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SUPPLEMENTARY INFORMATION

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Distinct phenotype of CD4+ T cells driving celiac disease identified in multiple autoimmune conditions

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Supplementary Tale 1. Mass cytometry antibody panel for celiac disease patients.

Label	Target	Clone	Supplier	Concentration
89Y	CD45	HI30	Fluidigm	2:100
108Pd	CD45	HI30	Biolegend	8 µg/ml
115In	CD57*, **	HCD57	Biolegend	1.5 µg/ml
139La	CD28*, **	CD28.2	Biolegend	4 µg/ml
141Pr	Intebrin-α4/CD49d*	9F10	Fluidigm	1:100
142Nd	KLRG1*, **	13F12F2	Thermo Fischer S.	3 µg/ml
143Nd	CD278/ICOS*, **	C398.4A	Fluidigm	0.5:100
144Nd	CD38*, **	HIT2	Fluidigm	1.5:100
145Nd	CD4	RPA-T4	Fluidigm	0.5:100
146Nd	CD8a	RPA-T8	Fluidigm	0.6:100
147Sm	CD137 (41BB)*	4-1BB	R&D systems	12 µg/ml
148Nd	CD27*, **	O323	Biolegend	1 µg/ml
149Sm	CD56 (NCAM)	NCAM16.2	Fluidigm	0.5:100
150Nd	CD127*, **	A019D5	Biolegend	1 µg/ml
151Eu	CD11c	Bu15	Biolegend	2 µg/ml
151Eu	CD19	HIB19	Biolegend	1 µg/ml
151Eu	CD14	M5E2	Fluidigm	1:100
152Sm	CD244*	2B4	R&D systems	4 µg/ml
153Eu	CD62L*, **	DREG-56	Fluidigm	0.5:100
154Sm	CD3	UCHT1	Fluidigm	0.8:100
155Gd	CD279 (PD-1)*, **	EH12.2H7	Fluidigm	1.8:100
156Gd	CD195 (CCR5)*	NP-6G4	Fluidigm	4:100
158Gd	CD194 (CCR4)*, **	L291H4	Fluidigm	0.5:100
159Tb	CD161*, **	HP-3G10	Fluidigm	0.5:100
160Gd	CD39*, **	A1	Fluidigm	1:100
161Dy	CD152 (CTLA-4)*, **	14D3	Fluidigm	5:100
162Dy	Integrin-β7*	FIB504	Fluidigm	0.5:100
163Dy	CD183 (CXCR3)*, **	G025H7	Fluidigm	0.75:100
164Dy	OX40 (CD134)*	Ber-ACT35	Biolegend	8 µg/ml
165Ho	Phycoerythrin	PE001	Fluidigm	1.25:100
166Er	CD85j/ILT2*	GHI/75	Fluidigm	1:100
167Er	CD197 (CCR7)*	G043H7	Fluidigm	1:100
168Er	CD73*, **	AD2	Fluidigm	1:100
169Tm	CD25 (IL-2R)*, **	2A3	Fluidigm	0.6:100
170Er	CD45RA*, **	HI100	Fluidigm	0.1:100
171Yb	CD185 (CXCR5)*, **	RF8B2	Fluidigm	0.75:100
172Yb	CD69*, **	FN50	Biolegend	1 µg/ml
173Yb	HLA-DR*, **	L243	Fluidigm	0.75:100
174Yb	CD196 (CCR6)*, **	G034E3	Biolegend	1 µg/ml
175Lu	CD184 (CXCR4)*	12G5	Fluidigm	1.25:100
176Yb	Allophycocyanin	APC003	Fluidigm	1.25:100
191Ir/193Ir	Nucleateed cells		Fluidigm	1:1000
195Pt	Dead cells		Fluidigm	1:1500
209Bi	CD11b*	ICRF44	Fluidigm	0.4:100

