Decrease in hospital admissions for respiratory diseases during the COVID-19 pandemic: a nationwide claims study

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ABSTRACT

Non-pharmaceutical interventions (NPIs) have been widely implemented to mitigate the spread of COVID-19. We assessed the effect of NPIs on hospitalisations for pneumonia, influenza, COPD and asthma. This retrospective, ecological study compared the weekly incidence of hospitalisation for four respiratory conditions before (January 2016–January 2020) and during (February–July 2020) the implementation of NPI against COVID-19. Hospitalisations for all four respiratory conditions decreased substantially during the intervention period. The cumulative incidence of admissions for COPD and asthma was 58% and 48% of the mean incidence during the 4 preceding years, respectively.

INTRODUCTION

Non-pharmaceutical interventions (NPIs) have been the most important public health measure to mitigate the impact of the COVID-19 pandemic. NPIs implemented against COVID-19 are expected to reduce the transmission of other respiratory viruses, and early studies have reported a decrease in the incidence of viral respiratory infections.[1 2]

Thus, we assessed the incidence of hospitalisations due to pneumonia, influenza and chronic lung diseases during the COVID-19 pandemic in South Korea and compared it with the previous seasonal average and temporal trends using nationwide healthcare claims database.

MATERIALS AND METHODS
Data source

The daily number of hospitalisations was obtained from the National Health Insurance Service (NHIS) claims database. South Korea has a universal, single-payer healthcare coverage for all residents, and all covered costs are reimbursed by the NHIS. The cause of admission was captured from the primary diagnosis code using the International Statistical Classification of Diseases and Related Health Problems, 10th edition. The weekly incidence of hospitalisations was calculated by dividing the weekly number of admissions by the annual mid-year population, obtained from the Korean Statistical Information Service (http://kosis.kr).

Study design and statistical analysis

This was a retrospective ecological study comparing the incidence of hospitalisation due to acute respiratory infections (pneumonia and influenza) and chronic respiratory diseases (COPD and asthma) before and during the COVID-19 pandemic. We also compared hospitalisations with the primary diagnosis of diabetic ketoacidosis or hyperosmolar hyperglycaemic state (DKA/HHS), intracranial haemorrhage (ICH), myocardial infarct (MI) and cancer to account for change in healthcare utilisation.

The baseline period was defined as January 2016 to January 2020 and the intervention period as February to July 2020. Prediction models were constructed for each disease based on the incidence during the entire baseline period using an autoregressive integrated moving average (ARIMA). Parameters for the ARIMA models were selected using the 'auto.arima' function in the 'forecast' package for R software (https://pkg.robjhyndman.com/forecast/). The weekly incidence of hospitalisations during the intervention period was visually compared with the 95% CI of the predicted values.

Furthermore, the cumulative incidence (CuI) during the intervention period (ie, sum of weekly incidences during the period) was compared with the 4-year mean CuI during the same months (February–July) of the baseline period. The difference in CuI was tested using a Poisson test. All tests were two-tailed and p values <0.05 were considered statistically significant. Statistical analyses were performed using R V.3.6.2 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Hospitalisations with the primary diagnosis of pneumonia decreased substantially during the intervention period (figure 1). The CuI during the intervention period was 0.47 times the CuI of the 4-year mean (95% CI 0.45 to 0.50; p<0.001; table 1). The weekly admissions for influenza were within 95% CI of the predicted values; however, the CuI was significantly lower than the 4-year mean (0.22 times the 4-year mean; 95% CI 0.19 to 0.25; p<0.001). Hospitalisations due to pneumonia or influenza have decreased to comparable proportions among patients with pre-existing COPD or asthma.

Hospital admissions due to COPD and asthma also decreased substantially. The CuIs for COPD and asthma admissions were 0.58 times (95% CI 0.49 to 0.68; p<0.001) and 0.48 times (95% CI 0.39 to 0.57; p<0.001) the mean baseline CuIs, respectively. The trend was consistent across all sex

