

Supplementary Materials

Table S1. Rates (%) of solicited local and systemic adverse events occurred within seven days of immunization with Covid-19 vaccines of different platforms.

		Severity grading/Rates %			
		Grade 1	Grade 2	Grade 3	No event
First dose					
Pain	AstraZeneca	60.8	19.7	1.01	18.5
	Moderna	73.9	13.9	1.74	10.4
Erythema	AstraZeneca	11.6	5.22	0.34	82.8
	Moderna	23.5	1.74	0.87	73.9
Swelling	AstraZeneca	23.6	5.56	0.17	70.7
	Moderna	37.4	9.57	0	53
Fever	AstraZeneca	35.5	10.8	2.02	51.7
	Moderna	3.48	0.87	0	95.7
Headache	AstraZeneca	28.5	22.2	3.03	46.3
	Moderna	12.2	7.83	0	80
Malaise	AstraZeneca	34.3	33.5	6.57	25.6
	Moderna	32.2	6.96	1.74	59.1
Myalgia	AstraZeneca	32.3	23.7	4.04	39.9
	Moderna	15.7	1.74	0.87	81.7
Anorexia	AstraZeneca	11.1	4.04	0.34	84.5
	Moderna	6.09	0.87	0	93
Diarrhea	AstraZeneca	9.6	4.21	0.51	85.7
	Moderna	6.96	2.61	0	90.4
Second dose					
Pain	AstraZeneca	47.3	2.66	0	50
	Moderna	45	38.3	8.81	7.9
Erythema	AstraZeneca	5.85	0.27	0	93.9
	Moderna	19.5	7.9	1.82	70.8
Swelling	AstraZeneca	12.5	0.53	0	87
	Moderna	35.6	11.6	1.52	51.4
Fever	AstraZeneca	4.26	0.53	0	95.2
	Moderna	41.6	12.8	1.52	44.1
Headache	AstraZeneca	11.7	2.93	1.33	84
	Moderna	31	22.49	3.95	42.55
Malaise	AstraZeneca	26.33	4.79	1.06	67.82
	Moderna	38.3	36.17	6.99	18.54
Myalgia	AstraZeneca	14.6	2.13	0.27	83

	Moderna	30.09	26.14	6.69	37.08
Anorexia	AstraZeneca	3.99	0	0	96
	Moderna	12.2	2.13	0	85.7
Diarrhea	AstraZeneca	3.72	0.27	0	96
	Moderna	11.3	3.34	0.91	84.5
Third dose					
Pain	Medigen	60.4	5.66	0	34.0
	Moderna	62.8	21.3	1.65	14.3
	Pfizer-BioNTech	63.8	18.8	0	17.4
Erythema	Medigen	7.55	0	0	92.5
	Moderna	11.0	3.85	0.37	84.8
	Pfizer-BioNTech	10.1	2.90	0	87.0
Swelling	Medigen	18.9	0	0	81.1
	Moderna	27.3	6.78	0.55	65.4
	Pfizer-BioNTech	8.62	9.76	0	11.1
Fever	Medigen	3.77	0	0	96.2
	Moderna	15.4	2.56	0.37	81.7
	Pfizer-BioNTech	14.5	1.45	0	84.1
Headache	Medigen	5.66	0	0	94.3
	Moderna	21.1	8.61	1.47	68.9
	Pfizer-BioNTech	26.1	5.80	0	68.1
Malaise	Medigen	18.9	0	0	81.1
	Moderna	36.5	12.8	2.38	48.4
	Pfizer-BioNTech	36.2	15.9	0	47.8
Myalgia	Medigen	7.55	0	0	92.5
	Moderna	24.0	11.9	1.65	62.5
	Pfizer-BioNTech	29.0	10.1	0	60.9
Anorexia	Medigen	0	0	0	100.0
	Moderna	6.41	1.65	0.18	91.8
	Pfizer-BioNTech	8.70	1.45	0	89.9
Diarrhea	Medigen	3.77	0	0	96.2
	Moderna	5.13	1.47	0.18	93.2
	Pfizer-BioNTech	5.80	1.45	0	92.8
Fourth dose					
Pain	Medigen	44.83	3.45	0	51.72
	Novavax	64.71	0	0	35.29
	Moderna	64.85	18.79	0.61	15.76
	Moderna_BA1	66.67	21.21	0	12.12