Supplementary Table 1. Mass cytometry antibody panel for celiac disease patients. Antibody panel for mass cytometry staining of HLA-DQ2.5:gluten tetramer-stained peripheral blood and single-cell suspensions of gut biopsies from celiac disease patients and controls subjects. The panel includes metal tags for sample barcoding (anti-CD45), secondary staining of phycoerythrin for identification of HLA-DQ2.5:gluten tetramer-binding cells and secondary staining of allophycocyanin for exclusion of non-HLA-DQ:gluten-specific HLA-DQ2.5:CLIP2 tetramer binding in addition to viability staining (195Pt) and nucleated cell staining (191/193Ir). One asterisk identifies markers included in the t-SNE plots in Fig. 1b, 2b, g and Extended Data Fig. 3c, 5c. Final concentrations are stated in µg/ml when using self-conjugated antibodies or per volume 100 when the concentration was not available from the manufacturer.

Suuplementary Table 2. Epitopes representad by HLA-DQ2.5 and HLA-DQ8 tetramers.

HLA-DQ2.5 epitope	Peptide sequence with underlined 9-mer core
DQ2.5-glia-α1a	QLQPFPQPELPY
DQ2.5-glia-α2	PQPELPYPQPE
DQ2.5-glia-ω1	QQPFPQPEQPFP
DQ2.5-glia-ω2	FPQPEQPFPWQP
DQ2.5-hor-3	PIPEQPQPYPQ
DQ2.5-CLIP2	MATPLLMQALPMGAL
HLA-DQ8 epitope	
DQ8-glia-α1a	SGEGSFQPSQENPQ
DQ2.5-glia-γ1b	FPEQPEQPYPEQ

Supplementary Table 2. Epitopes represented by HLA-DQ2.5 and HLA-DQ8 tetramers. We used soluble biotinylated HLA-DQ2.5 (i.e., *DQA1*05* and *DQB1*02*) or HLA-DQ8 (i.e., *DQA1*03* and *DQB1*03*) molecules covalently linked with the here listed gluten-derived $CD4^+$ T-cell epitopes (9-mer core sequence indicated in red).

Supplementary Table 3. Participant list.

