Effectiveness of mRNA BNT162b2 COVID-19 vaccine against SARS-CoV-2 Delta variant among elderly residents from a long-term care facility, South of France, May 2021

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Abstract. – OBJECTIVE: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Delta variant was classified as a variant of concern in May 2021 due to its increased transmissibility. It became dominant in Europe during the summer, raising concerns on the effectiveness of vaccines. We assessed the vaccine effectiveness (VE) of mRNA BNT162b2 (BioNTech-Pfizer) against SARS-CoV-2 Delta variant during an outbreak affecting long-term care facility (LTCF) residents in southern France, May 2021.

MATERIALS AND METHODS: We conducted a retrospective cohort study among LTCF residents. We described sex, age, dependency level, reverse transcription PCR and sequencing results, clinical evolution, vaccination status. We compared attack rates of SARS-CoV-2 infection, symptomatic coronavirus disease 2019 (COVID-19), and severe COVID-19 (respiratory support, hospitalization, and/or death) by vaccination status (two doses administered vs. none) to estimate VE (1 – Relative Risk [RR]) with 95% confidence intervals (CI). VE was adjusted by age (Poisson regression).

RESULTS: Among 72 LTCF residents, 75.0% (n=54) were women, mean age was 88.7 (SD 8.1) years, 69% (n=49/71) were severely dependent. SARS-CoV-2 infections were identified in 39 residents (54.2%), 11 with symptomatic, and eight with severe COVID-19. All sequenced samples (n=19, 48.7%) had the same Delta variant genomic sequence. Age-adjusted BNT162b2 VE against SARS-CoV-2 Delta variant infection was 11.2% (95% CI: 0.0-61.1%), it was 88.4% (95% CI: 59.9-96.7%) against symptomatic, and 93.5% (95% CI: 67.2-98.7%) against severe COVID-19.

CONCLUSIONS: We found a high BNT162b2 VE against symptomatic and severe COVID-19 caused by SARS-CoV-2 Delta variant among LTCF elderly residents, but not against Delta variant infection. This supports vaccination roll-out and the implementation of control measures for close contacts among vaccinated LTCF elderly residents.


Introduction

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Delta variant was classified as a variant of concern (VOC) in May 2021 due to its increased transmissibility. It became dominant in most European countries during the summer, raising concerns on the effectiveness of vaccines. Several studies¹-⁸ assessed the vaccine effectiveness (VE) of mRNA BNT162b2 (BioNTech-Pfizer) against SARS-CoV-2 Delta variant or during the Delta-dominance period. VE against infection ranged from 42% to 93%, with a waning effect observed over time since vaccination. VE against symptomatic coronavirus disease 2019 (COVID-19) and related hospitalization ranged from 75% to 96%; respectively¹-³,⁹,¹⁰. However, BNT162b2 VE against Delta variant among long-term care facility (LTCF) residents is not well understood yet, with one study reporting a VE against infection of 52% (95% CI: 48-56%). Further real-world evidence is needed, especially considering that
LTCF elderly residents are at higher risk of severe disease.

On 10 May 2021, residents from a LTCF were reported to have SARS-CoV-2 infections to the regional health authority and the national public health agency in Provence-Alpes-Côte d’Azur, France. We described the outbreak, estimated mRNA BNT162b2 VE against SARS-CoV-2 Delta variant, and explored risk factors contributing to symptomatic COVID-19 among LTCF residents.

Materials and Methods

We conducted a retrospective cohort study and followed the cohort from SARS-CoV-2 introduction to the LTCF on May 3 to 14 days after the last diagnosis date on June 11, as per national protocols.

