Post-vaccination, post-infection and hybrid immunity against severe cases of omicron subvariants of covid-19 and long covid: Czech Republic population study

Supplementary material

November 13, 2023

Introduction

In the present Supplementary Material, we list detailed results of all the there our analyses (Serious Course BA12, Serious Course BA45+ and Long Covid, all presented in Figure 1). Further, we present a methodology of comparison of different immunities (Figure 2).

Serious Course BA12 – Detailed Results

Characteristic	N = 40,769,524[1]
SeriousCovidProxy	7,496 (<0.1%)
Immunity	
_noimmunity	2,404,613 (5.9%)
_other	694,669 (1.7%)
boost_001-061	3,254,191 (8.0%)
boost_062-122	3,174,835 (7.8%)
boost_123-183	2,968,882 (7.3%)
boost_184-244	2,294,480 (5.6%)
full_001-061	558,388 (1.4%)
full_062-122	890,199 (2.2%)
full_123-183	2,671,078 (6.6%)
full_184-244	2,020,033 (5.0%)
full_245-305	1,051,807 (2.6%)
full_306-366	795,281 (2.0%)
full_367-427	257,726 (0.6%)
full_428-488	39,245 (<0.1%)
hybridboost_001-061	2,112,157 (5.2%)
hybridboost_062-122	2,036,853 (5.0%)
hybridboost_123-183	1,533,412 (3.8%)
hybridfull_001-061	1,793,417 (4.4%)
hybridfull_062-122	2,065,747 (5.1%)
hybridfull_123-183	2,376,032 (5.8%)
hybridfull_184-244	1,318,121 (3.2%)
hybridfull_245-305	595,755 (1.5%)
hybridfull_306-366	316,955 (0.8%)
inf_062-122	1,142,103 (2.8%)
inf_123-183	1,061,894 (2.6%)
inf_306-366	301,489 (0.7%)
inf_367-427	353,725 (0.9%)
inf_428-488	384,478 (0.9%)
inf_489-549	301,959 (0.7%)
Sex	
F	20,963,031 (51%)
M	19,806,493 (49%)

[1] n (%)

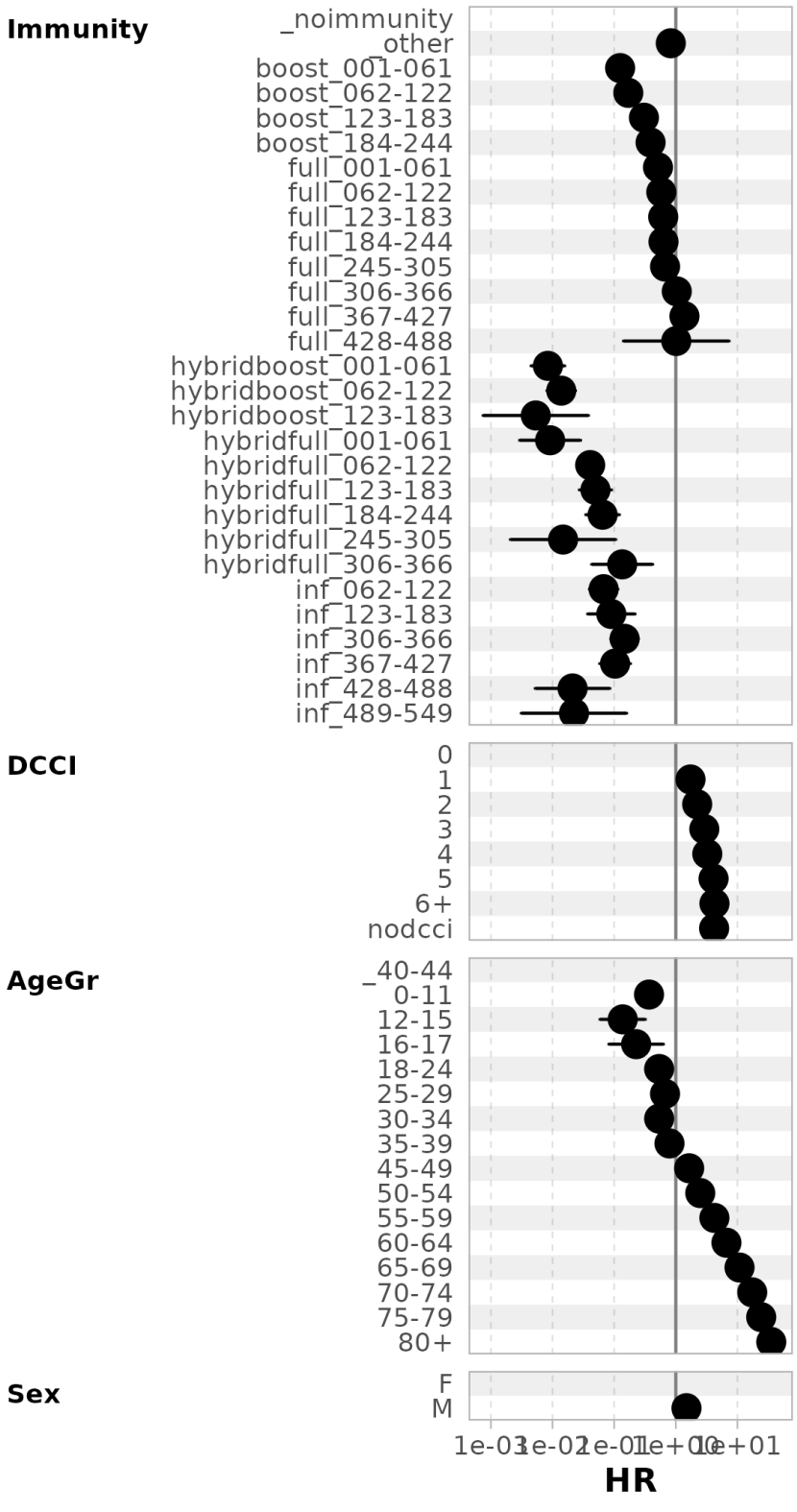

Table 1: Input Summary (left), Forest Plot (right)