Participant	Category	Sex	HLA type	Marsh Score	Anti-TG2	Anti-DGP	Matieral	Method
P1	UCeD	F	DQ2.5	3B-C	17	14	PBMC, SCS	Mass cytometry
P2	UCeD	F	DQ2.5/DQ2.2	3B-C	4.1	91	PBMC, SCS	Mass cytometry
P3	UCeD	F	DQ2.5	3B-C	>100	>100	PBMC, SCS	Mass cytometry
P4	UCeD	F	DQ2.5	3C	1	>100	PBMC, SCS	Mass cytometry
P5	UCeD	F	DQ2.5	3B	42	59	PBMC	Mass cytometry
P6	UCeD	M	DQ2.5	3A	100	37	PBMC	Mass cytometry
P7	UCeD	M	DQ2.5	3B	25	>100	PBMC	Mass cytometry
							SCS	Flow cytometry
P8	UCeD	M	DQ2.5	3C	not determined	not determined	PBMC	Mass cytometry
P9	UCeD	F	DQ2.5	3A	24.9	42	SCS	Mass cytometry
P10	UCeD	M	DQ2.5	3C	128	not determined	SCS	Mass cytometry
P11	UCeD	F	DQ2.5	3A	32	<5	SCS	Mass cytometry
P12	UCeD	M	DQ2.5	3b	>100	36	PBMC	Flow cytometry
P13	UCeD	M	DQ2.5	3C	>100	>100	PBMC, SCS	Flow cytometry
P14	UCeD	M	DQ2.5	3B-C	>100	41	PBMC, SCS	Flow cytometry
P15	UCeD	F	DQ2.5	3B	2.6	13	PBMC	Flow cytometry
P16	UCeD	F	DQ2.5	3A-B	20.8	64	PBMC	Flow cytometry
P17	UCeD	F	DQ2.5	3A	not determined	not determined	PBMC, SCS	Flow cytometry
P18	UCeD	M	DQ2.5	3B-C	>100	>100	SCS	Flow cytometry
P19	UCeD	F	DQ8	3B	77	not determined	SCS	Flow cytometry
P20	UCeD	F	DQ2.5	3B	27.3	>100	SCS	RNA Seq
P21	UCeD	F	DQ2.5	3C	>100	94	SCS	RNA Seq
P22	UCeD	F	DQ2.5	3A	4.2	18	SCS	RNA Seq
P23	UCeD	F	DQ2.5	3B	>100	>100	SCS	RNA Seq
P24	UCeD	F	DQ2.5	3C	>100	>100	SCS	RNA Seq
P25	TCeD	F	DQ2.5	not determined	<1	<5	PBMC	Mass cytometry
	Challenge	F	DQ2.5	not determined	<1	<5	PBMC	Flow & mass cytometry
P26	TCeD	F	DQ2.5	not determined	<1	<5	PBMC	Mass cytometry
	Challenge	F	DQ2.5	not determined	<1	<5	PBMC	Flow & mass cytometry
P27	Challenge	M	DQ2.5	not determined	<1	<5	PBMC	Flow cytometry
P28	Challenge	M		not determined	<1	<5	PBMC	Flow cytometry
P29	TCeD	F	DQ2.5	not determined	<1	7	PBMC	Mass cytometry
	Challenge				1.1	8		
P30	TCeD	F	DQ2.5	not determined	<1	<5	PBMC	Mass cytometry
	Challenge				<1	<5		
P31	TCeD	F	DQ2.5	not determined	not determined	not determined	PBMC	Mass cytometry
	Challenge				1.1	6		
P32	TCeD	F	DQ2.5	0	<1	<5	PBMC	Mass cytometry
P33	TCeD	F	DQ2.5	0	2.2	18	PBMC, SCS	Mass cytometry
P34	TCeD	M	DQ2.5	0	2	<5	PBMC, SCS	Mass cytometry
P35	TCeD	F	DQ2.5	0	<1	<5	PBMC	Mass cytometry
P36	TCeD	F	DQ2.5	0	1.1	13	PBMC	Mass cytometry
P37	TCeD	F	DQ2.5	0	<1	13	PBMC	Mass cytometry
P38	TCeD	F	DQ2.5	3A	<1	<5	PBMC	Mass cytometry
P39	TCeD	M	DQ2.5	1	<1	<5	SCS	Mass cytometry
P40	TCeD	F	DQ2.5	3A	2	5	SCS	Mass cytometry
P41	TCeD	F	DQ2.5	0	<1	<5	SCS	Mass cytometry
P42	TCeD	F	DQ2.5	3B	42.1	80	SCS	Mass cytometry
P43	Control	F	DQ2.5	0	<1	6	PBMC, SCS	Mass cytometry
P44	Control	F	DQ2.5	0	<1	<5	PBMC, SCS	Mass cytometry
P45	Control	F	DQ2.5	0	not determined	not determined	PBMC, SCS	Mass cytometry
P46	Control	M	DQ2.5	0	<1	<5	PBMC,SCS	Mass cytometry
P47	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P48	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P49	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P50	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P51	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P52	Control	Unknown	not determined	not determined	not determined	not determined	PBMC	Mass cytometry
P53	Control	F	DQ2.5	0	<1	<5	SCS	Mass cytometry
P54	Control	F	DQ2.5	0	<1	<5	SCS	Mass cytometry
P55	Control	M	DQ2.5	0	<1	14	SCS	Mass cytometry
P56	Control	M	DQ2.5	0	<1	<5	SCS	RNA Seq

P57	Control	M	DQ8	0	<1	<5	SCS	RNA Seq
P58	Control	F	DQ2.5	0	<1	<5	SCS	RNA Seq
P59	Control	F	DQ8	not determined	<1	<5	SCS	RNA Seq

Supplementary Table 3. Participant list. Untreated and treated celiac disease (UCeD and TCeD, respectively) patients and controls (for participants with other autoimmune diseases, influenza infection and controls, see Supplementary Table 6). The histological appearance in the duodenal mucosa was graded according to the Marsh score; Normal mucosa (Marsh score 0), increased number of intraepithelial lymphocytes (Marsh score 1), hyperplastic lesion and crypt hyperplasia (Marsh score 2) and various degree of villous atrophy (Marsh score 3A-C)[17,18]. Reference range anti-transglutaminase 2 IgA antibodies (Anti-TG2) <3U/mL, anti-deamidated gliadin peptide IgG antibodies (ant-DGP) < 20 Units/mL. Analyzed material: Peripheral blood mononuclear cells (PBMC), single-cell suspension (SCS) from duodenal biopsies.