We collected data on age, sex, dependency level (severe, non-severe), LTCF unit, immunization status, reverse transcription PCR (RT-PCR) and next generation sequencing results, and clinical evolution. LTCF units were grouped into two categories: dementia unit (hosting residents unable to follow control measures) and other units (where control measures were implemented). Vaccination status comprised fully vaccinated (two doses of vaccine administered ≥14 days before May 3) and unvaccinated residents (no dose administered and no previous SARS-CoV-2 infection). We compared attack rates (AR) of SARS-CoV-2 infection, symptomatic, and severe COVID-19 (with respiratory support, hospitalization, or death reported) by vaccination status to estimate VE [1 - Relative Risk (RR)] with 95% confidence intervals (CI). Results were adjusted by age using Poisson regression. Stratified analysis assessed risk factors contributing to symptomatic COVID-19; AR of symptomatic COVID-19 in vaccinated and unvaccinated residents were compared by sex, age group (<90, ≥90 years old), dependency level, LTCF unit (Fisher’s exact test). We estimated VE against symptomatic COVID-19 for covariates where significant AR differences were found (p<0.05). Information on staff was limited to RT-PCR and sequencing results. Hence, VE could not be estimated.

As per approval by the National Ethical Committee, the Regional Health Authority (Agence Régionale de Santé) and the National Public Health Agency (Santé publique France) have continual access to personal data to investigate and control identified public health threats. No additional ethical clearance was needed or sought. Personal information was anonymized in this publication.

Results

The LTCF hosted 72 residents, 75.0% (n=54) were women, mean age was 88.7 (SD 8.1) years, 69.0% (n=49/71) were severely dependent and 20.8% (n=15/72) lived in the dementia unit. On May 10, all residents and available staff went through RT-PCR screening; those with negative results were tested on weekly basis until June 7. SARS-CoV-2 infections were identified in 54.2% (n=39) of residents. Of them, 11 (28.2%) had symptomatic COVID-19, eight (20.5%) developed

![Figure 1. SARS-CoV-2 Infections among Residents and Staff from a Long-term Care Facility by Symptom Onset or Diagnosis Date, South of France, May 2021.](image-url)
severe COVID-19, and five (12.8%) died. Symptom onset or diagnosis date (for asymptomatic infections) ranged from May 9 to 28. SARS-CoV-2 infections were identified in 23.1% (n=12/52) of staff. All sequenced samples (n=19 residents, n=1 staff) had the same Delta variant genomic sequence (Figure 1).

The index case was a health professional vaccinated with one dose of COVID-19 vaccine. He/she returned from an Indian Ocean archipelago to France at the end of April, worked in all LTCF units on May 3, and became symptomatic on May 4. RT-PCR confirmed a SARS-CoV-2 infection on May 7, but sequencing could not be performed. On May 3, he/she treated a person unrelated to the LTCF with no other reported COVID-19 contacts. This person was subsequently identified to carry the same SARS-CoV-2 Delta variant genomic sequence as LTCF residents, confirming the index case.

BNT162b2 VE was estimated comparing fully vaccinated and unvaccinated residents (n=68). All vaccinated residents completed vaccination within three months before outbreak onset. Vaccination coverage was 83.8% (n=57/68). Age-adjusted VE was 11.2% (95% CI: 0.0-61.1%) against SARS-CoV-2 Delta variant infection, 88.4% (95% CI: 59.9-96.7%) against symptomatic COVID-19, and 93.5% (95% CI: 67.2-98.7%) against severe COVID-19 (Table I).

Vaccinated residents from the dementia unit had a significantly higher symptomatic COVID-19 AR than vaccinated residents from other units (n=3/10, 30.0% vs. n=3/47, 2.1%; p<0.05). Unvaccinated residents followed the same trend but results were not significant (n=3/3, 100% vs. n=4/8, 50.0%; p>0.05). Age-adjusted VE against symptomatic COVID-19 was 67.7% (95% CI: 0.0-93.6%) among residents from the dementia unit (n=13) and 94.8% (95% CI: 51.0-99.4%) among residents from other units (n=55). We did not find significant differences in symptomatic COVID-19 AR by other covariates.

