However, in cases of cocirculation or switch of VOC with antigenic drift within this period, this minimum retesting interval should be omitted to adequately detect SARS-CoV-2 reinfections.

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References:
1. Mullen JL, Tsueng G, Abdel Latif A, Alkuzweny M, Cano M, Haag E, et al. Outbreak information. A standardized, open-source database of COVID-19 resources and epidemiology data [cited 2022 Feb 4]. https://outbreak.info
2. Kim P, Gordon SM, Sheehan MM, Rothberg MB. Duration of severe acute respiratory syndrome coronavirus 2 natural immunity and protection against the Delta variant: a retrospective cohort study. Clin Infect Dis. 2021 Dec 3 [Epub ahead of print]. https://doi.org/10.1093/cid/ciab999
3. Pulliam JRC, van Schalkwyk C, Govender N, von Gottberg A, Cohen C, Groome MJ, et al. Increased risk of SARS-CoV-2 reinfection associated with emergence of Omicron in South Africa. Science. 2022;376:eabn4947. https://doi.org/10.1126/science.abn4947
4. European Centre for Disease Prevention and Control. Reinfection with SARS-CoV-2: implementation of a surveillance case definition within the EU/EEA [cited 2022 Mar 21]. https://www.ecdc.europa.eu/en/publications-data/reinfection-sars-cov-2-implementation-surveillance-case-definition-within-eea
5. European Commission. EU Digital COVID Certificate. 2022 [cited 2022 May 10]. https://ec.europa.eu/info/live-work-travel-eu/coronavirus-response/safe-covid-19-vaccines-europeans/eu-digital-covid-certificate_en
6. Cuypers L, Baele G, Dellicour S, Maes P, André E. Genomic surveillance of SARS-CoV-2 in Belgium. 2022 [cited 2022 May 10]. https://www.uzleuven.be/nl/laboratoriumgeneeskunde/genomic-surveillance-sars-cov-2-belgium
7. World Health Organization. Classification of Omicron (B.1.1.529): SARS-CoV-2 variant of concern. 2021 [cited 2022 May 10]. https://www.who.int/news/item/26-11-2021-classification-of-omicron-(b.1.1.529)-sars-cov-2-variant-of-concern
8. Vaesen J. Covid Vaccinaties België. 2022 [cited 2022 Mar 21]. https://covid-vaccinatie.be/nl

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Household Secondary Attack Rates of SARS-CoV-2 Omicron Variant, South Korea, February 2022

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We studied the effect of booster vaccinations on reducing household transmission of SARS-CoV-2 B.1.1.529 (Omicron) variant in a February 2022 sampling of contacts in South Korea. The secondary attack rate was lower for vaccinated versus unvaccinated contacts, and booster vaccination resulted in a lower incidence rate ratio.

Since its initial detection in November 2021, the SARS-CoV-2 B.1.1.529 (Omicron) variant has become the dominant strain in South Korea. Its emergence led to a large increase in the number of COVID-19 cases, mainly through household transmission (1,2). In this study, we sought to estimate the effect of booster vaccinations on reducing the household transmission of COVID-19 to guide current COVID-19 mitigation strategy.

This national, retrospective cohort study included all residents in South Korea with laboratory-confirmed SARS-CoV-2 infection reported during February 1–10, 2022. The background population was estimated as 53 million persons according to the 2021 census. Booster vaccinations with mRNA vaccines were provided in October 2021, reaching ≥30 million doses (60% of the total population) by February 2022. We retrieved epidemiologic data, merged with the national immunization registry of household contacts of persons infected with SARS-CoV-2, to describe the difference in secondary attack rates (SARs) by vaccination status. Details of the surveillance system, vaccination program, and dataset employed in this study are described in a previous study (3). Persons who had household contact with laboratory-confirmed SARS-CoV-2–positive patients underwent mandatory PCR testing, regardless of the presence of symptoms, and were put under active surveillance for 10

1These first authors contributed equally to this article.
days. During the quarantine period, PCR testing was mandated when the household contact had symptoms, and testing was performed on day 9 or day 10 if the contact had no symptoms.

We defined an index case-patient as a person with a positive SARS-CoV-2 test result determined through epidemiologic investigation who was most likely not infected in the household, a household contact as a person living in the same home as an index case-patient, and a household-infected case-patient as a person living in the same home as an index case-patient who had a positive PCR test result for SARS-CoV-2. We defined partly vaccinated persons as those who had received the first dose of a 2-dose vaccination regimen ≥14 days and fully vaccinated persons as those who had completed a 2-dose regimen of Pfizer-BioNTech (https://www.pfizer.com), AstraZeneca (https://www.astrazeneca.com), Moderna (https://www.moderna.com), or mix-and-match vaccines (time since vaccination ≥28 days) or those who completed a 1-dose regimen of the Janssen/Johnson & Johnson (https://www.janssen.com) vaccine (time since vaccination ≥14 days) or who received the Pfizer-BioNTech vaccine (34.1%), the Moderna vaccine (32.7%), or a mix-and-match vaccine series (30.4%) (p<0.001). In examining the incidence rate ratio of household contacts according to the vaccination status of the SARS-CoV-2 index case-patients (Figure), we found that booster vaccination in household contacts resulted in a lower incidence rate ratio, irrespective of vaccination status of the index case-patient.

