Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Review

Impact of non-pharmaceutical interventions targeted at COVID-19 pandemic on influenza burden – a systematic review

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SUMMARY

Objectives: To better understand the impact of comprehensive COVID-19 targeted non-pharmaceutical interventions (NPIs) on influenza burden worldwide.
Methods: We conducted a systematic literature search in selected databases (PubMed, WHO COVID-19), preprint servers (medRxiv, bioRxiv) and websites of European Public Health institutes. Documents that compared influenza estimates in the 2019/2020 season with previous seasons were included. Information synthesis was qualitative due to a high heterogeneity in the number and periods of comparative seasons, outcome measures and statistical methods.
Results: We included 23 records reporting from 15 countries/regions as well as 8 reports from European Public Health agencies. Estimates in the 2019/2020 season based on influenza virus tests (4 out of 7 countries/regions), defined influenza cases (8 out of 9), influenza positivity rate (7 out of 8), and severe complications (1 out of 2) were lower than in former seasons. Results from syndromic indicators, such as influenza-like-illness (ILI), were less clear or even raised (4 out of 7) after the influenza season indicating a misclassification with COVID-19 cases.
Conclusions: Evidence synthesis suggests that NPIs targeted at SARS-CoV-2-transmission reduce influenza burden as well. Low threshold NPIs need to be more strongly emphasized in influenza prevention strategies.

Introduction

According to estimates of the Global Burden of Diseases study, about 713 per 100,000 people worldwide fall ill on influenza within a year. Up to 73,864,000 episodes of lower respiratory tract infections can be attributed to influenza. At the same time, between 99,000 and 200,000 influenza-associated deaths are estimated.[1] Serious influenza epidemics and pandemics keep occurring. The latest pandemic in 2009/2010 was due to the H1N1pdm09 virus. In this context, up to 203,250 deaths are estimated worldwide, including up to 132,080 amongst people under 65 years of age.[2]

In addition to the worldwide implemented vaccination measures,[3] primary preventive non-pharmaceutical interventions (NPIs) including hygiene and distancing measures gain increasing importance. The effectiveness of NPIs on the spread of the 1918/1919 influenza pandemic was analysed for 43 cities in the USA. The majority of cities combined school closures with bans on public events. The effectiveness of the NPIs was not based on the introduction of the NPIs as such, but rather on the timing, duration and combination of NPIs.[4] Interestingly, more drastic NPIs did not necessarily lead to more serious consequences for the economy as the resumption of economic activity after the pandemic was more successful in regions with previously introduced drastic NPIs than in regions with less far-reaching NPIs.[5]

The effectiveness of NPIs in controlling influenza outbreaks in recent times has been evaluated in several studies. Liang et al. show in their systematic review a protective effect of mouth-nose covers (masks) on the transmission of laboratory confirmed respiratory viruses. With regard to influenza viruses, they determine an odds ratio of 0.55 (0.39–0.76 95% CI) in a meta-analysis comparing masks wearing vs. no masks wearing.[6] Yet, Mateus et al. show that travel restrictions alone have a limited effect on reducing the

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transmission of influenza diseases.[7] In a further systematic review, it is shown that school closures can have an effect on the transmission of seasonal and pandemic influenza in an outbreak situation, especially amongst school-age children. However, a definitive conclusion cannot be drawn, as the evidence synthesis is based on studies with school closures at different times in relation to the outbreak peak.[8]

In regard to the COVID-19 pandemic in 2020, the WHO issued recommendations for the introduction of NPIs.[9] As with influenza, droplet infection is assumed to be the main transmission route in COVID-19.[10] Potential transmission by fine respiratory aerosols is discussed.[11] Accordingly, a variety of NPIs have been taken to varying degrees with the aim of drastically reducing the frequency of contact in the entire population and thus slowing down the spread of the virus.[12,13] Likewise, these COVID-19 induced NPIs impacted on influenza morbidity allowing to determine the effect of NPIs on influenza morbidity in an unprecedented way.

This systematic review aims to provide evidence on the impact of current NPIs on influenza morbidity worldwide. The results may also give an indirect indication of the effectiveness of these NPIs in containing COVID-19 spread. With regard to the introduction of NPIs, previous influenza pandemic plans focus primarily on the protection of vulnerable groups and the isolation of those infected. Extensive protective measures for the general population in everyday life may be described, but were not the focus of attention.[14,15] This systematic review allows recommendations to be made for the planning of NPIs for future outbreaks based on the latest scientific evidence.

Methods

Screening

The reporting of this systematic review is based on the PRISMA Statement.[16] In advance, this systematic review was registered on PROSPERO.[17] The search strategy was developed in PubMed and applied in PubMed and WHO COVID-19 database. For the systematic search of the preprint databases medRxiv and bioRxiv we used the preprint viewer preVIEW COVID-19 (https://preview.zbmed.de).[18] English synonyms of the novel coronavirus were linked to English synonyms and MESH terms for influenza by the Boolean operator AND (supplement S1). The search was supplemented by screening the reference lists of included studies, as well as a broad internet search for corresponding reports from official European public health institutes. The search was conducted on July 3rd, 2020, and updated on July 21st, 2020.

Inclusion criteria

Included studies are published from January 1st, 2020 onwards, as the SARS-CoV-2 virus was not registered until the end of December 2019. Further inclusion criteria are studies that show results on the general population, refer to NPIs and compare influenza estimates during the COVID-19 pandemic with those of previous years. We include the following influenza estimates: absolute influenza-like illness (ILI) cases, ILI incidence as a proportion of a population, respiratory samples tested for influenza viruses, absolute influenza cases, influenza positivity rate, severe complications due to influenza and influenza reproduction number.

As a study type, ecological studies of any format including grey literature are included. Excluded are publications such as systematic/narrative reviews and news articles. Furthermore, studies that exclusively produce results for specific groups of people (e.g. institutionalised population) are excluded. Studies that refer to NPIs that do not have a COVID-19 pandemic reference, do not make a comparison with influenza estimates of previous years or report their results reduced to one value per season only are excluded as well.

Extraction

After exclusion of duplicates, titles, abstracts and full texts were screened by one reviewer (LF) and checked by another (SG, MD) using EndNote Version X9.[19] Disagreements were resolved by discussion and, if necessary, a third reviewer (BL) was asked to resolve them. The extraction was performed by LF and checked by SG.

Risk of bias assessment

The quality assessment was carried out by the modified instrument of NICE in a summarized format[20] (supplementary table S1, supplementary table S2) by LF and checked by SG, MD and BL. Based on most important aspects within the detailed instrument, a summary of the quality assessment was prepared.

Data analysis

The synthesis of results is narrative, as a large number of methodological differences is expected. The data analysis consists of two parts. First, the information from the studies identified by the systematic search is compiled. The narrative information synthesis is structured by influenza estimates identified in the included studies. The course of the influenza seasons considered are compared separately for each country included within a study. Finally, individual results at study level are summarised.

Results

A total of 1489 titles were obtained by systematic search, of which 350 could be excluded as duplicates. Finally 1139 titles were screened. After abstract screening of 120 titles, 61 abstracts could be excluded. The full text screening led to the exclusion of 37 publications (supplementary table S3, supplementary table S4). No further studies could be included by searching the reference lists or via internet-based search, so that a final number of 22 full texts are included.[21–42] The systematic search was updated July 21st, 2020, which led to the inclusion of 1[43] further publication (Fig. 1).

Characteristics of included studies

Of the 23 included studies, the results related to comparative seasons are presented. The majority of the studies ($n = 18$) describe results from the Asian region,[21–24,26–31,33,34,36,39–41,43] 9 from North America[21,27,28,32,37,38,41–43] and 5 from Europe.[21,25,27,28,41] The observation period of the studies in the 2020 season ends in the 8th[26] to 21st[38] calendar week. In total, the influenza estimates are compared with up to 1,[22,24,29,36,39,43] 2,[26,28,37] 3,[23,31,34,35,42] 4,[25,32,40] 5,[21,27,33] 6[30] comparison seasons or a mean value of past seasons.[24,34,38,41] All studies present their results descriptively. In addition, statistical evaluations such as the moving average,[21] difference-in-difference regression,[33] linear regressions,[29,30,36] *t*-test,[34,36] Theil-Sen trend test[23] or linear trend estimation method[23] are used. A study determines the effective R according to Cori[26] (Table 1).

Risk of bias assessment of included studies

The risk of bias of the included studies varies. In the risk of bias assessment the focus is on evaluation of population, exposure, outcome and analyses. An overall low risk of bias is achieved by

Table 1
Characteristics of included primary studies.

First author, alphabetical order	Country	Publication format	Observation period 2019/2020	Comparison season(s)	Data sources	Influenza estimates	Methods
Chan CP[21]	China (Hong Kong) (other regions examined: South Korea, Taiwan, Europe & USA)	Primary study	Until week 16/17 2020	2014/2015 (since week 40) 2015/2016 2016/2017 2017/2018 2018/2019	Weekly data in online databases of regions focused on (Flu News Europe is given as an example)	Laboratory confirmed influenza cases: weekly positivity rate	descriptive (supplemented by moving average)
Chan KH[22]	China (Hong Kong)	Primary study	End of season not clearly derivable (after January)	Since week 01 2018	Centre for Health Protection - Flu express	Positivity rate in%	descriptive
Chan K-S[23]	Taiwan	Brief report	November 2019 until April 2020	2016/2017, November until April 2017/2018, November until April 2018/2019, November until April	Taiwan CDC	Weekly number of severe complications (hospital admissions requiring treatment in the intensive care unit)	descriptive Theil-Sen trend test trend-season-model
Choe[24]	South Korea	Editorial	Until week 17 2020	Mean value of 2015–2019 2018/2019 (since week 37 2018)	syndromic sentinel surveillance system	ILI/1000 contacts in health care facilities Number of viruses detected with differentiation for virus type	descriptive
					laboratory sentinel surveillance system	Number of viruses detected with differentiation for virus type	
Coma[25]	Spain (Catalonia)	Primary study (pre-print)	Until week 12 2020 (19.03.2020, about 45 days after seasonal peak)	2011/2012, 100 days before and after seasonal peak 2012/2013, 100 days before and after seasonal peak 2013/2014, 100 days before and after seasonal peak 2016/2017, 100 days before and after seasonal peak	Diagnosticat (sentinel network of primary care providers)	Aggregated ILI cases of the past 7 days (based on ICD diagnoses)	descriptive modelling of excess-ILI cases (ARIMA) and comparison with COVID-19 diagnoses
Cowling[26]	China (Hong Kong)	Primary study	Week 47-week 8 (24.11.2019–23.02.2020)	Week 49 2010- week 13 2011 (12.12.2010–03.04.2011) Week 49 2014- week 18 2015 (07.12.2014–03.05.2015)	Centre for Health Protection	Weekly reports of proportion of ILI consultations	descriptive comprehensive model for calculating an influenza proxy and deriving effective reproduction figures: comparison of the effective reproduction figures according to Cori
					Public Health Laboratory Services	Influenza test results from public hospitals Influenza test results from sentinel surveillance: positivity rate of influenza virus types/subtypes on all samples tested	
					Census and Statistics Department of the Hong Kong Government	Data on population structure	
					Paediatric wards of two large hospitals	Hospitalisation rates for children tested positive for influenza	

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Table 1 (*continued*)

