

Article

Magnetic Enrichment of SARS-CoV-2 Antigen-Binding B Cells for Analysis of Transcriptome and Antibody Repertoire

Maureen Banach ¹, Isaac T. W. Harley ^{1,2,3}, Mary K. McCarthy ¹, Cody Rester ¹, Adonis Stassinopoulos ⁴, Ross M. Kedl ¹, Thomas E. Morrison ¹ and John C. Cambier ^{1,*}

Citation: Banach, M.; Harley, I.T.W.; McCarthy, M.K.; Rester, C.; Stassinopoulos, A.; Kedl, R.M.; Morrison, T.E.; Cambier, J.C. Magnetic Enrichment of SARS-CoV-2 Antigen-Binding B Cells for Analysis of Transcriptome and Antibody Repertoire. *Magnetochemistry* **2022**, *8*, 23. <https://doi.org/10.3390/magnetochemistry8020023>

Academic Editor: Marie Frenea-Robin

Received: 1 December 2021

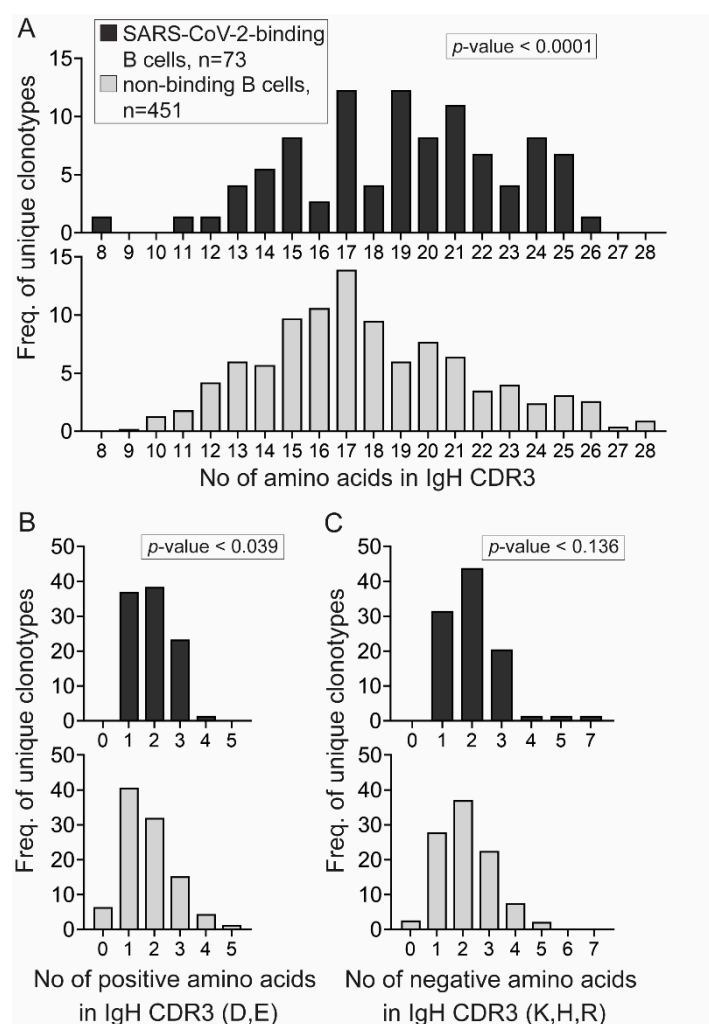
Accepted: 20 December 2021

Published: 5 February 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).



Supplementary Figure S1. Characteristics of IgH CDR3 segment from SARS-CoV-2 antigen-binding B cells. (A) Skewed length of IgH CDR3 segment in SARS-CoV-2 antigen-binding B cells compared to non-binding B cells. Non-binding B cells (median = 18, sum of ranks = 610), SARS-CoV-2 antigen-binding B cells (median = 3, sum of ranks = 293), $p < 0.0001$. **(B)** Composition of positively charged amino acid residues in heavy CDR3. Non-binding B cells (median = 49, sum of ranks = 52), SARS-CoV-2 antigen-binding B cells (median = 9, sum of ranks = 26), $p < 0.039$. **(C)** Composition of negatively charged amino acid residues in heavy CDR3. Non-binding B cells (median = 23, sum of ranks = 82.5), SARS-CoV-2 antigen-binding B cells (median = 1, sum of ranks = 53.5), $p < 0.136$. All tests were two-tailed Mann-Whitney U-test for similarity of distribution.

