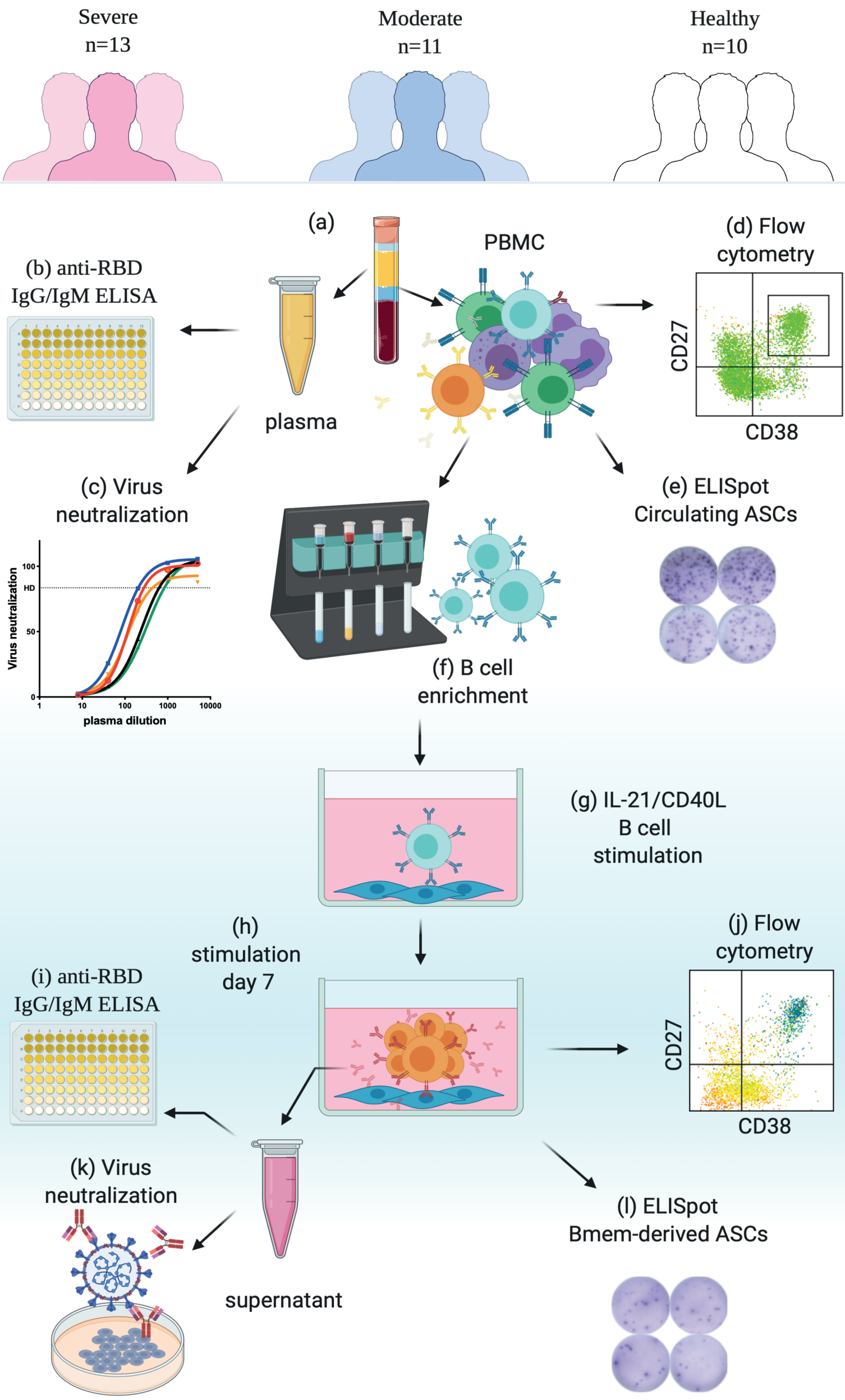
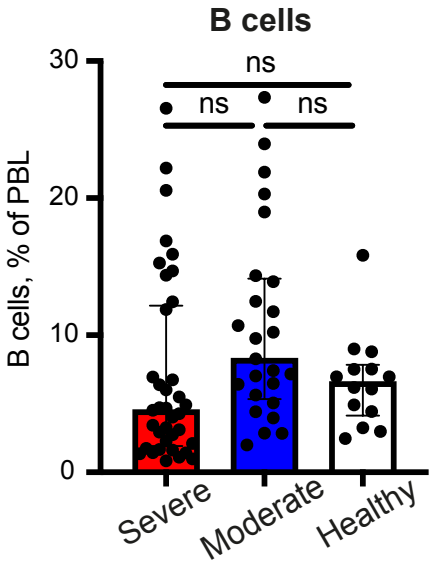
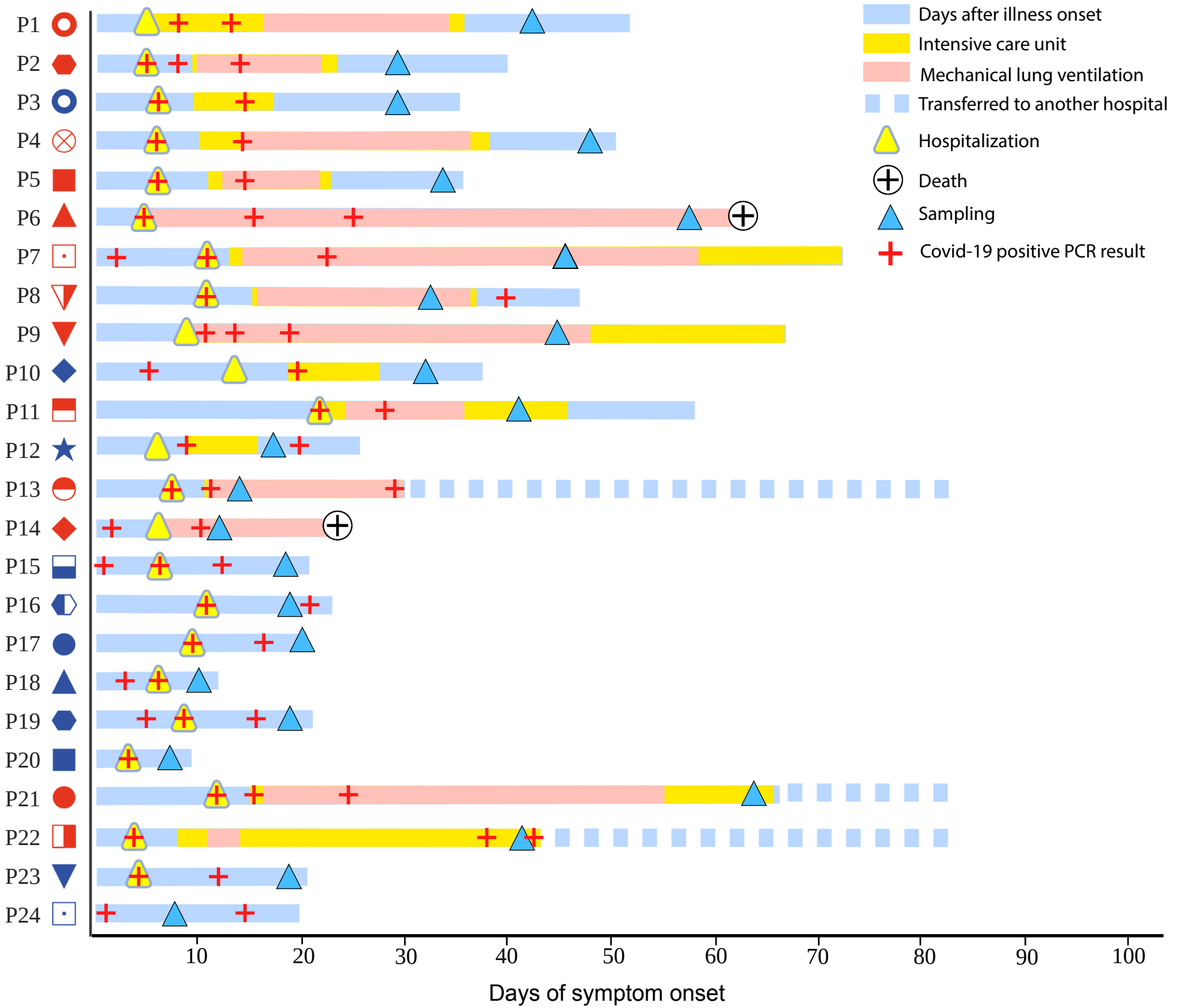


