

Aus dem Institut für Arbeits-, Sozial- und Umweltmedizin der
Universitätsmedizin der Johannes Gutenberg-Universität Mainz

Teachers' Health During the SARS-CoV-2 Pandemic in Consideration of
Occupational Safety and Health Measures

Lehrergesundheit während der SARS-CoV-2-Pandemie unter
Berücksichtigung von Arbeitsschutzmaßnahmen

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DEUTSCHSPRACHIGE ZUSAMMENFASSUNG DER STUDIEN UND BEITRAG ZUM GESAMTPROJEKT

Die vorliegende kumulative Dissertationsschrift beinhaltet vier wissenschaftliche Studien, von denen zum Zeitpunkt der Erstellung bereits drei in wissenschaftlichen Fachzeitschriften mit Gutachterverfahren veröffentlicht waren, sowie eine zur Veröffentlichung in Begutachtung war. Den Rahmen für die vier Studien stellte das Forschungsprojekt „SARS-CoV-2 Arbeits- und Infektionsschutzmaßnahmen an Schulen“ dar.

Erste Studie

In der ersten Studie wurde die Fragestellung behandelt, in welchem Umfang Lehrkräfte und Schüler*innen an deutschen Schulen relativ zur Allgemeinbevölkerung von SARS-CoV-2 Infektionen betroffen waren. Hierzu wurde eine vergleichende epidemiologische Studie auf der Grundlage offizieller Daten zum Infektionsgeschehen der untersuchten Gruppen durchgeführt. Hierbei zeigte sich, dass im Untersuchungszeitraum (August bis Dezember 2020) bei Lehrkräften und Schüler*innen relativ zur Allgemeinbevölkerung weniger SARS-CoV-2 Infektionen nachgewiesen wurden. Dies deutete darauf hin, dass die zum Infektionsschutz getroffenen Maßnahmen an Schulen als wirksam eingeschätzt werden konnten. Die Qualität und Vergleichbarkeit der offiziellen Daten zu SARS-CoV-2-Infektionen ließen nur bedingt klare Schlussfolgerungen zu; die identifizierten Probleme waren ein Ergebnis für sich. Es wurde deutlich, dass die Bewältigung der durch die SARS-CoV-2-Pandemie verursachten schulischen Herausforderungen durch einzelne Bundesländer an ihre Grenzen stieß, und dass ein koordinierteres bundesweites Vorgehen eine vorteilhafte Alternative hätte darstellen können.

Zweite Studie

Ziel der zweiten Studie war es, den aktuellen Stand der psychischen Belastungen bei deutschen Lehrkräften zu ermitteln und hoch belastete Untergruppen zu identifizieren, um daraus Interventionen abzuleiten und zu ergreifen. Im März 2021 wurden Lehrkräfte aus allen Bundesländern und Schulformen in Deutschland zur Teilnahme an einer Online-Befragung eingeladen. Nach der Datenbereinigung wurde eine Stichprobe von $N = 31.089$ für die weitere Analyse verwendet. Die psychischen Belastungen bei deutschen Lehrkräften lagen über dem Niveau der

Allgemeinbevölkerung, z. B. in Bezug auf depressive Symptome (PHQ-2, $M = 1,93$ vs. $1,24$) oder Symptomen generalisierter Angststörung (GAD-2, $M = 1,72$ vs. $1,03$). Subgruppenanalysen ergaben, dass psychische Belastungen in den verschiedenen Lehrkräftegruppen ungleich verteilt waren; so zeigten beispielsweise jüngere Lehrkräfte (18–30 Jahre) mehr depressive Symptome als ihre älteren Kollegen (56–67 Jahre). Ein weiteres Beispiel für Subgruppenunterschiede waren Risikofaktoren für einen schweren Verlauf von COVID-19. Lehrkräfte mit mehr Risikofaktoren waren psychisch stärker belastet als solche mit weniger oder gar keinen. Daher sollten subgruppenspezifische Interventionen durchgeführt werden, um die Gesundheit von Lehrkräften zu erhalten und zu fördern. Neben den spezifischen pandemiebedingten psychischen Belastungen sollten auch die klassischen arbeitsmedizinischen Herausforderungen durch körperliche, biologische und chemische Belastungen, sowie die daraus resultierenden Beanspruchungen nicht außer Acht gelassen werden, was die Bedeutung von Maßnahmen des Arbeitsschutzes (z. B. Gefährdungsbeurteilungen) unterstreicht.

Dritte Studie

Gegenstand der dritten Studie waren Maßnahmen des Arbeitsschutzes in deutschen Schulen (Gefährdungsbeurteilung, Infektionsschutzbelehrungen und Unterweisungen zum Arbeitsschutz) - ein Thema mit großen Forschungslücken. Ziel war es, den Status quo der Umsetzung von Arbeitsschutzmaßnahmen in Schulen zu untersuchen, zu analysieren, ob die Umsetzung von Arbeitsschutzmaßnahmen mit vorteilhaften Assoziationen einherging, sowie Prädiktoren für die Umsetzung von Arbeitsschutzmaßnahmen zu identifizieren. Ausgewertet wurde eine bundesweite Stichprobe von Lehrkräften ($N = 31.089$), die im März 2021 an einer Online-Umfrage teilnahmen. Nur ein Bruchteil (8,3 %) der befragten Lehrkräfte gab an, dass alle drei untersuchten (gesetzlich verpflichtenden) Arbeitsschutzmaßnahmen an ihrer Schule umgesetzt wurden. In Varianzanalysen wurden mehrere signifikante positive Zusammenhänge mit einer stärkeren Umsetzung von Arbeitsschutzmaßnahmen aufgedeckt, z. B. weniger somatische Symptome (PHQ-15) oder weniger Symptome von Depression und generalisierter Angst (PHQ-4). In einem multiplen linearen Regressionsmodell (nur Schulleitungsmitglieder, da sie rechtlich für die Umsetzung von Arbeitsschutzmaßnahmen verantwortlich sind) konnten signifikante Prädiktorvariablen für die Umsetzung von Arbeitsschutzmaßnahmen in Schulen

ermittelt werden. Diese Prädiktorvariablen waren meist auf einer systemischen Ebene zu finden (z. B. Bundesländer oder Schultypen). Wir empfehlen einen aus zwei Teilen aufgebauten Ansatz, bestehend aus a) Informationskampagnen und praktischen Leitlinien sowie b) Erinnerungen und Sanktionen, um die Umsetzung von Arbeitsschutzmaßnahmen in Schulen zu fördern. Nach unserem Kenntnisstand haben wir die erste breit angelegte bundesweite Studie zur Umsetzung von, Zusammenhängen mit und Prädiktoren für Arbeitsschutzmaßnahmen in deutschen Schulen durchgeführt und bieten daher eine Basis für zukünftige Studien.

Vierte Studie

Die vierte Studie zielte darauf ab, die Veränderungen im schulischen Umfeld aufgrund der SARS-CoV-2-Pandemie zu untersuchen, die damit verbundenen Folgen für Lehrkräfte zu ermitteln und Einschätzungen zu implementierten Maßnahmen von Seiten der Lehrkräfte zu erhalten. Die Datenerhebung erfolgte durch Fokusgruppeninterviews mit Lehrkräften ($N = 17$) an vier Schulen in Deutschland. Die befragten Lehrkräfte berichteten eine Vielzahl von arbeits- und gesundheitsbezogenen Belastungen (z. B. entgrenzte Arbeitszeiten, Schlafstörungen, corona-assoziierte Ängste), die während der Arbeit an Schulen unter pandemischen Bedingungen auftraten. Maßnahmen zur Eindämmung der Pandemie wurden grundsätzlich positiv bewertet (z. B. Abstandhalten oder das Tragen von Masken), auch wenn einige Probleme bei der Umsetzung deutlich wurden (z. B. die fehlende Möglichkeit, nichtkonformes Verhalten zu sanktionieren oder die unzureichende Versorgung mit benötigtem Material). Die negativen Auswirkungen des Unterrichts unter pandemischen Bedingungen auf Lehrkräfte stellen ein relevantes Risiko für die öffentliche Gesundheit dar. Daher sollten Prävention und Gesundheitsförderung intensiviert und an die veränderten Arbeitsbedingungen in Schulen während der SARS-CoV-2-Pandemie angepasst werden. Besondere Aufmerksamkeit sollte den Lehrkräften gewidmet werden, die viele Stunden im Homeoffice arbeiten, über eine zunehmende Vermischung von Berufs- und Privatleben sowie eine Verschlechterung ihrer psychischen Gesundheit berichten.

GENERAL COMMENTS

Structure of the thesis

This thesis comprises a synopsis and four studies. The studies included were published within the framework of and using data from the research project: “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures”, which was conducted between January and December 2021 at the Institute of Occupational, Social and Environmental Medicine of the University Medical Center Mainz.

Three of the four studies included in this thesis have already been published, and one is under review for publication by peer-reviewed journals. In-depth information about my authorship of and contributions to the studies is summarized in Tables 1 and 2. In addition to the four studies, another three project-related publications and four conference contributions were undertaken with me as the first or last author, as well as six project-related conference contributions, which were supported by me as a co-author. A comprehensive list of all my publications and conference papers can be found in the curriculum vitae at the end of this thesis.

The entire thesis is written in a consistent style to improve readability, and the references of the four studies are formatted in the style in which they were published. The original publications can be found in the appendix.

Authorship and contribution to each study

I am the first or last author of all four studies included in this thesis. I was also significantly involved in the planning and realization of the aforementioned underlying research project. My contributions include the development of the study concept, questionnaire design, stakeholder management, data collection, data analysis, data interpretation, and preparation of all manuscripts.

Table 1 Related studies, status, and authorship.

Study	Title	Status	Authorship	Impact factor
1	Comparing SARS-CoV-2 Case Rates Between Pupils, Teachers and the General Population: Results from Germany	Published by <i>European Journal of Public Health</i>	First	4.4
2	Psychological Burdens Among Teachers in Germany During the SARS-CoV-2 Pandemic—Subgroup Analysis from a Nationwide Cross-Sectional Online Survey	Published by <i>International Journal of Environmental Research and Public Health</i>	First	4.6
3	Implementation of Occupational Safety and Health Measures at German Schools During the SARS-CoV-2 Pandemic—Results from 31,089 Teachers	Under review by <i>Frontiers in Public Health—Occupational Safety and Health</i>	First	6.5
4	Bewertung und Folgen der SARS-CoV-2-Infektionsschutzmaßnahmen an Schulen. Ergebnisse von Fokusgruppen-Befragungen unter Lehrkräften in Deutschland	Published by <i>ASU Arbeitsmedizin Sozialmedizin Umweltmedizin</i>	Last	-

Table 2 Contribution to each study.

Study	Study design	Data collection	Data analysis	Data interpretation	Manuscript preparation
1	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓ ¹

¹ To a large extent, the manuscript was written by PD Dr. Pavel Dietz with extensive additions, editing, and proofreading by me.

ABBREVIATIONS

ANOVA	Analysis of variance
<i>b</i>	Regression coefficient
β	Standardized regression coefficient
BAuA	Federal Institute for Occupational Safety and Health (German: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin)
CI	Confidence interval
COVID-19	Coronavirus disease 2019
<i>df</i>	Degrees of freedom
<i>F</i>	F-value (Fisher distribution, $F(x, y) = F$ with x and y degrees of freedom)
LL	Lower limit (as of a confidence interval, CI)
<i>M</i>	Mean value
<i>n</i>	Number of cases in a subsample
<i>N</i>	Total number of cases
ns	non-significant
η^2	Eta squared
OSH	Occupational safety and health
<i>p</i>	Probability(-value)
PCR	Polymerase chain reaction
<i>r</i>	Pearson correlation coefficient
R^2	Coefficient of determination
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
<i>SD (SA)</i>	Standard deviation (German: Standardabweichung)
<i>SE</i>	Standard error
<i>t</i>	<i>T</i> -test statistic
UL	Upper limit (as of a confidence interval, CI)
WHO	World Health Organization

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1 SYNOPSIS

1.1 Background and research questions of the project “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures”

On December 31, 2019, the World Health Organization (WHO) received information about cases of pneumonia of unknown etiology in the Chinese city of Wuhan. Chinese authorities subsequently identified the cause—a novel coronavirus—on January 7, 2020. Due to the rapid increase in the number of cases outside China, the outbreak was officially declared a pandemic in March 2020 (WHO, 2020a). The novel coronavirus was named “SARS-CoV-2” by the Coronaviridae Study Group of the International Committee on Taxonomy of Viruses (2020). The associated disease caused by SARS-CoV-2 was named “COVID-19” (WHO, 2020b).

The impact on the school system and other structures and organizations was unprecedented. In March 2020, 1.5 billion students and their teachers were forced to stay away from schools around the world as a result of measures to contain the spread of SARS-CoV-2 (Suhr, 2020). German schools were also closed in March 2020 with the aim of mitigating rising infection numbers. This entailed far-reaching consequences not only for teachers and the education of their students but for the entire society. After the summer vacation of 2020, most schools returned to regular face-to-face teaching—as far as the pandemic situation and compliance with hygiene measures allowed—and switched back to distance learning in phases during the course of the school year. The contribution of face-to-face teaching in schools and the role of children and adolescents on infection numbers was unclear in 2020, when our research project “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures” was planned. It was necessary to close this knowledge gap since the daily work routine of teachers in schools is accompanied by a high number of interactions with students and colleagues—and during the SARS-CoV-2 pandemic, interaction could be synonymous with virus transmission. Since the early stages of the SARS-CoV-2 pandemic, studies showed that children and adolescents (who made up only a small proportion of PCR-test confirmed infection cases) often had either only mild or asymptomatic courses of COVID-19 infections (Parri et al., 2020). This might have led to less testing of this age group and therefore a systematic underestimation of

infection cases in school-aged individuals. Although there were indications that schools may have contributed less than other areas of life to the progression of the SARS-CoV-2 pandemic, and that private households or nursing homes were more relevant transmission sites (Buda et al., 2020), at the time, it was unclear what role schools played in the progression of the SARS-CoV-2 pandemic. We recognized this knowledge gap as one that should be urgently closed, which led to our first research question.

Research Question 1

To what extent are teachers (and students) affected by SARS-CoV-2 infections compared to the general population?

It was shown by multiple studies, that the SARS-CoV-2 pandemic caused a variety of burdens and negative effects in the general population, including reduced life satisfaction, increased stress, symptoms of anxiety or depression, subjectively poorer health, and increased health-related fears. (Li et al., 2020; Torales et al. 2020; Newby, 2020). Inauspicious self-reinforcing cycles emerged, in which (for specific days and across time) COVID-19-associated worries positively predicted COVID-19-related media consumption and vice versa (Schmidt et al., 2021). In addition, there were behavioral changes (e.g., social distancing, changes in hygiene behavior) that could have been perceived as stressful (Newby, 2020). These reactions are somewhat reminiscent of previous events, such as the 2015 outbreak of the Middle East respiratory syndrome coronavirus (MERS-CoV) in Korea, where, for example, medical staff reported interpersonal isolation and fears of becoming a transmitter of the virus (Lee et al., 2018; Torales et al., 2020).

The everyday working life of many employees has changed significantly as a result of the SARS-CoV-2 pandemic, for instance, through working in home offices or reduced working hours (Frodermann et al., 2020). Regarding the school system, the SARS-CoV-2 pandemic also entailed many impactful changes. These included, to name just a few, changes to organizational processes (e.g., increased workload), the emergence of new pedagogical challenges (e.g., distance teaching), and the implementation, communication, and adherence to hygiene plans, all of which created additional tasks for teachers to carry out. Not only did these changes, in themselves, impose a

burdensome potential on teachers, but they might also have acted as catalysts for a variety of preexisting physical, mental, and social burdens.

Consequently, in 2020, an urgent need emerged for knowledge about the specific stresses and strains teachers in Germany were encountering that accompanied the SARS-CoV-2 pandemic. There was also an attendant lack of knowledge on the state of the health of teachers in the occupational group, who were undergoing these stresses and strains while ensuring a good quality of education for their students. This led to the second research question.

Research Question 2

What is the status quo of teachers' (physical, mental, and social) health during the SARS-CoV-2 pandemic?

In addition to the specific health threats associated with the SARS-CoV-2 pandemic, it was also necessary to consider the preexisting occupational health risks caused by physical, biological, and chemical stress and the resulting impacts. Several occupational safety and health (OSH) measures were already legally obligatory before the SARS-CoV-2 pandemic (e.g., risk assessments, infection protection instructions, and instructions on occupational safety), and new ones were added (e.g., hygiene plans for schools) to mitigate the spread of the virus. These measures had to be assessed with regard to their implementation, practical feasibility, acceptance, and effectiveness for teachers and, if necessary, supplemented or implemented differently than before. Even before the pandemic, there were no systematic nationwide data regarding the implementation of OSH measures at schools. We therefore wanted to close this gap, collect best practice examples, and derive recommendations. This led to research question three.

Research Question 3

What is the status quo regarding the implementation of, associations with, and predictors for the implementation of OSH measures in German schools?

1.2 Project Framework

The research project “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures” was conducted by the research group Public Health and Social Medicine at the Institute of Occupational, Social and Environmental Medicine at the University Medical Center of the University of Mainz. The Federal Institute for Occupational Safety and Health (BAuA²) funded and supported the research project. The ethical committee of the Medical Association of Rhineland-Palatinate approved the study before it was conducted (application number: 2020-15531).

1.3 Methods Overview

In the project “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures,” a mixed methods research approach was used. The study design included the following methods:

- (1) a **comparative epidemiological study** of official data on SARS-CoV-2 infection rates (students, teachers, and the general population),
- (2) a **quantitative study** based on online survey data, and
- (3) a **qualitative study** of data collected in focus groups.

1.3.1 *Methods of the Comparative Epidemiological Study*

Official documentation of SARS-CoV-2 cases of teachers, students, and the general population was analyzed. 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) were used. The data from these different sources were transformed to a common denominator: a rolling seven-day average estimate of active SARS-CoV-2 cases per 100,000 persons. Non-pharmaceutical interventions and school vacation periods were

² Special thanks to the Federal Institute for Occupational Safety and Health (BAuA) for funding the research project, the content support, and great personal cooperation.

researched and incorporated into the 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. For this purpose, open access data for the daily average outside temperature from the federal German Weather Service (DWD) were used.

1.3.2 Methods of the Quantitative Study

For (both) the quantitative (and qualitative) study, the following superordinate topics were used to structure the data collection in terms of content regarding teachers' health in Germany during the SARS-CoV-2 pandemic:

- (1) sociodemographic and workplace-related information,
- (2) SARS-CoV-2-specific stresses and challenges while teaching in schools under pandemic conditions,
- (3) implementation, communication and adherence regarding hygiene plans, both general and school-based,
- (4) the physical, mental, and social health of teachers, and
- (5) best practice examples regarding the implementation of infection protection measures and the conducting of educational tasks under pandemic conditions.

Between March 1 and 31, 2021, teachers from all federal states and school types in Germany were invited to participate in our online survey. The participants were recruited with the support of governmental (Ministry of Education in Rhineland-Palatinate) and non-governmental institutions (Education and Science Workers' Union), teacher-related societies (German Teachers Association), and projects associated with education (Monitor Lehrerbildung). There was a non-monetary incentive (a EUR 2,000.00 donation to the German Children's Fund) to foster the willingness to participate. Informed written consent was obtained at the beginning of the online survey. A total of 39,359 teachers participated in the online survey. After data cleansing, a sample of $N = 31,089$ was used for further analysis.

1.3.3 Methods of the Qualitative Study

The focus group interviews were conducted with teachers from two German states (Rhineland-Palatinate and Hamburg). The focus groups were conducted in June 2021.

This accompanying qualitative data collection through focus group interviews addressed the same abovementioned five superordinate topics for the quantitative data collection (1.3.2). The goal of the combination of both quantitative and qualitative data collection was to provide a more comprehensive analysis. The focus groups were designed in a multistage process (guideline development, discussion in expert teams, pretests, final design of guidelines and digital tools). The duration of the focus groups was 165 minutes. In each focus group, three to five people were interviewed by a psychologist supported by an assistant.

Four focus group interviews were conducted. A total of 17 teachers from different school types participated. Teachers' statements in the focus groups were analyzed in aggregated form in order to ensure anonymity. In accordance with the method of qualitative content analysis according to Mayring (2015), statements associated with each other in terms of content were summarized with reference to the questions, and categories were formulated on their basis.

1.3.4 Timetable

The time schedule for conducting the various elements of the research project was planned in advance. An overview can be found in Figure 1.

	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sept 2021	Oct 2021	
Monitoring infection rates	■												
Quantitative data collection					■								
Qualitative data collection								■					
Data Analysis						■							
Publications				■									

Figure 1. Timetable for the research project “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures”

1.4 Summary of the Studies and Contribution to the Overall Project

1.4.1 First Study

The first study addressed the question of the extent to which teachers and students at German schools were affected by SARS-CoV-2 infections relative to the general population. For this purpose, a comparative epidemiological study was conducted on the basis of official data on the incidence of infection in the investigated groups. The

results showed that fewer SARS-CoV-2 infections were detected in teachers and students compared to the general population during the study period (August to December 2020). This indicated that the measures taken to reduce the number of infections in schools were effective. The quality and comparability of the official data regarding SARS-CoV-2 infections limited the possibility of drawing clear conclusions, and these identified problems were a result in themselves. It became apparent that the management of school-related challenges caused by the SARS-CoV-2 pandemic by individual federal states had its limitations and that a more coordinated nationwide approach might provide a beneficial alternative.

1.4.2 Second Study

The aims of the second study were to assess the current state of psychological burdens on German teachers and identify highly burdened subgroups to derive and address interventions. In March 2021, teachers from all federal states and school types in Germany were invited to participate in an online survey. After data cleansing, a sample of $N = 31,089$ was used for further analysis. Psychological burdens on German teachers exceeded the level of the general population regarding, for example, symptoms of depression (PHQ-2, $M = 1.93$ vs. 1.24) or generalized anxiety (GAD-2, $M = 1.72$ vs. 1.03). Subgroup analysis revealed that psychological burdens were unevenly distributed among different groups of teachers; for example, younger teachers (18–30 years) showed more depression symptoms compared with their older colleagues (56–67 years). Another example of subgroup differences is risk factors for a severe course of COVID-19. Teachers with more risk factors were more psychologically burdened compared to those with fewer or none. Therefore subgroup-specific interventions should be implemented in order to sustain and foster teachers' health. Beyond the specific pandemic-related psychological burdens, classic occupational health challenges of physical, biological, and chemical stress and their resulting strains should not be disregarded, which underlines the importance of OSH measures (e.g., risk assessments).

1.4.3 Third Study

The subject of interest for the third study was OSH measures in German schools (i.e., risk assessment, infection protection instructions, and instructions on occupational safety)—a topic with large research gaps. The aims were to examine the status quo of

the implementation of OSH measures in schools, to analyze whether the implementation of OSH measures was associated with preferable outcomes, and to identify predictors for the implementation of OSH measures. A nationwide sample of teachers ($N = 31,089$) that participated in an online survey in March 2021 was analyzed. Only a fraction (8.3%) of the surveyed teachers reported the implementation of all three studied (legally obligatory) OSH measures in their schools. Several significant preferable associations with more implementation of OSH measures were found in our analysis of variance, for example, fewer somatic symptoms (PHQ-15) or fewer symptoms of depression and generalized anxiety (PHQ-4). In a multiple linear regression model (using school management members only since the legal responsibility to implement OSH measures is theirs), we were able to identify significant predictor variables for the implementation of OSH measures in schools. Those predictor variables were mostly found on a systemic level (e.g., federal states or school types). We recommend a twofold approach, consisting of a) information campaigns & practical guidelines as well as b) reminders and sanctions, to increase the implementation of OSH measures in schools. To the best of our knowledge, we conducted the first broad-scale nationwide study on the implementation of, associations with, and predictors for the implementation of OSH measures in German schools, which therefore may represent a basis for future studies.

1.4.4 Fourth Study

The fourth study aimed to investigate changes in the school setting due to the SARS-CoV-2 pandemic to assess the related consequences for teachers as well as teachers' evaluation of implemented measures. Data were collected by conducting focus group interviews with teachers ($N = 17$) at four schools in Germany. Teachers reported a multitude of work- and health-related burdens (e.g., increased working hours, sleep disturbances, corona-associated fears) that arose while working under pandemic conditions in schools. Measures to mitigate the pandemic were evaluated positively in principle (e.g., social distancing or wearing of masks), even though some problems regarding their implementation became evident (e.g., not being able to sanction non-compliant behavior or insufficient supplies of needed materials). The negative effects of teaching under pandemic conditions for teachers represented a relevant public health risk. Therefore, prevention and health promotion should be intensified and adapted to the changing work environments in schools during the SARS-CoV-2

pandemic. Special attention should be paid to teachers working extensive hours in home offices, reporting increasing levels of work-life blending, and decreasing mental health.

1.5 Overall Discussion, Recommendations and Outlook

The four research papers of this thesis addressed teachers' health during the SARS-CoV-2 pandemic. Teachers' health is a highly relevant topic from a public health point of view. The approximately 800,000 to 900,000 teachers in Germany not only represent a huge occupational group; they also have enormous societal leverage due to the high number of students (9,000,000 to 10,000,000) they are responsible for (KMK, 2022). Since teachers and their students represent more than 10% of the German population, scientific research regarding teachers' health during the SARS-CoV-2 pandemic was not only appropriate but necessary.

School life and, thus, the professional life of teachers in Germany have undergone fundamental—and often abrupt—changes during the SARS-CoV-2 pandemic. Just to name a few: sick leaves and quarantines due to COVID-19 became an issue, corona-associated anxieties emerged, organizational processes changed (e.g., increased workload), pedagogical challenges arose (e.g., distance teaching), and new work tasks were added (e.g., implementation of school-related hygiene plans). Therefore, it was necessary to assess the accompanying consequences and evaluate measures that were implemented. In the underlying research project, “SARS-CoV-2 at Schools—Occupational Safety, Health and Infection Prevention Measures,” we collected epidemiological, quantitative, and qualitative data to study teachers' health. It was possible to recruit a large-scale sample of over 31,089 teachers from all federal states and school types in Germany to participate in an online survey, which enabled us to derive results of high significance.

The following sections are structured in accordance with the three research questions. After an overview of the respective results, practical and scientific recommendations are provided.

Research Question 1

To what extent are teachers (and students) affected by SARS-CoV-2 infections compared to the general population?

Even though the extensive measures that were implemented in schools to mitigate the SARS-CoV-2 pandemic seemed to have accomplished their goal (my analysis showed that infection numbers of teachers and students were below those of the general population), data quality was a huge obstacle. The results of Study 1 might help to improve processes of epidemiological data collection, documentation, and processing, thus enhancing protection against contagious diseases, with consequences not only for the ongoing SARS-CoV-2 pandemic but for comparably impactful future events as well.

Research Question 2

What is the status quo of teachers' (physical, mental, and social) health during the SARS-CoV-2 pandemic?

The combination of quantitative and qualitative data, subgroup-specific analysis, and the collection of best practices provided the basis for information regarding the status quo and the derivation of evidence-based recommendations to improve teachers' health. The results of Studies 2 and 4 support the assumption that for teachers, the SARS-CoV-2 pandemic acted as a catalyst for a variety of existing physical, mental, and social burdens and added new ones. To name some relevant examples, teachers that participated in the focus group interviews linked pain and tension in the back, neck, or arms to sitting for extended working hours in front of computers and stated that they missed the movement inherent in regular days in schools—especially during times of home office/distance teaching. Data from the online survey showed that during the SARS-CoV-2 pandemic, teachers reported higher levels of symptoms of depression and generalized anxiety when compared to the general population. Subgroup analysis revealed that specific groups of teachers (e.g., female and diverse gender or full-time working schedule) were significantly more burdened by the aforementioned mental conditions than others (e.g., male or part-time working schedule). Surprising results were found too. For instance, teachers in special needs schools systematically reported mental burdens significantly below the levels of teachers working in other school types. This raises questions regarding the underlying structural differences between school types (e.g., student-teacher ratios) and their implications. Lastly, teachers also reported that the SARS-CoV-2 pandemic caused social burdens (e.g., increased problems in balancing the demands of one's own family

with demands from work), while compensating became more challenging due to a lack of variety in leisure activities.

Research Question 3

What is the status quo regarding the implementation of, associations with, and predictors for the implementation of OSH measures in German schools?

To the best of our knowledge, the first large-scale nationwide research regarding the implementation of OSH measures in German schools, presented in Study 3, provided novel information. It became evident that on average, OSH measures in German schools were insufficiently implemented and did not meet legal requirements, while at the same time, desirable associations with higher levels of implementation were found. Less than 10% of the surveyed teachers reported that their schools met the legal requirements by conducting all three OSH measures studied (risk assessments, infection protection instructions, and instructions on occupational safety). Moreover, better implementation of these OSH measures in schools was associated with desirable outcomes (e.g., fewer health concerns, fewer symptoms of depression or generalized anxiety, as well as fewer somatic symptoms). It was also possible to find predictors for the implementation of OSH measures at schools. These predictors were predominantly found on a systemic level (e.g., the federal states in which schools were located in, school types, or the existence of concepts for the implementation of digital teaching). The results provide implications for interventions to promote better implementation of OSH measures at schools.

Given the high societal and public health relevance of the occupational group of teachers, interventions with the aims of remediating damage incurred (to physical, mental, and social health) while working under pandemic conditions, preventing further damage, as well as fostering health promotion are of the highest importance.

Based on the study results presented in this thesis, the following practical recommendations can be derived.

1. *The nationwide standardization of SARS-CoV-2 (or other contagious diseases) case collection, documentation, and processing for teachers, students, and the general population.* Federalism in the German school system and

accompanying heterogeneity in datasets seemed to be a hindering factor in managing the SARS-CoV-2 pandemic in schools; therefore, a more coordinated approach should be advantageous. This is in line with the demands of teachers in our study, who explicitly called for a suspension of federalism during interventions in nationwide crises.

2. *The conducting of evidence-based interventions to recover, sustain and foster teachers' health.* These interventions should be implemented at a technical, organizational, and personal level. The following list of examples (which is not exhaustive) may help to plan interventions.

- a. On a technical level, the spread of contagious diseases might be reduced by assuring that school buildings allow for ventilation through windows or by installing air-conditioning systems. To prevent musculoskeletal diseases, it would be a viable measure to ensure ergonomically designed workplaces in the home office (e.g., by providing height-adjustable desks). A way to reduce a source of stress and voice disorders of teachers (who reported that speaking through masks was overstraining their voices) is the reduction of reverberation in classrooms (e.g., by installing acoustic absorber elements or noise monitors).
- b. On an organizational level, to reduce the spread of contagious diseases, establishing and enforcing rules that prohibit school attendance in the event of illness may be helpful; moreover, teachers demanded them. Due to the high prevalence of mental health burdens on teachers, the implementation of communication campaigns to reduce mental illness stigma and offering mental health first aid training represent promising interventions. The realization of lower student-teacher ratios may be additionally disburdening for teachers.
- c. On a personal level, to reduce the spread of contagious diseases, supplying teachers with personal protective equipment should be ensured. Furthermore, to improve the psychological coping skills of teachers, stress-management training should be offered, especially for

highly burdened subgroups of teachers (e.g., younger age, diverse and female gender, full-time working schedule).

3. *The nationwide implementation of legally obligatory OSH measures in schools.* A twofold approach seems to be well suited to increase such implementation and should be politically fostered and ensured. On the one hand, informational campaigns (e.g., on health benefits and legal obligations), as well as practical guidelines on how to perform OSH measures for teachers and school management teams, should be conducted. On the other hand, reminders and sanctions for noncompliance should be considered. An example of a practical way to realize this twofold approach is provided by IT-supported school-specific risk assessments. They offer easy-to-conduct, time-efficient structured surveys, as well as the documentation and evaluation of environmental conditions that represent possible hazards for teachers. They allow the implementation of risk assessment to be checked centrally and, if necessary, of reminders or sanctions in the case of noncompliance with legal obligations.

Scientific recommendations that might help to plan future studies can also be derived based on the results of the four studies.

1. In addition to research regarding their effectiveness, infection prevention measures at schools should also be studied in detail with regard to their acceptance, compliance, and feasibility to ensure their continual improvement.
2. Following up on the practical recommendation for interventions to recover, sustain, and foster teachers' health, such interventions should be scientifically evaluated to ensure their suitability and effectiveness. One example is teacher-specific web-based stress-management training that could be flanked by assessments of pre- and post-completion stress levels. Regarding the physical aspects of teachers' health, a better understanding of the ergonomic conditions of home offices in which teachers work is needed.
3. OSH measures in schools should be studied individually using multiple study designs (e.g., randomized assignment of schools to specific measures or longitudinal studies) to facilitate analysis of their associations with and effects

on a broad range of work-related and health outcomes. Predictor variables for conducting OSH measures are another promising area of research. It seems appropriate to examine in particular predictors that can be found at the systemic level (e.g., the financial situation of the school or teacher-student ratio), although it is also quite possible that more predictors could be found at the individual level (e.g., knowledge of the benefits associated with the implementation of OSH measures, as well as of how to implement them).

To conclude this thesis, it is of personal concern to me to emphasize that teachers are an occupational group of outstanding societal importance. They are the providers of a resource that is one of the most valuable—if not the most valuable—for a prosperous future: well-socialized and educated children.

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2 FIRST STUDY

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

Reference

Koestner, C., Letzel, S., Eggert, V., Beutel, T., & Dietz, P. (2022). Comparing SARS-CoV-2 case rates between pupils, teachers and the general population: results from Germany. *European journal of public health*, 32(1), 158–160. <https://doi.org/10.1093/eurpub/ckab196>

2.1 Abstract

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 differed in active case rates or not. The data showed that pupils and teachers case rates didn't exceeded those of the general population. In conclusion, it seems appropriate to appraise school-related measures to mitigate the SARS-CoV-2 pandemic sufficiently. Data-quality is a yet to overcome obstacle to provide good evidence-based recommendations regarding the management around infection cases in schools.

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

2.2 Introduction

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-2.¹ With the aim to positively influence the course of infection rates, schools in Germany were closed in March 2020 as response to the pandemic. This happened with far-reaching consequences not only for the education of the pupils, but for the entire society. Thenceforward, there was and still is 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 school-wide safety-measures (e.g., mask-wearing, distance) are sufficient to keep pandemic risks at an acceptably low level.²⁻⁴ Other studies showed that school closures are effective measures to slow down the pandemic.⁵⁻⁷ 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 the general population differ in active SARS-CoV-2 case rates.

2.3 Methods

Official documentations of SARS-CoV-2 cases were analyzed. 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.⁸⁻¹⁰ Furthermore, some studies described that climatic conditions could have an impact on the spread of SARS-CoV-2, therefore this variable was included in the analysis.⁴⁻⁵ For this purpose, open access data of the daily average outside temperature from the federal German Weather Service (DWD) was used.¹¹ The dataset for statewide (RLP) cases of pupils and teachers was started in August 2020, at the beginning of the school-year 2020/21 and ended in December, before the winter-break (data provided by the BM-RLP). The BM-RLP dataset for pupils and teachers was compared to the official dataset for infection cases of the Federal State Agency for Consumer & Health Protection of Rhineland-Palatinate (FSA-RLP).¹² Cases in the BM-RLP dataset were interpreted as active cases since this was what schools were obliged to record. We calculated the estimate for daily active SARS-CoV-2 cases for the RLP general population by using the accumulated cases and subtracting the recovered cases (estimated by using 14 day as well as 23 day dropout algorithms, which are representing the lower boundary for the dropout algorithms used by the RKI and the lower boundary for the dropout algorithm used by the FSA-RLP) and the deceased cases. Further information regarding the methodology and a detailed list of limitations noticed during the analysis can be found in appendix.

The nationwide data for teachers and pupils was reported on a weekly basis and included five data-points of infection cases for a time period of five weeks starting in November and ending in mid-December 2020 (KMK).⁹ The KMK dataset was compared to the official dataset for infection cases in the general population of the RKI.¹⁰ We interpreted the nationwide weekly accumulated KMK SARS-CoV-2 cases for pupils and teachers as active cases and compared them to the respective active cases documented in the situation reports published by the RKI. To crosscheck the statewide findings for RLP, an analysis of the five available data-points for nationwide data of active cases for pupils and teachers from the KMK and general population from the RKI was performed.⁹⁻¹⁰

After identifying and obtaining the required SARS-CoV-2 data from official sources, school related data were transformed to bring all sources to a common denominator (i.e., rolling 7-day average estimate of active 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 non-pharmaceutical 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.

2.4 Results

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

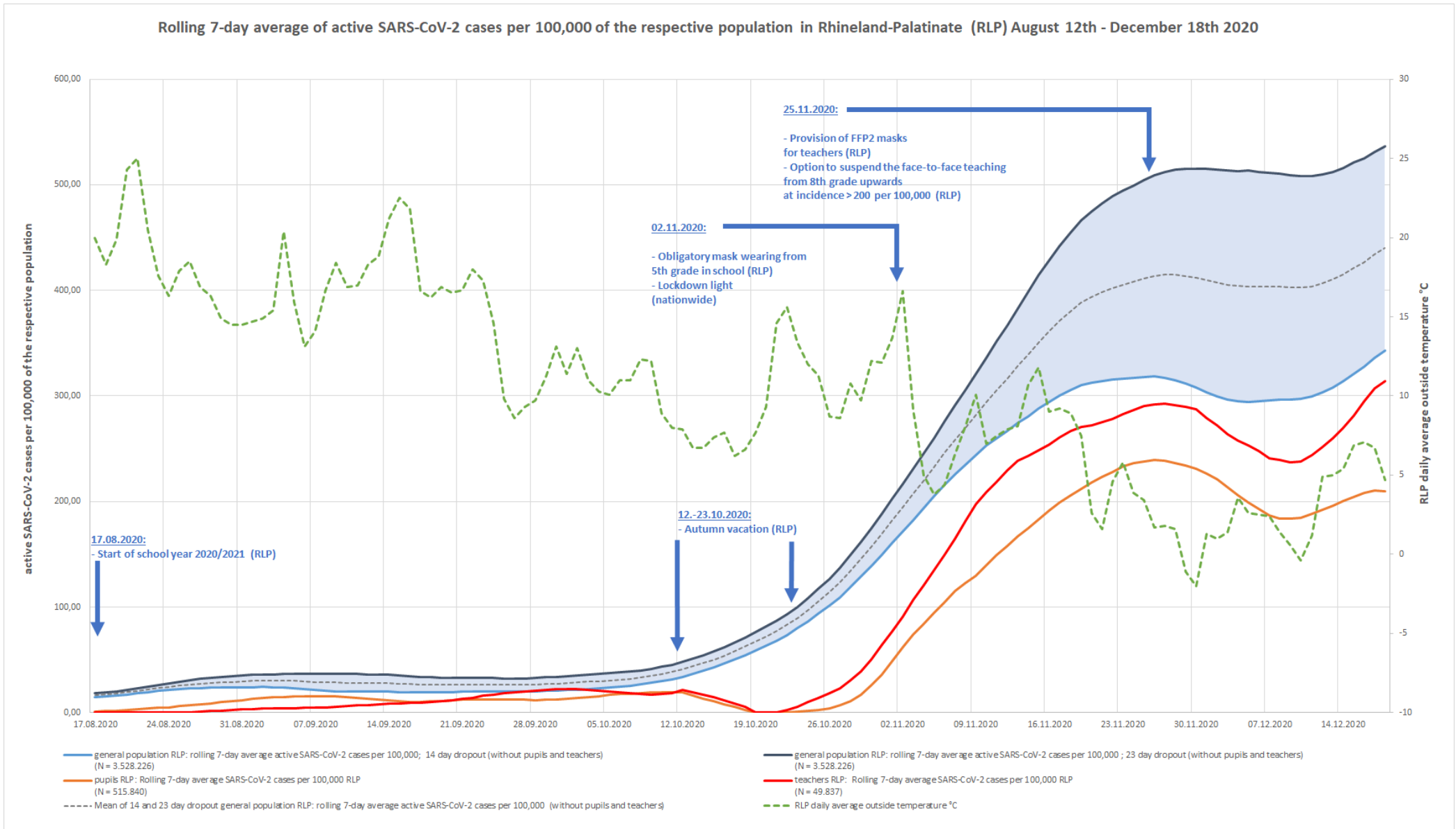


Figure 1: Rolling 7-day average SARS-CoV-2 cases per 100,000 of the respective population in Rhineland-Palatinate (RLP), August 12th - December 18th 2020

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, active case rates in pupils and teachers moved below the estimated active case rates in the general population. In addition, there was an inverse proportional relation between the daily average outside temperature and estimated active cases of the general population, $r = -.76, p = < .001$ (14 day dropout estimation) and $r = -.78, p = < .001$ (23 day dropout estimation).

