Brief Communication

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# Surveillance of Close Contacts and Implications of Pediatric Patients with COVID-19–Experiences from a Single Residential Treatment Center

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Residential treatment centers (RTCs) are successful in isolating and closely monitoring adults confirmed with coronavirus disease 2019 (COVID-19), but there are concerns for children who need care. This study was conducted as a retrospective analysis of the surveillance of guardians who entered an RTC with infected pediatric patients to identify the secondary attack rate of COVID-19 to close contacts in a single RTC and to provide directions for developing guidelines for caregivers who co-isolate with infected children. When caregivers were admitted to this RTC, aside from negative confirmation before discharge, tests were additionally performed one or two times. There were 57 index children and adolescent patients who entered the RTC with their parents as caregivers. The secondary attack rate by pediatric patients to close contacts outside their households was 25% (95% confidence interval, 10.0 to 40.0) (8 out of 32 contacts). The transmissibility of SARS-CoV-2 in children was close to zero at 6 days after the confirmation tests. It is reasonable to test the close contacts of pediatric patients after 7 days of isolation to identify infections among caregivers.

**Key Words:** COVID-19, residential treatment center, secondary attack rate, children, surveillance, caregivers

Since the first case of the new coronavirus disease 2019 (COVID-19) in the Republic of Korea was confirmed in January 2020, the total number of COVID-19 cases has increased to over 300000 as of September 2021. Initially, the Korean government had implemented a policy that required all confirmed patients to be hospitalized in isolation units, and thus, when the number of infections surged, acute care hospitals had difficulties in accommodating all patients despite maximizing their capacities. To solve the shortage of hospital beds in the pandemic, the concept of an alternate care site (ACS) was been suggested.[1] ACS refers to locations that serve to expand the capacity of a hospital or community to accommodate or care for patients or to protect the general population from infected individuals.[2] The Korean government adopted a dormitory-type model by utilizing training centers at public institutions or private companies and university dormitories as ACSs, which were designated as residential treatment centers (RTCs). These RTCs have been in operation since March 2020, and low-risk patients with asymptomatic or mild symptoms have been isolated at RTCs.[3] The centers successfully facilitated the isolation and monitoring of symptomatic and asymptomatic adults confirmed to have COVID-19.

Experts, however, have raised concerns about the effects and benefits of admitting children to RTCs. While the presentation of COVID-19 in children is usually mild, compared to that in adults,[4] and transmissibility is expected to be low in children, the impact of isolating children at RTCs who are in need of care from guardians on physical and mental health should not be neglected.[5] For these reasons, guidelines for home treatment for pediatric patients have been issued by the Korean government.[6] According to the guidelines, young patients aged 12 years or under can choose home treatment: home treatment com-

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prises constant tele-monitoring of a patient at home by medical workers in the self-isolation period.

There are still many circumstances where home treatment is not possible, and therefore, many families choose to be isolated at RTCs. When a confirmed pediatric patient is released from isolation either at home or at hospitals, a caregiver is required to self-quarantine for an additional 2 weeks. Caregivers should undergo tests before being released from self-quarantine. It is specified that quarantine can be lifted after being confirmed as negative. However, guidelines for a co-isolated person entering isolation units have not been established, and the viral dynamics of isolating patients along with co-isolated people have not been verified. In this study, we aimed to identify the secondary attack rate of COVID-19 from children to close contacts at a single RTC and to provide directions for developing guidelines for caregivers who co-isolate with infected children.