Erythema	Pfizer-BioNTech	58.7	15.22	2.17	23.91
	Medigen	0	0	0	100
	Novavax	0	0	5.88	94.12
	Moderna	3.64	5.45	1.21	89.7
	Moderna_BA1	3.03	0	6.06	90.91
Swelling	Pfizer-BioNTech	6.52	2.17	6.52	84.78
	Medigen	3.45	0	3.45	93.1
	Novavax	5.88	0	0	94.12
	Moderna	11.52	8.48	9.09	70.91
	Moderna_BA1	6.06	0	3.03	90.91
Fever	Pfizer-BioNTech	8.7	13.04	8.7	69.57
	Medigen	0	0	0	100
	Novavax	5.88	0	0	94.12
	Moderna	8.48	1.21	0	90.3
	Moderna_BA1	6.06	0	0	93.94
Headache	Pfizer-BioNTech	10.87	2.17	0	86.96
	Medigen	6.9	3.45	0	89.66
	Novavax	11.76	5.88	5.88	76.47
	Moderna	11.52	6.06	0.61	81.82
	Moderna_BA1	18.18	12.12	0	69.7
Malaise	Pfizer-BioNTech	13.04	6.52	0	80.43
	Medigen	6.9	0	0	93.1
	Novavax	23.53	5.88	5.88	64.71
	Moderna	23.03	10.91	1.21	64.85
	Moderna_BA1	27.27	21.21	0	51.52
Myalgia	Pfizer-BioNTech	28.26	13.04	0	58.7
	Medigen	6.9	3.45	0	89.66
	Novavax	11.76	5.88	0	82.35
	Moderna	12.12	8.48	1.82	77.58
	Moderna_BA1	33.33	6.06	0	60.61
Anorexia	Pfizer-BioNTech	26.09	8.7	0	65.22
	Medigen	3.45	0	0	96.55
	Novavax	0	0	0	100
	Moderna	1.82	2.41	0	93.94
	Moderna_BA1	6.06	3.03	0	90.91
Diarrhea	Pfizer-BioNTech	4.35	0	0	95.65
	Medigen	0	0	0	100
	Novavax	0	0	0	100

Moderna	2.42	1.82	0	95.76
Moderna_BA1	6.06	0	0	93.64
Pfizer-BioNTech	10.87	0	0	89.13

Table S2. Grading of severity in subjects with adverse events post immunization.

Adverse events	Descriptions
General severity	
0	Normal
1	Mild, no interference with daily activity
2	Moderate, mild to moderate interference of daily activity, minimal medical intervention/therapy required (i.e. use of non-opioid treatment, vomitus no more than 2 times per day, diarrhea episodes no more than 3 times per day)
3	Severe, considerable interference with the daily activity; medical intervention/therapy required (i.e. use of opioid treatment, required anti-emetic agents for vomiting, diarrhea episodes more than five times per day)
4	Life-threatening; requiring hospitalization
Fever severity	
0	< 38°C
1	38 – < 39°C
2	39 – < 40°C
3	≥ 40°C
Erythema severity	
0	0 cm
1	< 5 cm
2	5 – < 10 cm
3	> 10 cm
Swelling severity	
0	0 cm
1	< 5 cm
2	5 – < 10 cm
3	> 10 cm

Table S3. List of the non-solicited adverse events (AEs) that occurred within 7 days of immunization against COVID-19. The number in the parenthesis following the AE indicates the number of subjects reporting the AE.

AstraZeneca Dose 1 (N = 594)	dizziness (16, 2.69%), chillness (13, 2.19%), rash (11, 1.85%), abdominal pain (8, 1.35%), palpitation (6, 1.01%), joint pain (6, 1.01%), itching of injection site (6, 1.01%), dyspnea (5), sore throat (5), sleepy (4), poor appetite (4), Lymphadenitis (4), sweating (4), menstrual cycle change (3), chest tightness/pain (3), ecchymosis (3), itching of trunk (3), dysgeusia (3), running nose (3), periorbital swelling (3), tinnitus (2), thirsty (1), feel pain of internal organs (1), gum swelling (1), tension at head (1), toothache (1), weakness (1), buttock pain (1), interchangeable warm and cold sensation over limbs (1), generalized sting pain (1), parotiditis (1), hypoglycemia (1), convulsion (1), hypertension (1), scar formation of injection site (1), soreness of the injected arm (1), frozen shoulder (1), shoulder pain (1), increased appetite (1), mania (1), eye pain (1), conjunctivitis (1), oral ulcer (1), hand numbness (1), face numbness (1), dysesthesia (1), dry eyes (1), epistaxis (1)
AstraZeneca Dose 2 (N = 376)	Dizziness (6, 1.60%), abdominal pain (5, 1.33%), rash (3), hypertension (3), palpitation (2), limb weakness (2), itching of injection site (2), increased appetite (2), generalized itching (2), limb soreness (1), soreness of injection site (1), frozen shoulder (1), periorbital swelling (2), dry eyes (1), sore throat (2), menstrual cycle change (1), flank pain (1), joint pain (1), migraine (1), periorbital pain (1)
Moderna Dose 1 (N = 115)	itching of injection site (23, 20.0%), lymphadenitis (9, 7.83%), dizziness (4, 3.48%), joint pain (3, 2.60%), palpitation (2, 1.74%), sore throat (2, 1.74%), abdominal pain (2, 1.74%), generalized rash (2, 1.74%), rash of injection site (2, 1.74%), dysesthesia (1), generalized itching (1), thirsty (1), toothache (1), numbness of injection site (1), running nose (1), chest tightness (1), red eyes (1), dry eyes (1), decreased visual acuity (1), menstrual cycle change (1), flank pain (1), generalized heat sensation (1), dyspnea (1), frozen shoulder (1), sneezing (1).

