

Causes and Risk Factors for Absenteeism among Medical Staff in German Specialized Lung Clinics during the COVID Pandemic

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Keywords

COVID-19 pandemic · Healthcare workers · Staff shortage · Vaccination · Specialized lung clinics · Long-term effects

Abstract

Background: Staff shortages pose a major challenge to the health system. **Objectives:** The objective of this study was to clarify the role of different causative factors we investigated on staff absenteeism during the COVID pandemic. **Methods:** The prospective multicentre cohort study assessed the

private and professional impact of the pandemic on health care workers (HCWs) using a specially developed questionnaire. HCWs from 7 specialist lung clinics throughout Germany were surveyed from December 1 to December 23, 2021. The current analysis addresses pandemic-related absenteeism. **Results:** 1,134 HCW (55% female; 18.4% male, 26.3% not willing to provide information on age or gender) participated. 72.8% had received at least one vaccination dose at the time of the survey, and 9.4% reported a COVID infection. Of those with positive tests, 98% reported home quarantine for median (IQR) 14 (12–17) days; 10.3% of

those who ultimately tested negative also reported quarantine periods of 14 (7–14) days. 32.2% of vaccinated respondents reported absenteeism due to vaccine reactions of 2 (1–3) days. Overall, 37% ($n = 420$) of HCW reported pandemic-related absenteeism, with 3,524 total days of absenteeism, of which 2,828 were due to illness/quarantine and 696 to vaccination effects. Independent risk factors for COVID-related absenteeism ≥ 5 days included already having COVID, but also concern about long-term effects of COVID (OR 1,782, $p = 0.014$); risk factors for vaccine-related absenteeism ≥ 2 days included concerns of late effects of vaccination (OR 2.2, 95% CI: 1.4–3.1, $p < 0.000$). **Conclusion:** Staff shortages due to quarantine or infections and vaccine reactogenicity have put a strain on German respiratory specialists. The fact that staff concerns also contributed to absenteeism may be helpful in managing future pandemic events to minimize staff absenteeism.

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Introduction

The coronavirus disease (COVID) pandemic had a far-reaching impact on the health care system, with its demands placing a particular strain on health care workers (HCW). Unlike other employees who could shift part of their professional activity to working from home, HCWs being in direct patient care did not have these options [1]. Due to this fact, HCWs were themselves a high-risk group for occupational COVID infections [2]. This challenging situation, together with the uncertainties about the novel infectious disease and its possible long-term effects, put a great physical and psychological strain on the HCWs [3–5]. It is estimated that at the beginning of the pandemic, 5–20% of SARS-CoV-2 cases involved HCWs [6–8]. Staff from intensive care units was at particular risk being often involved in the direct care of critically ill SARS-CoV-2 patients and having intense contact with oronasal secretions and aerosols [9].

The introduction of the novel SARS-CoV-2 vaccines, the first of which were available in Germany from December 2020 onwards, was associated with the hope for an end to the pandemic, but also with concerns about unknown side effects and late sequelae [10]. Again, these concerns hit HCWs in particular as vaccinating HCWs was a high priority in Germany. Early vaccination was intended to protect this occupationally exposed group and the vulnerable patients entrusted to them. The vaccines were reported to prevent severe courses of COVID, which besides having major consequences for the personal health of the HCW would also lead to prolonged absences from work [11].

At the same time, workplace absenteeism as a result of vaccination was also reported. A study performed in several general hospitals in Germany showed that SARS-CoV-2 vaccination caused symptoms in 75% of participants, and one or more days of absenteeism in almost 25% of the cases [12]. Although it is known that absenteeism has increased under pandemic conditions [13], there is little information on the underlying causes and the relative contributions of infection, isolation, quarantine, and vaccine reactogenicity. As staff shortages are likely to continue in the post-COVID era, it is worth examining pandemic-related absenteeism in more detail to potentially derived strategies to identify preventable causes of absenteeism. We thus investigated the impact of various aspects of the pandemic in seven pulmonology clinics across Germany using a specially developed questionnaire. In the present analysis, we examined factors for absenteeism such as COVID-19 disease and SARS-CoV-2 vaccination, considering also the respective attitudes of HCW towards the pandemic.