	beta	lower	upper	HR	lower	upper	eff	upper	lower
Immunity_other	-0.19	-0.37	-0.01	0.83	0.69	0.99	0.17	0.31	0.01
Immunityboost_001-061	-2.08	-2.18	-1.98	0.12	0.11	0.14	0.88	0.89	0.86
Immunityboost_062-122	-1.77	-1.84	-1.71	0.17	0.16	0.18	0.83	0.84	0.82
Immunityboost_123-183	-1.19	-1.29	-1.10	0.30	0.28	0.33	0.70	0.72	0.67
Immunityboost_184-244	-0.94	-1.41	-0.48	0.39	0.24	0.62	0.61	0.76	0.38
Immunityfull_001-061	-0.67	-0.85	-0.48	0.51	0.43	0.62	0.49	0.57	0.38
Immunityfull_062-122	-0.54	-0.70	-0.38	0.58	0.50	0.68	0.42	0.50	0.32
Immunityfull_123-183	-0.47	-0.62	-0.32	0.63	0.54	0.72	0.37	0.46	0.28
Immunityfull_184-244	-0.46	-0.56	-0.36	0.63	0.57	0.70	0.37	0.43	0.30
Immunityfull_245-305	-0.40	-0.51	-0.29	0.67	0.60	0.75	0.33	0.40	0.25
Immunityfull_306-366	0.04	-0.11	0.18	1.04	0.90	1.20	-0.04	0.10	-0.20
Immunityfull_367-427	0.32	0.03	0.62	1.38	1.03	1.86	-0.38	-0.03	-0.86
Immunityfull_428-488	0.02	-1.95	1.98	1.02	0.14	7.27	-0.02	0.86	-6.27
Immunityhybridboost_001-061	-4.78	-5.40	-4.16	0.01	0.00	0.02	0.99	1.00	0.98
Immunityhybridboost_062-122	-4.28	-4.80	-3.75	0.01	0.01	0.02	0.99	0.99	0.98
Immunityhybridboost_123-183	-5.23	-7.19	-3.27	0.01	0.00	0.04	0.99	1.00	0.96
Immunityhybridfull_001-061	-4.69	-5.83	-3.56	0.01	0.00	0.03	0.99	1.00	0.97
Immunityhybridfull_062-122	-3.20	-3.66	-2.73	0.04	0.03	0.06	0.96	0.97	0.94
Immunityhybridfull_123-183	-3.00	-3.59	-2.41	0.05	0.03	0.09	0.95	0.97	0.91
Immunityhybridfull_184-244	-2.73	-3.36	-2.11	0.06	0.03	0.12	0.94	0.97	0.88
Immunityhybridfull_245-305	-4.21	-6.17	-2.25	0.01	0.00	0.11	0.99	1.00	0.89
Immunityhybridfull_306-366	-2.00	-3.13	-0.87	0.14	0.04	0.42	0.86	0.96	0.58
Immunityinf_062-122	-2.70	-3.22	-2.17	0.07	0.04	0.11	0.93	0.96	0.89
Immunityinf_123-183	-2.41	-3.29	-1.53	0.09	0.04	0.22	0.91	0.96	0.78
Immunityinf_306-366	-1.91	-2.42	-1.41	0.15	0.09	0.25	0.85	0.91	0.75
Immunityinf_367-427	-2.27	-2.83	-1.70	0.10	0.06	0.18	0.90	0.94	0.82
Immunityinf_428-488	-3.86	-5.24	-2.47	0.02	0.01	0.08	0.98	0.99	0.92
Immunityinf_489-549	-3.80	-5.76	-1.84	0.02	0.00	0.16	0.98	1.00	0.84
DCCI1	0.55	0.46	0.64	1.73	1.59	1.89	-0.73	-0.59	-0.89
DCCI2	0.80	0.71	0.89	2.22	2.03	2.43	-1.22	-1.03	-1.43
DCCI3	1.07	0.98	1.16	2.90	2.65	3.17	-1.90	-1.65	-2.17
DCCI4	1.18	1.08	1.27	3.24	2.95	3.57	-2.24	-1.95	-2.57
DCCI5	1.41	1.31	1.51	4.09	3.70	4.53	-3.09	-2.70	-3.53
DCCI6+	1.44	1.35	1.53	4.24	3.87	4.64	-3.24	-2.87	-3.64
DCCInodcci	1.43	1.24	1.63	4.18	3.44	5.08	-3.18	-2.44	-4.08
AgeGr0-11	-1.00	-1.39	-0.61	0.37	0.25	0.54	0.63	0.75	0.46
AgeGr12-15	-1.98	-2.82	-1.14	0.14	0.06	0.32	0.86	0.94	0.68
AgeGr16-17	-1.48	-2.49	-0.47	0.23	0.08	0.63	0.77	0.92	0.37
AgeGr18-24	-0.62	-1.05	-0.20	0.54	0.35	0.82	0.46	0.65	0.18
AgeGr25-29	-0.40	-0.83	0.02	0.67	0.44	1.02	0.33	0.56	-0.02
AgeGr30-34	-0.62	-1.05	-0.19	0.54	0.35	0.82	0.46	0.65	0.18
AgeGr35-39	-0.24	-0.62	0.15	0.79	0.54	1.16	0.21	0.46	-0.16
AgeGr45-49	0.50	0.19	0.81	1.65	1.21	2.25	-0.65	-0.21	-1.25
AgeGr50-54	0.91	0.61	1.21	2.49	1.85	3.37	-1.49	-0.85	-2.37
AgeGr55-59	1.44	1.16	1.72	4.22	3.19	5.60	-3.22	-2.19	-4.60
AgeGr60-64	1.89	1.62	2.16	6.63	5.05	8.71	-5.63	-4.05	-7.71
AgeGr65-69	2.38	2.12	2.64	10.81	8.30	14.07	-9.81	-7.30	-13.07
AgeGr70-74	2.85	2.59	3.11	17.37	13.39	22.53	-16.37	-12.39	-21.53
AgeGr75-79	3.19	2.93	3.45	24.30	18.74	31.50	-23.30	-17.74	-30.50
AgeGr80+	3.57	3.31	3.82	35.35	27.32	45.75	-34.35	-26.32	-44.75
SexM	0.40	0.35	0.44	1.49	1.42	1.56	-0.49	-0.42	-0.56