First author, alphabetical order	Country	Publication format	Observation period 2019/2020	Comparison season(s)	Data sources	Influenza estimates	Methods
Hsieh[43]	Taiwan (other country examined: USA)	Brief report	Week 36-week 17	2018/2019, since week 40	Taiwan CDC	Confirmed influenza cases (A and B) ILI cases Examined specimens	descriptive
					US CDC	Confirmed influenza cases (A and B)	
Itaya[27]	Japan (other regions examined: North China, South China, Hong Kong, South Korea, Taiwan, Canada, USA, England, France, Germany)	Short communication	Week 40-week 10	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	Open access databases of the health authorities of the countries/regions	ILI incidence: North China, South China:% of outpatient contacts with ILI symptoms per sentinel Hong Kong: consultation rate with ILI symptoms per 1000 consultations in the private medical sentinel system South Korea, Canada, Germany:% contacts with ILI symptoms per sentinel Taiwan:% outpatient contacts with ILI symptoms USA:% contacts with ILI symptoms according to ILINet England: General practice consultation rate with ILI symptoms per 100,000 population France: ILI rate per 100,000 inhabitants Number of samples tested for influenza: North China, South China, Hong Kong, South Korea, USA	descriptive difference-in-difference design
Kong[28]	China (other countries examined: USA, France, Italy)	Primary study (pre-print)	China, USA, France: week 40-week 11 Italy: week 16-week 11	China, USA: 2017/2018, week 40-week 39 2018/2019, week 40-week 39 France: 2017/2018, week 40-week 20 2018/2019, week 40-week 17 Italy: 2017/2018, week 46-week 17 2018/2019, week 46-week 17	China: Chinese National Influenza centre (CNIC)	Positivity rate	descriptive
					China: National health commission of the People's Republic of China	ILI rate	
					USA, France, Italy: WHO GISRS	Positivity rate	
Kuo[29]	Taiwan	Research letter	Week 1-week 12 (until 21.03.2020)	2019, week 1-week 12	Taiwan National Infectious Disease Statistics System (Taiwan Centers for Disease Control)	Number of persons with an ILI diagnosis who have visited outpatient health care facilities Rate of persons with an ILI diagnosis coming to outpatient health care facilities per 1000 persons Number of influenza strains identified Influenza positivity rate $\frac{Number\ of\ samples\ tested\ positive\ for\ influenza}{all\ samples\ tested}$ Number of samples tested positive for influenza	descriptive linear regression

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Table 1 (*continued*)

First author, alphabetical order	Country	Publication format	Observation period 2019/2020	Comparison season(s)	Data sources	Influenza estimates	Methods
Lee[30]	South Korea	Primary study	Week 36-week 17	2013/2014, week 36-week 35 2014/2015, week 36-week 35 2015/2016, week 36-week 35 2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	syndromic sentinel surveillance system	ILI incidence per 1000 outpatient contacts	descriptive Interrupted time series based on linear regressions (only in season 2019/2020)
					laboratory sentinel surveillance system (KINRESS, South Korea Influenza and Respiratory Viruses Surveillance System) hospital based surveillance system	Absolute cases of influenza, weekly	
Noh[31]	South Korea	Brief communication	Week 36-week 16	2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	South Korea Influenza and Respiratory Viruses Surveillance System	Detection rate of influenza viruses (%)	descriptive
					South Korea Centers for Disease Control and Prevention	ILI rates (per 1000 outpatient contacts)	
Rivera[32]	USA	Primary study (pre-print)	Until week 19 (09.05.2020)	Since week 40, 2015	National centre for Health Statistics (NCHS) Mortality Surveillance Survey, data of 12.06.2020	Influenza-associated mortality, weekly	Descriptive modelled estimates of excess mortality
Sakamoto[33]	Japan	Research letter	Week 40-week 11 (30.09.2019–15.03.2020)	2014/2015, week 40-week 11 2015/2016, week 40-week 11 2016/2017, week 40-week 11 2017/2018, week 40-week 11 2018/2019, week 40-week 11	National Institute of Infectious Diseases Japan	Weekly number of influenza cases (syndromically or laboratory diagnosed) from about 5000 sentinel centers (60% pediatrics and 40% internal medicine or general medicine)	descriptive difference-in-difference design
Soo[34]	Singapore	Research letter	*t*-test: week 1-week 4 vs. week 5-week 8 descriptive: week 27-week 9	Individual (week 27-week 26) and average of:2016/2017 2017/2018 2018/2019	Routine sentinel data from primary care hospitals	Number of persons who have contacted primary public health care providers due to symptoms of ILI (ILI cases) per day Number of ILI samples per week influenza positivity rate Estimate of influenza cases per day ILI cases per day $*$ Influenza positvity rate amongst ILI cases	descriptive *t*-test
					National Public Health Laboratories		

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Table 1 (*continued*)

First author, alphabetical order	Country	Publication format	Observation period 2019/2020	Comparison season(s)	Data sources	Influenza estimates	Methods
Sun[35]	China	Not clear	Week 40-week 10	2016/2017, week 40-week 12 2017/2018, week 40-week 12 2018/2019, week 40-week 12	CDC Weekly China Influenza Surveillance Report	Incidence of laboratory-confirmed influenza cases in sentinel clinics (positivity rate)	descriptive
Suntronwong[36]	Thailand	Commentary	Week 1-week 18	2019, week 1-week 18	Sentinel hospital in Bangkok	ILI cases Laboratory confirmed influenza cases influenza positivity rate	descriptive *t*-test linear regression
Wiemken[37]	USA	Brief report	Week 40-week 12	2017/2018, week 40-week 12 2018/2019, week 40-week 12	Centers for Disease Control	weighted percentage of ILI total number of influenza diagnoses total number of confirmed influenza diagnoses from clinical and public health laboratories	descriptive
Wiese[38]	USA	Primary study (accepted manuscript)	Week 40-week 21	Weekly median of the seasons 2015 to 2019: week 40-week 39	Prevention FluView Interactive WHO, National Respiratory and Enteric Virus Surveillance System (NREVSS) of CDC, ILINet of CDC	Determination of the positivity rate based on virologic and syndromic surveillance data	descriptive
Wu[39]	China	Letter to the editor	Week 1-week 13	2019, week 1-week 13	Chinese National Influenza centre	ILI% (China, North and South, and Guangzhou City) Positivity rate (China, North and South, and Guangzhou City) Influenza cases (Guangzhou City)	descriptive
Yang[40]	Taiwan	Letter to the editor	Week 1-week 14	2016, week 1-week 14 2017, week 1-week 14 2018, week 1-week 14 2019, week 1-week 14	Taiwan CDC	Weekly number of severe complications (hospital admissions requiring intensive care or influenza-associated mortality)	descriptive
Young[41]	China (other countries examined: USA, Italy)	Primary study (pre-print)	Calendar week not presented (up to 14 weeks before and 12 weeks after the peak)	Average of the influenza cases 2015–2019 in relation to the respective seasonal peak, calendar week not presented (up to 14 weeks before and 12 weeks after the peak)	WHO FluNet	Influenza cases: $\frac{\textit{number of cases per week (in 2019/2020) or average number of cases per week (2015 – 2019)}}{\textit{number of cases during the peak (in 2019/2020) or average number of cases during the peak (2015 – 2019)}}$	descriptive
Zipfel[42]	USA	Primary study (pre-print)	Week 41-week 10	2002/2003, week 41-week 10 2008/2009, week 41-week 10 2015/2016, week 41-week 10	U.S. centre for Disease Control and Prevention's (CDC) Outpatient Influenza-like Illness Surveillance Network (ILINet)	ILI incidence: $\frac{\textit{ILI contacts in sentinel clinics}}{\textit{all contacts in sentinel clinics}}$, the authors carry out a z-transformation based on the data	descriptive intervention analysis regression model metapopulation model

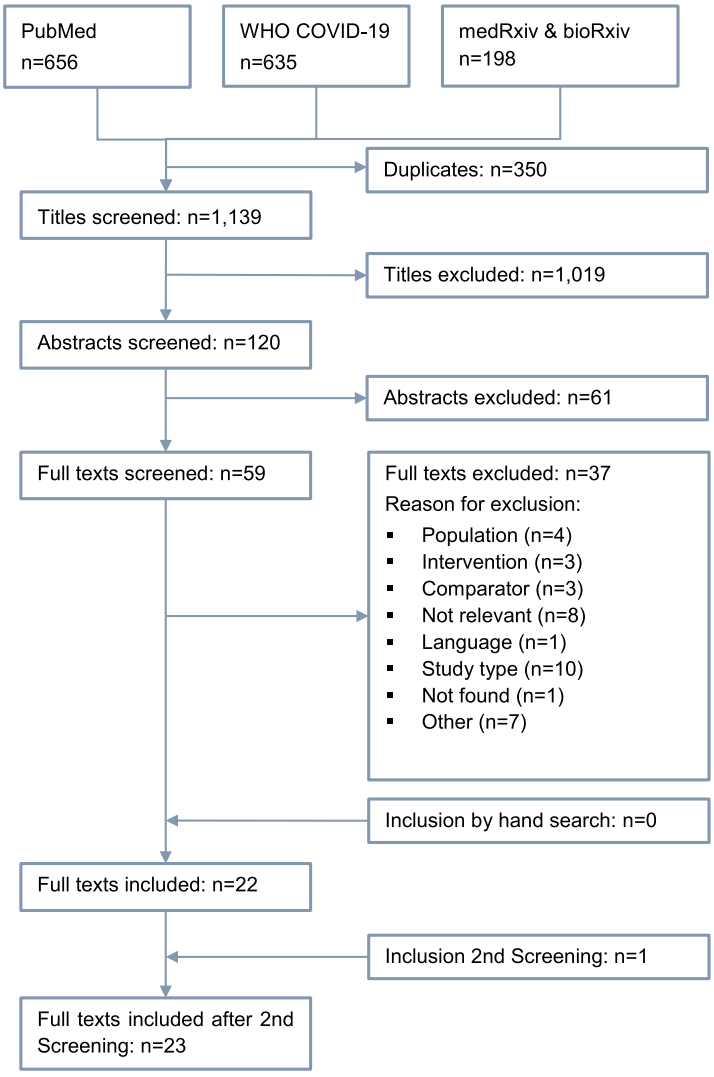

Fig. 1. Flow chart.

5 studies. Two studies achieve only moderate or high risk in all categories.

We classify 2 studies as high risk because of insufficient description of data sources.[21,27] Four studies refer to only 1 comparison season and are classified as high risk in terms of exposure.[29,36,39,43] With regard to the outcome presentation, 3 studies are classified as high risk.[28,35,41] The basis for this assessment is whether the observation period in 2020 was long enough to detect effects of the NPIs on influenza estimates and whether the authors discuss any limitations of the respective surveillance system in their studies at all. In most of the studies limitations such as a change in care seeking behaviour are discussed. Lastly, 5 studies[25,27,37,42,43] are identified as high risk regarding analyses, because the observation period was too short to detect clear effects of the influenza estimates. When further statistical analyses were performed, missing confidence intervals are considered as negative factors, this was the case in 3 studies[29,34,36] (supplementary table S5).

Outcome measures of included studies

Five studies report results on influenza-like illness (ILI) cases absolute,[25,29,34,36,43] 8 studies on ILI incidence as a proportion of a population,[24,27,29–31,37,39,42] and 11 studies on absolute influenza cases.[24,26,27,29,30,33,34,36,39,41,43] The majority of studies report results on influenza positivity rates.[21,22,28–31,34–39] In addition, 9 studies give information on samples tested for influenza viruses.[21,24,27,29–31,33,34,43] Four studies additionally show results on serious complications related to influenza virus infection,[23,29,32,40] including 1 reporting mortality[32] (Table 2).

Overall, most identified studies show a clear influence of the NPIs on influenza morbidity and mortality. Specific influenza estimates reveal significantly lower values under the influence of NPIs compared to previous years. However, the direction of more unspecific ILI estimates varies. The positivity rate shows indications of proportionally fewer influenza cases diagnosed compared to the sample material sent in (Tables 3, 4).

Respiratory samples tested for influenza viruses

A total of 9 studies provide information on respiratory samples tested for influenza viruses.[21,24,27,29–31,33,34,43] Of these, 4 studies describe which viruses were predominant.[24,30,31,33] The identified influenza strains per week are lower in Taiwan compared to the previous year.[29,43] The results on the number of respiratory samples tested for influenza provide a diverse picture. In the majority of countries/regions the values are at least tending to be lower compared to previous seasons: Hong Kong,[21,27] South Korea,[21,27] Taiwan[21] and Europe.[21] The results for the USA are inconsistent:

Table 2
Influenza estimates with comparison to previous seasons as reported by primary studies.

