 (71.7%)	56,147 (70.5%)	9,083 (75.3%)	7,415 (78.8%)	159,679 (71.8%)	
Yes	34,288 (28.3%)	23,546 (29.5%)	2,983 (24.7%)	1,997 (21.2%)	62,814 (28.2%)	

Supplementary Table 1. Characteristics of participants with two vaccine doses and at least one antibody measurement from 91 days before the first vaccination through to 4th October. Continuous variables were compared using Kruskall-Wallis tests, and categorical variables were compared using one-sided Chi-squared tests.

(a)

			Without prior infection		With prior infection	
Time from second dose (days)	**Dosing interval (days)**	**Age (years)**	**ChAdOx1**	**BNT162b2**	**ChAdOx1**	**BNT162b2**
21	21	60	NA	276 (236-324)	NA	305 (212-440)
21	56	60	159 (147-172)	371 (340-405)	312 (219-443)	418 (284-614)
21	70	60	175 (168-182)	400 (386-415)	325 (278-380)	425 (355-509)
21	84	60	169 (161-178)	392 (367-418)	280 (218-360)	426 (308-588)
42	21	60	NA	328 (284-378)	NA	347 (243-495)
42	56	60	132 (123-141)	357 (324-394)	277 (197-390)	392 (261-587)
42	70	60	137 (132-142)	375 (359-391)	294 (251-344)	406 (342-481)
42	84	60	143 (137-150)	356 (330-383)	274 (215-347)	395 (286-547)
63	21	60	NA	287 (249-331)	NA	371 (260-530)
63	56	60	109 (101-116)	321 (295-350)	230 (163-326)	372 (241-572)
63	70	60	111 (107-115)	321 (310-333)	254 (217-298)	379 (318-453)
63	84	60	121 (116-127)	323 (304-344)	266 (209-339)	395 (288-542)

(b)

			Without prior infection		With prior infection	
Time from second dose (days)	**Dosing interval (days)**	**Age (years)**	**ChAdOx1**	**BNT162b2**	**ChAdOx1**	**BNT162b2**
-49	70	20	108 (90-130)	295 (208-417)	351 (317-388)	347 (273-440)
21	70	20	183 (154-217)	317 (225-447)	404 (362-450)	420 (308-574)
-49	70	40	81 (76-87)	247 (203-300)	219 (208-231)	293 (243-353)
21	70	40	156 (148-165)	289 (241-348)	394 (377-413)	410 (342-492)
-49	70	60	65 (62-68)	255 (216-301)	142 (135-150)	234 (195-282)
21	70	60	175 (168-182)	325 (278-380)	400 (386-415)	425 (355-509)
-49	70	80	37 (33-42)	112 (85-148)	91 (83-100)	141 (107-185)
21	70	80	175 (160-193)	254 (193-334)	404 (377-432)	422 (324-548)

Supplementary Table 2. Predicted anti-spike IgG levels (BAU/mL) with 95% confidence interval (CI) from generalised additive models. a, Comparison of 8-, 10-, 12-, and 3-week dosing interval 21, 42, 63 days after the second dose in 60-year-olds. **b,** Comparison of 20-, 40-, 60-, and 80-year-olds 21 days after the first and second dose in those with 10-week dosing interval. The 95% confidence intervals are calculated by prediction ± 1.96*standard error of prediction. Values truncated at 450 BAU/mL counted as =450 BAU/mL.

(a) Frequency of antibody measurements per participant		
	ChAdOx1	**BNT162b2**
1	37,478	17,863
2	39,268	16,444
3	20,450	13,839
4	3,442	6,074
5	1	832
6	0	1
(b) Frequency of antibody measurements relative to the second vaccination		
(days)	**ChAdOx1**	**BNT162b2**
21-28	15,693	6,964
28-35	16,403	7,161
35-42	16,535	6,934
42-49	16,427	7,061
49-56	16,200	6,973
56-63	16,788	7,310
63-70	16,284	7,507
70-77	15,750	7,471
77-84	14,258	7,709
84-91	12,962	7,925
91-98	11,070	8,064
98-105	8,873	7,934
105-112	7,219	7,215
112-119	5,886	6,436
119-126	789	5,837
126-133	0	4,721
133-140	0	3,732
140-147	0	2,831
147-149	0	945

Supplementary Table 3. Frequency of antibody measurements per participant and frequency of antibody measurements relative to the time of the second vaccination in the Bayesian linear mixed model. 100,639 ChAdOx1 participants contributed 191,137 antibody measurements ≥21 days after the second dose, median (IQR) [range] 2 (1-2) [1-5] measurements per participant. 55,053 BNT162b2 participants contributed 120,728 antibody measurements ≥21 days after the second dose, median (IQR) [range] 2 (1-3) [1-6] per participant. The antibody measurements were taken a median (IQR) [range] 61 (41-83) [21-119] days after the second vaccination for ChAdOx1 and 79 (51-106) [21-149] days for BNT162b2.