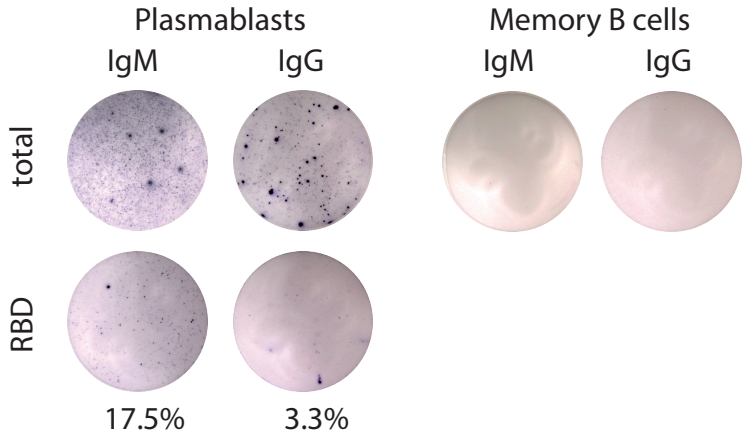
Supplementary figure 1. Study design and analysis of B cell response in patients with acute COVID-19. The cohorts of severe (n = 13) and moderate (n = 11) patients, and healthy donors (n = 10) were included in the study. (a) Blood was collected and peripheral mononuclear cells (PBMCs) were isolated by density gradient centrifugation. Plasma samples were collected and stored at −80°C. (b) The level of plasma antibodies against SARS-CoV-2 RBD was measured using ELISA. (c) Virus-neutralization activity of plasma was evaluated in pseudotyped virus neutralization assay. (d) The frequencies of total and RBD-binding plasmablasts in PBMC population were measured by ow cytometry. (e) Circulating RBD-specific antibody secreting cells were evaluated by ELISpot assay. (f) B cells were purified from PBMCs using immunomagnetic cell separation. (g) To stimulate the differentiation of Bmem cells into ASCs, purified B lymphocytes were stimulated using A549-CD40L feeder cells in the presence of 25 ng mL-1 IL-21 for 7 days. (h) After stimulation for 7 days, (i) the concentration of secreted IgM or IgG in the culture supernatants of IL-21/CD40L-stimulated B cells was quantified using ELISA. (j) The generation of total and RBD-binding plasmablasts were measured by flow cytometry. (k) The supernatants from the cultures of stimulated B cells were analyzed in a neutralization assay using HIV-1-based virions pseudotyped with spike proteins of SARS-CoV-2. (l) Bmem-derived RBD-specific antibody secreting cells were evaluated by ELISpot. Illustration was created with BioRender.



