Impact of the COVID-19 pandemic on other respiratory virus outbreaks

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Abstract

The preventive measures to control the coronavirus disease (COVID-19) pandemic could affect other virus outbreaks. However, any changes in their incidence have not been evaluated. This study aimed to determine how the COVID-19 management policy has influenced the positive rates of other respiratory viruses. We collected data from the weekly reports of Korea Influenza and Respiratory Viruses Surveillance System on eight targeted viruses—adenovirus, human bocavirus, human coronavirus, human metapneumovirus, human rhinovirus, influenza virus, parainfluenza virus, and respiratory syncytial virus—from weeks 1 to 18 per year for the past 10 years. We compared the mean of each week in 2020 with the past 10 years using paired t-test. The study period was divided based on the date of the first COVID-19 case in South Korea (before: weeks 1–4; after: weeks 5–18). The overall positive rate of the respiratory viral infection was 38.7% in 2020 and 62.0% in 2010–2019. The positive rates of respiratory viruses with seasonality—hRV, IFV, and PIV—decreased during the COVID-19 pandemic. Although the positive rate of RSV increased significantly in the early weeks, the changes after week 5 were not significant. This phenomenon may be attributed to the strict COVID-19 control measures.

Introduction

To curb the coronavirus disease (COVID-19) pandemic, many countries are taking strong preventative measures. These interventions can affect the incidence of not only COVID-19 but also other respiratory infectious diseases that are preventable through personal hygiene[1]. Hence, there is essential to measure the actual impact of these interventions on the incidence of other respiratory viral diseases considering their high incidence and morbidity[2].

Prevention measures, including hand hygiene, social distancing, and school closure, began in South Korea after the first confirmed COVID-19 case was reported [3]. According to the report by Korea Centers for Disease Control and Prevention (KCDC) on the number of infectious diseases until April 2020 based on the data from the Korea Influenza and Respiratory Viruses Surveillance System (KINRESS), there was a decrease in the incidence of respiratory viral infections (decrease range by disease, 6%–91%). The influenza outbreak in 2019–2020 ended 12 weeks earlier than that in 2018–2019. These trends were presumably because of the adoption of strict personal hygiene measures and the bans and restrictions on international travel after the COVID-19 outbreak [4].

In a previous study, respiratory infections were analyzed only in terms of the total number of reported cases without weekly comparisons. Furthermore, the timing of the first imported COVID-19 case was not considered. Therefore, this study aimed to determine the effect of COVID-19 preventative measures on the positive rates of other respiratory viral diseases by comparing of the 10-year average incidence of each viral disease while accounting for the period when the first confirmed COVID-19 case was reported in South Korea.

Methods

The KINRESS is a passive surveillance network that was established by the KCDC in 2009 and originated from the Acute Respiratory Illness-Network (ARI-NET, since 2006). This system collects throat or nasal swab samples from enrolled outpatients visiting 36–100 sentinel medical institutions (primary hospitals) with symptoms of acute respiratory infections. Samples are tested for eight target viruses—adenovirus (AdV), human bocavirus (hBoV), human coronavirus (hCoV), human metapneumovirus (hMPV), human rhinovirus (hRV), influenza virus (IFV), parainfluenza virus (PIV), and respiratory syncytial virus (RSV)—using real-time reverse transcription polymerase chain reaction (RT-PCR). The positive rate of each respiratory virus is reported every week in KCDC's Pathogens and Vector Surveillance Weekly Reports (PVSWR). We extracted the weekly positive rate of each respiratory virus from the PVSWR for weeks 1–18 every year from 2010 to 2020. We calculated the positive rate by dividing the number of tests with positive results with the total number of tests conducted when the actual rates were not given. For hMPV, data were only available in the surveillance system from 2012; hence, we extracted data only from 2012.

After calculating the mean and standard deviation of the positive rate of each respiratory virus, we plotted the weekly positive rates of each virus by year. In addition, we compared the rate for 2020 with the mean rate of the past 10 years. The comparison was made only for the period after the first confirmed COVID-19 case was reported in South Korea (week 5). Each reported week was paired as a calendar week to perform paired t-test. When normality distribution was insufficient using the Shapiro–Wilk normality test, Wilcoxon's signed rank test was used. The estimated differences from week 5 to week 18 are shown with 95% confidence intervals (CIs). All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 24.0 (Armonk, NY: IBM Corp.).

Results

The overall mean positive rate of the respiratory viruses was 62.0% in 2010–2019 and 38.7% in 2020 (p for difference < 0.01). The mean positive rate of the past 10 years was the highest for IFV, followed by hRV, AdV, hMPV, hCoV, RSV, PIV, and hBoV while that for 2020 was the highest for IFV, followed by AdV, hRV, hCoV, RSV, hMPV, hBoV, and PIV. Figure 1 shows the positive rate by week in 2020 and the mean positive rate of the past 10 years. The positive rate of all the viruses decreased sharply from the week 5 in 2020, when the first confirmed COVID-19 case was reported in South Korea.

To evaluate the impact of the COVID-19 pandemic on other respiratory virus outbreaks more accurately, we compared their positive rates from week 5 to week 18 only (Table 1). The positive rates of hMPV, hRV, IFV, and PIV decreased, while that of RSV increased before week 5 ($p < 0.01$), but the change was not significant after week 5 ($p = 0.11$).

