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Nationwide Social Distancing and the Epidemiology of Severe Acute Respiratory Infections

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Nonpharmaceutical interventions (e.g., social distancing) are recommended to prevent the spread of respiratory viruses. However, few epidemiological studies have assessed whether social distancing in actual settings reduces the disease burden of severe acute respiratory infections (SARIs) in the general population. Accordingly, we aimed to assess associations between nationwide social distancing for coronavirus disease 2019 (COVID-19) and non-COVID-19 SARIs. We collected data on SARI epidemiologic characteristics recorded from January 2018 through December 2020 from the nationwide sentinel SARI surveillance data maintained by the Korea Disease Control and Prevention Agency. The number of SARIs per 1000 hospitalized patients decreased significantly to 18.61, 18.15, and 6.25 in 2018, 2019, and 2020 (p<0.001), respectively, during the surveillance period of 3 years. The number of intensive care unit admissions associated with SARIs per 1000 hospitalized patients was 0.83, 0.69, and 0.54 in 2018, 2019, and 2020 (p< 0.001), respectively, and the number of SARI-associated mortalities per 1000 patients was 0.42, 0.29, and 0.27 in 2018, 2019, and 2020 (p<0.001), respectively. Moreover, SARIs had two peak seasons in 2 years of the surveillance period (2018 and 2019). However, seasonality was not observed since social distancing was initiated. Our sentinel surveillance data demonstrated a remarkable reduction in SARI disease burden and a change in seasonality following the implementation of nationwide social distancing. Accordingly, we suggest that social distancing could be effective in forthcoming seasonal epidemics of non-COVID-19 origin, although the impact thereof on other aspects of society needs to be carefully considered.

Key Words: Respiratory tract infections, physical distancing, epidemiology

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Emerging respiratory infectious diseases pose a substantial risk to the community because of their high-spreading potential. Major epidemics involving emerging respiratory infections have led to the establishment of sentinel hospital-based surveillance systems for monitoring influenza-related hospitalization for severe acute respiratory infections (SARIs).[1] Meanwhile, nonpharmaceutical interventions (NPIs), such as personal preventive measures and social distancing, have been recommended to prevent the spread of respiratory viruses transmitted by large droplets from infected to susceptible persons.[2] The effectiveness of personal preventive measures, including frequent hand hygiene, physical distancing, respiratory etiquette,

and wearing masks, in reducing transmission of respiratory virus infections has been studied, especially within the context of pandemic influenza.[3,4] However, few epidemiological studies have assessed whether social distancing in actual settings reduces the disease burden of SARIs in the general population.[5,6]

With the first report of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019, governments worldwide acted rapidly to introduce NPIs, including social distancing, aimed at reducing contact rates in the community and thereby reducing virus transmission.[7] In South Korea, the first confirmed case of coronavirus disease 2019 (COVID-19) was registered on January 22, 2020. A month later, a regional outbreak led to an explosive increase in the number of cases over the next 2 months. Accordingly, the health authorities of South Korea implemented nationwide social distancing with personal preventive measures and continuously adjusting degrees thereof based on the number of new cases of COVID-19 (Fig. 1). This study was undertaken to determine the impact of NPIs on the epidemiology of SARIs over time by evaluating associations between nationwide social distancing and the epidemiology of SARIs using nationwide sentinel surveillance data.

