

		PCS⁺ (n=16)	PCS⁻ (n=16)	CTRL (n=10)
symptoms during acute phase (T0)	median age (IQR), years	50 (47-52)	46 (44-49)	43 (25-57)
	<50 years, n (%)	10 (62.5%)	14 (87.5%)	6 (60%)
	>50 years, n (%)	6 (37.5%)	5 (31.3%)	4 (40%)
	sex, n (%)			
	male	8 (50%)	8 (50%)	5 (50%)
	female	8 (50%)	8 (50%)	5 (50%)
	WHO progression scale, n (%)			
	I - II (ambulatory mild disease, independent)	16 (100%)	16 (100%)	n.a.
	III (ambulatory mild disease, assistance needed)	0	0	n.a.
	IV-X (hospitalised: moderate or severe disease)	0	0	n.a.
	oxygen support	0	0	n.a.
	COVID-19 vaccination	0	0	0
	pre-existing conditions, n (%)	5 (31.25%)	3 (18.75 %)	0 (0 %)
	hypertension	2 (12.5%)	1 (6.25%)	0 (0 %)
	diabetes	1 (6.25%)	0 (0 %)	0 (0 %)
	chronic lung disease	1 (6.25%)	0 (0 %)	0 (0 %)
	autoimmune disease	2 (12.5%)	0 (0 %)	0 (0 %)
	malignancies	0 (0%)	0 (0 %)	0 (0 %)
	congenital heart defects	0 (0 %)	2 (12.5%)	0
	PCS defining symptoms, n (%)	15 (93.75%)	10 (62.5%)	n.a.
symptoms at 2 nd visit (median 7 months after initial symptoms)	anosmia	15 (93.75%)	9 (56.25%)	n.a.
	ageusia	13 (81.25%)	9 (56.25%)	n.a.
	fatigue	0 (0 %)	0 (0 %)	n.a.
	dyspnea	0 (0 %)	0 (0 %)	n.a.
	concomitant symptoms, n (%)	15 (93.75%)	16 (100%)	n.a.
	median (IQR)	3 (2-4)	3 (2-4)	n.a.
	cough	12 (75%)	12 (75%)	n.a.
	rhinitis	8 (50%)	7 (43,75%)	n.a.
	headache	6 (37,5%)	8 (50%)	n.a.
	muscle pain	10 (62,5%)	10 (62,5%)	n.a.
	concentration disorder	0 (0%)	0 (0%)	n.a.
	fever	1 (6,25%)	8 (50%)	n.a.
	no symptoms	0	0	n.a.
	PCS defining symptoms T2, n (%)	16 (100%)	0	n.a.
	anosmia	13 (81.25%)	0	n.a.
	ageusia	11 (68.25%)	0	n.a.
	fatigue	6 (37.5%)	0	n.a.
	dyspnea	5 (31.25%)	0	n.a.
	concomitant symptoms T2, n (%)	6 (37.5%)	0	n.a.
	median (IQR)	0 (0-4)	0 (0)	n.a.
	cough	2 (12.5%)	0	n.a.
	rhinitis	0	0	n.a.
	headache	2 (12.5%)	0	n.a.
	muscle pain	2 (12.5%)	0	n.a.
	concentration disorder	4 (25%)	0	n.a.
	fever	0	0	n.a.
	no symptoms	0	16 (100%)	n.a.

Supplementary table 1. Patient characteristics. COVID-19, coronavirus disease 19; WHO, world health organisation; PCS, post-COVID syndrome; PCS+, patients with PCS; PCS-, patients without PCS; CTRL, unvaccinated controls; CTRL_{vac}, vaccinated controls; T0, symptom onset; T1, first visit; T2, second visit; IQR, interquartile range; n.a., not

variable	parametric distribution (SWT/KST)?	ANOVA/ KWT	PCS ⁺ T1 vs. CTRL	PCS ⁺ T2 vs. CTRL	PCS ⁺ T1 vs. CTRL	PCS ⁺ T2 vs. CTRL	PCS ⁺ T1 vs. PCS ⁺ T1	PCS ⁺ T2 vs. PCS ⁺ T2
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percentage distribution (%)

T _{CD4}	yes	.0002	.0071	.0620	.7920	.9996	.0180	.0263
T _M	yes	.9412	.9996	.9996	.9996	.9996	.9996	.9998
T _N	yes	.0160	.0207	.1670	.2338	.7145	.6632	.5378
T _{CM}	no	.0002	.0023	< .0001	.0796	.0002	> .9999	.9999
T _{EM}	no	.6143	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
T _{TM}	no	< .0001	< .0001	< .0001	.0247	.0290	.9426	.3423
TR1	yes	< .0001	< .0001	.0003	.0072	.0726	.7175	.8203
pDC	no	.3190	> .9999	> .9999	.6757	.6812	> .9999	> .9999
CD4 _{SARS} IFN γ	no	< .0001	.0486	.0185	.9999	.9999	.3774	< .0001
CD4 _{SARS} TNF	no	< .0001	< .0001	.0008	> .9999	> .9999	.0058	.0006
CD4 _{SARS} CD40L	no	< .0001	.0002	.0005	> .9999	> .9999	.0085	< .0001
CD8 _{SARS} IFN γ	no	.0001	.0040	.1845	.8362	> .9999	.5381	.0408
CD8 _{SARS} TNF	no	< .0001	.0005	< .0001	> .9999	> .9999	.0630	.0008
CD8 _{SARS} CD40L	no	< .0001	.0331	.0002	.1686	> .9999	> .9999	.0009

expression of (gMFI)