Discussion

This study describes the impact of COVID-19 prevention measures on the incidence of other respiratory viral infections based on the weekly change in positive rates reported by the KINRESS. Because of the preventive measures, the overall positive rate of the respiratory viruses decreased by 32.6% in 2020

compared to the mean positive rate in the past 10 years. In particular, hMPV, hRV, IFV, and PIV showed a significant decrease in the same calendar weeks. The results suggest the presence of additional effects of COVID-19 pandemic control measures, as previously discussed in a study of Hong Kong [5]. However, further investigation is needed to identify which measure among the various defense strategies against COVID-19 mainly affected the incidence of other respiratory viral infections.

The seasonality of respiratory viruses seemed to be the main concern when the interventions were implemented after the COVID-19 outbreak in late January. The study results indicate that COVID-19 prevention measures may have changed the outbreak pattern of respiratory viruses with seasonality. Hence, the incidence of diseases caused by winter viruses such as hMPV, hRV, IFV, and PIV declined in 2020. However, the incidence of diseases caused by viruses such as AdV and hBoV, which are prevalent in all seasons, neither decreased nor increased during the COVID-19 pandemic. Further, RSV outbreaks occur mainly in early winter, but this season was a time when COVID-19 did not occur [6].

This study has some limitations. We compared the positive rate only from week 5 to week 18th every year for 10 years for each virus to account for the timing of the COVID-19 outbreak. Some viruses that are more prevalent in summer or fall may have not been analyzed sufficiently. In addition, the sentinel surveillance system covers only patients who visited hospitals. There could be other confounding factors that may have had an impact on the outbreaks of respiratory viral infections.

Personal hygiene practices, such as washing hands and wearing masks, can block the spread of waterborne and respiratory infections. We were able to reaffirm the importance of preventive interventions in this study, which revealed a decrease in the incidence of respiratory viral infections nationally. Even if the COVID-19 pandemic ends, continuous promotional efforts to raise awareness regarding the benefits of preventive measures will be required.

Declarations

Availability of data and material

We used public data from weekly reports of the Korea Centers for Disease Control and Prevention titled “Pathogens and Vector Surveillance Weekly Reports” that are available at https://www.cdc.go.kr/board/board.es?mid=a30501000000&bid=0031&cg_code=C04.

Author Contributions

All authors contributed to the study conception and design. S.Y., K.H., S.S., J.K. and B.C.C. performed material preparation, data collection and analysis. S.Y. wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare no competing interests.

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Table

Table 1. Comparison of the positive rates of respiratory viruses reported in the surveillance system for 2020 and the past 10 years from week 5 to 18. AdV, adenovirus; hBoV, human bocavirus; hCoV, human coronavirus; hMPV, human metapneumovirus; hRV, human rhinovirus; IFV, influenza virus; PIV, parainfluenza virus; RSV, respiratory syncytial virus; SD, standard deviation; CI, confidence interval. [a]The positive rate of hMPV in 2020 compared with the 8-year mean because the surveillance began in 2012. [b]Analyzed by Wilcoxon's signed rank test instead of the paired t-test.

Virus	2010–2019 (%)		2020 (%)		Difference (%)		
	Mean	SD	Mean	SD	Mean	95% CI	
Total	61.9	3.3	32.3	18.0	-32.6	-44.2	-21.1
AdV	4.8	0.8	6.1	2.8	1.3	-0.5	3.1
hBoV	1.5	1.3	1.4	1.5	0.0	-1.2	1.2
hCoV	3.9	1.4	4.3	4.1	0.0[b]	-1.7	1.7
hMPV[a]	6.1	3.3	2.0	2.1	-4.1	-7.1	1.1
hRV	12.8	4.0	6.7	4.6	-5.9	-9.4	-2.4
IFV	28.6	7.0	8.2	11.7	-23.0[b]	-29	-16.9
PIV	2.9	2.7	0.4	0.5	-2.5[b]	-4.2	-0.8
RSV	2.1	1.1	3.2	2.7	0.8	-0.2	1.8

Figures

Figure 1

Positive rate of respiratory viruses for 18 weeks in 2020 and the 10-year mean. The first COVID-19 case in South Korea was reported in week 5 in 2020 (represented by the straight line) a Mean positive rate of all respiratory viruses. It increased in 2020 before week 5, but it decreased significantly after week 5 b Mean positive rate of adenovirus (AdV). There was no significant difference in 2020 compared with the past 10 years c Mean positive rate of human bocavirus (hBoV). There was no significant difference in 2020 compared with the past 10 years d Mean positive rate of human coronavirus (hCoV). There was no significant difference in 2020 compared with the past 10 years e Mean positive rate of human metapneumovirus (hMPV). It decreased in 2020 compared with the past 10 years after week 5, but there was no change before week 5 f Mean positive rate of human rhinovirus (hRV). It decreased in 2020 compared with the past 10 years g Mean positive rate of influenza virus (IFV). It increased in 2020 before week 5, but it decreased significantly after week 5 h Mean positive rate of parainfluenza virus (PIV). There was no change in 2020 before week 5, but the rate decreased after week 5 i Mean positive rate of respiratory syncytial virus (RSV). It increased in 2020 before week 5, but there was no change after week 5