First author (alphabetical order)	ILI cases	ILI incidence	Samples tested	Influenza cases	Influenza positivity rate	Severe complications due to influenza	Influenza reproduction number
Chan CP[21]			✓		✓		
Chan KH[22]					✓		
Chan K-S[23]						✓	
Choe[24]		✓	✓	✓			
Coma[25]	✓						
Cowling[26]				✓			✓
Hsieh[43]	✓		✓	✓			
Itaya[27]		✓	✓	✓			
Kong[28]					✓		
Kuo[29]	✓	✓	✓	✓	✓	✓	
Lee[30]		✓	✓	✓	✓		
Noh[31]		✓	✓		✓		
Rivera[32]						✓	
Sakamoto[33]			✓	✓			
Soo[34]	✓		✓	✓	✓		
Sun[35]					✓		
Suntronwong[36]	✓			✓	✓		
Wiemken[37]		✓			✓		
Wiese[38]					✓		
Wu[39]		✓		✓	✓		
Yang[40]						✓	
Young[41]				✓			
Zipfel[42]		✓					

Table 3
Direction of transmission measures as reported in primary studies.

Estimate	First author	Country	Data sources	Results	Difference of estimate during COVID-19 pandemic as compared to previous seasons
R_t	Cowling[26]	China (Hong Kong)	Estimation of an influenza proxy (cases) by influenza virus A H1N1 (dominant subtype) for season 2019/2020 weekly ILI consultation rate*proportion of weekly positive tested specimens of A H1N1 Determination of the daily influenza proxy from the weekly influenza proxy using flexible cubic splines Using the daily influenza proxy calculation of the effective reproduction rate	A R_t is calculated on the basis of the influenza proxy. In all three seasons (2010/2011, 2014/2015 & 2019/2020) the curves start at a R_t of just under 1.5. The 2010/2011 and 2014/2015 seasons show a general decreasing trend (with fluctuations) to a value below 1 in February. Then the curves show a one-time rising trend to values above 1 within 2 weeks, followed by a steady decrease to values just below 1, where the graph ends. The curve for the 2019/2020 season, on the other hand, initially also shows a decreasing trend until the turn of the year to a value just above 1, but then rises again significantly to a value of about 1.7 at the beginning of January. Thereafter, the curve resembles that of the reference seasons.	↓

ILI: Influenza-like illness.
R_t: effective reproduction number.
↓: Values in the 2019/2020 season below those of the reference seasons.

Chan CP et al. show values up to week 17 and report a rather negative trend,[21] while Itaya et al. achieve the opposite result based on values up to week 10.[27] Soo et al., after initially showing significantly more samples for influenza at the beginning of 2020 compared to previous years, describe values in the range of the comparative values of previous years at the end of the observation period in week 9.[34] Values similar to those of previous years are also reported for North and South China, after an initially more extreme peak[27] (Table 4).

Laboratory confirmed influenza estimates and positivity rate

The majority of the studies consistently show that the number of influenza cases in 2020 during the COVID-19 pandemic was lower overall than in previous years.[24,26,27,29,30,33,34,36,39,41,43] A shorter influenza season is reported by 10 studies[24,26,29,30,33,34,36,39,41,43] and lower case counts during the influenza season by 2 studies.[26,33] An exception is the result of Hsieh et al. reporting results from the USA. They show an influenza course similar to that of the previous year, but end the observation period while the trend in the values is still declining.[43] Methodologically, Young et al. report influenza cases differently from the other authors. They do not report on the basis of calendar weeks, but in relation to the seasonal peak. Furthermore, they do not show the absolute influenza cases, but the influenza cases relative to the value reached at the seasonal peak. For China and Italy, they thus show a significant reduction in influenza cases after the peak, while for the USA only a tendency.[41]

Three studies from Taiwan[23,29,40] report weekly cases of serious complications due to influenza. The cases in 2020 show an earlier negative trend compared to the previous season. As of week 9, no more cases of serious complications are documented. Additionally, a study from the USA describes influenza-associated mortality and finds no difference to the comparison seasons except for the data from New York City. There a clear peak is evident, which the authors explain as misclassified COVID-19 cases.[32]

Also, based on the positivity rate it is clear that the values of observed influenza cases after taking measures during the COVID-

Table 4
Direction of frequency measures as reported in primary studies.

Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
Influenza-like illness cases	Coma[25]	Spain (Catalonia)	Number of ILI cases of the past 7 days in relation to the respective season highlight (day 0)	2011/2012, 100 days before and after seasonal peak 2012/2013, 100 days before and after seasonal peak 2013/2014, 100 days before and after seasonal peak 2016/2017, 100 days before and after seasonal peak	Results presentation of the 2019/2020 season in relation to comparison seasons, see column: results of 2019/2020	Until week 12 2020 (19.03.2020, about 45 days after seasonal peak)	Until the seasonal peak, the ILI curve in the 2019/2020 season is similar to the comparative season. A peak is reached with about 12,000 ILI diagnoses in the past 7 days. After the peak, the values initially decrease similar to the comparative seasons. About 20 days after the peak in 2019/2020, the curve drops for a short time and then proceeds at a slightly slower rate than in the reference seasons.	(↑) course of curve in 2020 similar to that of previous years with a less continuous drop after the peak
	Hsieh[43]	Taiwan	Number of ILI cases per week	2018/2019, since week 40 2018	The values in 2018 start at a level around 50,000 in week 40 and peak around the turn of the year at 120,000, after which the values fall to a constant level around 60,000 to 80,000 as the year 2019 progresses.	2019/2020, until week 17 2020	At the turn of the year 2019/2020 the values increase and reach a peak of 125,000 in the 2nd week of 2020, after which the values decrease significantly and are permanently below the previous lows of 30,000 to 40,000 from week 9 onwards.	↓
	Kuo[29]	Taiwan	ICD diagnoses in outpatient health care facilities per week	2019, week 1-week 12	In 2019, in the first weeks of observation, the cases increase from about 75,000 to 100,000 in week 5 and then decrease again to a steady level of about 75,000.	2020, week 1-week 12	The cases at the beginning of the observation in 2020 are high at about 100,000, but then fall from the 4th week and reach a constant level below 50,000 at the end of the observation.	↓
	Soo[34]	Singapore	Number of persons who have contacted public primary care providers due to symptoms of ILI per day	Individual and average of: 2016/2017, week 27-week 26 2017/2018, week 27-week 26 2018/2019, week 27-week 26	An apparently regular fluctuating curve is noticeable. Around week 29, a peak between 60 and 100 persons per day can be seen due to ILI symptoms. After that, the curve initially decreases and culminates in a clear peak at the turn of the year. Again the curve decreases and shows another peak at a lower level around weeks 17 to 23. The 2016/2017 season is an exception. It does not show a peak at the turn of the year, but a clear peak in the weeks 17 to 23.	2019, week 27–2020, week 9	In the 2019/2020 season, the curve initially starts out similarly. However, the peak at the turn of the year is (somewhat) higher and earlier than in the comparative seasons. From week 7 onwards, the values are at a level below the comparative values.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Suntronwong[36]	Thailand (Bangkok)	Number of persons who have contacted health care providers due to ILI symptoms	2019, week 1-week 18	ILI cases start at a level around 50 and peak at around 210 in week 4. After that, the values drop sharply until week 7 and then somewhat more slowly. At the end of observation a value around 60 is reached.	2020, week 1-week 12	ILI cases start at a level around 50 and peak at around 180 in week 5. After that the ILI cases fall sharply until week 7 and then somewhat more slowly. At the end of observation a level around 10 is reached.	↓
Influenza-like illness incidence	Choe[24]	South Korea	ILI/1000 persons presented in health care facilities per week	mean (95% CI) 2015–2019 2018/2019 (since 2018, week 37)	The mean value shows a peak at the turn of the year with a fluctuating but decreasing tendency until week 22, when the year settles down at a constant low level.	2020, until week 17	The 2019/2020 season will see a peak at the turn of the year followed by a declining trend. However, the values in the 2019/2020 season reach the constantly low level already in week 11.	↓
	Itaya[27]	North China	ILI% of persons presented in outpatient health care providers with ILI symptoms per sentinel	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	Initially, the values increase similarly strongly in all seasons. They begin in week 40 between 2 and 3. At the turn of the year they are between 3 and 6. In the majority of the seasons the values initially decrease at the beginning of the year and reach a peak between 4 and 6 after a few weeks. In week 10 values between 2.5 and 3.8 are reached.	2019, week 40–2020, week 10	The values start at 3 in week 40, then increase to 6 by the turn of the year. After that, lower values are reached at first and in week 5 a maximum at about 8.5. At the end of the observation period the values are at 2.8.	→
		South China	ILI% of persons presented in outpatient health care providers with ILI symptoms per sentinel	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	In all seasons the values in week 40 are between 2.9 and 3.9, and in the seasons 2018/2019 and 2017/2018 a maximum between 6.8 and 6 is reached in week 4. In both seasons, the values then initially decrease and increase again until week 6 and week 7. Also in season 2015/2016 a maximum of 4.5 is reached in week 6. The other values of the other seasons remain fluctuating around 3 and at the end of the observation period the values are between 2.3 and 4.	2019, week 40–2020, week 10	In the 2019/2020 season, the values in week 40 start at 3.6, then increase to 6.6 by the turn of the year. After that, lower values are reached at first and in week 5 a maximum at about 8. At the end of the observation period the values are at 3.	→

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		China (Hong Kong)	Consultation rate with ILI symptoms per 1000 consultations in the private medical sentinel system	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values of the reference seasons start fluctuating between 30 and 60 and around week 4, peaks between 62 and 78 are reached in the seasons 2018/2019, 2017/2018, 2015/2016 and 2014/2015. The values of the season 2015/2016 are rising at the end of the observation period. At the end of the observation period the values are between 40 (2017/2018) and 82 (2015/2016).	2019, week 40–2020, week 10	The values generally fluctuate in the lower range of the values of the comparison seasons (between 15 and 40). At the end of the observation period, the values below all values of the comparison seasons are at 24.	↓
		Canada	Percentage of contacts with ILI symptoms per sentinel	2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values of the reference seasons start at 1, then fluctuate between 1 and 3 and reach a peak between 3.3 and 4.7 at the turn of the year, while the seasons 2016/2017 and 2017/2018 are bimodal. A second peak is at 3.3 and 4.5 after a few weeks. At the end of the observation period the values are between 1.2 and 1.7.	2019, week 40–2020, week 10	The course of the values is similar to that of the comparison seasons. A peak is reached at 3 in week 1 and at the end of the observation period the value 1.5 is reached.	→
		Germany	Percentage of contacts with ILI symptoms per sentinel	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values of the reference seasons start fluctuating around 1 to 2, and from week 5 onwards a peak between 2.5 and 3.5 is reached. Until the end of the observation period, the values then remain at a level similar to that of the peak or begin to decrease. In week 10 values between 1.2 and 3.2 are reached.	2019, week 40–2020, week 10	The values initially fluctuate around 1 until the turn of the year, after which the values increase and a peak is reached in week 7 at 2.2. In week 8 the values decrease slightly and rise again to 2 by week 10.	→
		Taiwan	Percentage of outpatient contacts with ILI symptoms per sentinel	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values remain generally constant until the turn of the year, with values between 0.7 and 1 depending on the season. In the seasons 2015/2016 and 2018/2019, a clear peak at 3 and 2.6 is reached in week 6. In the 2017/2018 season, the values from week 3 to week 8 are permanently high at values around 2. Only a small, rather continuous increase can be seen in the 2014/2015 and 2016/2017 seasons. At the end of the observation period values between 0.9 and 2.5 are reached.	2019, week 40–2020, week 10	The curve initially resembles that of the previous seasons with values just above 1. At the end of the year the values initially rise and from week 1 to week 5 the values are at 2. After that they fall sharply and reach a value of 0.7 below those of previous years in week 10.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation slightly below the level of the comparison seasons