The crosscheck analysis for nationwide data provided the same relative positions of the three compared groups after subtracting pupils and teachers from the general population to create groups without autocorrelation. The general population showed the highest average active SARS-CoV-2 case rate per 100,000 people in that period of time ($M = 389.19$), followed by teachers ($M = 351.35$) and pupils ($M = 192.03$). Results for three bivariate correlations for the compared nationwide groups revealed no significant associations for the active SARS-CoV-2 cases between the three groups. On a non-significant level, pupils and teachers were more closely correlated, $r = .78, p = < .12$, than pupils and the general population, $r = .14, p = < .82$, and teachers and the general population, $r = .21, p = < .74$.

2.5 Discussion

The results of our analysis imply that there were relatively more reported SARS-CoV-2 cases in the general population compared to pupils and teachers, especially after the autumn vacation. This pattern was found on a statewide and nationwide level of analysis. Knowing that the results for nationwide correlations between the compared groups are non-significant it seems reasonable to interpret those correlations in a way that pupils and teachers had to some extent more homogeneous infection case rates compared to the general population which showed a more independent course of case rates. Different explanations can be derived from the deviating rates of active 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 the ventilation through open windows in classrooms (which was mandatory for schools) more efficient.

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.² This could have led to fewer testing of pupils compared to adults.

The ongoing narrative in the social discourse of pupils and teachers being relatively safe and not being drivers of the pandemic can be confirmed by our results. Nevertheless, recent studies targeting this topic showed that school closures slowed down the spread of SARS-CoV-2.⁵⁻⁷ In conclusion, it seems appropriate to continue to evaluate and improve school-related measures to mitigate the SARS-CoV-2 pandemic. With regard to potential limitations, it would have been preferable 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 for pupils and teachers was not continued, cases were artificially set to zero in the BM-RLP dataset. Another important limitation of our results is that the dropout algorithms for the subtraction of recovered SARS-CoV-2 cases from active cases used for the general population data (RKI & FSA-RLP) differ from the algorithm used for the 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., RKI standard-dropout 14 days after a positive test, FSA-RLP standard-dropout 23 days after a positive test). Consequently, results should be interpreted with caution. A detailed and more in depth discussion of the potential limitations is given in appendix 1. It is important to consider, that SARS-CoV-2 cases of pupils and teachers do not necessarily indicate that the infections took place in schools.

Despite those limitations we conclude to further use the apparently useful school-related measures 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, teachers and the general population to make them more adequately comparable. 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). All data (BM-RLP, KMK, RKI, DWD & FSA) underlying this article are open access too and available via the URLs shared in the references section.⁸⁻¹²

Key points:

- Pupils and teachers showed lower SARS-CoV-2 case rates than the general population.
- The present paper provides a detailed list of potential pitfalls regarding the comparison of school related SARS-CoV-2 data with data of the general population.
- Data-quality is a yet to overcome obstacle to provide good evidence-based recommendations regarding the management around infection cases in schools.
- Apparently useful school related measures to mitigate the SARS-CoV-2 pandemic should be continued.

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2.7 Appendix

A detailed list and more in depth discussion of the potential limitations and pitfalls noticed while analyzing the data for the present paper.

1. Active SARS-CoV-2 cases were the unit for our between group comparisons. The formula to calculate active cases for the state of Rhineland-Palatinate (RLP) was: cumulated SARS-CoV-2 cases minus deceased cases, minus recovered cases. The part of the formula where estimations were indispensable was the number of recovered cases, since there were (and still are) two distinct algorithms used by official institutions to calculate these active cases from the total cases of general population in RLP.

To make this point clear: the RKI calculated the number of recovered cases with a dropout algorithm starting to remove cases a) 14 days after entering the dataset if mild symptoms were reported, b) 4 weeks for pneumonia, and c) the end of hospitalization if hospitalization was reported. Since we had no further information available regarding the cases reported for the RKI dataset, a 14 day dropout was our best approximation for the estimation of active cases.

Federal State Agency for Consumer & Health Protection of Rhineland-Palatinate (FSA-RLP) used a dropout algorithm starting to remove recovered cases with a different definition of steps and different dropout-delays. Recovered cases were defined as follows: a) non-deceased, non-hospitalized, and ill more than 21 days ago from data cutoff date; b) non-deceased, reported hospitalized and ill more than 28 days ago from data cut-off date; c) non-deceased, hospitalization unknown and ill more than 28 days ago from data cut-off date. If no date of illness was available, the estimated date of illness from reporting date minus a mean reporting delay of 5 days was used. Since there was no information available regarding hospitalization, we used c) as the standard case for the FSA-RLP dataset (28 days). In the next step we corrected those 28 days by subtracting 5 days, because there was no data on the date of illness available. So for the FSA -RLP dataset, a 23 day dropout was our best approximation for estimating active cases.

From the circumstances described above, it is obvious that estimates of active cases for RLP differ between the RKI and FSA-RLP. Even today, in September

2021, there are still deviating officially reported numbers of active cases for RLP from the RKI and the FSA-RLP.

Since there was no further information available to specify the category (e.g., pneumonia: yes /no) and date of illness for official records of SARS-CoV-2 cases, we used two variations of dropout algorithms as lower and upper boundaries (i.e., 14 days and 23 days) for our estimations. To be transparent regarding this issue, we plotted both, curves and their mean for active cases in RLP in Figure 1. We do think that since the values for recovered cases (which are the basis for active cases) are estimates, it is reasonable to assume that the range between the estimates of the RKI and the FSA-RLP algorithms is most likely a good approximation of the active SARS-CoV-2 cases.

To validate our assumptions empirically, we compared our (as described above) calculated mean estimates for active cases in RLP for August 2021 and the official data provided by the FSA-RLP for active cases (unfortunately the available documentation for active cases in RLP has just started in August 2021). Our estimations and the reported official data for August 2021 only had a 5.1% deviation. We do think that given the fact that some assumptions had to be made to calculate the active cases estimates a 5.1% deviation was acceptably adequate and represents the best approximation we could achieve.

2. The mentioned differences in dropout calculations from the RKI and the FSA-RLP were not the only difficulty by estimating the active cases. The dataset for pupils and teachers provided by the BM-RLP used an “empirically dropout” , i.e., the recording of a case started when a pupil or teacher was absent due to illness and ended when the person was back at school. As one can easily see, there was no perfect match of the different datasets in use.
3. Another aspect regarding the datasets that is not easily comparable: entering the datasets. Schools in RLP had the obligation to record all active SARS-CoV-2 cases in pupils and teachers that led to absence from school. For schools it was not part of the standard procedure to check or verify, e.g., via documented PCR test, that one had a SARS-CoV-2 infection. We do think that it is reasonable to assume that most of the pupils and teachers that claimed to have

a SARS-CoV-2 infection really had it and that most of the cases with SARS-CoV-2 reported this to the school, but there is certainly room for doubt.

On the other side the process to enter the RKI or FSA-RLP datasets was different: a laboratory confirmed positive PCR test was necessary. Laboratories reported positive SARS-CoV-2 cases directly to the local public health departments which then reported the numbers to the RKI.

Given that knowledge, comparisons between school-related and general population-related datasets become less convincing.

4. Another important limitation to our study is the switch in the process of documenting SARS-CoV-2 cases for pupils and teachers in RLP. Before the autumn vacation in RLP officials from the Ministry of Education documented cases for all schools in RLP on the basis of information they could get from schools. After the autumn vacation schools themselves were obliged to document and report the daily number (without recording Name or unique ID) of all known active SARS-CoV-2 cases of pupils and teachers to the Ministry of Education RLP (except for weekends where documentation stopped / autumn vacation where all documented case-numbers were artificially set to zero) by using an online-tool. Therefore the timespan before and after the autumn vacation is not based on a consistent process for documenting SARS-CoV-2 cases for pupils and teachers in RLP.
5. Even though it is obvious that all the above mentioned limitations had an impact on the calculated results reported in our paper, there was a lack of better alternative dataset to choose from. We gave our best to be as precise and transparent as possible when analyzing the data and writing the manuscript and the appendix. Furthermore, we used the – to our knowledge – best possible way to estimate active cases from heterogeneous data-sources, knowing that with more consistent data our estimations would have been better or even unnecessary (if all infections would have been recorded and reported equally).

3 SECOND STUDY

Psychological Burdens among Teachers in Germany during the SARS-CoV-2 Pandemic–Subgroup Analysis from a Nationwide Cross-Sectional Online Survey

Reference

Koestner, C., Eggert, V., Dicks, T., Kalo, K., Zähme, C., Dietz, P., Letzel, S., & Beutel, T. (2022). Psychological Burdens among Teachers in Germany during the SARS-CoV-2 Pandemic-Subgroup Analysis from a Nationwide Cross-Sectional Online Survey. *International journal of environmental research and public health*, 19(15), 9773. <https://doi.org/10.3390/ijerph19159773>

3.1 Abstract

Background: Schools underwent massive changes during the SARS-CoV-2 pandemic worldwide. Besides existing occupational health challenges, teachers had to deal with biological and psychological burdens that had the potential to impact their psychological well-being. The aim of the present study was to (i) assess the current state of psychological burdens in German teachers and (ii) identify highly burdened subgroups to derive and address interventions.

Methods: A nationwide cross-sectional online survey was conducted among teachers at all school types in Germany in March 2021. Data on psychological strains were assessed using established (e.g., PHQ-4) and new—pandemic-specific—(e.g., COVID-19-associated anxieties) instruments. ANOVAs and Tukey’s post hoc tests were used to identify highly burdened subgroups (e.g., gender, age, and number of risk factors for severe courses of COVID-19) of teachers.

Results: Psychological burdens in German teachers ($N = 31.089$) exceeded the level of the general population, for example, regarding symptoms of depression (PHQ-2, $M = 1.93$ vs. 1.24) or generalized anxiety (GAD-2, $M = 1.72$ vs. 1.03). Subgroup analysis revealed that psychological burdens were unevenly distributed among different groups of teachers; for example, younger teachers (18–30 years) showed more depression symptoms compared with their older colleagues (56–67 years) (PHQ-2, $M = 2.01$ vs. 1.78).

Conclusions: The online survey was conducted during the “third wave” of SARS-CoV-2 in Germany, which might have influenced risk perception and psychological strains. Future studies at different times, ideally longitudinal monitoring of the mental health of teachers, are recommended. Based on our results, evidence-based subgroup-specific interventions should be implemented to sustain teachers’ mental health; for example, younger teachers or teachers with risk factors for a severe course of COVID-19 should receive special attention and support. Teachers from special needs schools whose mental health is, on average, good could also be a starting point for identifying the health promotion structural elements of this school type (e.g., fewer students per teacher). However, beyond the specific pandemic-related psychological burdens, the classic occupational health challenges of physical, biological, and chemical stress and their resulting strains should not be disregarded

3.2 Background

The ongoing SARS-CoV-2 pandemic has shown the potential to act as a catalyst for a variety of existing somatic, psychological, and social burdens worldwide. Furthermore, it has generated new ones. Several international studies analyzing the general population have provided evidence that, in various countries, alarming associations between the SARS-CoV-2 pandemic and psychological burdens (e.g., stress, anxiety, depression, insomnia, or anger) emerged. This is in line with findings about responses to other, previous outbreaks of infections, for example, the 2015 MERS-CoV outbreak in Korea [1]. In a Chinese study that included 17,865 participants, various negative emotions (e.g., anxiety, de-pression, or indignation) increased, whereas the sources of positive emotions (happiness) and life satisfaction decreased [2]. Furthermore, acute mental health impacts in response to the pandemic were found in an Australian study with 5070 participants, which re-ported COVID-19-related fears, elevated levels of psychological distress (e.g., depression, anxiety, alcohol use, loneliness, or stress), and precautious behaviors [3]. In line with the aforementioned results, a nationally representative study from the United Kingdom (N = 14,393) showed that the prevalence of mental health problems (measured with the General Health Questionnaire, GHQ-12) had increased in all examined sociodemographic groups since the outbreak of the pandemic [4]. The results from Germany pointed in the same direction. In the general population, significantly increasing problems in relevant dimensions of mental health during the pandemic were detected in Germany, for exam-ple, regarding generalized anxiety, depression, or pandemic-related anxieties [5,6]. There is also research from the early stages of the SARS-CoV-2 pandemic in which a significant increase in depression and generalized anxiety symptomatology could not be empirically detected when longer periods of comparisons were taken into account regarding the aforementioned studies [7].

Stress or burdens can be interpreted as the entirety of influences (e.g., biological, mental, and social) that induce reactions from organisms. The level of strain (e.g., physical, psychological, and behavioral) resulting from stressors depends on an individual's biological, psychological, and social resources [8,9]. In this regard, it is important to be aware that pandemic-related psychological burdens are unevenly distributed among different subgroups of the general population. There is evidence that the implementation of lockdown restrictions to mitigate the spread of SARS-CoV-

2 was associated with increased levels of depression and anxiety, which varied in intensity depending on socio-demographic variables. Even recovery from mental health problems differed between subgroups when lockdown restrictions began to be eased. For example, 18–34-year-old participants in a study from April to June 2020, when lockdown restrictions were eased, recovered from existing mental health problems at a mean of 9.5%, whereas 50–64-year-old participants recovered only 2.9% during the same period [4]. The risk factors for mental health problems due to pandemic-related lockdowns were younger age, being female, or living with young children [10].

Being clinically/physically vulnerable to developing complications in the case of a COVID-19 infection seemed to increase mental health problems. Carriers of risk factors had higher levels of mental health problems during the pandemic compared with persons without risk factors [4]. Perceived risk theory [11] offers a framework for categorizing hazards and describes how risk perception is structured. In this framework, risks are described by two factors: dread risk and unknown risk (both containing different subdimensions). On the one hand, the SARS-CoV-2 pandemic could be described as a dreadful, uncontrollable, global, and involuntary risk. On the other hand, the SARS-CoV-2 pandemic appeared to be a new risk with delayed effects, which is not easily observable. In this respect, the pandemic can be considered problematic by both factors; therefore, the resulting risk perception can be considered to be high on average. Individual risk perception might have been even more complex, considering that each person had a more or less known set of risk factors for a severe course of COVID-19. This is relevant since being a carrier of one or more of these risk factors seemingly fueled the emergence or levels of psychological burdens, as described [4].

A noteworthy fact with regard to the sphere of school life is that in March 2020, about 1.5 billion students worldwide—as well as their teachers—were absent from schools as a result of measures to contain the spread of the SARS-CoV-2 virus [12]. Due to closures, teachers in many schools were forced to teach their lessons entirely using digital tools for the first time. Besides the required changes in the teaching mode during periods of open schools, a multitude of measures to mitigate the spread of SARS-CoV-2 were taken that affected teachers' work lives by expanding and complicating tasks. Together with many other organizational changes in teachers' day-to-day work since the pandemic, the amount of—often abrupt—changes demanded

many adjustments, which increased the burnout risk for teachers [13]. With approximately 800,000 to 900,000 teachers in Germany, teachers are a huge occupational group; therefore, targeting teachers' health is relevant to public health. Teachers' health importance is leveraged when taking the number of students into account: teachers are responsible for between 9,000,000 and 10,000,000 individuals [14]. Teachers' health is highly relevant to the socioeconomic system in Germany, too, due to the high number of people dependent on teachers being able to work. During the pandemic, school closures created a cascade of consequences for parents, employees, and companies, since parents had to take care of the children during the otherwise school time. Another important argument for researching teachers' mental health, especially during the SARS-CoV-2 pandemic is that they work in an environment with a high number of interactions per day. At a time when interaction could mean transmission of the SARS-CoV-2 virus, this could have felt like a burden for teachers. Besides these tangible reasons for conducting research on teachers, there are superordinate ones, too. In Germany, we live in a society broadly dependent on the economic output of well-educated people since the possibility of relying on selling natural resources is limited in comparison with other countries. Following that line of thought, well-socialized and educated children are one of the, if not the most important, resources for our society. Beyond other aspects, healthy teachers play a key role in safeguarding and expanding the standard of living. The allocation of resources to research and derived interventions regarding teacher's health therefore seems to be an enterprise that serves multiple worthwhile purposes simultaneously (e.g., better health, education, or prosperity). Especially in Germany, teachers' health is more than just scientifically interesting—it is vital.

As stated before, the pandemic's impacts differed between subgroups in the general population. For example, subgroups of university students showed more mental health problems during the pandemic than others (e.g., women vs. men) [15]. We were highly curious to discover the picture that a data sample of teachers in Germany would give us about the distribution of psychological burdens among subgroups of teachers. This might even be more relevant since there are opposing results indicating that there were no significant differences in mental health outcomes regarding gender or age in teachers [16]. Based on our experiences in supportive and consulting work with teachers and schools during the pandemic, we believe it is plausible to assume that the implementation of pandemic-related measurements and changes came with distinctive

problems across school types. If one imagines distance learning or the implementation of hygienic measures in schools, it becomes clear that, for example, elementary schools with close to kindergarten-aged children can be a quite different scenario compared with special needs schools or high schools. Therefore, the additional strains and resulting stress for teachers could also potentially vary. We see our study closing a research gap.

Given the high relevance of teachers in Germany, the present study aimed to (i) investigate the status quo of the psychological burdens of teachers during the SARS-CoV-2 pandemic. We further aimed to (ii) identify subgroups of teachers with higher risks of psychological burdens (e.g., groups divided by gender, age, or risk factors for a severe course of COVID-19). These results for this subgroup analysis may provide a basis for the development of evidence-based and subgroup-specific interventions for the treatment of psychological burdens in German teachers.

3.3 Methods

3.3.1 Procedure and Study Sample

Between 1 March and 31 March 2021, teachers from all federal states in Germany were invited to participate in an online survey. The participants were recruited with the support of governmental (Ministry of Education in Rhineland-Palatinate) and non-governmental institutions (Education and Science Workers' Union), teacher-related societies (German Teachers Association), and projects associated with education (Monitor Lehrerbildung). There was a non-monetary incentive (EUR 2000.00 donation to the German Children's Fund) to foster the willingness to participate. Informed written consent was obtained at the beginning of the online survey. The ethical committee of the Medical Association of Rhineland-Palatinate approved the study before it was conducted (application number: 2020-15531).

3.3.2. Questionnaire and Measures

Participants completed an online questionnaire with approximately 350 items (presented in the online survey tool LimeSurvey), covering a wide range of topics, which were arranged under the following categories: (1) sociodemographic and workplace information; (2) identification of SARS-CoV-2-specific stresses and challenges in schools for teachers; (3) implementation, communication, and

compliance with hygiene policies/plans, both general and school-based; (4) impact of school operations during the SARS-CoV-2 pandemic on teachers; and (5) collection of examples of proven interventions and derivation of recommendations for schools. Before being applied in the present study, the questionnaire was pretested and revised in three steps. First, experts from the Institute for Teachers' Health and the Institute for Occupational, Social and Environmental Medicine of the University Medical Center Mainz answered and commented on the questionnaire. After revising the questionnaire, we asked the teachers to take part in a comprehensive probing for the exact understanding and associations of all items. We did this to make sure that the items were understood in the way we intended or were otherwise able to collect suggestions for (mostly minor) linguistic adaptations. After the probing, the questionnaire was revised again, and our team conducted a final (linguistic and grammatical) quality check to eliminate final errors (typing errors).

Dependent variables: Participants were asked to complete the validated German version of the Patient Health Questionnaire 4 [17], an established instrument for the combined screening for symptoms of depression [18] and generalized anxiety disorder [19]. Burnout was measured by two items from the Maslach Burnout Inventory (MBI) [20], which represent the dimensions of (a) emotional exhaustion (*"How often do you feel burned out from your work?"*) and (b) depersonalization (*"How often do you feel you have become more callous toward people since you took this job?"*). Relative to the full MBI, this two-item solution is optimized in terms of the questionnaire economy and still provides good predictive value [21]. After both burnout items, there was a question regarding the delta relative to pre-pandemic times (*"How would you describe this aspect in comparison to before the COVID-19 pandemic?"*). A 5-point Likert scale was used, ranging from *"(1) Currently much more often than before the COVID-19 pandemic"* to *"(5) Currently much less often than before the COVID-19 pandemic."* To measure COVID-19-associated anxieties, participants rated items on a scale from 0 (no anxiety) to 100 (powerful anxiety). The items covered the anxiety of getting infected (*"How strong is your fear of being infected with the SARS-CoV-2 virus?"*), anxiety about infecting others (*"How strong is your fear of becoming a transmitter of the SARS-CoV-2 virus yourself, that is, infecting others around you with the corona virus?"*), and anxiety about infecting close people (*"How strong is your fear of friends or loved ones becoming infected with the SARS-CoV-2 virus?"*). We

were given permission to use these items, which have also been used in other studies [22,23].

Independent variables: Sociodemographic variables (sex, age, or number of persons in household), work-related variables (part-time vs. full-time, member of school administration team, or school type), and health-related variables (COVID-19 risk factors) were surveyed. Age (in years, range 18–67) was converted into four quartiles for further analysis. Following official recommendations [24] and with the involvement of medical experts, eight personal risk factors for a severe course of COVID-19 disease were identified, and items were generated. All risk factor items began with the stem question: “*Which of the currently known risk factors for a severe course of the COVID-19 disease apply to you,*” on the basis of which specific risks were added, for example, “*cardiovascular disease with severely impaired cardiac pumping function of the heart or consequential damage (e.g., heart failure or coronary heart disease).*” Response options were “yes,” “no,” and “no answer.” The number of “yes” responses was counted and summarized on a “risk factor scale” ranging from 0 to 8. Because of the low number of participants having more than two of these severe risk factors, we combined 2–8 risk factors into a 2+ category for further analysis. Our classification of school types was based on the official classification of the federal government [25].

3.3.3. Statistical Analyses

Statistical analysis was performed using SPSS Statistics Version 27 [26]. Descriptive analyses were conducted to (i) demonstrate sample characteristics and (ii) identify subgroups of teachers with increased psychological burdens. Analyses of variance (ANOVA) and Tukey’s post hoc tests were calculated to assess the differences in psychological burdens between the subgroups. Our interpretation of the ANOVAs followed the classification of effect sizes as small (0.01), medium (0.06), and large (0.14), as suggested by Cohen [27].

3.4 Results

A total of 39,359 teachers participated in the online survey. After data cleansing, a sample of $N = 31,089$ was used for further analysis. Of the participants, 77.5% were female, 22.0% male, and 0.4% diverse. The average age of the participants was 45.8

years (± 10.5). Detailed sample characteristics are displayed in Table 1. An overview of mean values and standard deviations for the dependent and independent variables, as well as the results for differences in subgroups of teachers (ANOVA), can be found in Table 2.

Table 1. Sample characteristics.

Subgroups	<i>n</i>	%	<i>M (SD)</i>
Gender	31,089	100%	
Female	24,099	77.5%	
Male	6851	22.0%	
Diverse	139	0.4%	
Age (years)	31,089	100%	45.78 (10.46)
18–30	2473	8.0%	
31–43	10,957	35.2%	
44–55	10,799	34.7%	
56–67	6860	22.1%	
Work schedule ^a	30,959	100%	
Part-time	12,297	39.7%	
Full-Time	18,662	60.3%	
School management	30,981	100%	
Yes	3290	10.6%	
No	27,691	89.4%	
Persons in household ^b	30,706	100%	2.73 (1.24)
1	4540	14.8%	
2	11,373	37.0%	
3	5538	18.0%	
4	6844	22.3%	
5+	2411	7.9%	
School type ^c	27,960	100%	
Primary	9030	32.3%	

Secondary general	539	1.9%	
Secondary Academic secondary	2162	7.7%	
Comprehensive	5451	19.5%	
Special needs	4016	14.4%	
Vocational	2969	9.6%	
Other	2699	9.7%	
Risk factors	1367	4.9%	
	21,654	100%	0.17 (0.45)
0	18,586	85.8%	
1	2428	11.2%	
2+	640	3.0%	

^a Reflects the number, percentage, and mean values of participants answering the questions. The number of participants (*n*) may differ between items because responding was voluntary, and therefore not all participants answered all items. ^b Including the answering participant. ^c Multiple responses were possible; only participants with exactly one school type selected were included in the table for further analyses.

Table 2. Psychological burdens in different subgroups of German teachers during the SARS-CoV-2 pandemic.

Variables	PHQ-2 ^β	GAD-2 ^β	EE ^γ	ΔEE ^γ	DP ^γ	ΔDP ^γ	Anxiety-i ^δ	Anxiety-t ^δ	Anxiety-o ^δ
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Gender^α									
F	38.84 ***	228.17 ***	111.92 ***	68.33 ***	16.54 ***	4.15 *	124.80 ***	175.31 ***	176.53 ***
η ²	0.004	0.021	0.011	0.006	0.002	0.000	0.012	0.016	0.016
Female ^a	1.93 (1.44) ^b	2.18 (1.67) ^b	2.75 (1.76) ^b	3.83 (0.90) ^{b,c}	1.04 (1.56) ^b	3.29 (0.69) ^b	53.19 (27.82) ^b	65.47 (29.22) ^b	65.52 (28.09) ^b
Male ^b	1.72 (1.40) ^{a,c}	1.60 (1.52) ^{a,c}	2.31 (1.74) ^a	3.66 (0.87) ^a	1.19 (1.64) ^a	3.33 (0.70) ^a	45.89 (28.78) ^a	56.29 (30.53) ^a	56.67 (29.43) ^a
Diverse ^c	2.25 (1.82) ^b	2.09 (1.81) ^b	2.75 (1.91)	3.56 (0.85) ^a	1.12 (1.60)	3.26 (0.74)	48.70 (29.40)	58.51 (33.24)	57.82 (34.33)
Age (years)									
F	16.76 ***	3.06 *	1.15 (ns)	6.87 ***	21.27 ***	8.93 ***	3.82 **	356.25 ***	143.60 ***
η ²	0.002	0.000	0.000	0.001	0.003	0.001	0.001	0.048	0.020
18–30 ^a	2.01 (1.43) ^{c,d}	2.09 (1.65)	2.63 (1.69)	3.72 (0.89) ^{b,c}	1.11 (1.58) ^d	3.30 (0.68)	52.31 (26.80)	75.10 (24.42) ^{b,c,d}	71.06 (25.32) ^{b,c,d}
31–43 ^b	1.94 (1.43) ^{c,d}	2.02 (1.65)	2.67 (1.75)	3.81 (0.91) ^{a,d}	1.18 (1.64) ^{c,d}	3.33 (0.71) ^{c,d}	52.36 (28.17) ^c	69.77 (27.81) ^{a,c,d}	67.60 (27.66) ^{a,c,d}
44–55 ^c	1.88 (1.47) ^{a,b,d}	2.09 (1.69)	2.67 (1.80)	3.81 (0.89) ^{a,d}	1.06 (1.58) ^{b,d}	3.29 (0.68) ^b	50.88 (28.47) ^b	61.44 (30.05) ^{a,b,d}	61.88 (29.08) ^{a,b,d}
56–67 ^d	1.78 (1.40) ^{a,b,c}	2.02 (1.62)	2.62 (1.79)	3.77 (0.86) ^{b,c}	0.94 (1.49) ^{a,b,c}	3.27 (0.67) ^b	51.38 (28.19)	54.59 (30.31) ^{a,b,c}	58.49 (29.00) ^{a,b,c}
Work schedule									
F	12.90 ***	89.63 ***	5.15 *	2.12 (ns)	14.18 ***	14.76 ***	0.38 (ns)	0.89 (ns)	0.17 (ns)
η ²	0.001	0.004	0.000	0.000	0.001	0.001	0.000	0.000	0.000
Part-time	1.93 (1.43)	2.18 (1.66)	2.69 (1.73)	3.78 (0.91)	1.02 (1.55)	3.28 (0.66)	51.73 (27.71)	63.18 (29.41)	63.46 (28.14)
Full-Time	1.86 (1.44)	1.96 (1.65)	2.63 (1.79)	3.80 (0.88)	1.10 (1.59)	3.32 (0.71)	51.49 (28.51)	63.58 (30.00)	63.63 (28.96)
School management									
F	61.45 ***	22.47 ***	17.12 ***	35.77 ***	1.80 (ns)	9.44 **	116.49 ***	76.89 ***	84.43 ***
η ²	0.003	0.001	0.001	0.002	0.000	0.000	0.005	0.004	0.004

Yes	1.66 (1.40)	1.90 (1.63)	2.51 (1.79)	3.90 (0.84)	1.03 (1.50)	3.34 (0.71)	45.62 (27.84)	58.30 (31.08)	58.39 (29.84)
No	1.91 (1.44)	2.07 (1.66)	2.67 (1.77)	3.78 (0.90)	1.08 (1.59)	3.30 (0.69)	52.30 (28.16)	64.07 (29.54)	64.20 (28.43)
Persons in household									
F	17.42 ***	6.21 ***	7.43 ***	9.04 ***	3.77 **	1.52 (ns)	11.54 ***	2.98 **	2.27 *
η^2	0.003	0.001	0.001	0.002	0.001	0.000	0.002	0.001	0.000
1 ^a	2.07 (1.50) b,c,d,e	2.17 (1.68) ^{b,d,e}	2.78 (1.77) ^{b,d,e}	3.78 (0.91) ^d	1.14 (1.60) ^{b,d}	3.31 (0.72)	52.01 (28.14) ^e	62.18 (29.93) ^d	63.87 (28.81)
2 ^b	1.87 (1.45) ^a	2.03 (1.66) ^a	2.64 (1.78) ^a	3.75 (0.90) c,d,e	1.04 (1.56) ^a	3.29 (0.68)	52.39 (27.91) ^{d,e}	63.52 (29.84)	63.93 (28.45) ^e
3 ^c	1.87 (1.45) ^a	2.08 (1.69)	2.70 (1.78) ^e	3.81 (0.90) ^b	1.12 (1.60)	3.30 (0.70)	52.62 (28.37) ^{d,e}	63.80 (29.78)	63.92 (28.58)
4 ^d	1.84 (1.38) ^a	2.00 (1.62) ^a	2.60 (1.74) ^a	3.85 (0.86) ^{a,b}	1.03 (1.55) ^a	3.31 (0.68)	50.35 (28.05) ^{b,c,e}	64.47 (29.11) ^a	63.33 (28.45)
5+ ^e	1.79 (1.37) ^a	2.00 (1.66) ^a	2.52 (1.76) ^{a,c}	3.82 (0.87) ^b	1.10 (1.61)	3.33 (0.68)	48.05 (29.39) ^{a,b,c,d}	63.02 (30.64)	61.69 (29.69) ^b
School type									
F	12.26 ***	22.78 ***	26.31 ***	32.86 ***	12.44 ***	7.00 ***	7.34 **	10.97 ***	8.35 ***
η^2	0.004	0.008	0.010	0.012	0.005	0.003	0.003	0.004	0.003
Primary ^a	1.91 (1.45) ^f	2.25 (1.68) b,c,d,e,f,g,h	2.86 (1.79) b,c,d,e,f,g,h	3.91 (0.86) b,c,d,e,f,g,h	1.09 (1.60) ^f	3.33 (0.71) ^f	52.57 (28.23) ^f	65.38 (29.46) ^{d,f,g}	65.31 (28.48) ^{d,f,g}
Secondary General ^b	1.93 (1.43) ^f	1.94 (1.66) ^a	2.53 (1.77) ^a	3.69 (0.94) ^a	1.13 (1.63) ^f	3.27 (0.67)	54.15 (28.79) ^f	63.89 (29.54)	63.63 (27.44)
Secondary ^c	1.92 (1.42) ^f	2.00 (1.64) ^{a,f}	2.62 (1.74) ^{a,f}	3.73 (0.94) a,d,f	1.21 (1.68) ^{d,f}	3.30 (0.74) ^f	53.82 (28.34) ^{d,f,g}	62.95 (30.64) ^g	63.49 (29.16) ^g
Academic Secondary ^d	1.95 (1.43) ^{f,g}	2.04 (1.68) ^{a,f,g}	2.61 (1.75) ^{a,f}	3.82 (0.89) a,c,e,f	1.02 (1.55) ^{c,e,f}	3.29 (0.68) ^f	50.97 (28.08) ^{c,f}	62.24 (29.73) ^{a,g}	63.34 (28.37) ^{a,g}
Comprehensive ^e	1.94 (1.44) ^f	2.02 (1.65) ^{a,f,g}	2.67 (1.76) ^{a,f,g}	3.75 (0.92) a,d,f	1.17 (1.62) ^{d,f}	3.29 (0.71) ^f	52.70 (28.11) ^f	64.19 (29.67) ^g	64.10 (28.45) ^g

Special needs ^f	1.61 (1.34) a,b,c,d,e,g,h	1.80 (1.55) a,c,d,e	2.29 (1.66) a,c,d,e,g,h	3.58 (0.89) a,c,d,e,g,h	0.79 (1.34) a,b,c,d,e,g,h	3.21 (0.60) a,c,d,e,g	48.49 (27.26) a,b,c,d,e	62.50 (29.08) ^{a,g}	62.09 (28.38) ^a
Vocational ^g	1.81 (1.47) ^{d,f}	1.87 (1.64) ^{a,d,e}	2.48 (1.78) ^{a,e,f}	3.75 (0.85) ^{a,f}	1.15 (1.60) ^f	3.34 (0.69) ^f	50.53 (28.62) ^c	59.05 (30.81) a,c,d,e,f,h	60.03 (29.21) ^{a,c,d,e}
Other ^h	1.89 (1.48) ^f	1.98 (1.64) ^a	2.62 (1.79) ^{a,f}	3.75 (0.95) ^{a,f}	1.03 (1.56) ^f	3.27 (0.68)	50.87 (28.57)	62.79 (30.04) ^g	62.47 (29.54)
Risk factors									
F	72,18 ***	94,76 ***	114,19 ***	13,28 ***	31,53 ***	5,92 **	295,14 ***	2,76 (ns)	27,26 ***
η^2	0.007	0.009	0.011	0.001	0.003	0.001	0.027	0.000	0.003
0 ^a	1.84 (1.41) ^{b,c}	1.99 (1.63) ^{b,c}	2.58 (1.75) ^{b,c}	3.78 (0.89) ^{b,c}	1.04 (1.55) ^{b,c}	3.30 (0.68) ^c	49.67 (27.93) ^{b,c}	63.21 (29.77)	62.93 (28.80) ^{b,c}
1 ^b	2.11 (1.55) ^{a,c}	2.38 (1.73) ^{a,c}	3.03 (1.80) ^{a,c}	3.87 (0.92) ^a	1.21 (1.69) ^{a,c}	3.32 (0.74)	61.41 (27.24) ^{a,c}	64.62 (29.57)	66.76 (27.37) ^a
2+ ^c	2.34 (1.65) ^{a,b}	2.59 (1.89) ^{a,b}	3.33 (1.80) ^{a,b}	3.88 (0.94) ^a	1.47 (1.82) ^{a,b}	3.39 (0.83) ^a	67.52 (26.52) ^{a,b}	64.54 (30.79)	68.23 (27.58) ^a

^a (ns) = non-significant on $p > 0.05$ level, * p -value < 0.05 , ** p -value < 0.01 , *** p -value < 0.001 , F = F-value, η^2 = Eta squared, degree of freedom = number of subgroups – 1. ^b Depression symptoms: PHQ-2 (0–3), generalized anxiety symptoms: GAD-2 (0–3). ^γ Burnout items: EE = emotional exhaustion (0–6), DP = depersonalization (0–6), as well as Δ EE/ Δ DP (0–5) for the change in the respective items relative to pre-pandemic times. ^δ COVID-19 associated anxieties items (0–100): anxiety-i = anxiety of own infection, anxiety-t = anxiety of transmitting infection to others, anxiety-o = anxiety of friends of loved ones becoming infected. ^{a–h} significant differences in Tukey’s test with group(s): ^{a–h} (p -value < 0.05); Tukey’s test conducted only for subgroups $n > 2$.

3.4.1. Level of Burdens

Teachers with two or more risk factors showed the highest mean value for **depression symptoms** ($M = 2.34$, $SD = 1.65$), whereas teachers working in special needs schools showed the lowest ($M = 1.61$, $SD = 1.34$). Regarding **generalized anxiety**, again, teachers with two or more risk factors for a severe course of COVID-19 showed the highest burdens ($M = 2.59$, $SD = 1.89$), whereas the lowest burdens were found in male teachers ($M = 1.60$, $SD = 1.52$). **Emotional exhaustion** was highest in teachers with two or more risk factors for a severe course of COVID-19 ($M = 3.33$, $SD = 1.80$) and lowest in teachers working in special needs schools ($M = 2.29$, $SD = 1.66$). The **pre/during pandemic change in emotional exhaustion** was biggest for teachers in primary schools ($M = 3.91$, $SD = 0.86$) and lowest for teachers in special needs schools ($M = 3.58$, $SD = 0.89$). **Depersonalization** was highest among teachers with two or more risk factors for a severe course of COVID-19 ($M = 1.47$, $SD = 1.82$) and lowest for teachers at special needs schools ($M = 0.79$, $SD = 1.34$). The **pre/during pandemic change in depersonalization** was biggest for teachers with two or more risk factors for a severe course of COVID-19 ($M = 3.39$, $SD = 0.83$) and lowest for teachers working in special needs schools ($M = 3.21$, $SD = 0.60$). The **anxiety of getting infected with SARS-CoV-2** was highest in teachers with two or more risk factors for a severe course of COVID-19 ($M = 67.52$, $SD = 26.52$), whereas members of the school management team showed the lowest anxiety ($M = 45.62$, $SD = 27.84$). The highest **anxiety of transmitting SARS-CoV-2 to others** was found in the first age quartile of teachers (18–30 years, $M = 75.10$, $SD = 24.42$), whereas the lowest anxiety was found in the fourth quartile of teachers (56–67 years, $M = 54.59$, $SD = 30.31$). The highest **anxiety of friends or loved ones becoming infected with SARS-CoV-2** was found in the first age-quartile of teachers (18–30 years, $M = 71.06$, $SD = 25.32$), and the lowest anxiety was found in male teachers ($M = 56.67$, $SD = 29.43$).