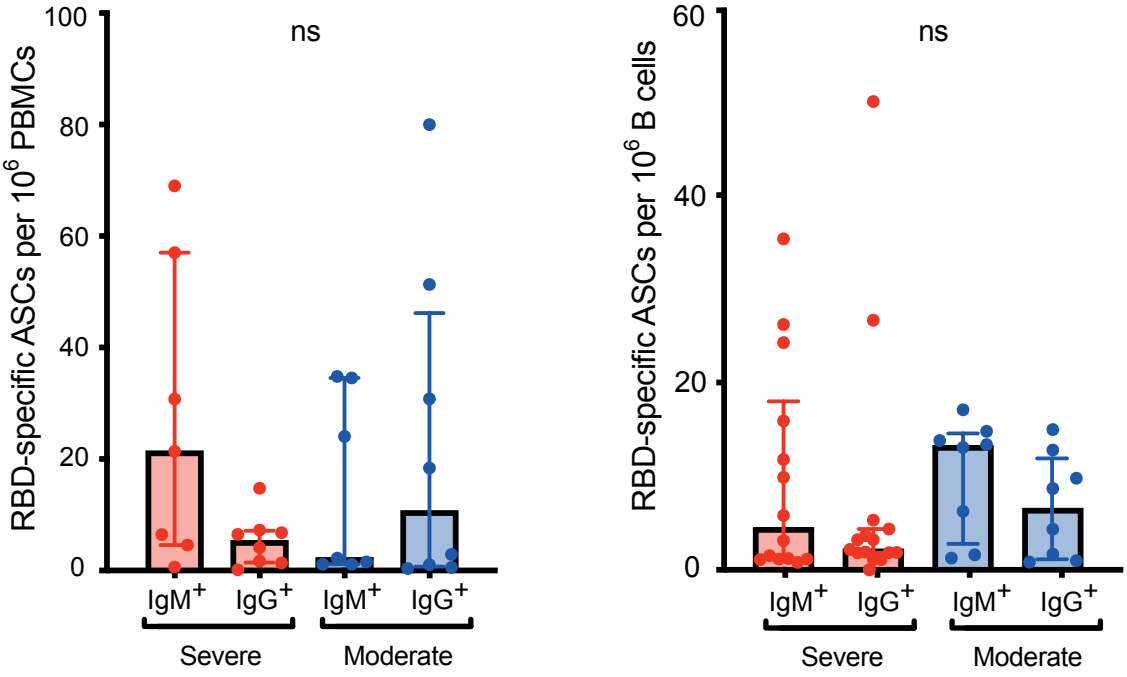
Supplementary figure 2. The frequencies of total CD19^{+} B cells did not change significantly in patients with COVID-19 compared to those of healthy donors. Results are shown for individual samples (symbols) from HDs (n = 12), moderate (n = 25), and severe (n = 38) COVID-19 cases.