		ChAdOx1			BNT162b2		
		Posterior mean	95% CrI		Posterior mean	95% CrI	
Unadjusted baseline	Peak level (Intercept)	184	183	185	959	944	974
	IgG half-life (slope)	79	78	80	51	50	52
Adjusted baseline	Peak level (Intercept)	160	155	162	976	903	1011
	IgG half-life (slope)	81	79	83	52	50	53
Age	Peak level: 60 years						
	IgG half-life: 60 years						
	Change in peak level: per 10-years older	**3**	**2**	**4**	**-76**	**-84**	**-68**
	Change in half-life: per 10-years older	**-1**	**-1**	**0**	0	0	0
Sex	Peak level: Female						
	IgG half-life: Female						
	Change in peak level: Male	**-5**	**-7**	**-3**	**-140**	**-164**	**-117**
	Change in half-life: Male	0	-1	2	-1	-2	1
Ethnicity	Peak level: White						
	IgG half-life: White						
	Change in peak level: Non-white	**41**	**36**	**47**	**141**	**78**	**208**
	Change in half-life: Non-white	**-8**	**-11**	**-5**	0	-3	2
Report having a long-term health condition	Peak level: No						
	IgG half-life: No						
	Change in peak level: Yes	**-5**	**-7**	**-3**	**-79**	**-104**	**-55**
	Change in half-life: Yes	**-2**	**-4**	**-1**	**-1**	**-2**	**0**
Report working in patient-facing healthcare	Peak level: No						
	IgG half-life: No						
	Change in peak level: Yes	**10**	**2**	**19**	**287**	**221**	**358**
	Change in half-life: Yes	0	-6	6	**-5**	**-6**	**-3**
Deprivation	Peak level: 60 (median)						
	IgG half-life: 60 (median)						
	Change in peak level: per 10 percentile higher	**-1**	**-1**	**-1**	**5**	**1**	**10**
	Change in half-life: per 10 percentile higher	**1**	**0**	**1**	0	0	0
3-week interval	Peak level: No						
	IgG half-life: No						

	Change in 'peak level': Yes (vs 8 weeks) *				**-163**	**-227**	**-95**
	Change in half-life: Yes (vs 8 weeks)				**6**	**2**	**10**
Dosing interval	Peak level: 8 weeks (median)						
	IgG half-life: 8 weeks (median)						
	Change in peak level: per 1 week longer	**6**	**5**	**7**	**12**	**1**	**23**
	Change in half-life: per 1 week longer	0	-1	0	0	0	1
Prior infection	Peak level: No						
	IgG half-life: No						
	Change in peak level: Yes	**219**	**210**	**227**	**312**	**248**	**381**
	Change in half-life: Yes	**13**	**9**	**17**	**11**	**8**	**15**

Supplementary Table 4. Posterior mean and 95% credible intervals for anti-spike IgG peak level (intercept) (BAU/mL) and half-life (slope) (days) in the unadjusted models and multivariable models in 100,639 participants with two ChAdOx1 doses and 55,053 participants with two BNT162b2 doses. The reference categories in the multivariable model are: 60-year-old, female, white ethnicity, not reporting a long-term health condition, not a healthcare worker, deprivation percentile=60, 8-week dosing interval, and no prior infection. Bold numbers indicate an effect not compatible with chance (95% credible interval excludes no effect). *The predicted peak level in 3-week vs 8-week is extrapolated and for modelling purpose only, it should not be interpreted as an actual peak.

Days from first vaccination	ChAdOx1	BNT162b2
35-49	1,364	1,875
49-63	4,766	4,327
63-77	9,681	5,027
77-91	14,081	5,830
91-105	18,268	7,318
105-119	22,644	9,288
119-133	26,749	10,725
133-147	27,934	11,090
147-161	28,251	12,327
161-175	27,636	13,392
175-189	26,770	14,111
189-203	21,210	14,195
203-217	14,786	13,397
217-231	10,285	11,202
231-245	4,640	7,638
245-259	993	3,966
259-273	65	1,673
273-287	1	647
287-298	0	103

Supplementary Table 5. Frequency of visits relative to the time of the first vaccination in the generalised additive models estimating correlates of protection. Study visits were included from 17th May 2021 to 4th October 2021, i.e. while the Delta variant accounted for nearly all cases. The median (IQR) [range] was 149 (115-182) [36-273] days for ChAdOx1 and 167 (123-204) [35-298] days for BNT162b2. Note that UK started its booster programme from 16th September 2021, so a small number of visits occurred in the first two weeks after initiating the booster campaign.