Materials and Methods

Subjects and Sampling

The first survey had been conducted between March 15 and March 28, 2021 in five German pulmonary clinics to assess personal attitudes and opinions during the pandemic [10]; the second survey was conducted in six pulmonary clinics and one specialized lung rehabilitation clinic between December 1 and December 23, 2021. In the present analysis, only the data from the second survey was considered. The complete questionnaire can be found in the supplementary material, available at <https://doi.org/10.1159/000534327>.

Questionnaire

For the survey, a comprehensive questionnaire consisting of 119 questions was designed to capture the individual experiences and attitudes of HCW. In this multicenter study, a total of six German pulmonology clinics (Thoraxklinik Heidelberg, SLK Lungenklinik Löwenstein, Klinik Schillerhöhe, Asklepios-Fachkliniken München-Gauting, LungenClinic Grosshansdorf, and Fachkliniken Wangen) and one specialized lung rehabilitation clinic (Klinik Bad Reichenhall) took part. In addition to the responsible Ethics Committees, the questionnaire also had to be submitted in advance to the works councils of the respective hospitals for inspection and agreement on the questions. An English translation of the questionnaire can be found in Supplement 1.

Conducting the Survey

Study data were collected anonymously via the online survey system LimeSurvey® from December 1, 2021 to December 23, 2021. Initially, HCWs were invited to participate by an e-mail, containing a web link and a QR code to the survey. Additionally, a total of 1,400 flyers, 70 posters, and 2,500 giveaways were

Table 1. Demographic characteristics of survey responders

All participants	1,134 (100)
Gender	
Male	209 (18.4)
Female	627 (55.3)
Not specified	298 (26.3)
Age groups	
18–25 years	69 (6.1)
26–35 years	208 (18.3)
36–45 years	189 (16.7)
46–55 years	199 (17.5)
56–65 years	164 (14.5)
>65 years	8 (7)
Not specified	297 (26.2)
Lung clinic	
Thoraxklinik Heidelberg	240 (21.2)
Asklepios Gauting	95 (8.4)
Klinik Bad Reichenhall	49 (6.7)
LungenClinic Grosshansdorf	76 (6.7)
Fachkliniken Wangen	192 (16.9)
SLK Lungenklinik Löwenstein	192 (16.9)
Klinik Schillerhöhe	84 (7.4)
Not specified	308 (27.2)
Department	
Anaesthesia	24 (2.2)
Thoracic surgery	37 (3.3)
Pneumology	267 (23.5)
Thoracic oncology	62 (5.5)
Radiology	16 (1.4)
Clinical research	26 (2.3)
Other	201 (26.5)
Not specified	401 (35.4)

Absolute numbers are given, with percentages in parentheses.

distributed in the clinics, all of them containing the web link and QR code. A second invitation per e-mail was sent as a reminder in the final week of the survey.

The questionnaire included an information sheet about the scope of the study and the data confidentiality management. It was based on that of the first survey, but all questions were revised and adapted to the present situation. New questions were added, such as the topic of a third vaccination and an expanded question on absence from work. The main topics addressed by the questionnaire were demographics (age, gender, profession, clinic, position and place of work, previous SARS-CoV-2 infection and respective concerns, workplace absenteeism due to infection or exposure to the virus, vaccination status and side effects, concerns with regard to the available vaccines, and workplace absenteeism because of a vaccination against SARS-CoV-2).

Data Analyses

The statistical analysis aimed at a detailed description of the data addressing a variety of factors potentially underlying the answers. As a first step, univariate analyses (χ^2 statistics, Student's

t-tests) were performed with the aim of identifying basic unadjusted relationships between variables. The reported results included absolute numbers and percentages as well as odds ratios with 95% confidence intervals. The variables identified as potentially relevant in the univariate analyses ($p \leq 0.05$) were then used in multiple (logistic) regression analyses to identify statistically independent predictors. Invalid answers (i.e., “no answer”) were possible in the questionnaire; these answers were considered in the analyses by a special code as the omission of statements could contain a bias. We performed the statistical analysis using SPSS version 28.0 (IBM, Armonk, NJ, USA). *p* values <0.05 were considered statistically significant. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test.

