Comparing SARS-CoV-2 case rates between pupils, teachers and the general population: results from Germany

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NOTE: This preprint reports new research that has not been certified by peer review and should not be used to guide clinical practice.
Summary: Given the inconsistent state of research regarding the role of pupils and teachers during the SARS-CoV-2 pandemic in Germany, statewide and nationwide data of infection case rates were analyzed to contribute to the discourse. Infection data from official sources ranging from mid to late 2020 were collected, prepared and analyzed to answer the question if pupils, teachers and general population differ in infection case rates or not. Statewide and nationwide data showed that pupils and teachers infection case rates exceeded those of the general population. However, present data do not necessarily indicate that SARS-CoV-2 cases of pupils and teachers infections took place at schools. Actually, data demonstrate an increase of infection cases after vacation, indicating that infections of pupils and teachers might occur during leisure time and not in the school setting. In conclusion, it seems appropriate to reconsider school-related measures to mitigate the SARS-CoV-2 pandemic.

Keywords: schools, teachers, pupils, corona, COVID-19, SARS-CoV-2,
Introduction

On December 31, 2019, cases of pneumonia with unknown cause in the Chinese city of Wuhan were reported to the World Health Organization (WHO). Subsequently, on January 7, 2020, Chinese authorities identified a novel coronavirus (SARS-CoV-2) and its associated coronavirus disease (COVID-19) as the cause. Due to the rapid increase in cases, the outbreak was officially declared as a pandemic by the WHO [1]. In March 2020, 1.5 billion pupils and their teachers worldwide were forced to stay away from schools as a result of measures to contain the spread of SARS-CoV-2 [2]. In response to the pandemic, schools in Germany were closed in March 2020 with the aim of positively influencing the course of infection. This happened with far-reaching consequences not only for the education of the pupils, but for the entire society. Thenceforward, there was a debate in Germany about the effectiveness of school closures and the role of children as drivers of the SARS-CoV-2 pandemic which led to several studies.

Some studies suggested that children and schools are not driving the pandemic and schoolwide safety-measures (e.g., mask-wearing, distance) are sufficient to keep pandemic risks at an acceptably low level [3-5]. Other studies showed that school closures are effective measures to slow down the pandemic [6-8]. Based on this inconsistent state of research, the aim of the present study was to gather and analyze infection data from official sources to answer the question if pupils, teachers and general population differ in SARS-CoV-2 infection case rates. For the analysis, infection data provided by the ministry of education in Rhineland-Palatinate (BM-RLP), the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) and the Robert Koch Institute (RKI), which is the government’s central scientific institution in the field of biomedicine in Germany, were used. Furthermore, some studies [5-6] described that climatic conditions could have an impact on the
spread of SARS-CoV-2, therefore this variable was included in the analysis. For this purpose, open access data of the daily average outside temperature from the federal German Weather Service (Deutscher Wetterdienst) were used.

Methods

Official documentations of SARS-CoV-2 cases were analyzed. The dataset for statewide (RLP) cases of pupils and teachers was starting in August, with the beginning of the school-year 2020/21 and ended in December, before winter-break (data provided by the BM-RLP). The nationwide data for teachers and pupils included infection cases of pupils and teachers for a time period of five weeks starting in November and ending in mid-December 2020 (KMK) [9]. Those datasets were compared to the official dataset for infection cases in the general population of the RKI [10].

After identifying and obtaining the required SARS-CoV-2 data from official sources, the school related data were transformed to bring all sources to a common denominator (rolling 7-day average SARS-CoV-2 cases per 100,000). In the next step, the cases for pupils and teachers were subtracted from those of the general population for each analyzed day to generate distinct groups without autocorrelations. Then, state- and nationwide nonpharmaceutical interventions and school vacation periods were researched and incorporated into analysis and data presentation. Finally, information about the daily average outside temperature was integrated in order to take possible associations between the spread of the SARS-CoV-2 cases and outside temperature into account.

Results

Figure 1 shows separate SARS-CoV-2 case rates for pupils, teachers and the
general population, information about state- and nationwide nonpharmaceutical interventions, school vacations and the daily average outside temperature in the state of Rhineland-Palatinate (RLP).

It can be seen that after relatively few SARS-CoV-2 cases in summer 2020, when schools reopened after the Autumn vacation in late October 2020, cases in pupils and teachers had a more dynamic growth than the cases in the general population. In addition, there was an inverse proportional relation between the daily average outside temperature and cases, \( r = -.76, p = < .001 \).

To crosscheck the statewide findings for RLP, an analysis of the nationwide data from the KMK [9] was performed. The analysis provided the same relative positions of the three compared groups. The German general population showed the lowest average SARS-CoV-2 case rate per 100,000 in that period of time (\( M = 136.11 \)), followed by pupils (\( M = 192.03 \)) and teachers (\( M = 351.35 \)).

**Discussion**

The results of our analysis imply that there were more reported SARS-CoV-2 cases in pupils and teachers relative to the general population, especially after the Autumn vacation. Different explanations can be derived from the disproportionately steeper curves of SARS-CoV-2 cases of pupils and teachers relative to the general population. One might partly be the decrease in daily average outside temperature. This, for example, could have made sufficient ventilation through open windows in classrooms more inconvenient or could have increased the use of public transport relative to walking or using bicycles on the way to/from school in fall and winter. Furthermore, the increase of cases after Autumn vacation may have resulted from contacts with infected persons during vacation independent of the setting school.
The lower rates in pupils relative to teachers might be explained by an underestimation of cases among pupils due to the fact that SARS-CoV-2 infected children on average show fewer symptoms than adults or are even completely asymptomatic [3]. This could have led to fewer testing of pupils compared to adults.