Table 2: Cox model summary

	immunities	deltas	lower_of_deltas	upper_of_deltas
2	Immunityfull	0.03	0.02	0.04
3	Immunityboost	0.03	0.03	0.04
4	Immunitysecboost			
5	Immunitysecbnew			
6	Immunityinf	-0.00	-0.01	-0.00
7	Immunityhybridfull	0.00	0.00	0.01
8	Immunityhybridboost	0.00	-0.00	0.00

Table 3: Monthly percentage decrease of effectiveness/protection

	1	2	3	4	5	6	7	8
1		45.44%	81.92%			91.87%	97.73%	99.03%
2			37.22%			48.23%	52.82%	56.41%
3		-37.22%				10.12%	15.67%	17.29%
4								
5								
6		-48.23%	-10.12%				2.87%	5.33%
7		-52.82%	-15.67%			-2.87%		2.41%
8		-56.41%	-17.29%			-5.33%	-2.41%	

Table 4: Effectiveness/protection differences in 3

1	2	3	4	5	6	7	8
	16.65	161.92			55.25	231.57	424.18
		13.26			10.97	18.94	19.34
	-13.26				5.35	19.72	30.65
	-10.97	-5.35				1.47	2.87
	-18.94	-19.72			-1.47		3.70
	-19.34	-30.65			-2.87	-3.70	

Table 5: Z-scores of effectiveness/protection differences in 3

	1	2	3	4	5	6	7	8
1		36.34%	71.97%			92.94%	96.49%	
2			30.62%			64.26%	59.00%	
3		-30.62%					23.05%	
4								
5								
6		-64.26%					2.74%	
7		-59.00%	-23.05%			-2.74%		
8								

Table 6: Effectiveness/protection differences in 6

1	2	3	4	5	6	7	8
	17.69	57.22			72.65	137.07	
		6.49			17.37	27.09	
	-6.49					11.78	
	-17.37					0.92	
	-27.09	-11.78			-0.92		

Table 7: Z-scores of effectiveness/protection differences in 6

Serious Course BA45+ – Detailed Results

Characteristic	N = 63,501,948[1]
SeriousCovidProxy	5,885 (<0.1%)
Immunity	
_noimmunity	1,844,967 (2.9%)
_other	4,494,631 (7.1%)
bnew_001-061	13,498 (<0.1%)
bnew_062-122	13,321 (<0.1%)
boost_001-061	76,530 (0.1%)
boost_062-122	165,370 (0.3%)
boost_123-183	1,370,062 (2.2%)
boost_184-244	2,944,858 (4.6%)
boost_245-305	2,922,762 (4.6%)
boost_306-366	2,624,724 (4.1%)
boost_367-427	2,303,551 (3.6%)
boost_428-488	2,211,194 (3.5%)
boost_489-549	2,177,620 (3.4%)
full_123-183	198,969 (0.3%)
full_184-244	445,432 (0.7%)
full_245-305	660,354 (1.0%)
full_306-366	1,151,507 (1.8%)
full_367-427	1,217,724 (1.9%)
full_428-488	1,215,370 (1.9%)
full_489-549	1,197,386 (1.9%)
hybridboost_001-061	933,778 (1.5%)
hybridboost_062-122	1,206,170 (1.9%)
hybridboost_123-183	2,084,365 (3.3%)
hybridboost_184-244	2,406,237 (3.8%)
hybridboost_245-305	1,999,130 (3.1%)
hybridboost_306-366	1,527,103 (2.4%)
hybridboost_367-427	1,260,989 (2.0%)
hybridboost_428-488	1,138,388 (1.8%)
hybridboost_489-549	827,183 (1.3%)
hybridfull_062-122	351,432 (0.6%)
hybridfull_123-183	1,119,432 (1.8%)
hybridfull_184-244	1,665,206 (2.6%)
hybridfull_245-305	1,788,641 (2.8%)
hybridfull_306-366	1,820,728 (2.9%)
hybridfull_367-427	1,540,876 (2.4%)
hybridfull_428-488	1,198,480 (1.9%)
hybridfull_489-549	1,015,852 (1.6%)
inf_123-183	732,924 (1.2%)
inf_184-244	1,131,426 (1.8%)
inf_245-305	1,163,437 (1.8%)
inf_306-366	1,127,355 (1.8%)
inf_367-427	1,090,138 (1.7%)
inf_428-488	1,190,924 (1.9%)
inf_489-549	1,249,488 (2.0%)
secbnew_001-061	283,928 (0.4%)
secbnew_062-122	281,950 (0.4%)
secbnew_123-183	279,701 (0.4%)
secbnew_184-244	281,897 (0.4%)
secboost_001-061	319,737 (0.5%)
secboost_062-122	314,740 (0.5%)
secboost_123-183	310,488 (0.5%)
secboost_184-244	307,915 (0.5%)
secboost_245-305	302,080 (0.5%)
Sex	
F	32,878,534 (52%)
M	30,623,414 (48%)

[1] n (%)