Supplementary Table 4. Mass cytometry-derived fold change, P values with false discovery rate per marker.

UCeD tetramer pos vs neg CD4+ blood T cells			
Variable	Fold chang	P value	FDR
PD-1	3.37446489	6.2625E-06	0.00018161
CD161	2.17292987	3.0457E-05	0.00044163
CD39	3.66724386	4.7212E-05	0.00045638
CD45RA	-1.8726527	9.614E-05	0.00055962
CXCR3	2.67875437	9.6486E-05	0.00055962
CD25	-2.0599651	0.0003219	0.00084863
CD38	2.00321055	0.0002185	0.00084863
CTLA-4	0.70632218	0.00022526	0.00084863
HLA-DR	3.54694316	0.0002385	0.00084863
ICOS	1.98031909	0.00029958	0.00084863
Integrin-β7	3.35498746	0.00031919	0.00084863
CD49d	1.52339882	0.00039355	0.00095108
CXCR4	-0.8217108	0.00054343	0.00121227
CCR6	0.94168994	0.0008466	0.00165236
CCR7	-1.5620493	0.00085467	0.00165236
CD28	1.03068158	0.00126272	0.00218587
OX40	1.57652604	0.00128137	0.00218587
CD62L	-3.0189471	0.00169502	0.00273086
CD73	-1.5208278	0.00189519	0.00289265
CXCR5	0.16313598	0.00250674	0.00363478
CCR4	0.20448483	0.00312444	0.00431471
CD127	-1.4573202	0.0038376	0.00505865
CD137	2.20559632	0.06803669	0.08578539
CD85j	-0.5616357	0.07339271	0.08868286
CD27	-0.9823509	0.11666971	0.13533686
CCR5	-0.6718246	0.16377833	0.18267583
CD69	-0.4542505	0.31769572	0.34122874
KLRG1	-0.543436	0.82730049	0.85684694
CD57	-2.4448589	0.97096702	0.97096702

UCeD tetramer pos vs control CD4+ blood T cells			
Variable	Fold chang	P value	FDR
PD-1	2.15156943	1.1733E-07	3.4026E-06
CD161	1.67125133	6.7931E-06	0.00019021
CD62L	-1.538977	7.0713E-06	0.00019093
CD39	2.83912916	1.7926E-05	0.00046607
CCR6	0.72083885	2.1544E-05	0.0005386
CXCR3	1.64067935	3.9765E-05	0.00095437
CD25	-0.9838858	6.2388E-05	0.00143493
CD45RA	-1.3467149	0.00012626	0.00277762
HLA-DR	2.19361245	0.00013194	0.00277762
CCR4	0.29149137	0.00017006	0.00340113
CD73	-0.7563181	0.00032984	0.00626701
CXCR4	-0.2944311	0.00070688	0.01272393
CD38	0.99668453	0.00096018	0.01626858
Integrin-β7	1.83268317	0.00095698	0.01626858
CD49d	0.81238742	0.00153617	0.02304254
ICOS	1.16189932	0.0016852	0.02359284
CD127	-0.2952447	0.00483982	0.0629177
CD69	-1.2463682	0.0063521	0.07622523
CCR7	-0.4932464	0.00819167	0.08676084
CXCR5	0.50363021	0.00788735	0.08676084
OX40	1.1529639	0.01037375	0.09336372
CTLA-4	0.23881263	0.05660291	0.4528233
CD85j	-0.7565234	0.0690963	0.4836741
CD137	0.82384276	0.08622295	0.51733769
CCR5	0.18679908	0.27049022	1
CD27	-0.4337247	0.21267916	1
CD28	0.09696722	0.46916725	1
CD57	-1.4186848	0.33503479	1
KLRG1	0.23814081	0.82236883	1