The still used narrative in the social discourse of pupils and teachers being relatively safe and not being drivers of the pandemic cannot be confirmed by our results. However, it is important to stress that SARS-CoV-2 cases of pupils and teachers do not necessarily indicate that the infections took place at schools. Recent studies targeting this topic conversely showed that school closures slowed down the spread of SARS-CoV-2 [6-8]. In conclusion, it seems appropriate to reconsider school-related measures to mitigate the SARS-CoV-2 pandemic.

With regard to potential limitations, it would have been preferable to be able to use higher quality data for state- and nationwide SARS-CoV-2 cases of pupils and teachers, as documentation procedures changed during the analyzed period. Furthermore, during the period of the Autumn vacation, the documentation of SARS-CoV-2 cases was not continued, cases have been artificially set to zero in the BM-RLP dataset. Another important limitation of our results is that the dropout algorithm for the subtraction of recovered SARS-CoV-2 cases from active cases used for the general population data (RKI) differs from the documentation of school-based datasets (pupils and teachers). In the school-based datasets active SARS-CoV-2 cases would drop out if the pupil or teacher continues to go to school (or uses a digital alternative) whereas for the general population dataset an algorithm estimates dropouts (e.g., standard-dropout 14 days after a positive test, dropout after four weeks for cases with pneumonia). Consequently, results should be interpreted with caution.
Despite those limitations we conclude to reconsider school-related measures when schools will be opened again in order to mitigate the SARS-CoV-2 pandemic. In order to improve data quality, we encourage statewide officials to implement nationwide consistent methods of tracking and reporting SARS-CoV-2 infection cases of pupils and teachers. This would enable politicians in charge to better evidence-based decisions for the protection of pupils and teachers and to mitigate the SARS-CoV-2 pandemic in Germany.

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**Data availability:** The BM-RLP data underlying this article were provided by Aufsichts- und Dienstleistungsdirektion (ADD) are open access and available online: [https://add.rlp.de/de/corona-schulen/ueberblick-ueber-corona-infektionszahlen-an-schulen-in-rlp/](https://add.rlp.de/de/corona-schulen/ueberblick-ueber-corona-infektionszahlen-an-schulen-in-rlp/). All other data (KMK & RKI) underlying this article are open access too and available via the URLs [9 & 10] shared in the references section.

**Key points:**

- Pupils and teachers showed higher SARS-CoV-2 case rates than the general population.
• Infection cases were significantly increased after vacation, indicating that infections of pupils and teachers might occur during leisure time and not in the school setting.

• The daily average outside temperature might have influenced infection cases.

• Data-quality is a yet to overcome obstacle to provide good evidence-based recommendations regarding the management around infection cases among pupils and teachers.

• School related measures to mitigate the SARS-CoV-2 pandemic need to be reconsidered.
References

[1] World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic: https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov [Accessed 2021-01-25].

[2] United Nations Educational, Scientific and Cultural Organization (UNESCO). COVID-19 Impact on Education: https://en.unesco.org/covid19/educationresponse [Accessed 2021-01-25].

[3] Ludvigsson JF. Children are unlikely to be the main drivers of the COVID-19 pandemic - a systematic review. Acta Paediatr 2020;109:1525–1530.

[4] Otte im Kampe E, Lehfeld A-S, Buda S, Buchholz U, Haas W. Surveillance of COVID-19 school outbreaks, Germany, March to August 2020. Euro Surveill 2020;25(38):2001645. https://doi.org/10.2807/1560-7917.ES.2020.25.38.2001645.

[5] Isphording IE, Lipfert M, Pestel N. School re-openings after summer breaks in Germany did not increase SARS-CoV-2 Cases. IZA Discussion Papers (No. 13790). 2020;1-38.

[6] Li, Y, Campbell H, Kulkarni D et al. The temporal association of introducing and lifting non-pharmaceutical interventions with the time-varying reproduction number (R) of SARS-CoV-2: a modelling study across 131 countries. Lancet Infect Dis 2020;1-10. https://doi.org/10.1016/S1473-3099(20)30785-4.

[7] Persson J, Parie JF, Feuerriegel S. Monitoring the COVID-19 epidemic with nationwide telecommunication data. arXiv preprint arXiv:2101.02521.
[8] Davies NG, Kucharski A, Eggo RME, Gimma A, Edmunds WJ. Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modelling study. The Lancet Public Health. 2020; 5: e375–85.

[9] Kultusministerkonferenz (KMK). Schulstatistische Informationen zur Covid-19-Pandemie (School statistical information on the Covid-19 pandemic):
https://www.kmk.org/dokumentation-statistik/statistik/schulstatistik/schulstatistische-informationen-zur-covid-19-pandemie.html [Accessed 2021-01-25].

[10] Robert Koch Institut (RKI). Gesamtübersicht der pro Tag ans RKI übermittelten Fälle, Todesfälle und 7-Tage-Inzidenzen nach Bundesland und Landkreis (Total overview of cases, deaths and 7-day incidences transmitted to the RKI per day by federal state and district):
https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Daten/Fallzahlen_Daten.htm?lsessionid=BFE70E3E9F65759B70884E18258973E0.internet102?nn=13490888 [Accessed 2021-01-25].