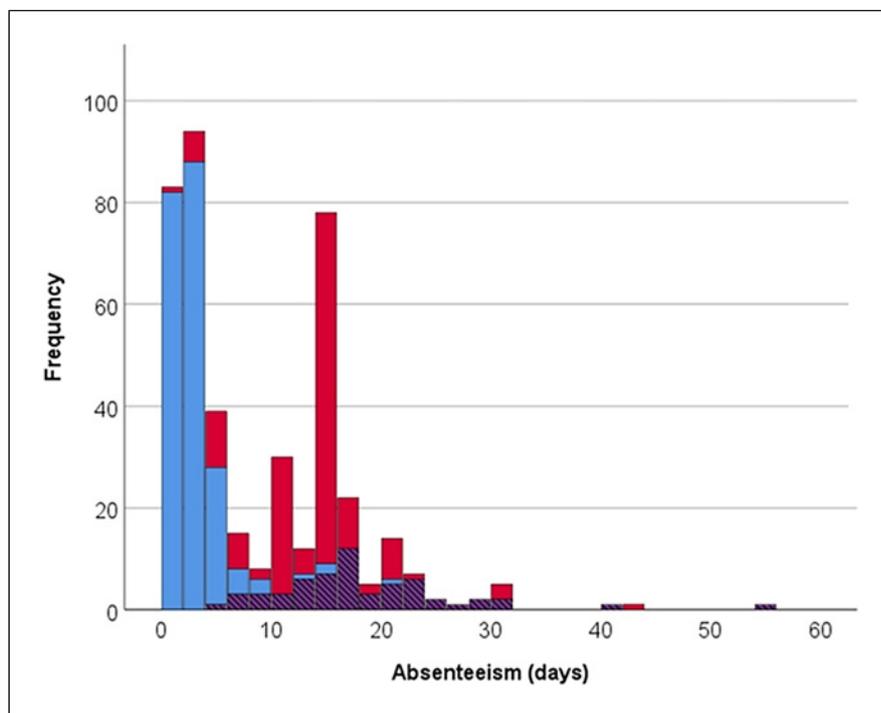
Results

By December 23, 2021, 1,136 HCWs had participated in the survey. In total, 1,134 of the questionnaires answered could be evaluated and considered in the analysis. The majority of participants ($n = 627$; 55.3%) were female, while 298 (26.3%) provided no information on gender. Age groups 18–25/26–35/36–45/46–55/56–65/>65 years accounted for 6.1/18.3/16.7/17.5/14.5/7% of participants, respectively, while 26.2% did not provide information regarding age. Employees from various medical and non-medical departments of pulmonary clinics took part in the survey including administrative and support staff, with clinical pneumological staff being dominant. The characteristics of the participants and their affiliations are shown in Table 1.

SARS-CoV-2 Infections, Vaccination Status, and Reported Workplace Absenteeism

Among all respondents, 107 (9.4%) reported having had a corona infection, 96 (89.7%) of whom reported having been symptomatic at that time. Participants reporting infection had a quarantine time of median (IQR) 12 (14–17) days. Among those who reported no infection, there were also participants who reported quarantine periods; in this group, the quarantine period of median (IQR) 14 (7–14) days. The majority of respondents (72.8%) indicated that they had been vaccinated at least once, while 5.8% indicated that they had not received any corona vaccination at the time of the questionnaire; 21.4% did not answer the question. Of the 825 study participants who reported having received the vaccine, 62% reported side effects or reactions to the vaccine. Specifically, 52.8% reported flu-like symptoms such as fever, muscle aches, or chills, 41.2% reported problems at the injection site, 0.4% reported severe allergic reactions, 14.4% reported other symptoms, with 0.8% rating these as

Fig. 1. Number of participants with absenteeism due to different causes: histograms for absenteeism (days) stratified due to their cause. Red: COVID/quarantine; blue: vaccination; dashed: both.



severe. Of the 825 vaccinated participants, 266 (32.2%) reported illness-related absenteeism due to vaccination, with a mean (\pm SD) duration of 2.47 ± 2.1 days.