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		USA	Percent contacts with ILI symptoms according to ILINet	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The curve of the comparison seasons is similar. In week 40, values just over 1 are reached in all seasons, then the curve rises slowly at first and then significantly in the last weeks of the year. At the turn of the year in week 52, maxima of varying intensity are reached in all seasons. The values lie between about 2.3 in 2015/2016 and 6 in week 52. In almost all seasons the values then initially decrease slightly (except in 2017/2018) and increase again from about week 2. In the seasons 2016/2017, 2017/2018 and 2018/2019, respectively, a second peak is reached at 5, 7.5 and 5, respectively. In the 2015/2016 season, the values increase continuously until the end of the observation period, reaching values at 3.5. In all other seasons, a decreasing trend to values between 2.4 and 4.5 in week 10 can be observed.	2019, week 40–2020, week 10	The curve is also bimodal and similar to that of previous years. After a slight increase from the beginning of the observation (values at 1.5), a rapid increase in value occurs at the end of the year and a first maximum is reached at 7 in week 52. After that, the values decrease at first and a second maximum at 6.8 in week 5 and week 6 can be seen. In week 10 the values are lower at 5.2, but a slightly increasing trend can be seen.	↑
		England	General practitioner consultation rate with ILI symptoms per 100,000 population	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	All curves of the previous seasons start at a level around 5 and remain constant at this level. From week 48 the values increase and fluctuate between 5 and 20 at the beginning of the year, with the 2017/2018 season being an exception. In this season, a clear maximum is reached from week 2 to week 4 around 40 and only in week 9 are values corresponding to the reference seasons reached again. In week 10 the values of all seasons are between 5 and 17.	2019, week 40–2020, week 10	The 2019/2020 season will initially be similar to that of previous years. First the values are constant at 5, increase from week 27 and in week 52 to week 1 a maximum at 17 is reached. Until week 4 the values below those of the reference seasons drop to about 8, but then remain constant and show a slightly increasing trend at 8 in week 10.	→

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		France	ILI rate per 100,000 inhabitants	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The curves of the reference seasons start out consistently low at values around 25, with peaks around 400 and 450 in the 2016/2017 and 2017/2018 seasons around the turn of the year. The maxima of the seasons 2014/2015 and 2018/2019 are reached in week 6 at 820 and 600. In the season 2015/2016 there is no peak within the observation period, but a constantly increasing trend until week 10 at 400. The values in week 10 of the other reference seasons are between 20 and 220.	2019, week 40–2020, week 10	The curve initially resembles that of the previous seasons, starting constantly at values between 25 and 50 and increasing at the end of the year to a maximum in week 6 at 300. After that, the curve decreases to values of 170 in week 10.	→
		South Korea	Percent contacts with ILI symptoms per sentinel	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The comparison seasons start uniformly with values constantly around 4, with a peak in all seasons. The values remain similarly low until shortly before the peak. In the seasons 2016/2017, 2017/2018 and 2018/2019 a peak between 71 and 87 is reached at the turn of the year at week 52. In the seasons 2014/2015 and 2015/2016 a peak in week 8 at 46 and week 7 at 54 is reached. In all seasons a decreasing curve is observed after the peak. In week 10 the values finally lie between 9 and 32.	2019, week 40–2020, week 10	A similar curve is shown in season 2019/2020. The values start slightly rising by 5 from week 40 and increase significantly from week 47. In week 52 to week 2 a maximum is reached at 50. After that the values decrease slightly at first, then more strongly and reach a value just below that of the comparison seasons at 5 in week 10.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation slightly below the level of the comparison seasons
	Kuo[29]	Taiwan	ILI/1000 persons presenting themselves in outpatient health care facilities per week	2019, week 1-week 12	ILI diagnoses vary in 2019 by a value between 13 and 15 visits.	2020, week 1-week 12	In 2020, the values are between 15 and 20 in the first 5 weeks, but then fall to values around 6.	↓
	Lee[30]	South Korea	ILI/1000 persons presenting themselves in outpatient health care facilities per week	2013/2014, week 36-week 35 2014/2015, week 36-week 35 2015/2016, week 36-week 35 2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	The seasons 2014/2015, 2015/2016, 2016/2017 and 2018/2019 show a bimodal pattern of ILI activity and the seasons 2013/2014 and 2017/2018 a single peak.	2019, week 36–2020, week 17	In the 2019/2020 season, there will be a single highlight. Since week 10 2020 the ILI activity is below comparable periods of the previous seasons.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Noh[31]	South Korea	ILI/1000 persons presenting themselves in outpatient health care facilities	2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	The course of the described influenza seasons is similar in week 36 to about 49. In all seasons the (first) peak is reached around the turn of the year. After the first peak, the seasons 2016/2017 and 2018/2019 show a steep drop in the ILI rate and a second peak from week 14 of the following year. In comparison, the 2017/2018 season has only one peak. In the end, the values of the comparison seasons settle down to a value of about 5 from week 14 (season 2017/2018) and 22 (season 2016/2017).	2019, week 36–2020, week 16	In weeks 36 to about 49, the curve resembles that of previous years. The only peak is reached around the turn of the year, but is generally lower than in previous years. From week 9 2020, the values are permanently below those of the previous seasons.	↓
	Wiemken[37]	USA	Weighted percentage	2017/2018, week 40-week 12 2018/2019, week 40-week 12	Both curves initially show a steady increase in the ILI incidence until the turn of the year. In the 2017/2018 season, a plateau is reached there, which reaches a peak at 8% by week 5. In the 2018/2019 season, a peak at 4% is reached at the turn of the year. This is followed by a drop in the curve, but within a few weeks a second peak at just under 6%. Up to the end of the observation period, the values from the only (2017/2018) or second (2018/2019) decrease continuously. At the end of the observation period, a further downward trend is shown.	2019, week 40–2020, week 12	At the turn of the year a peak is reached at just under 8%. This is followed by a drop in the curve, which however culminates in a second peak at about 7% within a few weeks. In the 2019/2020 season, the values fall from the second peak. From week 9 onwards, a steady increase is recorded, which reaches the level of the second peak at the end of the observation period.	↑

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Wu[39]	China	ILI percentage (China, North and South, and Guangzhou City)	2019, week 1-week 13	The ILI% are listed separately for North and South China and Guangzhou City. In 2019, at the beginning of the year, the value in China initially decreases slightly until week 5, peaks in week 6 and reaches a level in week 7 that is kept general in the following weeks (3–4%). A similar curve is seen in Guangzhou City. However, the peak is higher than in China as a whole at around 9% in week 5. After a rapid decline to 4% by week 6, the curve rises slightly to values around 5% in week 13.	2020, week 1-week 13	In 2020, at the beginning of the year, the value in China initially decreases to approx. 5% by week 3, peaks in week 5 at 8% and then decreases continuously to values below those of the previous year. At the end of the observation period the values are at 3%. In Guangzhou City the peak is about one week later than in China as a whole at about 10%. After the curve drops, the values settle at a slightly higher level than in China as a whole, at values around 6%. From the 6th week the values in 2020 are permanently above those of 2019.	China: ↓ Guangzhou City: ↑
	Zipfel[42]	USA	ILI incidence (z-transformed)	2002/2003, week 41-week 10 2008/2009, week 41-week 10 2015/2016, week 41-week 10	The z-transformed course of the described seasons (2002/2003, 2008/2009, 2015/2016) is similar at the beginning of the observation period (early October to early March). A peak is reached in all seasons shortly before the turn of the year in the comparative seasons is around 0.2 to 0.5. A second peak is reached in February. This lies at about 1.9 to 2.1. The 2015/2016 season is an exception: it does not show a second peak, but a further increasing trend at the end of the observation period (at 2.3). In the other seasons, the values fall again until the end of the observation period and show a decreasing trend (at 0.2 to 0.8).	2019, week 41–2020, week 10	The z-transformed course at the beginning of the observation period (early October to early March) is similar to that of the reference seasons. A peak is reached shortly before the turn of the year. The peak is about 1.5, which is higher than in the reference seasons. A second peak is reached in February. This is lower in the 2019/2020 season (about 1.5) than in the reference seasons. This is followed by a declining trend, which shows a renewed increase shortly before the end of the observation period (at 0.5).	(↑) at the end of the observation period in 2020, the values are in the lower range of the comparative seasons, but an increase in the values is foreseeable
Respiratory samples tested for influenza virus	Chan CP[21]	China (Hong Kong)	Number of samples tested for influenza per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The number of samples tested is approximately constant throughout the year with a slight increase during influenza seasons (about 4000 to 8000). No winter influenza estimates are recorded for the 2016/2017 season.	2019, week 40–2020, week 17	In the first quarter of 2020, the number of tests examined reaches a low level at around 2000 as last seen in 2014, but there is no peak significantly above the level of previous years.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		South Korea	Number of samples tested for influenza per week	2015/2016, week 52-week 39 2016/2017, week 40-week 28 2017/2018, week 41-week 39 2018/2019, week 40-week 39	The number of samples examined fluctuates throughout the year with fewer samples in the middle of the year (about 100 to 340).	2019, week 40–2020, week 17	In the first quarter of 2020, the number of tests examined reaches a significantly lower value than in previous years, at around 50 to 75, but there is no peak significantly above the level of previous years.	↓
		Taiwan	Number of samples tested for influenza per week	2014/2015, week 40-week 19, week 38 & week 39 2015/2016, week 40-week 7, week 38 & week 39 2018/2019, week 40-week 39	The number of investigated samples has been continuously available since week 40 2018 and shows a rather constant pattern (between 100 and 200).	2019, week 40–2020, week 12	At the beginning of 2020, the number of tests examined shows a significant decline since week 5 to a level around 50.	↓
		Europe	Number of samples tested for influenza per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The number of samples examined shows a seasonal trend with a significant increase in the winter months (approx. 2500 to 3500) and values close to zero in the summer months.	2019, week 40–2020, week 17	The peak and further course of the 2020 influenza season is similar to that of previous years (around 3000). There is a slight reduction in the number of tests examined a few weeks earlier compared to previous seasons. However, the season is described as cancelled.	(↓) at the end of the observation period in 2020 the values are at a comparatively low level, but the influenza season is described as truncated
		USA	Number of samples tested for influenza per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The number of samples examined shows a seasonal trend with a significant increase in the winter months (approx. 4000 to 8000) and significantly lower values in the summer months (up to 500).	2019, week 40–2020, week 17	The peak and further course of the 2020 influenza season is similar to that of previous years (around 7000). However, the high levels will be reached for several weeks longer. There is a slight reduction in the number of tests examined a few weeks earlier compared to previous seasons (around 1000). However, the season is described as cancelled.	(↓) at the end of the observation period in 2020 the values are at a comparatively low level, but the influenza season is described as truncated

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Choe[24]	South Korea	Identified influenza strains descriptively in the curve diagram (A(H1N1)pdm09, A(H3N2), b)	2018/2019 (since week 37 2018)	2018/2019 First wave: A(H1N1)pdm09 Second wave: B	2019/2020 (until week 17)	2019/2020 Predominant: A(H1N1)pdm09	n.a. visual representation of the dominant virus strain
	Hsieh[43]	Taiwan	Number of isolates representing the distribution of the 6 most common viral diseases based on ILI cases	2018/2019 (since week 40 2018)	Due to the presentation as a stack diagram, the definite number of identified influenza samples cannot be derived in detail. Maxima in the upper two-digit range around the turn of the year and in the middle of the year can be seen.	2019/2020 (until KW14)	In the 2019/2020 season, the values from week 8 in 2020 fall to lows below the level of the lows identified up to that point in the single-digit range.	↓
	Itaya[27]	North China	Number of samples tested for influenza per week	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values of the reference seasons 2014/2015, 2015/2016 and 2016/2017 fluctuate between 1800 and 3500. The values of the seasons 2017/2018 and 2018/2019 show a rather increasing, but fluctuating course from 3000 to 5500 until week 4, after which the values of all seasons settle at values around 1800 to 4000.	2019, week 40–2020, week 10	The curve is similar to that of the seasons 2017/2018 and 2019/2020, with values varying from 4000 to 5500. From week 4 to week 5 the values drop to values around 3000 and remain at the level until week 10 with a slightly increasing trend.	→
		South China	Number of samples tested for influenza per week	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The values of the comparison seasons vary between 2500 and 4500. Outliers are shown in season 2018/2019 (week 5 at 6200 and week 6 at 1100). In week 10 the values lie between 2900 and 4000.	2019, week 40–2020, week 10	The course of the curves is similar to that of the previous seasons. However, the values generally fluctuate above those of the previous seasons between 2700 and 5000. From week 4 to week 5, the values fall to values around 3000 and remain at the level until week 10 with a slightly increasing trend.	→
		China (Hong Kong)	Number of samples tested for influenza per week	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The curve from week 40 is generally slightly rising with little fluctuations. The values of the reference seasons are between 1800 and 5500 until the turn of the year. At the beginning of the year the trend is slightly more increasing and in week 10 values between 4100 and 6300 are reached.	2019, week 43–2020, week 10	In the 2019/2020 season, the curve is also relatively constant around 5000 up to the turn of the year, but from week 50 the values increase and between week 2 and week 5 they reach values around 7000 and are thus at the upper limit of the curves of the reference seasons. After that, the curve decreases and reaches a value of 4100 in week 10, which is at the lower limit of the curves of the comparison seasons.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation show trend below the level of the comparison seasons

