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Short communication

Significant impact of nationwide SARS-CoV-2 lockdown measures on the circulation of other respiratory virus infections in Austria

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ABSTRACT

Background: Since the worldwide spread of SARS-CoV-2, different European countries reacted with temporary national lockdowns with the aim to limit the virus transmission in the population. Also Austria started a lockdown of public life in March 2020.
Objectives: In this study we investigated whether the circulation of different respiratory virus infections in Austria, as assessed by the established respiratory virus surveillance system, is affected by these measures as well and may reflect the success of the lockdown in limiting respiratory virus transmission.
Study design: Sentinel data obtained for influenza virus, respiratory syncytial virus, human metapneumovirus and rhinovirus cases were analyzed and compared between the season 2019/2020 and the five previous seasons.
Results: We observed a rapid and statistically significant reduction of cumulative cases for all these viruses within short time after the lockdown in March 2020, compared to previous seasons (each $p < 0.001$). Also, sentinel screening for SARS-CoV-2 infections was performed and a decrease of SARS-CoV-2 was seen after the lockdown. While for the seasonally occurring viruses as influenza, respiratory syncytial virus or human metapneumovirus the lockdown led to the end of the annual epidemics, a re-increase of rhinovirus infections was observed after liberalization of numerous lockdown measures.
Conclusions: Our data provide evidence that occurrence of different respiratory virus infections reflect not only the efficiency of lockdown measures taken against SARS-CoV-2 but it shows also the effects of lockdown releases on the transmission of respiratory viruses.

1. Background

The SARS-Coronavirus-2 (SARS-CoV-2) epidemics started in 2019 in Hubei, spread around the world and reached the pandemic status in March 2020. In Europe first SARS-CoV-2 infections were detected end of January 2020 [1] but spread in European countries started probably already in December 2019 according to recent retrospective studies [2]. As larger outbreaks followed in Europe[3,4], countries developed different strategies to combat the SARS-CoV-2 epidemics. Most European countries decided for a temporarily strict downregulation of public life. In Austria, a public lockdown was started at 16th of March 2020, with the closure of public areas, including schools, universities, restaurants, or shops, with the exception of structurally important shops and enterprises. Furthermore the government gave strict order to keep physical distance, wear face masks in public indoor locations, and to frequently wash and/or disinfect hands. These measures, kept until April 14th 2020, were efficient against SARS-CoV-2 spread, but it was unclear whether they prohibited in parallel the spread of other respiratory viruses.

2. Objectives

The aim of the present study was to assess the impact of these lockdown measures on the epidemic spread of other respiratory viruses such as Influenza viruses, Respiratory Syncytial Virus (RSV), human Metapneumovirus (hMPV) and Rhinoviruses (RHIV). Therefore, we compared the influenza virus, RSV, hMPV and RHIV cases detected by the Austrian Influenza sentinel surveillance system between weeks 48/2019 to week 28/2020 to those identified during the equivalent period of the five previous seasons, starting from week 40/2014.

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3. Study design

This study is a retrospective analysis of data previously generated from the sentinel surveillance system for influenza viruses in Austria, and electronically stored at the Center of Virology, Medical University Vienna [5]. This system is based on sentinel physicians (general practitioners and pediatricians throughout Austria) collecting nasopharyngeal swabs from patients with influenza like illness as defined by the ECDC. Samples are analyzed immediately by the Center of Virology by realtime PCR (RT-PCR) for Influenza strains [5]. In addition, nasopharyngeal swab samples from a defined subset of sentinel physicians from all over Austria are also routinely tested for RSV, hMPV and RHIV by realtime-PCR assays [6–8]. For this study data from 25.491 sentinel samples obtained between weeks 40/2014 and 28/2020 were retrospectively analyzed. Influenza test results were available for all 25.491 samples, RSV, hMPV and RHIV data for a subset of 4.544 samples. Altogether 10.009 samples were positive for either Influenza (7.211), RSV (1.231), hMPV (239) or RHIV (1.265). Detailed information on the number of samples tested each year and the number of positive samples observed during the seasons 2014/15–2019/20 is shown in Table 1.