a)		ChAdOx1			BNT162b2		
		Total	**Non-responder**	**%**	**Total**	**Non-responder**	**%**
First dose	At least one antibody measurement >=21 days after first dose and before second dose	57,650	4,280	7.4	30,843	1,374	4.5
	Two or more antibody measurements, including at least one antibody measurement >=21 days after first dose and before second dose	29,277	1,706	5.8	15,525	546	3.5
Second dose	At least one antibody measurement >=21 days after second dose	100,776	1,010	1	57,313	312	0.5
	Two or more antibody measurements, including at least one antibody measurement >=21 days after second dose	77,947	496	0.6	44,311	146	0.3

b)		ChAdOx1			BNT162b2		
First and second dose	At least one Ab measurement >=21 days after first dose and before second dose, and after second dose	**Second dose: non-responder**	**Second dose: responder**	**Total**	**Second dose: non-responder**	**Second dose: responder**	**Total**
	First dose: non-responder	192 (0.5%)	3,243 (7.2%)	3,435 (7.7%)	37 (0.2%)	1,036 (5.8%)	1,073 (6.0%)
	First dose: responder	99 (0.2%)	41,212 (92.1%)	41,311 (92.3%)	15 (0.1%)	16,909 (93.9%)	16,924 (94.0%)
	Total	291 (0.7%)	44,455 (99.3%)	44,746 (100%)	52 (0.3%)	17,945 (99.7%)	17,997 (100%)
	Two or more antibody measurements, including at least one antibody measurement >=21 days after first dose and before second dose, and after second dose	**Second dose: non-responder**	**Second dose: responder**	**Total**	**Second dose: non-responder**	**Second dose: responder**	**Total**
	First dose: non-responder	59 (0.3%)	1,092 (5.7%)	1,151 (6.0%)	8 (0.1%)	364 (5.1%)	372 (5.2%)
	First dose: responder	10 (0.1%)	17,965 (93.9%)	17,975 (94.0%)	0 (0%)	6,731 (94.8%)	6,731 (94.8%)
	Total	69 (0.4%)	19,057 (99.6%)	19,126 (100%)	8 (0.1%)	7,095 (99.9%)	7,103 (100%)

Supplementary Table 6. Percentages of non-responders to first or second dose of ChAdOx1 or BNT162b2 using a heuristic rule as all antibody measurements being <16 BAU/mL and having at least one antibody measurement 21 days after the first or second dose. a, Non-responders in those who had antibody measurements after first dose or second dose. **b,** Non-responders in those who had antibodies measured after both first and second dose by responses to each dose. To examine the robustness of this definition, this rule was further applied in those having at least two antibody measurements.

	Responders (N=215,746)	Non-responders (N=6,747)	Total (N=222,493)	p value
Dosing interval (days)				< 0.001
Median	74	77	74	
Q1, Q3	64, 78	70, 79	64, 78	
Age (years)				< 0.001
Median	56	63	57	
Q1, Q3	43, 67	53, 72	43, 68	
Sex				< 0.001
Female	11,7859 (54.6%)	3,007 (44.6%)	120,866 (54.3%)	
Male	97,887 (45.4%)	3,740 (55.4%)	101,627 (45.7%)	
Ethnicity				< 0.001
Non-white	12,383 (5.7%)	212 (3.1%)	12,595 (5.7%)	
White	203,363 (94.3%)	6,535 (96.9%)	209,898 (94.3%)	
Household size				< 0.001
1	39,556 (18.3%)	1,541 (22.8%)	41,097 (18.5%)	
2	105,134 (48.7%)	3,490 (51.7%)	108,624 (48.8%)	
3	33,046 (15.3%)	847 (12.6%)	33,893 (15.2%)	
4	27,405 (12.7%)	621 (9.2%)	28,026 (12.6%)	
5+	10,605 (4.9%)	248 (3.7%)	10,853 (4.9%)	
Deprivation percentile				< 0.001
Median	63	60	62	
Q1, Q3	39, 82	36, 81	39, 82	
Report working in patient facing healthcare				< 0.001
No	208,765 (96.8%)	6,657 (98.7%)	215,422 (96.8%)	
Yes	6,981 (3.2%)	90 (1.3%)	7,071 (3.2%)	
Report having a long-term health condition				< 0.001
No	156,009 (72.3%)	3,670 (54.4%)	159,679 (71.8%)	
Yes	59,737 (27.7%)	3,077 (45.6%)	62,814 (28.2%)	

Supplementary Table 7. Comparison of the characteristics of responders with non-responders to first or second dose of ChAdOx1 or BNT162b2. Non-responders were identified using a heuristic rule as all antibody measurements being <15 BAU/mL and having at least one antibody measurement 21 days after the first or second dose. Continuous variables were compared using Kruskall-Wallis tests, and categorical variables were compared using one-sided Chi-squared tests.