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		South Korea	Number of samples tested for influenza per week	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	The curves in the reference seasons are permanently fluctuating between 140 and 340 with a tendency to slightly more samples at the turn of the year. One outlier can be seen in week 50 in the 2017/2018 season. The value is 600 and in week 10 the values are uniformly between 220 and 230.	2019, week 40–2020, week 10	In the 2019/2020 season, the curve is similar to that of previous years with values between 200 and 340, but from week 8 onwards, a clearly decreasing curve is observed, ending at 100 in week 10.	↓
		USA	Number of samples tested for influenza per week	2014/2015, week 40-week 10 2015/2016, week 40-week 10 2016/2017, week 40-week 10 2017/2018, week 40-week 10 2018/2019, week 40-week 10	Up to week 48 the curves of the reference seasons are uniformly and continuously rising from 10,000–18,000 to 15,000–29,000. After that the curves vary. In the 2014/2015 season, a peak is initially reached at 41,000 in week 52, after which the values decrease continuously throughout the season. The seasons 2015/2016 and 2018/2019 show a tendency to increase until week 10 at different levels. In week 10 a value of 38,000 is reached in week 2015/2016 and in 2018/2019 a value of 53,000. The seasons 2016/2017 and 2017/2018 each have a peak at the beginning of the year at 50,000 in week 7 and 80,000 in week 5. After that, a decreasing curve to values around 40,000 can be observed.	2019, week 40–2020, week 10	The curve of the 2019/2020 season is similar to the 2018/2019 season at a higher level. From 20,000 in week 40 the values rise to 71,000 in week 5. Until week 10 they decrease only slightly to a value around 63,000 and thus above the values in week 10 of the previous years.	↑
	Kuo[29]	Taiwan	Identified influenza strains per week, absolute & identification of virus strains (influenza A and B)	2019, week 1-week 12	The curve shows a fluctuating course between 40 and 75 identified influenza strains.	2020, week 1-week 12	The curve starts at a high level around 80 and then drops to a level around 50 by week 7. This is followed by a rapid fall of the curve to around 5 by week 8, and from week 11 the curve rises again slightly, reaching a value of around 10 by the end of the observation.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Lee[30]	South Korea	Identified influenza strains, absolute (%) per season & identification of virus strains per week (A(H1N1)pdm09, A(H3N2), A without subtyping, B)	2018/2019 2017/2018 2016/2017 2015/2016 2014/2015 2013/2014	2018/2019 A(H1N1)pdm09: 760 (42.1) A(H3N2): 379 (21.0) B: 675 (37,4) 2017/2018 A(H1N1)pdm09: 141 (7.0) A(H3N2): 771 (38.4) B: 1.101 (54,9) 2016/2017 A(H1N1)pdm09: 6 (0.5) A(H3N2): 882 (72.9) B: 322 (26,6) 2015/2016 A(H1N1)pdm09: 582 (44.1) A(H3N2): 62 (4.7) B: 675 (51,1) 2014/2015 A(H1N1)pdm09: 175 (11.0) A(H3N2): 827 (51.9) B: 591 (37,1) 2013/2014 A(H1N1)pdm09: 346 (16.5) A(H3N2): 640 (30.6) B: 1.108 (52,9)	2019/2020	2019/2020 A(H1N1)pdm09: 825 (70.6) A(H3N2): 297 (25.4) B: 47 (4.0)	n.a. tabular description of identified influenza strains
	Noh[31]	South Korea	Identified influenza strains per season (%)	2018/2019 2017/2018 2016/2017	2018/2019 A(H1N1)pdm09 (41.9%) B (37,2%) 2017/2018 B (54.7%) A(H3N2) (38.3%) 2016/2017 A(H3N2) (72.9%) B (26.6%)	01.09.2019–18.04.2020	2019/2020 A(H1N1)pdm09 (70.6%) A(H3N2) (25.4%)	n.a. tabular description of identified influenza strains
	Sakamoto[33]	Japan	Analysis of the dominant influenza subtypes based on data from 10% of sentinel centres per season	2018/2019, week 40-week 11 2017/2018, week 40-week 11 2016/2017, week 40-week 11 2015/2016, week 40-week 11 2014/2015, week 40-week 11	2018/2019: A(H3) 2017/2018: B 2016/2017: A(H3) 2015/2016: A(H1)pdm09 2014/2015: A(H3)	2019, week 40–2020, week 11 (30.09.2019–15.03.2020)	2019/2020: A(H1)pdm09	n.a. Naming of dominant identified influenza strains

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Soo[34]	Singapore	Number of ILI samples per week	Individually and average of: 2016/2017, week 27-week 26 2017/2018, week 27-week 26 2018/2019, week 27-week 26	In general, a fluctuating curve that appears regularly over the year can be observed. There are clear peaks between weeks 29 to 31 (on average around 90) and occasionally at the turn of the year (on average around 60).	2019, week 27–2020, week 9	A highlight in season 2019/2020 between week 1 and 9 with up to 180 tested samples per week. This peak is clearly above the curve of the previous years. After that, the curve decreases rapidly to a level corresponding to the average of the previous years (approx. 60), where the observation ends.	(→) course of curve in 2020 similar to that of the comparison seasons with a clear peak shortly after the turn of the year
Influenza cases	Choe[24]	South Korea	Number of viruses detected by laboratory diagnostics of viruses per week	2018/2019 (since week 37 2018)	The highlights of both seasons are about the same at 140 to 150, with two highlights being shown in the 2018/2019 season, one at the turn of the year and one a few weeks later.	2019/2020 (until week 17)	The highlights of both seasons are about the same at 140 to 150, with the 2019/2020 season reporting a peak at the turn of the year. As of week 9, no more viruses are identified.	↓
	Cowling[26]	China (Hong Kong)	Calculation of an influenza proxy (cases) using the influenza A(H1N1) virus	2014/2015, week 49-week 18 (07.12.2014–03.05.2015) 2010/2011, week 49-week 13 (12.12.2010–03.04.2011)	The beginning of the curve is at a similarly low level in all three seasons under consideration, at around 10 to 20, with the influenza cases per week reaching a peak in mid-January at up to 500, then falling to varying degrees and reaching a second peak at a lower level within a few weeks. After that, influenza cases show a decreasing trend to a level around 50.	2019, week 47–2020, week 8 (24.11.2019–23.02.2020)	For all three seasons considered, the curve begins at a similarly low level, with influenza cases reaching a comparatively lower peak in mid-January at around 10, after which the curve declines steeply until it remains constant at a low level of around 10 from the beginning of February.	↓
	Hsieh[43]	Taiwan	Number of influenza cases (A and B) per week	2018/2019, week 40-week 20	The values in the 2018/2019 season start at a level around 800 in week 40 and peak in week 6 2019 at around 4000. thereafter, the values fall to a fluctuating level around 1000 to 1500 in the further course of 2019. In the middle of 2019, values will initially reach just over 2000, which will fall to a level just below 1000 by week 47 2019.	2019, week 36–2020, week 10	Until the turn of the year 2019/2020 the values increase and reach a peak in the 4th week 2020 at 3250. After that the values decrease significantly and run from week 9 towards 0.	↓
		USA	Number of influenza cases (A and B) per week	2018/2019, week 40-week 20	The curves are characterized by constant values towards 0 in the middle of the year and a peak a few weeks after the turn of the year. In the 2018/2019 season, the peak is reached in week 10 at about 10,500 and from week 19 onwards, the values increasingly move towards 0.	2019, week 36–2020, week 10	In the 2019/2020 season, the values increase at the end of the year, decrease briefly in the first two weeks after the turn of the year and then peak at 17,000 in week 6 2020, after which the values decrease and reach around 9500 at the end of the observation period in week 10.	→

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Kuo[29]	Taiwan	Number of viruses detected by laboratory diagnostics per week	2019, week 1-week 12	The values are 2000 until week 8, after which the curve slowly drops to a value around 1200 at the end of observation.	2020, week 1-week 12	The curve initially shows higher values around 3000, followed by a rapid fall from week 5 to 6 to about 500. After that, the curve shows a continuous drop to near 0.	↓
	Lee[30]	South Korea	Number of viruses detected by laboratory diagnostics per week	2013/2014, week 36-week 35 2014/2015, week 36-week 35 2015/2016, week 36-week 35 2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	Influenza cases show a clear bimodal pattern in the years 2016/2017 and 2018/2019. In these seasons, an influenza A type was predominant at first and an influenza B type in the second wave. The seasons with only one peak show rather mixed forms of existing influenza types.	2019, week 36–2020, week 17	An influenza A virus with very few influenza B cases is dominant. In 2020, compared to all previous seasons, the levels will fall towards 0 weeks earlier, without a second peak following.	↓
	Sakamoto[33]	Japan	Number of viruses detected by laboratory diagnostics or syndromes per week	2018/2019, week 40-week 11 2017/2018, week 40-week 11 2016/2017, week 40-week 11 2015/2016, week 40-week 11 2014/2015, week 40-week 11	The peak of the seasons is reached at different levels shortly after the turn of the year (2800 to 4100). After that the cases fall off again. At the end of the observation period in week 11 the values are between 250 and 1500.	2019, week 40–2020, week 11 (30.09.2019–15.03.2020)	The curve for the number of influenza cases in the 2019/2020 season is generally flatter than all comparative seasons. The curve shows a peak before the turn of the year at 1700, then drops slightly (1000) and has a second peak at a slightly lower level after the turn of the year (1300). The highest value in the season is about half of the highest values of the seasons 2014/2015, 2015/2016 & 2016/2017, and the difference is even greater for the two seasons 2017/2018 & 2018/2019. While the course of the curve from week 40 to 46 is similar to that of the reference seasons, from week 46 to week 52 the influenza cases of the 2019/2020 season are higher than those of the previous seasons. From week 4 onwards, however, the cases of the 2019/2020 season remain permanently below the cases of the reference seasons.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Soo[34]	Singapore	Estimated cases of influenza per day	Individually and average of: 2016/2017, week 27-week 26 2017/2018, week 27-week 26 2018/2019, week 27-week 26	In the comparative seasons, recurring peaks can be observed at the turn of the year (50 on average) and in the middle of the year (40 on average). In the 2016/2017 season, a short peak in week 17 is also evident.	2019, week 27–2020, week 9	The season will initially be similar to those of previous years. However, the peak at the turn of the year exceeds that of previous years (at 80). From week 5 2020, a rapid drop in the curve can be seen, which from week 5 is below the level of previous years and from week 7 runs towards 0.	↓
	Suntronwong[36]	Thailand (Bangkok)	Number of laboratory diagnostic confirmed influenza cases per week	2019, week 1-week 18	The values start at a low level at about 5 and peak at about 60 in week 4. After that, the cases drop sharply until week 7. Then a second peak is reached at about 60 in week 9. At the end of the observation period the values fluctuate around 40 to 60.	2020, week 1-week 12	The values start at a low level at about 15 and peak at about 55 in week 5. After that, the influenza cases drop sharply until week 7. From week 12 on, no more cases are recorded.	↓
	Wu[39]	China	Reported influenza cases (Guangzhou City) per week	2019, week 1-week 13	In week 1, there were 2500 influenza cases, and by week 3 this number had risen to about 8000. By week 6, the number is decreasing continuously and is approaching zero, but in contrast to 2020, the number of influenza cases is then increasing again and settles at a regular level around 2500.	2020, week 1-week 13	The number of weekly influenza cases in 2020 is decreasing continuously in Guangzhou City from about 17,000 and is approaching zero from week 5.	↓
	Young[41]	China	Influenza cases in relation to the value at the time of the peak (respective seasonal peak week 0)	Average of influenza cases 2015–2019 in relation to seasonal peak, 14 weeks before and 12 weeks after peak	Results presentation of the 2019/2020 season in relation to comparative seasons, see column: Results of 2019/2020	14 weeks before until 12 weeks after the peak	The 2019/2020 influenza season is significantly shorter compared to the average of previous years and is characterised by a more pronounced decrease in values in relation to the values reached at the peak. Within 6 weeks after the peak in 2019/2020, values close to 0 are reached.	↓
		USA	Influenza cases in relation to the value at the time of the peak (respective seasonal peak week 0)	Average of influenza cases 2015–2019 in relation to seasonal peak, 14 weeks before and 9 weeks after peak	Results presentation of the 2019/2020 season in relation to comparative seasons, see column: Results of 2019/2020	14 weeks before until 9 weeks after the peak	The 2019/2020 influenza season is somewhat shorter than the average of previous years. However, after the peak in the 2019/2020 season, higher case numbers are initially recorded in relation to the peak than in the average of the weeks following the peak of previous years. Within 9 weeks after the peak in 2019/2020, values close to 0 are achieved.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation slightly below the level of the comparison seasons