3.4.2. Subgroup Differences

The biggest differences in the mean values of **depression symptoms** were found when the number of risk factors for a severe course of a COVID-19 disease was used to divide into subgroups: $F(2, 21348) = 72.18$, $p < 0.001$, $\eta^2 = 0.007$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of depression symptoms for subgroups of risk factors. Mean values increased from no risk factor to

one risk factor (+0.28, 95%-CI[0.20, 0.35]) and no risk factor to two or more risk factors (+0.50, 95%-CI[0.37, 0.64]).

With regard to **generalized anxiety symptoms**, the biggest differences were found when divided into subgroups by gender: $F(2, 21470) = 228.17, p < 0.001, \eta^2 = 0.021$. Tukey's test revealed significant differences ($p < 0.05$) between mean values of generalized anxiety symptoms for subgroups by gender. Mean values increased from males to females (+0.58, 95%-CI[0.52, 0.64]) and from males to diverse (+0.50, 95%-CI[0.05, 0.94]).

The biggest differences in **emotional exhaustion** were found when divided into subgroups by gender: $F(2, 20937) = 111.92, p < 0.001, \eta^2 = 0.011$; and risk factors for a severe course of COVID-19: $F(2, 20788) = 114.19, p < 0.001, \eta^2 = 0.011$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of emotional exhaustion for males and females. Mean values increased from males to females (+0.44, 95%-CI[0.37, 0.51]). Since the effect-size for the differences between subgroups by gender was equal to subgroups by risk factors for a severe course of COVID19, Tukey's test was conducted too. Mean values of emotional exhaustion increased from no risk factor to one risk factor (+0.45, 95%-CI[0.36, 0.54]) and from no risk factor to two or more risk factors (+0.75, 95%-CI[0.58, 0.92]).

Regarding the **pre/during pandemic change in emotional exhaustion**, the biggest differences were found between teachers at different school types: $F(7, 18925) = 32.86, p < 0.001, \eta^2 = 0.012$. Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of the pre/during pandemic change in emotional exhaustion for teachers working in primary schools compared with other school types. Mean values from primary school to special needs school showed the biggest difference (-0.32, 95%-CI[-0.40, -0.25]). Mean values from primary school to secondary general school showed the second biggest difference (-0.22, 95%-CI[-0.37, -0.07]), followed by primary school to secondary school (-0.18, 95%-CI[-0.25, -0.10]), primary school to comprehensive school (-0.16, 95%-CI[-0.22, -0.10]), primary school to vocational school (-0.16, 95%-CI[-0.23, -0.89]) and primary school to other school (-0.16, 95%-CI[-0.25, -0.06]). The difference in mean values from primary school to academic secondary school (-0.09, 95%-CI[-0.14, -0.03]) was the smallest.

With respect to the level of **depersonalization**, school type was the subgroup division that showed the biggest differences: $F(7, 17866) = 12.44, p < 0.001, \eta^2 = 0.005$.

Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of depersonalization for teachers working in special needs schools compared with other school types. Mean values from special needs school to secondary school showed the biggest difference (+0.42, 95%-CI[0.25, 0.59]). Mean values from special needs school to comprehensive school showed the second biggest difference (+0.38, 95%-CI[0.23, 0.52]), followed by special needs school to vocational school (+0.36, 95%-CI[0.20, 0.52]), special needs school to secondary general school (+0.34, 95%-CI[0.06, 0.62]), special needs school to primary school (+0.30, 95%-CI[0.17, 0.43]) and special needs school to other school (+0.24, 95%-CI[0.04, 0.44]). The difference in mean values from special needs school to academic secondary school (+0.23, 95%-CI[0.09, 0.37]) was the smallest.

Differences in the **pre/during pandemic change in depersonalization** were greatest between teachers at different school types: $F(7, 18038) = 7.00, p < 0.001, \eta^2 = 0.003$. Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of the pre/during pandemic change in depersonalization in teachers working in special needs schools compared with other school types. Mean values from special needs school to vocational school showed the biggest difference (+0.13, 95%-CI[0.06, 0.20]). Mean values from special needs school to primary school showed the second biggest difference (+0.12, 95%-CI[0.06, 0.17]), followed by special needs school to secondary school (+0.09, 95%-CI[0.01, 0.16]), special needs school to comprehensive school (+0.08, 95%-CI[0.02, 0.14]) and special needs school to academic secondary school (+0.07, 95%-CI[0.01, 0.13]). The differences in mean values from special needs school to secondary general school and other school were non-significant.

The number of risk factors for a severe course of COVID-19 was the subdivision of teachers in which the **anxiety of getting infected with SARS-CoV-2** was most clearly visible: $F(2, 21291) = 295.14, p < 0.001, \eta^2 = 0.027$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of the anxiety of getting infected with SARS-CoV-2 for subgroups of risk factors. Mean values increased from no risk factor to one risk factor (+11.74, 95%-CI[13.16, 10.32]) and no risk factor to two or more risk factors (+17.85, 95%-CI[15.20, 20.49]).

The difference in the **anxiety of transmitting SARS-CoV-2 to others** was biggest between the four age-quartiles of teachers: $F(3, 21170) = 356.25, p < 0.001, \eta^2 = 0.048$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values

of the anxiety of transmitting SARS-CoV-2 to others for subgroups of age quartiles. Mean values decreased from 18–30 years to 31–43 years (-5.33 , 95%-CI $[-7.50, -3.16]$), 18–30 years to 44–55 years (-13.66 , 95%-CI $[-15.81, -11.52]$) and 18–30 years to 56–67 years (-20.51 , 95%-CI $[-22.74, -18.28]$).

Subgroup differences in the **anxiety of friends or loved ones becoming infected with SARS-CoV-2** were biggest between the four age-quartiles of teachers: $F(3, 21161) = 143.60$, $p < 0.001$, $\eta^2 = 0.020$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of anxiety of friends or loved ones becoming infected with SARS-CoV-2 for subgroups of age quartiles. Mean values decreased from 18–30 years to 31–43 years (-3.46 , 95%-CI $[-5.57, -1.35]$), 18–30 years to 44–55 years (-9.18 , 95%-CI $[-11.27, -7.09]$) and 18–30 years to 56–67 years (-12.57 , 95%-CI $[-14.75, -10.40]$).

3.5 Discussion

The present study aimed to (i) investigate the status quo of the psychological burdens of German teachers during the SARS-CoV-2 pandemic. Another goal was to analyze psychological burdens in particularly strained groups of teachers by (ii) identifying subgroups with higher risks. The results of this subgroup analysis may provide a basis for the development of evidence-based and subgroup-specific interventions for the treatment of psychological burdens in German teachers.

3.5.1. Level of Burdens and Comparisons Pre/during Pandemic and Teachers/General Population

During the SARS-CoV-2 pandemic in Germany, we detected comparatively high levels of psychological burdens of teachers. For example, comparing the depression symptoms (PHQ-2) of our teacher sample with those of a representative sample from the general population [6], female teachers ($M = 1.93$ vs. 1.24) and male teachers ($M = 1.72$ vs. 1.03) on average showed higher levels of burdens compared with females and males in the general population. The same pattern emerged when comparing the scores for generalized anxiety. In a comparison of our teacher sample with the aforementioned general population sample, female teachers ($M = 2.18$ vs. 1.19) and male teachers ($M = 1.60$ vs. 0.89) on average expressed higher levels of generalized anxiety (GAD-2) compared with the general population. Unfortunately, we had no

access to during-pandemic representative data from the general population containing diverse persons for our outcome variables; therefore, comparisons are restricted to a binary level here.

Since in our study we used a two-item solution to approximate MBI burnout, comparisons with other studies were difficult. It is still possible to show the direction of the perceived change pre/during the pandemic, since teachers were asked questions directly regarding the change in emotional exhaustion and depersonalization. Regarding emotional exhaustion, the presented results show that the mean values for the delta question in all subgroups ranged above the scale mean of three, pointing in the direction of increased emotional exhaustion since the beginning of the SARS-CoV-2 pandemic. The same holds true for depersonalization. Again, all mean values ranged above the scale mean, which indicated an increase in depersonalization during the course of the pandemic.

Regarding corona-associated anxieties, the best approximation for a comparison of our data with the general population data was possible for the questions used in our study, “How strong is your fear of being infected with the SARS-CoV-2 virus?” and “Please rate your anxiety about the coronavirus” (both 0–100), which was used by Jungmann and Witthöft [22]. The respective means were 51.58 (SD 28.20) and 47.18 (SD 27.12). Teachers showed higher mean values for corona-associated anxiety than the sample from the general population [22]. The comparison is weakened insofar as different wordings were used and the surveys were one year apart (March 2020 vs. 2021). We think it is still possible to carefully interpret the higher corona-associated anxiety that the teachers expressed during the pandemic, as the higher values here line up with the higher values for the other psychological burdens mentioned. The risk of getting infected with COVID-19 most likely was lower for teachers in Germany in 2020 (when strict pandemic mitigating measures in schools were applied) relative to the general population [28]. The perceived risk, however—and therefore a potential parameter in the psychological processes of the genesis of corona-associated anxieties—seems to have been higher in teachers. This accelerated risk perception may have been amplified due to a vivid debate in the media regarding the role of schools as drivers of the pandemic.

3.5.2. Subgroup Differences

After determining the absolute level of psychological burdens and comparing them to general population samples and pre-pandemic times, the next point of interest was the analysis of subgroup differences in the dependent variables.

As the ANOVA results demonstrated, there were many significant differences in the levels of depression symptoms (PHQ-2) in all the considered subgroups of teachers. However, the differences revealed were small in terms of the effect sizes. The most accentuated difference was seen when teachers were subdivided based on the number of risk factors for a severe course of COVID-19 ($\eta^2 = 0.007$). Most teachers did not have a risk factor for a severe course of COVID-19 (85.8%), which corresponded with fewer depression symptoms ($M = 1.84$, $SD = 1.41$) compared with having one risk factor ($M = 2.11$, $SD = 1.55$) or two or more ($M = 2.34$, $SD = 1.65$). Having risk factors was associated with more psychological burdens from depression symptoms. These included not only having to isolate oneself during the pandemic due to lockdown restrictions, but also having a severely increased risk of harm in case of an infection seemed to promote depression symptoms in teachers.

Regarding the symptoms of generalized anxiety (GAD-2), there were significant differences in all the considered subgroups of teachers. Subdivided by gender, the biggest effect on the symptoms of generalized anxiety was found ($\eta^2 = 0.021$). This is still considered a small effect. Female teachers showed the highest mean value ($M = 2.18$) in the GAD-2 scores, followed by diverse ($M = 2.09$) and male teachers ($M = 1.60$). The disproportional distribution we found in our teacher sample is in line with other studies showing that females have considerably higher lifetime (1:1.9) and 12-month (1:2.2) prevalence ratios for generalized anxiety disorders [29] than men.

The levels of emotional exhaustion differed significantly in all analyzed subgroups, except for the division in quartiles of age. This result is interesting insofar as the results from a pre-pandemic study indicate that there were age-related differences in psychological burdens, such as burnout, in teachers in Germany. The highest incidence of burnout was found in teachers in the range of 50–59 years of age (6.6%) and the lowest within 18–29 years of age (1.4%) [30]. It might be that the levels of burnout in the different age quartiles were “equalized” by the SARS-CoV-2 pandemic since it fundamentally disrupted and stressed the professional and private lives of teachers equally without sparing any age group. As in depression symptoms, the most accentuated difference in emotional exhaustion was found when teachers were subdivided based on the number of risk factors for a severe course of COVID-19 (η^2

= 0.011). Living a private life and working as a teacher during the pandemic while having a severely increased risk of harm in the case of an infection seemed to amplify the levels of emotional exhaustion in teachers. The mean values for emotional exhaustion support this perspective, since teachers with no risk factors showed the lowest ($M = 2.58$, $SD = 1.75$), teachers having one risk factor in the middle ($M = 3.03$, $SD = 1.80$) and teachers with or more than two risk factors had the highest ($M = 3.33$, $SD = 1.80$) levels of emotional exhaustion. Regarding the pre/during pandemic change in emotional exhaustion, subgroups of teachers subdivided by school type differed the most ($\eta^2 = 0.012$) compared with the other subdivisions conducted in the study. As stated earlier, different school types were affected differently by the impact of the pandemic. One can easily imagine how different a day of teaching in an elementary school, a special needs school, and an academic secondary school might look like under normal circumstances; add extensive anti-pandemic measures and COVID-19-related uncertainties for all persons involved, and the differences between school types are unlikely to shrink.

It was noticeable that the level of depersonalization (independent of subgroups) was far below the level of emotional exhaustion, even though the items used the same wording for the answers. This may be an indication that for teachers, having good and respectful contact with their students was important and that teachers were more prone to exhaust themselves emotionally than to become cynical about their students' needs. When assessing subgroup differences in depersonalization, only the subdivision by school management membership did not reveal significant differences. Depersonalization differed the most between school types ($\eta^2 = 0.005$). Teachers in secondary schools expressed the highest mean values for depersonalization ($M = 1.21$, $SD = 1.69$), and teachers in special needs schools expressed the lowest ($M = 0.79$, $SD = 1.34$). Explanations for differences in depersonalization between school types are difficult to derive. One possibility arose from the accompanying qualitative research (not all school types were included) that we conducted [31]. In this context, we talked to a group of teachers from a special needs school and were therefore able to cautiously formulate the hypothesis that the lower levels of depersonalization might be because most teachers in special needs schools are working in smaller classes and are likelier to medically supervise their students and therefore may have closer relationships with students, which might keep the level of depersonalization comparatively low. Regarding the pre/during pandemic change in depersonalization, no significant

differences in subdivision by number of persons in the household were found. All other ANOVAs showed significant subgroup differences, with the biggest effect for the subdivision by school type ($\eta^2 = 0.003$). Teachers from vocational schools reported the highest ($M = 3.34$, $SD = 0.69$) and teachers from special needs schools the lowest ($M = 3.21$, $SD = 0.60$) pre/during pandemic change in depersonalization. The line of potential explanation overlaps heavily with depersonalization. To avoid redundancies, this part is not repeated.

Before discussing the subgroup results for the three corona-associated anxieties considered (getting infected, infecting others, and infection of close people) independently, it is noticeable that subdividing by working schedule (full-time vs. part-time) did not reveal significant differences in any of them. The lesson learned from that is that, independent of how many hours teachers had to work in schools during the pandemic, the levels of corona-associated anxieties were the same. Unsurprisingly, regarding the anxiety of getting infected, when subdividing by the number of risk factors for a severe course of COVID-19, teachers with 2+ risk factors ($M = 67.52$, $SD = 26.52$) exceeded the level of anxiety of teachers with one ($M = 61.41$, $SD = 27.24$) or none ($M = 49.67$, $SD = 27.93$). We think that this result is self-explanatory because it is in line with a realistic risk perception. The effect size for this subgroup comparison exceeded the size of the others ($\eta^2 = 0.027$). The data regarding the anxiety of getting infected also showed that teachers working on the school management team were significantly less anxious compared with teachers who did not. This might be explained by the fewer hours school management team members have to spend in a classroom, where the risk perception may be more tilted toward a higher risk of infection. Another explanation could be that, by being responsible for the school and, therefore, the health of their employees and students, individual fears possibly faded from perception. The differences in the anxiety to infect others were most accentuated when subdividing by age quartiles ($\eta^2 = 0.048$). The same holds true for the anxiety of infections of close people here, too; by subdivision in age quartiles, the most accentuated group effects were found ($\eta^2 = 0.020$). For both anxieties, the subgroup differences considered had the same direction; that is, younger teachers reported higher levels of anxiety than their older colleagues. The decrease in anxiety about infecting others with age might be explained partly because teachers in their twenties are exposed to more risk contacts during leisure time compared with teachers who are close to retirement. The pattern that was harder to explain was a decrease in anxiety

regarding the infection of people close in age. A partial explanation might lie in the order of the questions since both questions were presented in the order used in this paper. When first asked about the level of anxiety of becoming a transmitter of the SARS-CoV-2 virus, the idea of being someone who could transmit the virus might have gotten primed. Being asked about the anxiety of close people getting infected next might have unconsciously included the idea of oneself being a potential transmitter.

What surprised us was the result that teachers in special needs schools showed lower levels of psychological burdens across all variables considered. Teaching in an environment that can be described as having smaller classes and a potentially higher focus on the individual needs of students might have buffered—at least to some extent—against the burdens of the pandemic. An alternative explanation for the lower psychological burdens of teachers working in special needs schools might be self-selection. Future studies should analyze the specific factors that made teaching in special needs schools during the pandemic less psychologically burdening.

Overall, the results of the ANOVAs conducted showed that, on the one hand, significant subgroup differences were detected; on the other hand, only small effect sizes regarding subgroup differences were found. Even the biggest effect size found in our study, subdivision by age regarding the corona-associated anxiety of transmitting an infection ($\eta^2 = 0.048$), should be considered small.

3.5.3. Limitations and Future Studies

The cross-sectional design of the present study limited its potential to describe and explain the emergence and change in the psychological burdens considered. Longitudinal monitoring of teachers' health in Germany is a goal that we were unable to achieve. The comparisons between teachers and the general population conducted in the present study relied on relatively short (pre-/during pandemic) periods of time. Therefore, it was not possible to identify long-term trends. With the cross-sectional design comes the heightened relevance of the specific timing of the survey. Our study took place during the “third wave of SARS-CoV-2” in Germany, when pandemic-mitigating measures were in place (“lockdown light”) to counter rising infection numbers and a—at the time—relatively new and easier-to-spread virus variant of concern (B.1.1.7) [32]. This context might have exacerbated risk perception and led to

the amplified psychological strains we detected. Since teachers in Germany are predominantly female, there is a gender imbalance in our sample with females (77.5%) outweighing males (22.0%) and diverse persons (0.4%). Another limiting factor regarding comparisons with other studies was the lack of data for diverse persons, since the availability of such data was—and still is—limited.

3.6 Conclusions

Our research can serve as a base for future studies, since it provides a broad-scale (N = 31,089) actual statement on the mental health of teachers in Germany. Furthermore, our subgroup analysis revealed details about which groups of teachers were especially burdened in different dimensions of mental health. By these attributes, our data offer considerable help to derive evidence-based interventions for teachers' most relevant mental health challenges—tailored to specific subgroups.

To conclude, we share our thoughts regarding the question: What are the lessons learned? As our comparisons with the general population indicated, teachers in Germany showed relatively high levels of psychological burdens, which most likely were amplified during the SARS-CoV-2 pandemic. Additionally, the results of our study indicate that psychological burdens in teachers were unevenly distributed among subgroups. Therefore, it is worth diving deep into subgroup analysis and identifying especially vulnerable subgroups of teachers to enable deriving interventions that extinguish fire where it burns the brightest. To name a few, teachers with risk factors for a severe course of COVID-19 should receive special attention and support, given their elevated burdens on mental health. Since teachers working at special needs schools showed lower levels of psychological burdens than teachers at other school types, differing structural elements that promote mental health should be identified (e.g., fewer students per teacher) and transferred to other school types. More depression symptoms in younger teachers, compared with their older colleagues, indicate that countermeasures, such as offers for counselling or training in relaxation techniques, could be useful and appropriate for addressing threats to their mental health. However, in addition to specific pandemic-related psychological stresses, the classic occupational health challenges of physical, biological, and chemical burdens and their resulting strains should not be disregarded. We encourage political decision makers to take these results seriously and derive interventions accordingly. We are

open to supporting such interventions with the best of our study results and knowledge. Psychologically burdened teachers are not only feeling human beings who deserve help to mitigate their suffering, they are the providers of valuable resources for a prospering future well-socialized and educated children.

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4 THIRD STUDY

Implementation of occupational safety and health measures at German schools during the SARS-CoV-2 pandemic – cross-sectional results from 31,089 teachers

Reference

Koestner, C., Eggert, V., Dicks, V., Beutel, T., Kalo, K., Zähme, C., Letzel, S., Dietz, P. (2022). Implementation of occupational safety and health measures at German schools during the SARS-CoV-2 pandemic – cross-sectional results from 31,089 teachers. [Manuscript submitted for publication].

4.1 Abstract

Background: The SARS-CoV-2 pandemic exacerbated existing health-related challenges in schools and created new ones. Under pandemic conditions, health risks increased, and with them the requirements for occupational safety and health (OSH) measures. The aim of the study was a) to examine the status quo of OSH measures in German schools, b) to analyze whether the implementation of OSH measures was associated with preferable outcomes and c) to identify predictors for the implementation of OSH measures. **Methods:** A nationwide cross-sectional online survey was conducted among teachers at all school types in Germany in March 2021. Data on the implementation of OSH measures (risk assessments, infection protection instructions and instructions on occupational safety), associated health-related parameters (e.g., somatic symptoms, PHQ-15) and predictor variables (e.g., gender, age or federal states) were assessed using descriptive statistics, analysis of variance and multiple linear regression analysis. **Results:** Less than 10% of surveyed teachers (N = 31,089) reported that their schools met legal requirements for occupational safety and health measures. Beneficial associations became apparent where more measures were implemented, e.g., significantly better somatic and mental health. Predictors for the implementation of OSH measures were found, especially on a systemic level (e.g., federal states schools were located in). **Conclusions:** Our study can serve as a basis for future studies. It provides a status quo regarding the implementation of, associations with and predictors for OSH measures in German schools. Our results are best understood as evidence-based arguments to encourage political decision makers to improve the implementation of OSH measures in German schools and thereby foster teachers' health.

Keywords: occupational safety and health, schools, teachers, SARS-CoV-2, COVID-19

4.2 Background

From March 2020, about 1.5 billion students worldwide as well as their teachers were absent from schools as a result of extensive measures to mitigate the spread of SARS-CoV-2 (Suhr, 2020). Due to school closures, many teachers were forced to teach their classes entirely by using digital tools for the first time in their career. In addition to the required changes during school closures, in periods of open schools, there was a multitude of measures to mitigate the spread of SARS-CoV-2 that affected teachers' work and private lives by expanding and complicating tasks. Together with new burdens in the private life, the amount of - often abrupt - changes in teachers' day-to-day working life demanded a lot of adjustments and adaptations, which increased mental health risks for teachers, e.g., regarding burnout (Koestner et al., 2022; Pressley, 2021). This result is in line with an overall increase in depressive symptoms and generalized anxiety in the general population in Germany (Bäuerle et al., 2020; Beutel et al., 2021). Not only did the aforementioned mental health problems increase, new ones, like anxieties associated with SARS-CoV-2, emerged (Jungmann & Witthöft, 2020; Biermann et al., 2021). In addition to that, Lizhi (2021) reported impactful changes due to the pandemic (e.g., isolation) and high levels of somatic health issues among teachers.

Targeting teachers' health is highly relevant from a public health point of view since teachers are a huge occupational group in Germany (between 800,000 and 900,000) and responsible for the education of approximately 10,000,000 students, which amplifies their relevance even further (KMK, 2022). Given the aforementioned elevation and changes of health risks under pandemic conditions, the relevance for occupational safety and health (OSH) measures - such as (1) risk assessments, (2) infection protection instructions or (3) instructions on occupational safety - increased, not only in schools. OSH measures in German schools a) impact the whole school-workforce, while b) the implementation of these measures is initiated by the school management team. The school management teams act in place of the employer in German schools and are therefore responsible to assure the fulfilment of OSH measures. Accordingly, these organizational layers should be considered separately. Before broaching the issue of background information and legal details regarding OSH measures in Germany, the terminology used in this paper should be clarified. The International Labour Organization (ILO) defines the term "*hazard*" as "*the inherent*

potential to cause injury or damage to people's health". "Risk" in this framework is "a combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event". "Risk assessment" consequently is the "process of evaluating the risks to safety and health arising from hazards at work" (ILO, 2001).

In the course of a **risk assessment**, a structured survey, documentation and evaluation of environmental conditions that represent a possible hazard for employees have to be conducted. It is a basis for the systematic and effective management of OSH. All employers in Germany are legally obliged to conduct risk assessments in accordance with the *Act on the Implementation of Measures of Occupational Safety and Health to Encourage Improvements in the Safety and Health Protection of Workers at Work*, Section 5 (German: Arbeitsschutzgesetz, §5). Given the non-voluntary nature of risk assessments in Germany, it may be surprising that in 2013 only 51% of surveyed companies reported to have conducted risk assessments (GDA, 2013). Along the same line are results from another study in which only 22% of companies reported to have conducted a risk assessment that explicitly took mental strains into account (Rothe, 2017). These studies reveal a huge gap between legal obligations and their implementation in German companies. To the best of our best knowledge, there is no systematic nationwide data regarding the implementation of risk assessments in German schools. Only for defined regions there is some school related data on risk assessments available, which points into the same direction as mentioned for companies. A survey conducted in the German state of Rhineland-Palatine revealed that only 28.1% of teachers stated that risk assessment took place at their school (Letzel et al., 2019). Therefore, research regarding the nationwide status quo of risk assessment at schools was much needed, since work-related hazards and risks changed or emerged since the outbreak of the SARS-CoV-2 pandemic, while at the same time somatic and mental health strains of teachers increased, as described above.

Since COVID-19 is an infectious disease, the measure of **infection protection instructions** became more important during the SARS-CoV-2 pandemic for obvious reasons. In Germany, these infection protection instructions were obligatory for employers even before the SARS-CoV-2 pandemic and are defined in the *German Infection Protection Act* (German: Infektionsschutzgesetz, IfSG). Little is known regarding the implementation at schools. To our best knowledge there is no data

published regarding this topic. In this sense, the SARS-CoV-2 pandemic could act as a driving force to change this lack of knowledge.

For **instructions on occupational safety** too, employers in Germany are legally obliged to conduct this measure in accordance with the *Act on the Implementation of Measures of Occupational Safety and Health to Encourage Improvements in the Safety and Health Protection of Workers at Work*, Section 12 (German: Arbeitsschutzgesetz, §12). The law requires that instructions on occupational safety include directives and explanations that are specifically tailored to the workplace or the employee's area of responsibility. The instruction on occupational safety must take place when the employee is hired, in the event of changes in the scope of duties, when new work equipment or a new technology is introduced – before the employee starts work. The instruction must be adapted to the development of hazards and, if necessary, repeated regularly. Study results from Germany showed that 80.5% of surveyed managers or persons responsible for OSH in companies stated that they had instructed their employees in occupational safety (NAK, 2017). In contrast to that, there was a lack of knowledge regarding the implementation of this measure in German schools.

The focus on these three specific OSH measures for the school setting during pandemic times was derived out of a mutual selection process with experts from the German Federal Institute for Occupational Safety and Health (BAuA) and the Institute of Occupational, Social and Environmental Medicine, University Medical Center of the University of Mainz, Germany. Therefore, for these three a priori selected OSH measures, data has been collected in a nationwide survey on teachers in Germany (Koestner et al., 2022). Another straightforward reason for the relevance of these specific measures is, that the legislator decided to make them obligatory, which implies a broad applicability and impact for public health.

Given the absence of school-related data on the impact of these measures, especially during pandemic conditions, the aforementioned justification of the relevance of the selected OSH measures by experts and lawmakers was the rational starting point for our research. Still, this justification can and should be tested empirically by analyzing associations with and predictors for OSH measures, which could help to prove their actual relevance. Due to the lack of literature regarding associations with health outcomes and predictors for the implementation of OSH measures in German schools, an explorative approach seemed to be suitable to close this gap.

Therefore, the aim of the present study was a) to examine the status quo of OSH measures in German schools, b) to analyze whether the implementation of OSH measures was associated with preferable outcomes and c) to identify predictors for the implementation of OSH measures. This may enable us to formulate recommendations on how to raise the level of implementation of OSH measures in German schools.

4.3 Methods

Procedure and Study Sample

Between March 1st and March 31st, 2021, teachers from all federal states in Germany were invited to participate in an online survey. The participants were recruited in cooperation with governmental (Ministry of Education in Rhineland-Palatinate) and non-governmental institutions (e.g., Education and Science Workers' Union), teacher-related societies (German Teachers Association), and projects associated with education (Monitor Lehrerbildung). There was a non-monetary incentive (EUR 2000.00 donation to the German Children's Fund) to foster the willingness to participate. Informed written consent was obtained at the beginning of the online survey. The ethical committee of the Medical Association of Rhineland-Palatinate approved the study before it was conducted (application number: 2020-15531).

Questionnaire and Measures

Participants completed an online questionnaire with approximately 350 items (presented in the survey tool LimeSurvey), covering a wide range of topics, which were arranged under the following categories: (1) sociodemographic and workplace information; (2) identification of SARS-CoV-2-specific stresses and challenges in schools for teachers; (3) implementation, communication, and compliance with hygiene policies/plans, both general and school-based; (4) impact of school operations during the SARS-CoV-2 pandemic on teachers; and (5) collection of best practices for infection protection and the implementation of the educational task during the pandemic. Before being applied in the present study, the questionnaire was pretested and revised in three steps. In the first step, experts from the Institute for Teachers' Health and the Institute for Occupational, Social and Environmental Medicine of the University Medical Center Mainz answered and commented on the questionnaire. In

the second step, after revising the questionnaire, we invited teachers to take part in a comprehensive probing for the exact understanding of and associations with all items. We did this to ensure that the items were understood in the way we intended or were otherwise able to collect suggestions for (mostly minor) linguistic adaptations. In the third step, after the probing, the whole questionnaire was revised again, and our team conducted a final (linguistic and grammatical) quality check to eliminate final flaws (e.g., typing errors).

Dependent Variables

Occupational safety and health measures

The items regarding the school-related implementation of OSH measures were self-designed. Risk assessment was measured by the item *“Has a risk assessment already been carried out at your school?”* (“yes”, “no”, “do not know”). Infection protection instructions were measured by the item *“How long has it been since your last infection prevention training?”* (“< 1 year”, “1-2 years”, “2-3 years”, “3-5 years”, “5-10 years”, “>10 years”, “never participated”, “do not know”). Instructions on occupational safety were measured by the item *“Did briefings on special hazards take place due to the COVID 19 pandemic?”* (“yes”, “no”, “do not know”). For further analysis, the responses to all three questions were condensed to the scale “Implementation of OSH measures” ranging from 0 to 3. For this purpose, answers to the three questions were dichotomized into “fulfilled” (= 1) and “not fulfilled” (= 0) before being accumulated into the OSH scale. Requirement fulfilled was defined as “yes” for the items on risk assessment and instructions on occupational safety and “< 1 years” or “1-2 years” for the item on infection protection instructions, since these two answers comply with the legal requirements. A Principal Component Analysis (PCA) including the three aforementioned OSH measures was calculated to check if they load on more than one component. The Kaiser-Meyer-Olkin value for the PCA was .58 and the Bartlett-test was significant, $p < 0.001$, so both requirements were sufficiently met. One component was extracted with loadings of .72 (instructions on occupational safety), .70 (infection protection instructions) and .62 (risk assessments), therefore the OSH scale was used for further analysis.

Mental health and psychological conditions in the workplace

The following variables were used as dependent variables in research question b) and as candidates for independent variables in research question c).

Participants were asked to complete the validated German version of the Patient Health Questionnaire 4 (PHQ-4; Löwe et al., 2010), an established instrument for the combined screening for symptoms of depression (PHQ-2; Kroenke, Spitzer, & Williams, 2001) and generalized anxiety disorder (GAD-2; Spitzer, Kroenke, Williams, & Löwe, 2006), ranging from 0 to 12. To measure COVID-19-associated anxiety, participants rated the item *“How strong is your fear of being infected with the SARS-CoV-2 virus?”* on a scale from 0 (no anxiety) to 100 (powerful anxiety). We were given permission to use the item, which had also been used in other studies (Jungmann & Witthöft, 2020; Biermann et al., 2021). Job satisfaction was measured by a single item *“Overall, how satisfied are you with your work situation?”* (*“not at all”, “not very much”, “quite a bit”, “very much”, “extremely”*), ranging from 1-5. The item was created by the Institute for Teachers’ Health, University Medical Center of the Johannes Gutenberg University of Mainz and is frequently used. To measure meaning of work, the item *“Is your work meaningful?”* (*“to a very large extend”* to *“to a very small extend”*) was taken from the validated German version of the Copenhagen Psychological Questionnaire (COPSOQ III, Lincke et al., 2021). A self-created item was used to measure work-related health concerns during the pandemic. The item was *“I am concerned about my health at the prospect of working in my school/office during the COVID-19 pandemic.”* (*“don’t agree at all”, “rather disagree”, “partly”, “agree rather”, “fully agree”*), ranging from 1-5.

Somatic symptoms

Somatization symptoms were assessed with the German version of the PHQ-15 (Kroenke et al., 2002; Löwe et al., 2002) ranging from 0-30. The PHQ-15 covers the most prevalent somatic symptoms for somatization disorder as defined in the Diagnostic and Statistical Manual of Mental Disorders, DSM-IV (APA, 2000).

Independent variables

Given the research gap regarding the prediction of OSH measures in schools, the selection of predictor variables was method-guided. The starting point for the selection process included all items of the online-survey. To reduce the number of potential predictor variables, we first excluded all items containing information which a priori was non-relevant for the prediction of OSH measures (e.g., pseudonymization-code, information about the recruitment process or best practices examples for the implementation of educational tasks) and redundant items (e.g., implementation of the OSH measures or school management affiliation, see statistical analysis section for more details). For the remaining 243 scales and items, a correlation matrix was calculated. Scales or items where the Pearson correlation with OSH measures was above the predefined cut-off value of $r > 0.1$ (representing a small correlation regarding to Cohen, 1988) were selected, resulting in 32 variables that qualified as independent variables for a multiple regression analysis on OSH measures.

Statistical Analysis

Descriptive statistics were calculated a) to examine the status quo of the implementation of OSH measures in German schools. Analysis of variance (ANOVA) were calculated b) to analyze whether the implementation of OSH measures was associated with somatic and psychological health outcomes. Linear multiple regression was calculated c) to identify predictors for the implementation of OSH measures.

For analysis a) and b), the total sample (teachers and school management members) was used. For analysis c), the prediction of the implementation of OSH measures, a subsample of school management members only was used, because the legal responsibility for implementation OSH measures in German schools is with them. Statistical analysis was performed using SPSS Statistics Version 27 (IBM, Armonk, NY).

4.4 Results

Overall, 39,359 teachers from all federal states and school types in Germany participated in our survey. After data cleansing, a sample of $N = 31,089$ was used for further analyses. 77.5% of the participants were female, the mean age was 45.8 years (SD: 10.5). Detailed sample characteristics are displayed in Table 1.

Table 1 Sample characteristics.

Subgroups	Total sample (teachers & school management)			Subsample (school management only)		
	<i>n</i>	%	<i>M (SD)</i>	<i>n</i>	%	<i>M (SD)</i>
Gender	31,089	100%		3290	100%	
Female	24,099	77.5%		2451	74.5%	
Male	6851	22.0%		832	25.3%	
Diverse	139	0.4%		7	0.2%	
Age (years) ^a	31,089	100%	45.78 (10.46)	3290	100%	49.82 (8.85)
18–30	2473	8.0%		49	1.5%	
31–43	10,957	35.2%		775	23.6%	
44–55	10,799	34.7%		1488	45.2%	
56–67	6860	22.1%		978	29.7%	
Work schedule ^b	30,959	100%		3279	100%	
Part-time	12,297	39.7%		602	18.4%	
Full-Time	18,662	60.3%		2677	81.6%	
School type ^c	28,233	100%		3000	100%	
Primary	9030	32.3%		1389	46.3%	
Secondary general	539	1.9%		43	1.4%	
Secondary Academic secondary	2162	7.7%		203	6.8%	
Comprehensive	5451	19.5%		363	12.1%	
Special needs	4016	14.4%		313	10.4%	
Vocational	2969	9.6%		291	9.7%	
Other	2699	9.7%		236	7.9%	
Other	1367	4.9%		162	5.4%	
Federal State ^c	30,792	100%		3,252	100%	
Baden-Württemberg	5935	19.3%		719	22.1%	
Bavaria	913	3.0%		96	3.0%	
Berlin	2496	8.1%		193	5.9%	
Brandenburg	903	2.9%		66	2.0%	
Bremen	431	1.4%		44	1.4%	

Hamburg	1374	4.5%	83	2.6%
Hesse	2994	9.7%	298	9.2%
Lower Saxony	3430	11.1%	331	10.2%
Mecklenburg- Vorpommern	488	1.6%	53	1.6%
North Rhine- Westphalia	5520	17.9%	544	16.7%
Rhineland Palatinate	2839	9.2%	417	12.8%
Saarland	216	0.7%	19	0.6%
Saxony-Anhalt	370	1.2%	41	1.3%
Saxony	985	3.2%	84	2.6%
Schleswig-Holstein	1328	4.3%	201	6.2%
Thuringia	570	1.9%	63	1.9%

^a age in years is displayed in quartiles. ^b Reflects the number, percentage, and mean values of participants answering the questions. The number of participants (*n*) may differ between items because responding was voluntary, therefore not all participants answered all items. ^c Multiple responses and skipping items were possible, only participants with exactly one school type or federal state selected were included.

Status quo of occupational safety and health measures in German schools

Regarding our first research question, the status quo of OSH measures in German schools, only 8.3% of the participants reported that all three OSH measures were implemented. More than a third (36.6%) reported the implementation of none of the measures. For more details see Figure 1.

Implemented OSH measures in German schools

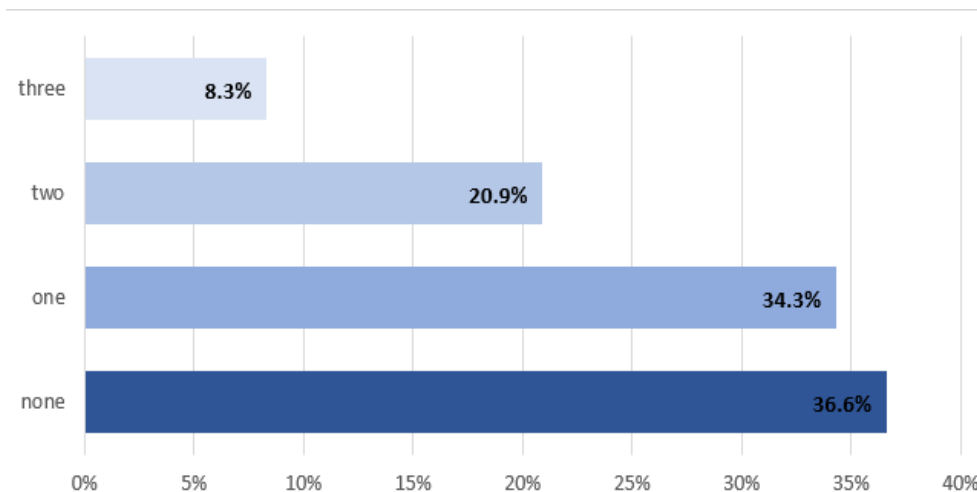


Figure 2 Distribution of the implementation of occupational safety and health measures in German schools during the SARS-CoV-2 pandemic in March 2021.