PD-1 on T _{CM}	no	.0002	.0010	< .0001	.0042	.0089	.9999	.99999
PD-1 on T _{EM}	yes	.0025	.0211	.0010	.0433	.0183	> .9999	> .9999
PD-1 on T _{TM}	yes	.0007	.0061	.0004	.0114	.0036	> .9999	> .9999
CXCR3 on T _{CM}	no	.0065	.0104	.0074	.0364	.0359	> .9999	> .9999
CXCR3 on T _{EM}	no	.0114	.0256	.0084	.3810	.2506	> .9999	> .9999
CXCR3 on T _{TM}	no	.0023	.0047	.0032	.0127	.0106	> .9999	> .9999
PD-1 on TR1	no	.0010	.0050	.0007	.0206	.0038	> .9999	> .9999
HLA-DR on pDC	no	.0008	.0379	.0415	> .9999	> .9999	.05	.0651

levels (pg/ml)

APRIL	yes	.0015	.0222	.0032	.0032	.0023	.9998	> .9999
BAFF	yes	.0163	.0211	.1935	.2975	.9810	.9365	.7305
CCL11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CCL20	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CCL3	no	.0172	.0265	.0187	.3638	.6125	> .9999	> .9999
CCL4	no	.0022	> .9999	.0160	.4600	.1239	.6328	> .9999
CD40L	yes	< .0001	< .0001	< .0001	< .0001	< .0001	.9986	> .9999
CRP	yes	.0005	> .9999	> .9999	.1148	.0712	.0210	.0231
CXCL13	yes	.6599	> .9999	.9990	.8657	.9714	.9616	> .9999
CXCL9	no	.0748	> .9999	.1937	> .9999	> .9999	> .9999	.2419
FasL	yes	.6227	.9872	.9872	.9700	.9766	.8516	.9872
FGF acidic	no	.0891	> .9999	> .9999	> .9999	.7314	.5808	> .9999
G-CSF	no	.3565	> .9999	.4169	> .9999	> .9999	> .9999	> .9999
GM-CSF	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IFN α	no	.0003	.0003	.0009	.0027	.0061	.9980	.9992
IFN β	no	.1050	> .9999	> .9999	> .9999	> .9999	.4225	.6974
IFN γ	no	.0875	> .9999	.2427	> .9999	.7269	> .9999	> .9999
IL-10	no	.0396	> .9999	> .9999	> .9999	.3707	.8635	.1840
IL-12 p70	no	.0006	.0070	.0564	> .9999	> .9999	.0070	.0564
IL-16	no	.0050	> .9999	.0199	.0767	.0979	.4274	> .9999
IL-17A	no	.4441	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
IL-17C	no	.0031	.0268	.00570	> .9999	> .9999	.3247	.1376
IL-1a	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-1b	no	.0413	> .9999	> .9999	> .9999	> .9999	.1808	> .9999
IL-1ra	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-2	no	.0052	.9603	> .9999	> .9999	> .9999	.5740	> .9999
IL-3	no	.0655	> .9999	.1142	.1004	.3804	> .9999	> .9999
IL-36b	no	.1038	> .9999	> .9999	.8996	.3183	> .9999	> .9999
IL-4	no	< .0001	.1575	< .0001	.0589	.1688	> .9999	.0297
IL-5	no	.7876	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
IL-6	no	.1825	> .9999	.8245	.9919	.3217	> .9999	> .9999
IL-8	no	< .0001	.2871	< .0001	.0635	.0002	> .9999	> .9999
TNF	no	.0623	.6437	> .9999	> .9999	.1804	> .9999	> .9999
VEGF	no	.0441	.7472	.0289	.5589	.1231	> .9999	> .9999
beta-NGF	no	.1332	> .9999	> .9999	> .9999	> .9999	> .9999	.3567
CCL2	no	.0004	.0987	.0001	.0665	.0188	> .9999	> .9999
CCL5	no	.7390	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
CXCL1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CXCL10	no	.9739	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
Granzyme A	no	.0053	.0018	.2741	.0427	.1818	> .9999	> .9999
HGF	no	.0003	.5872	.0023	.0228	.0006	> .9999	> .9999
IL-12	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-13	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-17E	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-18	yes	.0292	.0554	.2078	.7139	.8113	.3084	.4913
IL-1b	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-33	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-7	yes	.0185	.1141	.0107	.6467	.3180	.9738	.7897
LIF	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
LT-alpha	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M-CSF	no	.0130	.0936	> .9999	> .9999	> .9999	> .9999	> .9999
MIF	no	.0002	.3099	> .9999	.6165	> .9999	> .9999	> .9999
Procalcitonin	no	.7391	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
S100A9	no	.0003	.0100	.0005	.0002	.0009	> .9999	> .9999
SCF	no	.1160	> .9999	> .9999	> .9999	> .9999	> .9999	> .9999
SCGF	no	.0168	> .9999	> .9999	.3616	.3105	.5188	.1175
TGF-alpha	no	.0020	.8814	.0051	.5284	.0054	> .9999	> .9999
TRAIL	yes	.0017	.0207	.0010	.5168	.1358	.7402	.5285
CCL7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
IL-34	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
LIGHT	no	< .0001	.2359	< .0001	.0003	< .0001	.3192	> .9999

Supplementary table 2. Detailed statistical analysis. Normality was assessed by Shapiro-Wilk (SWT) or Kolmogorov-Smirnov test (KST), respectively. If parametrically distributed, analysis of variance (ANOVA) was performed. If non-parametrically distributed, Kruskal-Wallis test (KWT) was performed. p < 0.05 shows statistical significance: * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001, **** p ≤ 0.0001, and n.a., not applicable.

