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# Prevalence of Upper Respiratory Tract Infections Before, During, and After the COVID-19 Pandemic in Germany: A Cross-Sectional Study of 2 167 453 Outpatients

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## Abstract

**Background:** Although the burden of the COVID-19 pandemic on global healthcare systems is declining, long-term sequelae such as long COVID syndrome and other disease dynamics not primarily associated with COVID-19 remain a challenge. Recent data suggest that the incidence of non-COVID upper respiratory tract infections (URTI) is increasing sharply in the post-pandemic period, but there is a lack of real-world data from Germany in this respect. **Methods:** This cross-sectional study evaluated the number of patients with a diagnosis of URTI from the Disease Analyzer database (IQVIA) between January 2019 and December 2022. The number of URTI diagnoses per practice and the duration of sick leave per patient were compared over time. **Results:** A total of 1 872 935 individuals (1 403 907 patients from general practices (GP) and 469 028 patients from pediatric offices) were included, 48% of whom were female. The number of URTI patients per practice was significantly higher in 2022 than in 2019 (732 vs 464, 58%,  $P < .001$ ), and this was observed for both women (56%,  $P < .001$ ) and men (60%,  $P < .001$ ). The post-pandemic increase in the number of URTI diagnoses correlated with age and was highest in the age group between 18 and 30 years (22%,  $P < .001$ ) and lowest in older patients  $> 70$  years (3%). In pediatric patients ( $< 18$  years), the increase was highest in the age group  $\leq 5$  years (89%). Both the number of patients per practice on sick leave due to URTI (184 vs 92) and the average duration of sick leave (+2 days) increased from 2019 to 2022. **Conclusion:** Our data suggest a dramatic increase in the incidence of URTI among all demographic subgroups in Germany between 2019 and 2022, which was associated with a tremendous impact on socioeconomic variables such as the frequency or duration of sick leave. These data could be of great importance in current pandemic management and the management of future pandemics.

## Keywords

URTI, COVID-19, SARS-CoV-2, infection, pneumonia, sick leave

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## Introduction

The COVID-19 pandemic has posed major challenges to global health systems.<sup>1</sup> Even though the peak of the pandemic has passed and the longer-term sequelae of the SARS-CoV-2 infection, such as long COVID syndrome, now dominate medical and scientific dialogue, non-COVID-related disease phenomena also pose a particular challenge. During the pandemic, multiple measures were taken all over

the world to reduce the number of infections and minimize mortality.<sup>2,3</sup> In Germany, these measures included legally defined contact and travel restrictions, the compulsory use of masks in large parts of public life, and specific hygiene measurements often summarized as non-pharmaceutical interventions (NPIs).<sup>2</sup> A large part of these NPI were in force mainly in 2020 and 2021 and were gradually withdrawn during 2022. Although the benefits of most of these NPIs have been demonstrated in terms of the probability of



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SARS-CoV-2 infection,<sup>4,5</sup> their effects on the longitudinal course of other non-COVID-19-related diseases have hardly been studied systematically to date.

Several studies have shown that the NPIs put in place in response to the COVID-19 pandemic were associated with a decreased incidence of previous common respiratory pathogens, such as influenza and streptococcus pneumonia.<sup>6,7</sup> This association between NPIs and the incidence of infectious disease has also been observed for pediatric patients, for example, with respect to viral respiratory infections<sup>8,9</sup> or middle ear infections and effusion.<sup>10</sup> Interestingly, there are currently several reports of an increased incidence of common infectious diseases following the successive cessation of NTIs after the end of the pandemic.<sup>11</sup> This has been associated with high levels of sick leave, which in turn poses major socio-economic challenges.

In the present manuscript, we have used a large German electronic medical records (EMR) database to study the prevalence of upper respiratory tract infections (UTRI) as well as the associated duration of sick leave before, during, and after the main peak of the COVID-19 pandemic in Germany in adult and pediatric patients.

## Materials and Methods

### Study Design and Database

This cross-sectional study is based on electronic health record data from the Disease Analyzer database (IQVIA), which compiles drug prescriptions, diagnoses, and general medical and demographic data obtained directly and anonymously from computer systems used in primary care and specialty physicians' offices.<sup>12</sup> Diagnoses, prescriptions, and the quality of reported data are monitored by IQVIA based on a number of criteria. The coverage of this database is approximately 3% of all private practices in Germany. In Germany, the sampling methods used to select physician practices have been shown to be appropriate for obtaining a population-representative database of primary and specialty care.<sup>12</sup> The study was conducted in accordance with the latest version of the Declaration of Helsinki.