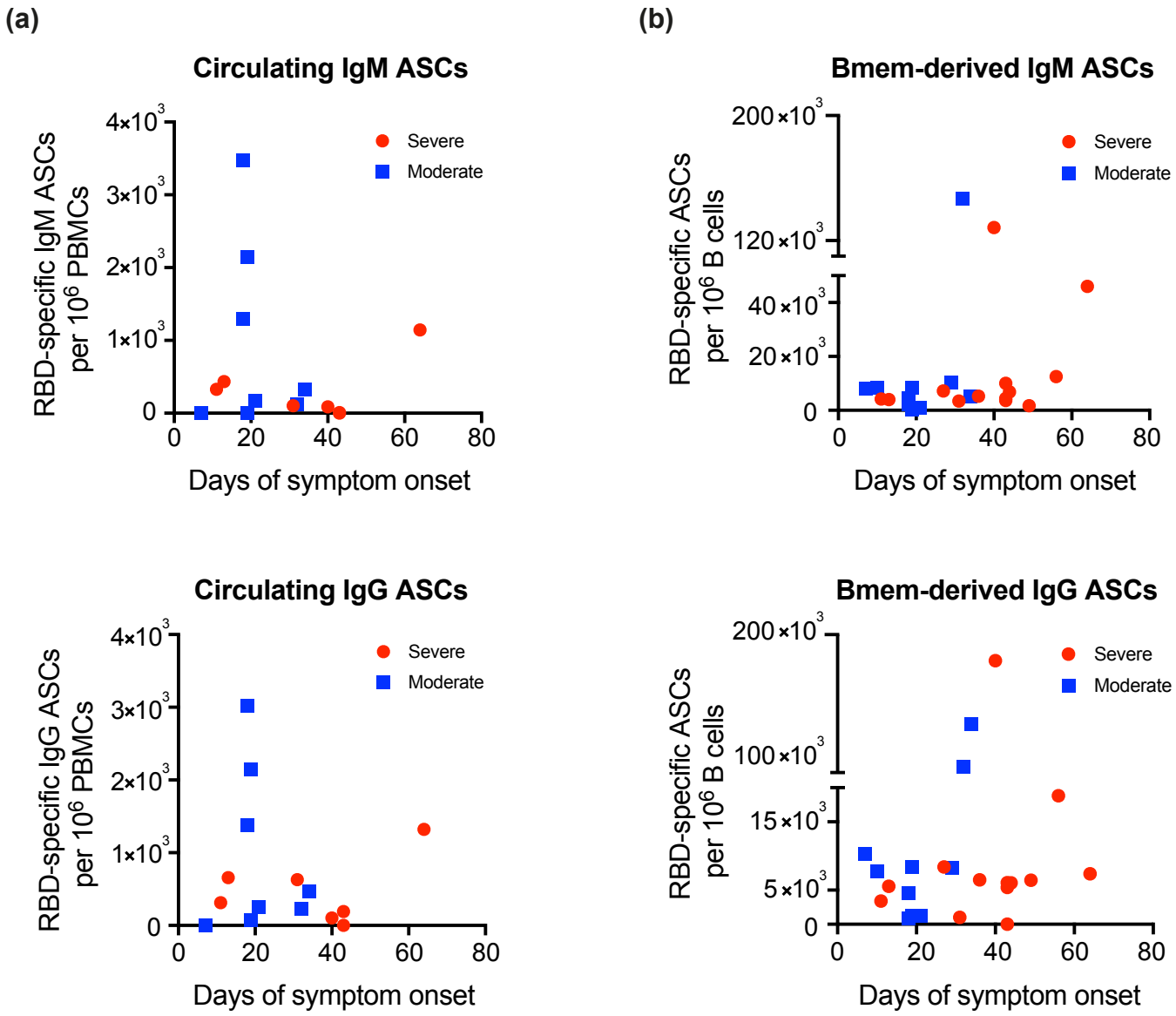
Supplementary figure 3. Swimmer plot of 24 patients with COVID-19. The study group included 11 patients with the moderate form (blue symbols) and 13 patients with the severe form (red symbols) of COVID-19. Patient numbers and corresponding symbols are indicated on the left of the Y-axis.