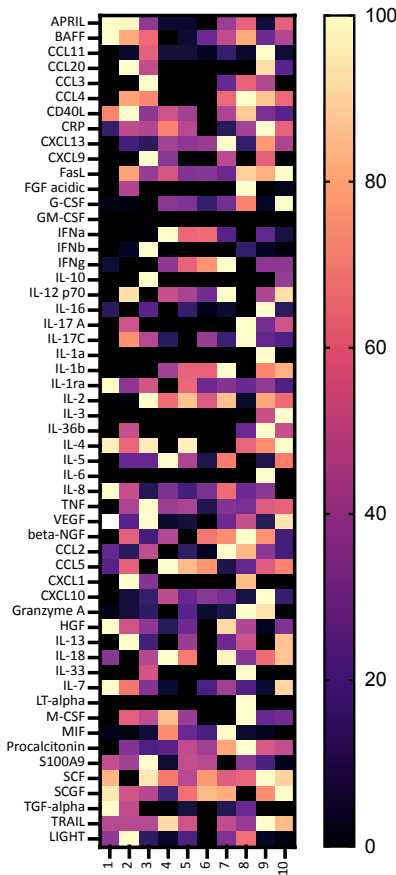
SARS-CoV-2, severe acute respiratory syndrome coronavirus type 2; PCS, post-COVID syndrome; PCS+, patients with PCS; PCS-, patients without PCS; CTRL, unvaccinated controls; T1, first visit; T2, second visit; gMFI, geometric mean fluorescence intensity; n.a., not applicable; T_{CD4}, CD4+ T-cells; T_N, antigen-naïve T-cells; T_M, memory T-cells; T_{CM}, central memory T-cells; T_{EM}, effector memory T-cells; T_{TM}, transitional memory T-cells; pDC, plasmacytoid dendritic cells; TR1, type 1 regulatory T-cells; CD4_{SARS}, CD4 positive SARS-CoV-2-reactive T-cells; CD8_{SARS}, CD8 positive SARS-CoV-2-reactive T-cells; IFN γ , interferon-gamma; TNF, tumor necrosis factor alpha; CD40L, CD40 ligand; PD-1, programmed cell death protein 1; CXCR3, chemokine receptor 3; HLA-DR, human leukocyte antigen DR; APRIL, a proliferation-inducing ligand; BAFF, B-cell activating factor; CCL, chemokine ligand; CRP, C reactive protein; CXCL, chemokine ligand; FasL, Fas ligand; FGF acidic, fibroblast growth factor acidic; G-CSF, granulocyte colony-stimulating factor; GM-CSF, granulocyte/macrophage colony-stimulating factor; M-CSF, macrophage colony-stimulating factor; IFN, interferon; IL, interleukin; TNF, tumor necrosis factor; VEGF, vascular endothelial growth factor; beta-NGF, beta nerve growth factor; HGF, hepatocyte growth factor; LIF, leukemia inhibitory factor; LT-alpha, lymphotoxin-alpha; MIF, macrophage migration inhibitory factor; S100A9, S100 calcium-binding protein; SCF, stem cell factor; SCGF, stem cell growth factor; TGF-alpha, transforming growth factor-alpha; TRAIL, TNF-related apoptosis-inducing ligand; LIGHT, lymphotoxin-like inducible protein that competes with glycoprotein D for herpesvirus entry on T-cells.