### Study Population

The present analysis included patients who received at least 1 diagnosis of upper respiratory tract infection (ICD-10: J00-J06) between January 2019 and December 2022 from 1 of 947 general practices (GP) or 175 pediatric practices (PP) that routinely submit data to the Disease Analyzer database (IQVIA). A total of 1 872 935 individuals were included (GP patients: 1 403 907; pediatric patients: 469 028).

### Study Outcomes

The primary outcomes of this study were the number of patients per practice diagnosed with upper respiratory tract infections documented by primary care physicians and pediatricians in 2019, 2020, 2021, and 2022. The number of patients per practice in 2022 was compared with that in 2019. These analyses were performed separately for general practitioners and pediatricians, female and male patients, and different age groups (<18, 18-30, 31-40, 41-50, 51-60, 61-70, 71-80, and >80 for general practitioner patients and ≤5, 6-12, 13-17 for pediatric patients). In addition, the number of patients with at least 1 day of sick leave and the average duration of sick leave per patient in days were compared and shown for each year between 2022 and 2019. These analyses were conducted for adult patients in general practices aged 18 to 65 years, as children rarely call in sick.

### Statistical Analyses

To assess changes in the detection of upper respiratory tract infections, the percentage change between 2 periods (2022 vs 2019) was calculated. The 1-sample Kolmogorov-Smirnov test was used to determine whether the data (number of patients per practice) were normally distributed or not. Because there was evidence that the data were not normally distributed, the number of patients with diagnoses per practice, the number of patients with sick days per practice, and the mean duration of sick days per patient were compared for 2 distinct periods using the nonparametric Wilcoxon signed-rank test. *P*-values <.05 were considered

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**Table 1.** Sociodemographic Characteristics of Patients Diagnosed With Upper Respiratory Tract Infections in the Years 2019, 2020, 2021, and 2022.

Sociodemographic characteristics	2019	2020	2021	2022
<b>GPs</b>				
N	439 546	426 621	392 075	693 629
Age in years, mean (SD)	39.4 (18.9)	40.4 (18.9)	39.7 (19.4)	41.1 (19.2)
<18	6.9	7.4	8.6	9.1
18-30	21.4	21.3	23.2	21.6
31-40	20.1	19.9	20.0	19.4
41-50	16.0	16.7	16.2	16.4
51-60	16.2	16.6	15.8	17.9
61-70	11.4	10.9	9.8	9.7
71-80	4.1	3.7	3.6	3.3
>80	4.0	3.5	3.0	2.7
Men	53.0	53.2	52.0	52.4
Women	47.0	46.8	48.0	47.6
<b>Pediatricians</b>				
N	195 862	167 311	174 998	230 339
Age in years, mean (SD)	5.0 (3.8)	5.7 (4.5)	4.5 (4.6)	5.6 (5.0)
≤5	33.2	40.2	55.4	53.1
7-12	50.4	44.1	33.5	35.4
13-17	16.4	15.7	11.1	11.5
Women	48.1	48.0	48.1	47.9
Men	51.9	52.0	51.9	52.1

Abbreviation: SD, standard deviation.

Data are percentages unless otherwise specified.

statistically significant. Analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

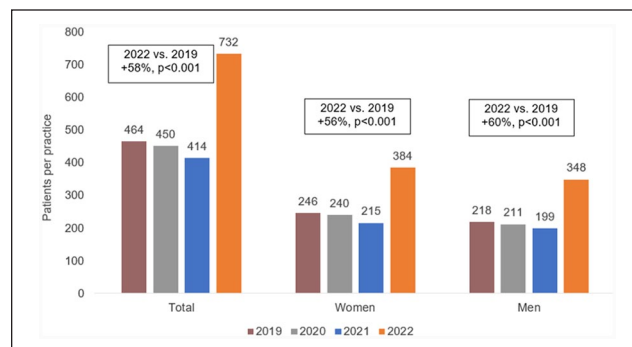
## Results

### Patient Characteristics

In total, 2 269 607 patients visited 1 of 947 GP practices in 2019 and 2.265 182 in 2022 ( $\pm 0\%$ ). In PP practices, there were 546 017 patients in 2019 and 584 293 in 2022 ( $+7\%$ ). A total of 439 546 GP patients with upper respiratory tract infections (URTI) were available in 2019 compared to 693 629 in 2022 ( $+58\%$ ), while 195 862 PP patients were available in 2019 and 230 339 in 2022 ( $+18\%$ ). Patient characteristics are shown in Table 1. The mean age increased slightly from 39.4 years in 2019 to 41.1 years in 2022 in GP patients and from 5.0 to 5.6 years in PP patients. The proportion of women was between 47% and 48% for general practitioners and 48% for pediatricians.