Number of antibody measurements	0 (N=179,855)	1-2 (N=92,397)	3-4 (N=78,565)	≥5 (N=51,531)	Total (N=402,348)
Dosing interval (days)					
Median	74	74	74	75	74
Q1, Q3	62, 78	63, 78	64, 77	67, 78	63, 78
Age (years)					
Median	55	54	56	60	56
Q1, Q3	39, 69	41, 67	43, 67	49, 69	41, 68
Sex					
Female	95,435 (53.1%)	49,544 (53.6%)	42,821 (54.5%)	28,501 (55.3%)	216,301 (53.8%)
Male	84,420 (46.9%)	42,853 (46.4%)	35,744 (45.5%)	23,030 (44.7%)	186,047 (46.2%)
Ethnicity					
Non-white	13,874 (7.7%)	5,099 (5.5%)	4,521 (5.8%)	2,974 (5.8%)	26,468 (6.6%)
White	165,981 (92.3%)	87,298 (94.5%)	74,044 (94.2%)	48,557 (94.2%)	375,880 (93.4%)
Household size					
1	36,725 (20.4%)	15,928 (17.2%)	14,239 (18.1%)	10,930 (21.2%)	77,822 (19.3%)
2	82,100 (45.6%)	43,323 (46.9%)	38,341 (48.8%)	26,960 (52.3%)	190,724 (47.4%)
3	27,952 (15.5%)	14,580 (15.8%)	12,301 (15.7%)	7,012 (13.6%)	61,845 (15.4%)
4	22,978 (12.8%)	12,970 (14.0%)	10,027 (12.8%)	5,029 (9.8%)	51,004 (12.7%)
5+	10,100 (5.6%)	5,596 (6.1%)	3,657 (4.7%)	1,600 (3.1%)	20,953 (5.2%)
Deprivation percentile					
Median	61	63	62	63	62
Q1, Q3	37, 81	40, 82	38, 82	39, 83	38, 82
Report working in patient facing healthcare					
No	175,361 (97.5%)	89,467 (96.8%)	76,008 (96.7%)	49,947 (96.9%)	390,783 (97.1%)
Yes	4,494 (2.5%)	2,930 (3.2%)	2,557 (3.3%)	1,584 (3.1%)	11,565 (2.9%)
Report having a long-term health condition					
No	130,595 (72.6%)	67,246 (72.8%)	56,574 (72.0%)	35,859 (69.6%)	290,274 (72.1%)
Yes	49,260 (27.4%)	25,151 (27.2%)	21,991 (28.0%)	15,672 (30.4%)	112,074 (27.9%)

Supplementary Table 8. Comparison of the characteristics of all participants ≥16 years in the COVID-19 Infection Survey who received two ChAdOx1 or two BNT162b2 vaccinations from 8th December 2020 to 4th October 2021 by number of antibody measurements. 179,855 participants did not provide blood samples for antibody testing. 222,493 participants provided blood samples (92,397 had 1-2 measurements, 78,565 had 3-4 measurements, and 51,531 had ≥5 measurements) and were included in the analyses.

