Vaccine efficacy against the SARS-CoV-2 Delta variant during a COVID-19 outbreak aboard a military ship

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Nowadays, vaccination has become the main tool in the strategy to fight COVID-19 as it reduces the severity of the disease,[1] the infectiousness of infected cases and the circulation of the virus by contributing to achieving herd immunity.[2] We report the investigation of a COVID-19 outbreak that occurred among the 91 crew members of a French Navy ship from May to July 2021. Before the mission, 87% of the crew were immune: 57% were fully vaccinated with the BNT162b2 vaccine in April–May 2021, 30% had had a previous SARS-CoV-2 infection less than three months before (Alpha or Beta variants) and were not vaccinated (recovered), and 13% had no immunity at all. All had been tested with Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) and were negative, so that face masks were not mandatory on board. Once the mission began, an RT-PCR test was required for any crew members who had symptoms, for the entire crew before disembarking, and for those who were still negative seven days later at the end of the quarantine period. We studied the outbreak dynamics based on the epidemic curve and the instantaneous reproduction rate (Rt).[3]

From 27 June to 12 July, 47 RT-PCR-confirmed cases occurred (Figure 1). All cases were men, the median age was 26 years and none was immunocompromised. As expected, previous immunity, especially vaccine-induced immunity, decreased the intensity of COVID-19: all non-immune cases had symptoms, whereas 93% of recovered and 84% of vaccinated individuals did. The median duration of symptoms was 10 days among the non-immune, four days among the recovered and five days among vaccinated cases. The main symptoms were headache (75%), asthenia (65%), rhinitis (52%), cough (48%), myalgia (44%), mild dyspnoea (27%), anosmia (33%), fever (33%), ageusia (23%) and diarrhoea (10%).

From a public health point of view, previous immunity led to decreased incidence, which was 67% (eight of 12) for the non-immune, 52% (14 of 27) for recovered individuals and 48% (25 of 52) for those who were vaccinated. However, it did not prevent viral circulation on board (Rt >1); the reinfection rate was 48.3% (15 of 31), the infection rate among the vaccinated was 48.0% (25 of 52) and vaccine efficacy was 39.4% (95% CI 27.1 to 50.9), lower than the >80% expected.[2] The high viral load present in a confined ambient air (highlighted by the detection of SARS-CoV-2 RNA in the air conditioning system) may have been implicated.

Moreover, among vaccinated cases, the low median cycle threshold (Ct) value of the RT-PCR (23) and the high proportion of individuals with symptoms were compatible with their infectiousness.

The specific immune response following infection with coronaviruses or following vaccination decreases after a few months, which has led to the recommendation for a third dose of the vaccine.[4] Here, the outbreak occurred only two months after crew members had received the second dose so that we suspected a new variant capable of evading immunity. Viral genome sequencing identified the Delta variant. Indeed, virus neutralisation of Delta may be four to five times lower than for Alpha.[5]

Finally, reintroducing mandatory face masks and isolating COVID-19 symptomatic cases made it possible to end viral circulation (Rt <1). These preventive measures remain necessary to prevent viral circulation in immune populations in confined environments such as on a ship or in case of an outbreak.

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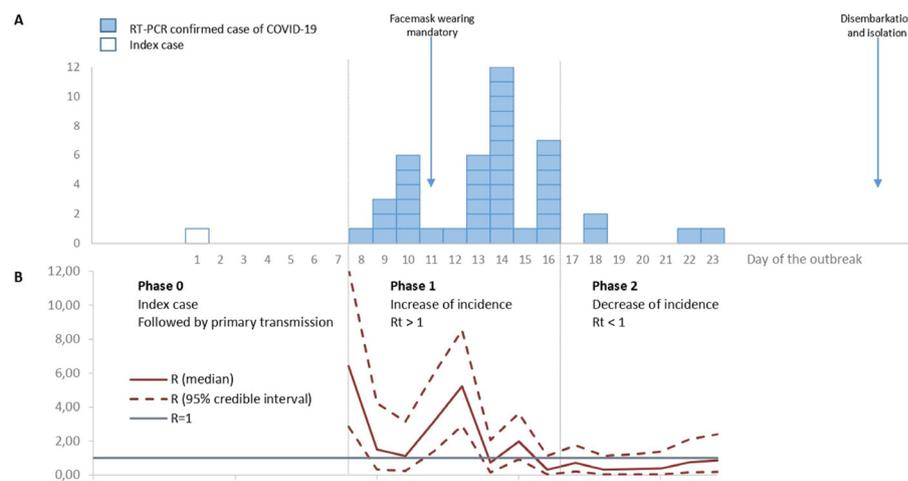
Figure 1 (A) Epidemic curve of symptomatic COVID-19 cases according to date of symptom onset, June–July 2021, COVID-19 outbreak on a ship (n=42). (B) Reproduction rate (Rt) averaged over time periods. RT-PCR: Reverse Transcriptase Polymerase Chain Reaction

Participants gave informed consent to participate in the investigation before taking part.

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