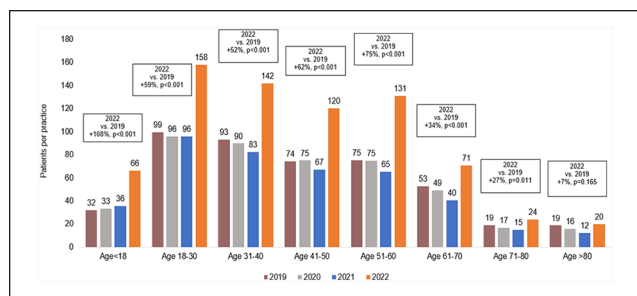
### Documented Diagnosis of Upper Respiratory Tract Infection

Figures 1 and 2 show the number of patients per GP practice with upper respiratory tract infections from 2019 to 2022 by

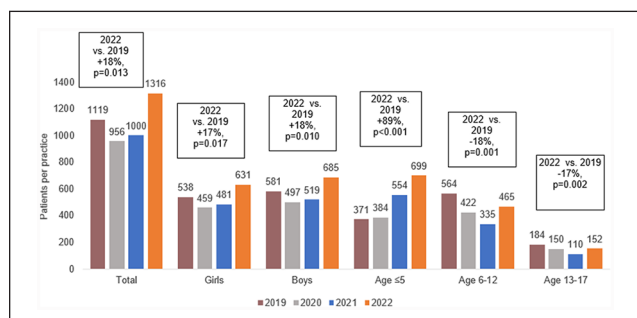


**Figure 1.** Number of GP patients with upper respiratory tract infections in 2019 to 2022 (total and by sex).

sex and age. The number of patients was significantly higher in 2022 than in 2019 (732 vs 464,  $+58\%$ ,  $P<.001$ ); this significant difference was observed in both women ( $+56\%$ ,  $P<.001$ ) and men ( $+60\%$ ,  $P<.001$ , Figure 2). This increase differed with age. The greatest increase was observed in the age group 18 to 30 years ( $+22\%$ ,  $P<.001$ ), followed by 31 to 40 years ( $+19\%$ ,  $P<.001$ ), 51 to 60 years ( $+18\%$ ), and 41 to 50 years ( $+16\%$ ). In the age group 61 to 70 years the increase was  $+10\%$  ( $P<.001$ ), in children and adolescents ( $<18$  years)  $+9\%$  ( $P<.001$ ). Finally, in older



**Figure 2.** Number of GP patients with upper respiratory tract infections in 2019 to 2022 by age group.



**Figure 3.** Number of PP patients with upper respiratory tract infections in 2019 to 2022 total, and by sex and age group.

patients (>70), the increase was only +3% (Figure 3). The changes were less pronounced in PP patients than in GP patients (1316 patients in 2022 vs 1119 in 2019, +18%,  $P=.013$ ), and similar in girls (+17%,  $P=.017$ ) and boys (+18%,  $P=.010$ ). While the increase was very strong in the age group  $\leq 5$  years (+89%,  $P<.001$ ), however, a decrease was observed in the other 2 age groups (6-12 years: -18%, 13-17 years: -17%, Figure 3).

### Duration of Sick Leave

Table 2 shows the results of the sick leave analyses. The number of patients on sick leave due to upper respiratory tract infection increased strongly and significantly from 92 to 184 patients per practice and this trend was observed in women, men, and the 4 age groups analyzed. The increase in the average duration of sick leave was significant and averaged +2 days in 2021 compared to 2019.

### Discussion

Our analysis, covering real-world data from 947 GP practices and 175 PP practices in Germany, revealed a reduction in URTI diagnoses in parallel to lockdowns and stay at home orders during the first year of the pandemic as well as

a strong increase in URTI diagnoses after the withdrawal of most non-pharmacological interventions in 2022.