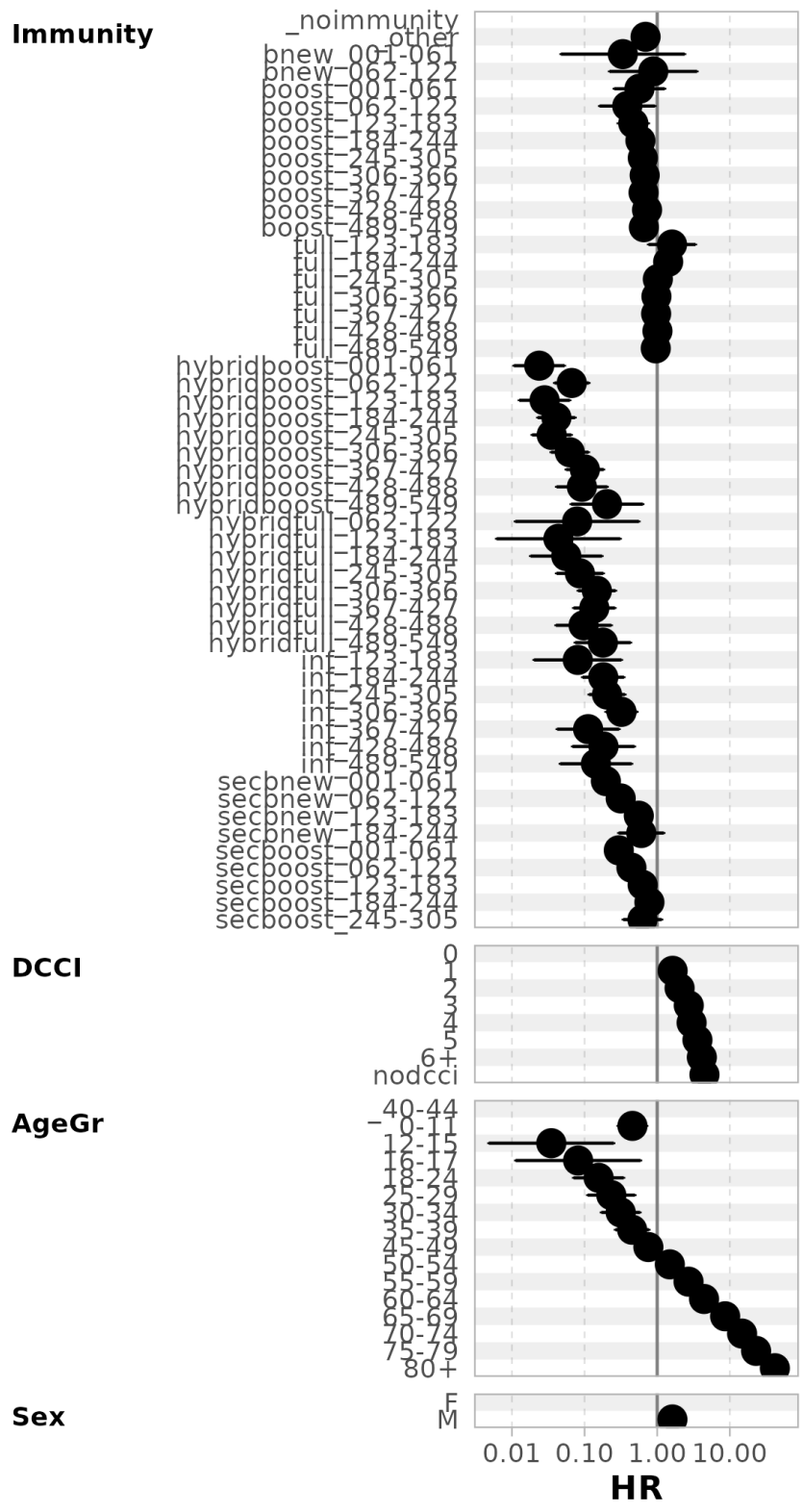

Table 8: Input Summary (left), Forest Plot (right)

