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Supplemental Information

Antigen-Specific Adaptive Immunity to SARS-CoV-2 in Acute COVID-19 and Associations with Age and Disease Severity

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Table S1. Participant characteristics, Related to Fig.1-7

	Unexposed (n = 15)	Convalescent COVID-19 (n = 15)	Acute COVID-19 (n = 24)
Age (years)	20-64 [Median = 26, IQR = 27.5]	27-68 [Median = 44, IQR = 11.5]	25-86 [Median = 55.5, IQR = 33]
Gender			
Male (%)	20% (3/15)	47% (7/15)	71% (17/24)
Female (%)	80% (12/15)	53% (8/15)	29% (7/24)
Race			
African American or Black (%)	0% (0/15)	N/A	13% (3/24)
Alaskan Native or American Indian (%)	0% (0/15)	N/A	0% (0/24)
Asian (%)	13% (2/15)	N/A	4% (1/24)
Native Hawaiian or Pacific Islander (%)	7% (1/15)	N/A	0% (0/24)
Other/Mixed Race (%)	7% (1/15)	N/A	46% (11/24)
Unknown (%)	33% (5/15)	100% (15/15)	8% (2/24)
White (%)	40% (6/15)	N/A	29% (7/24)
Ethnicity			
Hispanic (%)	20% (3/15)	N/A	29% (7/24)
Non-Hispanic (%)	60% (9/15)	N/A	58% (14/24)
Unknown (%)	20% (3/15)	100% (15/15)	13% (3/24)
Hospitalization status			
Never hospitalized (%)	100% (15/15)	100% (15/15)	8% (2/24)
Hospitalized at the time of blood collection (%)	0% (0/15)	0% (0/15)	92% (22/24)
Sample Collection Dates	September 2018-October 2019	March-May 2020	March-June 2020
SARS-CoV-2 PCR Positivity	N/A	100% (13/13); 13 tested	100% (23/23); 23 tested
Antibody Test Positivity	N/A	100% (15/15)	75% (3/4); 4 tested
Peak Disease Severity			
Healthy/No disease (0)	100% (15/15)	0% (0/15)	0% (0/24)
Mild (1-2)	N/A	73% (11/15)	8% (2/24)
Moderate (3-5)	N/A	27% (4/15)	13% (3/24)
Severe (6-7)	N/A	0% (0/15)	33% (8/24)
Critical (8-9)	N/A	0% (0/15)	38% (9/24)
Fatal (10)	N/A	0% (0/15)	8% (2/24)
Disease Severity at Time of Blood Collection			*n=30 (4 donors with 2 time points, 1 donor with 3 time points)
Healthy/No disease (0)	100% (15/15)	100% (15/15)	0% (0/30)
Mild (1-2)	N/A	0% (0/15)	7% (2/30)
Moderate (3-5)	N/A	0% (0/15)	33% (10/30)
Severe (6-7)	N/A	0% (0/15)	37% (11/30)
Critical (8-9)	N/A	0% (0/15)	23% (7/30)
Fatal (10)	N/A	0% (0/15)	0% (0/30)
Presenting Symptoms			
Cough (%)	N/A	80% (12/15)	67% (16/24)
Fatigue (%)	N/A	73% (11/15)	25% (6/24)
Fever (%)	N/A	47% (7/15)	54% (13/24)
Anosmia (%)	N/A	40% (6/15)	21% (5/24)
Dyspnea (%)	N/A	47% (7/15)	79% (19/24)
Diarrhea (%)	N/A	13% (2/15)	17% (4/24)
Days Post Symptom Onset at Collection	N/A	25-56 [Median = 34, IQR = 16]	4-37 [Median = 11, IQR = 11.5]; *n=30 (4 donors with 2 time points, 1 with 3 time points)
Past Medical History			
No known (%)	100% (15/15)	53% (8/15)	13% (3/24)
Hyperlipidemia (%)	N/A	20% (3/15)	8% (2/24)
Hypertension (%)	N/A	20% (3/15)	29% (7/24)
Coronary artery disease (%)	N/A	7% (1/15)	8% (2/24)
Diabetes (%)	N/A	7% (1/15)	17% (4/24)
Obesity (%)	N/A	7% (1/15)	17% (4/24)
Other (%)	N/A	40% (6/15)	63% (15/24)
Known or suspected sick contact/exposure (%)	0% (0/15)	87% (13/15)	67% (16/24)