4. Ethics statement

The study was approved by the ethics committee of the Medical University of Vienna (EK 1339/2017) and performed in accordance with the Declaration of Helsinki (2013).

5. Results

5.1. Epidemiological analyses

In Austria comprehensive lockdown measures for prevention of further SARS-CoV-2 spread were adopted on March 16th 2020 (calendar week 12). In Fig. 1 the weekly numbers of influenza, RSV, hMPV and RHIV cases detected by the sentinel system are shown for the season 2019/20, before and after the starting of the lockdown. For all these respiratory viruses a significant decrease was observed within one week after the lockdown. To assess whether the development of cases of influenza viruses, RSV, hMPV and RHIV in 2019/20 was different to previous seasons, a comparative analysis between the respiratory virus circulation pattern of this and the previous 5 seasons was performed. The data of the respiratory infections over the years are presented in detail in Fig. 2 and in Figure S1.

5.2. Statistical analyses

The differences between the seasons were calculated for the individual viruses. For comparison of influenza viruses (Fig. 2a) those seasons between 2014/15–2018/19 were chosen, which were comparable with respect to influenza type distribution. For these selected seasons the average number of cases for each week weighted by the number of tested patients was computed and then the cumulative number of cases for the duration of activity was obtained. The total number of cases from week of lockdown until end of activity was computed for season 2019/20 and the same computation was performed for the corresponding period of the comparator seasons to obtain the expected number of cases. The hypothesis of equality of the number of observed and expected cases was tested by chi^2 tests assuming a Poisson distribution. The influenza season 2019/2020 already peaked between calendar weeks 04/2020 and 06/2020. Based on data of previous influenza seasons in Austria an end of the influenza season would have been expected at around week 15/2020 to 16/2020. By implementing the lockdown measures, the influenza season 2019/20 was ended earlier than expected and its course differed significantly from that of previous seasons ($p < 0.001$) (Table 2).

For comparison of seasonal RSV and hMPV (Fig. 2b, c), seasons were chosen with respect to the shape of the seasonal activity distribution until the week corresponding to the week of lockdown 2019/20. Also for RSV a sharp decrease was observed after the nationwide lockdown and, although this year's RSV activity was generally low, reduction in the circulation of RSV detected after week 12 of virus activity was significantly different compared to previous seasons ($p < 0.001$). Also, the lockdown measures led to a significant decrease in the number of hMPV detections ($p < 0.001$) (Table 2), which was especially impressive, as the hMPV season 2019/20 started with a very high hMPV activity. For both viruses circulation remained low until week 28 after start of the respective epidemic viruscirculation. Detailed analyses on the reduction of cumulative cases are provided in Supplementary material Figure S2.

To compare the non-seasonal RHIV circulation between different years, the cumulative number of cases between calendar week 12/2020 (start of lock down) and week 22/2020 was computed for all seasons (Fig. 2d). The 5 seasons 2014/15–2018/19 were compared to season 2019/20 by chi^2 test. Also for RHIV a statistically significant decrease of cases was observed after the lockdown ($p < 0.001$) (Table 2). Cases increased after the end of lockdown again (Fig. 2d).

6. Discussion

The present data clearly show that this national lockdown, with a 70

Table 1
Overview on the RT-PCR test results generated during different seasons from the Austrian Influenza sentinel system and used for the retrospective data analyses. Each season (2014/15 to 2019/20) the data were generated in scope of the routine virological surveillance and stored electronically. Sentinel samples are obtained from 97 sentinel physicians throughout Austria are analyzed for influenza virus and in season 2019/20 also for SARS CoV 2. Additionally, samples that were received from a defined subset of 20 sentinel physicians over Austria are tested for Respiratory Syncytial Virus (RSV), human Metapneumovirus (hMPV) and Rhinovirus (RHIV).