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		Italy	Influenza cases in relation to the value at the time of the peak (respective seasonal peak week 0)	Average of influenza cases 2015–2019 in relation to seasonal peak, 14 weeks before and 7 weeks after peak	Results presentation of the 2019/2020 season in relation to comparative seasons, see column: Results of 2019/2020	14 weeks before until 7 weeks after the peak	The 2019/2020 influenza season is significantly shorter compared to the average of previous years and is characterised by a more pronounced decrease in values in relation to the values reached at the peak. Within 6 weeks after the peak in 2019/2020, values close to 0 are reached.	↓
Influenza positivity rate	Chan CP[21]	China (Hong Kong)	Positivity rate in% per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	In general, a seasonal trend in the positivity rate is evident. However, it shows a bimodal trend in the 2014/2015 season and there is no winter influenza season in the 2016/2017 season, but there is an increase in the positivity rate from week 25 2017 onwards, peaking at 25 to 40.	2019, week 40–2020, week 17	Compared to previous seasons, the positivity rate of the 2019/2020 season has a lower (at about 20) and shorter peak. Furthermore, it seems to reach a level closer to 0 for a few weeks.	↓
		South Korea	Positivity rate in% per week	2015/2016, week 50-week 39 2016/2017, week 40-week 28 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The positivity rate shows a clearly bimodal trend in the 2018/2019 season and a seasonal trend in the other seasons. The peaks are around 45 to 70.	2019, week 40–2020, week 17	Compared to the previous seasons, the positivity rate tends towards zero for a few weeks. The peak is at 40.	↓
		Taiwan	Positivity rate in% per week	2014/2015, week 40-week 19, week 38 & week 39 2015/2016, week 40-week 18, week 38 & week 39 2016/2017, week 40-week 30, week 38 & week 39 2017/2018, week 40-week 13, week 38 & 39 2018/2019, week 40-week 39	The positivity rate has only been continuously available since week 38 2018. It is permanently comparatively high with a slight increase around the turn of the year (approx. 25 to 50). As the data for the seasons 2014/2015 to 2017/2018 are reported incompletely, no detailed reference is made to them here - but a seasonal trend in the positivity rate can be assumed.	2019, week 40–2020, week 16	Since week 8 2020, however, the positivity rate has been close to zero. The peak is not significantly higher than reported in previous years.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		Europe	Positivity rate in% per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The positivity rate shows a seasonal trend with a significant increase in the winter months and values close to zero in the summer months. The peak lies between 40 and 55.	2019, week 40–2020, week 17	The positivity rate in 2020 is similar to that of previous years, but for a few weeks closer to zero than in the comparable seasons. However, the season is described as having been truncated.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation slightly earlier at the lowest level as compared to previous seasons
		USA	Positivity rate in% per week	2014/2015, week 40-week 39 2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	The positivity rate shows a seasonal trend with a significant increase in the winter months and values close to zero in the summer months. The peak lies between 20 and 30.	2019, week 40–2020, week 17	The positivity rate in 2020 is close to zero for a few weeks rather than in the reference seasons. However, the season is described as having been abandoned.	(↓) course of curve in 2020 initially similar to that of previous years, values at the end of observation slightly earlier at the lowest level as compared to previous seasons
	Chan KH[22]	China (Hong Kong)	Positivity rate in% (Influenza A, Influenza B, Influenza in general)	2017/2018, since 2018, week 01 2018/2019	A seasonal trend with a peak at the turn of the year can be seen. The peak of the overall influenza positivity rate is over 25 to 30 at the turn of the year and values spread over the year between 2 and 10. In 2019 influenza A viruses dominate and in 2018 influenza B.	2019/2020, end of observation in 2020 not clearly defined	Compared with 2018 and 2019, the influenza season 2020 is shorter and the peak is lower (at 18). Influenza A viruses dominate.	↓
	Kong[28]	China	Positivity rate in% per week	2017/2018, week 40-week 39 2018/2019, week 40-week 39	In the previous seasons, a peak is recorded shortly after the turn of the year (approx. 42 to 47), although the decline in the positivity rate is not continuous after the peak in 2018/2019. There are indications of a bimodal trend. The peak of the positivity rate in the 2019/2020 season is in the range of the previous years at 48. In the 2017/2018 season, permanent lows at 0 are reached from week 23 onwards. The lowest values of the 2018/2019 season are roughly reached from week 35 (at 5).	2019, week 40–2020, week 11	The peak in the 2019/2020 season is similar to that of previous years. According to this, the values already run towards 0 in week 10 and are permanently below those of the comparative seasons from week 3 onwards.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
		USA	Positivity rate in% per week	2017/2018, week 40-week 39 2018/2019, week 40-week 39	The seasons show a similar course. The highlights of each season are at similar levels (at 27/28). In all seasons the peak is reached shortly after the turn of the year. In the seasons 2017/2018 and 2018/2019 a constant low level is reached from week 22 (at max. 5).	2019, week 40–2020, week 11	The curve of the 2019/2020 season is similar to that of previous years. In week 6 a peak of about 30 is reached. After that, a decreasing trend in line with previous years can be observed. The observation period ends during the decreasing trend in week 11 at about 15.	(→) course of curve in 2020 similar to previous years, but the curve was truncated during the curve descent after the peak
		France	Positivity rate in% per week	2017/2018, week 40-week 20 2018/2019, week 40-week 17	The seasons show a similar course. The highlights of each season are at similar levels (from 28 to about 34). In all seasons a peak is reached shortly after the turn of the year. In the 2017/2018 season, however, two highlights can be seen, the first in week 52 at about 28. In the 2017/2018 and 2018/2019 seasons a low level is reached in week 17 (2018/2019) and week 19 (2017/2018) respectively.	2019, week 40–2020, week 11	The curve is similar to that of previous years. In week 6 a peak of about 25 is reached. After that, a decreasing trend similar to the previous years can be observed. The observation period ends during the decreasing trend in week 11 at about 15	(→) course of curve in 2020 similar to previous years, but the curve was truncated during the curve descent after the peak
		Italy	Positivity rate in% per week	2017/2018, week 46-week 17 2018/2019, week 46-week 17	The seasons show a similar course. The highlights of each season are at similar levels (around 50). In all seasons a peak is reached shortly after the turn of the year. In the 2017/2018 season, a second high point can be read as an outlier in week 52 at about 50. In the 2017/2018 and 2018/2019 seasons, a low level is reached in week 17 at about 5.	2019, week 16–2020, week 11	The curve is similar to that of previous years. The peak is also in week 7, but somewhat lower than in previous years (42). After that, a decreasing trend in line with previous years can be observed. The observation period ends during the declining trend in week 11 at around 10.	(→) course of curve in 2020 similar to previous years, but the curve was truncated during the curve descent after the peak
	Kuo[29]	Taiwan	Positivity rate in% per week	2019, week 1–12	In 2019, the values of the positivity rate fluctuate around 30, with the curve showing a slight decrease overall.	2020, week 1–12	In 2020 the curve begins with higher values around 50, then falls to a value around 30 by week 7 and then shows a rapid fall to below 10 by week 8, with a slight increase from week 11 to 12, but remains below 10.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Lee[30]	South Korea	Positivity rate in% per week	2013/2014, week 36-week 35 2014/2015, week 36-week 35 2015/2016, week 36-week 35 2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	The detection rate shows a clear bimodal pattern in the years 2016/2017 and 2018/2019, with only a peak in the other seasons. The peaks are at most between about 50 and 70.	2019, week 36–2020, week 17	Compared to all previous seasons, the detection rate in 2020 will fall towards 0 weeks earlier, peaking around 45 at the turn of the year.	↓
	Noh[31]	South Korea	Positivity rate in% per week	2016/2017, week 36-week 35 2017/2018, week 36-week 35 2018/2019, week 36-week 35	All seasons have a peak around the turn of the year (around 45 to 55), with the season 2017/2018 being the highest and lasting the longest. In the seasons 2016/2017 (at 15) and 2018/2019 (at 45), a second peak is seen in the first third of the year. The 2017/2018 season shows a decreasing trend at the beginning of the year, the 2016/2017 and 2018/2019 seasons only after the second peak. From week 23 onwards, the values of the detection rate of the 3 comparison seasons are increasingly close to 0.	2019, week 36–2020, week 16	The 2019/2020 season shows a peak at 70 at the beginning of the year, followed by a declining trend. From week 11 onwards, the values for the 2019/2020 season are constant at 0.	↓
	Soo[34]	Singapore	Positivity rate in% per week	Individually and common average of: 2016/2017, week 27-week 26 2017/2018, week 27-week 26 2018/2019, week 27-week 26	The positivity rate shows a fluctuating trend (15 to 55) with peaks (45 to 65) at the turn of the year and mid-year (35 to 65).	2019, week 27–2020, week 9	The highlights (at 60 to 65) of the 2019/2020 season are above the annual average of previous years. However, from week 6 onwards the values fall below those of the comparative seasons and from week 7 onwards they are permanently below 10.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Sun[35]	China	Incidence of laboratory-confirmed influenza cases in sentinel clinics, weekly	2016/2017, week 40-week 12 2017/2018, week 40-week 12 2018/2019, week 40-week 12	From observation week 40 onwards, the curve of the seasons under consideration shows an upward trend. The 2017/2018 season has its peak at the turn of the year at almost 50%. In the 2018/2019 season, the peak is somewhat later towards the end of January at about 40%. The curve of the 2016/2017 season is generally flatter and a peak is also found around the turn of the year at a value around 20%, after which the curve flattens only slightly and remains constant at values around 15%. The curve for the 2018/2019 season is also only slightly flatter and remains constant at values around 30%. The curve for the 2017/2018 season is continuously decreasing.	2019, week 40–2020, week 10	From observation week 40 onwards, the curve of the seasons under consideration shows an upward trend. The 2019/2020 season has its peak at the turn of the year at almost 50%. Continuously but steeply, the curve of the 2019/2020 season decreases. From week 6 on, the values of the 2019/2020 season are below the values of the reference seasons and run towards 0 at the end of observation in week 10.	↓
	Suntronwong[36]	Thailand (Bangkok)	Positivity rate in% per week	2019, week 1-week 18	The values start in week 1 at about 25. In week 9 a peak is reached at about 50. After the peak, the values fluctuate around 25 to 40 until the end of the observation.	2020, week 1-week 12	The values start at about 30 in week 1 and peak at about 40 in week 4. After that, the values drop towards 0 until week 12 and remain at that level.	↓
	Wiemken[37]	USA	Positivity rate in% per week	2017/2018, week 40-week 12 2018/2019, week 40-week 12	The curves initially show a steady rise until the turn of the year. In season 2017/2018 a plateau at 30 is reached, which remains constant until week 7. In the 2018/2019 season, a peak is reached at the turn of the year at 20, followed by a drop in the curves, which however ends within a few weeks in a second peak (plateau) at about 30. From week 7 in 2017/2018 and from week 11 in 2018/2019 the values slowly decrease and are at about 15 and 25 at the end of the observation period.	2019, week 40–2020, week 12	At the turn of the year a peak is reached at just under 30, followed by a drop in the curve (to around 25), which ends within a few weeks in a second peak (plateau) (just under 35). From the second peak, the values fall steeply from week 9 onwards and at the end of the observation at around 5 are clearly below the values of the previous seasons.	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Wiese[38]	USA	Positivity rate in% per week (USA in general and 10 regions separately)	Median of season 2015–2019, week 40-week 39	According to the median of the past years, the values of the influenza positivity rate in the years 2015 to 2020 increase at the end of the year, then reach a peak around or shortly after the turn of the year between 17 and 30 for varying lengths of time depending on the region. After that, the values decrease and reach a similar level as before the influenza season with values between 1 and 6 from about week 20 onwards.	2019, week 40–2020, week 21	In the 2019/2020 season, the increase in the positivity rate initially ran similar to that of previous years, and the peak was also reached around the same time. Depending on the region, the peak values were just as high or higher (27 to 38) compared to previous years. Afterwards, however, the values decrease more rapidly and reach almost zero from week 15 or 16.	↓
	Wu[39]	China	Positivity rate in% per week (China, North and South, Guangzhou City)	2019, week 1-week 13	The positivity rate is listed separately for North and South China and Guangzhou City. The values for China as a whole are around 30 at the beginning of the observation period, then rise to 40 by around week 4 and fluctuate at values between 30 and 40 until the end of the observation period. In Guangzhou City, the values initially fluctuate around the value 35 and peak at 45 in week 4, after which the value drops and fluctuates between 20 and 30 until the end of the observation period.	2020, week 1-week 13	The positivity rate is listed separately for North and South China and Guangzhou City. The values in China as a whole start at a high level of 50, then decrease continuously and remain at 0 from week 8 onwards. In Guangzhou City, the curve starts fluctuating around 20 to 30 and drops to 0 in week 8. Until week 13 the values remain unchanged.	↓
Severe complications due to influenza	Chan K-S[23]	Taiwan	Cases per week	2016/2017, November-April 2017/2018, November-April 2018/2019, November-April	In the 2016/2017 season, the values start at a low level around 35 in November and then drop almost constantly to values around 15 in April. The 2017/2018 and 2018/2019 seasons, on the other hand, start at values around 10 in November, then peak around February at between 75 (2017/2018) and 85 (2018/2019) and then fall again by April to a level around 5 (2017/2018) and 25 (2018/2019).	2019, November-2020, April	The 2019/2020 season starts in November at a level around 25, then reaches a peak around 110 somewhat earlier than in 2017/2018 and 2018/2019, after which the values fall within a few weeks to a level below that of previous years (around 0).	↓

