

**Table S1** The marker genes of immune cells

Cell type	Marker genes
B cells	<i>MS4A1, TCL1A, HLA-DOB, PNOC, KIAA0125, CD19, CR2, FCRL2, BLK, IGHG1, COCH, OSBPL10, IGHA1, TNFRSF17, ABCB4, BLNK, GLDC, MEF2C, IGHM, FAM30A, SPIB, GNG7, IGKC, CD72, MICAL3, BCL11A, BACH2, IGL@, CCR9, DTNB, HLA-DQA1, SCN3A, QRSL1, SLC15A2</i>
T cells	<i>CD3D, CD3G, CD28, TRAT1, PRKCQ, BCL11B, CD2, LCK, TRBC1, ITM2A, SH2D1A, CD6, CD96, NCALD, GIMAP5, CD3E, SKAP1, TRA@</i>
T helper cells	<i>ICOS, LRBA, ITM2A, FAM111A, PHF10, NUP107, SEC24C, NAP1L4, BATF, ASF1A, FRYL, FUSIP1, TRA@, RPA1, ANP32B, UBE2L3, DDX50, C13orf34, SLC25A12, PPP2R5C, ATF2, CD28, GOLGA8A</i>
Tcm	<i>CDC14A, ATM, USP9Y, PCNX, FOXP1, KLF12, ST3GAL1, INPP4B, CASP8, MLL, PCM1, RP11-74E24.2, PHC3, NFATC3, LOC202134, TIMM8A, ATF7IP, REPS1, PSPC1, RPP38, HNRPH1, STX16, CYLD, SNRPN, TRAF3IP3, NEFL, POLR2J2, AQP3, CG030, PDXDC2, CLUAP1, DOCK9, CYorf15B, CREBZF, CEP68, TXK, SLC7A6, FYB, MAP3K1</i>
Tem	<i>TRA@, PRKY, VIL2, GDPD5, CCR2, MEFV, C7orf54, FLI1, TBC1D5, DDX17, AKT3, EWSR1, TBCD, NFATC4, LTK</i>
Th1 cells	<i>IFNG, LTA, D0K5, IL12RB2, APBB2, APOD, ZBTB32, CD38, CSF2, CTLA4, CD70, DPP4, EGFL6, BST2, DUSP5, LRP8, IL22, DGKI, CCL4, GGT1, LRRN3, SYNGR3, ATP9A, BTG3, CMAH, HBEGF, SGCB</i>
Th2 cells	<i>PMCH, AHI1, PTGIS, CXCR6, EVI5, IL26, MB, NEIL3, GSTA4, PHEX, SMAD2, CENPF, ANK1, ADCY1, AI582773, LAIR2, SNRPD1, MICAL2, DHFR, WDHD1, BIRC5, SLC39A14, HELLS, LIMA1, CDC25C, CDC7, GATA3</i>
TFH	<i>CHI3L2, CXCL13, CHGB, MY07A, ICA1, HEY1, CDK5R1, ST8SIA1, PDCD1, BLR1, KIAA1324, PVALB, TSHR, C18orf1, TOX, SLC7A10, SMAD1, P0MT1, PASK, MKL2, PTPN13, KCNK5, ZNF764, MAF, MY06, SIRPG, THADA, MAGEH1, B3GAT1, SH3TC1, HIST1H4K, STK39</i>
Th17 cells	<i>IL17A</i>
Th18 cells	<i>IL17RA</i>
Th19 cells	<i>RORC</i>
TReg	<i>FOXP3</i>
CD8 T cells	<i>CD8B, PF4, PRR5, SF1, LIME1, ARHGAP8, GZMM, SLC16A7, SFRS7, APBA2, C4orf15, LEPR0TL1, GADD45A, ZFP36L2, MYST3, ZEB1, ZNF609, C12orf47, THUMPD1, VAMP2, ZNF91, ZNF22, TMC6, DNAJB1, FLT3LG, CDKN2AIP, TSC22D3, TBCC, RBM3, ABT1, C19orf6, CAM LG, PPP1R2, AES, KLF9, PRF1</i>
Tgd	<i>TRD@, C1orf61, TRGV9, CD160, TARP, FEZ1</i>
Cytotoxic cells	<i>KLRD1, KLRF1, GNLY, CTSW, KLRB1, KLRK1, NKG7, GZMH, SIGIRR, ZBTB16, RUNX3, AP0L3, RORA, APBA2, WHDC1L1, DUSP2, GZMA</i>
NK cells	<i>LOC643313, GAGE2, ZNF747, XCL1, XCL2, AF107846, SLC30A5, NM_014114, MCM3AP, TBXA2R, CDC5L, LOC730096, FUT5, FGF18, MRC2, RP5-886K2.1, PSMD4, PRX, ZNF205, AL080130, ZNF528, MAPRE3, BCL2, NM_017616, ARL6IP2, SPN, FZR1, PDLIM4, NM_014274, LDB3, ADARB1, SMEK1, TCTN2, TINAGL1, IGFBP5, ALDH1B1, NCR1</i>
NK CD56dim cells	<i>KIR3DL2, SP0N2, KIR2DL3, GZMB, KIR3DS1, KIR3DL1, FLJ20699, TMEPAI, IL21R, KIR3DL3, KIR2DS5, KIR2DS2, GTF3C1, KIR2DS1, EDG8</i>
NK CD56bright cells	<i>RRAD, XCL1, NIBP, FOXJ1, MARCHF6, DUSP4, PLA2G6, MADD, BG255923, MPPED1, MUC3B</i>
DC	<i>CD209, CCL17, HSD11B1, CCL13, CCL22, PPFIBP2, NPR1</i>
iDC	<i>CD1B, VASH1, F13A1, CD1E, MMP12, FABP4, CLEC10A, SYT17, MS4A6A, CTNS, GUCA1A, CARD9, ABCG2, CD1A, PPARG, RAP1GAP, SLC7A8, GSTT1, NM_021941, FZD2, CSF1R, HS3ST2, CH25H, LMAN2L, SLC26A6, BLVRB, NUDT9, PREP, TM7SF4, TACSTD2, CD1C</i>
aDC	<i>CCL1, EBI3, INDO, LAMP3, OAS3</i>
pDC	<i>IL3RA</i>

