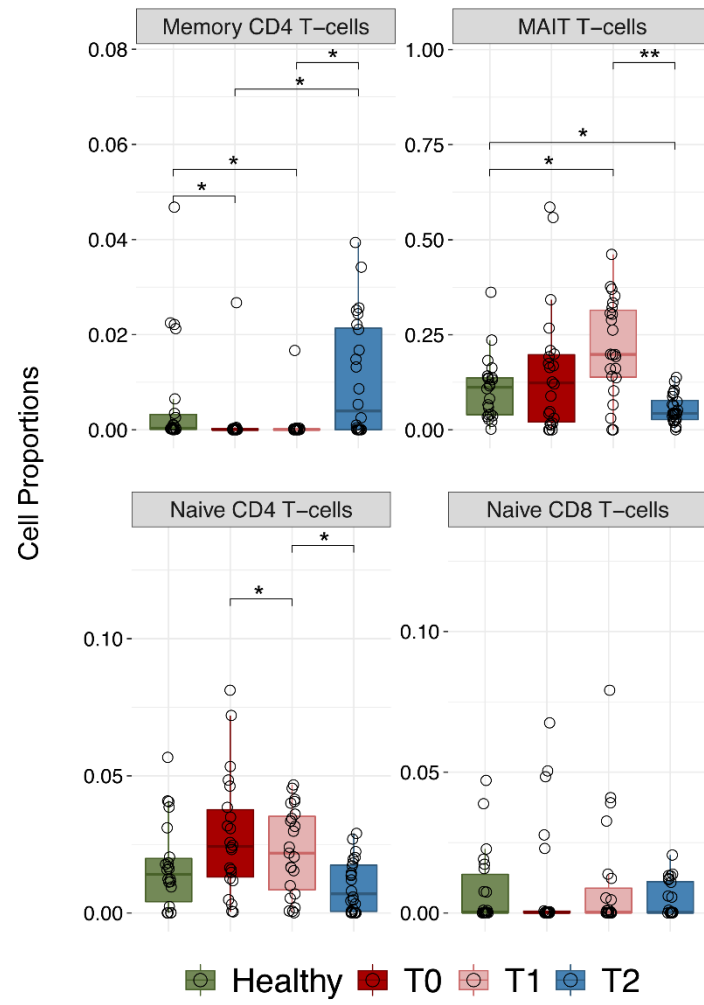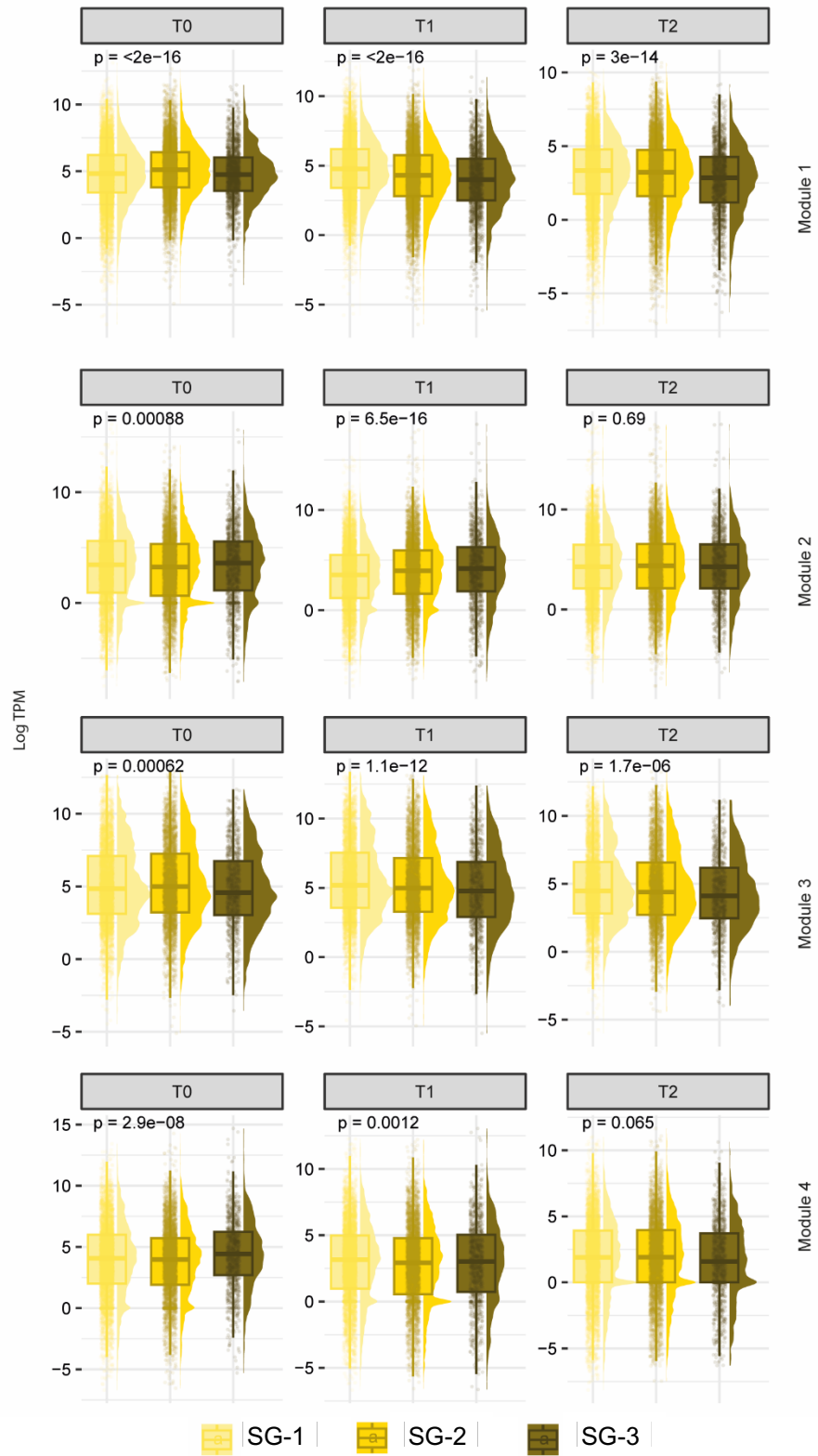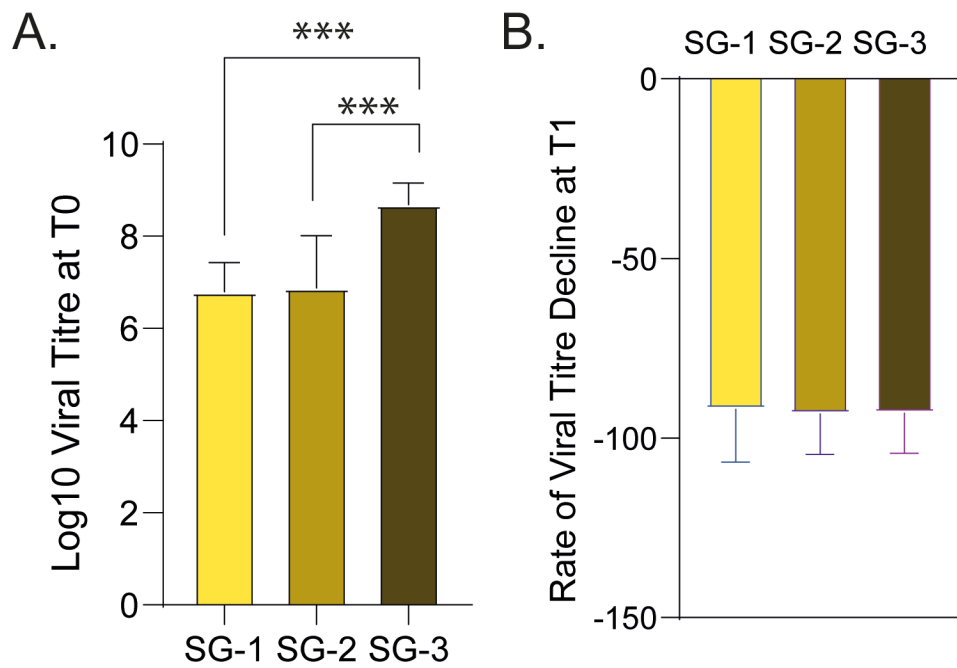**Supplementary Fig. S1.** Clinical manifestations and symptoms at the time of hospital admission.