Moderna Dose 2 (N = 329)	Itching of injection site (17, 5.17%), dizziness (15, 4.56%), chills (11, 3.34%), palpitation (10, 3.04%), lymphadenitis (7, 2.13%), rash (7, 2.13%), joint pain (7, 2.13%), chest pain/tightness (7, 2.13%), abdominal pain/distension (3), stuffy nose (3), sore throat (3), general soreness (3), limb pain (3), generalized itching (2), dry eyes (2), sting pain (2), tinnitus (2), poor appetite (2), dyspnea (2), menstrual cycle change (2), flank pain (2), oral ulcer (1), shoulder pain (2), sweating (2), insomnia (1), ecchymosis (1), tongue numbness (1), finger numbness (1), limb numbness (1), running nose (1), urine urgency (1), ear pain (1), hypotension (1), interchangeable warm and cold sensation (1), limb weakness (1), increased appetite (1), eye pain (1)
Moderna Dose 3 (N = 546)	Lymphadenitis (20, 3.66%), chills (19, 3.48%), dizziness (10, 1.83%), palpitation (6, 1.10%), sleepy (4), rash (4), chest pain (3), limb pain (3), generalized itching (3), bone pain (2), itching of injection site (2), dry eyes (2), joint pain (2), sweating (2), ecchymosis (2), generalized soreness (1), tinnitus (1), dyspnea (1), hoarseness (1), dry mouth (1), toothache (1), weakness (1), cold sensation over limbs (1), menstrual cycle change (1), interchangeable heat and cold sensation, zoster (1), periorbital swelling (1), flank pain (1), sore throat (1), limb numbness (1), stuffy nose (1)
Moderna Dose 4 (N = 165)	Lymphadenitis (3), limb pain (1), general itching (1), bone soreness (1), urticaria (1), flank pain (1), injection site itching (1), sleepy (1), abdominal pain (1)
Pfizer-BioNTech Dose 3 (N = 69)	Lymphadenitis (5, 7.25%), itching sensation of injection site (2, 2.90%), chills (2, 2.90%), dizziness (1), palpitation (1), bone pain (1), joint pain (1), chest pain (1)
Pfizer/BioNTech Dose 4 (N = 46)	Lymphadenitis (1), limb pain (1), general itching (1), dyspnea (1), palpitation (1)
Medigen Dose 3 (N = 53)	Dizziness (1), limb pain (1), increased appetite (1)

Medigen Dose 4 (N = 29)	Bone soreness (1)
Moderna BA1 Dose 4 (N = 33)	Lymphadenitis (1), abdominal pain (1), eye pain (1)
Novavax Dose 4 (N = 17)	Toothache (1), ecchymosis (1), stuffy nose (1), acnes (1), cough (1)

Table S4. Geometric mean titers and 95% confidence limits of neutralizing antibody against SARS-CoV-2 in different occasions in individuals on different immunization schedules.

	GMT	95% CL-Lower	95% CL-Upper
Pre first vaccine dose			
AAG (n=28)	6.15	6.15	6.15
AAM(n=267)	6.15	6.15	6.15
AAB(n=53)	6.24	6.15	6.34
AMG(n=16)	6.15	6.15	6.15
AMM(n=178)	6.15	6.15	6.15
AMB(n=13)	6.38	6.03	6.76
MMG(n=9)	6.15	6.15	6.15
MMM(n=101)	6.15	6.15	6.15
Pre second vaccine dose			
AAG (n=28)	19.3	11.6	32.1
AAM(n=267)	20	16.9	23.7
AAB(n=53)	23.1	15.4	34.8
AMG(n=16)	27.5	11.7	64.5
AMM(n=178)	16.9	14	20.4
AMB(n=13)	19.3	7.92	46.9
MMG(n=9)	327.3	225.9	474.4
MMM(n=101)	231.8	190.2	282.4
30 days post second vaccine dose (			
AAG (n=28)	63.1	33.8	117.8
AAM(n=267)	55.4	46.7	65.6
AAB(n=53)	61.5	42.5	88.8
AMG(n=16)	663.6	454	969.7
AMM(n=178)	648.2	595.7	705.3
AMB(n=13)	650.4	541.9	780.8
MMG(n=9)	1379.9	676.2	2815.9
MMM(n=101)	1113.6	972.5	1275.2