The COVID-19 pandemic brought significant restrictions to German society, affecting every aspect of daily life. To limit the spread of the virus and protect public health, the German government implemented various measures, including mandatory mask-wearing, social distancing, and restrictions on gatherings and events. In addition, non-urgent medical procedures were postponed, outpatient services were reduced, and hospital visits were limited to ensure adequate resources for COVID-19 patients. While these non-pharmacological interventions proved effective in preventing the uncontrolled spread of SARS-CoV-2 infections, their long-term consequences are only poorly understood. Our data confirm the effectiveness of these interventions through a slight but measurable decrease in URTI diagnosis frequency in general medical practices in 2020 and 2021 compared to the pre-COVID year 2019. Supporting our data, marked reductions in the incidence of almost all respiratory viruses were observed in 2020 compared to the pre-SARS-Cov-2 reference period in New Zealand (respiratory syncytial virus 98.0% reduction, human metapneumovirus 92.2% reduction, enterovirus 82.2% reduction, adenovirus 81.4% reduction, parainfluenza virus types 1 to 3 80.1% reduction, and rhinovirus 74.6% reduction).<sup>13</sup> In addition, lower incidences of influenza during the pandemic were reported in Israel and other countries compared to previous years.<sup>14,15</sup> The clinical significance of these findings is corroborated by decreases in Israeli emergency department visits for URTI in 2020 compared to the preceding years<sup>16</sup> and a sharp decline in antibiotic prescriptions in Finland during the pandemic.<sup>17</sup> In our cohort, we demonstrate a reduction in URTI diagnoses by GPs in both males and females and across all age groups for adults, which is in line with previous findings.<sup>14,16</sup> However, we observed a different picture in children treated by GPs, with URTI diagnoses already rising in 2021. The specific reasons for these differences between adults and children and between our data and some previous findings are certainly multifactorial and complex. We therefore next analyzed frequencies of URTI diagnoses specifically in pediatric practices. Interestingly, the overall trend was very similar to that observed in children treated by GPs, with an almost constant consultation frequency in 2020 compared to 2019 and a small increase in 2021. However, subgroup analyses revealed that the lack of a decrease in URTI diagnoses in 2021 was almost exclusively limited to very young children (<5 years), while children aged 6 to 12 years and those over 12 years were similar to adults in terms of URTI diagnosis frequency. Different patterns in children and adults may indicate different behaviors, with older children staying home more, wearing masks, and maintaining physical distance from others, while young children were less



**Table 2.** Days of Sick Leave Among Adult Patients Diagnosed With Upper Respiratory Tract Infections in the Years 2019, 2020, 2021, and 2022.

Patient group	2019	2020	2021	2022	P-value (2019 vs 2022)
Number of patients with at least 1 day of sick leave per practice					
Total	92	104	101	184	<.001
18-30	26	29	32	53	<.001
31-40	27	29	27	47	<.001
41-50	20	23	21	39	<.001
51-65	19	22	19	42	<.001
Women	45	51	49	90	<.001
Men	47	53	53	93	<.001
Average time of sick leave per patient in days (mean, SD)					
Total	6.4 (5.6)	7.7 (6.8)	7.2 (6.7)	8.5 (7.0)	<.001
18-30	5.3 (4.1)	6.4 (4.9)	6.0 (4.7)	7.4 (5.4)	<.001
31-40	6.0 (4.4)	7.1 (5.2)	6.8 (5.1)	8.0 (5.5)	<.001
41-50	6.5 (4.7)	7.6 (5.5)	7.2 (5.5)	8.2 (5.6)	<.001
51-65	7.0 (4.9)	8.0 (5.8)	7.5 (5.6)	8.5 (5.6)	<.001
Women	6.2 (4.6)	7.3 (5.5)	6.8 (5.2)	8.1 (5.7)	<.001
Men	6.2 (4.6)	7.3 (5.5)	6.8 (5.2)	8.1 (5.7)	<.001

likely to wear masks (correctly) and to social distance. The greatest change in children's exposure was likely related to school closures. In 2021 restrictions were relaxed, children were back at school camps and congregating with others, likely to a greater degree than adults. This might explain the earlier increase in UTRI diagnoses compared to adults and in particular a rise in children <5 years, who did not wear masks in kindergarten. Nevertheless, it is important to note that our database does not contain any information on social or community activities, nor does it contain any data on adherence to SARS-Cov-2 measures, so these considerations cannot be proven conclusively, at least by our data. Indeed, the World Health Organization had different mask-wearing recommendations for children depending on the age group.<sup>18</sup> For example, WHO and other international guidelines recommended face masks for children aged 6 years and older, but not for children under 6 years old.<sup>19</sup> As pointed out above, small children in Germany were still able to attend kindergarten, where they could play without masks, probably also explaining the finding that no decrease in UTRI diagnoses was observed in this age group, but only in older children and adolescents.