UCeD tetramer pos vs neg CD4+ gut T cells			
Variable	Fold chang	P value	FDR
CD161	0.97220416	0.00032835	0.00952204
CXCR3	0.80636811	0.00108693	0.01208599
HLA-DR	1.39450801	0.00125028	0.01208599
CD39	1.39717471	0.00233828	0.01520002
OX40	1.46577946	0.00268195	0.01520002
PD-1	1.85744183	0.00314483	0.01520002
CD38	1.06108479	0.00368047	0.01524766
CCR4	0.68483148	0.0069221	0.02007409
CXCR5	0.77724598	0.00662812	0.02007409
ICOS	1.41940434	0.00618273	0.02007409
CD49d	0.66196686	0.01584541	0.04177427
CD127	-2.1500238	0.01862315	0.04500594
CCR6	0.2253228	0.02394554	0.05239352
Integrin-β7	0.35987293	0.02529342	0.05239352
CD69	0.46978026	0.02812773	0.05438027
CD85j	1.19527263	0.03840194	0.06960352
CD28	0.40522775	0.07587382	0.1294318
CTLA-4	0.38342996	0.13391463	0.21575135
CD57	-0.9246062	0.14609522	0.21576885

UCeD tetramer pos vs control CD4+ gut T cells			
Variable	Fold chang	P value	FDR
CD39	2.76037179	3.1303E-06	9.078E-05
CD49d	0.04227848	1.1633E-05	0.00032572
CCR4	1.17800479	0.00010815	0.00292013
CD127	-1.1591164	0.0001516	0.0039416
ICOS	3.41784645	0.00031783	0.00794571
OX40	2.03091136	0.00150522	0.0361252
PD-1	2.07209776	0.00168659	0.03879168
Integrin-β7	0.34402756	0.00268442	0.05905725
HLA-DR	0.38887431	0.00339612	0.0713185
CD161	0.85093757	0.00784807	0.15696138
CD85j	-0.3621977	0.01661189	0.315626
CD38	-0.8229729	0.03193237	0.57478262
CCR7	-0.1859834	0.036309	0.61725301
CTLA-4	0.26910706	0.05595624	0.89529979
CD137	-0.2766683	0.06308645	0.93138189
CD28	0.6410895	0.06209213	0.93138189
CD62L	-1.672258	0.07571616	0.98431007
CCR5	0.02622354	0.75333356	1
CCR6	-0.1799132	0.28255317	1

CXCR4	-1.1292641	0.1488061	0.21576885
CD25	-0.4054953	0.18510135	0.25561614
CD45RA	-0.6689098	0.23821767	0.3140142
CD27	-1.3612242	0.3278513	0.41337773
CCR5	-0.0952532	0.34324992	0.41476032
CD73	-1.3430901	0.50025216	0.5802925
KLRG1	-0.6835401	0.53751303	0.59953377
CCR7	-0.024925	0.67654213	0.70070434
CD137	-0.1678129	0.65930509	0.70070434
CD62L	-0.6591668	0.9103162	0.9103162

CD25	1.17686872	0.9910158	1
CD27	0.71823074	0.95712371	1
CD45RA	0.64616154	0.24243876	1
CD57	-1.6656093	0.13109569	1
CD69	-0.1206862	0.54090404	1
CD73	-0.7077205	0.09137822	1
CXCR3	-0.62058	0.73659431	1
CXCR4	-0.5520921	0.21856755	1
CXCR5	0.33254566	0.10640317	1
KLRG1	-0.9329318	0.46390184	1

Supplementary Table 4. Fold change, P values with false discovery rate per marker. Mass cytometry-derived fold change (> 1.5 highlighted) of indicated markers (visualized as heat map in Figure 1e (gut) and 2e (blood). P values (< 0.05 highlighted) and false discovery rate (FDR) (<0.05 highlighted) are also shown. The fold change is calculated as the log2 fold change of the grand mean of donor marker intensity for tetramer positive versus tetramer pre-enriched (blood, n = 7, upper left) or tetramer negative (gut, n = 6, lower left) $CD4^+$ T cells in untreated celiac disease (UCeD) patients. Fold change, P values and FDR are also shown for tetramer positive blood T cells in UCD patients versus $CD4^+$ blood T cells in controls (n = 10 controls, upper right) and for tetramer positive gut T cells of UCeD patients versus $CD4^+$ gut T cells of controls (n = 7 controls, lower right). P values and FDRs were calculated using an unpaired, two-tailed t-test and the Benjamini-Hochberg procedure, respectively.