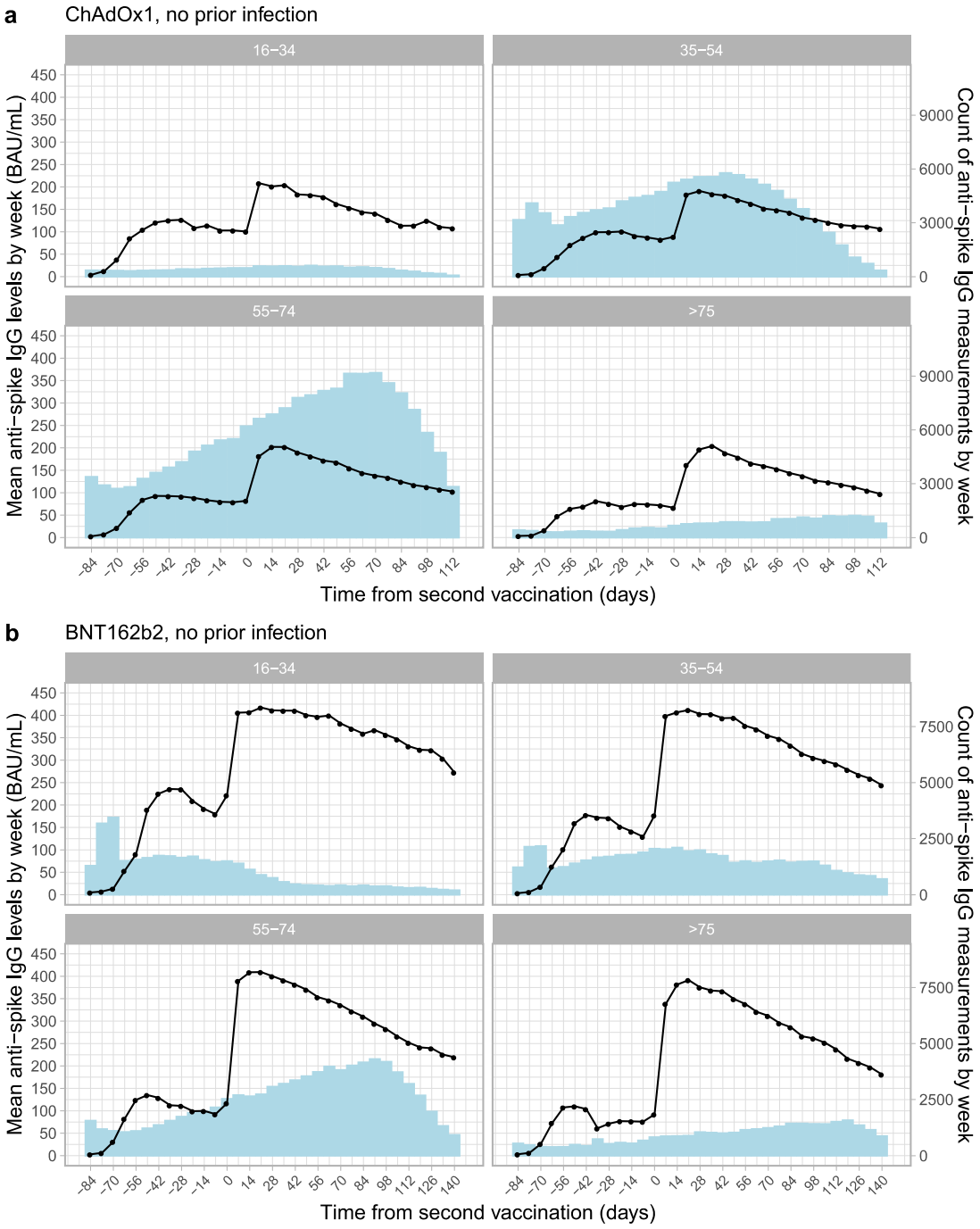
Model term	Priors for ChAdOx1	Priors for BNT162b2
Intercept	normal (7.5,1)	normal (9.5, 1)
Slope	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (age)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (age)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (sex)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (sex)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (ethnicity)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (ethnicity)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (long-term health condition)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (long-term health condition)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (healthcare worker)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (healthcare worker)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (deprivation)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (deprivation)	normal (0, 0.01)	normal (0, 0.01)
Coefficient for change in intercept (3-week interval)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (3-week interval)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (dosing interval)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (dosing interval)	normal (0, 0.1)	normal (0, 0.1)
Coefficient for change in intercept (prior infection)	normal (0, 1)	normal (0, 1)
Coefficient for change in slope (prior infection)	normal (0, 0.1)	normal (0, 0.1)
Random effect SD: intercept	cauchy(0, 0.5)	cauchy(0, 0.5)
Random effect SD: slope	cauchy(0, 0.01)	cauchy(0, 0.01)
Random effect intercept & slope covariance	lkj_corr_cholesky(2)	lkj_corr_cholesky(2)

Supplementary Table 9. Priors used in the Bayesian linear mixed interval-censored models. Age (16-85 years) and deprivation percentile (0-100) were scaled by dividing by 10; dosing interval (42-91 days) was scaled by dividing by 7.