Certainly, the most significant finding of our analysis is the dramatic and sudden increase in UTRI visits following the relaxation of COVID measures in 2022. Remarkably, among patients treated in GP practices this increase was found in both men and women, and across all age groups. In pediatric practices, however, the only significant increase was observed in the age group of very young children (<5 years old), with no appreciable rise in the age groups 6 to 12 years and 13 to 17 years. At this point in time, we can only hypothesize about the reason for this

finding. First, there is the possibility that people have had too little contact with pathogens since the beginning of 2020 because of the COVID-19 measures implemented, and their immune systems have not been able to exercise. This hypothesis has appeared frequently in the daily press but not in scientific literature and is still considered unproven. Second, Wang et al suggest that prior COVID-19 infection could be a risk factor for respiratory syncytial virus (RSV) infection, a major URTI. The authors compared children with and without RSV infection and reported that among RSV-infected children, 19% had had a prior documented COVID-19 infection, which was higher than the 10% among children without RSV (<https://pubmed.ncbi.nlm.nih.gov/36482981/>). Unfortunately, we would need detailed information on COVID-19 in the past to repeat a study of this kind with our data. However, this information is not available for all children in our cohort but only for some of them. Nevertheless, our findings are not surprising. A simulation modeling study from the US predicted an increase in RSV epidemics in the post-COVID-19 era (2021 and 2022), which could be more intense and occur in a broader range of ages than typical RSV seasons.<sup>20,21</sup> The authors concluded that the reason for the severe RSV outbreak may be a lack of immunity from previous seasons, and thus, the current RSV patient numbers reflect a dependence of infection susceptibility on immunity from previous exposure.<sup>20</sup> Nevertheless, we cannot exclude that does having had a COVID-19 infection (or subsequent Long Covid) might predispose an individual to subsequent UTRI. Since our data does not allow to exclude this link as potential confounder, this represent a potential bias in our study.

In addition, our analysis provided evidenced that average duration of sick leave for URTI increased by approximately 2 years days from 2019 to 2022. According to the *Federal Institute for Occupational Safety and Health (BAuA)*, every single day of sick leave leads to an economic loss of 347€ (in 2021). Given the high number of patients with URTI and the increased duration of sick leave in 2021, the economy is facing a significant and increasing financial loss due to URTI.

Our study was subject to a number of inevitable limitations related to the study design and methods. The use of ICD-10 codes might result in misclassification and under-coding of specific diagnoses, especially for rare and highly specific ones. In addition, since many upper respiratory tract infections (URTI) are asymptomatic or might not lead to a GP or PP visit, the database may not include all cases, and misdiagnoses or false diagnoses cannot be ruled out. However, previous publications have demonstrated the statistical validity of the IQVIA Disease Analyzer database. Unfortunately, we did not have information on patients' socioeconomic status or lifestyle-related risk factors, which may be strong risk factors for URTI development. Furthermore, co-morbidities, such as other inflammatory diseases, could also influence the development of URTI. Further studies using similar designs with databases from other countries are necessary to draw final conclusions. Finally, it is important to note that, the COVID-19 pandemic has led to considerable restrictions in Germany, as well as worldwide. Many of these may have led to changes in people's behavior regarding the frequency of visits to medical practices. For example, patients may have sought sick leave with a trivial diagnosis such as UTRI to avoid salary reductions due to inability to visit the workplace. In Germany, this has been countered by special government support programs. A comparative analysis between different European countries would certainly be interesting for epidemiological reasons but is far beyond the scope of this manuscript.

In summary, we show a significant rise in the occurrence of upper respiratory tract infections (URTI) across all demographic subgroups in Germany from 2019 to 2022. This increase has had a considerable impact on various socioeconomic factors, including sick leave frequency and duration. These findings have significant implications for current and future pandemic management in Germany.

### Author Contributions

KK designed the study, performed statistical analyses, and generated figures and tables. SHL, CR, and KK wrote the manuscript. TL, MK, WP, and CT provided intellectual input and corrected the manuscript. All authors have approved the final version of the manuscript.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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### Ethical Approval

The "Disease Analyzer" database used for analysis contains anonymized electronic patient records. Patient data was analyzed in aggregated form and no individual data was available. As a result, no individual consent forms were obtained, in line with national and European legislation.

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