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Estimate	First author	Country	Definition of estimate	Comparison season	Results of comparison season	Observation period in 2019/2020	Results of 2019/2020	Difference of estimate after implementation of NPIs during COVID-19 pandemic as compared to previous seasons
	Kuo[29]	Taiwan	Cases per week	2019, week 1-week 12	The number of serious complications per week shows a generally slightly negative trend. The curve starts around 60 cases and ends at about 20 cases, with a peak of 80 cases in week 8.	2020, week 1-week 12	The values start at about 100 cases and then decrease from week 2 to about 5 cases in week 8; no cases are documented from week 9 to 12.	↓
	Rivera[32]	USA	Mortality (cases) per week	Since week 40, 2015	The course of mortality in the USA in the reference seasons is similar in each state and USA in general. Peaks between 175 and 500 are reached. Only the maximum for the 2017/2018 season, at 1300, clearly surpasses the highlights of the other seasons. The peaks are documented a few weeks after the turn of the year and are seasonally with values around 0 in the middle of the year.	Until week 19 (09.05.2020)	The values of the season in the USA are similar to those of previous years. A maximum of 350 is reached and after that a decreasing trend can be observed. The observation period ends in 2020 in week 16 at about 175, similar to the comparative values. The course of the mortality curves for the 2019/2020 season is similar to that of previous years in the majority of the states under consideration (California, Colorado, Illinois, Massachusetts, Michigan, New Jersey, New York State, Washington). The values are in the middle range of those of previous years. New York City is an exception. While in previous years the maximum is 40, in the 2019/2020 season a peak of about 330 is apparently reached after the flu season. The authors explain this clear peak with misclassified COVID-19 deaths.	(→) mortality attributed to influenza generally similar to that of the comparison seasons, but with an extreme peak in New York City
	Yang[40]	Taiwan	Cases per week	2016, week 1-week 14 2017, week 1-week 14 2018, week 1-week 14 2019, week 1-week 14	The curve of serious complications per week differs between seasons. The seasons 2016 and 2017 show a rather constant curve with a maximum of 20 to 40 cases per week. The seasons 2018 and 2019 start at a higher level with about 40 cases and reach a peak around week 8 with about 80 cases. At the end of the observation period, the curves of the previous years converge to a similar level.	2020, week 1-week 14	The values in 2020 start at a high level of more than 100 cases per week and then fall. From week 9 onwards the values are close to 0.	↓

↑: Values in the 2019/2020 season above those of the reference seasons.
→: Values in the 2019/2020 season are similar to the reference seasons.
↓: Values in the 2019/2020 season below those of the reference seasons.
() in conjunction with corresponding arrow: tendency, but no clear difference.

19 pandemic are below the level of previous years.[21,22,28–31,34–39] Kong et al. are the only ones to show a positivity rate similar to previous seasons in the USA, France and Italy. In their study, however, the observation period ends in week 11 while the positivity rate decreases[28] (Table 4).

Syndromic influenza estimates

The results regarding the syndromic presentation of influenza refer to ILI cases and ILI incidence as a proportion of a population. Uniformly, the studies that report ILI cases show fewer reported cases at the end of influenza season compared to previous seasons with one exception.[25] As of week 6,[29,34] and week 8,[36,43] the reported ILI cases are below the level of the comparative seasons. In 4 of the studies the course of the ILI cases at the beginning of the influenza seasons was similar[25,34] or above to that of the comparison seasons.[29,36,43] The observation period of the studies ends in week 9,[34] 12,[29,36] or 17.[43] Coma et al. compare the seasons in relation to the seasonal peak. The curve in 2019/2020 initially resembles that of the reference seasons. A few weeks after the peak, however, the usually following drop in value stagnates somewhat and the ILI cases decrease more slowly.[25]

The results on ILI incidence are inconsistent. For the regions of South Korea,[24,27,30,31] Taiwan,[27,29] Hong Kong (China)[27] and China in general,[39] a generally lower incidence of ILI is reported for the end of influenza period during the COVID-19 pandemic. The course of ILI incidence in 2019/2020 was around the turn of the year in 4 studies similar[24,27,30,37] or in 4 studies above[27,29,39,42] that of previous years. Wu et al. emphasize that in Guangzhou City, a city in China, ILI incidences from week 6 onwards are higher than in the previous year.[39] A comparatively higher ILI incidence is also reported for the USA.[27,37,42] Itaya et al. report results for China divided into North and South China. In their evaluation, which is based on data up to week 10 in 2020, no clear difference in the ILI incidence in 2020 as compared to previous seasons can be found. They report similar results as compared to previous seasons for Germany, France, England and Canada[27] (Table 4).

Reported non-pharmaceutical interventions in included studies

The information on the measures taken in each of the countries reported varies. Most of the studies summarise NPIs in varying degrees of detail. Almost all studies report social distancing measures.[22–24,26,28,29,31–36,38–42] Two studies refer to a mobility index.[21,28] For this purpose, Chan CP et al. determined a mobility trend in transit stations[21] and Kong et al. calculated the passenger railway flow.[28] In 2 studies the measures are described comprehensively, as they are also the focus of the study group's analyses.[30,43] These include quarantine for confirmed and suspected cases together with a contact person in a home or facility, self-monitoring via an app, intensive COVID-19 screening, intensive contact tracing, public education on hygiene, wearing of mouth and nose covers, forced social distancing, closure of schools, online teaching, closure of businesses, working from home, adjustments to the triage of the health system, increased surveillance of health personnel, and risk communication twice a day by the government. Soo et al., on the other hand, describe that in Singapore measures such as school closures were deliberately not taken,[34] which is stated by Chan K-S et al. and Hsieh et al., as well, for Taiwan.[23,43]

Reports from public health agencies in Europe

In total, reports in English or German on influenza estimates for the 2019/2020 season were obtained from 8 out of 42 considered European countries, with comparisons to previous years. For the European countries not included, either no reports with comparative seasons were available or available reports were not published in English or German. The countries included are Austria,[44] Belgium,[45] Germany,[46,47] Ireland,[48] Poland,[49] Russia,[50] Switzerland[51] and the United Kingdom of Great Britain and Northern Ireland (UK).[52] This year's influenza season is compared with up to 4 previous influenza seasons (Belgium, Poland). Results are presented on ARI rate (Belgium, Germany), ILI rate (Belgium, Germany, Ireland, Austria, Poland, Switzerland), influenza cases (Belgium, Ireland) and incidence (Russia), severe acute respiratory illnesses (SARI) cases (Germany), influenza and ARI morbidity (Russia), hospitalisation rate (Russia) and influenza positivity rate (UK) (Table 5).

Course of influenza estimates in 2020 during influenza season

In the majority of reports, influenza estimates are similar to those of previous years during the influenza season. In Germany, Ireland, Poland, Russia, Switzerland and UK, the course of the influenza season in 2019/2020 began similar to comparison seasons. Belgium initially had a comparatively milder influenza season based on ILI estimates and number of positive samples for influenza. In Austria the ILI incidence per 100,000 population is comparatively higher than in previous seasons (Table 5).

Course of influenza estimates in 2020 after influenza season

The further course of the 2019/2020 influenza season then varies considerably. While influenza-specific parameters continue to be comparable with previous years or even below the level of the reference seasons, ILI figures increase markedly in 4 of the 6 countries reporting them after the actual influenza season (Belgium, Ireland, Austria, Switzerland). In Germany, this effect is only observed for a short period of time and in the further course of the year the values are below those of previous years in the comparative period. In Poland, too, ILI rates are falling below the level of the comparable years. However, a joint ILI and influenza estimate is reported there (Table 5).

Second peak of influenza estimates

In some countries, unlike in previous years, a second peak of the respective influenza estimate is described. A second peak in Ireland and Belgium, or an indication of a second maximum in Switzerland and Austria, is prominent in the ILI figures after the end of the influenza season. The reporting period in Switzerland and Austria ends, while the ILI estimates show an increasing trend towards a second peak. In Germany there are indications of a second peak in ARI incidence, shortly after the first maximum. However, the values subsequently fall significantly below the level of previous years (Table 5).

Discussion

In this comprehensive systematic review we include 23 studies originated mostly from Asia followed by the USA and Europe. The results are supplemented by reports from 8 European Public Health institutes. Most studies are rated as moderate or high risk of bias. This was mainly due to a poorly detailed description of methods, few included comparison seasons, as well as a too short observation period in 2020. The main results show, stratified by reported influenza estimate, a mostly negative trend of influenza morbidity in 2020 after first measures taken to fight SARS-CoV-2 spread compared to the respective previous seasons. Thereby, specific influenza estimates draw a clearer image than unspecific ones, which reflect respiratory disease in general.

ILI rates are sometimes rising compared to previous seasons. This may be due to the similarity in the symptoms of SARS-CoV-2

Table 5
Direction of outcome measures as reported by Public Health agencies.