A Detailed statistical analysis of 61 cytokines or chemokines, respectively

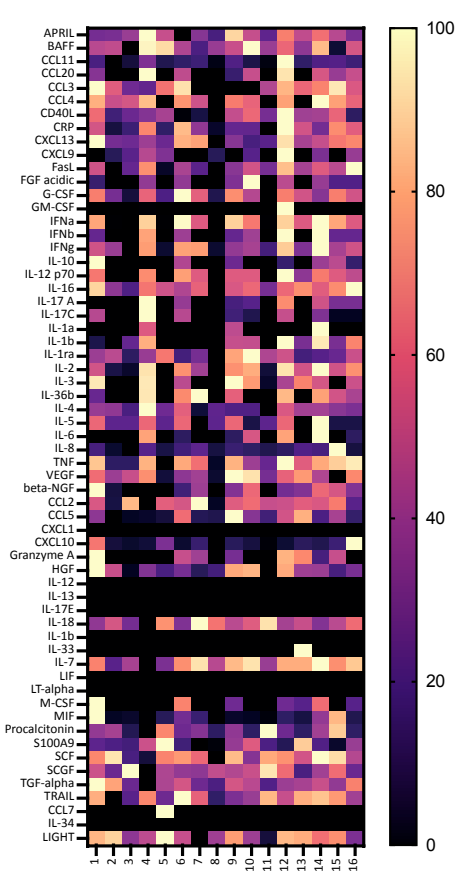
cytokine or chemokine	parametric?	1st ANOVA/ KWT	2nd post hoc: significant increase PCS ⁺ vs. PCS ⁻	cytokine or chemokine	parametric?	1st ANOVA/ KWT	2nd post hoc: significant increase PCS ⁺ vs. PCS ⁻
APRIL	yes	.0015	no	IL-8	no	<.0001	no
BAFF	yes	.0163	no	TNF	no	.0623	no
CCL11	n.a.	n.a.	no	VEGF	no	.0441	no
CCL20	n.a.	n.a.	no	beta-NGF	no	.1332	no
CCL3	no	.0172	no	CCL2	no	.0004	no
CCL4	no	.0022	no	CCL5	no	.7390	no
CD40L	yes	<.0001	no	CXCL11	n.a.	n.a.	n.a.
CRP	yes	.0005	no	CXCL10	no	.9739	no
CXCL13	yes	.6599	no	Granzyme A	no	.0053	no
CXCL9	no	.0748	no	HGF	no	.0003	no
FasL	yes	.6227	no	IL-12	n.a.	n.a.	n.a.
FGF acidic	no	.0891	no	IL-13	n.a.	n.a.	n.a.
G-CSF	no	.3565	no	IL-17E	n.a.	n.a.	n.a.
GM-CSF	n.a.	n.a.	n.a.	IL-18	yes	.0292	no
IFN α	no	.0003	no	IL-1b	n.a.	n.a.	n.a.
IFN β	no	.1050	no	IL-33	n.a.	n.a.	n.a.
IFN γ	no	.0875	no	IL-7	yes	.0185	no
IL-10	no	.0396	no	LIF	n.a.	n.a.	n.a.
IL-12 p70	no	.0006	no	LT-alpha	n.a.	n.a.	n.a.
IL-16	no	.0050	no	M-CSF	no	.0130	no
IL-17A	no	.4441	no	MIF	no	.0002	no
IL-17C	no	.0031	no	Procalcitonin	no	.7391	no
IL-1a	n.a.	n.a.	n.a.	S100A9	no	.0003	no
IL-1b	no	.0413	no	SCF	no	.1160	no
IL-1ra	n.a.	n.a.	n.a.	SCGF	no	.0168	no
IL-2	no	.0052	no	TGF-alpha	no	.0020	no
IL-3	no	.0655	no	TRAIL	yes	.0017	no
IL-36b	no	.1038	no	CCL7	n.a.	n.a.	n.a.
IL-4	no	<.0001	yes	IL-34	n.a.	n.a.	n.a.
IL-5	no	.7876	no	LIGHT	no	<.0001	no
IL-6	no	.1825	no				

PCS⁺, patients with Post-COVID syndrome (PCS); PCS⁻, patients without PCS; ANOVA, analysis of variance; KWT, Kruskal-Wallis test; 1st, first analysis; 2nd, second analysis; n.a., not applicable. p < 0.05 shows statistical significance.