Surveillance of SARIs in South Korea has been conducted

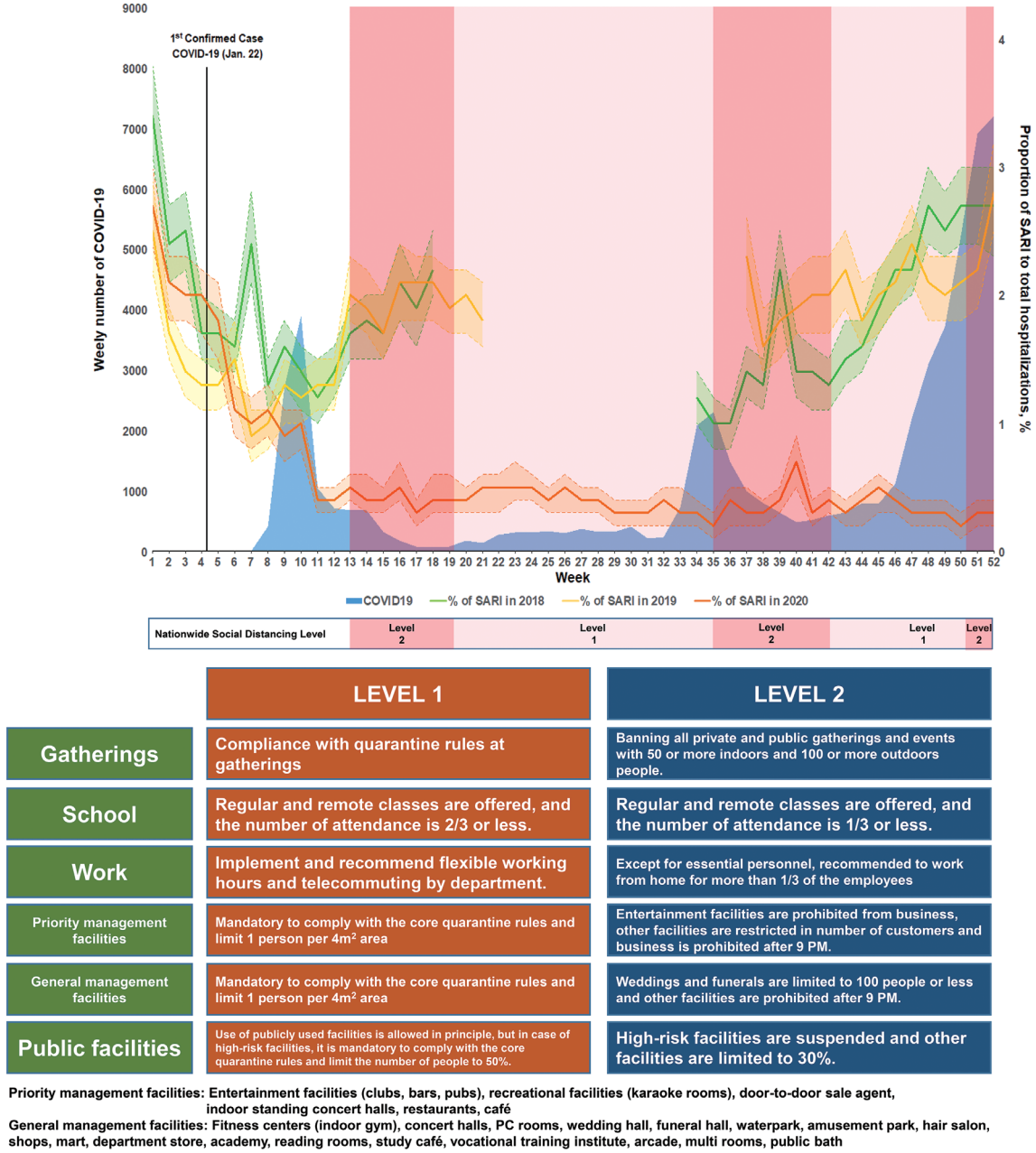

Fig. 1. Epidemic proportion curves (95% confidence intervals) of SARIs relative to total hospitalizations and weekly number of confirmed cases of COVID-19 in Korea for 2018–2020. Nationwide social distancing was implemented in week 13 of 2020, and degrees level thereof were adjusted based on the number of new cases of COVID-19. COVID-19, coronavirus diseases 2019; SARIs, severe acute respiratory infections.

since July 2017 at 13 sentinel sites, which were selected based on operational guidelines for sentinel SARI surveillance by the World Health Organization.[1] A SARI is defined as a case exhibiting three elements: hospitalization with an acute respiratory infection, history of fever over the past 10 days or a measured fever ≥38°C at admission, and cough.[8] Individual data on the epidemiologic characteristics of SARI were collected for all hospitalized cases, and the proportion of hospitalizations for SARI and the numbers of intensive care unit (ICU) admissions and mortalities associated with SARI were analyzed and reported weekly under the guidance of the Korea Disease Control and Prevention Agency.[9] Data on the epidemiologic characteristics of SARIs from January 2018 to December 2020 were extracted from the nationwide sentinel SARI surveillance system. The weekly number of COVID-19 cases in South Korea was extracted from an online interactive dashboard hosted by the Center for Systems Science and Engineering at Johns Hopkins University, Baltimore, MD, USA.[10] This research protocol was exempt from an ethics review by the institutional review board of Samsung Medical Center (IRB No. 2021-01-007). Nationwide social distancing was classified into three categories (Fig. 1): Level 1 was defined as strict adherence to infection prevention rules, including personal preventive measures with no restrictions on social and economic activities. Level 2 was defined as staying at home as much as possible and the avoidance of outings, gatherings, and the use of public facilities. Level 3 was defined as a lockdown measure for social activity.[11]

