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Supplemental information

Neutralization of SARS-CoV-2

Omicron sublineages by 4 doses

of the original mRNA vaccine

Xuping Xie, Jing Zou, Chaitanya Kurhade, Mingru Liu, Ping Ren, Pei-Yong Shi

Table S1. Twenty-five pairs of human serum samples collected after dose 3 and 4 of mRNA vaccine, Related to Figure 1.

Serum ID	Pair #	Age (year)	Gender (F/M)	Ethnicity	Serum collection time (days post-dose 3 vaccination)	Serum collection time (days post-dose 4 vaccination)	Interval days between dose 3 & 4 vaccination	mRNA Vaccine type	*FFRNT ₅₀						
									USA-WA1/2020	BA.1-spike	BA.2-spike	BA.2.12.1-spike	BA.3-spike	BA.4/5-spike	BA.2.75-spike
1	1	62	F	White	174	37	174	Pfizer	17	^10	10	10	10	10	-
2					320				40	28	20	20	10	40	
3	2	84	M	White	186	26	217	Pfizer	17	10	10	10	10	10	-
4					640				160	80	80	80	20	80	
5	3	80	M	Hispanic	184	30	196	Pfizer	34	10	10	10	10	10	-
6					10240				453	640	905	320	320	640	
7	4	78	M	White	184	56	209	Pfizer	57	10	10	10	10	10	-
8					453				28	20	20	14	10	14	
9	5	87	M	White	243	24	247	Pfizer	57	10	10	10	10	10	-
10					1810				1280	453	640	453	113	640	
11	6	66	F	White	184	48	241	Pfizer	67	20	10	10	10	10	-
12					453				160	80	40	40	20	28	
13	7	83	F	White	148	23	222	Pfizer	67	10	10	10	10	10	-
14					1522				320	320	320	160	160	320	
15	8	84	F	White	174	55	209	Pfizer	80	10	20	14	10	10	-
16					1076				160	226	160	113	80	160	
17	9	86	M	White	189	51	215	Pfizer	95	40	28	40	20	10	-
18					1522				640	320	320	320	20	640	
19	10	87	F	Hispanic	195	43	259	Pfizer	135	40	20	40	20	20	-
20					1076				320	320	226	160	160	113	
21	11	67	F	Black	186	50	233	Pfizer	135	20	10	10	10	10	-
22					1522				160	160	226	80	80	160	
23	12	86	M	White	156	49	217	Pfizer	135	40	40	80	20	40	-
24					1810				640	320	320	160	320	320	
25	13	80	M	Black	184	44	240	Pfizer	160	10	10	10	10	10	-
26					1280				640	320	453	320	160	320	
27	14	72	F	White	191	52	230	Pfizer	190	20	14	10	10	10	-
28					1522				1280	320	453	320	40	453	
29	15	75	F	White	143	78	209	Pfizer	190	40	28	28	20	14	-
30					2560				905	905	1280	640	453	640	
31	16	73	M	White	163	94	192	Moderna	226	40	20	80	40	40	-
32					640				80	57	40	57	40	40	
33	17	75	M	Black	198	47	207	Pfizer	226	80	40	40	40	40	-
34					2153				453	113	57	80	57	640	
35	18	80	M	White	146	52	205	Pfizer	226	80	80	20	20	14	-
36					3620				1280	1280	1280	640	640	640	
37	19	78	M	White	196	73	214	Pfizer	320	80	40	40	40	20	-
38					761				226	80	80	80	40	320	
39	20	92	F	White	163	27	228	Pfizer	320	113	80	80	40	20	-
40					2153				160	160	160	80	113	640	
41	21	59	F	Hispanic	203	27	254	Pfizer (dose 1-3) Moderna (dose 4)	381	40	20	20	20	10	-
42					1810				640	640	1280	320	160	453	

43	22	90	M	Black	231		231	Pfizer	453	80	40	40	57	20	-
44						34				2560	453	320	320	320	160
45	23	94	F	White	110		228	Pfizer	453	40	40	40	20	40	-
46						47				1280	320	160	160	80	80
47	24	71	F	White	143		243	Moderna (dose 1-3) Pfizer (dose 4)	640	226	160	160	160	80	-
48						27				2153	905	640	640	640	320
49	25	84	F	White	235		257	Pfizer	905	160	160	160	80	80	-
50						35				20480	3620	2560	2560	1280	3620
#GMT PD3	-	-	-	-	-	-	-	-	144	32	24	25	20	17	-
†95% CI PD3									93-220	22-48	17-34	17-37	14-27	13-23	-
GMT PD4	-	-	-	-	-	-	-	-	1554	357	236	236	165	95	263
95% CI PD4									1069-2261	224-569	147-379	136-409	101-268	56-160	157-441

*Individual FFRNT₅₀ value is the geometric mean of duplicate plaque assay results.

