Current COVID-19 vaccines induce robust cellular immunity against Omicron variant, researchers demonstrate

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On January 11, the United States reported a record-breaking 1.35 million new COVID-19 infections, shattering the previous record set just eight days before. The sky-high case rate—roughly four times higher than numbers of daily infections seen last January—are a testament to the

transmissibility of the Omicron variant. A highly mutated version of SARS-CoV-2, the virus that causes COVID-19, the Omicron variant has been shown to cause breakthrough infections among the vaccinated thanks to its ability to evade the virus-killing neutralizing antibodies that the body makes in response to getting vaccinated.

However, a new study by researchers at Beth Israel Deaconess Medical Center (BIDMC) demonstrated that cellular immunity—or the production of protective immune cells, such as so-called killer and memory cells—induced by current COVID-19 vaccines provided robust protection against severe disease caused by both the Delta and Omicron variants. The team assessed samples from 47 individuals vaccinated with either the Johnson & Johnson or Pfizer-BioNTech vaccines. The findings are published in *Nature*.

"Our data provide immunological context for the observation that current vaccines still provide robust protection against severe disease and hospitalization due to the Omicron variant despite substantially reduced neutralizing antibody responses and increased breakthrough infection," said corresponding author Dan H. Barouch, MD, Ph.D., director of the Center for Virology and Vaccine Research at BIDMC, whose team was involved in the development of the Johnson & Johnson vaccine.

Using samples from uninfected individuals who received either the Johnson & Johnson or Pfizer-BioNTech vaccines, Barouch and colleagues measured CD8+ T cell and CD4+ T cell responses to the original, Delta and Omicron strains of the SARS-CoV-2 virus after one month and then again after eight months following final vaccination. They likewise assessed antibody responses to the variants at one and eight months out.

Consistent with previous reports, the scientists observed minimal cross-reactive Omicron-specific neutralizing antibodies. In contrast, the team's

data suggested that Omicron-specific CD8+ T cell responses were more than 80 percent cross-reactive with the CD8+ T cell response to the original strain of the virus. Similarly, more than 80 percent of Omicron-specific CD4+ T cells demonstrated cross-reactivity, although responses could vary among individuals, the scientists note.

"Given the role of CD8+ T cells in clearance of viral infections, it is likely that cellular immunity contributes substantially to vaccine protection against severe SARS-CoV-2 disease," said Barouch, who is also professor of medicine at Harvard Medical School and a member of the Ragon Institute of MGH, MIT, and Harvard. "This may be particularly relevant for Omicron, which dramatically evades neutralizing antibody responses.

Co-authors included co-first authors Jinyan Liu, Abishek Chandrashekar and Daniel Sellers of BIDMC, as well as Julia Barrett, Catherine Jacob-Dolan, Michelle Lifton, Katherine McMahan, Michaela Sciacca, Haley VanWyk, Cindy Wu, Jingyou Yu, and Ai-ris Y. Collier, of BIDMC.

More information: Jinyan Liu et al, Vaccines Elicit Highly Conserved Cellular Immunity to SARS-CoV-2 Omicron, *Nature* (2022). DOI: 10.1038/s41586-022-04465-y

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