**Table S1** (continued)

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Cell type	Marker genes
Eosinophils	<i>IL5RA, KCNH2, TKTL1, EMR1, CCR3, GALC, RNU2, CLC, THBS1, HIST1H1C, CYSLTR2, HRH4, RNASE2, CAT, LRP5L, SYNJ1, THBS4, GPR44, KBTBD11, ABHD2, TIPARP, SMPD3, MYO15B, TGIF1, RRP12, IGSF2, HES1, RCOR3, EPN2, C9orf156, SIAH1, ACACB</i>
Macrophages	<i>MARCCT, CXCL5, SCG5, SULT1C2, MSR1, CTSK, C0LEC12, PC0LCE2, CHIT1, PTGDS, KAL1, CLEC5A, GPC4, ME1, DNASE2B, CCL7, FN1, CD163, GM2A, SCARB2, BCAT1, RAI14, COL8A2, APOE, CHI3L1, ATG7, CD84, FDX1, MS4A4A, SGMS1, EMP1, CYBB, CD68</i>
Mast cells	<i>PRG2, CTSG, SLC18A2, MS4A2, CPA3, TPSB2, NM_003293, TPSAB1, GATA2, HDC, ELA2, L0H11CR2A, CMA1, SIGLEC6, PG DS, MLPH, ADCYAP1, CALB2, SLC24A3, KIT, TAL1, ABCC4, PPM1H, MAOB, HPGD, SCG2, PTGS1, CEACAM8, MPO, NR0B1, LOC339524</i>
Neutrophils	<i>CSF3R, CYP4F3, VNN3, KCNJ15, IL8RA, IL8RB, MME, FCGR3B, DYSF, FCAR, CEACAM3, FPRL1, HIST1H2BC, HPSE, FLJ11151, CREB5, S100A12, TNFRSF10C, SLC22A4, KIAA0329, SLC25A37, BST1, CRISPLD2, G0S2, SIGLEC5, CD93, MGAM, ALPL, FPR1, PDE4B, LILRB2</i>

NK, natural killer.

**Table S2** Primer sequences

Genes	Forward primer	Reverse primer
<i>OR51E1</i>	CCTCCCTGGTTTAGAAGAGGC	GCTCAGTCCGCACAATGTAGA
<i>NDRG2</i>	AGACTCACTCTGTGGAGACAC	CGTGGTAGGTAAGGATCGCTG
<i>SQLE</i>	GGCATTGCCACTTTCACCTAT	GGCCTGAGAGAATATCCGAGAAG
<i>RGS2</i>	AAGATTGGAAGACCCGTTTGAG	GCAAGACCATATTTGCTGGCT
<i>TSPAN7</i>	ACCAAACCTGTGATAACCTGTCT	AGGGAGATATAGGTGCCAAGA