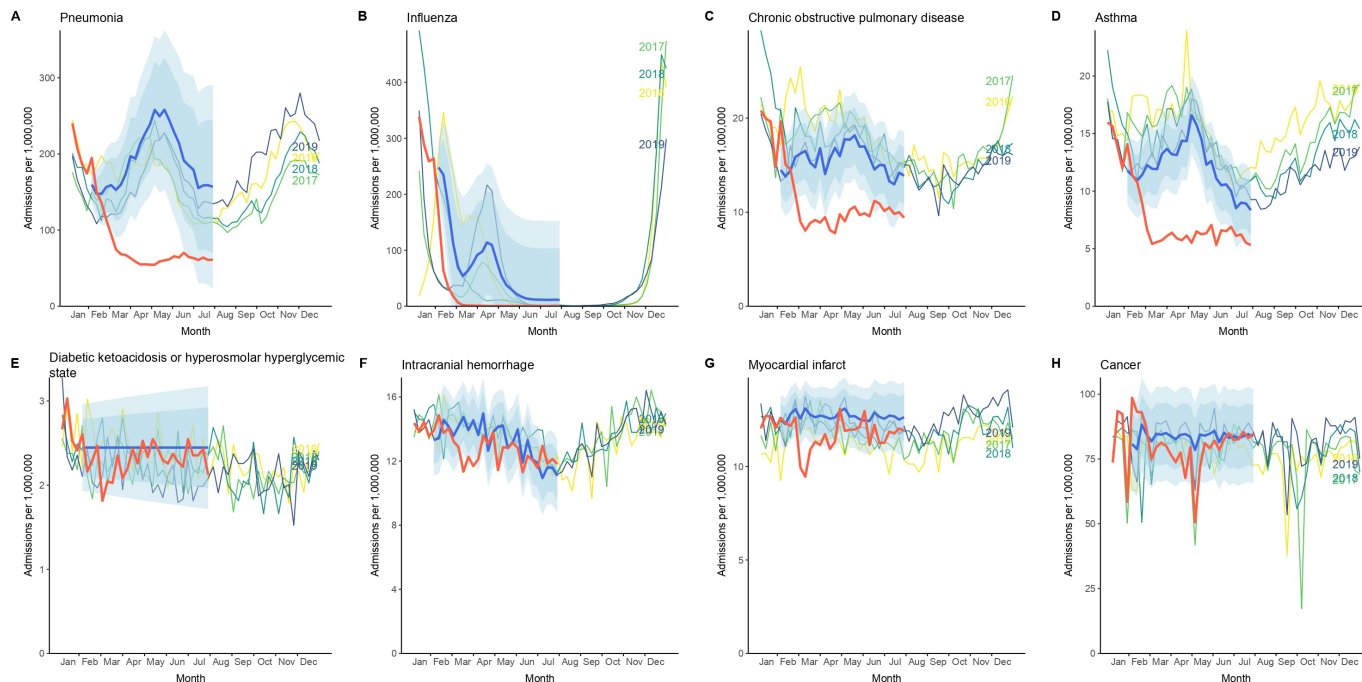**Figure 1** Weekly incidence of hospital admission per 1 000 000 population by primary diagnosis. Bold red lines denote the actual incidence during the intervention period; bold blue lines denote the predicted incidence; and dark and light blue shades denote the 80% and 95% CIs of the predicted incidence, respectively. Panels A–D show the hospitalisations due to respiratory diseases; panels E–H, hospitalisations for non-respiratory acute (E–G) and chronic (H) conditions.

and age groups (data not shown).

In contrast, hospital admissions for other acute (DKA/HHS, ICH and MI) and chronic (cancer) conditions during the intervention period were not significantly different from the predicted values or the 4-year means. Transient short-term decreases in admissions were observed from March through May 2020, but these 'dips' were not sustained and there was no significant difference in the CuI between the intervention and the baseline period (table 1).

DISCUSSION

Influenza and a substantial portion of pneumonia are primarily mediated through droplet transmission. Personal hygiene and droplet precautions are well-known effective prevention measures for these

infections.[3] Since the early days of the COVID-19 epidemic, South Korea has thoroughly carried out social distancing, personal hygiene and universal use of face masks.[4] In this study, the significant decrease in hospital admissions for influenza, pneumonia, COPD and asthma suggests the unintended benefits of these measures. This finding is consistent with previous reports that showed a decreased incidence of respiratory infections and influenza.[1 2 5]

It is noteworthy that not only the admissions for respiratory infections but also the overall admissions for COPD and asthma decreased substantially. Similar observations have been reported from Europe and the USA during the early stage of the COVID-19 epidemic.[6–8] Our results reaffirm those findings; also, our findings are unique as South Korea did not undergo 'lockdown' as many

Table 1 Cumulative incidence of hospital admission from February through July in 2020 versus 2016–2019

Disease	Cumulative incidence, February–July (per 1 000 000)		Rate ratio (95% CI)	P value
	Mean (2016–2019)	Observed (2020)		
Pneumonia	3965.29	1872.59	0.47 (0.45 to 0.50)	<0.001
Patients with COPD	28 304.95	15 182.24	0.54 (0.53 to 0.55)	<0.001
Patients with asthma	3196.58	1200.35	0.38 (0.35 to 0.40)	<0.001
Influenza	1366.09	299.33	0.22 (0.19 to 0.25)	<0.001
Patients with COPD	1355.74	363.06	0.27 (0.24 to 0.30)	<0.001
Patients with asthma	554.65	79.56	0.14 (0.11 to 0.18)	<0.001
COPD	435.11	251.70	0.58 (0.49 to 0.68)	<0.001
Asthma	353.16	168.13	0.48 (0.39 to 0.57)	<0.001
Diabetic ketoacidosis/hyperosmolar hyperglycaemic state	54.94	55.25	1.02 (0.69 to 1.51)	>0.999
Intracranial haemorrhage	329.17	305.69	0.93 (0.79 to 1.09)	0.361
Myocardial infarct	286.37	280.00	0.98 (0.82 to 1.15)	0.801
Cancer	1914.28	1922.59	1.00 (0.94 to 1.07)	0.910

European countries did and we demonstrated that the decrease was sustained for at least 6 months. Conversely, hospital admissions due to other acute (DKA/HHS, ICH and MI) and chronic (cancer) conditions did not decrease, which shows this was not attributable to an alteration in healthcare-seeking behaviour. Our findings suggest that the decrease in admissions due to COPD and asthma might be associated with the decrease in respiratory infections, which are the most common triggers for acute exacerbation of COPD and asthma.[9 10]

This study has some limitations. First, we identified the cause of admission from the primary diagnosis code used for billing. However, there is no reason to suspect a change of coding practices during the intervention period. Second, we could not directly confirm from the claims database that the reduction in respiratory infections led to the decrease in admissions among patients with COPD and asthma. There remains a possibility that the decrease in admissions resulted from the alteration in healthcare-seeking behaviour, although no significant change was observed in admissions for non-respiratory conditions. In such case, the decrease in hospitalisation may lead to delayed care and increased mortality later.

In conclusion, we found that the hospital admission rates for respiratory infections and chronic lung diseases decreased significantly after the implementation of NPIs against COVID-19, despite the lack of change in admission rates for non-respiratory conditions.

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