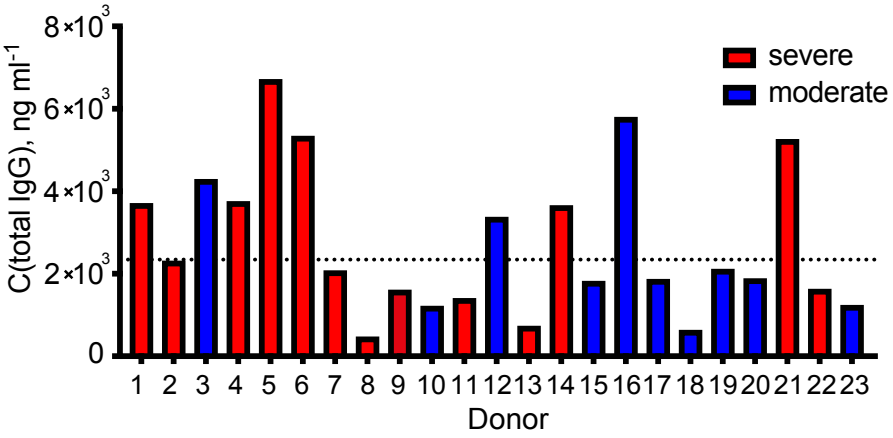
Supplementary figure 4. Preliminary experiment, which showed that spontaneous ASCs were detected in the plasmablast population, but not in the unstimulated Bmem cell population. Plasmablasts ($CD19^{+}CD27^{hi}CD38^{hi}$) (two left columns) and Bmem cells ($CD19^{+}CD27^{+}CD38^{-}$) (two right columns) were sorted separately by flow cytometry and their capacity to secrete total (top row) or RBD-specific (bottom row) IgM or IgG antibodies were determined. The percentages indicated beside the wells represent the frequencies of antigen-specific ASCs relative to the total number of IgMs or IgGs.



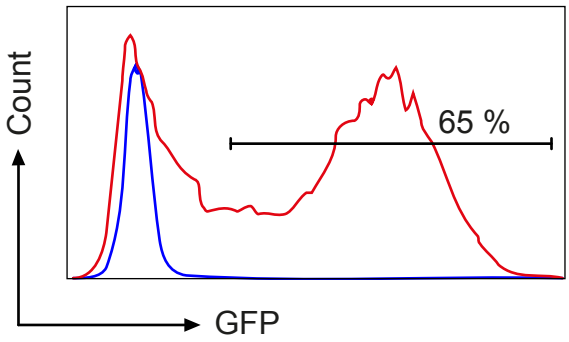
Supplementary figure 5. The percentage of total IgM or IgG-secreting cells that were RBD-specific in patients with severe and moderate COVID-19. ELISpot assay of circulating ASCs (left panel) or Bmem cell-derived ASCs (right panel).



Supplementary figure 6. Dynamic changes in RBD-specific ASCs based on the number of days after symptom onset. (a) RBD-specific circulating ASC IgMs (top panel) or IgGs (bottom panel) collected from 15 patients with COVID-19 determined using the ELISpot assay. (b) RBD-specific Bmem cell-derived ASC IgMs (top panel) or IgGs (bottom panel) collected from 23 patients with COVID-19 determined using the ELISpot assay.