Austria	Zentrum für Virologie, Medizinische Universität Wien[44]	2019, week 40–2020, week 12	2017/2018, week 40-week 152018/2019, week 40-week 15	AGES	Estimated ILI incidence per 100,000 population	The ILI incidence at the end of 2019 was initially similar to previous years. At the beginning of the year a peak was reached that was significantly higher than in previous years. Afterwards, however, there was a significant drop in the values. In week 12, however, the values were above the comparative values of previous years.	↑	↑	?
Belgium	Sciensano[45]	2019, week 40–2020, week 26	2015/2016, week 40-week 39 2016/2017, week 40-week 39 2017/2018, week 40-week 39 2018/2019, week 40-week 39	Incidence including telephone contacts in general primary care	ARI per 100,000 population	The curve is fluctuating in all seasons, at the end of the year and at the turn of the year at a higher level than in the middle of the year. The course of the 2019/2020 season is similar to that of previous years, with a maximum being reached a little later than in previous years around week 13. Thereafter, the values drop significantly and remain permanently below the values of previous years.	(→)	↓	
					ILI per 100,000 population	The previous seasons consistently show a peak shortly after the turn of the year. After that, the values decrease and reach values close to zero in spring. The curve of the 2019/2020 season is bimodal. Similar to previous years, a peak is initially reached at the beginning of the year. However, this is below the level of the comparative seasons. Thereafter, the values initially fall and reach a peak at the level of previous years a few weeks later. Although the values fall after the second peak, the values in 2020 are not as low as in previous years.	↓	↑	✓
		2019, week 40–2020, week 20		Sentinel laboratories	Number of positive influenza samples	All seasons show a peak shortly after the turn of the year. However, the seasons 2017/2018 and 2018/2019 have significantly higher maximum values than seasons 2015/2016, 2016/2017 and 2019/2020. The 2019/2020 season is similar to the 2016/2017 season.	(↓)	(→)	
Germany	RKI[46,47]	2019, week 27–2020, week 13	2016/2017, week 27-week 26 2017/2018, week 27-week 26 2018/2019, week 27-week 26	Approximately 5000 messages from people registered at GrippeWeb	ARI rate in%	The ARI rate for the 2019/2020 season initially resembles that of previous seasons. In 2020, following the introduction of the NPIs in Germany, it falls rapidly and within a few weeks reaches a level below that of the comparable seasons in the same period. Subsequently, over time, the ARI rate remains below the levels of the reference seasons.	→	↓	(✓)
					ILI rate in%	The ILI rate of the 2019/2020 season is initially similar to the 2018/2019 season, but the 2016/2017 and 2017/2018 seasons show a higher maximum. In 2020 the ILI rate drops rapidly after the introduction of the NPIs in Germany and within a few weeks reaches a level below that of the comparable seasons in the same period.	(→)	↓	
		2019/2020, until week 23	2018/2019, since week 40	556 registered medical outpatient facilities with at least one active weekly report	ARI consultation incidence per 100,000 population	Compared to the previous season, the values at the beginning of the year initially rise, but then fall rapidly after week 12 to lower values than in the same period a year earlier.	(→)	↓	(✓)
		2019/2020, until week 23	2017/2018, since week 40 2018/2019	70 sentinel hospitals	Number of SARI cases	The course of the SARI cases is similar to that of previous years, and in the 2019/2020 season the figures tend to be even slightly lower than in previous years. The rapid decline in SARI cases is particularly noticeable in the 0–4-year-old age group at the end of the influenza season.	→	(→)	
Ireland	Health Protection Surveillance Centre[48]	2019, week 40–2020, week 27	2017/2018, week 40-week 39 2018/2019, week 40-week 39	Sentinel of general primary care practitioners	ILI rate per 100,000 population	The ILI rates of the three seasons are similar with a maximum at the turn of the year. The maximum of the 2019/2020 season is similar to that of the 2017/2018 season, and after the maximum at the turn of the year the ILI rates decrease to values close to zero until summer time. In the 2019/2020 season, however, after initially declining values, a new peak occurs, which surpasses the peaks at the turn of the year. Only in week 23 the values reach zero again.	→	↑	✓

(*continued on next page*)

Table 5 (*continued*)

Austria	Zentrum für Virologie, Medizinische Universität Wien[44]	2019, week 40–2020, week 12	2017/2018, week 40-week 152018/2019, week 40-week 15	AGES	Estimated ILI incidence per 100,000 population	The ILI incidence at the end of 2019 was initially similar to previous years. At the beginning of the year a peak was reached that was significantly higher than in previous years. Afterwards, however, there was a significant drop in the values. In week 12, however, the values were above the comparative values of previous years.	↑	↑	?
					Number of positive influenza samples	The number of positive influenza samples of the three seasons is similar with a maximum at the turn of the year and values close to 0 in the middle of the year. The maximum of the 2019/2020 season is at a level between that of the 2017/2018 season and the 2018/2019 season, and in the 2019/2020 season the values are closer to 0 for a few weeks rather than in the reference seasons.	→	↓	
Poland	National Institute of Public Health[49]	2019, September-2020, July	2015/2016 2016/2017 2017/2018 2018/2019	Not explicitly described	ILI and influenza incidence per 100,000 population	The curves are similar on a logarithmic scale. The curves of the 2019/2020 season are also similar to those of previous years. From the end of March onwards, however, the values fall well below the level of the comparative seasons.	→	↓	
Russia	Ministry of Health of the Russian Federation[50]	2019, week 40–2020, week 20	2018/2019, week 40-week 39	Not explicitly described	Incidence of clinically diagnosed influenza per 10,000 population	The curves of both seasons are similar with a peak shortly after the turn of the year. The peak in the 2019/2020 season is slightly lower and the drop in the curves is slightly slower.	→	→	
				61 cities in the surveillance system	Influenza and acute respiratory virus morbidity per 10,000 population	The curves of both seasons are similar with a peak shortly after the turn of the year. The peak in 2020 lasts a little longer, but then reaches values below the curve in 2019 from week 15.	→	(↓)	
				Not explicitly described	Hospitalisation rate with clinical diagnosis influenza per 10,000 population	The curves of both seasons are similar with a peak shortly after the turn of the year. The peak in the 2019/2020 season is slightly lower and the drop in the curves is slightly slower.	→	→	
Switzerland	Bundesamt für Gesundheit BAG[51]	2019, week 26–2020, week 11	2017/2018, week 26-week 25 2018/2019, week 26-week 25	Sentinella network of primary care physicians	ILI Consultation incidence per 100,000 population	The seasonal curves are similar, with lows around 0 in the middle of the year and a peak around or shortly after the beginning of the year. After the peak, the values in the reference seasons decrease rapidly. In the 2019/2020 season, on the other hand, the values initially decline somewhat, but begin to rise again from week 10 onwards.	→	(↑)	?
UK	Public Health England National Influenza Report[52]	2019, week 40–2020, week 25	2018/2019, week 40-week 39	Respiratory DataMart system (England)	Positivity rate in% (data on ILI consultation rate not readable)	The curves are similar, but with a time lag. The peaks are reached around the turn of the year (2019/2020) or shortly after the turn of the year (2018/2019) and have about the same level. At the middle of the year values close to 0 are reached. The lows are reached in the 2019/2020 season a few weeks earlier than in the 2018/2019 season.	→	(↓)	

ARI: Acute respiratory illness.
ILI: Influenza-like illness.
RKI: Robert Koch-Institute.
NPIs: Non-pharmaceutical interventions.
SEED^{ARE}: Sentinel electronic recording of ICD-10 diagnostic codes of acute respiratory diseases.
SARI: Severe acute respiratory infections.
AGES: Austrian Agency for Health and Food Safety GmbH.
↑: Values in the 2019/2020 season above those of the reference seasons.
→: Values in the 2019/2020 season are similar to the reference seasons.
↓: Values in the 2019/2020 season below those of the reference seasons.
() in conjunction with corresponding arrow: tendency, but no clear difference.
?: Observation period ended too early for a reliable result to be derived.

infection and people seeking care not due to influenza but COVID-19. A study from the USA focuses on non-influenza-related excess ILI cases. The authors suspect a high number of unidentified COVID-19 cases in the population.[53] Rivera et al. describe this possible misclassification in connection with influenza-associated mortality in New York City[32] and Coma et al. discuss misclassified influenza cases in Catalonia, Spain.[25]

These results are similar to publicly available reports from Europe. While explicit influenza parameters at the end of the influenza season and thereafter are below the previous years' values, ILI estimates sometimes show a second peak after the end of the actual influenza season (Belgium, Ireland, Austria, Switzerland). We suppose that this second peak of ILI is due to COVID-19 cases rather than influenza cases. In contrast, explicit influenza parameters in Russia do not seem to have differed significantly this season from last year, which might reflect the comparable low strength of population-wide NPIs.

One study calculated the effective reproduction figures (R_t) for COVID-19 and influenza over time in Hong Kong. While the R_t for influenza fall significantly below 1 after taking measures to build social distance, the R_t for SARS-CoV-2 remain around 1, which results in at least an endemic SARS-CoV-2 spread.[26] Consequently, influenza might be more controllable by appropriate measures.

The extent to which this decrease is due to individual NPIs cannot be determined from the available data, however. For example, in some of the countries reported in the studies, the wearing of facial masks in everyday life was discussed to have been widespread even before the COVID-19 pandemic, but influenza rates are nevertheless falling comparatively strongly and rapidly in 2020 compared to previous seasons.[27]

Our study has some limitations. Firstly, in the dynamic context of research on the SARS-CoV-2 virus, new findings are constantly being published worldwide. Despite a broad search strategy and an update of the search shortly before completion of the review, more recent studies may not have been included. In addition, included studies could hardly show any long-term effects of the NPIs due to the actuality of the topic. It cannot yet be proven whether the influenza estimates will remain at a low level even after a relaxation of the NPIs.

On the other hand, the comparability of the results is at least debatable due to different surveillance systems and populations on which the results of the included studies are based. A detailed description of the populations considered by each surveillance system is insufficiently presented in the studies. However, since we have made comparisons with previous seasons within a surveillance system, this aspect may be neglected. What must be taken into account, however, is the assumption that the populations may have changed its use of medical services under the circumstances of the pandemic. This may have a significant impact on influenza estimates in 2020. The majority of studies has also discussed this.[21–26,29–31,33,34,38,42,43] Another assumption is that the reporting and/or testing capacity of influenza surveillance has been reduced in favour of COVID-19 identification.[22,23,27,30,32–34,37,38,41]

The vaccination rates of individual countries are also not considered in this context. However, since a general decrease in influenza estimates with the emergence of the COVID-19 pandemic and the associated restrictions in daily life has been observed worldwide, independent of the country-specific vaccination behaviour of the population, the influence of this year's vaccination rate might have a minor impact in these circumstances.

However, despite these limitations we show that population-wide NPIs have an important impact on influenza morbidity and mortality. While population-wide NPIs during influenza seasons might only be feasible in pandemic-similar situations, we do believe that this holds lessons for a) future influenza pandemics as well as b) seasons.

In terms of pandemic situations the positive effect of school closures on the spread of influenza has already been extensively researched.[8] To date, national pandemic plans have largely focused on isolating the sick and protecting vulnerable populations,[14,15] and have not always included more far reaching measures. However, under the special circumstances of the COVID-19 pandemic the influence of wide-ranging NPIs on seasonal influenza could be investigated.

In seasonal influenza extensive distancing measures – outside of pandemic like situations – even if focused very much on only the most relevant weeks of regional influenza epidemics, despite their large impact, might be problematic in terms of support from the population as well as adverse effects. Low-threshold measures that can be implemented during the most relevant influenza season weeks by the general population could however be an important complement in the control of seasonal and pandemic influenza outbreaks. Personal precautionary behaviour, namely improved hand hygiene and respiratory etiquette, including the wearing of masks, is probably most likely to be accepted – if clearly communicated to the population. Our evidence synthesis suggests that these additional components of local influenza strategies would – added to vaccination – lead to a relevant decrease in influenza disease burden and excess mortality.[54]

Conclusion

Even though the effect of individual measures cannot be quantified with this study, we were able to demonstrate the far-reaching effects of the globally introduced NPIs on influenza estimates. Specific influenza indicators in particular showed significantly lower values compared to previous seasons, while less specific indicators were in part more pronounced during the COVID-19 pandemic than in comparative seasons. Based on these clear results, low-threshold measures, such as the wearing of face masks and possibly social distance, should be considered when planning future responses to outbreaks of influenza.

Declaration of Competing Interest

None.

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Author's contributions

BL had the idea for the systematic review. Concept and protocol were devised by BL, MD and LF. After exclusion of duplicates, titles, abstracts and full texts were screened by LF and checked by SG and MD. Disagreements were resolved by discussion and, if necessary, BL was asked to resolve them. The extraction was performed by LF and checked by SG. The quality assessment was carried out by LF and checked by SG, MD and BL. A first draft of the manuscript was prepared by LF, all authors contributed to revising and editing the subsequent versions until the final manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jinf.2020.11.039.

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