Our findings offer evidence of improved protection against SARS-CoV-2 transmission when household contacts have received booster vaccinations. Transmission occurred in 36.7% (59,982/163,581) of the household contacts we studied, a percentage that falls within the range of results from similar studies in Denmark (29%–39%) and the United States (67.8%) (4,5). Another study demonstrated an association between booster vaccination with mRNA vaccines and protection against symptomatic Omicron infection (6). Consistent with these findings, our observations suggest that booster vaccination offers a higher level of protection against Omicron infection when household contacts are vaccinated and boosted.

### Table. Household contacts, household infected cases, and secondary attack rate of SARS-CoV-2 Omicron variant, South Korea, February 1–10, 2022

| Characteristic | No. household contacts | No. household infection cases | Secondary attack rate, % |
|---------------|------------------------|-------------------------------|-------------------------|
| Total         | 163,581                | 59,982                        | 36.7                    |
| Sex           |                        |                               |                         |
| M*            | 80,145                 | 27,595                        | 34.4                    |
| F             | 83,436                 | 32,387                        | 38.8                    |
| Age group, y  |                        |                               |                         |
| 0–11†         | 18,456                 | 10,173                        | 55.1                    |
| 12–17         | 13,266                 | 5,839                         | 44.0                    |
| 18–29         | 26,243                 | 8,497                         | 32.4                    |
| 30–39         | 15,920                 | 7,006                         | 44.0                    |
| 40–49         | 31,477                 | 12,497                        | 39.7                    |
| 50–59         | 33,920                 | 9,302                         | 27.4                    |
| 60–74         | 18,037                 | 5,056                         | 28.0                    |
| >75           | 6,262                  | 1,612                         | 25.7                    |
| Vaccine type† |                        |                               |                         |
| Comirnaty/Pfizer-BioNTech* | 87,296     | 29,808                        | 34.1                    |
| Vaxzevria/AstraZeneca  | 1,638      | 610                            | 37.2                    |
| Spikevax/Moderna    | 19,398     | 6,335                         | 32.7                    |
| Jcovden/Janssen  | 261               | 128                           | 49.0                    |
| Mix-and-match†      | 26,780    | 8,144                         | 30.4                    |
| Unvaccinated      | 28,208            | 14,957                        | 53.0                    |

*p<0.001.
†Pfizer-BioNTech, https://www.pfizer.com; AstraZeneca, https://www.astrazeneca.com; Moderna, https://www.modernatx.com; Janssen/Johnson & Johnson, https://www.janssen.com.
‡Heterologous (mix-and-match) vaccinations with mRNA vaccines were provided to AstraZeneca-primed and Janssen-primed persons.
The first limitation of our study is that surveillance did not clearly distinguish other potential sources of transmission within a household. Exposure outside the household might have led to some secondary cases. Second, difference in testing behavior based on vaccination status might have introduced bias into our findings. If unvaccinated persons have a different probability of getting tested compared with vaccinated persons, our results could be underestimating the true effectiveness of vaccines against household transmission; therefore, results of this study should be interpreted cautiously. Last, results based on such a large population might have produced statistical significance despite small effect size.

In summary, we provide real-world evidence to better understand the effect of booster vaccination in preventing household transmission of the Omicron variant of SARS-CoV-2. Additional studies are needed to determine the effectiveness of booster vaccination in regard to severe infections and deaths across different age groups. However, the higher SAR in younger household contacts we studied supports the need for public health initiatives to extend booster vaccination in younger age groups.

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References
1. Kim EY, Choe YJ, Park H, Jeong H, Chung JH, Yu J, et al. Community transmission of SARS-CoV-2 Omicron variant, South Korea, 2021. Emerg Infect Dis. 2022; 28:989–900. https://doi.org/10.3201/eid2804.220066
2. Song JS, Lee J, Kim M, Jeong HS, Kim MS, Kim SG, et al. Serial intervals and household transmission of SARS-CoV-2 Omicron variant, South Korea, 2021. Emerg Infect Dis. 2022;28:756–9. https://doi.org/10.3201/eid2803.212607
3. Yi S, Choe YJ, Lim DS, Lee HR, Kim J, Kim YY, et al. Impact of national Covid-19 vaccination campaign, South Korea. Vaccine. 2022;40):3670–5. https://doi.org/10.1016/j.vaccine.2022.05.002

4. Madewell ZJ, Yang Y, Longini IM, Halloran ME, Dean NE. Household secondary attack rates of SARS-CoV-2 by variant and vaccination status: an updated systematic review and meta-analysis. JAMA Netw Open. 2022;5:e229317. https://doi.org/10.1001/jamanetworkopen.2022.9317

5. Baker JM, Nakayama JY, O’Hegarty M, McGowan A, Teran RA, Bart SM, et al. SARS-CoV-2 B.1.1.529 (Omicron) variant transmission within households—four U.S. jurisdictions, November 2021–February 2022. MMWR Morb Mortal Wkly Rep. 2022;71:341–6. https://doi.org/10.15585/mmwr.mm7109e1

6. Accorsi EK, Britton A, Fleming-Dutra KE, Smith ZR, Shang N, Derado G, et al. Association between 3 doses of mRNA COVID-19 vaccine and symptomatic infection caused by the SARS-CoV-2 Omicron and Delta variants. JAMA. 2022;327:639–51. https://doi.org/10.1001/jama.2022.0470

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Estimating COVID-19 Vaccine Effectiveness for Skilled Nursing Facility Healthcare Personnel, California, USA

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We estimated real-world vaccine effectiveness among skilled nursing facility healthcare personnel who were regularly tested for SARS-CoV-2 infection in California, USA, during January–March 2021. Vaccine effectiveness for fully vaccinated healthcare personnel was 73.3% (95% CI 57.5%–83.3%). We observed high real-world vaccine effectiveness in this population.