Supplementary Table 5. List of differentially expressed genes. See separate excel-file.

Supplementary Table 6. Participants (P) with autoimmune disorders, influenza and controls in Fig. 2h-i, Extended Data Fig. 8 and 10e-f

Participant	Category	Sex	Disease	Organ involvement and other information	Elevated autantibodies or relevant test
P60	Untreated	F	Systemic sclerosis	Pulmonary arterial hypertension, digital ulcers, sclerodactily, oesophagal dysmotility	ANA, anti-centromere, anti-Ro/SSA
P61	Untreated	F	Systemic sclerosis	Worsening skin thickening	ANA, anti-Scl-70
P62	Untreated	F	Systemic sclerosis	Pulmonary fibrosis, Stable skin and lung disease	ANA, anti-RNA polymerase III
P63	Untreated	F	Systemic sclerosis	Renaud syndrom, active digital ulcers, osteomyelitis	ANA, anti-centromere, anti-Ro/SSA
P64	Untreated	F	Systemic sclerosis	Raynaud, interstitial lung disease, oesophagal dysmotility	ANA
P65	Untreated	M	Systemic sclerosis	Raynaud sondrom, sclerodactily, subcutaneous calcinosis, oesophagal dysmotility	ANA, anti-centromere (CENP-B), anti-Ro/SSA
P66	Untreated	F	Systemic sclerosis	Raynaud, digital ulcers, oesophagal dysmotility	ANA, anti-centromere
P67	Untreated	M	Systemic sclerosis	Raynaud, sclerodactily, renal crisis, Interstitial lung disease	ANA, anti-RNA polymerase III
P68	Untreated	F	Systemic sclerosis	Worsening skin thickening	ANA, anti-Scl-70
P69	Untreated	F	Systemic sclerosis	Stable disease, sclerodactyly Stable disease Sclerodactyly Stable disease, sclerodactyly	ANA, Scl-70
P70	Untreated	F	Systemic lupus erythematosus	Flare of malar rash, fatigue, arthralgia	ANA, anti-dsDNA, anti-RO, anti-U1-snRNP, anti-Sm
P71	Untreated	F	Systemic lupus erythematosus	Nephritis (LN III A/C), arthritis	ANA, anti-dsDNA
P72	Untreated	F	Systemic lupus erythematosus	Lupus nephritis, arthitis	anti-Ro/SSA, anti-RNP, anti-Ku
P73	Untreated	F	Systemic lupus erythematosus	UV-sensitive rash, arthritis	ANA, anti-dsDNA, anti-beta2-glycoprotein 1
P74	Untreated	F	Systemic lupus erythematosus	In remission	ANA
P75	Untreated	F	Systemic lupus erythematosus	Raynaud's disease, arthritis, telangiectasias Arthritis	ANA, anti-RNP