	beta	lower	upper	HR	lower	upper	eff	upper	lower
Immunity_other	-0.37	-0.50	-0.23	0.69	0.60	0.79	0.31	0.40	0.21
Immunitybnew_001-061	-1.09	-3.05	0.87	0.34	0.05	2.39	0.66	0.95	-1.39
Immunitybnew_062-122	-0.12	-1.51	1.26	0.88	0.22	3.54	0.12	0.78	-2.54
Immunityboost_001-061	-0.56	-1.36	0.24	0.57	0.26	1.27	0.43	0.74	-0.27
Immunityboost_062-122	-0.95	-1.83	-0.07	0.39	0.16	0.93	0.61	0.84	0.07
Immunityboost_123-183	-0.76	-1.24	-0.28	0.47	0.29	0.76	0.53	0.71	0.24
Immunityboost_184-244	-0.53	-0.67	-0.39	0.59	0.51	0.68	0.41	0.49	0.32
Immunityboost_245-305	-0.46	-0.55	-0.37	0.63	0.58	0.69	0.37	0.42	0.31
Immunityboost_306-366	-0.40	-0.49	-0.30	0.67	0.61	0.74	0.33	0.39	0.26
Immunityboost_367-427	-0.43	-0.55	-0.31	0.65	0.58	0.73	0.35	0.42	0.27
Immunityboost_428-488	-0.32	-0.45	-0.19	0.73	0.63	0.83	0.27	0.37	0.17
Immunityboost_489-549	-0.42	-0.65	-0.20	0.66	0.52	0.82	0.34	0.48	0.18
Immunityfull_123-183	0.47	-0.27	1.21	1.60	0.76	3.37	-0.60	0.24	-2.37
Immunityfull_184-244	0.35	0.03	0.67	1.42	1.03	1.95	-0.42	-0.03	-0.95
Immunityfull_245-305	0.02	-0.25	0.29	1.02	0.78	1.33	-0.02	0.22	-0.33
Immunityfull_306-366	-0.02	-0.28	0.24	0.98	0.75	1.27	0.02	0.25	-0.27
Immunityfull_367-427	-0.03	-0.22	0.15	0.97	0.80	1.17	0.03	0.20	-0.17
Immunityfull_428-488	0.01	-0.16	0.17	1.01	0.86	1.19	-0.01	0.14	-0.19
Immunityfull_489-549	-0.05	-0.23	0.14	0.96	0.79	1.15	0.04	0.21	-0.15
Immunityhybridboost_001-061	-3.74	-4.54	-2.94	0.02	0.01	0.05	0.98	0.99	0.95
Immunityhybridboost_062-122	-2.71	-3.26	-2.16	0.07	0.04	0.11	0.93	0.96	0.89
Immunityhybridboost_123-183	-3.57	-4.37	-2.77	0.03	0.01	0.06	0.97	0.99	0.94
Immunityhybridboost_184-244	-3.19	-3.79	-2.60	0.04	0.02	0.07	0.96	0.98	0.93
Immunityhybridboost_245-305	-3.34	-3.97	-2.72	0.04	0.02	0.07	0.96	0.98	0.93
Immunityhybridboost_306-366	-2.77	-3.36	-2.18	0.06	0.03	0.11	0.94	0.97	0.89
Immunityhybridboost_367-427	-2.29	-2.89	-1.70	0.10	0.06	0.18	0.90	0.94	0.82
Immunityhybridboost_428-488	-2.39	-3.19	-1.58	0.09	0.04	0.21	0.91	0.96	0.79
Immunityhybridboost_489-549	-1.59	-2.73	-0.45	0.20	0.07	0.64	0.80	0.93	0.36
Immunityhybridfull_062-122	-2.54	-4.50	-0.58	0.08	0.01	0.56	0.92	0.99	0.44
Immunityhybridfull_123-183	-3.13	-5.09	-1.17	0.04	0.01	0.31	0.96	0.99	0.69
Immunityhybridfull_184-244	-2.88	-4.02	-1.75	0.06	0.02	0.17	0.94	0.98	0.83
Immunityhybridfull_245-305	-2.45	-3.19	-1.71	0.09	0.04	0.18	0.91	0.96	0.82
Immunityhybridfull_306-366	-1.91	-2.51	-1.32	0.15	0.08	0.27	0.85	0.92	0.73
Immunityhybridfull_367-427	-1.99	-2.65	-1.34	0.14	0.07	0.26	0.86	0.93	0.74
Immunityhybridfull_428-488	-2.33	-3.21	-1.45	0.10	0.04	0.23	0.90	0.96	0.77
Immunityhybridfull_489-549	-1.72	-2.60	-0.84	0.18	0.07	0.43	0.82	0.93	0.57
Immunityinf_123-183	-2.52	-3.91	-1.13	0.08	0.02	0.32	0.92	0.98	0.68
Immunityinf_184-244	-1.71	-2.37	-1.05	0.18	0.09	0.35	0.82	0.91	0.65
Immunityinf_245-305	-1.59	-2.16	-1.02	0.20	0.12	0.36	0.80	0.88	0.64
Immunityinf_306-366	-1.13	-1.63	-0.64	0.32	0.20	0.53	0.68	0.80	0.47
Immunityinf_367-427	-2.19	-3.17	-1.21	0.11	0.04	0.30	0.89	0.96	0.70
Immunityinf_428-488	-1.70	-2.69	-0.72	0.18	0.07	0.49	0.82	0.93	0.51
Immunityinf_489-549	-1.94	-3.08	-0.81	0.14	0.05	0.45	0.86	0.95	0.55
Immunitysecbnew_001-061	-1.63	-1.97	-1.28	0.20	0.14	0.28	0.80	0.86	0.72
Immunitysecbnew_062-122	-1.16	-1.47	-0.84	0.31	0.23	0.43	0.69	0.77	0.57
Immunitysecbnew_123-183	-0.58	-0.86	-0.30	0.56	0.42	0.74	0.44	0.58	0.26
Immunitysecbnew_184-244	-0.50	-1.22	0.21	0.60	0.30	1.23	0.40	0.70	-0.23
Immunitysecboost_001-061	-1.22	-1.42	-1.01	0.30	0.24	0.36	0.70	0.76	0.64
Immunitysecboost_062-122	-0.82	-1.02	-0.61	0.44	0.36	0.54	0.56	0.64	0.46
Immunitysecboost_123-183	-0.46	-0.66	-0.26	0.63	0.52	0.77	0.37	0.48	0.23
Immunitysecboost_184-244	-0.25	-0.48	-0.01	0.78	0.62	0.99	0.22	0.38	0.01
Immunitysecboost_245-305	-0.47	-1.08	0.14	0.63	0.34	1.15	0.37	0.66	-0.15
DCCI1	0.49	0.39	0.59	1.63	1.48	1.80	-0.63	-0.48	-0.80
DCCI2	0.71	0.61	0.81	2.03	1.84	2.25	-1.03	-0.84	-1.25
DCCI3	1.00	0.90	1.10	2.72	2.46	3.01	-1.72	-1.46	-2.01
DCCI4	1.09	0.98	1.20	2.98	2.67	3.32	-1.98	-1.67	-2.32
DCCI5	1.28	1.16	1.39	3.58	3.19	4.02	-2.58	-2.19	-3.02
DCCI6+	1.42	1.31	1.52	4.12	3.72	4.57	-3.12	-2.72	-3.57
DCCInodcci	1.50	1.28	1.72	4.47	3.58	5.59	-3.47	-2.58	-4.59
AgeGr0-11	-0.79	-1.24	-0.33	0.46	0.29	0.72	0.54	0.71	0.28
AgeGr12-15	-3.36	-5.34	-1.38	0.03	0.00	0.25	0.97	1.00	0.75
AgeGr16-17	-2.51	-4.49	-0.53	0.08	0.01	0.59	0.92	0.99	0.41
AgeGr18-24	-1.86	-2.65	-1.06	0.16	0.07	0.35	0.84	0.93	0.65
AgeGr25-29	-1.46	-2.21	-0.71	0.23	0.11	0.49	0.77	0.89	0.51
AgeGr30-34	-1.16	-1.77	-0.54	0.31	0.17	0.58	0.69	0.83	0.42
AgeGr35-39	-0.79	-1.33	-0.26	0.45	0.27	0.77	0.55	0.73	0.23
AgeGr45-49	-0.28	-0.70	0.14	0.76	0.50	1.15	0.24	0.50	-0.15
AgeGr50-54	0.40	0.03	0.77	1.49	1.03	2.16	-0.49	-0.03	-1.16
AgeGr55-59	0.99	0.66	1.33	2.70	1.93	3.77	-1.70	-0.93	-2.77
AgeGr60-64	1.48	1.17	1.80	4.41	3.21	6.07	-3.41	-2.21	-5.07
AgeGr65-69	2.15	1.85	2.46	8.62	6.38	11.65	-7.62	-5.38	-10.65
AgeGr70-74	2.69	2.39	2.99	14.74	10.96	19.83	-13.74	-9.96	-18.83
AgeGr75-79	3.13	2.84	3.43	22.99	17.11	30.89	-21.99	-16.11	-29.89
AgeGr80+	3.73	3.44	4.02	41.70	31.10	55.91	-40.70	-30.10	-54.91
SexM	0.48	0.43	0.53	1.62	1.54	1.71	-0.62	-0.54	-0.71

Table 9: Cox model summary

	immunities	deltas	lower_of_deltas	upper_of_deltas
2	Immunityfull	-0.02	-0.05	0.01
3	Immunityboost	0.01	0.00	0.03
4	Immunitysecboost	0.07	0.05	0.10
5	Immunitysecbnew	0.08	0.04	0.11
6	Immunityinf	0.00	-0.01	0.02
7	Immunityhybridfull	0.01	-0.00	0.02
8	Immunityhybridboost	0.00	0.00	0.01