The days of absence due to COVID or quarantine, even if the test was ultimately negative, and the absences due to the consequences of vaccination are shown in Figure 1. Information on SARS-CoV-2 infections, vaccination status, and reported absenteeism from work is summarized in Table 2. Overall, 420 employees (37%) reported pandemic-related absences, with a total sum of 3,524 days of absence from work, among them 2,828 related to COVID-19 illness or quarantine, and 696 due to vaccination effects. The median duration was 5 days, whereby 231 (20%) employees reported absences from work of more than 5 days duration.

Correlates of Absence from Work by More than 5 Days either due to COVID, Infection, Quarantine, or Side Effects of Vaccination

Overall, women were slightly more likely than men to report absences of more than 5 days, while participants who did not indicate their gender were least likely to report such absences. Employees who worked in high-risk areas or in direct patient care reported absences of >5 days more frequently than employees from other areas. In addition to the presence of vaccination, vaccine responses and reported COVID, COVID-related concerns

associated with long-term effects of vaccination were also associated with absenteeism of more than 5 days. Details of this analysis are shown in Table 3.

Independent Factors Associated with Absenteeism of More than 2 Days due to Vaccination Effects

Binary logistic regression analyses were performed to identify factors associated with prolonged vaccine-related absenteeism (Table 4). It was found that neither age (cut-off 45 years) nor gender were independent factors for absenteeism of more than 2 days, but that the groups of those willing to report their age and gender, and those who did not, were significantly different. Another independent risk factor that was identified was fear of late effects of vaccination.

Independent Factors Associated with Absence of More than 5 Days due to COVID Infection and/or Quarantine

Similarly, for COVID-related absences, employees who were willing to provide information on gender and age were more likely to report absences of more than 5 days than those who were not (Table 5). In addition to COVID infection, concern about possible late effects was also a relevant risk factor for longer absences. In this context, however, the concerns related to the late effects of COVID infection.

Table 2. SARS-CoV-2 infections, vaccination status, and reported workplace absenteeism

Questions	Reference	Number (%) or median (IQR)
Did you have to quarantine yourself due to exposure or infection?	1,134	
Yes		211 (18.6)
No		789 (70.4)
Not specified		125 (11)
Were you yourself affected by COVID-19?	1,134	
Yes		107 (9.4)
No		902 (79.5)
Not specified		125 (11)
If yes, did you have symptoms? (any; severe)	107	96 (89.7)
Respiratory symptoms	107	95 (88.8); 0 (0)
Gastrointestinal symptoms		95 (88.8); 0 (0)
Ageusia/dysgeusia		30 (28.0); 8 (7.5)
Fatigue		95 (88.8); 2 (1.9)
Flu-like symptoms		93 (86.9); 50 (46.7)
If yes, how long were you in quarantine (days)?	107	14 (12–17)
Are you already vaccinated?	1,134	
Yes		825 (72.8)
No		66 (5.8)
Not specified		243 (21.4)
If yes, did you have any side effects from vaccination?	825	
Yes		515 (62)
No		310 (37.6)
Reported side effects	825	
Swelling, redness at the injection site		340 (41.2)
Flu-like symptoms, fever, muscle aches, chills		436 (52.8)
Thromboembolic events		0 (0)
Severe allergic reactions, allergic shock		3 (0.4)
Other		119 (14.4)
Other severe side effects		7 (0.8)
Did you have to take sick leave because of the side effects of the vaccination?	825	
Yes		266 (32.2)
No		249 (30.2)
Not specified		310 (37.6)
If yes, how long have you been absent from work? (days)?	266	2 (1–3)

Discussion

In the present study, we investigated pandemic-related absenteeism among HCWs from specialized lung clinics across Germany. Of the 1,134 respondents, 37% reported pandemic-related absenteeism (median 5 days), with about 3,500 cumulative days of absence from work. Of these, about 2,800 days were due to illness or quarantine and about 700 days due to vaccine reactogenicity. As expected, quarantine and COVID led to significant absenteeism; in addition, a relevant number of absences during the survey period were related to vaccination.