		Influenza and SARS-CoV2 positive							subset additionaly tested positive for		
season	N analyzed overall	Influenza overall	A(H1N1) pdm09	A (H3N2)	A/ unsubtyped	Influenza B	SARS-CoV2	n subset additionally tested	RSV	hMPV	RHIV
2014/15	4106	1232	250	649	60	273	na	541	212	24	182
2015/16	4025	894	309	101	3	481	na	472	162	25	172
2016/17	4426	1042	21	994	2	25	na	629	364	17	157
2017/18	6873	2334	665	137	60	1472	na	1084	231	81	240
2018/19	2047	587	326	154	2	105	na	899	170	20	242
2019/20	4014	1122	352	489	43	238	63	919	92	72	272

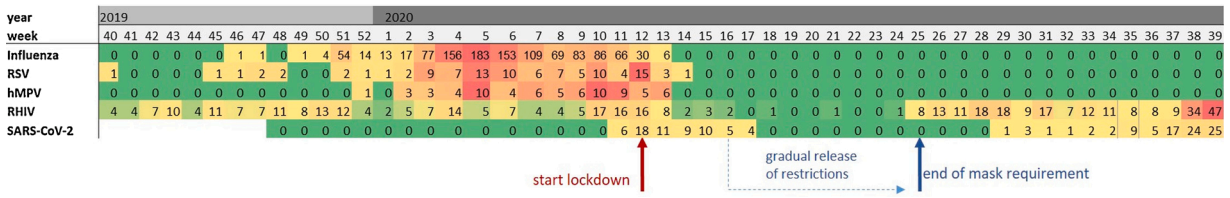

Fig. 1. Number of Influenza virus, Respiratory Syncytial Virus (RSV), human Metapneumovirus (hMPV) and Rhinovirus (RHIV) detections per week during the period between week 40/2019 and 28/2020. Color coding shows the intensity of virus circulation for each virus, green = no activity, yellow = sporadic detections, orange = medium activity, red = peak activity, red arrow indicates state of lockdown (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