Table 10: Monthly percentage decrease of effectiveness/protection

1	2	3	4	5	6	7	8
1	-19.61%	46.17%	55.44%	65.41%	85.90%	96.18%	97.01%
2		63.00%	118.40%	127.52%	97.82%	116.12%	125.89%
3	-63.00%		-1.96%	11.82%	33.85%	48.22%	52.94%
4	-118.40%	1.96%		10.68%	58.78%	41.77%	40.86%
5	-127.52%	-11.82%	-10.68%		53.23%	25.73%	30.58%
6	-97.82%	-33.85%	-58.78%	-53.23%		12.03%	13.42%
7	-116.12%	-48.22%	-41.77%	-25.73%	-12.03%		2.39%
8	-125.89%	-52.94%	-40.86%	-30.58%	-13.42%	-2.39%	

Table 11: Effectiveness/protection differences in 3

1	2	3	4	5	6	7	8
	-1.15	9.42	21.52	20.30	16.36	30.14	155.51
		3.56	1.80	1.01	5.09	6.33	6.76
	-3.56		-0.19	1.08	4.18	7.85	10.06
	-1.80	0.19		2.75	3.69	5.34	15.59
	-1.01	-1.08	-2.75		1.78	2.88	9.29
	-5.09	-4.18	-3.69	-1.78		1.88	2.38
	-6.33	-7.85	-5.34	-2.88	-1.88		0.68
	-6.76	-10.06	-15.59	-9.29	-2.38	-0.68	

Table 12: Z-scores of effectiveness/protection differences in 3

1	2	3	4	5	6	7	8
1	-14.05%	42.01%	33.21%	41.73%	85.04%	93.75%	96.03%
2		54.35%	78.59%	92.91%	93.41%	107.91%	115.53%
3	-54.35%		-11.76%	-8.85%	38.27%	50.33%	55.06%
4	-78.59%	11.76%		11.27%	55.52%	60.44%	62.07%
5	-92.91%	8.85%	-11.27%		45.05%	57.49%	52.69%
6	-93.41%	-38.27%	-55.52%	-45.05%		9.96%	12.05%
7	-107.91%	-50.33%	-60.44%	-57.49%	-9.96%		2.85%
8	-115.53%	-55.06%	-62.07%	-52.69%	-12.05%	-2.85%	

Table 13: Effectiveness/protection differences in 6

1	2	3	4	5	6	7	8
	-1.09	12.25	6.61	5.49	23.19	43.25	188.08
		4.19	2.67	2.65	6.59	7.94	8.45
	-4.19		-1.70	-0.70	6.84	11.95	15.42
	-2.67	1.70		1.25	8.32	10.59	12.27
	-2.65	0.70	-1.25		3.63	5.34	6.81
	-6.59	-6.84	-8.32	-3.63		2.27	3.18
	-7.94	-11.95	-10.59	-5.34	-2.27		1.24
	-8.45	-15.42	-12.27	-6.81	-3.18	-1.24	

Table 14: Z-scores of effectiveness/protection differences in 6

Long Covid BA12 - Infected – Detailed Results

Characteristic	N = 1,176,493[1]
LongCovid	15,587 (1.3%)
Immunity	
_noimmunity	253,202 (22%)
_other	13,320 (1.1%)
boost_001-061	126,737 (11%)
boost_062-122	121,903 (10%)
boost_123-183	41,718 (3.5%)
boost_184-244	48,291 (4.1%)
boost_245-305	38,005 (3.2%)
boost_306-366	4,909 (0.4%)
full_001-061	23,079 (2.0%)
full_062-122	28,503 (2.4%)
full_123-183	85,332 (7.3%)
full_184-244	118,129 (10%)
full_245-305	31,911 (2.7%)
full_306-366	14,088 (1.2%)
full_367-427	11,161 (0.9%)
full_428-488	3,053 (0.3%)
full_489-549	652 (<0.1%)
hybridboost_001-061	17,027 (1.4%)
hybridboost_062-122	13,256 (1.1%)
hybridboost_123-183	6,418 (0.5%)
hybridboost_184-244	10,842 (0.9%)
hybridboost_245-305	5,312 (0.5%)
hybridboost_306-366	415 (<0.1%)
hybridfull_001-061	3,393 (0.3%)
hybridfull_062-122	10,710 (0.9%)
hybridfull_123-183	19,823 (1.7%)
hybridfull_184-244	25,882 (2.2%)
hybridfull_245-305	10,386 (0.9%)
hybridfull_306-366	4,448 (0.4%)
hybridfull_367-427	2,813 (0.2%)
hybridfull_428-488	749 (<0.1%)
hybridfull_489-549	141 (<0.1%)
inf_062-122	10,435 (0.9%)
inf_123-183	7,152 (0.6%)
inf_184-244	7,406 (0.6%)
inf_245-305	6,841 (0.6%)
inf_306-366	13,880 (1.2%)
inf_367-427	14,166 (1.2%)
inf_428-488	13,251 (1.1%)
inf_489-549	5,942 (0.5%)
secboost_001-061	1,764 (0.1%)
secboost_062-122	48 (<0.1%)
DCCI	
0	648,332 (55%)
1	282,607 (24%)
2	118,879 (10%)
3	57,730 (4.9%)
4	29,690 (2.5%)
5	15,810 (1.3%)
6+	23,445 (2.0%)
Sex	
F	649,835 (55%)
M	526,658 (45%)

[1] n (%)