Pre third vaccine dose			
AAG (n=28)	11.6	7.76	17.2
AAM(n=267)	10	9.07	11.1
AAB(n=53)	8.05	6.94	9.34
AMG(n=16)	139	93.6	206.5
AMM(n=178)	122.6	107	140.5
AMB(n=13)	169.8	131.8	218.8
MMG(n=9)	210.6	165.9	267.3
MMM(n=101)	243.4	212.5	278.8
30 days post third vaccine dose			
AAG (n=28)	302.2	239.5	381.3
AAM(n=267)	698.5	665.5	733.1
AAB(n=53)	618.9	549.6	696.9
AMG(n=16)	269	221.1	327.3
AMM(n=178)	740.4	699	784.3
AMB(n=13)	718.8	577.6	894.6
MMG(n=9)	384.8	314.3	471
MMM(n=101)	915.3	879.9	952.1
Pre fourth vaccine dose			
Medigen (n=29)	192.1	140.4	263
Novavax (n=17)	251.4	159.9	395.2
Moderna (n=165)	200.7	165.8	243
Moderna BA1 (n=33)	265.2	133.1	528.5
BioNTech (n=46)	213.9	169.4	270.1
30 days post fourth vaccine dose			
Medigen (n=29)	333.3	261.4	425
Novavax (n=17)	666.7	437.6	1015.8
Moderna (n=165)	971.8	913.5	1033.7
Moderna BA1 (n=33)	1757.9	1378.8	2241.2
BioNTech (n=46)	872.8	745.3	1022

Table S5. COVID-19 diagnosis by the review of medical records, questionnaires, and the anti-N antibody measurement.

		Medical records and questionnaire			Total
		Negative	Positive	Not available	
Anti-N antibody	Negative	198 (A)	179 (B) [#]	123 (C)	500
	Positive	21 (D)	125 (E)	6 (F)	152
	Not available	1 (G)	4 (H)	53 (I)	58
	Total	220	308	182	710

COVID-19 diagnosis = B+D+E+F+H = 335

Absence of COVID-19 = A+C+G = 322

Not available (missing data) = I = 53

[#] The negative results of anti-N in subjects with COVID-19 were due to the fact that the blood samples were collected only before and 30 days after vaccination, but not at the time of diagnosis.

Table S6. Cox regression analysis of factors associated with absence of COVID-19 in 255 healthcare workers having the fourth dose of vaccine against SARS-CoV-2.

Parameter	Parameter estimate	Standard error	Chi-square	Pr > ChiSq	Hazard ratio	95% HR confidence limits	
Dose 4 (vs. Pfizer-BioNTech)							
Medigen	-0.40093	0.49158	0.6652	0.4147	0.670	0.256	1.755
Moderna	-0.29615	0.30967	0.9146	0.3389	0.744	0.405	1.365
Moderna_BA1	-1.04188	0.52452	3.9456	0.0470	0.353	0.126	0.986
Novavax	0.18593	0.53565	0.1205	0.7285	1.204	0.421	3.441
Dose 1-3 (vs. MMM)							
AAB	-0.20979	0.48394	0.1879	0.6646	0.811	0.314	2.093
AAG	-0.66248	0.80901	0.6706	0.4129	0.516	0.106	2.517
AAM	0.01542	0.34767	0.0020	0.9646	1.016	0.514	2.007
AMB	-0.40108	0.80129	0.2505	0.6167	0.670	0.139	3.220

AMG	-0.23421	0.84366	0.0771	0.7813	0.791	0.151	4.134
AMM	-0.27814	0.37671	0.5452	0.4603	0.757	0.362	1.584
MMB	1.02329	1.13355	0.8149	0.3667	2.782	0.302	25.662
MMG	0.46577	1.13636	0.1680	0.6819	1.593	0.172	14.776
Female gender	0.14587	0.24646	0.3503	0.5540	1.157	0.714	1.876
Age, in years	0.01051	0.00986	1.1344	0.2868	1.011	0.991	1.030