This study was conducted as a retrospective analysis of surveillance data for guardians who entered an RTC with an infected child. When the fourth wave of the COVID-19 pandemic in Korea started, one of the dormitories of a university in Seoul which was operated during the third wave of the outbreak reopened on July 2021. This RTC had 137 rooms and accommodated 274 patients. The size of the rooms patients shared was 3.25×3.96 $m^2$ with a bathroom and two single beds. Patients were required to wear masks and keep distancing unless it was unavoidable. We collected a cluster of pediatric patients who were confirmed with COVID-19 and caregivers who were negative upon arrival at the RTC between July 17, 2021 (date RTC opened) and September 16, 2021. When a caregiver was admitted to the RTC, aside from the negative confirmation before discharge, one or more nasopharyngeal tests with real-time reverse transcription-polymerase chain reaction (RT-PCR) using the Seegene kit (Allplex 2019-nCoV Assay kit, Seegene, Seoul, Korea) were performed when either the doctor in the RTC recommended or caregivers developed upper respiratory symptoms. Demographic, epidemiologic, and clinical data of the clusters, as well as the RT-PCR results of co-isolated people, were reviewed and analyzed. This study was approved by the Institutional Review Board of Severance Hospital (IRB Number: 4-2021-1239), and written consent was waived.

Fifty-seven households of index children and adolescents and their parents as caregivers were admitted to the RTC. In many cases, two people consisting of one child and one parent shared a room, although there were six families where three or four family members shared a room. The baseline characteristics of the index children and their close contacts are shown in Table 1.

Thirty-three percent of patients acquired infection via their households, while 52.6% of patients became infected in settings outside their household. The median number of days of hospitalization in the RTC was 10 days (IQR, 9–10), following treatment guidelines for asymptomatic or mild patients in Korea. A total of 100 tests was performed on the caregivers while in the RTC, and 19 cases were positive. The median days from admission to the test was 6 days (IQR 3–8).

**Table 1.** Demographic and Clinical Characteristics of the Index Pediatric Patients and Their Close Contacts

| | Index patients (n=57) | Close contacts (n=57) |
|---|---|---|
| Age, yr, median (range) | 7 (1–19) | 38 (5–48) |
| 1–5 | 20 (35.1) | 1‡ (1.8) |
| 6–10 | 29 (82.7) | 1§ (1.8) |
| 11–19 | 8 (9.7) | 1‡ (1.8) |
| >20 | - | 54 (94.7) |
| Sex | | |
| Female | 24 (42.1) | 44 (77.2) |
| Male | 33 (57.9) | 13 (22.8) |
| Initial symptom | | |
| Asymptomatic | 16 (28.1) | 73 (100) |
| Symptoms* | 41 (71.9) | 0 |
| Exposure route | | |
| Household | 19 (33.3) | 57 (100) |
| Non-household contact† | 30 (52.6) | 0 |
| Unknown | 8 (14.0) | 0 |
| Days from symptom onset to admit, day, median [IQR] | 1 [1–2] | - |

Data represent the number (%) of patients, unless otherwise indicated.
*Symptoms were mild, including fever, cough, sore throat, and headache, †Non-household contacts included kindergarten staff, baby-sitter, academy teachers, or friends, ‡Each child who was negative upon admission stayed with the index patient and infected father, §The child stayed with the index patient (younger sibling) and their mother who tested negative.

Data on index patients with contacts outside their household who possibly spread the infection to residents in the RTC were obtained. The the secondary attack rate of COVID-19 among children was 25% [95% confidence interval (CI), 10.0 to 40.0] (8 out of 32 contacts). Transmission occurred in five of nine close contacts (55.6%) with index patients under 5 years old and in three of 18 contacts (16.7%) with index patients in the 6- to 10-year-old group. Among the index patients, the median number of days from admission to testing of the caregivers was 3 days (IQR 2.5–4), and all positive tests were performed first upon admission. Caregivers who underwent additional tests until discharge were all confirmed to be negative. The graph of the time point of the SARS-CoV-2 RT-PCR test of caregivers from the confirmatory test of the infected child, age of children, and the test results are shown in Fig. 1. Seven days after confirmation tests, all additional test results were negative, implying that the index patients were less likely to spread the disease.