Supplementary figure 7. Production of total IgGs in cultures of IL-21/CD40L-stimulated B cells obtained from different patients with COVID-19 evaluated using ELISA. Results from three independent experiments. The dotted line indicates the mean level of total IgGs observed in the HD group.



Supplementary figure 8. Infection of ACE2-expressing HEK293T cells measured with lentiviral particles (VLP) pseudotyped with protein S from SARS-Cov-2.VLP infected approximately 50% of cells based on GFP expression (red line), the human monoclonal antibody 34B12 against RBD domain at a concentration of 60 ng ml^{-1} completely blocked SARS-Cov-2 infection (blue line). Representative plot from three independent experiments.

Supplementary table 1. Participant characteristics.

	Severe patients (n = 43)	**Moderate patients** (n = 28)	**Healthy donors** (n = 14)
Age	median = 65 min = 35 max = 93	median = 58.5 min = 24 max = 84	median = 59 min = 45 max = 73
Sex			
Female	21 (48.8%)	11 (39.3%)	7 (50%)
Male	22 (51.2%)	17 (60.7%)	7 (50%)
Days since onset of symptoms to the hospitalization	median=6	median=7	0
Comorbidity			
Hypertension	27 (62.8%)	15 (53.6%)	8 (57.1%)
Diabetes	13 (30.2%)	3 (10.7%)	0
Obesity	3 (7%)	4 (14.3%)	0
Coronary artery disease/myocardial infarction	11 (25.6%)	2 (7.1%)	1 (7.1%)
Length of stay in ICU[§]	median = 29	median = 7	0
Mechanical ventilation	60.0%	0%	0%
NIV/HFNC[§§]	22.2%	0%	0%
Total duration of mechanical ventilation	median = 11 min = 2 max = 62	0	0
Hospital mortality	37.2%	0%	0%

[§] intensive care unit
[§§] non-invasive ventilation or high-flow nasal cannula oxygen therapy

Supplementary table 2. Detailed clinical characteristics of individuals with moderate and severe COVID-19.