The proportion of SARIs to total hospitalizations and the number of ICU admissions and mortalities associated with SARI were examined. Annual changes in the rates thereof were analyzed with the Cochran–Armitage trend test. Additionally, epidemic curves for the proportion of SARIs and level of nationwide social distancing over the surveillance period were plotted.

The total number of hospitalizations at 13 sentinel sites was 402357, 406110, and 503060 in 2018, 2019, and 2020, respectively. However, the number of SARIs per 1000 hospitalized patients significantly decreased by 18.61, 18.15, and 6.25 in 2018, 2019, and 2020 (p<0.001) (Table 1). The number of ICU admissions associated with SARIs per 1000 hospitalized patients was 0.83, 0.69, and 0.54 in 2018, 2019, and 2020 (p<0.001), respectively. The number of SARI-associated mortalities per 1000 patients was 0.42, 0.29, and 0.27 in 2018, 2019, and 2020 (p<0.001), respectively (Table 1). The epidemic curves of SARI proportions and weekly number of COVID-19 cases, as well as the level of social distancing, are shown in Fig. 1. The proportion of SARIs to hospitalization decreased significantly by 1.86%, 1.81%, and 0.62% in 2018, 2019, and 2020, respectively. The average epidemic curves were similar over 3 years before social distancing implementation. SARIs had two peak seasons in 2 years of the surveillance period (2018 and 2019), in which the second peak was on week 12. However, seasonality was not observed at the start of social distancing from week 13 of 2020. In addition, the first peak that developed at weeks 37–38 in 2018 and 2019 was not observed after the implementation of social distancing in 2020.

Our sentinel surveillance data demonstrated a remarkable reduction in the proportion of SARIs to hospitalization and the absence of seasonality in SARIs following the implementation of nationwide social distancing with personal preventive measures. Moreover, ICU admissions and mortalities associated with SARIs also decreased significantly. Therefore, we suggests that social distancing with personal preventive measures could be an effective intervention to decrease the disease burden associated with non-SARS-CoV-2 respiratory viruses associated with seasonal epidemics.

The transmission of SARS-CoV-2 is similar to that of other respiratory viruses, and recent epidemiologic studies have indicated that NPIs are associated with a significant reduction in the incidence of respiratory infections, consistent with the findings of our study:[12-15] A recent study on epidemiologic outcomes following the implementation of NPIs during the COVID-19 outbreak in Wuhan, China suggested that multifaceted NPIs were associated with improved control of the COVID-19 outbreak.[12] Interestingly, in this study, we noted that the number of ICU admissions associated with SARIs decreased in 2020 after social distancing with personal preventive measures. This finding could be supported by recent epidemiological studies in which mask-wearing and other social distancing measures we found to reduce COVID-19 severity.[16]

Although this report provides new information on the impact of social distancing for SARS-CoV-2 on reductions of the disease burden associated with SARIs, several limitations should be acknowledged. First, the surveillance system covers only 13 hospitals in South Korea. Therefore, population-based incidence could not be calculated. However, generally, a small number of good quality data are more useful than a large num-

Table 1. Annual Changes in Non-COVID-19 SARIs and Burden of Disease following the Implementation of Nationwide Social Distancing for COVID-19 in Week 13 of 2020*

Variables	Year			*p* value for trends
	2018	2019	2020	
Number of SARIs per 1000 hospitalized patients	18.61	18.15	6.25	<0.001
Number of ICU admissions associated with SARIs per 1000 hospitalized patients	0.83	0.69	0.54	<0.001
Number of mortalities associated with SARIs per 1000 hospitalized patients	0.42	0.29	0.27	<0.001

COVID-19, coronavirus disease 2019; SARI, severe acute respiratory infection; ICU, intensive care unit.
*Data from the nationwide sentinel SARI surveillance system in Korea from January 2018 through December 2020.

