

**Supplementary Table 4. Instrument retention after allele-frequency-difference filtering across MR gene–cell type pairs**

Gene-cell type pair	original_nsnp	nsnp_after_EAF_0.10	nsnp_after_EAF_0.20	max_delta_eaf
cd8et__CD8 Effector memory__SLC25A29	2	0	1	0.231
dc__Dendritic Cell__AGER	2	0	1	0.222
nk__Natural Killer Cell__EIF2A	2	0	1	0.281
nk__Natural Killer Cell__SLC25A29	2	0	2	0.177
bin__Naive/Immature B Cell__EBPL	2	1	1	0.309
bin__Naive/Immature B Cell__WARS	2	1	2	0.152
cd4et__CD4 Effector memory/TEMRA__TMEM258	2	1	1	0.265
cd4nc__CD4 Naive/Central memory T cell__MAST4	2	1	2	0.109
cd4nc__CD4 Naive/Central memory T cell__TNFSF13B	2	1	1	0.324
cd4sox4__CD4 SOX4 T cell__HLA-DRB5	2	1	2	0.141
cd8et__CD8 Effector memory__FBXO2	2	1	2	0.125
cd8nc__CD8 Naive/Central memory T cell__PARP14	2	1	1	0.487
cd8s100b__CD8 S100B T cell__ZBTB9	3	1	2	0.204
cd4nc__CD4 Naive/Central memory T cell__POLR1D	2	2	2	0.059
dc__Dendritic Cell__APOM	5	2	5	0.126
nkr__Natural Killer Recruiting Cell__HLA-DQA2	3	2	2	0.212
bin__Naive/Immature B Cell__HLA-DQA2	6	3	5	0.210
cd8et__CD8 Effector memory__HLA-DQA1	4	3	3	0.214