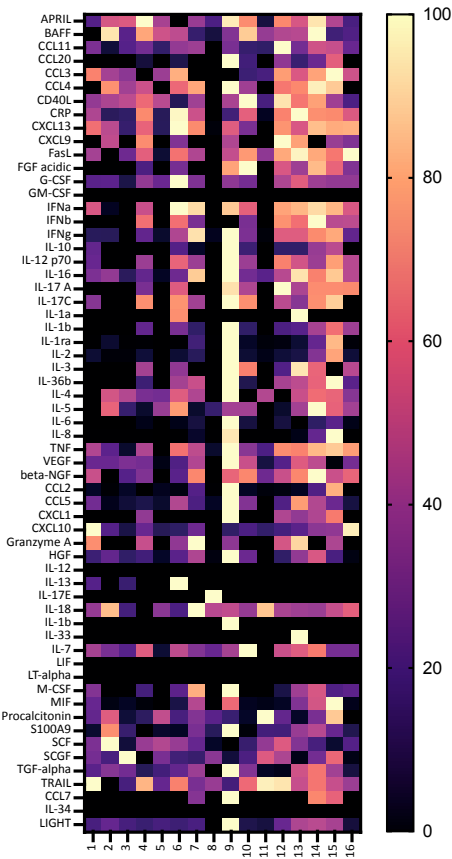
B CTRL



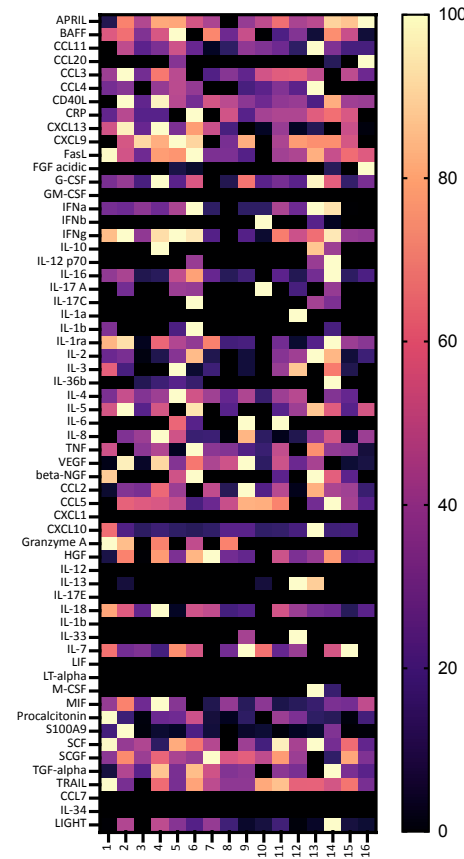
C PCS⁻ T1



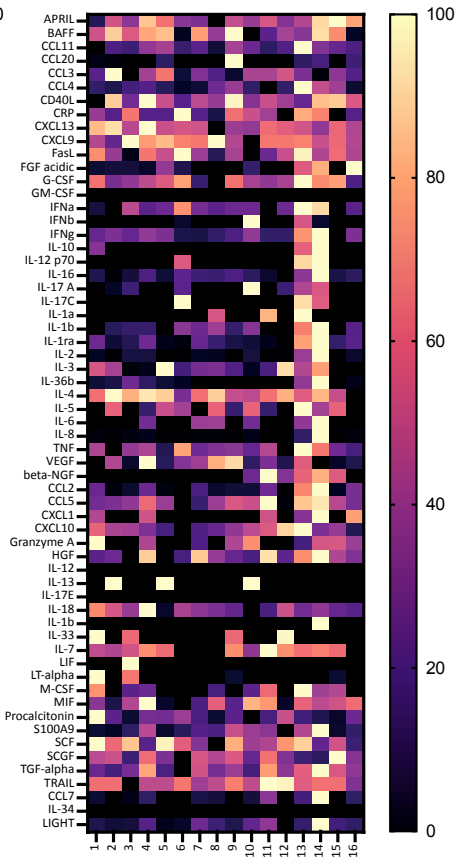
D PCS⁻ T2



E PCS⁺ T1



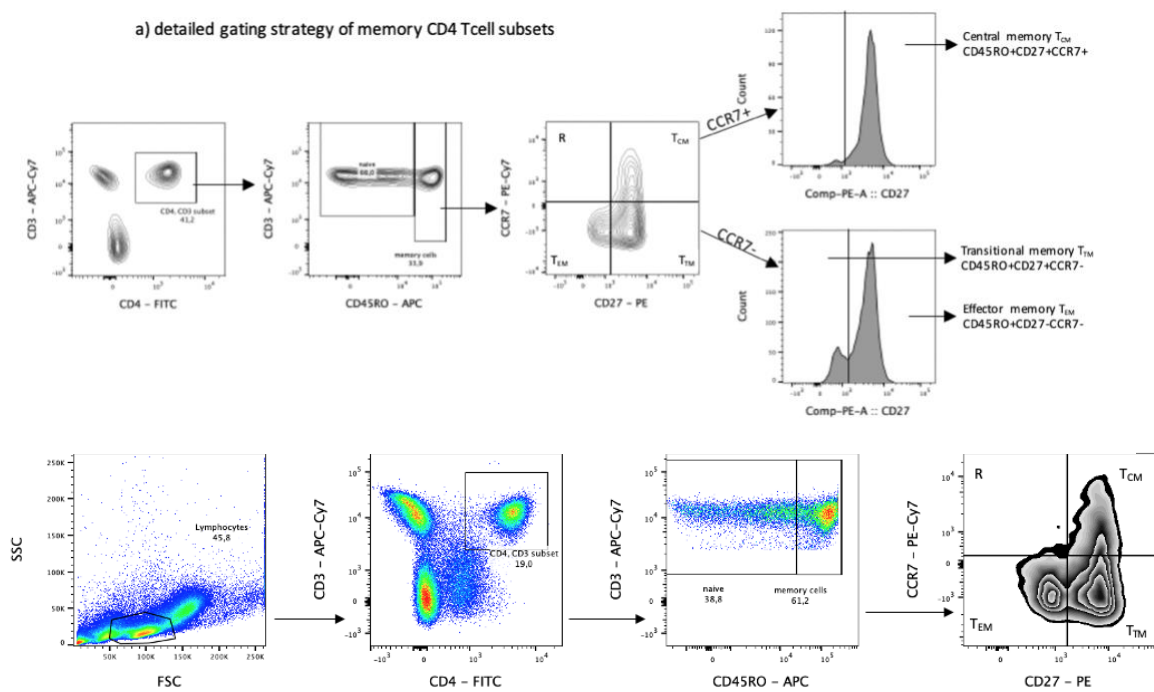
F PCS⁺ T2



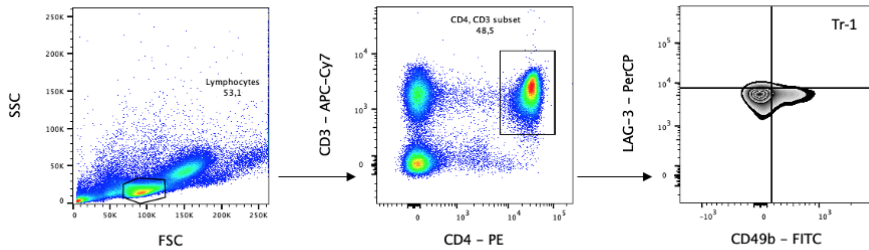
Supplementary Figure 1 Multiplex Luminex cytokine analysis.

A Detailed statistical analysis of 61 cytokines or chemokines, respectively. **B-F** Heatmap of individual normalized cytokine ratios (%) in CTRL, PCS⁻ and PCS⁺ at T1 and T2, respectively.