Supplementary Table S1. List of 45 out of 266 differentially and significantly expressed genes between SARS-CoV-2 antigen-binding B cells from seropositive donor 1 and non-binding B cells from seronegative donor.

Gene name	Gene ID	log ₂ fold change	p-value
ARPC1B	ENSG00000130429	3.8	1.3×10^{-19}
SELL	ENSG00000188404	4.1	6.9×10^{-19}
UCP2	ENSG00000175567	3.6	6.5×10^{-18}
ACTG1	ENSG00000184009	3.6	4.9×10^{-17}
RAC2	ENSG00000128340	3.2	6.5×10^{-15}
LSP1	ENSG00000130592	3.2	6.5×10^{-15}
CD53	ENSG00000143119	3.2	3.8×10^{-14}
OAZ1	ENSG00000104904	2.9	5.4×10^{-14}
CNN2	ENSG00000064666	2.8	5.1×10^{-13}
TKT	ENSG00000163931	2.9	1.1×10^{-11}
CORO1A	ENSG00000102879	2.5	2.4×10^{-11}
S100A10	ENSG00000197747	2.8	1.0×10^{-10}
CAPZB	ENSG00000077549	2.5	2.6×10^{-10}
PFN1	ENSG00000108518	2.3	3.2×10^{-10}
ARHGDIB	ENSG00000111348	2.4	4.0×10^{-10}
CD79B	ENSG00000007312	2.6	1.6×10^{-9}
CLIC1	ENSG00000213719	2.3	3.5×10^{-9}
ACTB	ENSG00000075624	2.2	6.1×10^{-9}
SNHG5	ENSG00000203875	2.3	8.1×10^{-9}
TMSB10	ENSG00000034510	2.1	1.5×10^{-8}
TMSB4X	ENSG00000205542	2.0	3.8×10^{-7}
GAPDH	ENSG00000111640	1.9	2.1×10^{-6}
LTB	ENSG00000227507	1.8	2.4×10^{-6}
MS4A1	ENSG00000156738	1.9	2.5×10^{-6}
IER2	ENSG00000160888	1.9	5.3×10^{-6}
PTPRCAP	ENSG00000213402	1.8	6.1×10^{-6}
NCF1	ENSG00000158517	1.9	1.1×10^{-5}
HLA-DQA1	ENSG00000196735	1.7	1.6×10^{-5}
COTL1	ENSG00000103187	1.9	2.6×10^{-5}
PRR13	ENSG00000205352	1.7	7.9×10^{-5}
CRIP1	ENSG00000213145	1.8	9.3×10^{-5}
ARPC3	ENSG00000111229	1.6	9.7×10^{-5}
CFL1	ENSG00000172757	1.6	9.8×10^{-5}
FCER2	ENSG00000104921	1.7	1.8×10^{-4}
S100A4	ENSG00000196154	2.2	3.5×10^{-4}
NME2	ENSG00000243678	1.5	5.0×10^{-4}
MYL12A	ENSG00000101608	1.5	5.4×10^{-4}
HLA-DMB	ENSG00000242574	1.5	6.4×10^{-4}
GPSM3	ENSG00000213654	1.5	9.2×10^{-4}
LY6E	ENSG00000160932	1.5	1.5×10^{-3}
HLA-DRB5	ENSG00000198502	-2.1	1.2×10^{-3}
CXCR4	ENSG00000121966	-2.0	1.3×10^{-3}
FTH1	ENSG00000167996	-1.5	1.1×10^{-2}

TSC22D3	ENSG00000157514	−1.6	2.2×10^{-2}
CD83	ENSG00000112149	−1.5	4.0×10^{-2}

Supplementary Table S2. List of six out of 240 differentially and significantly expressed genes between SARS-CoV-2 antigen-binding B cells from seropositive donor 2 and non-binding B cells from seronegative donor.

Gene name	Gene ID	log ₂ fold change	p-value
G0S2	ENSG00000123689	8.1	4.6×10^{-3}
ACTG1	ENSG00000184009	1.9	4.6×10^{-3}
LYZ	ENSG00000090382	6.9	5.3×10^{-3}
NEAT1	ENSG00000245532	3.0	8.9×10^{-3}
S100A4	ENSG00000196154	2.5	2.1×10^{-2}
TSC22D3	ENSG00000157514	−2.3	4.2×10^{-2}

Supplementary Table S3. Thirty-five unique and unambiguous genes with significantly increased or decreased expression in B cell subcluster 1 and subcluster 3.