When analyzing the OSH measures separately, the majority (76.2%) of the surveyed teachers stated that no risk assessment had been conducted at their school. Similarly, 67.1% of the teachers stated that infection protection instructions had not been carried out within the last two years. Regarding the implementation of instructions on occupational safety due to the SARS-CoV-2 pandemic, 55.8% of the teachers answered that they did not receive any.

Health related associations with OSH measures in schools

Regarding associations with somatic and psychological outcomes, our analysis revealed that teachers working at schools with a better implementation of OSH measures significantly differed from those working in schools with less implementation. ANOVA results can be found in Table 2.

Table 2 Health related associations with OSH measures

Variable	Somatic symptoms ^a	Depression & generalized anxiety ^b	Corona associated anxiety ^c	Health concerns ^d	Satisfaction with work ^e	Meaning of work ^f	
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	
Implemented OSH measures	0	9.30 (5.08)	4.22 (2.94)	53.93 (28.22)	3.59 (1.24)	2.61 (0.86)	75.58 (21.15)
	1	9.01 (5.05)	3.95 (2.85)	51.51 (28.06)	3.44 (1.26)	2.69 (0.86)	77.03 (20.00)
	2	8.75 (4.97)	3.70 (2.74)	49.79 (27.90)	3.30 (1.25)	2.79 (0.86)	78.39 (19.36)

	3	8.23 (5.01)	3.25 (2.71)	46.49 (28.37)	3.06 (1.27)	2.93 (0.85)	81.01 (19.10)
F	§	24.14***	70.89***	43.82***	112.50***	100.90***	48.84***
	η^2	0.004	0.010	0.006	0.016	0.012	0.006

^a Patient Health Questionnaire-15 (lower is better), ^b Patient Health Questionnaire-4 (lower is better), ^c Corona associated anxiety of getting infected with SARS-CoV-2 (lower is better), ^d health concerns regarding working in school during the pandemic (lower is better), ^e satisfaction with work (higher is better), ^f meaning of work (higher is better), ^g * p -value < 0.05, ** p -value < 0.01, *** p -value < 0.001, F = F-value, η^2 = Eta squared, degree of freedom = 3 for all ANOVAs.

Significant differences in the mean values of somatic symptoms were found when the number of implemented OSH measures was used to divide into subgroups: $F(3, 19384) = 24.15$, $p < 0.001$, $\eta^2 = 0.004$. A similar pattern was found in the mean values of symptoms for depression and generalized anxiety when the number of implemented OSH measures was used to divide into subgroups: $F(3, 21277) = 70.89$, $p < 0.001$, $\eta^2 = 0.010$. The corona associated anxiety of getting infected with COVID-19 also differed significantly when the number of implemented OSH measures was used to divide into subgroups: $F(3, 21322) = 43.82$, $p < 0.001$, $\eta^2 = 0.006$. Regarding health concerns too, significant differences were found when the number of implemented OSH measures was used to divide into subgroups: $F(3, 21429) = 112.50$, $p < 0.001$, $\eta^2 = 0.016$. Significant differences in satisfaction with work were found when the number of implemented OSH measures was used to divide into subgroups: $F(3, 24196) = 100.90$, $p < 0.001$, $\eta^2 = 0.012$. For the meaning of work too, significant differences were found when the number of implemented OSH measures was used to divide into subgroups: $F(3, 24174) = 48.84$, $p < 0.001$, $\eta^2 = 0.006$.

Predictors for the implementation of OSH measures in schools

Of the 32 independent variables that met the requirement ($r > 0.1$) to be included into the multiple linear regression model, 18 significantly predicted the number of implemented OSH measures. The R^2 for the regression model was 0.17 and the adjusted R^2 was 0.15, indicative for a moderate goodness-of-fit according to Cohen (1988). The independent variables included in the regression model were able to statistically significant predict the implementation of OSH measures, $F(30, 1107) = 7.67$, $p < 0.001$. Requirements for the conduction of a multiple linear regression analysis were tested and met. Neither multicollinearity, heteroscedasticity nor auto-correlation were problematic (Durbin-Watson statistic was

1.68). Detailed information regarding the predictive value and significance of the independent variables can be found in Table 3.

Table 3 Significant predictors of occupational safety and health measures

Dependent variable: Number of OSH measures

Coefficients	<i>B</i>	SE	β	<i>t</i>	<i>p</i>	95% CI	
						<i>LL</i>	<i>UL</i>
(constant)	0.38	0.26		1.45	0.15	-0.13	0.89
Age (quartiles)	0.10	0.04	0.07	2.40	0.02	0.02	0.17
Work schedule ^a	0.20	0.08	0.07	2.55	<0.01	0.05	0.35
Concept for digital teaching ^b	0.14	0.02	0.17	5.70	<0.001	0.09	0.19
Feedback ^c	0.11	0.04	0.08	2.88	<0.001	0.04	0.19
Depression symptoms ^d	-0.05	0.02	-0.06	-2.11	0.04	-0.09	0.00
Health concerns ^e	-0.06	0.03	-0.07	-2.39	0.02	-0.11	-0.01
Self-care during pandemic ^f	0.08	0.03	0.07	2.50	<0.01	0.02	0.13
School Type ^g							
Academic secondary	-0.33	0.09	-0.11	-3.66	<0.001	-0.51	-0.15
Comprehensive	-0.34	0.10	-0.10	-3.46	<0.001	-0.53	-0.15
Special needs	0.27	0.10	0.08	2.61	<0.01	0.07	0.47
Federal State ^g							
Brandenburg	0.69	0.23	0.09	2.97	<0.001	0.24	1.15
Lower Saxony	0.34	0.12	0.10	2.88	<0.001	0.11	0.58
Mecklenburg-Vorpommern	0.97	0.23	0.12	4.30	<0.001	0.53	1.41
North Rhine-Westphalia	0.32	0.10	0.12	3.32	<0.001	0.13	0.52
Rhineland Palatinate	0.30	0.10	0.10	2.85	<0.001	0.09	0.50
Saxony-Anhalt	0.61	0.26	0.07	2.32	0.02	0.09	1.13
Saxony	1.06	0.20	0.16	5.36	<0.001	0.67	1.44
Thuringia	0.67	0.21	0.09	3.23	<0.001	0.26	1.08

^a Work schedule: 1 = full time / 0 = part time, ^b Item: “Your school / office has a standardized overall concept for the implementation of digital teaching”, ^c COPSOQ III - Feedback (2-item scale), ^d Patient Health Questionnaire-2 (2-item scale), ^e Item: “I am concerned about my health at the prospect of working in my school / office during the COVID-19 pandemic.”, ^f Item: “I feel like I can actively do something positive for myself in this COVID-19 pandemic”, ^g Multiple responses were possible; only participants with exactly one selected federal state / school type were analyzed. Only significant predictors are reported (p-value < 0.05). Non-significant federal states (Baden-Württemberg, Bavaria, Berlin,

Bremen, Hamburg, Hesse, Saarland, Schleswig-Holstein) and school types (primary, secondary general, secondary, vocational, other) were excluded.

The variables with the highest positive beta-coefficients for the implementation of OSH measures in German schools were, existence of a concept for the implementation of digital teaching ($\beta = 0.17$, $p < 0.001$) followed by the federal states Saxony ($\beta = 0.16$, $p < 0.001$), Mecklenburg-Vorpommern ($\beta = 0.12$, $p < 0.001$) and North Rhine-Westphalia ($\beta = 0.12$, $p < 0.001$). The variables with the highest negative beta-coefficients for the implementation of OSH measures in German schools were the school types academic secondary school ($\beta = -0.11$, $p < 0.001$), comprehensive school ($\beta = -0.10$, $p < 0.001$), health concerns ($\beta = -0.07$, $p = 0.02$) and depression symptoms ($\beta = -0.06$, $p = 0.04$).

4.5 Discussion

The present study aimed a) to examine the status quo of OSH measures in German schools, b) to analyze whether the implementation of OSH measures was associated with preferable outcomes and c) to identify predictors for the implementation of OSH measures. Regarding all three aims - to our best knowledge - there were research gaps to be filled. Therefore, we were very interested to close these gaps.

With regard to the first aim, our results show that OSH measures were implemented insufficiently in German schools. Less than 10% of the teachers in our sample reported that their schools met the legal requirements for all three studied OSH measures. Especially during a global pandemic, it was a shocking result that the majority of schools did not have conducted risk assessments (76.2%), infection protection instructions (61.1%) or instructions on occupational safety (55.8%). Schools seemed to perform worse regarding the implementation of OSH measures, when data on the proportion of companies that had not carried out risk assessments (49%) or instructions on occupational safety (19.5%) is used for comparison (GDA, 2013; NAK, 2017).

Concerning the second aim, arguments can be derived from our study results. OSH measures are not an end in themselves to meet legal requirements. The results of several ANOVAs revealed desirable associations of the implementation of OSH measures with health-relevant outcomes. In schools with a better implementation of OSH measures, teachers showed significantly less somatic and psychological burdens (e.g., lower PHQ-15 and PHQ-4 scores) and significantly higher levels of satisfaction

with and meaning of work (Table 2). Due to the exploratory nature of our study, it was not possible to draw on previous data to compare the sizes of effects we obtained. It should be noted that the biggest effect size found in our study was $\eta^2 = 0.016$ (health concerns), so from a statistical point of view the reported effect sizes should be considered as small regarding to Cohen (1988). Still, we can give the cautious recommendation to foster the implementation of OSH measures in schools in order to promote the somatic and psychological health of teachers.

Referring to our third aim, the identification of predictors for the implementation of OSH measures in German schools, the best predictor variables were existing concepts for the implementation of digital teaching and federal states (Saxony, Mecklenburg-Vorpommern and North Rhine-Westphalia) in which the schools were located in. The provision of concepts for implementing digital teaching in schools is, at least to some extent, within the responsibility of the individual federal states. Since each state in Germany has the freedom and responsibility to shape its education system, it seems worthy and is therefore recommended to take a closer look at what is being done differently in the states with better implementation of OSH measures to be able to transfer knowledge. Overall, it became evident, that out of the big number of potential predictor variables for OSH measures in our survey (243 scales and items), systemic influences (e.g., federal states) were more important for the prediction of the implementation of OSH measures relative to individual factors (e.g., gender or age). Nevertheless, it should be kept in mind that the proportion of variance explained (around 15%) by the variables we examined signals that there are other influences for which we had no data to detect them. Still, our results suggest that necessary improvements of OSH measures in German schools should include actions targeting the aforementioned systemic level to ensure that the somatic and psychological wellbeing of teachers in Germany can be sustained and promoted.

One potential limitation of our study might have been, that information regarding the implementation of OSH measures was collected on the basis of self-reports. It is possible, that measures - e.g., risk assessments - had been implemented without all surveyed teachers in a school being aware of it. This might have led to an underestimation of the number of implemented OSH measures. Another potential limitation might have been, that the survey took place during the “third wave of SARS-CoV-2” in Germany, while infection numbers were rising rapidly and a new virus variant of concern (B.1.1.7) was spreading (RKI, 2021). The acute need to implement

infection control measures or distance learning in schools may have influenced the self-selection of study participants. Consequently, it might have been the case that only those teachers with still available capacities participated. It is unknown whether teachers and school management teams that did not participate in our study (e.g., due to high workloads) would have reported different implementation rates of OSH measures or characteristics in other items, compared to the sample analyzed in our study. Finally, it should be addressed that the cross-sectional design of our study limited the possibility to draw conclusions about the direction of causality. As an alternative to our interpretations, it could also have been that schools which were overall better organized also implemented more OSH measures and - independently of their effects - offered better organizational conditions for teachers' somatic and psychological health.

Conclusion with focus on practical recommendations

Regarding scientific implications, our study may represent the basis for future studies, since it provides a broad-scale (N = 31,089) actual status quo regarding the implementation of, associations with and predictors for OSH measures in German schools. Due to the fact, that the operative responsibility for implementing OSH measures lies with the school management, in depth data at this organizational level would be a useful extension of the approach used in our study. In addition, a broader range of data is needed to explain relationships with OSH measures in schools, since only a fraction (15%) of the variance could be explained by the variables we were able to use in our regression model. For example, it could be a promising direction to analyze whether schools that are better-funded, better-managed or have lower teacher to student ratios are systematically conducting more OSH measures. With additional data, it might be possible that the differences and associations that became apparent in our study, could be (partially) explained or moderated by other variables. Regarding the detection of causal links and to increase granularity, experimental study designs, such as a random assignment of schools to a group where specific OSH measures are conducted (e.g., risk assessments) compared to schools where the measures are not (or later) carried out, represent a feasible way to be able to determine concrete contributions of individual measures in a more finely resolved manner.

With respect to practical implications, our study demonstrated that teachers working in schools with better implementation of OSH measures showed less somatic and psychological burdens and higher satisfaction with and meaning of work. This is why we do hope that our results are understood as evidence-based arguments to encourage political decision makers to improve the implementation of OSH measures in German schools and thereby foster teachers' health. One possible way to achieve this goal could be the providence of wide spread information on why (health benefits & legal obligations) as well as practical guidelines on how to perform OSH measures to teachers and school management teams. Since all OSH measures analyzed in this study are already legally obligatory in Germany, the assurance of their implementation by monitoring combined with reminders or potential sanctions (in case of non-compliance) might be a feasible adjuvant way to increase awareness. Overall, a goal worth achieving and useful framing for the implementation of OSH measures in schools should be the creation of working environments that sustain and foster teachers' health, with expectable benefits not only for them, but also for their students.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethical Committee of the Medical Association of Rhineland-Palatinate before it was conducted (application-number: 2020-15531).

Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Conflicts of Interest: The funder and other parties had no influence on study design, data collection and analysis, presentation and interpretation of the results or the present manuscript.

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5 FOURTH STUDY

Bewertung und Folgen der SARS-CoV-2-Infektionsschutzmaßnahmen an Schulen

Ergebnisse von Fokusgruppen-Befragungen unter Lehrkräften in Deutschland

Reference

Dietz, P., Kalo, K., Zähme, C., Dicks, T., Beutel, T., Eggert, V., Letzel, S., Köstner, C. (2022). Bewertung und Folgen der SARS-CoV-2-Infektionsschutzmaßnahmen an Schulen. Ergebnisse von Fokusgruppen-Befragungen unter Lehrkräften in Deutschland. In *ASU Arbeitsmedizin Sozialmedizin Umweltmedizin* (Vol. 2022, Issue 04, pp. 242–248). Alfons W. Gentner Verlag GmbH & Co. KG. <https://doi.org/10.17147/asu-1-182156>

5.1 Abstract

Introduction: In order to stem the spread of the SARS-CoV-2 pandemic, there were wide-ranging changes in the school setting from March 2020 onwards, characterised by changing teaching formats (alternating between distance, face-to-face and hybrid teaching) and the implementation of infection control measures. **Aim and Method:** The aim of the present study was to investigate the evaluation of these measures and the consequences for teachers in Germany and to formulate best practice examples for school education in the further course of the pandemic. For this purpose, focus group interviews were conducted with 17 teachers at four schools and evaluated by content analysis. **Results:** It was found that the teachers felt burdened by teaching under pandemic conditions and that their health behaviour had deteriorated. In addition, new pandemic-related fears arose and the implementation of infection control measures (implementation of AHA-L rules (distance, hygiene, mask, ventilation), performance of SARS-CoV-2 tests) was accompanied by work-related and health-related problems. The quality of training of prospective teachers was also questioned. The introduction of SARS-CoV-2 vaccinations and the relatively high ranking of teachers in prioritisation was experienced as a relief and very much welcomed. In places, difficulties in communicating and implementing infection control measures were reported, resulting in the formulation of best practices, such as the implementation of SARS-CoV-2 testing by trained staff or the formulation of school form-specific measures. **Conclusions:** The stress caused by teaching during the pandemic and the negative development of health behaviour represent a relevant public health risk. For this reason, the idea of prevention and health promotion should or must be intensified even more during the SARS-CoV-2 pandemic, further developed in view of the pandemic specifics and applied in the living environments.

Keywords: Corona – COVID-19 – school – teachers.

5.2 Zusammenfassung

Einleitung: Zur Eindämmung der Ausbreitung der SARS-CoV-2-Pandemie kam es ab März 2020 zu weitreichenden Veränderungen des Schulunterrichts, der durch sich verändernde Unterrichtsformate (Wechsel zwischen Fern-, Präsenz- und Hybridunterricht) und die Umsetzung von Infektionsschutzmaßnahmen geprägt war.

Ziel und Methode: Ziel der vorliegenden Studie war es, die Bewertung dieser Maßnahmen durch und die Folgen auf Lehrkräfte in Deutschland zu untersuchen und Best-Practice-Beispiele für den Schulunterricht im weiteren Pandemieverlauf zu formulieren. Hierzu wurden Fokusgruppen-Befragungen mit 17 Lehrkräften an vier Schulen durchgeführt und inhaltsanalytisch ausgewertet.

Ergebnisse: Es zeigte sich, dass sich die Lehrkräfte durch das Unterrichten und den veränderten Arbeitsbedingungen während der Pandemie beansprucht fühlten und sich deren Gesundheitsverhalten verschlechtert hatte. Zudem kamen neue, pandemiebedingte Ängste auf und die Umsetzung der Infektionsschutzmaßnahmen (Umsetzung der AHA-L-Regeln (Abstand, Hygiene, Alltagsmaske, Lüften), Durchführung von SARS-CoV-2-Tests) ging mit arbeitsspezifischen und gesundheitlichen Problemen einher. Auch die Ausbildungsqualität der Anwärterinnen und Anwärter wurde in Frage gestellt. Die Einführung von SARS-CoV-2-Schutzimpfungen und die relativ hohe Einstufung von Lehrkräften bei der Priorisierung wurden als Erleichterung erlebt und sehr begrüßt. Stellenweise wurden Schwierigkeiten bei der Kommunikation und Umsetzung von Infektionsschutzmaßnahmen berichtet, die in die Formulierung von Best-Practice-Beispielen, wie die Durchführung von SARS-CoV-2-Tests durch geschultes Personal oder die Formulierung schulformspezifischer Maßnahmen, gemündet sind.

Schlussfolgerungen: Die durch das Unterrichten während der Pandemie bedingten Belastungen sowie eine negative Entwicklung des Gesundheitsverhaltens von Lehrkräften stellt ein relevantes Public-Health-Risiko dar. Aus diesem Grund sollte beziehungsweise muss während der SARS-CoV-2-Pandemie der Gedanke von Prävention und Gesundheitsförderung noch stärker intensiviert, angesichts der pandemischen Besonderheiten weiterentwickelt und in den Lebenswelten angewandt werden.

Schlüsselwörter: Corona – COVID-19 – Schule – Lehrkräfte

5.1 Einleitung

Aufgrund der SARS-CoV-2-Pandemie mussten im März 2020 weltweit rund 1,5 Milliarden Schülerinnen und Schüler sowie deren Lehrkräfte infolge von Maßnahmen zur Eindämmung der Ausbreitung von SARSCoV-2 den Schulen fernbleiben (Suhr 2020). Auch in Deutschland folgten ab März 2020 Schließungen der Schulen, mit dem Ziel, das Infektionsgeschehen positiv zu beeinflussen. Die Ende April 2020 folgende schrittweise Rückkehr zum Schulalltag stellte dann hohe Anforderungen an den Unterricht und das Lehrpersonal. Nach den Sommerferien 2020 wurde in den meisten Schulen wieder zu Präsenzunterricht im Regelbetrieb – sofern es die Einhaltung der Hygienerichtlinien und das Infektionsgeschehen ermöglichten – zurückgekehrt und im Verlauf des Schuljahres phasenweise wieder in Distanzunterricht gewechselt. Daraus resultierten neue Herausforderungen für das gesamte Schulsystem und dessen Beteiligte, auch da der Einfluss von Schulöffnungen auf das Infektionsgeschehen ebenso wie die Rolle der Kinder und Jugendlichen in der SARS-CoV-2-Pandemie noch diskutiert wurde (Parri et al. 2020). Obwohl es Hinweise darauf gibt, dass Schülerinnen und Schüler sowie Lehrkräfte relativ gesehen weniger als andere Bevölkerungsgruppen von Infektionen betroffen waren (Köstner et al. 2021), lässt sich zum gegenwärtigen Zeitpunkt nicht klar abschätzen, welche Rolle diese letztlich beim Infektionsgeschehen spielen. Unbestritten ist, dass das Lehrpersonal beim Unterrichten unter pandemischen Bedingungen an Schulen mit besonderen, SARSCoV-2-spezifischen Belastungen, Beanspruchungen und Herausforderungen konfrontiert wurde und nach wie vor wird. Dies kann sich unter anderem auf einer arbeitsbezogenen Ebene abzeichnen. Es ist bekannt, dass sich der Berufsalltag von Beschäftigten insgesamt durch die SARS-CoV-2-Pandemie deutlich verändert hat, durch zum Beispiel Homeoffice oder Kurzarbeit (Frodermann et al. 2020). Bislang fehlen jedoch empirische Befunde, mit welchen arbeitsbezogenen Herausforderungen und Auswirkungen (z. B. arbeitsorganisatorisch und pädagogisch) Lehrkräfte konfrontiert sind. Hinzu kommen mit dem Arbeitsplatz verbundene gesundheitsbezogene Sorgen und Ängste in Bezug auf eine eigene Infektion oder die einer nahestehenden Person. Aktuelle Studienergebnisse zeigen in der Allgemeinbevölkerung gestiegene vielfältige Beanspruchungen beziehungsweise negative Auswirkungen aufgrund der SARS-CoV-2-Pandemie (Beutel et al. 2021). Diese beziehen sich beispielsweise auf eine verminderte Lebenszufriedenheit,

erhöhtes Stresserleben, Angst sowie depressive Symptome, einen subjektiv schlechteren Gesundheitszustand oder vermehrte gesundheitsbezogene Ängste sowie Sorgen um die eigene Familie (Li et al. 2020; Newby et al. 2020; Torales et al. 2020). Hinzu kommen potenziell belastende Veränderungen von Verhaltensweisen (z. B. soziale Distanz, verändertes Hygieneverhalten; Newby 2020). Negative Auswirkungen auf die psychische Gesundheit (v. a. Depression, Angst) zeigten sich zudem bei spezifischen Berufsgruppen, wie beispielsweise medizinischem Personal mit Kontakt zu COVID-19-Patientinnen und -Patienten (Lu et al. 2020). Es kann davon ausgegangen werden, dass Lehrkräfte ebenso wie die Allgemeinbevölkerung mit multiplen Belastungen im Zusammenhang mit der SARS-CoV-2-Pandemie konfrontiert sind, die wiederum zu unterschiedlichen Beanspruchungen bei Lehrkräften führen. Diese können sich auf der somatischen, psychischen und sozialen Ebene abzeichnen, deren Erforschung ein Ziel der vorliegenden Studie war. Zum Schutz des Lehrpersonals und deren Schülerinnen und Schülern vor Infektionen mit SARS-CoV-2 wurden entsprechende Hygienepläne erarbeitet, die technische sowie vor allem organisatorische und personale Maßnahmen enthielten. Diese Maßnahmen sind hinsichtlich ihrer praktischen Umsetzbarkeit, Akzeptanz, möglicher Folgen sowie Wirksamkeit für Sicherheit und Gesundheit des Lehrpersonals abzuschätzen, gegebenenfalls zu ergänzen oder auf Basis dieser Erkenntnisse zu adaptieren. Hierzu ist es erforderlich, den aktuellen Sachstand an den Schulen aus Perspektive von Lehrkräften zu erfassen sowie Best-Practice-Beispiele zum Einsatz unterschiedlicher Schutzmaßnahmen hinsichtlich ihrer Praktikabilität einzuschätzen. Um diese Forschungslücken zu adressieren, wurde Anfang 2021 das Drittmittelprojekt „SARS-CoV-2-Arbeits- und Infektionsschutzmaßnahmen an Schulen“ initiiert, um die Folgen der SARS-CoV-2-Pandemie auf Lehrkräfte empirisch zu untersuchen. Das Projekt verfolgt einen Mixed-Methods-Ansatz, bestehend aus einem Monitoring der Infektionszahlen von Schülerinnen und Schülern sowie Lehrkräften (Köstner et al. 2021), einer bundesweiten quantitativen Untersuchung von Lehrkräften und Fokusgruppen-Befragungen mit Lehrkräften. Im Rahmen dieser Arbeit stellen wir die Ergebnisse der Fokusgruppen-Befragungen vor.

5.2 Fragestellung/Zielstellung

Im Rahmen der Fokusgruppen-Befragungen wurden folgende Themenbereiche adressiert:

- Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen,
- Umsetzung, Kommunikation und Einhaltung von Hygieneplänen,
- Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte,
- Sammlung von Best-Practice-Beispielen und Ableitung von Empfehlungen.

Bei der Bearbeitung dieser Fragestellungen wurde zwischen einer persönlichen, lehrkräftezentrierten und einer pädagogischen Perspektive, mit Fokus auf Umsetzung des Bildungsauftrages, unterschieden. Aus arbeitsmedizinischer Sicht ist vor allem die lehrkräftezentrierte Perspektive von Relevanz, der im Rahmen dieses Beitrags verstärkt Aufmerksamkeit geschenkt wird.

5.3 Methoden

Zu den Fokusgruppen

Die Fokusgruppen-Befragungen wurden mit Lehrkräften aus zwei Bundesländern, jeweils in einem Flächen- und einen Stadtstaat (Rheinland-Pfalz und Hamburg), durchgeführt. Die Durchführung der Fokusgruppen fand im Zeitraum vom 08.06.2021 bis 24.06.2021 statt. Dieser Zeitraum wurde durch eine Infektionslage mit hohen Inzidenzen in Deutschland gekennzeichnet (Statista 2021). Zeitgleich dominierte in diesem Zeitraum die gegenüber dem SARS-CoV-2-Wildtyp ansteckendere Variante B.1.1.7 in Deutschland. Neben der bundesweiten „Notbremse“ ab dem 23.04.2021 zur Eindämmung der Pandemie waren (Stand 30.04.2021) bereits 7,7 % der Bevölkerung vollständig geimpft und 26,9 % einfach geimpft. Insgesamt wurde die Rekrutierung der Teilnehmenden durch das dynamische Infektionsgeschehen und die damit verbundene Unsicherheiten deutlich erschwert. Die Konzeption der Fokusgruppen-Befragung erfolgte in einem mehrstufigen Prozess (Leitfadenentwicklung, Diskussion in Expertenteams, Pretests, finale Gestaltung von Leitfaden und digitalen Unterstützungstools). Die Dauer der Fokusgruppen betrug etwa 165 inuten, inklusive Einführungs- und Vorstellungsphase sowie einer Pause. Dabei wurden jeweils Gruppen von 3–5 Personen analog zu den oben beschriebenen Leitthemen befragt.

Pandemiebedingt fanden die Fokusgruppen digital über Microsoft-Teams statt. Zur Unterstützung der Moderation und zur Dokumentation der Ergebnisse wurde die Online-Kollaborations-Plattform „Miro“ genutzt. Vor die jeweiligen Fokusgruppen wurde eine kurze Online-Befragung via Limesurvey geschaltet, um die Erhebung soziodemografischer Variablen der Teilnehmenden abzubilden. Nach dieser Limesurvey-Befragung und der Zustimmung zu Einverständnis- und Datenschutzerklärung konnten die Teilnehmenden über einen Link der Besprechung via Microsoft-Teams beitreten. Die Teilnahme an den Fokusgruppen war freiwillig. Alle Aussagen der Teilnehmenden wurden ohne Personenbezug dokumentiert. Die Ergebnissammlung in den Fokusgruppen erfolgte digital in Form von thematisch sortierten Antwortkarten innerhalb eines von einem Psychologen moderierten Prozesses und durch Unterstützung von Mitarbeitenden des Instituts für Arbeits-, Sozial- und Umweltmedizin in Mainz. Die Studie wurde durch die Ethikkommission der Landesärztekammer Rheinland-Pfalz begutachtet und genehmigt (Antragsnummer 2020-15531).

Rekrutierung

Die Rekrutierung der Teilnehmenden für die Fokusgruppen-Befragungen erfolgte in Abstimmung mit dem Ministerium für Bildung in Rheinland-Pfalz und der Gewerkschaft Erziehung und Wissenschaft (GEW). Die Rekrutierung der einzelnen Teilnehmenden in Rheinland-Pfalz wurde durch eine randomisierte Auswahl aus einer dem Forschungsteam vorliegenden Schulliste in sechs Rekrutierungswellen durchgeführt. Hierbei erhielten die zufällig ausgewählten Schulen ein Informationsschreiben, mit allen wichtigen Informationen zum Forschungsprojekt und eine Einladung zur Teilnahme an einer der Fokusgruppen. Durch die geringe Anzahl an Rückmeldungen wurde in der letzten Rekrutierungswelle ein Teil der Schulen, zu denen in anderen Projekten bereits ein Kontakt über das Institut für Lehrgesundheit (Mainz) bestand, ein zweites Mal angeschrieben. Da für Hamburg kein systematischer Zugang über Schullisten gegeben war, erfolgte die Rekrutierung der Fokusgruppen in Hamburg in Kooperation mit der GEW. Ein Informationsschreiben wurde über GEW-interne Verteiler an deren Mitglieder an Schulen in Hamburg weitergeleitet, verbunden mit der Bitte, dieses in deren jeweiligen Dienststellen/Schulen zu verteilen. Aufgrund der beschriebenen Vorgehensweise liegen keine Daten zu der genauen Anzahl der kontaktierten Personen/Schulen in Hamburg vor.

Auswertung

Die gesammelten Antworten beziehungsweise Aussagen der Teilnehmenden wurden über alle Fokusgruppen hinweg aggregiert ausgewertet. In Anlehnung an die Methode der qualitativen Inhaltsanalyse nach Mayring (2015) wurden inhaltlich miteinander assoziierte Aussagen mit Bezug auf die Fragestellungen zusammengefasst und auf deren Basis Kategorien formuliert. Hierbei arbeiteten mindestens zwei Mitarbeitende unabhängig voneinander, um im Anschluss die unabhängig voneinander gebildeten Kategorien auf Übereinstimmung beziehungsweise Unterschiede hin zu vergleichen, mit dem Ziel, konsensuell geteilte Kategorien zu bilden (Mayring 2015). Die Ergebnisse wurden anschließend in themenbezogene Mindmaps übertragen und die Kategorien durch Ankerbeispiele belegt.

5.4 Ergebnisse

Stichprobenbeschreibung

Insgesamt wurden drei Fokusgruppen mit Schulen aus Rheinland-Pfalz und eine Fokusgruppe mit einer Schule aus Hamburg durchgeführt (n = 17 Teilnehmende). Der Altersdurchschnitt betrug 43,8 Jahre (SA = 9,0) und 88,2 % (n = 15) der Befragten waren weiblichen Geschlechts. Von den Teilnehmenden gaben 23,5 % an, Schulleiterinnen beziehungsweise Schulleiter zu sein (n = 4), 64,7 % ordneten sich der Berufsgruppe der Lehrkräfte zu (n = 11), 5,9 % gaben an, eine pädagogische Fachkraft zu sein (n = 1) und eine Lehrkraft machte hierzu keine Angabe. Die Verteilung nach Schulformen setzte sich folgendermaßen zusammen: 5,9 % Realschule (n = 1), 29,4 % Förderschule (n = 5), 29,4 % Gymnasium (n = 5), 29,4 % Integrierte Gesamtschule (n = 5) und 5,9 % Berufsschule (n = 1). Insgesamt gaben 52,9 % der Teilnehmenden an, Mitglied einer Gewerkschaft zu sein (n = 9).

Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen

Die Synthese aus den Fokusgruppen zur Identifizierung SARS-CoV-2-spezifischer Belastungen und Herausforderungen mit Fokus auf schulorganisatorische Faktoren¹ ist in Abb. 1 dargestellt. In Abb. 1 wird illustriert, dass die befragten Lehrkräfte den durch die SARS-CoV-2-Pandemie bedingten erhöhten Arbeitsaufwand, die entgrenzten Arbeitszeiten sowie die fehlende Planungssicherheit als herausfordernd empfanden. Dies wird zum Beispiel durch die Aussage eines Teilnehmenden verdeutlicht, in der es heißt: „Man hat das Gefühl nie Feierabend zu haben“. Zudem wurden Schwierigkeiten für Anwärterinnen und Anwärter beschrieben und deren Ausbildungsqualität unter pandemischen Bedingungen in Frage gestellt. Des Weiteren wurde Kritik an den Landesbehörden geäußert: Diese würden die Verantwortung im Umgang mit der Pandemie häufig an die Schulleitungen delegieren und zudem die Fürsorgepflicht gegenüber ihren Beschäftigten, den Lehrkräften, verletzen.

¹ Neben schulorganisatorischen Belastungen und Herausforderungen wurden im Rahmen der Studie zudem pädagogische Belastungen und Herausforderungen und jene mit Schwerpunkt auf Unterrichtsformate herausgearbeitet. Aus arbeitsmedizinischer Sicht spielen allerdings die schulorganisatorischen eine zentrale Rolle.



Abbildung 1 Identifizierung von schulorganisatorischen SARS-CoV-2-spezifischen Belastungen und Herausforderungen

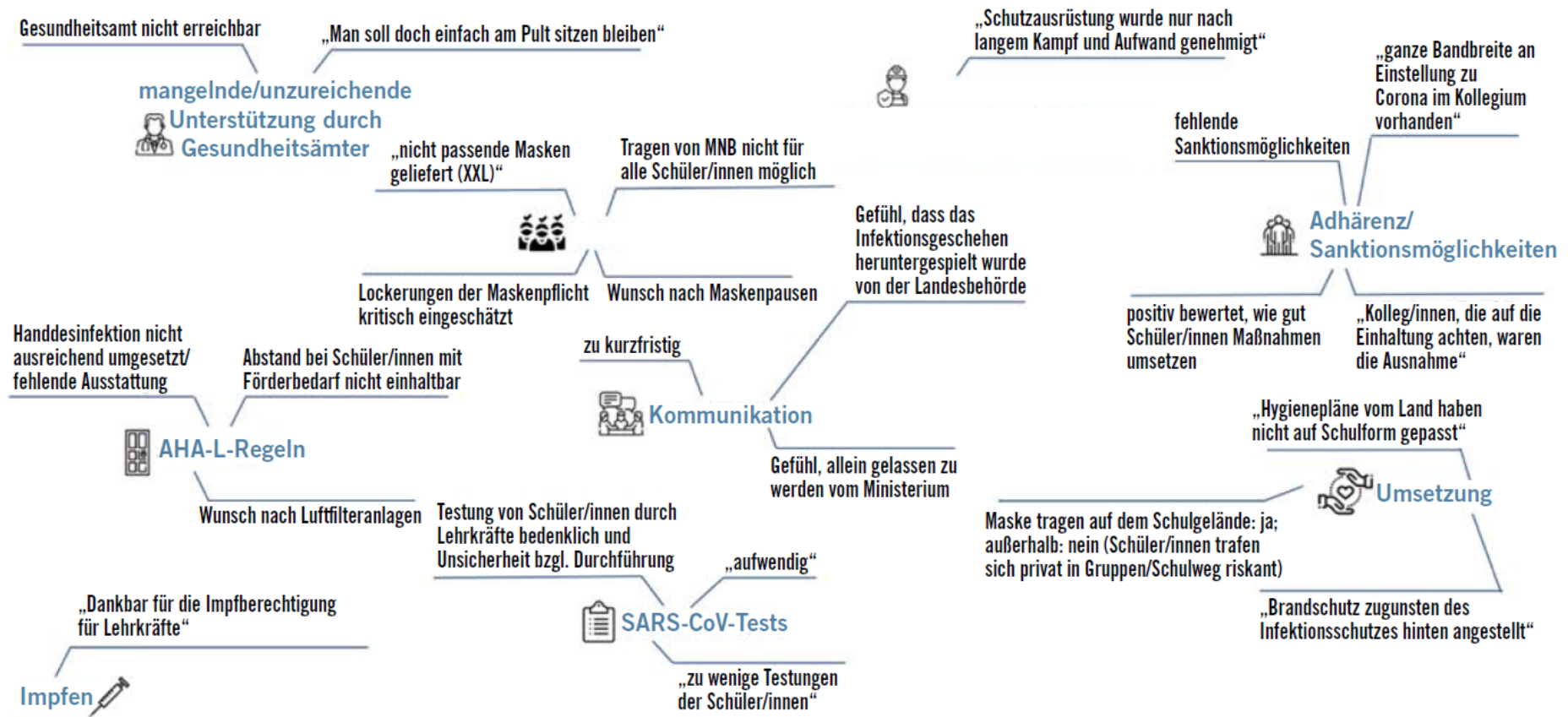


Abbildung 2 Schulspezifische Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien oder -pläne

Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen

Bei der Kategorisierung der Aussagen zur Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen wurde zwischen einer persönlichen, also lehrkräftezentrierten, schulspezifischen und arbeitsbezogenen Ebene unterschieden. Die Synthese aus schulspezifischer Ebene ist in Abb. 2 dargestellt. Es ist zu sehen, dass konkrete Infektionsschutzmaßnahmen von den befragten Lehrkräften grundsätzlich als wirksam angesehen werden, deren Umsetzung im Schulalltag allerdings kontrovers bewertet und diskutiert wird. Dies zeigt sich vor allem beim Tragen von Mund- Nase-Bedeckungen (MNB), der Einhaltung der AHA-L-Regeln (Abstand, Hygiene, Alltagsmaske, Lüften) und bei der Durchführung von SARS-CoV-2-Tests in der Schule. Insbesondere das Testen von Schülerinnen und Schülern durch Lehrkräfte wurde als bedenklich und aufwendig eingeschätzt. Die Umsetzung der Maßnahmen würde zudem durch Uneinigkeit beziehungsweise unterschiedliche Einstellungen zur SARS-CoV-2-Pandemie innerhalb des Kollegiums erschwert; unter anderem durch fehlende Sanktionsmöglichkeiten bei Verstößen gegen Maßnahmen, unzureichende Ausstattung mit Infektionsschutzmaterial (z. B. Masken, Desinfektionsmittel) sowie mangelnde und zu kurzfristige Kommunikation, vor allem seitens der Gesundheitsämter und Ministerien. Zudem gilt es zu resümieren, dass die befragten Lehrkräfte dem Thema des Impfens positiv gegenüberstanden und dankbar für die Einordnung in eine hohe Priorisierungsgruppe waren.

Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte

Die Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte zeichneten sich auf somatischer, psychischer und sozialer Ebene ab und sind in Abb. 3 zusammengefasst. Es wird deutlich, dass das Gesundheitsverhalten während der Pandemie beeinträchtigt war (z. B. unzureichende körperliche Aktivität, lange Sitzzeiten, hoher Medienkonsum, gestörter Schlaf), was von einer teilnehmenden Lehrkraft als „Raubbau am Selbst ...“ beschrieben wurde. Auf psychischer Ebene wurden Reaktionen von Überlastung wie subjektiv empfundener Stress, Dünnhäutigkeit, Schwierigkeiten abzuschalten, Panik oder Wut berichtet und im Zuge dessen der Wunsch nach Entlastung und von einer Person sogar nach einem Sabbatjahr geäußert. Auf sozialer Ebene stand das Thema Familie im Fokus. Hier

wurde einerseits die Vereinbarkeit von Familie und Beruf sowie pandemiebedingte Sorgen um die Familie negativ herausgestellt, der Rückhalt der Familie allerdings auch als wertvolle Ressource in der Pandemie erachtet

Sammlung von Best-Practice-Beispielen und Ableitung von Empfehlungen

Um Empfehlungen für die gegenwärtige Pandemie und die Zukunft ableiten zu können, wurden die Lehrkräfte gefragt, was ihrer Meinung nach gut lief und was benötigt würde, um den Infektionsschutz an Schulen noch effektiver umsetzen zu können. Neben Empfehlungen zur Verbesserung konkreter Maßnahmen wie zum Beispiel bezüglich der Umsetzung der AHA-L-Regeln (z. B. kleinere Klassen, Sanktionsmöglichkeiten bei Missachtung von Infektionsschutzmaßnahmen, räumliche bzw. bauliche Trennung) oder Durchführung der SARS-CoV-2-Tests (z. B. Durchführung durch medizinisches Fachpersonal) fällt aus arbeitsmedizinischer Sicht auf (Abb. 4), dass die Sicherstellung von Strukturen des Arbeitsschutzes erbeten wurde, auch und insbesondere in Pandemiezeiten. Auf politischer Ebene wurde einerseits die Aussetzung des Föderalismus, beispielweise bei der Durchsetzung der Bundesnotbremse, als positiv bewertet und andererseits die Bereitstellung von Ressourcen zur Umsetzung der Infektionsschutzmaßnahmen gefordert. Impfungen trugen zur Erleichterung und Entspannung der Gesamtsituation bei und wurden von der Lehrerschaft prinzipiell, wie auch schon zuvor im Kapitel zur Umsetzung der Maßnahmen erkenntlich wurde, als äußerst relevant angesehen, um den Infektionsschutz an Schulen zu gewährleisten und damit einhergehende negative Konsequenzen (z. B. Ängste) zu reduzieren.

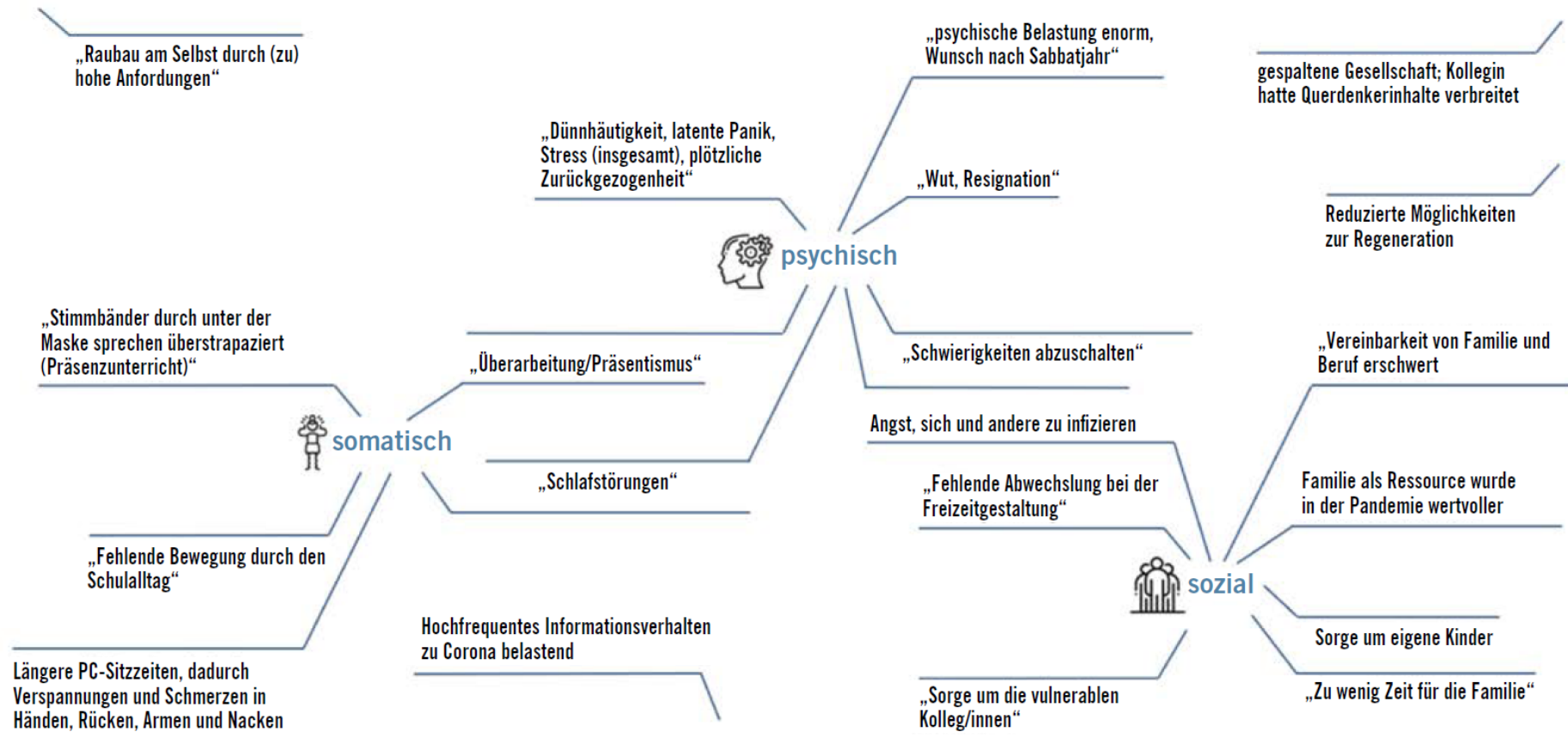


Abbildung 3 Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte

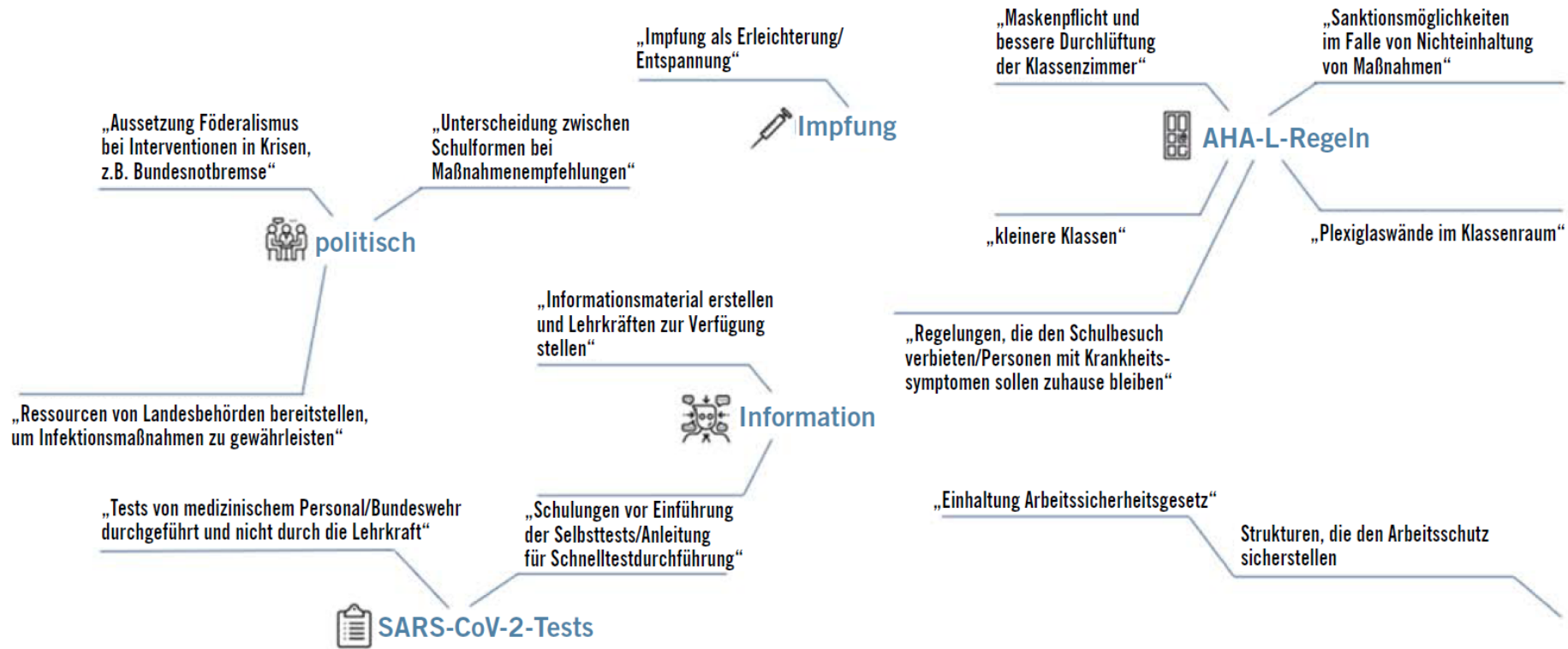


Abbildung 4 Sammlung von Best-Practice Beispielen und Ableitung von Empfehlungen Umsetzung des Infektionsschutzes

5.5 Diskussion

Ziel der Studie war es, mittels eines qualitativen Forschungsdesigns Lehrkräfte in Deutschland zum Unterrichten während der SARSCoV-2-Pandemie zu befragen. Besonderes Augenmerk lag hierbei auf der Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen, der Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen sowie den Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte. Ebenfalls wurden Best-Practice-Beispiele gesammelt, um Empfehlungen für die Schulpraxis unter pandemischen Bedingungen ableiten zu können. Aufgrund der Vielzahl an Ergebnissen wird sich im Rahmen der Diskussion auf ausgewählte Aspekte, die aus arbeitsmedizinischer Sicht von besonderem Interesse sind, fokussiert. Aus arbeitsmedizinischer Sicht besonders relevant sind Aussagen wie beispielsweise die, dass es während der Pandemie zunehmend zu entgrenzten Arbeitszeiten und somit zu einer Verschmelzung von Arbeit- und Privatleben kam. Um dieses Phänomen, das vor allem während der SARS-CoV-2-Pandemie zunehmend in den arbeitsmedizinischen Fokus gerückt ist, hat sich der Begriff des Work-Life-Blendings konstituiert. Eine der ersten Studien zum Work-Life-Blending wurde Anfang 2021 durchgeführt (Bahr 2021). Im Rahmen dieser Studie wurden rund 2800 Beschäftigte aus kleinen und mittelständischen Unternehmen weltweit befragt, darunter 299 Teilnehmende aus deutschen Betrieben. Über die Hälfte (53 %) der Befragten dieser Studie gab an, im Homeoffice berufliche Anrufe vor oder nach den Arbeitszeiten zu beantworten, 48 % arbeiteten am Wochenende. Rund 44 % der Befragten beschrieben zudem, zu einem gewissen Grad ein Burnout zu erleben, seit sie im Homeoffice arbeiten. Die Ergebnisse unserer Studie zeigen einen ähnlichen Trend dahingehend auf, dass bei Lehrkräften in Deutschland während der Pandemie ebenfalls die Trennung zwischen Berufs- und Privatleben verschwommen war. Dies spiegelt sich auch in den berichteten Auswirkungen wider, die ebenfalls einen Hinweis auf emotionale Erschöpfung und Ausgebranntheit liefern. Daher empfehlen wir, die Ergebnisse der vorliegenden qualitativen Untersuchung von Lehrkräften durch quantitative Untersuchungen zu verifizieren und den Lehrkräften zudem Empfehlungen sowie Weiterbildungsmöglichkeiten zu entlastenden Kompetenzen (z. B. Zeitmanagement, Arbeitsorganisation) an die Hand zu geben, um einem Work-Life-Blending und den damit einhergehenden Beanspruchungsreaktionen entgegenzuwirken. Des Weiteren

klang im Rahmen der Untersuchung an, dass die Ausbildungsqualität der Anwärterinnen und Anwärter während der SARS-CoV-2-Pandemie, die wie auch in anderen Bereichen durch Fernunterricht, Selbststudium oder hybride Modelle geprägt war, in Frage gestellt wurde. Dabei stellen gerade die Lehramtsanwärterinnen und -anwärter die zukünftigen Lehrkräfte dar, die maßgeblich an der Umsetzung des Bildungsauftrags der nächsten Generationen von Schülerinnen und Schülern beteiligt sein werden. Zudem galt das Kollektiv der Lehramtsanwärterinnen und -anwärter auch vor der SARS-CoV-2-Pandemie als enorm beansprucht und als Risikogruppe für beeinträchtigte mentale Gesundheit (Darius et al. 2021; Drüge et al. 2014). Es erscheint plausibel anzunehmen und wurde im Rahmen unserer Untersuchung bestätigt, dass sich die Belastungen durch die SARS-CoV-2-Pandemie verändert und insgesamt verstärkt haben. Aus diesem Grund empfehlen wir, der Zielgruppe der Anwärterinnen und Anwärter besondere Aufmerksamkeit zu schenken und sicherzustellen, dass einerseits die Qualität deren Ausbildung gewährleistet ist und andererseits Maßnahmen initiiert werden, um gesundheitsfördernde Ressourcen in diese jungen Kollektiv zu stärken, um den Umgang mit der Pandemie und die damit assoziierten Herausforderungen besser bewältigen zu können. Hier wären Mentorinnen-/Mentorenprogramme ebenso denkbar wie digitale Unterstützungsangebote, wie sie beispielweise am Institut für Lehrgesundheit in Mainz angeboten werden. Einen weiteren kritischen Aspekt stellt die Verschlechterung des Gesundheitsverhaltens von Lehrkräften während der SARS-CoV-2-Pandemie dar. Dieses Phänomen wurde bereits durch zahlreiche quantitative Studien sowohl für die Allgemeinbevölkerung als auch für verschiedenste spezifische Kollektive nachgewiesen und lässt sich für eine Vielzahl an gesundheitlichen Dimensionen abbilden, so unter anderem für Bewegung, Schlaf, Ernährung, Tabak- und Alkoholkonsum (Ammar et al. 2020; Knell et al. 2020; Zvolensky et al. 2020; Carroll et al. 2020; Castañeda-Babarro et al. 2020). Diese negative Entwicklung des Gesundheitsverhaltens quer durch die Bevölkerung stellt ein enormes Public-Health-Risiko dar. Aus diesem Grund sollte beziehungsweise müssen während der SARS-CoV-2-Pandemie die Gedanken von Prävention und Gesundheitsförderung noch stärker intensiviert, angesichts der pandemischen Besonderheiten weiterentwickelt und in den verschiedenen Lebenswelten (Sozialgesetzbuch V 2018) angewandt werden. Ein Fokus sollte hierbei auf der Vermittlung gesundheitsfördernder Verhaltensweisen beziehungsweise eines gesundheitsfördernden Lebensstils für Lehrkräfte gelegt werden. Digitale Angebote

zur Vermittlung von Gesundheitsangeboten stellen vor allem unter pandemischen Bedingungen eine Methode der Wahl dar. Abschließend lässt sich resümieren, dass das Unterrichten an Schulen während der SARS-CoV-2-Pandemie für Lehrkräfte überwiegend als herausfordernd empfunden wurde und sich negativ auf deren Gesundheit ausgewirkt hat. Allerdings konnten im Rahmen dieser Studie auch positive Aspekte aus der Pandemie abgeleitet sowie Empfehlungen beschrieben werden, die im Rahmen dieses Beitrags in die Formulierung von Best-Practice-Beispielen eingeflossen sind und die es im weiteren Verlauf der SARS-CoV-2-Pandemie sowie in etwaigen zukünftigen Pandemien zu beachten gilt.

Limitationen

Es ist kritisch anzuführen, dass der zeitliche Kontext, in dem sich die Rekrutierung sowie Durchführung der Fokusgruppen-Befragungen abspielte durch sinkende Infektionszahlen sowie einer Rückkehr zum Wechsel- oder Präsenzunterricht an den Schulen geprägt war. Diese Umstände und die damit einhergehenden organisatorischen Aufgaben seitens der Schulen schienen sich negativ auf die Bereitschaft zur Teilnahme an den Fokusgruppen auszuwirken, was sich in der geringen Stichprobengröße ausdrückte. Zudem ist zu erwähnen, dass sich die Stichprobe lediglich aus Teilnehmenden der Bundesländer Rheinland-Pfalz und Hamburg zusammensetzt und somit, auch bedingt durch länderspezifische Unterschiede bei der Umsetzung des Bildungsauftrages an Schulen, keine Aussagen für Lehrkräfte im Allgemeinen beziehungsweise für Lehrkräfte in Deutschland getroffen werden können. Des Weiteren ist kritisch zu resümieren, dass durch Selbstselektionsprozesse zur Teilnahme an der Fokusgruppen-Befragung eine Stichprobenverzerrung stattgefunden haben kann. Diese könnte sich zum Beispiel dahingehend zeigen, dass sich besonders diejenigen Lehrkräfte angemeldet haben, die eine intrinsische Motivation zur Teilnahme an der Studie verspürten und zusätzlich die dafür nötigen zeitlichen Ressourcen zur Verfügung hatten.

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APPENDIX

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ORIGINAL PUBLICATIONS

Short Report

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

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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 differed in active case rates or not. The data showed that pupils and teachers case rates didn't exceeded those of the general population. In conclusion, it seems appropriate to appraise school-related measures to mitigate the SARS-CoV-2 pandemic sufficiently. Data quality is a yet to overcome obstacle to provide good evidence-based recommendations regarding the management around infection cases in schools.

Introduction

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-2.¹ With the aim to positively influence the course of infection rates, schools in Germany were closed in March 2020 as response to the pandemic. This happened with far-reaching consequences not only for the education of the pupils, but for the entire society. Thenceforward, there was and still is 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 school-wide safety-measures (e.g. mask-wearing, distance) are sufficient to keep pandemic risks at an acceptably low level.^{2–4} Other studies showed that school closures are effective measures to slow down the pandemic.^{5–7} 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 the general population differ in active SARS-CoV-2 case rates.

Methods

A retrospective analysis of open access data for SARS-CoV-2 cases from official sources and ecological data (temperature) was performed. Datasets were downloaded from the websites of the respective authorities and then analyzed. Statewide data provided by the Ministry of Education in Rhineland-Palatinate (BM-RLP), the Federal State Agency for Consumer & Health Protection of Rhineland-Palatinate (FSA-RLP) as well as nationwide data provided by 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.^{8–11} Furthermore, some studies described that climatic conditions could have an impact on the spread of SARS-CoV-2, therefore data of the daily average outside temperature from the federal German Weather Service (DWD) was used.^{4,5,12} The dataset for statewide (RLP) active cases of pupils and teachers started in August 2020, at the beginning of the school-year 2020/21 and ended in December, before the winter-break.⁸ The statewide dataset for pupils and teachers was compared to the dataset for the general population's (lab-confirmed) infection cases.⁹ Cases for pupils and teachers in RLP were interpreted as active cases since schools were obliged to record self-reported (not lab-confirmed) sickness absence due to SARS-CoV-2 infections. For the statewide general population, we calculated the estimate for daily active SARS-CoV-2 cases by using the accumulated cases and subtracting the recovered cases (estimated by using 14 day as well as 23 day dropout algorithms, which are representing the lower boundary for the dropout algorithms used by the RKI and the FSA-RLP) and the deceased cases. Further information regarding the methodology and a detailed list of limitations noticed during the analysis can be found in [Supplementary Appendix S1](#).

The nationwide data for teachers and pupils was reported on a weekly basis and included five data-points of infection cases for a time period of 5 weeks starting in November and ending in mid-December 2020.¹⁰ These school-related nationwide data were compared to the official dataset for infection cases in the general population of the RKI.¹¹ We interpreted the nationwide weekly accumulated SARS-CoV-2 cases for pupils and teachers again as active cases and compared them to the respective active cases documented in the situation reports published by the RKI.¹¹ To crosscheck the statewide findings, an analysis of the five available data-points for nationwide data of active cases for pupils and teachers and general population was performed.^{10,11}

After identifying and obtaining the required SARS-CoV-2 data from official sources, school related data were transformed to bring

all sources to a common denominator (i.e. rolling 7-day average estimate of active 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 non-pharmaceutical 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 non-pharmaceutical 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, active case rates in pupils and teachers moved below the estimated active case rates in the general population. In addition, there was an inverse proportional relation between the daily average outside temperature and estimated active cases of the general population, $r = -0.76$, $P < 0.001$ (14 day dropout estimation) and $r = -0.78$, $P < 0.001$ (23 day dropout estimation).

The crosscheck analysis for nationwide data provided the same relative positions of the three compared groups after subtracting pupils and teachers from the general population to create groups without autocorrelation. The general population showed the highest average active SARS-CoV-2 case rate per 100 000 people in that

period of time ($M = 389.19$), followed by teachers ($M = 351.35$) and pupils ($M = 192.03$). Results for three bivariate correlations for the compared nationwide groups revealed no significant associations for the active SARS-CoV-2 cases between the three groups. On a non-significant level, pupils and teachers were more closely correlated, $r = 0.78$, $P = 0.12$, than pupils and the general population, $r = 0.14$, $P = 0.82$, and teachers and the general population, $r = 0.21$, $P = 0.74$.

Discussion

The results of our analysis imply that there were relatively more reported SARS-CoV-2 cases in the general population compared to pupils and teachers, especially after the autumn vacation. This pattern was found on a statewide and nationwide level of analysis. Knowing that the results for nationwide correlations between the compared groups are non-significant, it seems reasonable to interpret those correlations in a way that pupils and teachers had to some extent more homogeneous infection case rates compared to the general population which showed a more independent course of case rates. Different explanations can be derived from the deviating rates of active SARS-CoV-2 cases of pupils and teachers relative to the general population. Differences in age composition of the various groups, different testing strategies in schools vs. in the general population or differing effects caused by the decrease in daily average outside temperature are possible but sure incomplete elements of explanation.

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.² This could have led to fewer testing of pupils compared to adults.

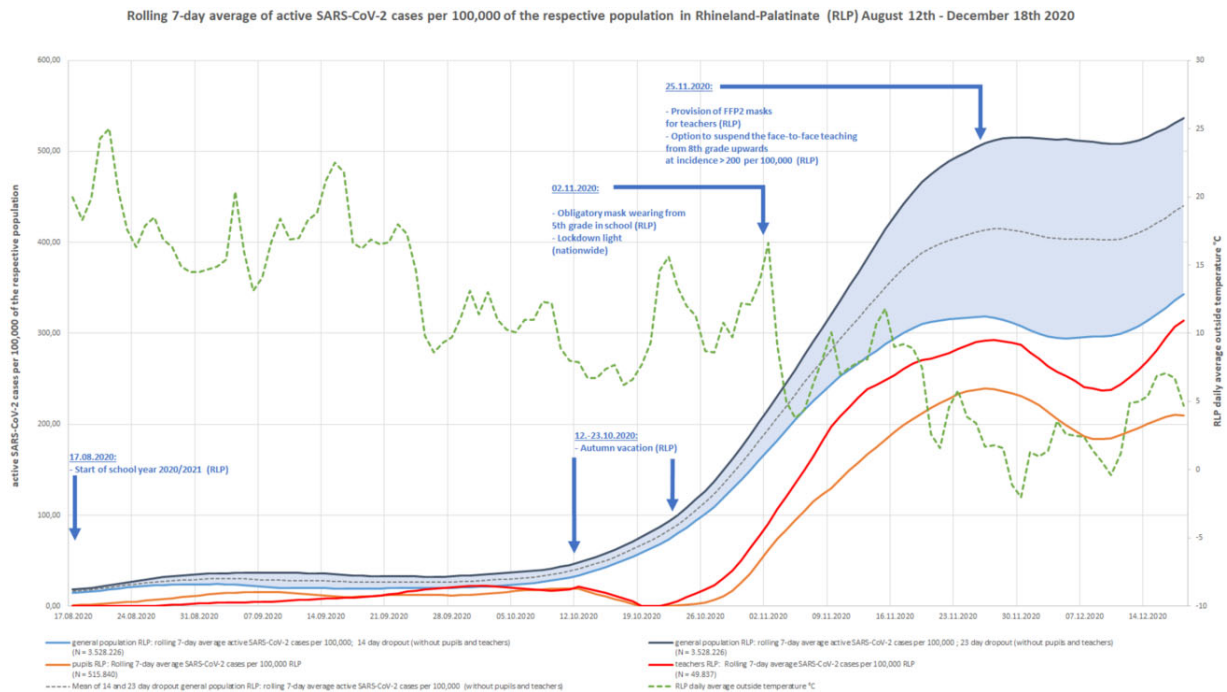


Figure 1 Rolling 7-day average SARS-CoV-2 cases per 100 000 of the respective population in Rhineland-Palatinate (RLP), 12 August to 18 December 2020

The ongoing narrative in the social discourse of pupils and teachers being relatively safe can be confirmed by our results. Nevertheless, recent studies targeting this topic showed that school closures slowed down the spread of SARS-CoV-2.^{5–7} In conclusion, it seems appropriate to continue to evaluate and improve school-related measures to mitigate the SARS-CoV-2 pandemic.

With regard to potential limitations, it would have been preferable to use higher quality and better comparable 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 for pupils and teachers was not continued, cases were artificially set to zero in the statewide dataset. Another important limitation of our results is that the dropout algorithms for the subtraction of recovered SARS-CoV-2 cases from active cases used for the general population data differed from the algorithm used for the school-based datasets. 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. RKI standard-dropout 14 days after a positive test, FSA-RLP standard-dropout 23 days after a positive test). Consequently, results should be interpreted with caution. A detailed and more in depth discussion of the potential limitations is given in [Supplementary Appendix S1](#). It is important to consider, that SARS-CoV-2 cases of pupils and teachers do not necessarily indicate that the infections took place in schools.

Despite those limitations, we conclude to further use the apparently useful school-related measures 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, teachers and the general population to make them more adequately comparable. This would enable politicians in charge to make better evidence-based decisions for the protection of pupils and teachers and to mitigate the SARS-CoV-2 pandemic in Germany.

Supplementary data

[Supplementary data](#) are available at *EURPUB* online.

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Conflicts of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

The BM-RLP data underlying this article were provided by Aufsichts- und Dienstleistungsdirektion (ADD). All data (BM-RLP, KMK, RKI, DWD & FSA) underlying this article are open access too and available via the URLs shared in the references section.^{8–12}

Key points

- Pupils and teachers showed lower SARS-CoV-2 case rates than the general population.
- The present paper provides a detailed list of potential pitfalls regarding the comparison of school related SARS-CoV-2 data with data of the general population.
- Data quality is a yet to overcome obstacle to provide good evidence-based recommendations regarding the management around infection cases in schools.
- Apparently useful school related measures to mitigate the SARS-CoV-2 pandemic should be continued.

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Article

Psychological Burdens among Teachers in Germany during the SARS-CoV-2 Pandemic—Subgroup Analysis from a Nationwide Cross-Sectional Online Survey

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Abstract: Background: Schools underwent massive changes during the SARS-CoV-2 pandemic worldwide. Besides existing occupational health challenges, teachers had to deal with biological and psychological burdens that had the potential to impact their psychological well-being. The aim of the present study was to (i) assess the current state of psychological burdens in German teachers and (ii) identify highly burdened subgroups to derive and address interventions. Methods: A nationwide cross-sectional online survey was conducted among teachers at all school types in Germany in March 2021. Data on psychological strains were assessed using established (e.g., PHQ-4) and new—pandemic-specific—(e.g., COVID-19-associated anxieties) instruments. ANOVAs and Tukey's post hoc tests were used to identify highly burdened subgroups (e.g., gender, age, and number of risk factors for severe courses of COVID-19) of teachers. Results: Psychological burdens in German teachers (N = 31.089) exceeded the level of the general population, for example, regarding symptoms of depression (PHQ-2, M = 1.93 vs. 1.24) or generalized anxiety (GAD-2, M = 1.72 vs. 1.03). Subgroup analysis revealed that psychological burdens were unevenly distributed among different groups of teachers; for example, younger teachers (18–30 years) showed more depression symptoms compared with their older colleagues (56–67 years) (PHQ-2, M = 2.01 vs. 1.78). Conclusions: The online survey was conducted during the “third wave” of SARS-CoV-2 in Germany, which might have influenced risk perception and psychological strains. Future studies at different times, ideally longitudinal monitoring of the mental health of teachers, are recommended. Based on our results, evidence-based subgroup-specific interventions should be implemented to sustain teachers' mental health; for example, younger teachers or teachers with risk factors for a severe course of COVID-19 should receive special attention and support. Teachers from special needs schools whose mental health is, on average, good could also be a starting point for identifying the health promotion structural elements of this school type (e.g., fewer students per teacher). However, beyond the specific pandemic-related psychological burdens, the classic occupational health challenges of physical, biological, and chemical stress and their resulting strains should not be disregarded.

Keywords: COVID-19; mental health; teachers; school; depression; anxiety; burnout

1. Background

The ongoing SARS-CoV-2 pandemic has shown the potential to act as a catalyst for a variety of existing somatic, psychological, and social burdens worldwide. Furthermore, it has generated new ones. Several international studies analyzing the general population have provided evidence that, in various countries, alarming associations between

the SARS-CoV-2 pandemic and psychological burdens (e.g., stress, anxiety, depression, insomnia, or anger) emerged. This is in line with findings about responses to other, previous outbreaks of infections, for example, the 2015 MERS-CoV outbreak in Korea [1]. In a Chinese study that included 17,865 participants, various negative emotions (e.g., anxiety, depression, or indignation) increased, whereas the sources of positive emotions (happiness) and life satisfaction decreased [2]. Furthermore, acute mental health impacts in response to the pandemic were found in an Australian study with 5070 participants, which reported COVID-19-related fears, elevated levels of psychological distress (e.g., depression, anxiety, alcohol use, loneliness, or stress), and precautionary behaviors [3]. In line with the aforementioned results, a nationally representative study from the United Kingdom (N = 14,393) showed that the prevalence of mental health problems (measured with the General Health Questionnaire, GHQ-12) had increased in all examined sociodemographic groups since the outbreak of the pandemic [4]. The results from Germany pointed in the same direction. In the general population, significantly increasing problems in relevant dimensions of mental health during the pandemic were detected in Germany, for example, regarding generalized anxiety, depression, or pandemic-related anxieties [5,6]. There is also research from the early stages of the SARS-CoV-2 pandemic in which a significant increase in depression and generalized anxiety symptomatology could not be empirically detected when longer periods of comparisons were taken into account regarding the aforementioned studies [7].

Stress or burdens can be interpreted as the entirety of influences (e.g., biological, mental, and social) that induce reactions from organisms. The level of strain (e.g., physical, psychological, and behavioral) resulting from stressors depends on an individual's biological, psychological, and social resources [8,9]. In this regard, it is important to be aware that pandemic-related psychological burdens are unevenly distributed among different subgroups of the general population. There is evidence that the implementation of lockdown restrictions to mitigate the spread of SARS-CoV-2 was associated with increased levels of depression and anxiety, which varied in intensity depending on sociodemographic variables. Even recovery from mental health problems differed between subgroups when lockdown restrictions began to be eased. For example, 18–34-year-old participants in a study from April to June 2020, when lockdown restrictions were eased, recovered from existing mental health problems at a mean of 9.5%, whereas 50–64-year-old participants recovered only 2.9% during the same period [4]. The risk factors for mental health problems due to pandemic-related lockdowns were younger age, being female, or living with young children [10].

Being clinically/physically vulnerable to developing complications in the case of a COVID-19 infection seemed to increase mental health problems. Carriers of risk factors had higher levels of mental health problems during the pandemic compared with persons without risk factors [4]. Perceived risk theory [11] offers a framework for categorizing hazards and describes how risk perception is structured. In this framework, risks are described by two factors: dread risk and unknown risk (both containing different subdimensions). On the one hand, the SARS-CoV-2 pandemic could be described as a dreadful, uncontrollable, global, and involuntary risk. On the other hand, the SARS-CoV-2 pandemic appeared to be a new risk with delayed effects, which is not easily observable. In this respect, the pandemic can be considered problematic by both factors; therefore, the resulting risk perception can be considered to be high on average. Individual risk perception might have been even more complex, considering that each person had a more or less known set of risk factors for a severe course of COVID-19. This is relevant since being a carrier of one or more of these risk factors seemingly fueled the emergence or levels of psychological burdens, as described [4].

A noteworthy fact with regard to the sphere of school life is that in March 2020, about 1.5 billion students worldwide—as well as their teachers—were absent from schools as a result of measures to contain the spread of the SARS-CoV-2 virus [12]. Due to closures, teachers in many schools were forced to teach their lessons entirely using digital tools for the first time. Besides the required changes in the teaching mode during periods

of open schools, a multitude of measures to mitigate the spread of SARS-CoV-2 were taken that affected teachers' work lives by expanding and complicating tasks. Together with many other organizational changes in teachers' day-to-day work since the pandemic, the amount of—often abrupt—changes demanded many adjustments, which increased the burnout risk for teachers [13]. With approximately 800,000 to 850,000 teachers in Germany, teachers are a huge occupational group; therefore, targeting teachers' health is relevant to public health. Teachers' health importance is leveraged when taking the number of students into account: teachers are responsible for between 9,000,000 and 10,000,000 individuals [14]. Teachers' health is highly relevant to the socioeconomic system in Germany, too, due to the high number of people dependent on teachers being able to work. During the pandemic, school closures created a cascade of consequences for parents, employees, and companies, since parents had to take care of the children during the otherwise school time. Another important argument for researching teachers' mental health, especially during the SARS-CoV-2 pandemic is that they work in an environment with a high number of interactions per day. At a time when interaction could mean transmission of the SARS-CoV-2 virus, this could have felt like a burden for teachers. Besides these tangible reasons for conducting research on teachers, there are superordinate ones, too. In Germany, we live in a society broadly dependent on the economic output of well-educated people since the possibility of relying on selling natural resources is limited in comparison with other countries. Following that line of thought, well-socialized and educated children are one of the, if not the most important, resources for our society. Beyond other aspects, healthy teachers play a key role in safeguarding and expanding the standard of living. The allocation of resources to research and derived interventions regarding teacher's health therefore seems to be an enterprise that serves multiple worthwhile purposes simultaneously (e.g., better health, education, or prosperity). Especially in Germany, teachers' health is more than just scientifically interesting—it is vital.

As stated before, the pandemic's impacts differed between subgroups in the general population. For example, subgroups of university students showed more mental health problems during the pandemic than others (e.g., women vs. men) [15]. We were highly curious to discover the picture that a data sample of teachers in Germany would give us about the distribution of psychological burdens among subgroups of teachers. This might even be more relevant since there are opposing results indicating that there were no significant differences in mental health outcomes regarding gender or age in teachers [16]. Based on our experiences in supportive and consulting work with teachers and schools during the pandemic, we believe it is plausible to assume that the implementation of pandemic-related measurements and changes came with distinctive problems across school types. If one imagines distance learning or the implementation of hygienic measures in schools, it becomes clear that, for example, elementary schools with close to kindergarten-aged children can be a quite different scenario compared with special needs schools or high schools. Therefore, the additional strains and resulting stress for teachers could also potentially vary. We see our study closing a research gap.

Given the high relevance of teachers in Germany, the present study aimed to (i) investigate the status quo of the psychological burdens of teachers during the SARS-CoV-2 pandemic. We further aimed to (ii) identify subgroups of teachers with higher risks of psychological burdens (e.g., groups divided by gender, age, or risk factors for a severe course of COVID-19). These results for this subgroup analysis may provide a basis for the development of evidence-based and subgroup-specific interventions for the treatment of psychological burdens in German teachers.

2. Method

2.1. Procedure and Study Sample

Between 1 March and 31 March 2021, teachers from all federal states in Germany were invited to participate in an online survey. The participants were recruited with the support of governmental (Ministry of Education in Rhineland-Palatinate) and non-governmental

institutions (Education and Science Workers' Union), teacher-related societies (German Teachers Association), and projects associated with education (Monitor Lehrerbildung). There was a non-monetary incentive (EUR 2000.00 donation to the German Children's Fund) to foster the willingness to participate. Informed written consent was obtained at the beginning of the online survey. The ethical committee of the Medical Association of Rhineland-Palatinate approved the study before it was conducted (application number: 2020-15531).

2.2. Questionnaire and Measures

Participants completed an online questionnaire with approximately 350 items (presented in the online survey tool LimeSurvey), covering a wide range of topics, which were arranged under the following categories: (1) sociodemographic and workplace information; (2) identification of SARS-CoV-2-specific stresses and challenges in schools for teachers; (3) implementation, communication, and compliance with hygiene policies/plans, both general and school-based; (4) impact of school operations during the SARS-CoV-2 pandemic on teachers; and (5) collection of examples of proven interventions and derivation of recommendations for schools. Before being applied in the present study, the questionnaire was pretested and revised in three steps. First, experts from the Institute for Teachers' Health and the Institute for Occupational, Social and Environmental Medicine of the University Medical Center Mainz answered and commented on the questionnaire. After revising the questionnaire, we asked the teachers to take part in a comprehensive probing for the exact understanding and associations of all items. We did this to make sure that the items were understood in the way we intended or were otherwise able to collect suggestions for (mostly minor) linguistic adaptations. After the probing, the questionnaire was revised again, and our team conducted a final (linguistic and grammatical) quality check to eliminate final errors (typing errors).

Dependent variables: Participants were asked to complete the validated German version of the Patient Health Questionnaire 4 [17], an established instrument for the combined screening for symptoms of depression [18] and generalized anxiety disorder [19]. Burnout was measured by two items from the Maslach Burnout Inventory (MBI) [20], which represent the dimensions of (a) emotional exhaustion ("How often do you feel burned out from your work?") and (b) depersonalization ("How often do you feel you have become more callous toward people since you took this job?"). Relative to the full MBI, this two-item solution is optimized in terms of the questionnaire economy and still provides good predictive value [21]. After both burnout items, there was a question regarding the delta relative to pre-pandemic times ("How would you describe this aspect in comparison to before the COVID-19 pandemic?"). A 5-point Likert scale was used, ranging from "(1) Currently much more often than before the COVID-19 pandemic" to "(5) Currently much less often than before the COVID-19 pandemic." To measure COVID-19-associated anxieties, participants rated items on a scale from 0 (no anxiety) to 100 (powerful anxiety). The items covered the anxiety of getting infected ("How strong is your fear of being infected with the SARS-CoV-2 virus?"), anxiety about infecting others ("How strong is your fear of becoming a transmitter of the SARS-CoV-2 virus yourself, that is, infecting others around you with the corona virus?"), and anxiety about infecting close people ("How strong is your fear of friends or loved ones becoming infected with the SARS-CoV-2 virus?"). We were given permission to use these items, which have also been used in other studies [22,23].