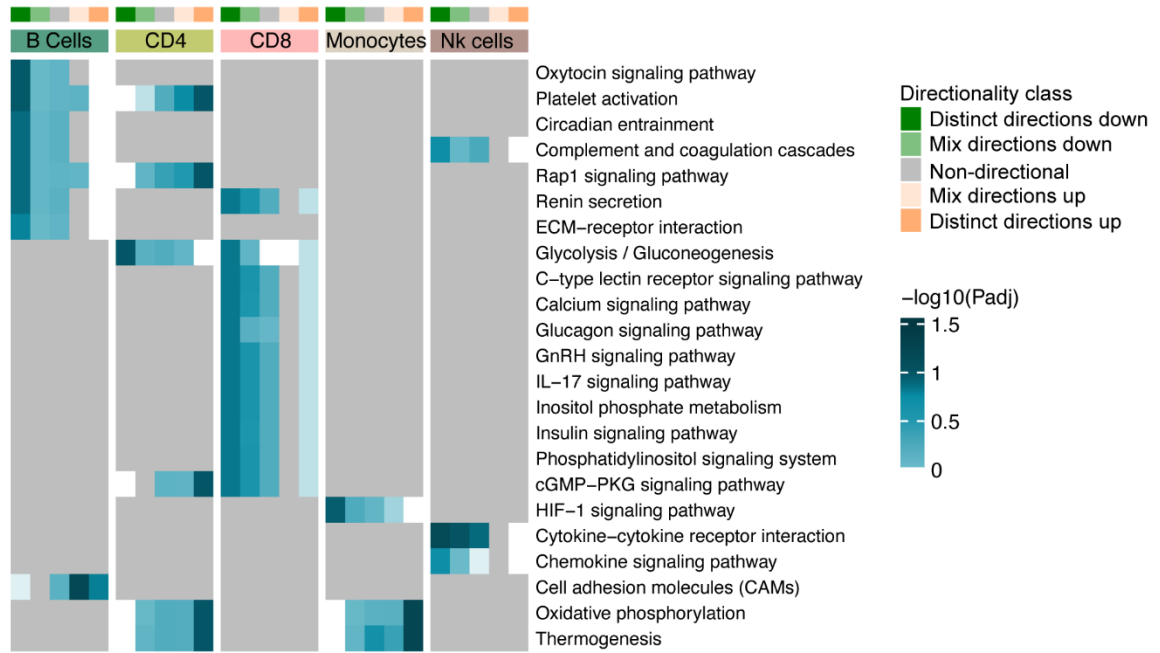
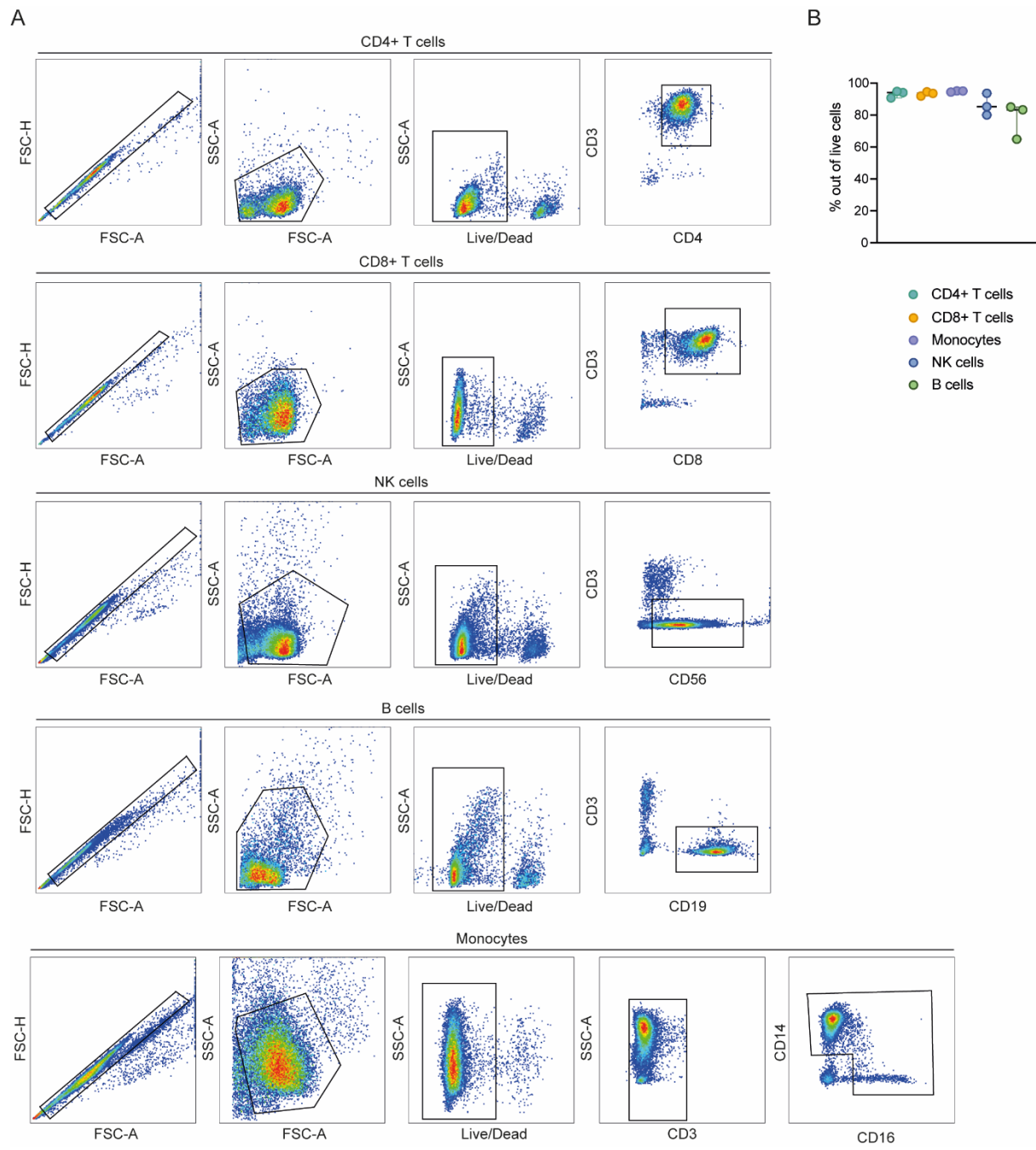**Supplementary Fig. S2.** Cell proportions identified by DCQ

Supplementary Fig. S3. Change in gene expression (log TPM) in different severity groups in a different module.

Supplementary Fig. S4. A. Viral load (log$_{10}$) on the day of hospitalization (T0). **B.** Rate of viral load decline in different severity groups at the discharge from hospital (T1). The rate was calculated as follows: 100 * ([(Viral load at T1- Viral load at T0) / Viral load at T0T1]*100

Supplementary Fig. S5. gene set enrichment analysis by PIANO in five different immune cells.

Supplementary Fig. S6. Cell purity of different immune cells