Gene name	Gene ID	subcluster 1		subcluster 3	
		log ₂ fold change	p-value	log ₂ fold change	p-value
ACTG1	ENSG00000184009	2.8	4.0×10^{-15}	−2.4	8.6×10^{-10}
COTL1	ENSG00000103187	2.0	9.6×10^{-10}	−2.0	2.4×10^{-8}
GAPDH	ENSG00000111640	1.9	2.1×10^{-8}	−1.8	3.0×10^{-7}
PFN1	ENSG00000108518	1.6	1.1×10^{-6}	−1.2	1.2×10^{-3}
ACTB	ENSG00000075624	1.6	2.3×10^{-6}	−1.2	1.4×10^{-3}
ARHGDIB	ENSG00000111348	1.5	1.0×10^{-5}	−0.9	6.4×10^{-2}
CORO1A	ENSG00000102879	1.5	1.1×10^{-5}	−1.1	6.7×10^{-3}
CRIP1	ENSG00000213145	1.5	5.6×10^{-5}	−0.9	9.1×10^{-2}
TMSB10	ENSG00000034510	1.4	6.9×10^{-5}	−0.8	9.8×10^{-2}
CLIC1	ENSG00000213719	1.4	1.3×10^{-4}	−1.0	2.4×10^{-2}
TMSB4X	ENSG00000205542	1.3	3.1×10^{-4}	−0.8	8.1×10^{-2}
MS4A1	ENSG00000156738	1.2	2.0×10^{-3}	−0.4	8.1×10^{-1}
PTPRCAP	ENSG00000213402	1.2	1.9×10^{-3}	−0.8	1.2×10^{-1}
NME2	ENSG00000243678	1.1	4.4×10^{-3}	−1.0	1.6×10^{-2}
LTB	ENSG00000227507	1.1	5.4×10^{-3}	−1.0	2.0×10^{-2}
CFL1	ENSG00000172757	1.1	5.3×10^{-3}	−0.8	7.9×10^{-2}
MEF2C	ENSG00000081189	1.1	7.8×10^{-3}	−0.6	5.4×10^{-1}
MIF	ENSG00000240972	1.0	1.0×10^{-2}	−0.6	3.8×10^{-1}
SH3BGRL3	ENSG00000142669	1.0	1.5×10^{-2}	−0.6	4.5×10^{-1}
ARPC2	ENSG00000163466	0.9	2.3×10^{-2}	−0.6	4.7×10^{-1}
YWHAB	ENSG00000166913	0.9	3.1×10^{-2}	−0.5	6.2×10^{-1}
PSME1	ENSG00000092010	0.9	4.4×10^{-2}	−0.7	2.9×10^{-1}
SMCHD1	ENSG00000101596	−0.5	5.6×10^{-1}	1.0	1.9×10^{-2}
PPP1R15A	ENSG00000087074	−0.7	2.9×10^{-1}	1.0	2.7×10^{-2}

JUN	ENSG00000177606	−0.8	1.6×10^{-1}	1.1	8.9×10^{-3}
FOXP1	ENSG00000114861	−0.9	7.5×10^{-2}	1.0	1.3×10^{-2}
BTG1	ENSG00000133639	−1.0	4.7×10^{-2}	1.1	3.8×10^{-3}
EIF1B	ENSG00000114784	−1.0	4.2×10^{-2}	0.8	1.0×10^{-1}
CD69	ENSG00000110848	−1.1	2.5×10^{-2}	1.3	5.3×10^{-4}
CD83	ENSG00000112149	−1.2	1.0×10^{-2}	1.0	1.2×10^{-2}
DUSP1	ENSG00000120129	−1.2	7.9×10^{-3}	1.3	8.2×10^{-4}
TSC22D3	ENSG00000157514	−1.3	4.0×10^{-3}	1.2	1.8×10^{-3}
FTH1	ENSG00000167996	−1.5	3.4×10^{-4}	1.0	1.5×10^{-2}
CXCR4	ENSG00000121966	−1.6	9.4×10^{-5}	1.2	1.8×10^{-3}
FOS	ENSG00000170345	−1.9	4.1×10^{-5}	2.1	1.6×10^{-8}