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ber of poor quality data. Moreover, no ideal number of sentinel sites for each country exists. Therefore, only 13 sentinel sites were carefully selected considering how feasible it would be for the site to conduct surveillance and how representative the site is of the population of interest.[1] Second, data during the summer of 2018–2019 were not collected because no seasonal threshold for influenza-like illness exists.[13] However, the low proportion of SARIs in the summer of 2020 could be considered a seasonal variation rather than an impact of social distancing, because the seasonality of SARIs is similar to that of influenza-like illnesses.

In summary, our sentinel surveillance data revealed a remarkable reduction in SARI disease burden and a change in seasonality following the implementation of nationwide social distancing. Accordingly, we suggest that social distancing could be an effective intervention in forthcoming seasonal epidemics of non-COVID-19 origin. However, the impact thereof on other aspects of society needs to be carefully considered.

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REFERENCES

1. World Health Organization. Global epidemiological surveillance standards for influenza [Internet] [accessed on 2021 January 15]. Available at: https://www.who.int/influenza/resources/documents/influenza_surveillance_manual/en/.
2. World Health Organization. Non-pharmaceutical public health measures for mitigating the risk and impact of epidemic and pandemic influenza [Internet] [accessed on 2021 January 15]. Available at: https://www.who.int/influenza/publications/public_health_measures/publication/en/.
3. Xiao J, Shiu EYC, Gao H, Wong JY, Fong MW, Ryu S, et al. Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings-personal protective and environmental measures. Emerg Infect Dis 2020;26:967-75.
4. Wong VW, Cowling BJ, Aiello AE. Hand hygiene and risk of influenza virus infections in the community: a systematic review and meta-analysis. Epidemiol Infect 2014;142:922-32.
5. Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database Syst Rev 2020;11:CD006207.
6. Fong MW, Gao H, Wong JY, Xiao J, Shiu EYC, Ryu S, et al. Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings-social distancing measures. Emerg Infect Dis 2020;26:976-84.
7. World Health Organization. Overview of public health and social measures in the context of COVID-19 [accessed on 2021 January 15]. Available at: https://www.who.int/publications/i/item/overview-of-public-health-and-social-measures-in-the-context-of-covid-19.
8. Fitzner J, Qasmieh S, Mounts AW, Alexander B, Besselaar T, Briand S, et al. Revision of clinical case definitions: influenza-like illness and severe acute respiratory infection. Bull World Health Organ 2018;96:122-8.
9. Korea Disease Control and Prevention Agency. Sentinel severe acute respiratory infection surveillance in Korea [accessed on 2021 January 15]. Available at: http://www.kdca.go.kr/npt/biz/npp/iss/sariStatisticsMain.do.
10. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis 2020;20:533-4.
11. Government of the Republic of Korea. All about Korea's response to COVID-19 [accessed on 2021 January 15]. Available at: http://ncov.mohw.go.kr/en/infoBoardView.do?brdId=14&brdGubun=141&dataGubun=&ncvContSeq=3855&contSeq=3855&board_id=&gubun=#.
12. Pan A, Liu L, Wang C, Guo H, Hao X, Wang Q, et al. Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA 2020;323:1915-23.
13. Huh K, Jung J, Hong J, Kim M, Ahn JG, Kim JH, et al. Impact of nonpharmaceutical interventions on the incidence of respiratory infections during the coronavirus disease 2019 (COVID-19) outbreak in Korea: a nationwide surveillance study. Clin Infect Dis 2021;72:e184-91.
14. Nolen LD, Seeman S, Bruden D, Klejka J, Desnoyers C, Tiesinga J, et al. Impact of social distancing and travel restrictions on non-coronavirus disease 2019 (non-COVID-19) respiratory hospital admissions in young children in rural Alaska. Clin Infect Dis 2021;72:2196-8.
15. Hatoun J, Correa ET, Donahue SMA, Vernacchio L. Social distancing for COVID-19 and diagnoses of other infectious diseases in children. Pediatrics 2020;146:e2020006460.
16. Burgess S, Smith D, Kenyon JC, Gill D. Lightening the viral load to lessen covid-19 severity. BMJ 2020;371:m4763.