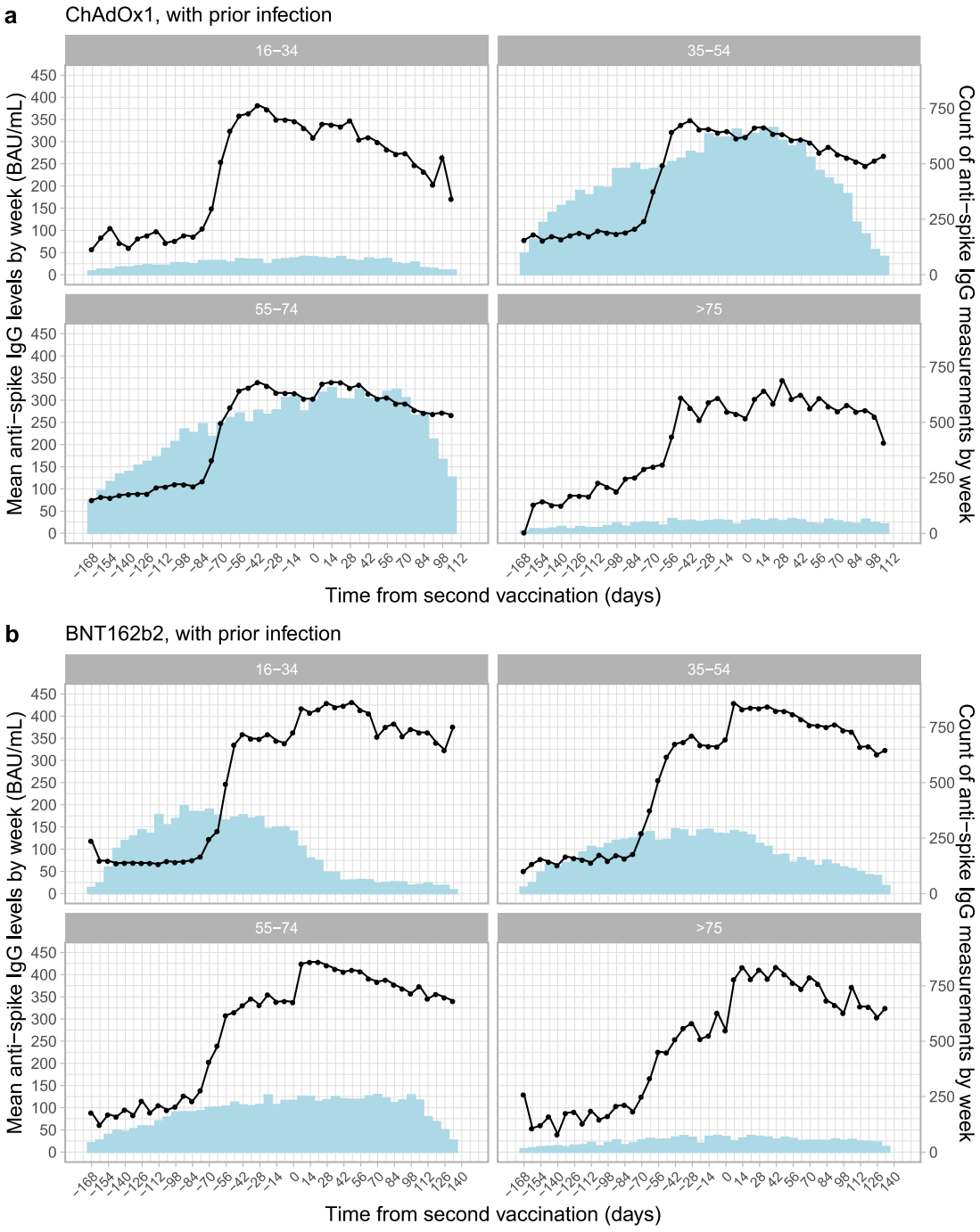
		Estimate	Est.Error	95%CrI		Rhat	Bulk_ESS	Tail_ESS
ChAdOx1	Intercept	7.3174	0.0111	7.2951	7.3391	1.0023	1375	2882
	time	-0.0124	0.0002	-0.0127	-0.0121	1.0000	6611	5322
	age	0.0254	0.0034	0.0187	0.0321	1.0024	1593	3235
	sex	-0.0466	0.0083	-0.0631	-0.0306	1.0015	1399	2808
	ethnicity	0.3331	0.0202	0.2946	0.3737	1.0040	1501	2532
	lthc	-0.0450	0.0093	-0.0632	-0.0267	1.0049	1102	2022
	hcw	0.0903	0.0374	0.0164	0.1634	1.0017	1509	2453
	deprivation	-0.0103	0.0016	-0.0134	-0.0072	1.0018	1550	2878
	dosing interval	0.0524	0.0036	0.0454	0.0593	1.0020	1560	2920
	prior infection	1.2453	0.0158	1.2146	1.2765	1.0038	1746	3266
	time:age	-0.0001	0.0000	-0.0002	0.0000	1.0014	6671	6023
	time:sex	0.0001	0.0001	-0.0001	0.0003	1.0006	6612	6153
	time:ethnicity	-0.0013	0.0003	-0.0019	-0.0008	1.0004	5712	5471
	time:lthc	-0.0004	0.0001	-0.0006	-0.0001	1.0005	6501	5556
	time:hcw	-0.0001	0.0005	-0.0010	0.0008	1.0005	6041	4866
	time:deprivation	0.0001	0.0000	0.0001	0.0001	1.0007	7110	5923
	time:dosing interval	-0.0001	0.0001	-0.0002	0.0000	1.0002	6541	5819
	time:prior infection	0.0017	0.0002	0.0012	0.0021	1.0000	6010	5228
	sigma	0.4757	0.0014	0.4729	0.4785	1.0131	400	677
	sd(Intercept)	1.0101	0.0028	1.0045	1.0157	1.0100	1090	2678
	sd(time)	0.0017	0.0002	0.0013	0.0022	1.0170	319	387
	cor(Intercept,time)	-0.2679	0.0159	-0.2983	-0.2367	1.0001	3372	4253