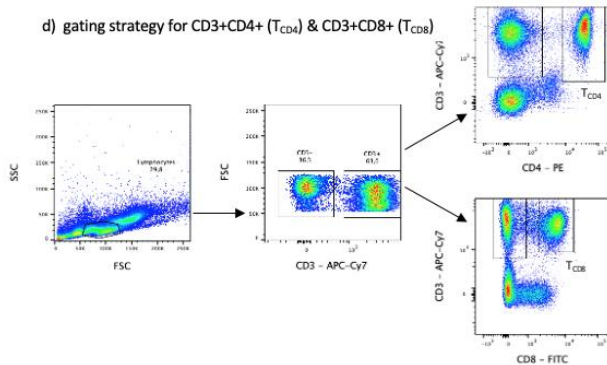
a) detailed gating strategy of memory CD4 Tcell subsets



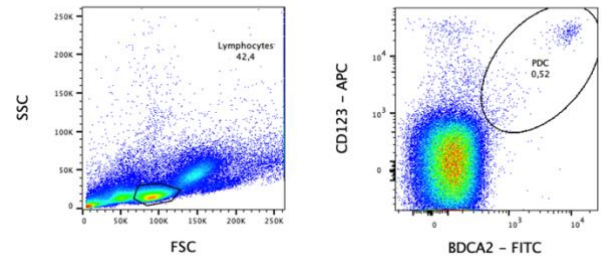
c) gating strategy for CD49b+LAG3+ Tr-1 cells



d) gating strategy for CD3+CD4+ (T_{CD4}) & CD3+CD8+ (T_{CD8})

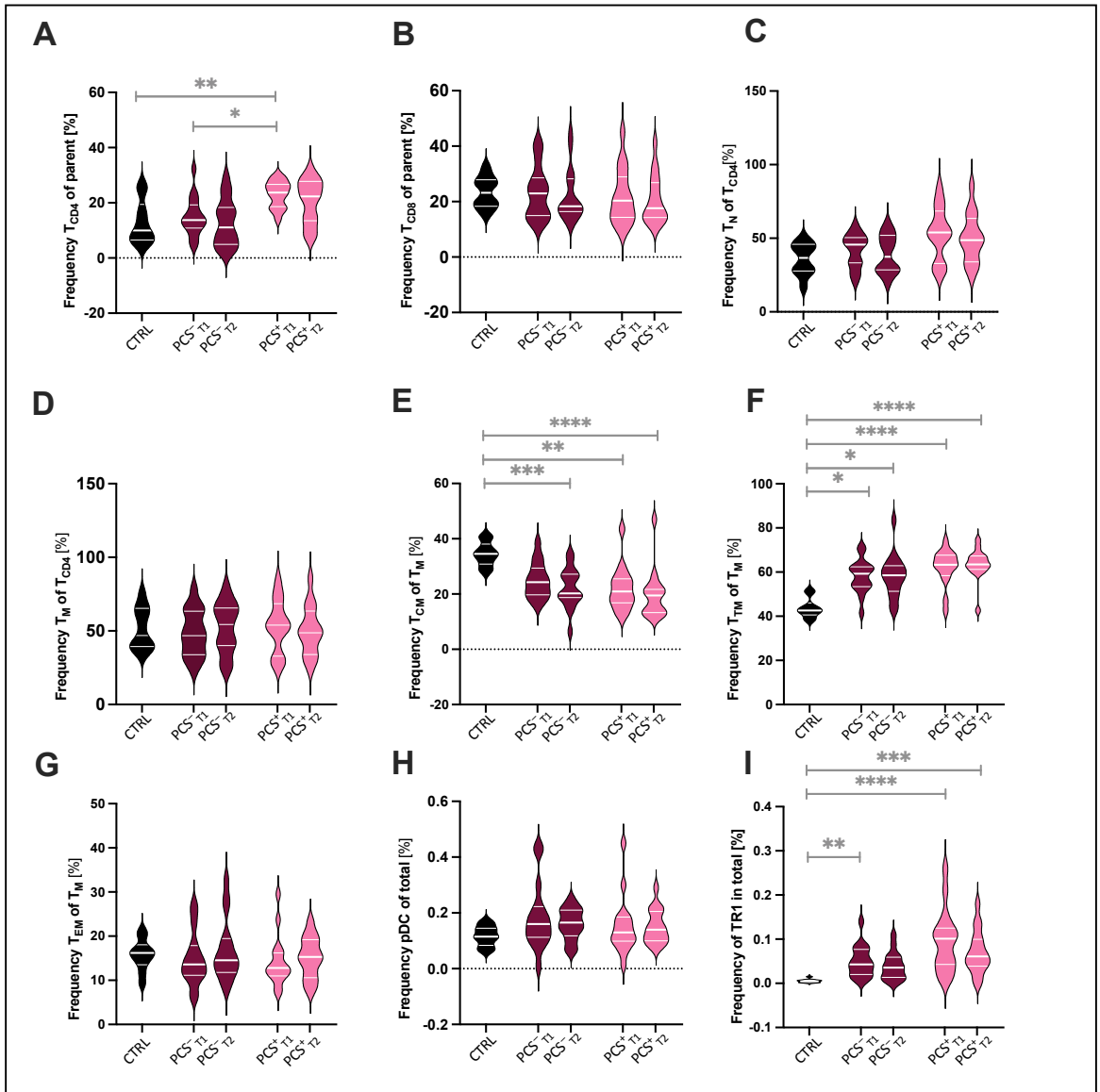


e) gating strategy for BDCA2+CD123+ plasmacytoid dendritic cells (pDC)