Independent variables: Sociodemographic variables (sex, age, or number of persons in household), work-related variables (part-time vs. full-time, member of school administration team, or school type), and health-related variables (COVID-19 risk factors) were surveyed. Age (in years, range 18–67) was converted into four quartiles for further analysis. Following official recommendations [24] and with the involvement of medical experts, eight personal risk factors for a severe course of COVID-19 disease were identified, and items were generated. All risk factor items began with the stem question: "Which of the currently known risk factors for a severe course of the COVID-19 disease apply to you," on the basis of which

specific risks were added, for example, “*cardiovascular disease with severely impaired cardiac pumping function of the heart or consequential damage (e.g., heart failure or coronary heart disease).*” Response options were “yes,” “no,” and “no answer.” The number of “yes” responses was counted and summarized on a “risk factor scale” ranging from 0 to 8. Because of the low number of participants having more than two of these severe risk factors, we combined 2–8 risk factors into a 2+ category for further analysis. Our classification of school types was based on the official classification of the federal government [25].

2.3. Statistical Analyses

Statistical analysis was performed using SPSS Statistics Version 27 [26]. Descriptive analyses were conducted to (i) demonstrate sample characteristics and (ii) identify subgroups of teachers with increased psychological burdens. Analyses of variance (ANOVA) and Tukey’s post hoc tests were calculated to assess the differences in psychological burdens between the subgroups. Our interpretation of the ANOVAs followed the classification of effect sizes as small (0.01), medium (0.06), and large (0.14), as suggested by Cohen [27].

3. Results

A total of 39,359 teachers participated in the online survey. After data cleansing, a sample of $N = 31,089$ was used for further analysis. Of the participants, 77.5% were female, 22.0% male, and 0.4% diverse. The average age of the participants was 45.8 years (± 10.5). Detailed sample characteristics are displayed in Table 1. An overview of mean values and standard deviations for the dependent and independent variables, as well as the results for differences in subgroups of teachers (ANOVA), can be found in Table 2.

Table 1. Sample characteristics.

Subgroups	<i>n</i>	%	<i>M (SD)</i>
Gender	31,089	100%	
Female	24,099	77.5%	
Male	6851	22.0%	
Diverse	139	0.4%	
Age (years)	31,089	100%	45.78 (10.46)
18–30	2473	8.0%	
31–43	10,957	35.2%	
44–55	10,799	34.7%	
56–67	6860	22.1%	
Work schedule ^a	30,959	100%	
Part-time	12,297	39.7%	
Full-Time	18,662	60.3%	
School management	30,981	100%	
Yes	3290	10.6%	
No	27,691	89.4%	
Persons in household ^b	30,706	100%	2.73 (1.24)
1	4540	14.8%	
2	11,373	37.0%	
3	5538	18.0%	
4	6844	22.3%	
5+	2411	7.9%	
School type ^c	27,960	100%	
Primary	9030	32.3%	
Secondary general	539	1.9%	
Secondary Academic	2162	7.7%	
secondary secondary	5451	19.5%	
Comprehensive	4016	14.4%	

Table 1. Cont.

Subgroups	<i>n</i>	%	<i>M</i> (<i>SD</i>)
Special needs	2969	9.6%	
Vocational	2699	9.7%	
Other	1367	4.9%	
Risk factors	21,654	100%	0.17 (0.45)
0	18,586	85.8%	
1	2428	11.2%	
2+	640	3.0%	

^a Reflects the number, percentage, and mean values of participants answering the questions. The number of participants (*n*) may differ between items because responding was voluntary, and therefore not all participants answered all items. ^b Including the answering participant. ^c Multiple responses were possible; only participants with exactly one school type selected were included in the table for further analyses.

3.1. Level of Burdens

Teachers with two or more risk factors showed the highest mean value for **depression symptoms** ($M = 2.34$, $SD = 1.65$), whereas teachers working in special needs schools showed the lowest ($M = 1.61$, $SD = 1.34$). Regarding **generalized anxiety**, again, teachers with two or more risk factors for a severe course of COVID-19 showed the highest burdens ($M = 2.59$, $SD = 1.89$), whereas the lowest burdens were found in male teachers ($M = 1.60$, $SD = 1.52$). **Emotional exhaustion** was highest in teachers with two or more risk factors for a severe course of COVID-19 ($M = 3.33$, $SD = 1.80$) and lowest in teachers working in special needs schools ($M = 2.29$, $SD = 1.66$). The **pre/during pandemic change in emotional exhaustion** was biggest for teachers in primary schools ($M = 3.91$, $SD = 0.86$) and lowest for teachers in special needs schools ($M = 3.58$, $SD = 0.89$). **Depersonalization** was highest among teachers with two or more risk factors for a severe course of COVID-19 ($M = 1.47$, $SD = 1.82$) and lowest for teachers at special needs schools ($M = 0.79$, $SD = 1.34$). The **pre/during pandemic change in depersonalization** was biggest for teachers with two or more risk factors for a severe course of COVID-19 ($M = 3.39$, $SD = 0.83$) and lowest for teachers working in special needs schools ($M = 3.21$, $SD = 0.60$). The **anxiety of getting infected with SARS-CoV-2** was highest in teachers with two or more risk factors for a severe course of COVID-19 ($M = 67.52$, $SD = 26.52$), whereas members of the school management team showed the lowest anxiety ($M = 45.62$, $SD = 27.84$). The highest **anxiety of transmitting SARS-CoV-2 to others** was found in the first age quartile of teachers (18–30 years, $M = 75.10$, $SD = 24.42$), whereas the lowest anxiety was found in the fourth quartile of teachers (56–67 years, $M = 54.59$, $SD = 30.31$). The highest **anxiety of friends or loved ones becoming infected with SARS-CoV-2** was found in the first age-quartile of teachers (18–30 years, $M = 71.06$, $SD = 25.32$), and the lowest anxiety was found in male teachers ($M = 56.67$, $SD = 29.43$).

3.2. Subgroup Differences

The biggest differences in the mean values of **depression symptoms** were found when the number of risk factors for a severe course of a COVID-19 disease was used to divide into subgroups: $F(2, 21348) = 72.18$, $p < 0.001$, $\eta^2 = 0.007$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of depression symptoms for subgroups of risk factors. Mean values increased from no risk factor to one risk factor (+0.28, 95%-CI[0.20, 0.35]) and no risk factor to two or more risk factors (+0.50, 95%-CI[0.37, 0.64]).

With regard to **generalized anxiety symptoms**, the biggest differences were found when divided into subgroups by gender: $F(2, 21470) = 228.17$, $p < 0.001$, $\eta^2 = 0.021$. Tukey's test revealed significant differences ($p < 0.05$) between mean values of generalized anxiety symptoms for subgroups by gender. Mean values increased from males to females (+0.58, 95%-CI[0.52, 0.64]) and from males to diverse (+0.50, 95%-CI[0.05, 0.94]).

Table 2. Psychological burdens in different subgroups of German teachers during the SARS-CoV-2 pandemic.

Variables	PHQ-2 β	GAD-2 β	EE γ	Δ EE γ	DP γ	Δ DP γ	Anxiety-i δ	Anxiety-t δ	Anxiety-o δ
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Gender α									
F	38.84 ***	228.17 ***	111.92 ***	68.33 ***	16.54 ***	4.15 *	124.80 ***	175.31 ***	176.53 ***
η^2	0.004	0.021	0.011	0.006	0.002	0.000	0.012	0.016	0.016
Female ^a	1.93 (1.44) ^b	2.18 (1.67) ^b	2.75 (1.76) ^b	3.83 (0.90) ^{b,c}	1.04 (1.56) ^b	3.29 (0.69) ^b	53.19 (27.82) ^b	65.47 (29.22) ^b	65.52 (28.09) ^b
Male ^b	1.72 (1.40) ^{a,c}	1.60 (1.52) ^{a,c}	2.31 (1.74) ^a	3.66 (0.87) ^a	1.19 (1.64) ^a	3.33 (0.70) ^a	45.89 (28.78) ^a	56.29 (30.53) ^a	56.67 (29.43) ^a
Diverse ^c	2.25 (1.82) ^b	2.09 (1.81) ^b	2.75 (1.91)	3.56 (0.85) ^a	1.12 (1.60)	3.26 (0.74)	48.70 (29.40)	58.51 (33.24)	57.82 (34.33)
Age (years)									
F	16.76 ***	3.06 *	1.15 (ns)	6.87 ***	21.27 ***	8.93 ***	3.82 **	356.25 ***	143.60 ***
η^2	0.002	0.000	0.000	0.001	0.003	0.001	0.001	0.048	0.020
18–30 ^a	2.01 (1.43) ^{c,d}	2.09 (1.65)	2.63 (1.69)	3.72 (0.89) ^{b,c}	1.11 (1.58) ^d	3.30 (0.68)	52.31 (26.80)	75.10 (24.42) ^{b,c,d}	71.06 (25.32) ^{b,c,d}
31–43 ^b	1.94 (1.43) ^{c,d}	2.02 (1.65)	2.67 (1.75)	3.81 (0.91) ^{a,d}	1.18 (1.64) ^{c,d}	3.33 (0.71) ^{c,d}	52.36 (28.17) ^c	69.77 (27.81) ^{a,c,d}	67.60 (27.66) ^{a,c,d}
44–55 ^c	1.88 (1.47) ^{a,b,d}	2.09 (1.69)	2.67 (1.80)	3.81 (0.89) ^{a,d}	1.06 (1.58) ^{b,d}	3.29 (0.68) ^b	50.88 (28.47) ^b	61.44 (30.05) ^{a,b,d}	61.88 (29.08) ^{a,b,d}
56–67 ^d	1.78 (1.40) ^{a,b,c}	2.02 (1.62)	2.62 (1.79)	3.77 (0.86) ^{b,c}	0.94 (1.49) ^{a,b,c}	3.27 (0.67) ^b	51.38 (28.19)	54.59 (30.31) ^{a,b,c}	58.49 (29.00) ^{a,b,c}
Work schedule									
F	12.90 ***	89.63 ***	5.15 *	2.12 (ns)	14.18 ***	14.76 ***	0.38 (ns)	0.89 (ns)	0.17 (ns)
η^2	0.001	0.004	0.000	0.000	0.001	0.001	0.000	0.000	0.000
Part-time	1.93 (1.43)	2.18 (1.66)	2.69 (1.73)	3.78 (0.91)	1.02 (1.55)	3.28 (0.66)	51.73 (27.71)	63.18 (29.41)	63.46 (28.14)
Full-Time	1.86 (1.44)	1.96 (1.65)	2.63 (1.79)	3.80 (0.88)	1.10 (1.59)	3.32 (0.71)	51.49 (28.51)	63.58 (30.00)	63.63 (28.96)
School management									
F	61.45 ***	22.47 ***	17.12 ***	35.77 ***	1.80 (ns)	9.44 **	116.49 ***	76.89 ***	84.43 ***
η^2	0.003	0.001	0.001	0.002	0.000	0.000	0.005	0.004	0.004
Yes	1.66 (1.40)	1.90 (1.63)	2.51 (1.79)	3.90 (0.84)	1.03 (1.50)	3.34 (0.71)	45.62 (27.84)	58.30 (31.08)	58.39 (29.84)
No	1.91 (1.44)	2.07 (1.66)	2.67 (1.77)	3.78 (0.90)	1.08 (1.59)	3.30 (0.69)	52.30 (28.16)	64.07 (29.54)	64.20 (28.43)

Table 2. Cont.

Variables	PHQ-2 β		GAD-2 β		EE γ		Δ EE γ		DP γ		Δ DP γ		Anxiety-i δ		Anxiety-t δ		Anxiety-o δ	
	M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)	
Persons in household																		
F	17.42 ***		6.21 ***		7.43 ***		9.04 ***		3.77 **		1.52 (ns)		11.54 ***		2.98 **		2.27 *	
η^2	0.003		0.001		0.001		0.002		0.001		0.000		0.002		0.001		0.000	
1 ^a	2.07 (1.50)	b,c,d,e	2.17 (1.68)	b,d,e	2.78 (1.77)	b,d,e	3.78 (0.91)	d	1.14 (1.60)	b,d	3.31 (0.72)		52.01 (28.14)	e	62.18 (29.93)	d	63.87 (28.81)	
2 ^b	1.87 (1.45) ^a		2.03 (1.66)	a	2.64 (1.78)	a	3.75 (0.90)	c,d,e	1.04 (1.56)	a	3.29 (0.68)		52.39 (27.91)	d,e	63.52 (29.84)		63.93 (28.45)	e
3 ^c	1.87 (1.45) ^a		2.08 (1.69)		2.70 (1.78)	e	3.81 (0.90)	b	1.12 (1.60)		3.30 (0.70)		52.62 (28.37)	d,e	63.80 (29.78)		63.92 (28.58)	
4 ^d	1.84 (1.38) ^a		2.00 (1.62)	a	2.60 (1.74)	a	3.85 (0.86)	a,b	1.03 (1.55)	a	3.31 (0.68)		50.35 (28.05)	b,c,e	64.47 (29.11)	a	63.33 (28.45)	
5 ^{+e}	1.79 (1.37) ^a		2.00 (1.66)	a	2.52 (1.76)	a,c	3.82 (0.87)	b	1.10 (1.61)		3.33 (0.68)		48.05 (29.39)	a,b,c,d	63.02 (30.64)		61.69 (29.69)	b
School type																		
F	12.26 ***		22.78 ***		26.31 ***		32.86 ***		12.44 ***		7.00 ***		7.34 **		10.97 ***		8.35 ***	
η^2	0.004		0.008		0.010		0.012		0.005		0.003		0.003		0.004		0.003	
Primary ^a	1.91 (1.45) ^f		2.25 (1.68)	b,c,d,e,f,g,h	2.86 (1.79)	b,c,d,e,f,g,h	3.91 (0.86)		1.09 (1.60)	f	3.33 (0.71)	f	52.57 (28.23)	f	65.38 (29.46)	d,f,g	65.31 (28.48)	d,f,g
Secondary General ^b	1.93 (1.43) ^f		1.94 (1.66) ^a		2.53 (1.77) ^a		3.69 (0.94) ^a		1.13 (1.63)	f	3.27 (0.67)		54.15 (28.79)	f	63.89 (29.54)		63.63 (27.44)	
Secondary ^c	1.92 (1.42) ^f		2.00 (1.64) ^{a,f}		2.62 (1.74) ^{a,f}		3.73 (0.94) ^{a,d,f}		1.21 (1.68)	d,f	3.30 (0.74) ^f		53.82 (28.34)	d,f,g	62.95 (30.64)	g	63.49 (29.16)	g
Academic Secondary ^d	1.95 (1.43) ^{f,g}		2.04 (1.68) ^{a,f,g}		2.61 (1.75) ^{a,f}		3.82 (0.89) ^{a,c,e,f}		1.02 (1.55)	c,e,f	3.29 (0.68) ^f		50.97 (28.08)	c,f	62.24 (29.73)	a,g	63.34 (28.37)	a,g
Comprehensive ^e	1.94 (1.44) ^f		2.02 (1.65) ^{a,f,g}		2.67 (1.76) ^{a,f,g}		3.75 (0.92) ^{a,d,f}		1.17 (1.62)	d,f	3.29 (0.71) ^f		52.70 (28.11)	f	64.19 (29.67)	g	64.10 (28.45)	g
Special needs ^f	1.61 (1.34) ^{a,b,c,d,e,g,h}		1.80 (1.55) ^{a,c,d,e}		2.29 (1.66) ^{a,c,d,e,g,h}		3.58 (0.89) ^{a,c,d,e,g,h}		0.79 (1.34) ^{a,b,c,d,e,g,h}		3.21 (0.60) ^{a,c,d,e,g}		48.49 (27.26) ^{a,b,c,d,e}		62.50 (29.08)	a,g	62.09 (28.38)	a
Vocational ^g	1.81 (1.47) ^{d,f}		1.87 (1.64) ^{a,d,e}		2.48 (1.78) ^{a,e,f}		3.75 (0.85) ^{a,f}		1.15 (1.60) ^f		3.34 (0.69) ^f		50.53 (28.62) ^c		59.05 (30.81) ^{a,c,d,e,f,h}		60.03 (29.21) ^{a,c,d,e}	
Other ^h	1.89 (1.48) ^f		1.98 (1.64) ^a		2.62 (1.79) ^{a,f}		3.75 (0.95) ^{a,f}		1.03 (1.56) ^f		3.27 (0.68)		50.87 (28.57)		62.79 (30.04) ^g		62.47 (29.54)	

Table 2. Cont.

Variables	PHQ-2 β		GAD-2 β		EE γ		Δ EE γ		DP γ		Δ DP γ		Anxiety-i δ		Anxiety-t δ		Anxiety-o δ		
	M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		M (SD)		
Risk factors																			
F	72.18 ***		94.76 ***		114.19 ***		13.28 ***		31.53 ***		5.92 **		295.14 ***		2.76 (ns)		27.26 ***		
η^2	0.007		0.009		0.011		0.001		0.003		0.001		0.027		0.000		0.003		
0 ^a	1.84 (1.41) b,c		1.99 (1.63) b,c		2.58 (1.75) b,c		3.78 (0.89) b,c		1.04 (1.55) b,c		3.30 (0.68) ^c		49.67 (27.93) b,c		63.21 (29.77)		62.93 (28.80) b,c		
1 ^b	2.11 (1.55) a,c		2.38 (1.73) a,c		3.03 (1.80) a,c		3.87 (0.92) a		1.21 (1.69) a,c		3.32 (0.74)		61.41 (27.24) a,c		64.62 (29.57)		66.76 (27.37) a		
2+ ^c	2.34 (1.65) a,b		2.59 (1.89) a,b		3.33 (1.80) a,b		3.88 (0.94) a,b		1.47 (1.82) a,b		3.39 (0.83) a		67.52 (26.52) a,b		64.54 (30.79)		68.23 (27.58) a		

^a (ns) = non-significant on $p > 0.05$ level, * p -value < 0.05 , ** p -value < 0.01 , *** p -value < 0.001 , F = F-value, η^2 = Eta squared, degree of freedom = number of subgroups – 1. ^b Depression symptoms: PHQ-2 (0–3), generalized anxiety symptoms: GAD-2 (0–3). ^c Burnout items: EE = emotional exhaustion (0–6), DP = depersonalization (0–6), as well as Δ EE/ Δ DP (0–5) for the change in the respective items relative to pre-pandemic times. ^d COVID-19 associated anxieties items (0–100): Anxiety-i = anxiety of own infection, Anxiety-t = anxiety of transmitting infection to others, Anxiety-o = anxiety of friends of loved ones becoming infected. ^{a–h} significant differences in Tukey's test with group(s): ^{a–h} (p -value < 0.05); Tukey's test conducted only for subgroups $n > 2$.

The biggest differences in **emotional exhaustion** were found when divided into subgroups by gender: $F(2, 20937) = 111.92, p < 0.001, \eta^2 = 0.011$; and risk factors for a severe course of COVID-19: $F(2, 20788) = 114.19, p < 0.001, \eta^2 = 0.011$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of emotional exhaustion for males and females. Mean values increased from males to females (+0.44, 95%-CI[0.37, 0.51]). Since the effect-size for the differences between subgroups by gender was equal to subgroups by risk factors for a severe course of COVID-19, Tukey's test was conducted too. Mean values of emotional exhaustion increased from no risk factor to one risk factor (+0.45, 95%-CI[0.36, 0.54]) and from no risk factor to two or more risk factors (+0.75, 95%-CI[0.58, 0.92]).

Regarding the **pre/during pandemic change in emotional exhaustion**, the biggest differences were found between teachers at different school types: $F(7, 18925) = 32.86, p < 0.001, \eta^2 = 0.012$. Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of the pre/during pandemic change in emotional exhaustion for teachers working in primary schools compared with other school types. Mean values from primary school to special needs school showed the biggest difference (−0.32, 95%-CI[−0.40, −0.25]). Mean values from primary school to secondary general school showed the second biggest difference (−0.22, 95%-CI[−0.37, −0.07]), followed by primary school to secondary school (−0.18, 95%-CI[−0.25, −0.10]), primary school to comprehensive school (−0.16, 95%-CI[−0.22, −0.10]), primary school to vocational school (−0.16, 95%-CI[−0.23, −0.89]) and primary school to other school (−0.16, 95%-CI[−0.25, −0.06]). The difference in mean values from primary school to academic secondary school (−0.09, 95%-CI[−0.14, −0.03]) was the smallest.

With respect to the level of **depersonalization**, school type was the subgroup division that showed the biggest differences: $F(7, 17866) = 12.44, p < 0.001, \eta^2 = 0.005$. Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of depersonalization for teachers working in special needs schools compared with other school types. Mean values from special needs school to secondary school showed the biggest difference (+0.42, 95%-CI[0.25, 0.59]). Mean values from special needs school to comprehensive school showed the second biggest difference (+0.38, 95%-CI[0.23, 0.52]), followed by special needs school to vocational school (+0.36, 95%-CI[0.20, 0.52]), special needs school to secondary general school (+0.34, 95%-CI[0.06, 0.62]), special needs school to primary school (+0.30, 95%-CI[0.17, 0.43]) and special needs school to other school (+0.24, 95%-CI[0.04, 0.44]). The difference in mean values from special needs school to academic secondary school (+0.23, 95%-CI[0.09, 0.37]) was the smallest.

Differences in the **pre/during pandemic change in depersonalization** were greatest between teachers at different school types: $F(7, 18038) = 7.00, p < 0.001, \eta^2 = 0.003$.

Tukey's post hoc test revealed the highest number of significant differences ($p < 0.05$) between mean values of the pre/during pandemic change in depersonalization in teachers working in special needs schools compared with other school types. Mean values from special needs school to vocational school showed the biggest difference (+0.13, 95%-CI[0.06, 0.20]). Mean values from special needs school to primary school showed the second biggest difference (+0.12, 95%-CI[0.06, 0.17]), followed by special needs school to secondary school (+0.09, 95%-CI[0.01, 0.16]), special needs school to comprehensive school (+0.08, 95%-CI[0.02, 0.14]) and special needs school to academic secondary school (+0.07, 95%-CI[0.01, 0.13]). The differences in mean values from special needs school to secondary general school and other school were non-significant.

The number of risk factors for a severe course of COVID-19 was the subdivision of teachers in which the **anxiety of getting infected with SARS-CoV-2** was most clearly visible: $F(2, 21291) = 295.14, p < 0.001, \eta^2 = 0.027$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of the anxiety of getting infected with SARS-CoV-2 for subgroups of risk factors. Mean values increased from no risk factor to one risk factor (+11.74, 95%-CI[13.16, 10.32]) and no risk factor to two or more risk factors (+17.85, 95%-CI[15.20, 20.49]).

The difference in the **anxiety of transmitting SARS-CoV-2 to others** was biggest between the four age-quartiles of teachers: $F(3, 21170) = 356.25, p < 0.001, \eta^2 = 0.048$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of the anxiety of transmitting SARS-CoV-2 to others for subgroups of age quartiles. Mean values decreased from 18–30 years to 31–43 years ($-5.33, 95\%-CI[-7.50, -3.16]$), 18–30 years to 44–55 years ($-13.66, 95\%-CI[-15.81, -11.52]$) and 18–30 years to 56–67 years ($-20.51, 95\%-CI[-22.74, -18.28]$).

Subgroup differences in the **anxiety of friends or loved ones becoming infected with SARS-CoV-2** were biggest between the four age-quartiles of teachers: $F(3, 21161) = 143.60, p < 0.001, \eta^2 = 0.020$. Tukey's post hoc test revealed significant differences ($p < 0.05$) between mean values of anxiety of friends or loved ones becoming infected with SARS-CoV-2 for subgroups of age quartiles. Mean values decreased from 18–30 years to 31–43 years ($-3.46, 95\%-CI[-5.57, -1.35]$), 18–30 years to 44–55 years ($-9.18, 95\%-CI[-11.27, -7.09]$) and 18–30 years to 56–67 years ($-12.57, 95\%-CI[-14.75, -10.40]$).

4. Discussion

The present study aimed to (i) investigate the status quo of the psychological burdens of German teachers during the SARS-CoV-2 pandemic. Another goal was to analyze psychological burdens in particularly strained groups of teachers by (ii) identifying subgroups with higher risks. The results of this subgroup analysis may provide a basis for the development of evidence-based and subgroup-specific interventions for the treatment of psychological burdens in German teachers.

4.1. Level of Burdens and Comparisons Pre/during Pandemic and Teachers/General Population

During the SARS-CoV-2 pandemic in Germany, we detected comparatively high levels of psychological burdens of teachers. For example, comparing the depression symptoms (PHQ-2) of our teacher sample with those of a representative sample from the general population [6], female teachers ($M = 1.93$ vs. 1.24) and male teachers ($M = 1.72$ vs. 1.03) on average showed higher levels of burdens compared with females and males in the general population. The same pattern emerged when comparing the scores for generalized anxiety. In a comparison of our teacher sample with the aforementioned general population sample, female teachers ($M = 2.18$ vs. 1.19) and male teachers ($M = 1.60$ vs. 0.89) on average expressed higher levels of generalized anxiety (GAD-2) compared with the general population. Unfortunately, we had no access to during-pandemic representative data from the general population containing diverse persons for our outcome variables; therefore, comparisons are restricted to a binary level here.

Since in our study we used a two-item solution to approximate MBI burnout, comparisons with other studies were difficult. It is still possible to show the direction of the perceived change pre/during the pandemic, since teachers were asked questions directly regarding the change in emotional exhaustion and depersonalization. Regarding emotional exhaustion, the presented results show that the mean values for the delta question in all subgroups ranged above the scale mean of three, pointing in the direction of increased emotional exhaustion since the beginning of the SARS-CoV-2 pandemic. The same holds true for depersonalization. Again, all mean values ranged above the scale mean, which indicated an increase in depersonalization during the course of the pandemic.

Regarding corona-associated anxieties, the best approximation for a comparison of our data with the general population data was possible for the questions used in our study, "How strong is your fear of being infected with the SARS-CoV-2 virus?" and "Please rate your anxiety about the coronavirus" (both 0–100), which was used by Jungmann and Witthöft [22]. The respective means were 51.58 (SD 28.20) and 47.18 (SD 27.12). Teachers showed higher mean values for corona-associated anxiety than the sample from the general population [22]. The comparison is weakened insofar as different wordings were used and the surveys were one year apart (March 2020 vs. 2021). We think it is still possible to carefully interpret the higher corona-associated anxiety that the teachers expressed

during the pandemic, as the higher values here line up with the higher values for the other psychological burdens mentioned. The risk of getting infected with COVID-19 most likely was lower for teachers in Germany in 2020 (when strict pandemic mitigating measures in schools were applied) relative to the general population [28]. The perceived risk, however—and therefore a potential parameter in the psychological processes of the genesis of corona-associated anxieties—seems to have been higher in teachers. This accelerated risk perception may have been amplified due to a vivid debate in the media regarding the role of schools as drivers of the pandemic.

4.2. Subgroup Differences

After determining the absolute level of psychological burdens and comparing them to general population samples and pre-pandemic times, the next point of interest was the analysis of subgroup differences in the dependent variables.

As the ANOVA results demonstrated, there were many significant differences in the levels of depression symptoms (PHQ-2) in all the considered subgroups of teachers. However, the differences revealed were small in terms of the effect sizes. The most accentuated difference was seen when teachers were subdivided based on the number of risk factors for a severe course of COVID-19 ($\eta^2 = 0.007$). Most teachers did not have a risk factor for a severe course of COVID-19 (85.8%), which corresponded with fewer depression symptoms ($M = 1.84$, $SD = 1.41$) compared with having one risk factor ($M = 2.11$, $SD = 1.55$) or two or more ($M = 2.34$, $SD = 1.65$). Having risk factors was associated with more psychological burdens from depression symptoms. These included not only having to isolate oneself during the pandemic due to lockdown restrictions, but also having a severely increased risk of harm in case of an infection seemed to promote depression symptoms in teachers.

Regarding the symptoms of generalized anxiety (GAD-2), there were significant differences in all the considered subgroups of teachers. Subdivided by gender, the biggest effect on the symptoms of generalized anxiety was found ($\eta^2 = 0.021$). This is still considered a small effect. Female teachers showed the highest mean value ($M = 2.18$) in the GAD-2 scores, followed by diverse ($M = 2.09$) and male teachers ($M = 1.60$). The disproportional distribution we found in our teacher sample is in line with other studies showing that females have considerably higher lifetime (1:1.9) and 12-month (1:2.2) prevalence ratios for generalized anxiety disorders [29] than men.

The levels of emotional exhaustion differed significantly in all analyzed subgroups, except for the division in quartiles of age. This result is interesting insofar as the results from a pre-pandemic study indicate that there were age-related differences in psychological burdens, such as burnout, in teachers in Germany. The highest incidence of burnout was found in teachers in the range of 50–59 years of age (6.6%) and the lowest within 18–29 years of age (1.4%) [30]. It might be that the levels of burnout in the different age quartiles were “equalized” by the SARS-CoV-2 pandemic since it fundamentally disrupted and stressed the professional and private lives of teachers equally without sparing any age group. As in depression symptoms, the most accentuated difference in emotional exhaustion was found when teachers were subdivided based on the number of risk factors for a severe course of COVID-19 ($\eta^2 = 0.011$). Living a private life and working as a teacher during the pandemic while having a severely increased risk of harm in the case of an infection seemed to amplify the levels of emotional exhaustion in teachers. The mean values for emotional exhaustion support this perspective, since teachers with no risk factors showed the lowest ($M = 2.58$, $SD = 1.75$), teachers having one risk factor in the middle ($M = 3.03$, $SD = 1.80$) and teachers with or more than two risk factors had the highest ($M = 3.33$, $SD = 1.80$) levels of emotional exhaustion. Regarding the pre/during pandemic change in emotional exhaustion, subgroups of teachers subdivided by school type differed the most ($\eta^2 = 0.012$) compared with the other subdivisions conducted in the study. As stated earlier, different school types were affected differently by the impact of the pandemic. One can easily imagine how different a day of teaching in an elementary school, a special needs school, and an academic secondary school might look like under normal circumstances;

add extensive anti-pandemic measures and COVID-19-related uncertainties for all persons involved, and the differences between school types are unlikely to shrink.

It was noticeable that the level of depersonalization (independent of subgroups) was far below the level of emotional exhaustion, even though the items used the same wording for the answers. This may be an indication that for teachers, having good and respectful contact with their students was important and that teachers were more prone to exhaust themselves emotionally than to become cynical about their students' needs. When assessing subgroup differences in depersonalization, only the subdivision by school management membership did not reveal significant differences. Depersonalization differed the most between school types ($\eta^2 = 0.005$). Teachers in secondary schools expressed the highest mean values for depersonalization ($M = 1.21$, $SD = 1.69$), and teachers in special needs schools expressed the lowest ($M = 0.79$, $SD = 1.34$). Explanations for differences in depersonalization between school types are difficult to derive. One possibility arose from the accompanying qualitative research (not all school types were included) that we conducted [31]. In this context, we talked to a group of teachers from a special needs school and were therefore able to cautiously formulate the hypothesis that the lower levels of depersonalization might be because most teachers in special needs schools are working in smaller classes and are likelier to medically supervise their students and therefore may have closer relationships with students, which might keep the level of depersonalization comparatively low. Regarding the pre/during pandemic change in depersonalization, no significant differences in subdivision by number of persons in the household were found. All other ANOVAs showed significant subgroup differences, with the biggest effect for the subdivision by school type ($\eta^2 = 0.003$). Teachers from vocational schools reported the highest ($M = 3.34$, $SD = 0.69$) and teachers from special needs schools the lowest ($M = 3.21$, $SD = 0.60$) pre/during pandemic change in depersonalization. The line of potential explanation overlaps heavily with depersonalization. To avoid redundancies, this part is not repeated.

Before discussing the subgroup results for the three corona-associated anxieties considered (getting infected, infecting others, and infection of close people) independently, it is noticeable that subdividing by working schedule (full-time vs. part-time) did not reveal significant differences in any of them. The lesson learned from that is that, independent of how many hours teachers had to work in schools during the pandemic, the levels of corona-associated anxieties were the same. Unsurprisingly, regarding the anxiety of getting infected, when subdividing by the number of risk factors for a severe course of COVID-19, teachers with 2+ risk factors ($M = 67.52$, $SD = 26.52$) exceeded the level of anxiety of teachers with one ($M = 61.41$, $SD = 27.24$) or none ($M = 49.67$, $SD = 27.93$). We think that this result is self-explanatory because it is in line with a realistic risk perception. The effect size for this subgroup comparison exceeded the size of the others ($\eta^2 = 0.027$). The data regarding the anxiety of getting infected also showed that teachers working on the school management team were significantly less anxious compared with teachers who did not. This might be explained by the fewer hours school management team members have to spend in a classroom, where the risk perception may be more tilted toward a higher risk of infection. Another explanation could be that, by being responsible for the school and, therefore, the health of their employees and students, individual fears possibly faded from perception. The differences in the anxiety to infect others were most accentuated when subdividing by age quartiles ($\eta^2 = 0.048$). The same holds true for the anxiety of infections of close people here, too; by subdivision in age quartiles, the most accentuated group effects were found ($\eta^2 = 0.020$). For both anxieties, the subgroup differences considered had the same direction; that is, younger teachers reported higher levels of anxiety than their older colleagues. The decrease in anxiety about infecting others with age might be explained partly because teachers in their twenties are exposed to more risk contacts during leisure time compared with teachers who are close to retirement. The pattern that was harder to explain was a decrease in anxiety regarding the infection of people close in age. A partial explanation might lie in the order of the questions since both questions were presented in the order

used in this paper. When first asked about the level of anxiety of becoming a transmitter of the SARS-CoV-2 virus, the idea of being someone who could transmit the virus might have gotten primed. Being asked about the anxiety of close people getting infected next might have unconsciously included the idea of oneself being a potential transmitter.

What surprised us was the result that teachers in special needs schools showed lower levels of psychological burdens across all variables considered. Teaching in an environment that can be described as having smaller classes and a potentially higher focus on the individual needs of students might have buffered—at least to some extent—against the burdens of the pandemic. An alternative explanation for the lower psychological burdens of teachers working in special needs schools might be self-selection. Future studies should analyze the specific factors that made teaching in special needs schools during the pandemic less psychologically burdening.

Overall, the results of the ANOVAs conducted showed that, on the one hand, significant subgroup differences were detected; on the other hand, only small effect sizes regarding subgroup differences were found. Even the biggest effect size found in our study, subdivision by age regarding the corona-associated anxiety of transmitting an infection ($\eta^2 = 0.048$), should be considered small.

4.3. Limitations and Future Studies

The cross-sectional design of the present study limited its potential to describe and explain the emergence and change in the psychological burdens considered. Longitudinal monitoring of teachers' health in Germany is a goal that we were unable to achieve. The comparisons between teachers and the general population conducted in the present study relied on relatively short (pre-/during pandemic) periods of time. Therefore, it was not possible to identify long-term trends. With the cross-sectional design comes the heightened relevance of the specific timing of the survey. Our study took place during the "third wave of SARS-CoV-2" in Germany, when pandemic-mitigating measures were in place ("lockdown light") to counter rising infection numbers and a—at the time—relatively new and easier-to-spread virus variant of concern (B.1.1.7) [32]. This context might have exacerbated risk perception and led to the amplified psychological strains we detected. Since teachers in Germany are predominantly female, there is a gender imbalance in our sample with females (77.5%) outweighing males (22.0%) and diverse persons (0.4%). Another limiting factor regarding comparisons with other studies was the lack of data for diverse persons, since the availability of such data was—and still is—limited.

5. Conclusions and Recommendations

Our research can serve as a base for future studies, since it provides a broad-scale (N = 31,089) actual statement on the mental health of teachers in Germany. Furthermore, our subgroup analysis revealed details about which groups of teachers were especially burdened in different dimensions of mental health. By these attributes, our data offer considerable help to derive evidence-based interventions for teachers' most relevant mental health challenges—tailored to specific subgroups.

To conclude, we share our thoughts regarding the question: What are the lessons learned? As our comparisons with the general population indicated, teachers in Germany showed relatively high levels of psychological burdens, which most likely were amplified during the SARS-CoV-2 pandemic. Additionally, the results of our study indicate that psychological burdens in teachers were unevenly distributed among subgroups. Therefore, it is worth diving deep into subgroup analysis and identifying especially vulnerable subgroups of teachers to enable deriving interventions that extinguish fire where it burns the brightest. To name a few, teachers with risk factors for a severe course of COVID-19 should receive special attention and support, given their elevated burdens on mental health. Since teachers working at special needs schools showed lower levels of psychological burdens than teachers at other school types, differing structural elements that promote mental health should be identified (e.g., fewer students per teacher) and transferred to other school types. More

depression symptoms in younger teachers, compared with their older colleagues, indicate that countermeasures, such as offers for counselling or training in relaxation techniques, could be useful and appropriate for addressing threats to their mental health. However, in addition to specific pandemic-related psychological stresses, the classic occupational health challenges of physical, biological, and chemical burdens and their resulting strains should not be disregarded. We encourage political decision makers to take these results seriously and derive interventions accordingly. We are open to supporting such interventions with the best of our study results and knowledge. Psychologically burdened teachers are not only feeling human beings who deserve help to mitigate their suffering, they are the providers of valuable resources for a prospering future well-socialized and educated children.

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Implementation of occupational safety and health measures at German schools during the SARS-CoV-2 pandemic – cross-sectional results from 31,089 teachers

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11 **Keywords:** occupational safety and health, schools, teachers, SARS-CoV-2, COVID-19

12

13 Abstract

14 **Background:** The SARS-CoV-2 pandemic exacerbated existing health-related challenges in schools
15 and created new ones. Under pandemic conditions, health risks increased, and with them the
16 requirements for occupational safety and health (OSH) measures. The aim of the study was a) to
17 examine the status quo of OSH measures in German schools, b) to analyze whether the implementation
18 of OSH measures was associated with preferable outcomes and c) to identify predictors for the
19 implementation of OSH measures. **Methods:** A nationwide cross-sectional online survey was
20 conducted among teachers at all school types in Germany in March 2021. Data on the implementation
21 of OSH measures (risk assessments, infection protection instructions and instructions on occupational
22 safety), associated health-related parameters (e.g., somatic symptoms, PHQ-15) and predictor variables
23 (e.g., gender, age or federal states) were assessed using descriptive statistics, analysis of variance and
24 multiple linear regression analysis. **Results:** Less than 10% of surveyed teachers (N = 31,089) reported
25 that their schools met legal requirements for occupational safety and health measures. Beneficial
26 associations became apparent where more measures were implemented, e.g., significantly better
27 somatic and mental health. Predictors for the implementation of OSH measures were found, especially
28 on a systemic level (e.g., federal states schools were located in). **Conclusions:** Our study can serve as

29 a basis for future studies. It provides a status quo regarding the implementation of, associations with
30 and predictors for OSH measures in German schools. Our results are best understood as evidence-
31 based arguments to encourage political decision makers to improve the implementation of OSH
32 measures in German schools and thereby foster teachers' health.