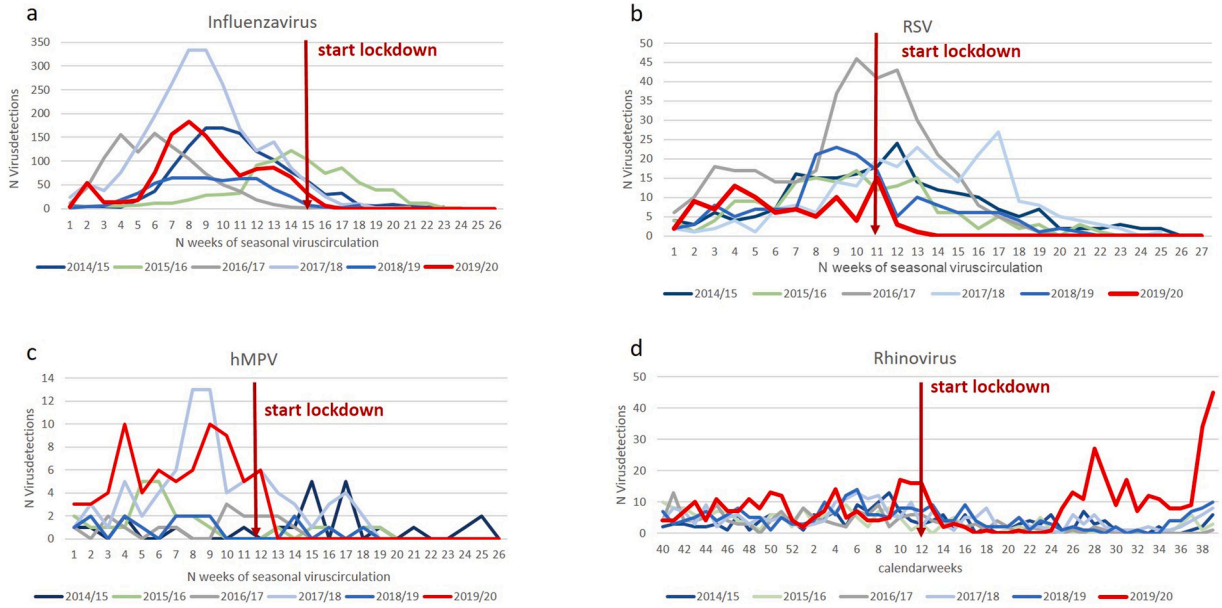

Fig. 2. Pattern in the circulation dynamics of (a) Influenza virus, (b) Respiratory Syncytial Virus (RSV), (c) human Metapneumovirus (hMPV) and (d) Rhinovirus (RHIV) of the six consecutive seasons 2014/15 to 2019/20. As Influenza, RSV, and hMPV exhibit clear seasonal activity, for a better comparability the weeks of the seasonal virus circulation was indicated. (a) (b) and (c): first week of seasonal virus circulation was defined as the first week of each season where >5% of samples were tested positive; as RHIV circulation has no expressed seasonality the calendar weeks are indicated.

Table 2
Results of statistical analyses (chi^2 test): number of cumulative detections after the lockdown in 2019/20 compared to the number of observed / estimated detections in the equivalent time period during the previous seasons and 95 % confidence intervals (CI) for Influenza viruses, Respiratory Syncytial Virus (RSV), human Metapneumovirus (hMPV) and Rhinovirus (RHIV).

Virus	N detections after lockdown	N detections observed/estimated in equivalent period during previous seasons (95 % CI)	p-value
Influenza	36	150 (127–179)	<0.001
RSV	19	82 (65–104)	<0.001
hMPV	6	23 (15–36)	<0.001
RHIV	17	28 (19–42)	<0.001

% reduction of mobility, had a significant impact on the prevalence of different respiratory viruses in Austria (Table 2). Interestingly, the decrease of cases happened already within one week after the start of the lockdown. This could be explained by the short incubation periods of the viruses analyzed. Recently, an Italian study described that lockdown measures lead to reduction effects onto the epidemic of chickenpox, rubella, pertussis or measles [9], showing that a lockdown may reduce the prevalence of different infectious diseases.

In addition, RT-PCR testing for SARS-CoV-2 virus [10], was performed with all sentinel samples received from December 6th 2019. As shown in Fig. 1 also SARS-CoV-2 cases decreased after the lockdown. Until March (week 11/2020) no SARS-CoV-2 positive samples were detected by this system supporting the current view that SARS-CoV-2 was not yet circulating in 2019 in Austria.

From week 16/2020 on lockdown measures were stepwise reduced in Austria, including reopening of shops (from week 16/2020), restaurants (week 20/2020), schools (week 21/2020), hotels and indoor events up to 100 persons (week 22/2020). These measures had only minor immediate effects on RHIV circulation. Obligation to wear face masks was released for many locations on week 25/2020 and this was in timely relation with a particularly steep increase of RHIV circulation. Albeit Rhinoviruses have different properties and a shorter incubation time than SARS-CoV-2, circulation of these viruses may potentially reflect the efficiency of measures taken against transmission of respiratory viruses in a population [11].

As the present data are limited for distinct respiratory viruses, further extended studies are needed to confirm the present findings and to reveal more complex data patterns. In addition, more sophisticated statistical approaches and/or modelling may be useful to further understand the patterns observed.

Author contributions

MRF: data analysis, first draft and revision of the manuscript MK: statistical analysis SWA: data analyses EP: first draft and revision of the manuscript

Declaration of Competing Interest

The authors declare no competing interests.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jcv.2021.104795.

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