

SARS-CoV-2 Research Summary

Omicron (BA.1) and Cellular Immunity

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Introduction

The rapid rise of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [Omicron](#) variant of concern ([VOC](#)), has led to a large number of studies detailing this variant's ability to escape neutralization by cellular immunity, which is largely mediated by CD8+ T-cells. Studies have focused on T-cell immunity induced either by various vaccines or through previous infections. Below we have compiled a list of studies and provide a brief summary of the main themes.

Major Conclusions

- While Omicron appears to have significant immune escape from B-cell-generated antibodies elicited by previous infection or vaccination due to the specific mutations in spike, T-cell epitopes found in spike and non-spike proteins remain largely intact.
- All 8 studies listed below showed that cellular immunity elicited either through vaccination or through previous infection, remained durable despite some decrease in reactivity.
- One study identified a minority of individuals with >50% reduction in T cell reactivity to the Omicron spike.
- Overall evidence points to current vaccines providing significant cellular immune protection against Omicron, despite a reduction in the humoral immune response.

[1. Liu, J., Chandrashekar, A., Sellers, D., Barrett, J., Jacob-Dolan, C., Lifton, M., McMahan, K., Sciacca, M., VanWyk, H., Wu, C., Yu, J., Collier, A. Y., & Barouch, D. H. \(2022\). Vaccines Elicit Highly Conserved Cellular Immunity to SARS-CoV-2 Omicron. *Nature* 2022, 1–7.](#)

Summary: This study compared the ability of vaccine (Ad26.COV2.S or BNT162b2) elicited cellular immunity to respond to the Omicron variant. Results showed that cellular immunity was highly cross reactive against Omicron, with vaccines showing durable CD8+ and CD4+ T cell responses.

[2. Marco, L. De, D'Orso, S., Pirronello, M., Verdiani, A., Termine, A., Fabrizio, C., Capone, A., Sabatini, A., Guerrera, G., Placido, R., Sambucci, M., Angelini, D. F., Giannessi, F., Picozza, M., Caltagirone, C., Salvia, A., Volpe, E., Balice, M. P., Rossini, A. Santa Lucia Foundation, R. I. \(2021\). Preserved T cell reactivity to the SARS-CoV-2 Omicron variant indicates continued protection in vaccinated individuals. *BioRxiv*, 2021.12.30.474453.](#)

Summary: This study compared the ability of vaccine (BNT162b2, mRNA-1273, Ad26.COV2.S, ChAdOx1-S), virus, or heterologous elicited cellular immunity to respond to the Omicron variant. Although T cell responses to peptides relevant to Omicron were decreased by over 47% compared to the ancestral SARS-CoV-2 virus, overall reactivity was largely maintained.

[3. Alison Tarke, A., Coelho, C. H., Zhang, Z., Dan, J. M., Dawen Yu, E., Methot, N., Bloom, N. I., Goodwin, B., Phillips, E., Mallal, S., Sidney, J., Filaci, G., Weiskopf, D., da Silva Antunes, R., Crotty, S., Grifoni, A., & Sette, A. \(2021\). SARS-CoV-2 vaccination induces immunological memory able to cross-recognize variants from Alpha to Omicron. *BioRxiv*, 2021.12.28.474333. <https://doi.org/10.1101/2021.12.28.474333>](#)

Summary: This study analyzed T cell responses elicited by vaccines (mRNA-1273, BNT162b2, Ad26.COV2.S, NVX-CoV2373) against multiple SARS-CoV-2 variants including Omicron. Results showed preservation of at least 83% and 85% for CD4+ and CD8+ T cell responses, respectively, regardless of vaccine platform or variants analyzed.

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[4. GeurtsvanKessel, C. H., Geers, D., Schmitz, K. S., Mykytyn, A. Z., Lamers, M. M., Boegers, S., Gommers, L., Sablerolles, R. S. G., Nieuwkoop, N. N., Rijsbergen, L. C., Dijk, L. L. A. van, Wilde, J. de, Alblas, K., Breugem, T. I., Rijnders, B. J. A., Jager, H. de, Weiskopf, D., Kuy, P. H. M. van der, Sette, A., ... Vries, R. D. de. \(2021\). Divergent SARS CoV-2 Omicron-specific T- and B-cell responses in COVID-19 vaccine recipients. MedRxiv, 2021.12.27.21268416.](#)

This study analyzed T and B- cell responses elicited by vaccines (ChAdOx-1 S, Ad26.COVS.2.S, mRNA-1273 or BNT162b2) against multiple SARS-CoV-2 variants including Omicron. Results showed that the T cell immunity elicited in vaccinated individuals was effective against Omicron, despite a significant decrease in neutralizing antibodies.