33

In review

34 **1 Background**

35 From March 2020, about 1.5 billion students worldwide as well as their teachers were absent from
36 schools as a result of extensive measures to mitigate the spread of SARS-CoV-2 (Suhr, 2020). Due to
37 school closures, many teachers were forced to teach their classes entirely by using digital tools for the
38 first time in their career. In addition to the required changes during school closures, in periods of open
39 schools, there was a multitude of measures to mitigate the spread of SARS-CoV-2 that affected
40 teachers' work and private lives by expanding and complicating tasks. Together with new burdens in
41 the private life, the amount of - often abrupt - changes in teachers' day-to-day working life demanded
42 a lot of adjustments and adaptations, which increased mental health risks for teachers, e.g., regarding
43 burnout (Koestner et al., 2022; Pressley, 2021). This result is in line with an overall increase in
44 depressive symptoms and generalized anxiety in the general population in Germany (Bäuerle et al.,
45 2020; Beutel et al., 2021). Not only did the aforementioned mental health problems increase, new ones,
46 like anxieties associated with SARS-CoV-2, emerged (Jungmann & Witthöft, 2020; Biermann et al.,
47 2021). In addition to that, Lizhi (2021) reported impactful changes due to the pandemic (e.g., isolation)
48 and high levels of somatic health issues among teachers.

49 Targeting teachers' health is highly relevant from a public health point of view since teachers are a
50 huge occupational group in Germany (between 800,000 and 900,000) and responsible for the education
51 of approximately 10,000,000 students, which amplifies their relevance even further (KMK, 2022).
52 Given the aforementioned elevation and changes of health risks under pandemic conditions, the
53 relevance for occupational safety and health (OSH) measures - such as (1) risk assessments, (2)
54 infection protection instructions or (3) instructions on occupational safety - increased, not only in
55 schools. OSH measures in German schools a) impact the whole school-workforce, while b) the
56 implementation of these measures is initiated by the school management team. The school management
57 teams act in place of the employer in German schools and are therefore responsible to assure the
58 fulfilment of OSH measures. Accordingly, these organizational layers should be considered separately.

59 Before broaching the issue of background information and legal details regarding OSH measures in
60 Germany, the terminology used in this paper should be clarified. The International Labour
61 Organization (ILO) defines the term "*hazard*" as "*the inherent potential to cause injury or damage to
62 people's health*". "*Risk*" in this framework is "*a combination of the likelihood of an occurrence of a
63 hazardous event and the severity of injury or damage to the health of people caused by this event*".

64 “*Risk assessment*” consequently is the “*process of evaluating the risks to safety and health arising from*
65 *hazards at work*” (ILO, 2001).

66 In the course of a **risk assessment**, a structured survey, documentation and evaluation of environmental
67 conditions that represent a possible hazard for employees have to be conducted. It is a basis for the
68 systematic and effective management of OSH. All employers in Germany are legally obliged to
69 conduct risk assessments in accordance with the *Act on the Implementation of Measures of*
70 *Occupational Safety and Health to Encourage Improvements in the Safety and Health Protection of*
71 *Workers at Work*, Section 5 (German: Arbeitsschutzgesetz, §5). Given the non-voluntary nature of risk
72 assessments in Germany, it may be surprising that in 2013 only 51% of surveyed companies reported
73 to have conducted risk assessments (GDA, 2013). Along the same line are results from another study
74 in which only 22% of companies reported to have conducted a risk assessment that explicitly took
75 mental strains into account (Rothe, 2017). These studies reveal a huge gap between legal obligations
76 and their implementation in German companies. To the best of our best knowledge, there is no
77 systematic nationwide data regarding the implementation of risk assessments in German schools. Only
78 for defined regions there is some school related data on risk assessments available, which points into
79 the same direction as mentioned for companies. A survey conducted in the German state of Rhineland-
80 Palatine revealed that only 28.1% of teachers stated that risk assessment took place at their school
81 (Letzel et al., 2019). Therefore, research regarding the nationwide status quo of risk assessment at
82 schools was much needed, since work-related hazards and risks changed or emerged since the outbreak
83 of the SARS-CoV-2 pandemic, while at the same time somatic and mental health strains of teachers
84 increased, as described above.

85 Since COVID-19 is an infectious disease, the measure of **infection protection instructions** became
86 more important during the SARS-CoV-2 pandemic for obvious reasons. In Germany, these infection
87 protection instructions were obligatory for employers even before the SARS-CoV-2 pandemic and are
88 defined in the *German Infection Protection Act* (German: Infektionsschutzgesetz, IfSG). Little is
89 known regarding the implementation at schools. To our best knowledge there is no data published
90 regarding this topic. In this sense, the SARS-CoV-2 pandemic could act as a driving force to change
91 this lack of knowledge.

92 For **instructions on occupational safety** too, employers in Germany are legally obliged to conduct
93 this measure in accordance with the *Act on the Implementation of Measures of Occupational Safety*
94 *and Health to Encourage Improvements in the Safety and Health Protection of Workers at Work*,

95 Section 12 (German: Arbeitsschutzgesetz, §12). The law requires that instructions on occupational
96 safety include directives and explanations that are specifically tailored to the workplace or the
97 employee's area of responsibility. The instruction on occupational safety must take place when the
98 employee is hired, in the event of changes in the scope of duties, when new work equipment or a new
99 technology is introduced – before the employee starts work. The instruction must be adapted to the
100 development of hazards and, if necessary, repeated regularly. Study results from Germany showed that
101 80.5% of surveyed managers or persons responsible for OSH in companies stated that they had
102 instructed their employees in occupational safety (NAK, 2017). In contrast to that, there was a lack of
103 knowledge regarding the implementation of this measure in German schools.

104 The focus on these three specific OSH measures for the school setting during pandemic times was
105 derived out of a mutual selection process with experts from the German Federal Institute for
106 Occupational Safety and Health (BAuA) and the Institute of Occupational, Social and Environmental
107 Medicine, University Medical Center of the University of Mainz, Germany. Therefore, for these three
108 a priori selected OSH measures, data has been collected in a nationwide survey on teachers in Germany
109 (Koestner et al., 2022). Another straightforward reason for the relevance of these specific measures is,
110 that the legislator decided to make them obligatory, which implies a broad applicability and impact for
111 public health.

112 Given the absence of school-related data on the impact of these measures, especially during pandemic
113 conditions, the aforementioned justification of the relevance of the selected OSH measures by experts
114 and lawmakers was the rational starting point for our research. Still, this justification can and should
115 be tested empirically by analyzing associations with and predictors for OSH measures, which could
116 help to prove their actual relevance. Due to the lack of literature regarding associations with health
117 outcomes and predictors for the implementation of OSH measures in German schools, an explorative
118 approach seemed to be suitable to close this gap.

119 Therefore, the aim of the present study was a) to examine the status quo of OSH measures in German
120 schools, b) to analyze whether the implementation of OSH measures was associated with preferable
121 outcomes and c) to identify predictors for the implementation of OSH measures. This may enable us
122 to formulate recommendations on how to raise the level of implementation of OSH measures in
123 German schools.

124 2 Methods

125 **2.1 Procedure and Study Sample**

126 Between March 1st and March 31st, 2021, teachers from all federal states in Germany were invited to
127 participate in an online survey. The participants were recruited in cooperation with governmental
128 (Ministry of Education in Rhineland-Palatinate) and non-governmental institutions (e.g., Education
129 and Science Workers' Union), teacher-related societies (German Teachers Association), and projects
130 associated with education (Monitor Lehrerbildung). There was a non-monetary incentive (EUR
131 2000.00 donation to the German Children's Fund) to foster the willingness to participate. Informed
132 written consent was obtained at the beginning of the online survey. The ethical committee of the
133 Medical Association of Rhineland-Palatinate approved the study before it was conducted (application
134 number: 2020-15531).

135 **2.2 Questionnaire and Measures**

136 Participants completed an online questionnaire with approximately 350 items (presented in the survey
137 tool LimeSurvey), covering a wide range of topics, which were arranged under the following
138 categories: (1) sociodemographic and workplace information; (2) identification of SARS-CoV-2-
139 specific stresses and challenges in schools for teachers; (3) implementation, communication, and
140 compliance with hygiene policies/plans, both general and school-based; (4) impact of school operations
141 during the SARS-CoV-2 pandemic on teachers; and (5) collection of best practices for infection
142 protection and the implementation of the educational task during the pandemic. Before being applied
143 in the present study, the questionnaire was pretested and revised in three steps. In the first step, experts
144 from the Institute for Teachers' Health and the Institute for Occupational, Social and Environmental
145 Medicine of the University Medical Center Mainz answered and commented on the questionnaire. In
146 the second step, after revising the questionnaire, we invited teachers to take part in a comprehensive
147 probing for the exact understanding of and associations with all items. We did this to ensure that the
148 items were understood in the way we intended or were otherwise able to collect suggestions for (mostly
149 minor) linguistic adaptations. In the third step, after the probing, the whole questionnaire was revised
150 again, and our team conducted a final (linguistic and grammatical) quality check to eliminate final
151 flaws (e.g., typing errors).

152 **2.2.1 Dependent Variables**

153 **2.2.1.1 Occupational safety and health measures**

154 The items regarding the school-related implementation of OSH measures were self-designed. Risk
 155 assessment was measured by the item *“Has a risk assessment already been carried out at your
 156 school?”* (“yes”, “no”, “do not know”). Infection protection instructions were measured by the item
 157 *“How long has it been since your last infection prevention training?”* (“< 1 year”, “1-2 years”, “2-3
 158 years”, “3-5 years”, “5-10 years”, “>10 years”, “never participated”, “do not know”). Instructions
 159 on occupational safety were measured by the item *“Did briefings on special hazards take place due to
 160 the COVID-19 pandemic?”* (“yes”, “no”, “do not know”). For further analysis, the responses to all
 161 three questions were condensed to the scale "Implementation of OSH measures" ranging from 0 to 3.
 162 For this purpose, answers to the three questions were dichotomized into “fulfilled” (= 1) and “not
 163 fulfilled” (= 0) before being accumulated into the OSH scale. Requirement fulfilled was defined as
 164 “yes” for the items on risk assessment and instructions on occupational safety and “< 1 years” or “1-
 165 2 years” for the item on infection protection instructions, since these two answers comply with the
 166 legal requirements. A Principal Component Analysis (PCA) including the three aforementioned OSH
 167 measures was calculated to check if they load on more than one component. The Kaiser-Meyer-Olkin
 168 value for the PCA was .58 and the Bartlett-test was significant, $p = < 0.001$, so both requirements were
 169 sufficiently met. One component was extracted with loadings of .72 (instructions on occupational
 170 safety), .70 (infection protection instructions) and .62 (risk assessments), therefore the OSH scale was
 171 used for further analysis.

172 **2.2.1.2 Mental health and psychological conditions in the workplace**

173 The following variables were used as dependent variables in research question b) and as candidates for
 174 independent variables in research question c).

175 Participants were asked to complete the validated German version of the Patient Health Questionnaire
 176 4 (PHQ-4; Löwe et al., 2010), an established instrument for the combined screening for symptoms of
 177 depression (PHQ-2; Kroenke, Spitzer, & Williams, 2001) and generalized anxiety disorder (GAD-2;
 178 Spitzer, Kroenke, Williams, & Löwe, 2006), ranging from 0 to 12. To measure COVID-19-associated
 179 anxiety, participants rated the item *“How strong is your fear of being infected with the SARS-CoV-2
 180 virus?”* on a scale from 0 (no anxiety) to 100 (powerful anxiety). We were given permission to use the
 181 item, which had also been used in other studies (Jungmann & Witthöft, 2020; Biermann et al., 2021).
 182 Job satisfaction was measured by a single item *“Overall, how satisfied are you with your work*

183 *situation?” (“not at all”, “not very much”, “quite a bit”, “very much”, “extremely”), ranging from 1-*
 184 *5. The item was created by the Institute for Teachers’ Health, University Medical Center of the*
 185 *Johannes Gutenberg University of Mainz and is frequently used. To measure meaning of work, the*
 186 *item “Is your work meaningful?” (“to a very large extend” to “to a very small extend”) was taken*
 187 *from the validated German version of the Copenhagen Psychological Questionnaire (COPSOQ III,*
 188 *Lincke et al., 2021). A self-created item was used to measure work-related health concerns during the*
 189 *pandemic. The item was “I am concerned about my health at the prospect of working in my*
 190 *school/office during the COVID-19 pandemic.” (“don’t agree at all”, “rather disagree”, “partly”,*
 191 *“agree rather”, “fully agree”), ranging from 1-5.*

192 **2.2.1.3 Somatic symptoms**

193 Somatization symptoms were assessed with the German version of the PHQ-15 (Kroenke et al., 2002;
 194 Löwe et al., 2002) ranging from 0-30. The PHQ-15 covers the most prevalent somatic symptoms for
 195 somatization disorder as defined in the Diagnostic and Statistical Manual of Mental Disorders, DSM-
 196 IV (APA, 2000).

197 **2.2.2 Independent variables**

198 Given the research gap regarding the prediction of OSH measures in schools, the selection of predictor
 199 variables was method-guided. The starting point for the selection process included all items of the
 200 online-survey. To reduce the number of potential predictor variables, we first excluded all items
 201 containing information which a priori was non-relevant for the prediction of OSH measures (e.g.,
 202 pseudonymization-code, information about the recruitment process or best practices examples for the
 203 implementation of educational tasks) and redundant items (e.g., implementation of the OSH measures
 204 or school management affiliation, see statistical analysis section for more details). For the remaining
 205 243 scales and items, a correlation matrix was calculated. Scales or items where the Pearson correlation
 206 with OSH measures was above the predefined cut-off value of $r > 0.1$ (representing a small correlation
 207 regarding to Cohen, 1988) were selected, resulting in 32 variables that qualified as independent
 208 variables for a multiple regression analysis on OSH measures.

209 **2.3 Statistical Analyses**

210 Descriptive statistics were calculated a) to examine the status quo of the implementation of OSH
 211 measures in German schools. Analysis of variance (ANOVA) were calculated b) to analyze whether
 212 the implementation of OSH measures was associated with somatic and psychological health outcomes.

213 Linear multiple regression was calculated c) to identify predictors for the implementation of OSH
 214 measures.

215 For analysis a) and b), the total sample (teachers and school management members) was used. For
 216 analysis c), the prediction of the implementation of OSH measures, a subsample of school management
 217 members only was used, because the legal responsibility for implementation OSH measures in German
 218 schools is with them. Statistical analysis was performed using SPSS Statistics Version 27 (IBM,
 219 Armonk, NY).

220 **3 Results**

221 Overall, 39,359 teachers from all federal states and school types in Germany participated in our survey.
 222 After data cleansing, a sample of N = 31,089 was used for further analyses. 77.5% of the participants
 223 were female, the mean age was 45.8 years (SD: 10.5). Detailed sample characteristics are displayed in
 224 Table 1.

225 **Table 1** Sample characteristics.

Subgroups	Total sample (teachers & school management)			Subsample (school management only)		
	<i>n</i>	%	<i>M (SD)</i>	<i>n</i>	%	<i>M (SD)</i>
Gender	31,089	100%		3290	100%	
Female	24,099	77.5%		2451	74.5%	
Male	6851	22.0%		832	25.3%	
Diverse	139	0.4%		7	0.2%	
Age (years) ^a	31,089	100%	45.78 (10.46)	3290	100%	49.82 (8.85)
18–30	2473	8.0%		49	1.5%	
31–43	10,957	35.2%		775	23.6%	
44–55	10,799	34.7%		1488	45.2%	
56–67	6860	22.1%		978	29.7%	
Work schedule ^b	30,959	100%		3279	100%	
Part-time	12,297	39.7%		602	18.4%	
Full-Time	18,662	60.3%		2677	81.6%	
School type ^c	28,233	100%		3000	100%	

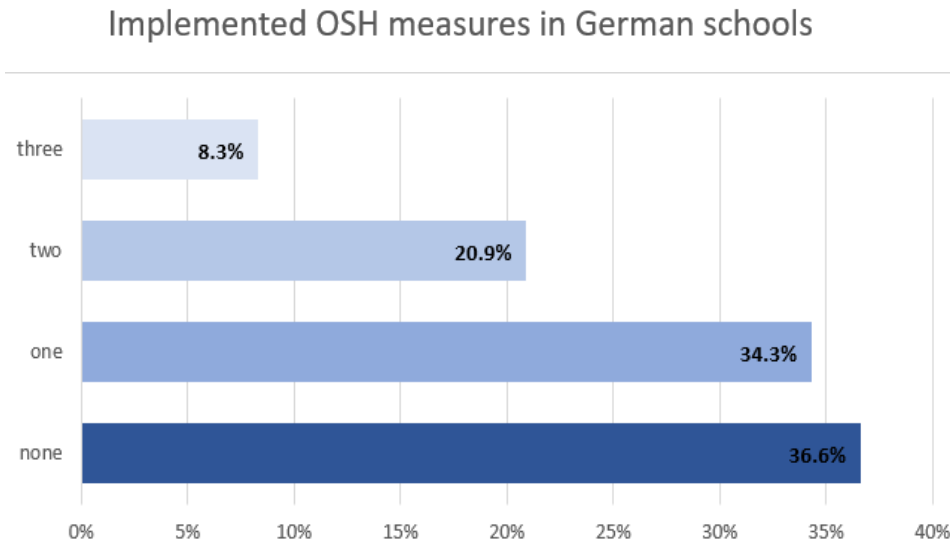
OSH measures at German schools

Primary	9030	32.3%	1389	46.3%
Secondary general	539	1.9%	43	1.4%
Secondary Academic	2162	7.7%	203	6.8%
secondary	5451	19.5%	363	12.1%
Comprehensive	4016	14.4%	313	10.4%
Special needs	2969	9.6%	291	9.7%
Vocational	2699	9.7%	236	7.9%
Other	1367	4.9%	162	5.4%
Federal State ^c	30,792	100%	3,252	100%
Baden- Württemberg	5935	19.3%	719	22.1%
Bavaria	913	3.0%	96	3.0%
Berlin	2496	8.1%	193	5.9%
Brandenburg	903	2.9%	66	2.0%
Bremen	431	1.4%	44	1.4%
Hamburg	1374	4.5%	83	2.6%
Hesse	2994	9.7%	298	9.2%
Lower Saxony	3430	11.1%	331	10.2%
Mecklenburg- Vorpommern	488	1.6%	53	1.6%
North Rhine- Westphalia	5520	17.9%	544	16.7%
Rhineland Palatinate	2839	9.2%	417	12.8%
Saarland	216	0.7%	19	0.6%
Saxony-Anhalt	370	1.2%	41	1.3%
Saxony	985	3.2%	84	2.6%
Schleswig-Holstein	1328	4.3%	201	6.2%
Thuringia	570	1.9%	63	1.9%

^a age in years is displayed in quartiles. ^b Reflects the number, percentage, and mean values of participants answering the questions. The number of participants (*n*) may differ between items because responding was voluntary, therefore not all participants answered all items. ^c Multiple responses and skipping items were possible, only participants with exactly one school type or federal state selected were included.

226 3.1 Status quo of occupational safety and health measures in German schools

227 Regarding our first research question, the status quo of OSH measures in German schools, only 8.3%
 228 of the participants reported that all three OSH measures were implemented. More than a third (36.6%)
 229 reported the implementation of none of the measures. For more details see Figure 1.



230
 231 **Figure 1** Distribution of the implementation of occupational safety and health measures in German schools during the
 232 SARS-CoV-2 pandemic in March 2021.

233 When analyzing the OSH measures separately, the majority (76.2%) of the surveyed teachers stated
 234 that no risk assessment had been conducted at their school. Similarly, 67.1% of the teachers stated that
 235 infection protection instructions had not been carried out within the last two years. Regarding the
 236 implementation of instructions on occupational safety due to the SARS-CoV-2 pandemic, 55.8% of
 237 the teachers answered that they did not receive any.

238 **3.2 Health related associations with OSH measures in schools**

239 Regarding associations with somatic and psychological outcomes, our analysis revealed that teachers
 240 working at schools with a better implementation of OSH measures significantly differed from those
 241 working in schools with less implementation. ANOVA results can be found in Table 2.

242

243

244 **Table 2** Health related associations with OSH measures

Variable	Somatic symptoms ^a	Depression & generalized anxiety ^b	Corona associated anxiety ^c	Health concerns ^d	Satisfaction with work ^e	Meaning of work ^f
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Implemented OSH measures	0 9.30 (5.08)	4.22 (2.94)	53.93 (28.22)	3.59 (1.24)	2.61 (0.86)	75.58 (21.15)
	1 9.01 (5.05)	3.95 (2.85)	51.51 (28.06)	3.44 (1.26)	2.69 (0.86)	77.03 (20.00)
	2 8.75 (4.97)	3.70 (2.74)	49.79 (27.90)	3.30 (1.25)	2.79 (0.86)	78.39 (19.36)
	3 8.23 (5.01)	3.25 (2.71)	46.49 (28.37)	3.06 (1.27)	2.93 (0.85)	81.01 (19.10)
F ^g	24.14***	70.89***	43.82***	112.50***	100.90***	48.84***
η^2	0.004	0.010	0.006	0.016	0.012	0.006

245 ^a Patient Health Questionnaire-15 (lower is better), ^b Patient Health Questionnaire-4 (lower is better), ^c Corona associated anxiety of
 246 getting infected with SARS-CoV-2 (lower is better), ^d health concerns regarding working in school during the pandemic (lower is better),
 247 ^e satisfaction with work (higher is better), ^f meaning of work (higher is better), ^g * p -value < 0.05, ** p -value < 0.01, *** p -value < 0.001,
 248 F = F -value, η^2 = Eta squared, degree of freedom = 3 for all ANOVAs.

249 Significant differences in the mean values of somatic symptoms were found when the number of
 250 implemented OSH measures was used to divide into subgroups: $F(3, 19384) = 24.15, p < 0.001, \eta^2 =$
 251 0.004 . A similar pattern was found in the mean values of symptoms for depression and generalized
 252 anxiety when the number of implemented OSH measures was used to divide into subgroups: $F(3,$
 253 $21277) = 70.89, p < 0.001, \eta^2 = 0.010$. The corona associated anxiety of getting infected with COVID-
 254 19 also differed significantly when the number of implemented OSH measures was used to divide into
 255 subgroups: $F(3, 21322) = 43.82, p < 0.001, \eta^2 = 0.006$. Regarding health concerns too, significant
 256 differences were found when the number of implemented OSH measures was used to divide into
 257 subgroups: $F(3, 21429) = 112.50, p < 0.001, \eta^2 = 0.016$. Significant differences in satisfaction with
 258 work were found when the number of implemented OSH measures was used to divide into subgroups:
 259 $F(3, 24196) = 100.90, p < 0.001, \eta^2 = 0.012$. For the meaning of work too, significant differences were
 260 found when the number of implemented OSH measures was used to divide into subgroups: $F(3, 24174)$
 261 $= 48.84, p < 0.001, \eta^2 = 0.006$.

262 **3.3 Predictors for the implementation of OSH measures in schools**

263 Of the 32 independent variables that met the requirement ($r > 0.1$) to be included into the multiple
 264 linear regression model, 18 significantly predicted the number of implemented OSH measures. The R^2
 265 for the regression model was 0.17 and the adjusted R^2 was 0.15, indicative for a moderate goodness-
 266 of-fit according to Cohen (1988). The independent variables included in the regression model were
 267 able to statistically significant predict the implementation of OSH measures, $F(30, 1107) = 7.67,$

268 $p < 0.001$. Requirements for the conduction of a multiple linear regression analysis were tested and
 269 met. Neither multicollinearity, heteroscedasticity nor auto-correlation were problematic (Durbin-
 270 Watson statistic was 1.68). Detailed information regarding the predictive value and significance of the
 271 independent variables can be found in Table 3.

272 **Table 3** Significant predictors of occupational safety and health measures

Dependent variable: Number of OSH measures

Coefficients	<i>B</i>	SE	β	<i>t</i>	<i>p</i>	95% CI	
						<i>LL</i>	<i>UL</i>
(constant)	0.38	0.26		1.45	0.15	-0.13	0.89
Age (quartiles)	0.10	0.04	0.07	2.40	0.02	0.02	0.17
Work schedule ^a	0.20	0.08	0.07	2.55	<0.01	0.05	0.35
Concept for digital teaching ^b	0.14	0.02	0.17	5.70	<0.001	0.09	0.19
Feedback ^c	0.11	0.04	0.08	2.88	<0.001	0.04	0.19
Depression symptoms ^d	-0.05	0.02	-0.06	-2.11	0.04	-0.09	0.00
Health concerns ^e	-0.06	0.03	-0.07	-2.39	0.02	-0.11	-0.01
Self-care during pandemic ^f	0.08	0.03	0.07	2.50	<0.01	0.02	0.13
School Type ^g							
Academic secondary	-0.33	0.09	-0.11	-3.66	<0.001	-0.51	-0.15
Comprehensive	-0.34	0.10	-0.10	-3.46	<0.001	-0.53	-0.15
Special needs	0.27	0.10	0.08	2.61	<0.01	0.07	0.47
Federal State ^g							
Brandenburg	0.69	0.23	0.09	2.97	<0.001	0.24	1.15
Lower Saxony	0.34	0.12	0.10	2.88	<0.001	0.11	0.58
Mecklenburg-Vorpommern	0.97	0.23	0.12	4.30	<0.001	0.53	1.41
North Rhine-Westphalia	0.32	0.10	0.12	3.32	<0.001	0.13	0.52
Rhineland Palatinate	0.30	0.10	0.10	2.85	<0.001	0.09	0.50
Saxony-Anhalt	0.61	0.26	0.07	2.32	0.02	0.09	1.13
Saxony	1.06	0.20	0.16	5.36	<0.001	0.67	1.44
Thuringia	0.67	0.21	0.09	3.23	<0.001	0.26	1.08

^a Work schedule: 1 = full time / 0 = part time, ^b Item: "Your school / office has a standardized overall concept for the implementation of digital teaching", ^c COPSOQ III - Feedback (2-item scale), ^d Patient Health Questionnaire-2 (2-item scale), ^e Item: "I am concerned about my health at the prospect of working in my school / office during the COVID-19 pandemic.", ^f Item: "I feel like I can actively do something positive for myself in this COVID-19 pandemic", ^g Multiple responses were possible; only participants with exactly one selected federal state / school type were analyzed. Only significant predictors are reported (p -value < 0.05). Non-significant federal states (Baden-Württemberg, Bavaria, Berlin, Bremen, Hamburg, Hesse, Saarland, Schleswig-Holstein) and school types (primary, secondary general, secondary, vocational, other) were excluded.

273 The variables with the highest positive beta-coefficients for the implementation of OSH measures in
 274 German schools were, existence of a concept for the implementation of digital teaching ($\beta = 0.17, p <$
 275 0.001) followed by the federal states Saxony ($\beta = 0.16, p < 0.001$), Mecklenburg-Vorpommern ($\beta =$
 276 $0.12, p < 0.001$) and North Rhine-Westphalia ($\beta = 0.12, p < 0.001$). The variables with the highest
 277 negative beta-coefficients for the implementation of OSH measures in German schools were the school
 278 types academic secondary school ($\beta = -0.11, p < 0.001$), comprehensive school ($\beta = -0.10, p < 0.001$),
 279 health concerns ($\beta = -0.07, p = 0.02$) and depression symptoms ($\beta = -0.06, p = 0.04$).

280 **4 Discussion**

281 The present study aimed a) to examine the status quo of OSH measures in German schools, b) to
 282 analyze whether the implementation of OSH measures was associated with preferable outcomes and
 283 c) to identify predictors for the implementation of OSH measures. Regarding all three aims - to our
 284 best knowledge - there were research gaps to be filled. Therefore, we were very interested to close
 285 these gaps.

286 With regard to the first aim, our results show that OSH measures were implemented insufficiently in
 287 German schools. Less than 10% of the teachers in our sample reported that their schools met the legal
 288 requirements for all three studied OSH measures. Especially during a global pandemic, it was a
 289 shocking result that the majority of schools did not have conducted risk-assessments (76.2%), infection
 290 protection instructions (61.1%) or instructions on occupational safety (55.8%). Schools seemed to
 291 perform worse regarding the implementation of OSH measures, when data on the proportion of
 292 companies that had not carried out risk-assessments (49%) or instructions on occupational safety
 293 (19.5%) is used for comparison (GDA, 2013; NAK, 2017).

294 Concerning the second aim, arguments can be derived from our study results. OSH measures are not
 295 an end in themselves to meet legal requirements. The results of several ANOVAs revealed desirable
 296 associations of the implementation of OSH measures with health-relevant outcomes. In schools with a
 297 better implementation of OSH measures, teachers showed significantly less somatic and psychological
 298 burdens (e.g., lower PHQ-15 and PHQ-4 scores) and significantly higher levels of satisfaction with
 299 and meaning of work (Table 2). Due to the exploratory nature of our study, it was not possible to draw
 300 on previous data to compare the sizes of effects we obtained. It should be noted that the biggest effect
 301 size found in our study was $\eta^2 = 0.016$ (health concerns), so from a statistical point of view the reported

302 effect sizes should be considered as small regarding to Cohen (1988). Still, we can give the cautious
303 recommendation to foster the implementation of OSH measures in schools in order to promote the
304 somatic and psychological health of teachers.

305 Referring to our third aim, the identification of predictors for the implementation of OSH measures in
306 German schools, the best predictor variables were existing concepts for the implementation of digital
307 teaching and federal states (Saxony, Mecklenburg-Vorpommern and North Rhine-Westphalia) in
308 which the schools were located in. The provision of concepts for implementing digital teaching in
309 schools is, at least to some extent, within the responsibility of the individual federal states. Since each
310 state in Germany has the freedom and responsibility to shape its education system, it seems worthy and
311 is therefore recommended to take a closer look at what is being done differently in the states with better
312 implementation of OSH measures to be able to transfer knowledge. Overall, it became evident, that out
313 of the big number of potential predictor variables for OSH measures in our survey (243 scales and
314 items), systemic influences (e.g., federal states) were more important for the prediction of the
315 implementation of OSH measures relative to individual factors (e.g., gender or age). Nevertheless, it
316 should be kept in mind that the proportion of variance explained (around 15%) by the variables we
317 examined signals that there are other influences for which we had no data to detect them. Still, our
318 results suggest that necessary improvements of OSH measures in German schools should include
319 actions targeting the aforementioned systemic level to ensure that the somatic and psychological
320 wellbeing of teachers in Germany can be sustained and promoted.

321 One potential limitation of our study might have been, that information regarding the implementation
322 of OSH measures was collected on the basis of self-reports. It is possible, that measures - e.g., risk
323 assessments - had been implemented without all surveyed teachers in a school being aware of it. This
324 might have led to an underestimation of the number of implemented OSH measures. Another potential
325 limitation might have been, that the survey took place during the “third wave of SARS-CoV-2” in
326 Germany, while infection numbers were rising rapidly and a new virus variant of concern (B.1.1.7)
327 was spreading (RKI, 2021). The acute need to implement infection control measures or distance
328 learning in schools may have influenced the self-selection of study participants. Consequently, it might
329 have been the case that only those teachers with still available capacities participated. It is unknown
330 whether teachers and school management teams that did not participate in our study (e.g., due to high
331 workloads) would have reported different implementation rates of OSH measures or characteristics in
332 other items, compared to the sample analyzed in our study. Finally, it should be addressed that the

333 cross-sectional design of our study limited the possibility to draw conclusions about the direction of
334 causality. As an alternative to our interpretations, it could also have been that schools which were
335 overall better organized also implemented more OSH measures and - independently of their effects -
336 offered better organizational conditions for teachers' somatic and psychological health.

337 **4.1 Conclusion with focus on practical recommendations**

338 Regarding scientific implications, our study may represent the basis for future studies, since it provides
339 a broad-scale (N = 31,089) actual status quo regarding the implementation of, associations with and
340 predictors for OSH measures in German schools. Due to the fact, that the operative responsibility for
341 implementing OSH measures lies with the school management, in depth data at this organizational
342 level would be a useful extension of the approach used in our study. In addition, a broader range of
343 data is needed to explain relationships with OSH measures in schools, since only a fraction (15%) of
344 the variance could be explained by the variables we were able to use in our regression model. For
345 example, it could be a promising direction to analyze whether schools that are better-funded, better-
346 managed or have lower teacher to student ratios are systematically conducting more OSH measures.
347 With additional data, it might be possible that the differences and associations that became apparent in
348 our study, could be (partially) explained or moderated by other variables. Regarding the detection of
349 causal links and to increase granularity, experimental study designs, such as a random assignment of
350 schools to a group where specific OSH measures are conducted (e.g., risk assessments) compared to
351 schools where the measures are not (or later) carried out, represent a feasible way to be able to
352 determine concrete contributions of individual measures in a more finely resolved manner.

353 With respect to practical implications, our study demonstrated that teachers working in schools with
354 better implementation of OSH measures showed less somatic and psychological burdens and higher
355 satisfaction with and meaning of work. This is why we do hope that our results are understood as
356 evidence-based arguments to encourage political decision makers to improve the implementation of
357 OSH measures in German schools and thereby foster teachers' health. One possible way to achieve
358 this goal could be the providence of wide spread information on why (health benefits & legal
359 obligations) as well as practical guidelines on how to perform OSH measures to teachers and school
360 management teams. Since all OSH measures analyzed in this study are already legally obligatory in
361 Germany, the assurance of their implementation by monitoring combined with potential reminders or
362 sanctions (in case of non-compliance) might be a feasible adjuvant way to increase awareness. Overall,
363 a goal worth achieving and useful framing for the implementation of OSH measures in schools should

364 be the creation of working environments that sustain and foster teachers' health, with expectable
365 benefits not only for them, but also for their students.

366

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369 **Institutional Review Board Statement:** The study was conducted in accordance with the Declaration
370 of Helsinki, and approved by the Ethical Committee of the Medical Association of Rhineland-
371 Palatinate before it was conducted (application-number: 2020-15531).

372 **Informed Consent Statement:** Informed consent was obtained from all participants involved in the
373 study.

374 **Data Availability Statement:** The data presented in this study are available on request from the
375 corresponding author. The data are not publicly available due to privacy restrictions.

376 **Conflicts of Interest:** The funder and other parties had no influence on study design, data collection
377 and analysis, presentation and interpretation of the results or the present manuscript.

378

In Review

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Bewertung und Folgen der SARS-CoV-2-Infektionsschutzmaßnahmen an Schulen

Ergebnisse von Fokusgruppen-Befragungen unter Lehrkräften in Deutschland

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ABSTRACT / ZUSAMMENFASSUNG

Evaluation and consequences of SARS-CoV-2 infection control measures in schools. Findings of focus group interviews among teachers in Germany

Introduction: In order to stem the spread of the SARS-CoV-2 pandemic, there were wide-ranging changes in the school setting from March 2020 onwards, characterised by changing teaching formats (alternating between distance, face-to-face and hybrid teaching) and the implementation of infection control measures.

Aim and Method: The aim of the present study was to investigate the evaluation of these measures and the consequences for teachers in Germany and to formulate best practice examples for school education in the further course of the pandemic. For this purpose, focus group interviews were conducted with 17 teachers at four schools and evaluated by content analysis.

Results: It was found that the teachers felt burdened by teaching under pandemic conditions and that their health behaviour had deteriorated. In addition, new pandemic-related fears arose and the implementation of infection control measures (implementation of AHA-L rules (distance, hygiene, mask, ventilation), performance of SARS-CoV-2 tests) was accompanied by work-related and health-related problems. The quality of training of prospective teachers was also questioned. The introduction of SARS-CoV-2 vaccinations and the relatively high ranking of teachers in prioritisation was experienced as a relief and very much welcomed. In places, difficulties in communicating and implementing infection control measures were reported, resulting in the formulation of best practices, such as the implementation of SARS-CoV-2 testing by trained staff or the formulation of school form-specific measures.

Conclusions: The stress caused by teaching during the pandemic and the negative development of health behaviour represent a relevant public health risk. For this reason, the idea of prevention and health promotion should or must be intensified even more during the SARS-CoV-2 pandemic, further developed in view of the pandemic specifics and applied in the living environments.

Keywords: Corona – COVID-19 – school – teachers

Bewertung und Folgen der SARS-CoV-2-Infektionsschutzmaßnahmen an Schulen. Ergebnisse von Fokusgruppen-Befragungen unter Lehrkräften in Deutschland

Einleitung: Zur Eindämmung der Ausbreitung der SARS-CoV-2-Pandemie kam es ab März 2020 zu weitreichenden Veränderungen des Schulunterrichts, der durch sich verändernde Unterrichtsformate (Wechsel zwischen Fern-, Präsenz- und Hybridunterricht) und die Umsetzung von Infektionsschutzmaßnahmen geprägt war.

Ziel und Methode: Ziel der vorliegenden Studie war es, die Bewertung dieser Maßnahmen durch und die Folgen auf Lehrkräfte in Deutschland zu untersuchen und Best-Practice-Beispiele für den Schulunterricht im weiteren Pandemieverlauf zu formulieren. Hierzu wurden Fokusgruppen-Befragungen mit 17 Lehrkräften an vier Schulen durchgeführt und inhaltsanalytisch ausgewertet.

Ergebnisse: Es zeigte sich, dass sich die Lehrkräfte durch das Unterrichten und den veränderten Arbeitsbedingungen während der Pandemie beansprucht fühlten und sich deren Gesundheitsverhalten verschlechtert hatte. Zudem kamen neue, pandemiebedingte Ängste auf und die Umsetzung der Infektionsschutzmaßnahmen (Umsetzung der AHA-L-Regeln (Abstand, Hygiene, Alltagsmaske, Lüften), Durchführung von SARS-CoV-2-Tests) ging mit arbeitsspezifischen und gesundheitlichen Problemen einher. Auch die Ausbildungsqualität der Anwärterinnen und Anwärter wurde in Frage gestellt. Die Einführung von SARS-CoV-2-Schutzimpfungen und die relativ hohe Einstufung von Lehrkräften bei der Priorisierung wurden als Erleichterung erlebt und sehr begrüßt. Stellenweise wurden Schwierigkeiten bei der Kommunikation und Umsetzung von Infektionsschutzmaßnahmen berichtet, die in die Formulierung von Best-Practice-Beispielen, wie die Durchführung von SARS-CoV-2-Tests durch geschultes Personal oder die Formulierung schulformspezifischer Maßnahmen, gemündet sind.

Schlussfolgerungen: Die durch das Unterrichten während der Pandemie bedingten Belastungen sowie eine negative Entwicklung des Gesundheitsverhaltens von Lehrkräften stellt ein relevantes Public-Health-Risiko dar. Aus diesem Grund sollte beziehungsweise muss während der SARS-CoV-2-Pandemie der Gedanke von Prävention und Gesundheitsförderung noch stärker intensiviert, angesichts der pandemischen Besonderheiten weiterentwickelt und in den Lebenswelten angewandt werden.