P76	Untreated	F	Systemic lupus erythematosus	Dry eyes and mouth, children with neonatal systemic lupus erythemotosus	ANA, anti-dsDNA, anti-Ro/SSA, anti-La/SSB
P77	Untreated	F	Systemic lupus erythematosus	Sicca symptoms, skin flare	ANA, anti-Ro/SSA, anti-La/SSB
P78	Untreated	F	Systemic lupus erythematosus	Stalbe disease	ANA
P79	Untreated	F	Systemic lupus erythematosus	New rash and headache	ANA, anti-Ro/SSA
P80	Control	Unknown	Unknown	Blood bank donor	Not determined
P81	Control	Unknown	Unknown	Blood bank donor	Not determined
P82	Control	Unknown	Unknown	Blood bank donor	Not determined
P83	Control	Unknown	Unknown	Blood bank donor	Not determined
P84	Control	Unknown	Unknown	Blood bank donor	Not determined
P85	Control	Unknown	Unknown	Blood bank donor	Not determined
P86	Control	Unknown	Unknown	Blood bank donor	Not determined
P87	Control	Unknown	Unknown	Blood bank donor	Not determined
P88	Control	Unknown	Unknown	Blood bank donor	Not determined
P89	Control	Unknown	Unknown	Blood bank donor	Not determined
P90	Control	Unknown	Unknown	Blood bank donor	Not determined
P91	Control	Unknown	Unknown	Blood bank donor	Not determined
P92	Control	Unknown	Unknown	Blood bank donor	Not determined
P93	Control	Unknown	Unknown	Blood bank donor	Not determined
P94	Control	Unknown	Unknown	Blood bank donor	Not determined
P95	Control	Unknown	Unknown	Blood bank donor	Not determined
P96	Control	Unknown	Unknown	Blood bank donor	Not determined
P97	Control	Unknown	Unknown	Blood bank donor	Not determined
P98	Untreated	M	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
			Recovery, 41 days	No influenza-related symptoms	Not determined
P99	Untreated	F	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
P100	Untreated	F	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
			Recovery, 27 days	No influenza-related symptoms	Not determined
P101	Untreated	F	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
			Recovery, 23 days	No influenza-related symptoms	Not determined
P102	Untreated	F	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+

			Recovery, 30 days	No influenza-related symptoms	Not determined
P103	Untreated	F	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
			Recovery, 30 days	No influenza-related symptoms	Not determined
P104	Untreated	M	Influenza	Fever, cough, soar throat, runny nose, myalgia	NP Swab: Influenza A^+
			Recovery, 28 days	No influenza-related symptoms	Not determined

Supplementary Table 6. Participants (P) with autoimmune disorders, influenza and controls in Fig. 2h-i, Extended Data Fig. 8 and 10e-f. For participants (P) with autoimmune disorders, autoantibodies that were measured above the upper limit of normal at the time-point of blood draw for this study are listed. For participants included before and after influenza infection, positive nasopharengeal (NP) swab test results for influenza A virus is indicated. The patients are listed as untreated as none of them were treated with steroids or other immunomodulating drugs at the time point of blood draw. However, P99, P100, P101, P103 and P104 were treated with the antiviral drug Oseltamivir between the first and second consultation.

Supplementary Table 7. Mass cytometry antibody panel for autoimmune disorders.

Label	Target	Clone	Supplier	Concentration
89Y	CD45	HI30	Fluidigm	2:100
108Pd	CD45	HI30	Biolegend	8 µg/ml
115In	CD57**	HCD57	Biolegend	1.5 µg/ml
139La	CD28**	CD28.2	Biolegend	4 µg/ml
141Pr	Intebrin-α4/CD49d	9F10	Fluidigm	1:100
142Nd	KLRG1**	13F12F2	Thermo Fischer S.	3 µg/ml
143Nd	CD278/ICOS**	C398.4A	Fluidigm	0.5:100
144Nd	CD38**	HIT2	Fluidigm	1.5:100
145Nd	CD4	RPA-T4	Fluidigm	0.5:100
146Nd	CD8a	RPA-T8	Fluidigm	0.6:100
147Sm	TIGIT	372702	Biolegend	8 µg/ml
148Nd	CD27**	O323	Biolegend	1 µg/ml
149Sm	CD56 (NCAM)	NCAM16.2	Fluidigm	0.5:100
150Nd	CD127**	A019D5	Biolegend	1 µg/ml
151Eu	CD11c	Bu15	Biolegend	2 µg/ml
151Eu	CD19	HIB19	Biolegend	1 µg/ml
151Eu	CD14	M5E2	Fluidigm	1:100
152Sm	TCRg/d	11F2	Fluidigm	1:100
153Eu	CD62L**	DREG-56	Fluidigm	0.5:100
154Sm	CD3	UCHT1	Fluidigm	0.8:100
155Gd	CD279 (PD-1)**	EH12.2H7	Fluidigm	1.8:100
156Gd	CD29	TS2/16	Biolegend	1.6 µg/ml
158Gd	CD194 (CCR4)**	L291H4	Fluidigm	0.5:100
159Tb	CD161**	HP-3G10	Fluidigm	0.5:100
160Gd	CD39**	A1	Fluidigm	1:100
161Dy	CD152 (CTLA-4)**	14D3	Fluidigm	5:100
162Dy	Integrin-β7	FIB504	Fluidigm	0.5:100
163Dy	CD183 (CXCR3)**	G025H7	Fluidigm	0.75:100
164Dy	CD200	OX-104	Biolegend	8 µg/ml
165Ho	CD103	B-Ly7	Thermo Fischer S.	0.5:100
166Er	CCR2	K036C2	Biolegend	2 µg/ml
167Er	CD197 (CCR7)**	G043H7	Fluidigm	1:100
168Er	CD73**	AD2	Fluidigm	1:100
169Tm	CD25 (IL-2R)**	2A3	Fluidigm	0.6:100
170Er	CD45RA**	HI100	Fluidigm	0.1:100
171Yb	CD185 (CXCR5)**	RF8B2	Fluidigm	0.75:100
172Yb	CD69**	FN50	Biolegend	1 µg/ml
173Yb	HLA-DR**	L243	Fluidigm	0.75:100
174Yb	CD196 (CCR6)**	G034E3	Biolegend	1 µg/ml
175Lu	CX3CR1	2A9-1	Biolegend	6 µg/ml
176Yb	TCRα/β	IP26	Fluidigm	1.5:100
191Ir/193Ir	Nucleateed cells		Fluidigm	1:1000
195Pt	Dead cells		Fluidigm	1:1500
209Bi	CD11b	ICRF44	Fluidigm	0.4:100