BNT162b2	Intercept	9.9300	0.0259	9.8796	9.9810	1.0003	3553	4861
	time	-0.0194	0.0003	-0.0200	-0.0188	1.0004	6401	6408
	age	-0.1167	0.0065	-0.1297	-0.1040	1.0003	4746	6190
	sex	-0.2235	0.0187	-0.2600	-0.1868	1.0007	4743	6293
	ethnicity	0.1944	0.0430	0.1106	0.2788	1.0010	4377	5850
	lthc	-0.1222	0.0196	-0.1601	-0.0843	1.0006	4213	5716
	hcw	0.3717	0.0397	0.2961	0.4521	1.0019	4062	4894
	deprivation	0.0075	0.0034	0.0007	0.0143	1.0006	4495	6470
	3-week	-0.2638	0.0571	-0.3754	-0.1489	1.0002	3648	5632
	dosing interval	0.0183	0.0085	0.0017	0.0351	1.0002	3599	5597
	prior infection	0.4002	0.0377	0.3270	0.4747	1.0000	4529	5485
	time:age	0.0000	0.0001	-0.0001	0.0002	1.0003	7850	6895
	time:sex	-0.0002	0.0002	-0.0006	0.0002	1.0003	8799	6686
	time:ethnicity	-0.0002	0.0005	-0.0012	0.0008	1.0007	7573	6634
	time:lthc	-0.0005	0.0002	-0.0009	0.0000	1.0009	8150	6849
	time:hcw	-0.0019	0.0004	-0.0027	-0.0011	1.0012	6397	6317
	time:deprivation	0.0000	0.0000	-0.0001	0.0001	1.0013	9273	6197
	time:3-week	0.0019	0.0006	0.0007	0.0031	0.9999	5061	6104
	time:dosing interval	0.0001	0.0001	-0.0001	0.0003	1.0010	7100	6346
	time:prior infection	0.0035	0.0005	0.0025	0.0044	0.9998	7001	6688
	sigma	0.8319	0.0036	0.8248	0.8389	1.0027	1982	4821
	sd(Intercept)	1.1414	0.0122	1.1175	1.1655	1.0032	2434	4901
	sd(time)	0.0027	0.0002	0.0023	0.0032	1.0180	315	396
	cor(Intercept,time)	-0.9189	0.0447	-0.9882	-0.8234	1.0203	283	324