According to a previous study, no case of transmission from children to adults in an RTC in Korea was confirmed during the last outbreak.[5] However, in this study, we identified eight children with secondary infections within an RTC, and the secondary attack rate of children was 25% (95% CI, 10.0 to 40.0). Variants of SARS-CoV-2 or different sizes and ventilation characteristics between facilities could generate secondary cases. The patients in our study were under medical care from July to September

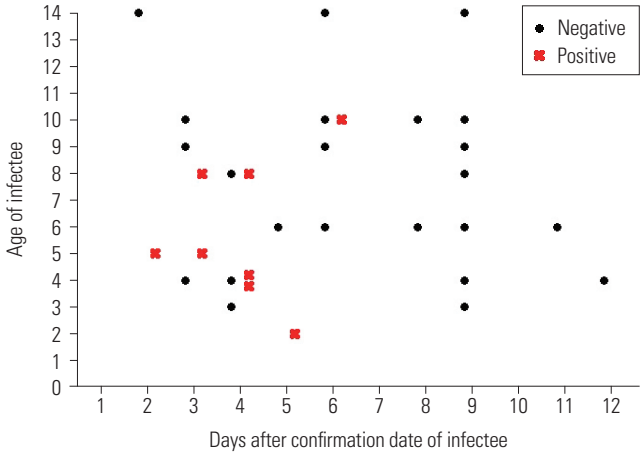


**Fig. 1.** Correlation of the period of SARS-CoV-2 tests of caregivers from the confirmatory test of the infected children, age of children, and the test results.

2021 when the delta variant had become predominant in Korea due to its high transmission rate. Another study in the United States indicated that the secondary attack rate was 45% during a COVID-19 outbreak at an overnight camp.[7] However, since quarantine rules and intensity vary from country to country and the tests were performed and reported voluntarily, it is difficult to compare these results. In addition, the proportion of vaccinated adults could impact outcomes. In our study, caregivers who were usually mothers in their thirties or forties were not expected to be vaccinated according to priority orders. In our study, infants below 5 years of age were more likely to spread the infection to their caregivers than children aged 6 to 10 years without statistical significance due to small samples (odds ratio 6.25, $p$=0.072). It is speculated that infants and preschoolers find it difficult to wear masks and live on their own, resulting in closer contact with caregivers.

Medical practitioners in the RTC performed frequent tests for caregivers since tests in the middle of admission could reduce the total quarantine period of both the children and the caregivers when the results were positive. If the test result of a caregiver before discharge was positive, there would be a problem with the child's care afterward. In our study, the transmissibility of SARS-CoV-2 in children was close to zero at 6 days after the confirmation tests. Therefore, it is reasonable to test close contacts after 7 days of isolation to identify infections in caregivers.

In one meta-analysis, children and adolescents were found to have lower susceptibility to SARS-CoV-2, with an odds ratio of 0.56 for being an infected contact, compared with adults.[8] The risk of SARS-CoV-2 transmission among children and adolescents is likely to be low,[9] and children and adolescents would play a less significant role in the transmission of SARS-CoV-2 at a population level, compared to the 2009 H1N1 pandemic.[10] However, children still infect others without social distancing or other quarantine rules. The secondary attack rates of variant strains estimated from contact tracing data appear to be higher than those of the wild type, but the relative difference between the young and adults seems to be preserved.[11] Considering the collateral damage suffered by children by depriving them of educational opportunities and lower transmission in school-age children than preschoolers or infants under quarantine rules, policies, such as school closures, should be seriously investigated.

Even though COVID-19 vaccination for children and adolescents is being authorized for use, it will take a longer time to increase the vaccination rate. Accordingly, medical evidence that supports vaccination programs for children and rapid return protocols for caregivers is important. Overall, effective quarantine strategies could allow for the attendance of schools and workplaces without a significant increase in COVID-19 related morbidity and mortality.[12]

The limitation of this study is that it was conducted as an observation study at a single treatment center to verify transmission rates according to the age categories of children. A larger multi-center study is warranted to identify the dynamics of SARS-CoV-2 in pediatric patients. Also, vaccination status and emerging variants could affect the transmission rate of children and the results of our study. Notwithstanding, this study could prove helpful to developing strategies for minimizing the burden of COVID-19 infections in all age groups.