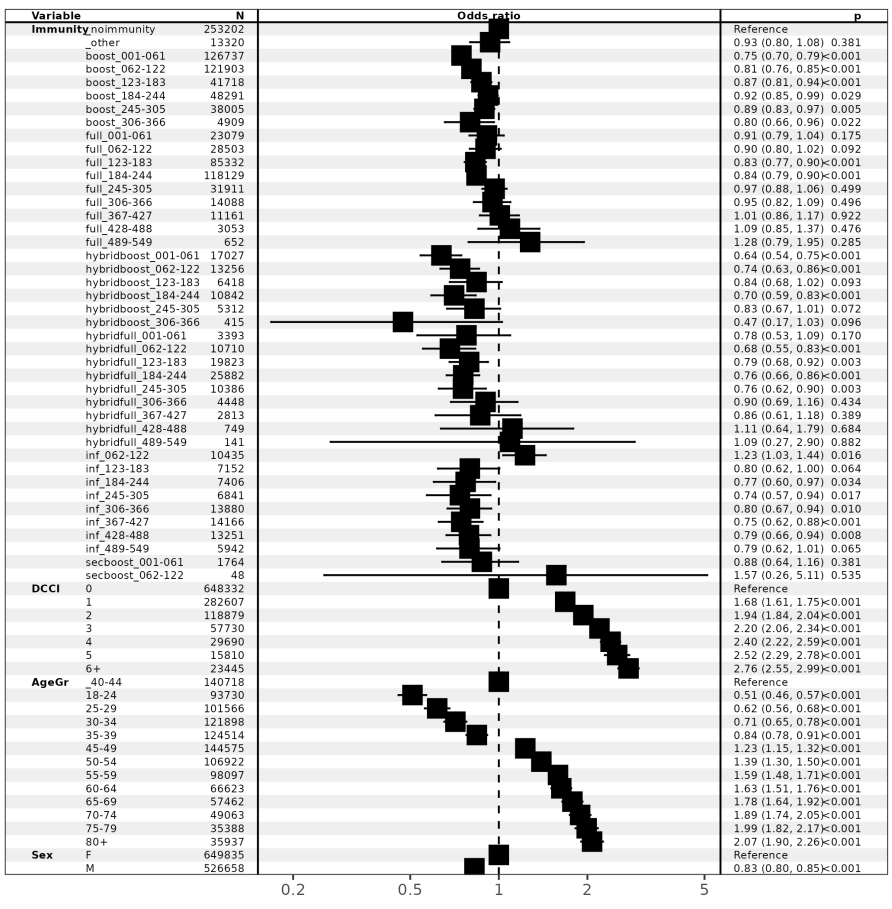

Table 15: Input Summary (left), Forest Plot (right)

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-4.6345	0.0331	-140.19	0.0000
Immunity_other	-0.0682	0.0780	-0.88	0.3813
Immunityboost_001-061	-0.2923	0.0319	-9.16	0.0000
Immunityboost_062-122	-0.2145	0.0292	-7.35	0.0000
Immunityboost_123-183	-0.1360	0.0402	-3.39	0.0007
Immunityboost_184-244	-0.0840	0.0385	-2.18	0.0291
Immunityboost_245-305	-0.1129	0.0401	-2.82	0.0048
Immunityboost_306-366	-0.2247	0.0979	-2.29	0.0217
Immunityfull_001-061	-0.0930	0.0685	-1.36	0.1747
Immunityfull_062-122	-0.1041	0.0618	-1.69	0.0919
Immunityfull_123-183	-0.1839	0.0423	-4.35	0.0000
Immunityfull_184-244	-0.1745	0.0333	-5.24	0.0000
Immunityfull_245-305	-0.0328	0.0485	-0.68	0.4990
Immunityfull_306-366	-0.0497	0.0730	-0.68	0.4965
Immunityfull_367-427	0.0077	0.0779	0.10	0.9216
Immunityfull_428-488	0.0870	0.1220	0.71	0.4759
Immunityfull_489-549	0.2451	0.2292	1.07	0.2848
Immunityhybridboost_001-061	-0.4493	0.0813	-5.53	0.0000
Immunityhybridboost_062-122	-0.3029	0.0770	-3.93	0.0001
Immunityhybridboost_123-183	-0.1741	0.1037	-1.68	0.0931
Immunityhybridboost_184-244	-0.3500	0.0887	-3.95	0.0001
Immunityhybridboost_245-305	-0.1908	0.1060	-1.80	0.0719
Immunityhybridboost_306-366	-0.7499	0.4511	-1.66	0.0964
Immunityhybridfull_001-061	-0.2532	0.1846	-1.37	0.1702
Immunityhybridfull_062-122	-0.3827	0.1042	-3.67	0.0002
Immunityhybridfull_123-183	-0.2319	0.0767	-3.02	0.0025
Immunityhybridfull_184-244	-0.2785	0.0651	-4.28	0.0000
Immunityhybridfull_245-305	-0.2804	0.0941	-2.98	0.0029
Immunityhybridfull_306-366	-0.1037	0.1326	-0.78	0.4341
Immunityhybridfull_367-427	-0.1456	0.1691	-0.86	0.3892
Immunityhybridfull_428-488	0.1067	0.2622	0.41	0.6839
Immunityhybridfull_489-549	0.0871	0.5860	0.15	0.8819
Immunityinf_062-122	0.2049	0.0849	2.41	0.0159
Immunityinf_123-183	-0.2269	0.1225	-1.85	0.0640
Immunityinf_184-244	-0.2596	0.1225	-2.12	0.0340
Immunityinf_245-305	-0.3043	0.1271	-2.40	0.0166
Immunityinf_306-366	-0.2262	0.0872	-2.59	0.0095
Immunityinf_367-427	-0.2943	0.0875	-3.36	0.0008
Immunityinf_428-488	-0.2335	0.0876	-2.67	0.0077
Immunityinf_489-549	-0.2296	0.1244	-1.85	0.0650
Immunitysecboost_001-061	-0.1327	0.1513	-0.88	0.3805
Immunitysecboost_062-122	0.4500	0.7252	0.62	0.5349
DCCI1	0.5195	0.0212	24.51	0.0000
DCCI2	0.6611	0.0260	25.48	0.0000
DCCI3	0.7873	0.0316	24.91	0.0000
DCCI4	0.8746	0.0390	22.45	0.0000
DCCI5	0.9262	0.0488	18.98	0.0000
DCCI6+	1.0152	0.0409	24.85	0.0000
AgeGr18-24	-0.6757	0.0551	-12.25	0.0000
AgeGr25-29	-0.4820	0.0492	-9.80	0.0000
AgeGr30-34	-0.3398	0.0441	-7.71	0.0000
AgeGr35-39	-0.1718	0.0414	-4.15	0.0000
AgeGr45-49	0.2071	0.0359	5.77	0.0000
AgeGr50-54	0.3327	0.0371	8.96	0.0000
AgeGr55-59	0.4629	0.0366	12.64	0.0000
AgeGr60-64	0.4888	0.0398	12.28	0.0000
AgeGr65-69	0.5756	0.0404	14.26	0.0000
AgeGr70-74	0.6362	0.0415	15.34	0.0000
AgeGr75-79	0.6872	0.0445	15.45	0.0000
AgeGr80+	0.7296	0.0437	16.69	0.0000
SexM	-0.1908	0.0166	-11.48	0.0000