Table S2. COVID-19 disease severity classifications, Related to Fig. 4-7

Disease Severity Score (0-10)	Description	Hospitalization Requirement	Supplemental Oxygen Needs for COVID-19
Healthy			
0	No known COVID-19 diagnosis or convalescent (fully recovered from COVID-19 and 3 weeks or more from initial diagnosis, without symptoms)	No	None
Mild			
1	Subclinical infection or asymptomatic (no symptoms preceding or up to time of COVID-19 diagnosis)	No	None
2	Symptoms consistent with COVID-19 without limitation of activities	No	None
Moderate			
3	Symptoms consistent with COVID-19 that limit activities and/or with home oxygen requirement (above baseline)	No	+/- home supplemental oxygen (above baseline)
4	Hospitalized for a reason other than COVID-19 but incidentally found to be positive on testing or recovered from COVID-19 to the extent that hospital care is no longer required for COVID-19 but hospitalization extended for infection-control or other reasons unrelated to COVID-19 management	Yes, but not requiring (ongoing) hospital care for COVID-19	None
5	Requiring ongoing medical care for COVID-19 other than supplemental oxygen (non-ICU level care)	Yes (non-ICU)	None
Severe			
6	Requiring ongoing medical care for COVID-19 including supplemental oxygen via nasal cannula	Yes (non-ICU)	Nasal cannula
7	Requiring ongoing medical care for COVID-19 including high-flow supplemental oxygen or non-invasive ventilation	Yes (non-ICU)	High-flow oxygen delivery device or non-invasive ventilation
Critical			
8	Requiring vasopressor support or other ICU level care for COVID-19 but not mechanical ventilation or extracorporeal membrane oxygenation (ECMO)	Yes (ICU)	+/- but not requiring mechanical ventilation or ECMO
9	Requiring ICU level care including mechanical ventilation or ECMO for management of COVID-19	Yes (ICU)	Mechanical ventilation or ECMO
Fatal			
10	Death attributable to COVID-19	+/-	+/-

Table S3. Immune cell phenotyping panel, Related to Fig. 5-7

Marker-Fluorophore	Clone	Vendor	Catalog #
Ki67-FITC	B56	BD	556026
CD4-percp efluor710	SK3	Invitrogen	46-0047-42
Gzm B- af647	GB11	Biolegend	515406
IgM- af700	MHM-88	Biolegend	314538
CD27-APCCy7	O323	Biolegend	302816
IgD- PE	IA6-2	BD	555779
CD56- PE Dazzle	HCD56	Biolegend	318348
HLA-DR	Tu39	BD	746979
CD19 PE-Cy5	H1B19	Biolegend	302210
CD38- PECy7	HIT2	Invitrogen	25-0389-42
CXCR5-bv421	J252D4	Biolegend	356920
CD14- bv510	63D3	Biolegend	367123
CD45RA- bv570	HI100	Biolegend	304132
CXCR3- bv605	G025H7	Biolegend	353728
CD20- bv650	2H7	Biolegend	302336
CCR7-bv711	G043H7	Biolegend	353228
PD-1-bv786	EH12.2H7	Biolegend	329930
CD3- buv395	UCHT1	BD	563546
Fixable live/dead Blue	N/A	Thermo Fisher	L34962
CCR6-buv496	11A9	BD	612948
CD16-buv737	3G8	BD	612786
CD8- buv805	SK1	BD	612889

Table S4. AIM Panel, Related to Fig. 2-7

Marker-Fluorophore	Clone	Vendor	Catalog #
CD69-FITC	FN50	Biologend	310904
CD4-percp efluor710	SK3	Invitrogen	46-0047-42
Ox40-APC	Ber-Act35	Biologend	350008
CD14/CD16/CD20-APCcy7	61D3/eBioCB16/2H7	Invitrogen	47-0149-42/47-0168-42/47-0209-42
PD-L1- PE	29E.2A3	Biologend	329706
CD40L	24-31	Biologend	310840
CD38- PECy7	HIT2	Invitrogen	25-0389-42
CXCR5-bv421	J252D4	Biologend	356920
CD25-bv510	BC96	Biologend	302640
CD45RA- bv570	HI100	Biologend	304132
CXCR3- bv605	G025H7	Biologend	353728
CCR7-bv711	G043H7	Biologend	353228
PD-1-bv786	EH12.2H7	Biologend	329930
CD3- buv395	UCHT1	BD	563546
Fixable live/dead Blue	N/A	Thermo Fisher	L34962
CCR6-buv496	11A9	BD	612948
ICOS-buv563	DX29	BD	741421

Table S5. ICS panel, Related to Fig. 2,3,5,6,7

Marker-Fluorophore	Clone	Vendor	Catalog #
IL13-FITC	85BRD	Invitrogen	11-7136-42
CD4-percp efluor710	SK3	Invitrogen	46-0047-42
GzmB-alexa-fluor 647	GB11	Biologend	515406
IL2- alexa-fluor 700	MQ1-17H12	Biologend	500320
CD14/CD16/CD20-APCcy7	61D3/eBioCB16/2H7	Invitrogen	47-0149-42/47-0168-42/47-0209-42
CD40L - PE	24-31	Biologend	310806
IL10-PE-Dazzle	JES3-19F1	Biologend	506812
TNFa- PE-Cy7	Mab11	Invitrogen	25-7349-82
CXCR5-bv421	J252D4	Biologend	356920
CD45RA- bv570	HI100	Biologend	304132
CXCR3- bv605	G025H7	Biologend	353728
CCR7-bv711	G043H7	Biologend	353228
IL17a-bv786	BL168	Biologend	512338
CD3- buv395	UCHT1	BD	563546
Fixable live/dead Blue	N/A	Thermo Fisher	L34962
IFNg- buv737	4S.D3	BD	612845
CD8-buv805	SK1	BD	612889