### Discussion

Our investigations suggest that SARS-CoV-2 Delta variant was imported from an Indian Ocean archipelago and introduced to a LTCF in southern France. We found a high BNT162b2 VE against symptomatic, and severe COVID-19 caused by Delta variant among LTCF elderly residents having received two doses of vaccine, consistently with other published studies in non-LTCF adults. However, BNT162b2 VE against SARS-CoV-2 Delta variant infection was very low, even considering the expected waning of immunity over time, as opposed to estimates found in studies in general and LTCF adult populations. The high risk of infection found among vaccinated LTCF residents could be explained by characteristics of the study population (mean age: 89 years, 69% severely dependent, 21% living in the dementia unit) including potential underlying health conditions. Even if the difference was not significant, a lower VE against symptomatic COVID-19 was found among residents from the dementia unit. This could be related to the fact that such residents were not able to respect isolation and other control measures due to their cognitive impairment.

In France, Delta variant became dominant during the summer of 2021, after the occurrence of the outbreak described in the present study. Since October 2021, booster vaccine doses (beyond a second dose) were administered due to the waning of vaccine-induced immunity against Delta variant. LTCF residents were given priority over other population groups.

### Table I. Effectiveness of mRNA BNT162b2 COVID-19 Vaccine against SARS-CoV-2 Delta Variant among Elderly Residents from a Long-term Care Facility, South of France, May 2021 (n=68).

<table>
<thead>
<tr>
<th></th>
<th>Unvaccinated [reference]</th>
<th>Fully Vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no. residents (n = 11)</td>
<td>no. residents (n = 57)</td>
</tr>
<tr>
<td>SARS-CoV-2 infection</td>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>SymptomaticCOVID-19</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Severe COVID-19</td>
<td>6</td>
<td>2</td>
</tr>
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AR, attack rate; CI, confidence interval; COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; VE, vaccine effectiveness. †VE adjusted by age (Poisson regression).
However, the Omicron VOC became dominant in France in January 2022. The first scientific publications suggested that this variant presents increased transmissibility, yet a lower risk of hospitalization, and less severe symptoms than the Delta VOC\textsuperscript{12-19}. Whereas findings from laboratory and epidemiological studies raised concerns on a potential reduction in VE compared to Delta, several publications showed that VE against severe COVID-19 caused by Omicron remains high after the administration of a booster dose of vaccine\textsuperscript{2-18,20-26}. Consistent with these findings, we observed five times more infections, a hospitalization rate nine times lower and a case fatality rate three times lower among LTCF residents in Provence-Alpes-Côte d’Azur in January 2022 compared to December 2021, when the Delta VOC was still dominant\textsuperscript{27}. An increase in vaccination coverage overtime may have also contributed to these results.

Further research is needed to better understand the effectiveness of COVID-19 vaccines among LTCF residents, considering their increased risk of severe COVID-19 compared to the general population. As the pandemic evolves, it is essential to study the duration of protection against severe COVID-19 caused by the Omicron variant, and the effectiveness of vaccines against new potential VOC in order to adapt recommendations. Hence, maintaining control measures remains of utmost importance in vulnerable population groups regardless of the vaccination status.

Conclusions

At the time of our study little was known about the Delta VOC; therefore, this investigation provided decision-makers with relevant information for the management of the outbreak. This highlights the value of field epidemiology. The high protection conferred by BNT162b2 vaccine against symptomatic and severe COVID-19 stressed the need to roll out vaccination in LTCF. The low VE found against SARS-CoV-2 infection in our study suggests that, in the context of LTCF outbreaks, both vaccinated and unvaccinated close contacts among residents should follow control measures.

Conflict of Interest

M.A. Sánchez Ruiz is an ECDC fellow, supported financially by the ECDC; F. Rapilly, M. Chabert, L. Ramalli, P. Malfait, and P. Chaud are employees at Santé Publique France Provence-Alpes-Côte d’Azur; M. Adonias, A. Robaglia-Shlip, O. Reilhes, and C. Brul are employees at Agence Régionale de Santé Provence-Alpes-Côte d’Azur, France. The views and opinions expressed herein do not state or reflect those of the European Centre for Disease Prevention and Control (ECDC). ECDC is not responsible for the data and information collection and analysis and cannot be held liable for conclusions or opinions drawn. The authors have no known competing financial interests or personal relationships that could have influenced the work reported in this manuscript.

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