Schlüsselwörter: Corona – COVID-19 – Schule – Lehrkräfte

Einleitung

Aufgrund der SARS-CoV-2-Pandemie mussten im März 2020 weltweit rund 1,5 Milliarden Schülerinnen und Schüler sowie deren Lehrkräfte infolge von Maßnahmen zur Eindämmung der Ausbreitung von SARS-CoV-2 den Schulen fernbleiben (Suhr 2020). Auch in Deutschland folgten ab März 2020 Schließungen der Schulen, mit dem Ziel, das Infektionsgeschehen positiv zu beeinflussen. Die Ende April 2020 folgende schrittweise Rückkehr zum Schulalltag stellte dann hohe Anforderungen an den Unterricht und das Lehrpersonal. Nach den Sommerferien 2020 wurde in den meisten Schulen wieder zu Präsenzunterricht im Regelbetrieb – sofern es die Einhaltung der Hygienerichtlinien und das Infektionsgeschehen ermöglichten – zurückgekehrt und im Verlauf des Schuljahres phasenweise wieder in Distanzunterricht gewechselt. Daraus resultierten neue Herausforderungen für das gesamte Schulsystem und dessen Beteiligte, auch da der Einfluss von Schulöffnungen auf das Infektionsgeschehen ebenso wie die Rolle der Kinder und Jugendlichen in der SARS-CoV-2-Pandemie noch diskutiert wurde (Parri et al. 2020). Obwohl es Hinweise darauf gibt, dass Schülerinnen und Schüler sowie Lehrkräfte relativ gesehen weniger als andere Bevölkerungsgruppen von Infektionen betroffen waren (Köstner et al. 2021), lässt sich zum gegenwärtigen Zeitpunkt nicht klar abschätzen, welche Rolle diese letztlich beim Infektionsgeschehen spielen.

Unbestritten ist, dass das Lehrpersonal beim Unterrichten unter pandemischen Bedingungen an Schulen mit besonderen, SARS-CoV-2-spezifischen Belastungen, Beanspruchungen und Herausforderungen konfrontiert wurde und nach wie vor wird. Dies kann sich unter anderem auf einer arbeitsbezogenen Ebene abzeichnen. Es ist bekannt, dass sich der Berufsalltag von Beschäftigten insgesamt durch die SARS-CoV-2-Pandemie deutlich verändert hat, durch zum Beispiel Homeoffice oder Kurzarbeit (Frodermann et al. 2020). Bislang fehlen jedoch empirische Befunde, mit welchen arbeitsbezogenen Herausforderungen und Auswirkungen (z. B. arbeitsorganisatorisch und pädagogisch) Lehrkräfte konfrontiert sind. Hinzu kommen mit dem Arbeitsplatz verbundene gesundheitsbezogene Sorgen und Ängste in Bezug auf eine eigene Infektion oder die einer nahestehenden Person.

Aktuelle Studienergebnisse zeigen in der Allgemeinbevölkerung gestiegene vielfältige Beanspruchungen beziehungsweise negative Auswirkungen aufgrund der SARS-CoV-2-Pandemie (Beutel et al. 2021). Diese beziehen sich beispielsweise auf eine verminderte Lebenszufriedenheit, erhöhtes Stresserleben, Angst sowie depressive Symptome, einen subjektiv schlechteren Gesundheitszustand oder vermehrte gesundheitsbezogene Ängste sowie Sorgen um die eigene Familie (Li et al. 2020; Newby et al. 2020; Torales et al. 2020). Hinzu kommen potenziell belastende Veränderungen von Verhaltensweisen (z. B. soziale Distanz, verändertes Hygieneverhalten; Newby 2020). Negative Auswirkungen auf die psychische Gesundheit (v. a. Depression, Angst) zeigten sich zudem bei spezifischen Berufsgruppen, wie beispielsweise medizinischem Personal mit Kontakt zu COVID-19-Patientinnen und -Patienten (Lu et al. 2020). Es kann davon ausgegangen werden, dass Lehrkräfte ebenso wie die Allgemeinbevölkerung mit multiplen Belastungen im Zusammenhang mit der SARS-CoV-2-Pandemie konfrontiert sind, die wiederum zu unterschiedlichen Beanspruchungen bei Lehrkräften führen. Diese können sich auf der somatischen, psychischen und sozialen Ebene abzeichnen, deren Erforschung ein Ziel der vorliegenden Studie war.

KERNAUSSAGEN

- Durch das Unterrichten unter veränderten Arbeitsbedingungen während der Pandemie fühlten sich die Lehrkräfte beansprucht.
- Das Gesundheitsverhalten von Lehrkräften hat sich während der Pandemie verschlechtert.
- Pandemiespezifische Ängste und die Umsetzung von Infektionsschutzmaßnahmen erschwerten die Arbeit von Lehrkräften.
- Der Corona-Schutzimpfung stehen Lehrkräfte positiv gegenüber und empfinden diese als Erleichterung.

Zum Schutz des Lehrpersonals und deren Schülerinnen und Schülern vor Infektionen mit SARS-CoV-2 wurden entsprechende Hygienepläne erarbeitet, die technische sowie vor allem organisatorische und personale Maßnahmen enthielten. Diese Maßnahmen sind hinsichtlich ihrer praktischen Umsetzbarkeit, Akzeptanz, möglicher Folgen sowie Wirksamkeit für Sicherheit und Gesundheit des Lehrpersonals abzuschätzen, gegebenenfalls zu ergänzen oder auf Basis dieser Erkenntnisse zu adaptieren. Hierzu ist es erforderlich, den aktuellen Sachstand an den Schulen aus Perspektive von Lehrkräften zu erfassen sowie Best-Practice-Beispiele zum Einsatz unterschiedlicher Schutzmaßnahmen hinsichtlich ihrer Praktikabilität einzuschätzen. Um diese Forschungslücken zu adressieren, wurde Anfang 2021 das Drittmittelprojekt „SARS-CoV-2-Arbeits- und Infektionsschutzmaßnahmen an Schulen“ initiiert, um die Folgen der SARS-CoV-2-Pandemie auf Lehrkräfte empirisch zu untersuchen. Das Projekt verfolgt einen Mixed-Methods-Ansatz, bestehend aus einem Monitoring der Infektionszahlen von Schülerinnen und Schülern sowie Lehrkräften (Köstner et al. 2021), einer bundesweiten quantitativen Untersuchung von Lehrkräften und Fokusgruppen-Befragungen mit Lehrkräften. Im Rahmen dieser Arbeit stellen wir die Ergebnisse der Fokusgruppen-Befragungen vor.

Fragestellung/Zielstellung

Im Rahmen der Fokusgruppen-Befragungen wurden folgende Themenbereiche adressiert:

- Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen,
- Umsetzung, Kommunikation und Einhaltung von Hygieneplänen,
- Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte,
- Sammlung von Best-Practice-Beispielen und Ableitung von Empfehlungen.

Bei der Bearbeitung dieser Fragestellungen wurde zwischen einer persönlichen, lehrkräftezentrierten und einer pädagogischen Perspektive, mit Fokus auf Umsetzung des Bildungsauftrages, unterschieden. Aus arbeitsmedizinischer Sicht ist vor allem die lehrkräftezentrierte Perspektive von Relevanz, der im Rahmen dieses Beitrags verstärkt Aufmerksamkeit geschenkt wird.

Methoden

Zu den Fokusgruppen

Die Fokusgruppen-Befragungen wurden mit Lehrkräften aus zwei Bundesländern, jeweils in einem Flächen- und einen Stadtstaat

(Rheinland-Pfalz und Hamburg), durchgeführt. Die Durchführung der Fokusgruppen fand im Zeitraum vom 08.06.2021 bis 24.06.2021 statt. Dieser Zeitraum wurde durch eine Infektionslage mit hohen Inzidenzen in Deutschland gekennzeichnet (Statista 2021). Zeitgleich dominierte in diesem Zeitraum die gegenüber dem SARS-CoV-2-Wildtyp ansteckendere Variante B.1.1.7 in Deutschland. Neben der bundesweiten „Notbremse“ ab dem 23.04.2021 zur Eindämmung der Pandemie waren (Stand 30.04.2021) bereits 7,7 % der Bevölkerung vollständig geimpft und 26,9 % einfach geimpft. Insgesamt wurde die Rekrutierung der Teilnehmenden durch das dynamische Infektionsgeschehen und die damit verbundene Unsicherheiten deutlich erschwert.

Die Konzeption der Fokusgruppen-Befragung erfolgte in einem mehrstufigen Prozess (Leitfadenentwicklung, Diskussion in Expertenteams, Pretests, finale Gestaltung von Leitfaden und digitalen Unterstützungstools). Die Dauer der Fokusgruppen betrug etwa 165 Minuten, inklusive Einführungs- und Vorstellungsphase sowie einer Pause. Dabei wurden jeweils Gruppen von 3–5 Personen analog zu den oben beschriebenen Leitthemen befragt.

Pandemiebedingt fanden die Fokusgruppen digital über Microsoft-Teams statt. Zur Unterstützung der Moderation und zur Dokumentation der Ergebnisse wurde die Online-Kollaborations-Plattform „Miro“ genutzt. Vor die jeweiligen Fokusgruppen wurde eine kurze Online-Befragung via Limesurvey geschaltet, um die Erhebung soziodemografischer Variablen der Teilnehmenden abzubilden. Nach dieser Limesurvey-Befragung und der Zustimmung zu Einverständnis- und Datenschutzerklärung konnten die Teilnehmenden über einen Link der Besprechung via Microsoft-Teams beitreten. Die Teilnahme an den Fokusgruppen war freiwillig. Alle Aussagen der Teilnehmenden wurden ohne Personenbezug dokumentiert. Die Ergebnissammlung in den Fokusgruppen erfolgte digital in Form von thematisch sortierten Antwortkarten innerhalb eines von einem Psychologen moderierten Prozesses und durch Unterstützung von Mitarbeitenden des Instituts für Arbeits-, Sozial- und Umweltmedizin in Mainz. Die Studie wurde durch die Ethikkommission der Landesärztekammer Rheinland-Pfalz begutachtet und genehmigt (Antragsnummer 2020-15531).

Rekrutierung

Die Rekrutierung der Teilnehmenden für die Fokusgruppen-Befragungen erfolgte in Abstimmung mit dem Ministerium für Bildung in Rheinland-Pfalz und der Gewerkschaft Erziehung und Wissenschaft (GEW). Die Rekrutierung der einzelnen Teilnehmenden in Rheinland-Pfalz wurde durch eine randomisierte Auswahl aus einer dem Forschungsteam vorliegenden Schulliste in sechs Rekrutierungswellen durchgeführt. Hierbei erhielten die zufällig ausgewählten Schulen ein Informationsschreiben, mit allen wichtigen Informationen zum Forschungsprojekt und eine Einladung zur Teilnahme an einer der Fokusgruppen. Durch die geringe Anzahl an Rückmeldungen wurde in der letzten Rekrutierungswelle ein Teil der Schulen, zu denen in anderen Projekten bereits ein Kontakt über das Institut für Lehrgesundheit (Mainz) bestand, ein zweites Mal angeschrieben. Da für Hamburg kein systematischer Zugang über Schullisten gegeben war, erfolgte die Rekrutierung der Fokusgruppen in Hamburg in Kooperation mit der GEW. Ein Informationsschreiben wurde über GEW-interne Verteiler an deren Mitglieder an Schulen in Hamburg weitergeleitet, verbunden mit der Bitte, dieses in deren jeweiligen Dienststellen/Schulen zu verteilen. Aufgrund der beschriebenen Vor-

gehensweise liegen keine Daten zu der genauen Anzahl der kontaktierten Personen/Schulen in Hamburg vor.

Auswertung

Die gesammelten Antworten beziehungsweise Aussagen der Teilnehmenden wurden über alle Fokusgruppen hinweg aggregiert ausgewertet. In Anlehnung an die Methode der qualitativen Inhaltsanalyse nach Mayring (2015) wurden inhaltlich miteinander assoziierte Aussagen mit Bezug auf die Fragestellungen zusammengefasst und auf deren Basis Kategorien formuliert. Hierbei arbeiteten mindestens zwei Mitarbeitende unabhängig voneinander, um im Anschluss die unabhängig voneinander gebildeten Kategorien auf Übereinstimmung beziehungsweise Unterschiede hin zu vergleichen, mit dem Ziel, konsensuell geteilte Kategorien zu bilden (Mayring 2015). Die Ergebnisse wurden anschließend in themenbezogene Mindmaps übertragen und die Kategorien durch Ankerbeispiele belegt.

Ergebnisse

Stichprobenbeschreibung

Insgesamt wurden drei Fokusgruppen mit Schulen aus Rheinland-Pfalz und eine Fokusgruppe mit einer Schule aus Hamburg durchgeführt (n = 17 Teilnehmende). Der Altersdurchschnitt betrug 43,8 Jahre (SA = 9,0) und 88,2 % (n = 15) der Befragten waren weiblichen Geschlechts. Von den Teilnehmenden gaben 23,5 % an, Schulleiterinnen beziehungsweise Schulleiter zu sein (n = 4), 64,7 % ordneten sich der Berufsgruppe der Lehrkräfte zu (n = 11), 5,9 % gaben an, eine pädagogische Fachkraft zu sein (n = 1) und eine Lehrkraft machte hierzu keine Angabe. Die Verteilung nach Schulformen setzte sich folgendermaßen zusammen: 5,9 % Realschule (n = 1), 29,4 % Förderschule (n = 5), 29,4 % Gymnasium (n = 5), 29,4 % Integrierte Gesamtschule (n = 5) und 5,9 % Berufsschule (n = 1). Insgesamt gaben 52,9 % der Teilnehmenden an, Mitglied einer Gewerkschaft zu sein (n = 9).

Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen

Die Synthese aus den Fokusgruppen zur Identifizierung SARS-CoV-2-spezifischer Belastungen und Herausforderungen mit Fokus auf schulorganisatorische Faktoren¹ ist in **Abb. 1** dargestellt.

In Abb. 1 wird illustriert, dass die befragten Lehrkräfte den durch die SARS-CoV-2-Pandemie bedingten erhöhten Arbeitsaufwand, die entgrenzten Arbeitszeiten sowie die fehlende Planungssicherheit als herausfordernd empfanden. Dies wird zum Beispiel durch die Aussage eines Teilnehmenden verdeutlicht, in der es heißt: „Man hat das Gefühl nie Feierabend zu haben“. Zudem wurden Schwierigkeiten für Anwärtinnen und Anwärter beschrieben und deren Ausbildungsqualität unter pandemischen Bedingungen in Frage gestellt. Des Weiteren wurde Kritik an den Landesbehörden geäußert: Diese würden die Verantwortung im Umgang mit der Pandemie häufig an die Schulleitungen delegieren und zudem die Fürsorgepflicht gegenüber ihren Beschäftigten, den Lehrkräften, verletzen.

¹ Neben schulorganisatorischen Belastungen und Herausforderungen wurden im Rahmen der Studie zudem pädagogische Belastungen und Herausforderungen und jene mit Schwerpunkt auf Unterrichtsformate herausgearbeitet. Aus arbeitsmedizinischer Sicht spielen allerdings die schulorganisatorischen eine zentrale Rolle.

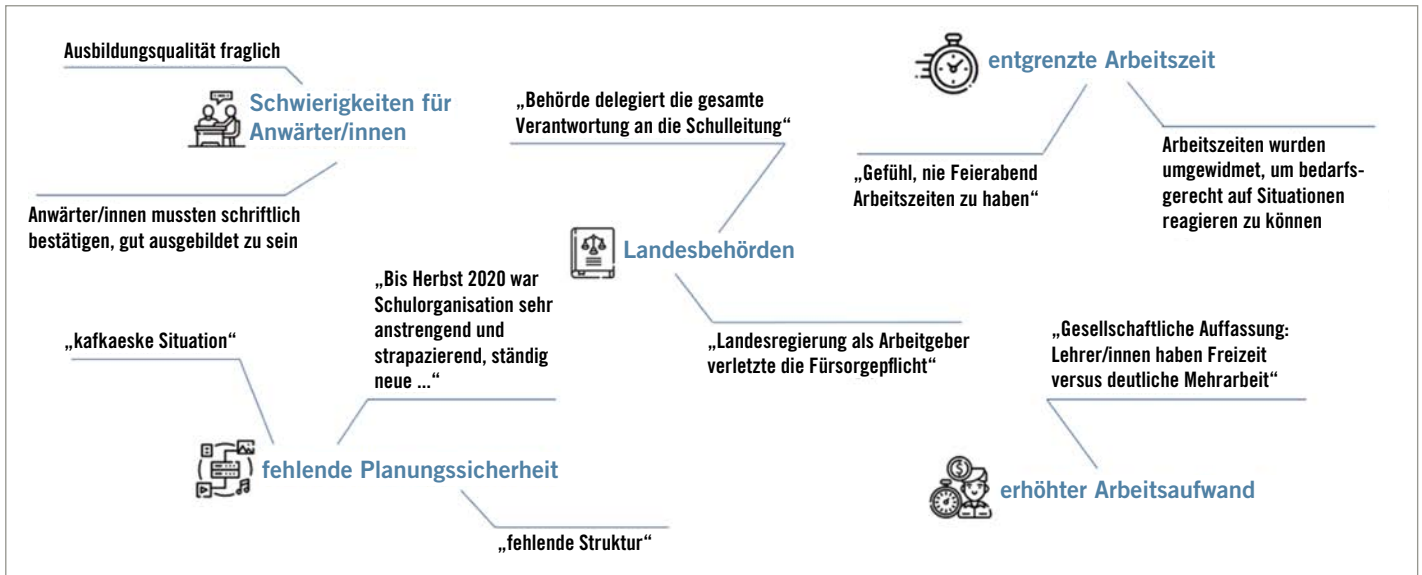


Abb. 1: Identifizierung von schulorganisatorischen SARS-CoV-2-spezifischen Belastungen und Herausforderungen
 Fig. 1: Identification of SARS-CoV-2-specific burdens and challenges in terms of school organisation

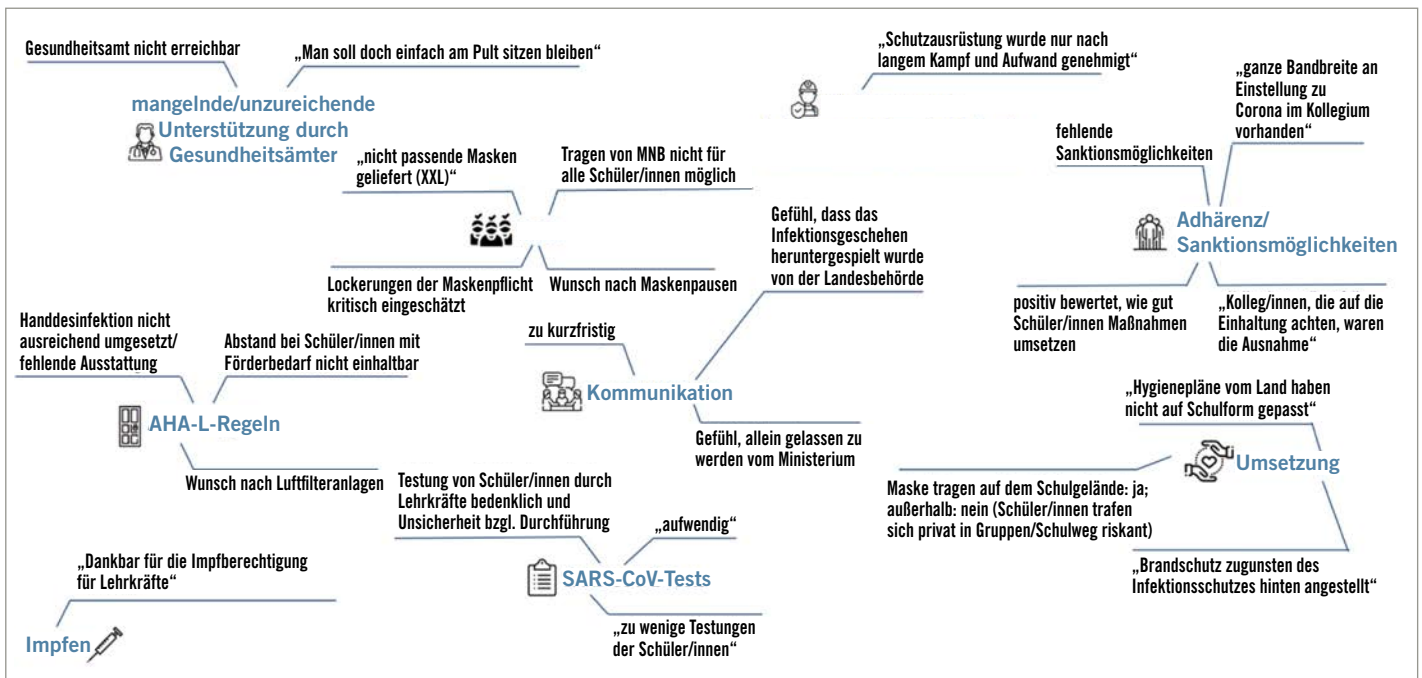


Abb. 2: Schulspezifische Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien oder -plänen
 Fig. 2: School-specific implementation, communication and observance of hygiene guidelines or plans

Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen

Bei der Kategorisierung der Aussagen zur Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen wurde zwischen einer persönlichen, also lehrkräftenzentrierten, schulspezifischen und arbeitsbezogenen Ebene unterschieden. Die Synthese aus schulspezifischer Ebene ist in **Abb. 2** dargestellt.

Es ist zu sehen, dass konkrete Infektionsschutzmaßnahmen von den befragten Lehrkräften grundsätzlich als wirksam angesehen werden, deren Umsetzung im Schulalltag allerdings kontrovers bewertet und diskutiert wird. Dies zeigt sich vor allem beim Tragen von Mund-

Nase-Bedeckungen (MNB), der Einhaltung der AHA-L-Regeln (Abstand, Hygiene, Alltagsmaske, Lüften) und bei der Durchführung von SARS-CoV-2-Tests in der Schule. Insbesondere das Testen von Schülerinnen und Schülern durch Lehrkräfte wurde als bedenklich und aufwendig eingeschätzt. Die Umsetzung der Maßnahmen würde zudem durch Uneinigkeit beziehungsweise unterschiedliche Einstellungen zur SARS-CoV-2-Pandemie innerhalb des Kollegiums erschwert; unter anderem durch fehlende Sanktionsmöglichkeiten bei Verstößen gegen Maßnahmen, unzureichende Ausstattung mit Infektionsschutzmaterial (z. B. Masken, Desinfektionsmittel) sowie mangelnde und zu kurzfristige Kommunikation, vor allem seitens

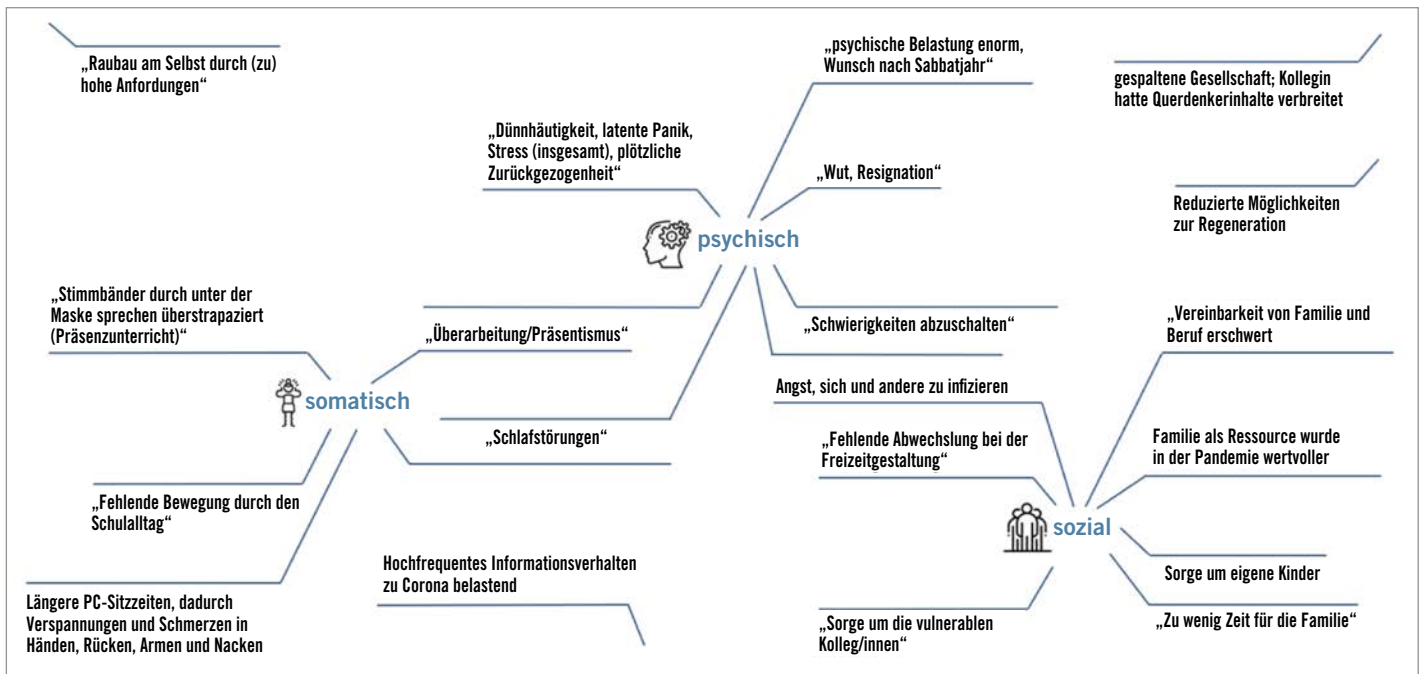


Abb. 3: Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte

Fig. 3: Effects of school operation on teachers during the SARS-CoV-2 pandemic

der Gesundheitsämter und Ministerien. Zudem gilt es zu resümieren, dass die befragten Lehrkräfte dem Thema des Impfens positiv gegenüberstanden und dankbar für die Einordnung in eine hohe Priorisierungsgruppe waren.

Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte

Die Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte zeichneten sich auf somatischer, psychischer und sozialer Ebene ab und sind in → Abb. 3 zusammengefasst.

Es wird deutlich, dass das Gesundheitsverhalten während der Pandemie beeinträchtigt war (z. B. unzureichende körperliche Aktivität, lange Sitzzeiten, hoher Medienkonsum, gestörter Schlaf), was von einer teilnehmenden Lehrkraft als „Raubbau am Selbst ...“ beschrieben wurde. Auf psychischer Ebene wurden Reaktionen von Überlastung wie subjektiv empfundener Stress, Dünnhäutigkeit, Schwierigkeiten abzuschalten, Panik oder Wut berichtet und im Zuge dessen der Wunsch nach Entlastung und von einer Person sogar nach einem Sabbatjahr geäußert. Auf sozialer Ebene stand das Thema Familie im Fokus. Hier wurde einerseits die Vereinbarkeit von Familie und Beruf sowie pandemiebedingte Sorgen um die Familie negativ herausgestellt, der Rückhalt der Familie allerdings auch als wertvolle Ressource in der Pandemie erachtet.

Sammlung von Best-Practice-Beispielen und Ableitung von Empfehlungen

Um Empfehlungen für die gegenwärtige Pandemie und die Zukunft ableiten zu können, wurden die Lehrkräfte gefragt, was ihrer Meinung nach gut lief und was benötigt würde, um den Infektionsschutz an Schulen noch effektiver umsetzen zu können. Neben Empfehlungen zur Verbesserung konkreter Maßnahmen wie zum Beispiel bezüglich der Umsetzung der AHA-L-Regeln (z. B. kleinere Klassen, Sanktionsmöglichkeiten bei Missachtung von Infektionsschutzmaßnahmen, räum-

liche bzw. bauliche Trennung) oder Durchführung der SARS-CoV-2-Tests (z. B. Durchführung durch medizinisches Fachpersonal) fällt aus arbeitsmedizinischer Sicht auf (→ Abb. 4), dass die Sicherstellung von Strukturen des Arbeitsschutzes erbeten wurde, auch und insbesondere in Pandemiezeiten. Auf politischer Ebene wurde einerseits die Aussetzung des Föderalismus, beispielweise bei der Durchsetzung der Bundesnotbremse, als positiv bewertet und andererseits die Bereitstellung von Ressourcen zur Umsetzung der Infektionsschutzmaßnahmen gefordert. Impfungen trugen zur Erleichterung und Entspannung der Gesamtsituation bei und wurden von der Lehrerschaft prinzipiell, wie auch schon zuvor im Kapitel zur Umsetzung der Maßnahmen erkenntlich wurde, als äußerst relevant angesehen, um den Infektionsschutz an Schulen zu gewährleisten und damit einhergehende negative Konsequenzen (z. B. Ängste) zu reduzieren.

Diskussion

Ziel der Studie war es, mittels eines qualitativen Forschungsdesigns Lehrkräfte in Deutschland zum Unterrichten während der SARS-CoV-2-Pandemie zu befragen. Besonderes Augenmerk lag hierbei auf der Identifizierung von SARS-CoV-2-spezifischen Belastungen und Herausforderungen, der Umsetzung, Kommunikation und Einhaltung von Hygienerichtlinien und -plänen sowie den Auswirkungen des Schulbetriebs während der SARS-CoV-2-Pandemie auf Lehrkräfte. Ebenfalls wurden Best-Practice-Beispiele gesammelt, um Empfehlungen für die Schulpraxis unter pandemischen Bedingungen ableiten zu können. Aufgrund der Vielzahl an Ergebnissen wird sich im Rahmen der Diskussion auf ausgewählte Aspekte, die aus arbeitsmedizinischer Sicht von besonderem Interesse sind, fokussiert.

Aus arbeitsmedizinischer Sicht besonders relevant sind Aussagen wie beispielsweise die, dass es während der Pandemie zunehmend zu entgrenzten Arbeitszeiten und somit zu einer Verschmelzung von Arbeit- und Privatleben kam. Um dieses Phänomen, das vor

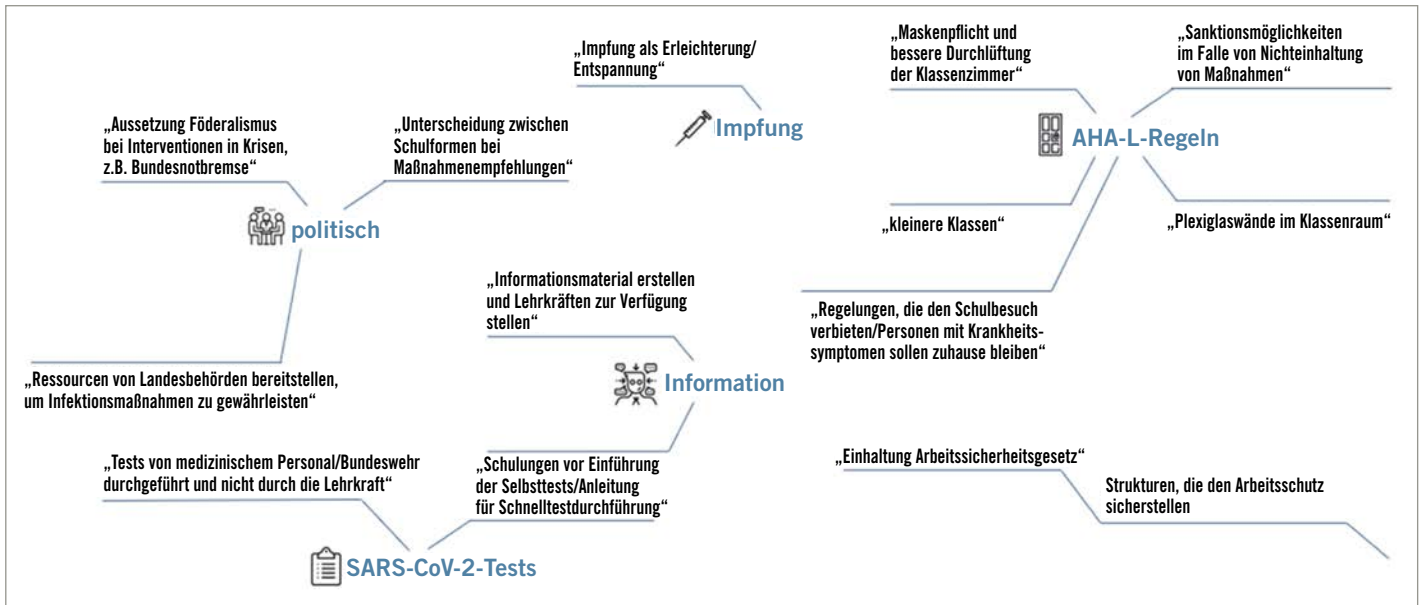


Abb. 4: Sammlung von Best-Practice Beispielen und Ableitung von Empfehlungen Umsetzung des Infektionsschutzes
 Fig. 4: Collection of best practice examples and derivation of recommendations for implementation of infection control

allem während der SARS-CoV-2-Pandemie zunehmend in den arbeitsmedizinischen Fokus gerückt ist, hat sich der Begriff des Work-Life-Blendings konstituiert. Eine der ersten Studien zum Work-Life-Blending wurde Anfang 2021 durchgeführt (Bahr 2021). Im Rahmen dieser Studie wurden rund 2800 Beschäftigte aus kleinen und mittelständischen Unternehmen weltweit befragt, darunter 299 Teilnehmende aus deutschen Betrieben. Über die Hälfte (53 %) der Befragten dieser Studie gab an, im Homeoffice berufliche Anrufe vor oder nach den Arbeitszeiten zu beantworten, 48 % arbeiteten am Wochenende. Rund 44 % der Befragten beschrieben zudem, zu einem gewissen Grad ein Burnout zu erleben, seit sie im Homeoffice arbeiten. Die Ergebnisse unserer Studie zeigen einen ähnlichen Trend dahingehend auf, dass bei Lehrkräften in Deutschland während der Pandemie ebenfalls die Trennung zwischen Berufs- und Privatleben verschwommen war. Dies spiegelt sich auch in den berichteten Auswirkungen wider, die ebenfalls einen Hinweis auf emotionale Erschöpfung und Ausgebranntheit liefern. Daher empfehlen wir, die Ergebnisse der vorliegenden qualitativen Untersuchung von Lehrkräften durch quantitative Untersuchungen zu verifizieren und den Lehrkräften zudem Empfehlungen sowie Weiterbildungsmöglichkeiten zu entlastenden Kompetenzen (z. B. Zeitmanagement, Arbeitsorganisation) an die Hand zu geben, um einem Work-Life-Blending und den damit einhergehenden Beanspruchungsreaktionen entgegenzuwirken.

Des Weiteren klang im Rahmen der Untersuchung an, dass die Ausbildungsqualität der Anwärterinnen und Anwärter während der SARS-CoV-2-Pandemie, die wie auch in anderen Bereichen durch Fernunterricht, Selbststudium oder hybride Modelle geprägt war, in Frage gestellt wurde. Dabei stellen gerade die Lehramtsanwärterinnen und -anwärter die zukünftigen Lehrkräfte dar, die maßgeblich an der Umsetzung des

Bildungsauftrags der nächsten Generationen von Schülerinnen und Schülern beteiligt sein werden. Zudem galt das Kollektiv der Lehramtsanwärterinnen und -anwärter auch vor der SARS-CoV-2-Pandemie als enorm beansprucht und als Risikogruppe für beeinträchtigte mentale Gesundheit (Darius et al. 2021; Drüge et al. 2014). Es erscheint plausibel anzunehmen und wurde im Rahmen unserer Untersuchung bestätigt, dass sich die Belastungen durch die SARS-CoV-2-Pandemie verändert und insgesamt verstärkt haben. Aus diesem Grund empfehlen wir, der Zielgruppe der Anwärterinnen und Anwärter besondere Aufmerksamkeit zu schenken und sicherzustellen, dass einerseits die Qualität deren Ausbildung gewährleistet ist und andererseits Maßnahmen initiiert werden, um gesundheitsfördernde Ressourcen in diesem

Anzeige

jungen Kollektiv zu stärken, um den Umgang mit der Pandemie und die damit assoziierten Herausforderungen besser bewältigen zu können. Hier wären Mentorinnen-/Mentorenprogramme ebenso denkbar wie digitale Unterstützungsangebote, wie sie beispielweise am Institut für Lehrgesundheit in Mainz angeboten werden.

Einen weiteren kritischen Aspekt stellt die Verschlechterung des Gesundheitsverhaltens von Lehrkräften während der SARS-CoV-2-Pandemie dar. Dieses Phänomen wurde bereits durch zahlreiche quantitative Studien sowohl für die Allgemeinbevölkerung als auch für verschiedenste spezifische Kollektive nachgewiesen und lässt sich für eine Vielzahl an gesundheitlichen Dimensionen abbilden, so unter anderem für Bewegung, Schlaf, Ernährung, Tabak- und Alkoholkonsum (Ammar et al. 2020; Knell et al. 2020; Zvolensky et al. 2020; Carroll et al. 2020; Castañeda-Babarro et al. 2020). Diese negative Entwicklung des Gesundheitsverhaltens quer durch die Bevölkerung stellt ein enormes Public-Health-Risiko dar. Aus diesem Grund sollte beziehungsweise müssen während der SARS-CoV-2-Pandemie die Gedanken von Prävention und Gesundheitsförderung noch stärker intensiviert, angesichts der pandemischen Besonderheiten weiterentwickelt und in den verschiedenen Lebenswelten (Sozialgesetzbuch V 2018) angewandt werden. Ein Fokus sollte hierbei auf der Vermittlung gesundheitsfördernder Verhaltensweisen beziehungsweise eines gesundheitsfördernden Lebensstils für Lehrkräfte gelegt werden. Digitale Angebote zur Vermittlung von Gesundheitsangeboten stellen vor allem unter pandemischen Bedingungen eine Methode der Wahl dar.

Abschließend lässt sich resümieren, dass das Unterrichten an Schulen während der SARS-CoV-2-Pandemie für Lehrkräfte überwiegend als herausfordernd empfunden wurde und sich negativ auf deren Gesundheit ausgewirkt hat. Allerdings konnten im Rahmen dieser Studie auch positive Aspekte aus der Pandemie abgeleitet sowie Empfehlungen beschrieben werden, die im Rahmen dieses Beitrags in die Formulierung von Best-Practice-Beispielen eingeflossen sind und die es im weiteren Verlauf der SARS-CoV-2-Pandemie sowie in etwaigen zukünftigen Pandemien zu beachten gilt.

Limitationen

Es ist kritisch anzuführen, dass der zeitliche Kontext, in dem sich die Rekrutierung sowie Durchführung der Fokusgruppen-Befragungen abspielte durch sinkende Infektionszahlen sowie einer Rückkehr zum Wechsel- oder Präsenzunterricht an den Schulen geprägt war. Diese Umstände und die damit einhergehenden organisatorischen Aufgaben seitens der Schulen schienen sich negativ auf die Bereitschaft zur Teilnahme an den Fokusgruppen auszuwirken, was sich in der geringen Stichprobengröße ausdrückte.

Zudem ist zu erwähnen, dass sich die Stichprobe lediglich aus Teilnehmenden der Bundesländer Rheinland-Pfalz und Hamburg zusammensetzt und somit, auch bedingt durch länderspezifische Unterschiede bei der Umsetzung des Bildungsauftrages an Schulen, keine Aussagen für Lehrkräfte im Allgemeinen beziehungsweise für Lehrkräfte in Deutschland getroffen werden können. Des Weiteren ist kritisch zu resümieren, dass durch Selbstselektionsprozesse zur Teilnahme an der Fokusgruppen-Befragung eine Stichprobenverzerrung stattgefunden haben kann. Diese könnte sich zum Beispiel dahingehend zeigen, dass sich besonders diejenigen Lehrkräfte angemeldet

haben, die eine intrinsische Motivation zur Teilnahme an der Studie verspürten und zusätzlich die dafür nötigen zeitlichen Ressourcen zur Verfügung hatten.

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