Patient	Sex	Age	Covid-19 positive PCR result, day	CT	ALV, days	Plasma transfusion, day	Day of sampling	Neutrophils, %	Eosinphils, %	T-lymphocytes, % from PBL	Basophils,%	Lymphocytes, %	Monocytes, %	Neutrophils, cells uL^{-1}	Lymphocytes, cells uL^{-1}	Monocytes, cells uL^{-1}	Eosinphils, cells uL^{-1}	Basophils, cells uL^{-1}	C-reactive protein, ug ml^{-1}	D-dimer, ug mL^{-1}	IL-6, pg ml^{-1}	Present status
P1	F	62	9, 15	2/3	18-36	w/o plasma transfusion	44	52.90	1.85	nd	1.89	36.90	6.55	0.00	2150.00	380.00	110.00	110.00	209.20	1.02	62.40	recovered
P2	F	54	7, 9, 16	2	10-23	10, 21	28	90.30	0.04	nd	0.36	6.70	2.58	0.00	410.00	160.00	0.00	20.00	10.20	1.00	13.54	recovered
P3	F	69	7, 17	2	w/o ALV	w/o plasma transfusion	30	72.00	2.70	nd	0.10	16.50	8.20	6140.00	1410.00	700.00	230.00	10.00	40.20	0.62	nd	recovered
P4	M	56	6, 16	2/3	15-39	w/o plasma transfusion	50	70.80	5.78	62.24	1.11	13.20	9.12	7130.00	1330.00	920.00	580.00	110.00	141.60	1.20	nd	recovered
P5	M	58	7,17	3/4	13-23	12	37	76,8	1.94	43.56	0.80	15.50	4.96	5030.00	1020.00	330.00	130.00	50.00	180.40	0.90	749.70	recovered
P6	M	55	5, 15, 26	4	5-67	w/o plasma transfusion, transfusion of red cell concentrates	57	63.30	9.23	39.47	1.04	18.60	7.83	8016.00	2390.00	1010.00	1190.00	130.00	109.40	0.58	63.51	died
P7	M	65	3, 13, 23	3/4	15-62	w/o plasma transfusion, transfusion of red cell concentrates	45	81.00	2.17	66.34	0.55	11.80	4.46	8210.00	1200.00	450.00	220.00	60.00	265.30	2.17	48.54	recovered
P8	F	57	13, 44	3/4	17-38	w/o plasma transfusion	32	63.80	7.17	20.48	0.80	18.80	9.45	6310.00	1860.00	940.00	710.00	80.00	289.90	1.84	52.00	recovered
P9	F	63	9, 12, 19	3	11-51	w/o plasma transfusion, transfusion of red cell concentrates	44	66.80	6.59	15.24	1.58	18.70	6.35	3950.00	1110.00	380.00	390.00	90.00	161.70	0.38	nd	recovered
P10	F	64	6, 20	2	w/o ALV	w/o plasma transfusion	33	47.60	9.10	70.74	0.90	27.60	14.50	1570.00	910.00	480.00	300.00	30.00	15.70	1.24	123.90	recovered
P11	F	69	23, 30	4	26-38	w/o plasma transfusion, transfusion of red cell concentrates	41	69.70	7.32	65.22	0.55	17.70	4.68	5980.00	1520.00	400.00	630.00	50.00	39.70	0.89	28.87	recovered
P12	M	51	12, 24	4	w/o ALV	13, 16	19	85.00	0.12	64.61	0.80	7.80	6.31	6440.00	590.00	480.00	10.00	60.00	4.10	1.72	20.36	recovered
P13	F	82	8, 11, 31	3	11-32	12, transfusion of red cell concentrates day 25	14	85.70	0.05	38.57	0.22	8.50	5.51	5790.00	570.00	370.00	0.00	20.00	239.20	0.57	297.10	transferred to another hospital
P14	M	56	2, 11	3	6-24	6, 10 transfusion of red cell concentrates days: 15, 18, 22	12	94.50	0.16	21.22	1.20	1.90	2.30	6200.00	120.00	150.00	10.00	80.00	47.70	3.28	8166.00	died
P15	M	42	1, 7, 14	2	w/o ALV	13	19	49.90	0.80	67.66	0.50	36.10	10.70	3330.00	2400.00	710.00	50.00	30.00	5.50	0.13	12.55	recovered
P16	M	43	12, 20	2	w/o ALV	w/o plasma transfusion	20	55.70	2.34	60.94	0.92	38.40	2.69	3889.00	2670.00	190.00	160.00	60.00	10.90	0.39	nd	recovered
P17	M	59	10, 17	2	w/o ALV	12	22	66.70	2.72	53.27	0.40	17.20	13.00	8150.00	2100.00	159.00	330.00	50.00	7.10	0.33	35.16	recovered
P18	M	46	3, 7	2	w/o ALV	w/o plasma transfusion	11	56.40	2.34	60.48	0.70	33.60	6.98	2570.00	1530.00	320.00	110.00	30.00	10.10	0.29	nd	recovered
P19	F	58	6, 9, 17	2	w/o ALV	11, 12	20	74.50	0.00	44.46	0.87	17.10	7.54	5900.00	1350.00	600.00	0.00	70.00	10.50	0.67	53.45	recovered
P20	F	52	3	nd	w/o ALV	w/o plasma transfusion	8	52.70	2.34	81.08	0.61	38.40	5.96	3840.00	2790.00	430.00	170.00	50.00	0.50	nd	nd	recovered
P21	F	68	13, 16, 25	3/4	17-59	15, 48	65	83.80	0.04	15.88	0.38	11.40	4.39	10220.00	1400.00	540.00	10.00	50.00	196.40	1.59	119.70	transferred to another hospital
P22	M	65	5, 38, 44	2/3	13-15	w/o plasma transfusion	44	74.90	16.20	43.13	6.29	2.24	0.40	7670.00	1660.00	640.00	230.00	40.00	18.20	1.23	39.77	transferred to another hospital
P23	M	62	5, 13	2/3	w/o ALV	w/o plasma transfusion	35	73.50	1.08	70.97	0.92	15.70	8.80	3520.00	750.00	420.00	50.00	40.00	2.90	1.01	8.02	recovered
P24	M	40	1, 15	1/2	w/o ALV	w/o plasma transfusion	14	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	recovered