Supplementary Table 7. Mass cytometry antibody panel for autoimmune disorders. Antibody panel for mass cytometry staining of peripheral blood from participants with autoimmune disease, participants during and after influenza infection and control subjects (Figure 2h-i and Extended Data Fig. 8). Two asterisks identify the markers used to generate Fig. 2i (22 $CD4^+$ T-cell markers common to mass cytometry staining panel in Supplementary table 1). Final concentrations are stated in µg/ml when using self-conjugated antibodies or per volume 100 when the concentration was not available from the manufacturer.

Supplementary Table 8. Antibodies used in flow cytometry experiments.

Label	Target	Clone	Supplier	Concentration
APC	FoxP3	PCH101	Thermo Fischer S.	5 µg/ml
Alexa 700	CD4	A161A1	Biolegend	3:100
APC-Cy7	CD25	BC96	Biolegend	4:100
PE-Cy5	CD45RA	HI100	Biolegend	1:100
PE-Cy7	CD127	A019D5	Biolegend	5:100
Alexa 488	Ki-67	Ki-67	Biolegend	5 µg/ml
Pacific Blue	CD11c	3.9	Biolegend	1.5:100
Pacific Blue	CD56	5.1H11	Biolegend	1.5:101
Pacific Blue	CD14	HCD14	Biolegend	1.5:102
Pacific Blue	CD19	6D5	Biolegend	1.5:103
Aqua/510	Dead cells		Biolegend	1:100
BV605	CD3	UCHT1	Biolegend	4:100
BV650	Integrin β7	FIB504	BD Bisciences	5:100
Alexa 488	CD278/ICOS	C398.4A	Biolegend	1 µg/ml
PerCP	CD62L	DREG-56	Biolegend	3:100
Pe-Cy7	CD45RA	HI100	Thermo Fischer S.	2.5:100
APC	CXCR4	12G5	Biolegend	1:100
APC	CXCR5	J252D4	Biolegend	1:100
APC-H7	CD4	SK3	BD Bisciences	0.36 µg/ml
Fixable Violet/405	Dead cells		Thermo Fischer S.	1:100
BV605	CD3	OKT3	Biolegend	3:100
Alexa 488	CD25	14101	Thermo Fischer S.	4:100

Supplementary Table 8. Antibodies used in flow cytometry experiments. Antibodies used for flow cytometry staining. Final concentrations are stated in µg/ml when information available or per volume 100 when the concentration was not available from the manufacturer.