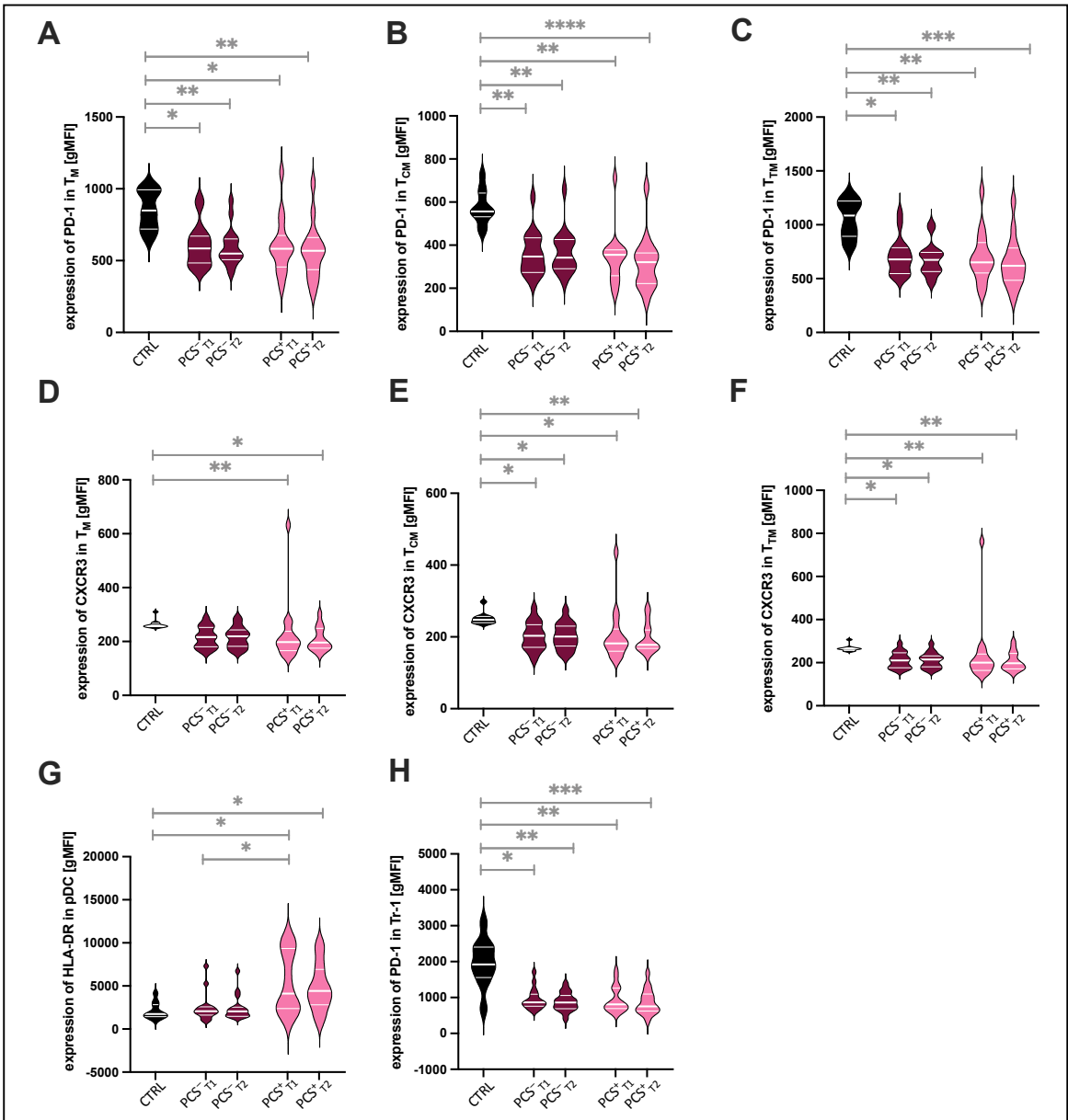
antigen	fluorochrome	clone	isotype	dilution	manufacturer
CD3	APC-H7	SK 7	mouse	1:40	BD
CD4	FITC	RPA-T4	mouse	1:40	BD
CD4	PE	M-T 466	mouse	1:20	Miltenyi Biotec
CD45RO	APC	REA 61 I	human	1:50	Miltenyi Biotec
CCR7	PE-CY7	3D12	rat	1:80	BD
CD27	PE	M-T 27 I	mouse	1:40	BD
PD-1	BV 421	EH12.2H7	mouse	1:20	Biolegend
CD49b	FITC	AK-7	mouse	1:20	BD
LAG-3	PerCP	C9B7W	goat	1:10	RD
CD8	FITC	REA 734	human	1:10	Miltenyi Biotec
CD38	PE-Vio770	IB6	mouse	1:50	Miltenyi Biotec
CD32	APC	FUN-2	mouse	1:10	Sony
HLA-DR	PerCP	AC 122	mouse	1:20	Miltenyi Biotec
BDAC-1	PE	AD5-8E7	mouse	1:50	Miltenyi Biotec
BDAC-2	FITC	AC 144	mouse	1:20	Miltenyi Biotec
CD123	APC	AC 145	mouse	1:20	Miltenyi Biotec
CD11c	PE-Vio770	BEA 618	human	1:50	Miltenyi Biotec

Supplementary figure 2. Flow cytometric gating strategy and detailed information on the antibodies and dilutions used.



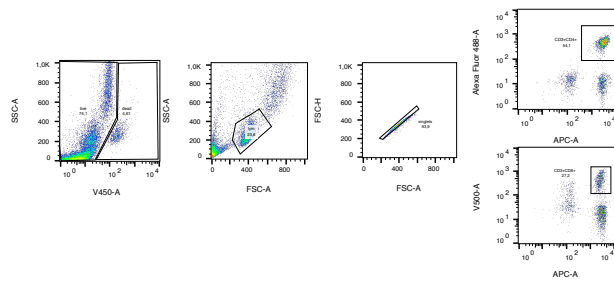
Supplementary figure 3. Distinct cell frequencies by cohort. Frequencies [%] of **A** CD4 positive T-cells (T_{CD4}) of parent **B** CD8 positive T-cells (T_{CD8}) of parent **C** antigen-naïve T-cells (T_N) **D** memory T-cells (T_M) of total [%] **E** central memory T-cells (T_{CM}) of T_M **F** transitional memory T-cells (T_{TM}) of T_M **G** effector memory T-cells (T_{EM}) of T_M **H** plasmacytoid dendritic cells (pDC) of total **I** type 1 regulatory T-cells (TR1) of total.