[5. Keeton, R., Tincho, M. B., Ngomti, A., Baguma, R., Benede, N., Suzuki, A., Khan, K., Cele, S., Bernstein, M., Karim, F., Madzorera, S. V., Moyo-Gwete, T., Mennen, M., Skelem, S., Adriaanse, M., Mutithu, D., Aremu, O., Stek, C., Bruyn, E. du, ... Riou, C. \(2021\). SARS-CoV-2 spike T cell responses induced upon vaccination or infection remain robust against Omicron. MedRxiv, 2021.12.26.21268380.](#)

This study analyzed T- cell responses elicited by vaccines (Ad26.COVS.2.S or BNT162b2) or infection against the SARS-CoV-2 Omicron variant. Results indicated that 70-80% of the CD4 and CD8 T cell response against Omicron spike was maintained.

[6. Gao, Y., Institutet, K., Cai, C., Grifoni, A., Müller, T., Niessl, J., Olofsson, A., Humbert, M., Hansson, L., Österborg, A., Bergman, P., Chen, P., Olsson, A., Sandberg, J. K., Weiskopf, D., Price, D. A., Ljunggren, H.-G., & Karlsson, A. C. \(2022\). Ancestral SARS-CoV-2-specific T cells cross-recognize Omicron \(B.1.1.529\).](#)

This study analyzed T-cell responses elicited by vaccines (BNT162b2) or infection against the SARS-CoV-2 Omicron variant. Results indicated that established SARS-CoV-2 spike-specific CD4+ and CD8+ T cell responses, especially after mRNA vaccination, were largely intact against Omicron.

[7. Naranbhai, V., Nathan, A., Kaseke, C., Berrios, C., Khatri, A., Choi, S., Getz, M. A., Tano-Menka, R., Ofoman, O., Gayton, A., Senjobe, F., Denis, K. J. S., Lam, E. C., Garcia-Beltran, W. F., Balazs, A. B., Walker, B. D., Iafrate, A. J., & Gaiha, G. D. \(2022\). T cell reactivity to the SARS-CoV-2 Omicron variant is preserved in most but not all prior infected and vaccinated individuals. MedRxiv, 2022.01.04.21268586.](#)

This study analyzed T-cell responses elicited by vaccines (BNT162b2) or infection against the SARS-CoV-2 Omicron variant. Results indicated that T cell responses in individuals with prior infection, vaccination, or both were largely preserved against Omicron spike and non-spike proteins. However, ~21% of individuals showed a >50% reduction in T cell reactivity to the Omicron spike.

[8. Cohen, H., Rotem, S., Elia, U., Bilinsky, G., Levy, I., Chitlaru, T., & Bar-Haim, E. \(2022\). T cell response following anti COVID-19 BNT162b2 vaccination is maintained against the SARS-CoV-2 Omicron B.1.1.529 variant of concern. BioRxiv, 2022.01.19.476497.](#)

This study analyzed T-cell responses elicited by vaccines (2 or 3 doses of BNT162b2) to ancestral and Omicron spike proteins. Results indicated comparable levels of reactivity to both ancestral and Omicron spike proteins.

[9. Bernasconi, A., Pinoli, P., Khalaf, R. Al, Alfonsi, T., Canakoglu, A., Cilibrasi, L., & Ceri, S. \(n.d.\). Report on Omicron Spike mutations on epitopes and immunological/ epidemiological/kinetics effects from literature - SARS-CoV-2 coronavirus / nCoV-2019 Genomic Epidemiology - Virological. Retrieved February 4, 2022.](#)

This study performed an *in silico* analysis of Omicron spike mutations in B- and T- cell epitopes. Results indicated that mutations affected: 348 IEDB T cell epitopes (27.29% of the total) and 550 IEDB B cell epitopes (30.91% of the total).

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[10. Ahmed, S. F., Quadeer, A. A., & McKay, M. R. \(2021\). SARS-CoV-2 T cell responses are expected to remain robust against Omicron. BioRxiv, 2021.12.12.472315.](#)

This study performed an *in silico* analysis of Omicron spike mutations in T- cell epitopes, concluding that T cell responses were likely to remain robust against Omicron.