^FFRNT₅₀ of <20 was treated as 10 for plot purposes and statistical analysis.

#Geometric mean neutralizing titers (GMT).

†95% confidence interval (95% CI) for the GMT.

Table S2. Twenty-nine human serum samples collected after 2 doses of mRNA vaccine and a subsequent Omicron BA.1 breakthrough infection, Related to Figure 2.

Sample ID	Age (year)	Gender (M/F)	Ethnicity	Vaccine type	COVID test positive days post last vaccine	Serum collection time (Post COVID test positive days)	*FFRNT ₅₀					
							USA-WA1/2020	BA.1-spike	BA.2-spike	BA.2.12.1-spike	BA.3-spike	BA.4/5-spike
1	37	F	White	Moderna	285	59	320	160	80	160	57	20
2	32	M	Hispanic	Pfizer	187	73	320	320	80	160	160	80
3	20	M	Hispanic	Moderna	401	48	640	640	320	320	320	160
4	96	F	Hispanic	Pfizer	341	50	640	640	226	320	320	113
5	87	M	White	Moderna	350	51	640	640	160	226	160	40
6	36	F	White	Pfizer	191	71	640	320	160	160	160	80
7	31	F	Black	Pfizer	124	58	905	640	320	320	320	320
8	51	F	White	Moderna	165	15	1280	1280	640	905	640	226
9	57	M	Asian	Pfizer	392	30	1280	1280	320	905	640	160
10	78	M	Black	Moderna	152	34	1280	1810	905	1280	1280	320
11	64	F	Black	Pfizer	232	35	1280	1280	640	905	640	320
12	30	M	Asian	Pfizer	214	64	1280	905	320	453	320	160
13	74	F	White	Pfizer	389	34	1810	1280	320	453	320	160
14	21	F	Hispanic	Moderna	254	49	1810	2560	1280	1280	1280	226
15	31	F	White	Pfizer	317	105	1810	1280	640	640	640	320
16	62	M	White	Pfizer	316	29	2560	1810	640	640	1280	320
17	38	F	Asian	Pfizer	98	33	2560	2560	1280	1280	1280	320
18	30	F	Hispanic	Pfizer	126	43	2560	2560	1280	1280	1280	453
19	33	F	Asian	Moderna	326	48	2560	2560	1280	1810	1280	320
20	28	M	Hispanic	Pfizer	159	60	3620	640	640	640	320	160
21	74	M	White	Pfizer	313	118	3620	1280	640	640	640	160
22	66	M	White	Pfizer	156	16	5120	3620	1280	2560	1280	640
23	59	M	White	Pfizer	239	18	5120	7241	2560	5120	5120	2560
24	18	F	Hispanic	Pfizer	309	18	5120	5120	1280	2560	1810	640
25	35	M	White	Moderna	303	63	5120	5120	2560	1280	2560	320
26	63	F	Hispanic	Pfizer	279	36	7241	5120	2560	2560	2560	1280
27	51	M	Asian	Pfizer	391	28	10240	10240	5120	10240	5120	1810
28	71	F	White	Pfizer	346	39	14482	7241	3620	5120	5120	640
29	46	F	Hispanic	Pfizer	266	29	20480	20480	10240	14482	10240	1280
#GMT	-	-	-	-	-	-	2114	1705	730	961	813	274
†95% CI	-	-	-	-	-	-	1411-3167	1112-2614	465-1145	612-1509	511-1294	182-412

*Individual FFRNT₅₀ value is the geometric mean of duplicate plaque assay results.

#Geometric mean neutralizing titers (GMT).

†95% confidence interval (95% CI) for the GMT.

Table S3. Thirty-eight human serum samples collected after 3 doses of mRNA vaccine and a subsequent Omicron BA.1 breakthrough infection, Related to Figure 2.