Supplementary Table 10. Model coefficients and MCMC diagnostics for the multivariable Bayesian linear mixed models.

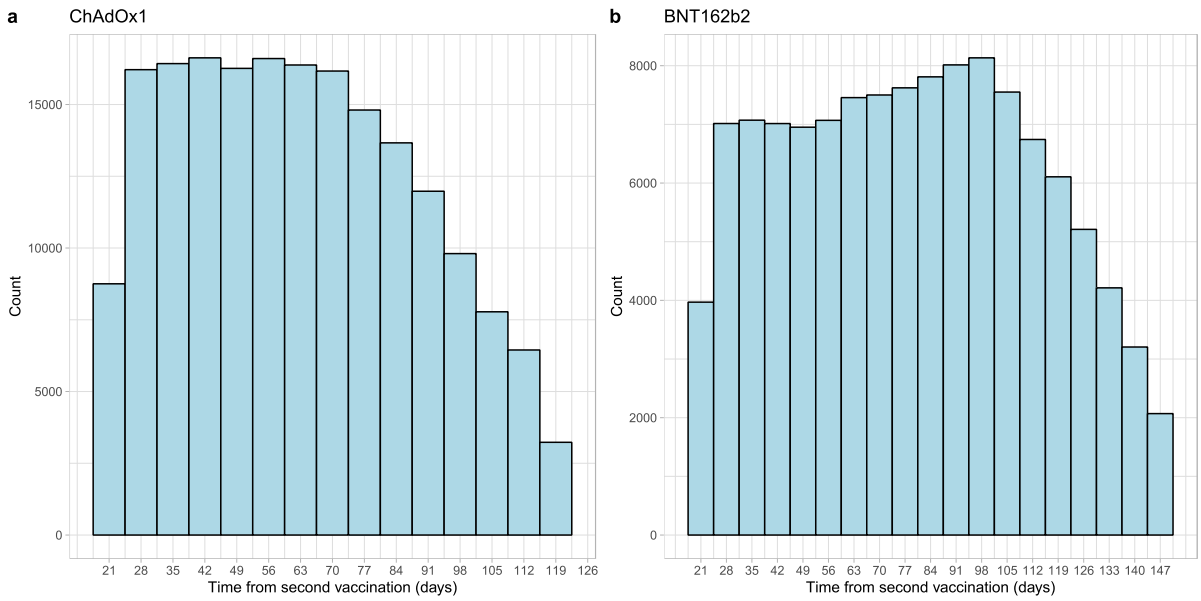
Supplementary Figures



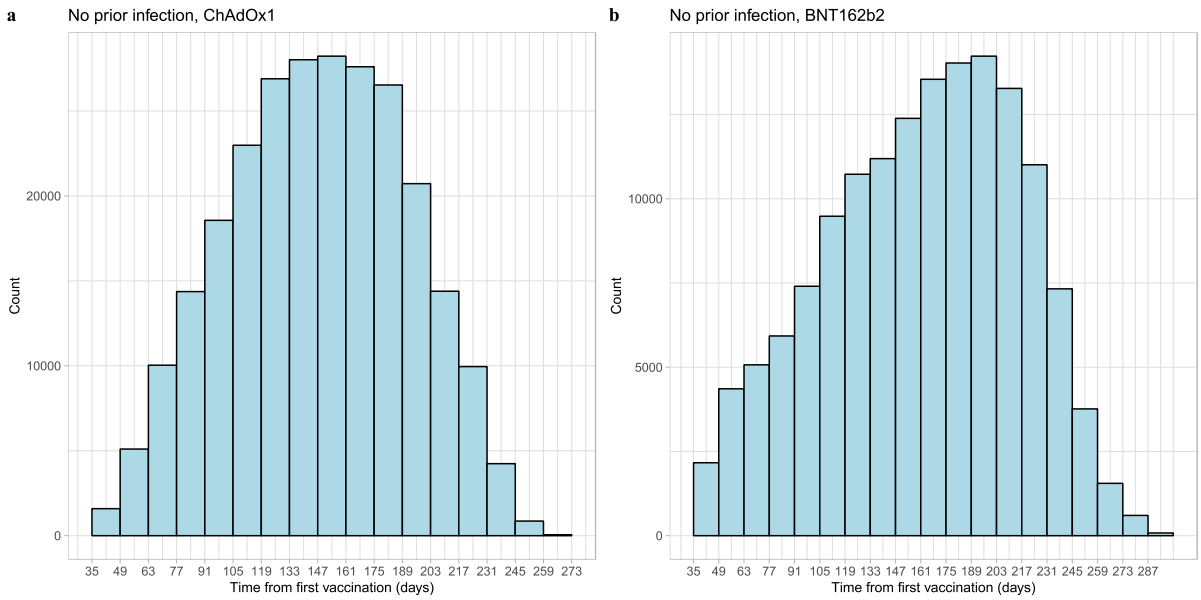
Supplementary Fig. 1. Unadjusted mean anti-spike IgG levels (BAU/mL) and count of IgG measurements by week from second vaccination in those without prior infection. Plots are separated by age group (16-34, 35-54, 55-74, and ≥75 years) and are not separated by dosing intervals. **a**, in those who received two ChAdOx1 vaccinations. **b**, in those who received two BNT162b2 vaccinations. Values truncated at 450 BAU/mL counted as =450 BAU/mL.



Supplementary Fig. 2. Unadjusted mean anti-spike IgG levels (BAU/mL) and count of IgG measurements by week from second vaccination in those with prior infection. Plots are separated by age group (16-34, 35-54, 55-74, and ≥75 years) and are not separated by dosing intervals. **a**, in those who received two ChAdOx1 vaccinations. **b**, in those who received two BNT162b2 vaccinations. Values truncated at 450 BAU/mL counted as =450 BAU/mL.



Supplementary Fig. 3. Distribution of antibody measurements relative to the time of the second vaccination in the Bayesian linear mixed model. The median (IQR) [range] was 61 (41-83) [21-119] days for ChAdOx1 and 79 (51-106) [21-149] days for BNT162b2.



Supplementary Fig. 4. Distribution of study visits relative to the time of the first vaccination in the generalised additive models estimating correlates of protection. Study visits were included from 17th May 2021 to 4th October 2021, i.e. while the Delta variant accounted for nearly all cases. The median (IQR) [range] was 149 (115-182) [36-273] days for ChAdOx1 and 167 (123-204) [35-298] days for BNT162b2.