Table 16: Logistic regression summary

	immunities	deltas	lower_of_deltas	upper_of_deltas
2	Immunityfull	0.01	0.00	0.02
3	Immunityboost	0.02	0.01	0.03
4	Immunitysecboost	0.35	-0.78	1.47
5	Immunitysecbnew			
6	Immunityinf	-0.02	-0.03	-0.00
7	Immunityhybridfull	0.01	-0.00	0.03
8	Immunityhybridboost	0.01	-0.01	0.03

Table 17: Monthly percentage decrease of effectiveness/protection

	1	2	3	4	5	6	7	8
1		16.86%	20.09%	-56.27%		6.30%	28.38%	29.98%
2			4.81%	-66.15%		-14.46%	11.82%	17.37%
3		-4.81%		-75.62%		-18.51%	10.53%	9.96%
4		66.15%	75.62%			34.10%	87.99%	82.49%
5								
6		14.46%	18.51%	-34.10%			30.08%	30.65%
7		-11.82%	-10.53%	-87.99%		-30.08%		-0.93%
8		-17.37%	-9.96%	-82.49%		-30.65%	0.93%	

Table 18: Effectiveness/protection differences in 3

1	2	3	4	5	6	7	8
	5.83	10.86	-0.50		0.98	6.15	9.12
		1.51	-0.59		-1.97	2.28	3.98
	-1.51		-0.67		-2.31	2.09	3.06
	0.59	0.67			0.30	0.78	0.73
	1.97	2.31	-0.30			3.54	3.17
	-2.28	-2.09	-0.78		-3.54		-0.15
	-3.98	-3.06	-0.73		-3.17	0.15	

Table 19: Z-scores of effectiveness/protection differences in 3

	1	2	3	4	5	6	7	8
1		13.17%	14.54%			11.19%	23.99%	26.42%
2			1.68%			-1.55%	11.26%	14.88%
3		-1.68%				-4.84%	10.97%	12.41%
4								
5								
6		1.55%	4.84%				14.25%	15.01%
7		-11.26%	-10.97%			-14.25%		1.16%
8		-14.88%	-12.41%			-15.01%	-1.16%	

Table 20: Effectiveness/protection differences in 6

1	2	3	4	5	6	7	8
	6.03	6.93			2.36	7.70	7.46
		0.73			-0.31	3.46	3.99
	-0.73				-0.99	3.35	3.47
	0.31	0.99				2.58	2.55
	-3.46	-3.35			-2.58		0.26
	-3.99	-3.47			-2.55	-0.26	

Table 21: Z-scores of effectiveness/protection differences in 6

Methodology of Effectiveness Comparison

Consider a Cox model

$$\lambda(t|X) = \lambda_0(t)\exp\{-X\beta\}$$

and the estimate b of β having variance matrix V. It is well knonw that, asymptotically, $b \sim \mathcal{N}(\beta, V)$.

Trend in Immunities

Let $h_{t_1}, \ldots, h_{t_n}$ be a series of HR's corresponding to a certain source of immunity, where the index stands for the time since obtaining the immunity. Asymptotically, by Delta Theorem[1] and Continuous Mapping Theorem,

$$\mathrm{var}(h) \doteq W := T'V^\star T, \qquad T = \mathrm{diag}(\exp\{b_{(1)}\}, \ldots, \exp\{b_{(n)}\})$$

where $(b_{(1)}, \ldots, b_{(n)})'$ is the vector of b's corresponding to h and $V^\star$ is the corresponding sub-matrix of V.

We assume a linear trend in h, i.e.

$$h_{t_i} = \eta + \delta t_i + \epsilon_i, \qquad i = 1, \ldots, n, \qquad \mathrm{var}(\epsilon) \doteq W.$$

The GLS estimate of (η, δ)' is given by

$$\begin{bmatrix} v \\ d \end{bmatrix} = (X'W^{-1}X)^{-1}X'W^{-1}h, \qquad X = \begin{bmatrix} 1 & t_1 \\ 1 & t_2 \\ \vdots & \vdots \\ 1 & t_n \end{bmatrix}$$

having

$$\mathrm{var}\begin{bmatrix} v \\ d \end{bmatrix} = (X'W^{-1}X)^{-1};$$

the estimate of the trend is then

$$\tau(t) = v + dt, \qquad t \geq 0.$$

Comparison of Immunities

The goal is to compare HR's $h = (h_{t_1}, \ldots, h_{t_n})'$ with another vector of HR's, say $k = (k_{t_1}, \ldots, k_{t_n})'$ assuming both to follow a (each their own) linear trend, which implies that

$$h_{t_i} - k_{t_i} = \sigma + \alpha t_i + e_i, \qquad i = 1, \ldots, n, \qquad \mathrm{var}(e) = U := SV^{\star\star}S',$$

$$S = \begin{bmatrix} \exp\{b_{[1]}\} & \cdots & 0 & -\exp\{b_{[n+1]}\} & \cdots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ 0 & \cdots & \exp\{b_{[n]}\} & 0 & \cdots & -\exp\{b_{[2n]}\} \end{bmatrix}$$

where $(b_{[1]}, \ldots, b_{[2n]})'$ is the vector of b's corresponding to $(h, k)'$ and $V^{\star\star}$is a corresponding sub-matrix of V.

The GLS estimator of $(\sigma, \alpha)'$ is

$$(s, a)' = (Z'U^{-1}Z)^{-1}Z'U^{-1}(h - k), \qquad Z = \begin{bmatrix} 1 & t_1 \\ \vdots & \vdots \\ 1 & t_n \end{bmatrix},$$

having the variance

$$M := \mathrm{var}([s, a]') = (Z'U^{-1}Z)^{-1}$$

Thus, being interested in the difference of immunities h and k at a specific time t,we can estimate it as

$$\Delta_t = s + ta,$$

having $\mathrm{var}(\Delta_t) = [1, t]M[1, t]'$

The corresponding Z-score is then

$$z = \frac{\Delta_t}{\sqrt{\mathrm{var}(\Delta)}}.$$

[1] https://www.jepusto.com/multivariate-delta-method/)