Sample ID	Age (year)	Gender (M/F)	Ethnicity	Vaccine type	COVID test positive days post last vaccine	Serum collection time (Post COVID test positive days)	FFRNT ₅₀						
							USA-WA1/2020	BA.1-spike	BA.2-spike	BA.2.12.1-spike	BA.3-spike	BA.4/5-spike	BA.2.75-spike
1	36	M	Hispanic	Pfizer	142	91	453	226	160	160	160	40	160
2	36	M	Hispanic	Pfizer	142	61	640	453	160	320	320	40	160
3	64	M	White	Pfizer	40	75	640	160	160	160	113	80	80
4	62	F	White	Pfizer	130	81	640	453	320	320	320	160	160
5	27	M	White	Moderna	111	134	640	320	160	320	226	80	160
6	34	F	Black	Pfizer	85	40	1280	1280	640	640	640	320	640
7	60	F	Hispanic	Pfizer	39	76	1280	640	320	320	320	80	453
8	29	F	White	Pfizer	15	91	1280	453	320	320	320	80	320
9	58	M	Asian	Pfizer	30	113	1280	1280	640	1280	640	453	640
10	39	F	Asian	Pfizer	110	23	2560	2560	1280	1280	1280	320	1280
11	72	M	White	Pfizer	28	32	2560	2560	1280	1810	1280	226	2560
12	43	F	Asian	Pfizer	89	58	2560	2560	2560	1810	1280	905	2560
13	45	F	Hispanic	Pfizer	141	46	2560	5120	1810	2560	2560	640	1810
14	51	F	Black	Pfizer	44	35	2560	2560	905	640	1280	320	1280
15	56	F	Black	Pfizer	98	93	2560	2560	640	1280	1280	226	1280
16	67	F	White	Pfizer	71	63	2560	1280	640	640	640	160	640
17	64	M	White	Pfizer	114	33	2560	2560	1280	1280	1280	320	905
18	28	F	White	Pfizer	158	61	2560	2560	1280	1280	1280	320	1810
19	64	M	Asian	Pfizer	117	73	2560	2560	1280	1280	1280	160	2560
20	63	F	White	Pfizer	174	22	2560	2560	1280	2560	905	1280	1280
21	41	F	Hispanic	Moderna (dose 1-2) & Pfizer (dose 3)	84	64	2560	1280	320	453	453	160	640
22	64	F	Asian	Pfizer	118	105	3620	2560	1280	1280	1280	320	2560
23	54	M	White	Pfizer	93	34	5120	2560	2560	2560	1810	640	2560
24	26	F	White	Moderna	63	51	5120	5120	1810	2560	2560	1280	2560
25	44	F	Hispanic	Pfizer	43	15	5120	2560	1280	1280	1280	640	1810
26	77	M	Hispanic	Pfizer	130	64	5120	5120	2560	2560	2560	1280	2560
27	69	M	White	Pfizer	124	79	5120	2560	1280	1810	1280	320	1280
28	73	F	White	Moderna	164	36	5120	3620	2560	1810	1280	226	640
29	84	F	Hispanic	Pfizer	99	46	5120	5120	1280	2560	1280	226	2560
30	61	F	White	Pfizer	169	40	5120	2560	640	1280	905	226	1280
31	58	M	Hispanic	Moderna	77	73	5120	1810	640	905	1280	320	1280
32	75	M	White	Pfizer	131	108	5120	2560	1280	1280	1280	320	1280
33	79	F	White	Pfizer	144	17	5120	2560	640	1280	905	640	1280
34	38	M	White	Pfizer	109	49	10240	5120	5120	5120	2560	1280	2560
35	71	M	White	Pfizer	129	54	10240	7241	2560	2560	2560	80	5120
36	39	F	Hispanic	Pfizer	118	126	10240	5120	2560	3620	2560	640	2560
37	68	M	White	Pfizer	125	71	10240	5120	2560	2560	2560	640	80
38	66	M	White	Pfizer	96	41	20480	20480	10240	14482	10240	1810	10240
#GMT	-	-	-	-	-	-	2962	2038	983	1190	1019	297	1019
†95% CI	-	-	-	-	-	-	2212-3967	1462-2841	712-1357	869-1630	759-1367	216-410	702-1480

*Individual FFRNT₅₀ value is the geometric mean of duplicate plaque assay results.

#Geometric mean neutralizing titers (GMT).

†95% confidence interval (95% CI) for the GMT.