## AUTHOR CONTRIBUTIONS

Conceptualization: Yae Jee Baek, Won Suk Chung, and Joon-Sup Yeom. Data curation: Yae Jee Baek and Won Suk Chung. Formal analysis: Yae Jee Baek and Won Suk Chung. Funding acquisition: Joon-Sup Yeom. Investigation: Yae Jee Baek, Jung Ho Kim, Jin Young Ahn, Su Jin Jeong, and Jun Yong Choi. Methodology: Yae Jee Baek, Won Suk Chung, and Joon-Sup Yeom. Project administration: Won Suk Chung and Joon-Sup Yeom. Resources: Won Suk Chung. Software: Yae Jee Baek. Supervision: Joon-Sup Yeom. Validation: Ki Hyun Lee, Eun Hwa Lee, Se Ju Lee, Jinnam Kim, Jung Ho Kim, Jin Young Ahn, Su Jin Jeong, and Jun Yong Choi. Visualization: Yae Jee Baek. Writing—original draft: Yae Jee Baek. Writing—review & editing: Won Suk Chung, Joon-Sup Yeom. Approval of final manuscript: all authors.

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## REFERENCES

1. Kim CS, Pile JC, Lozon MM, Wilkerson WM, Wright CM, Cinti S. Role of hospitalists in an offsite alternate care center (ACC) for pandemic flu. J Hosp Med 2009;4:546-9.


https://doi.org/10.3349/ymj.2022.63.3.292

2. Lam C, Waldhorn R, Toner E, Inglesby TV, O'Toole T. The prospect of using alternative medical care facilities in an influenza pandemic. Biosecur Bioterror 2006;4:384-90.
3. Yang Y, Kim H, Hwang J. Quarantine facility for patients with COVID-19 with mild symptoms in Korea: experience from eighteen residential treatment centers. J Korean Med Sci 2020;35:e429.
4. Seon JY, Jeon WH, Bae SC, Eun BL, Choung JT, Oh IH. Characteristics in pediatric patients with coronavirus disease 2019 in Korea. J Korean Med Sci 2021;36:e148.
5. Yun KW, Kim KM, Kim YK, Kim MS, Kwon H, Han MS, et al. Limited benefit of facility isolation and the rationale for home care in children with mild COVID-19. J Korean Med Sci 2021;36:e45.
6. Central Disease Control Headquarters. Guideline for home treatment of COVID-19 [Internet] [accessed on 2020 December 29]. Available at: http://ncov.mohw.go.kr/shBoardView.do?brdId=2&brdGubun=28&ncvContSeq=4540.
7. Chu VT, Yousaf AR, Chang K, Schwartz NG, McDaniel CJ, Lee SH, et al. Household transmission of SARS-CoV-2 from children and adolescents. N Engl J Med 2021;385:954-6.
8. Viner RM, Mytton OT, Bonell C, Melendez-Torres GJ, Ward J, Hudson L, et al. Susceptibility to SARS-CoV-2 infection among children and adolescents compared with adults: a systematic review and meta-analysis. JAMA Pediatr 2021;175:143-56.
9. Yung CF, Kam KQ, Nadua KD, Chong CY, Tan NWH, Li J, et al. Novel coronavirus 2019 transmission risk in educational settings. Clin Infect Dis 2021;72:1055-8.
10. Imamura T, Saito M, Ko YK, Imamura T, Otani K, Akaba H, et al. Roles of children and adolescents in COVID-19 transmission in the community: a retrospective analysis of nationwide data in Japan. Front Pediatr 2021;9:705882.
11. Public Health England. SARS-CoV-2 variants of concern and variants under investigation. Technical briefing 22. London: Public Health England; 2021.
12. Esposito S, Cotugno N, Principi N. Comprehensive and safe school strategy during COVID-19 pandemic. Ital J Pediatr 2021;47:6.