Data information: For statistical analysis, Kruskal-Wallis tests with Dunn's multiple comparisons were used. Here, individual Dunn's multiple comparisons are shown. P-values < 0.05 were considered as statistically significant: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, **** $p \leq 0.0001$, and ns, not significant. PCS⁺, convalescents with Post-COVID syndrome (PCS); PCS⁻, convalescents without PCS; CTRL, healthy controls, T1, first visit; T2, second visit.

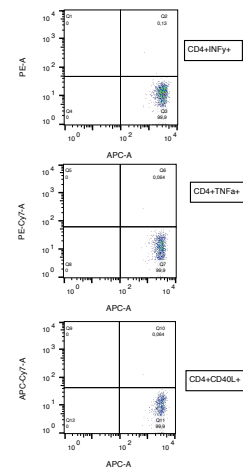


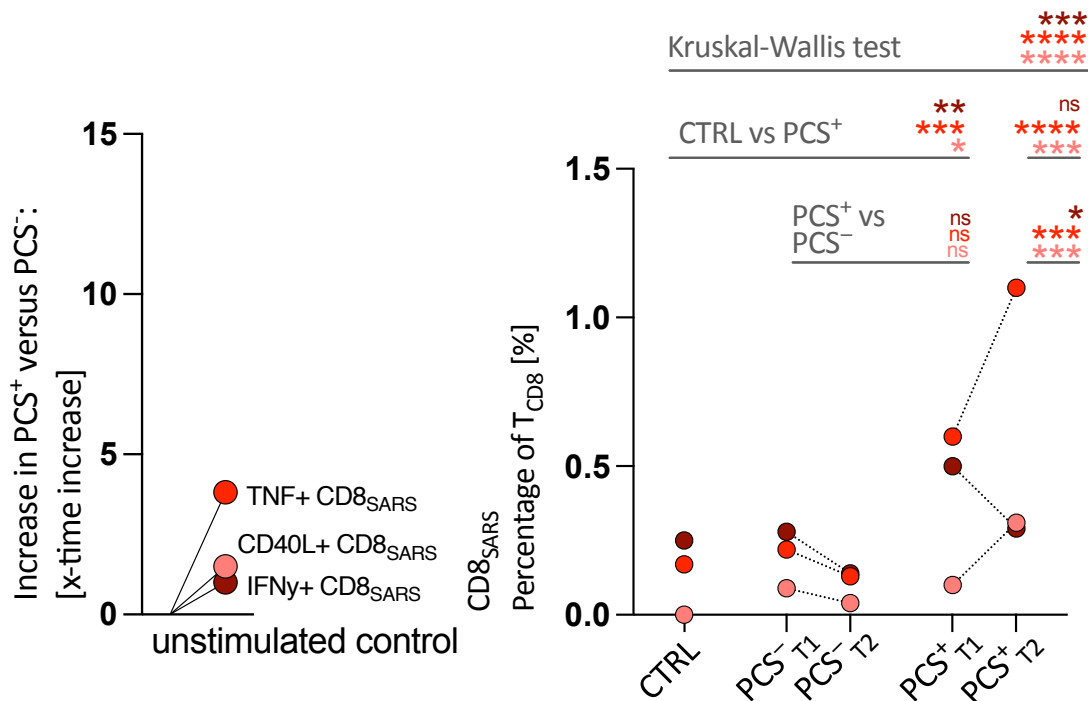
Supplementary figure 4. Surface marker expression by cohort. PD-1 expression [gMFI] on **A** CD4 positive memory T-cells (T_M) **B** CD4⁺ central memory T-cells (T_{CM}) **C** CD4⁺ transitional memory T-cells (T_{TM}). CXCR3 expression [gMFI] on **D** T_M **E** T_{CM} **F** T_{TM} **G** human leukocyte antigen DR (HLA-DR) expression [gMFI] on plasmacytoid dendritic cells (pDC). PD-1 expression [gMFI] on **H** type 1 regulatory T-cells (TR1).

Data information: For statistical analysis, Kruskal-Wallis tests with Dunn's multiple comparisons were used. Here, individual Dunn's multiple comparisons are shown. P-values < 0.05 were considered as statistically significant: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, **** $p \leq 0.0001$, and ns, not significant. PCS⁺, convalescents with Post-COVID syndrome (PCS); PCS⁻, convalescents without PCS; CTRL, healthy controls, T1, first visit; T2, second visit; gMFI, geometric mean fluorescence intensity.



Supplementary figure 5 Detailed FACS gating scheme for T cell assays.





Supplementary figure 6 Detection of distinct SARS-CoV-2 reactive CD8⁺ (CD8_{SARS}) T-cells.

Data information: For statistical analysis, Kruskal-Wallis tests with Dunn's multiple comparisons were used. P-values < 0.05 were considered as statistically significant: * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001, **** p ≤ 0.0001, and ns, not significant. PCS⁺, convalescents with Post-COVID syndrome (PCS); PCS⁻, convalescents without PCS; CTRL, healthy controls, T1, first visit; T2, second visit; ns, not significant.