In addition to the COVID infection itself, concern about the long-term effects of COVID-19 was also associated with longer absenteeism related to COVID. In

relation to vaccination, concern about late effects of vaccination was a relevant risk factor for longer absenteeism. At the time of the survey, the number of people who had already been infected was still relatively low. The reported courses were predominantly moderate. In line with previous findings [14], 90% of the participants infected with COVID reported symptoms, mostly respiratory and gastrointestinal symptoms, ageusia/dysgeusia, fatigue, and flu-like symptoms as expected. In 47% of cases, acute flu-like symptoms were reported as severe. Eight HCWs reported severe ageusia/dysgeusia, and 2 reported severe fatigue symptoms. Severe courses requiring treatment in the intensive care unit were not reported. The median quarantine period of participants with positive PCR test was 14 days. In contrast, those who

Table 3. Characteristics of participants with pandemic-related absences from work <5 days or ≥5 days due to COVID infection or quarantine or as a result of vaccination

	Number	<5 days	≥5 days	p value
Gender	1,133			<0.001
Male		165 (79.3)	43 (20.7)	
Female		471 (75.1)	156 (24.9)	
Not specified		266 (89.3)	32 (10.6)	
Age, years	1,133			0.116
<45		340 (73.1)	125 (26.9)	
≥45		297 (80.1)	74 (19.9)	
Not specified		265 (89.2)	32 (10.8)	
Employed in a high-risk area [§]	1,133			<0.001
Yes		219 (73.0)	81 (27.0)	
No		411 (78.0)	116 (22.0)	
Not specified		272 (88.9)	34 (11.4)	
Work in direct patient care	1,133			<0.001
Yes		408 (73.2)	149 (26.8)	
No		222 (82.2)	48 (17.9)	
Not specified		272 (88.9)	272 (11.1)	
At least one COVID vaccination	1,133			0.004
Yes		640 (77.7)	184 (22.3)	
No		262 (84.8)	47 (15.2)	
Side effects of the vaccination	1,133			<0.001
Yes		185 (67.8)	88 (32.2)	
No		717 (83.4)	143 (16.6)	
COVID-19 disease	1,133			<0.001
Yes		3 (2.8)	104 (97.2)	
No		899 (87.6)	127 (12.4)	
Fear of COVID-19 late effects	1,133			<0.001
Yes*		337 (74.1)	118 (25.9)	
No**		902 (79.6)	113 (16.7%)	
Fear of long-term effects of vaccination	1,133			<0.001
Yes*		159 (68.3)	74 (31.8)	
No**		742 (82.6)	157 (17.4)	

Absolute numbers are given, with percentages in parentheses. [§]OP, endoscopy, swab test location, COVID-19 ward, intensive care unit, emergency room. *Applies or fully applies. **Does not apply at all, does not apply, partly applies, or not specified.

Table 4. Independent risk factors for vaccination-related absenteeism of more than 2 days from multiple logistic regression analysis

Predictor	Coefficient	Odds ratio	95% CI of odds ratio		p value
			lower	upper	
Age and gender reported (n/y)	1.456	4.291	2.218	8.299	<0.001
Employed in a high-risk area (y/n)	0.263	1.301	0.903	1.875	0.158
Occurrence of COVID-19 (y/n)	0.173	1.189	0.701	2.017	0.522
Fear of long-term effects of vaccination (y/n)	0.779	2.179	1.509	3.147	<0.001
Fear of COVID-19 late effects (y/n)	0.308	1.361	0.966	1.918	0.078

The model showed good fit between predicted and observed probabilities: $\chi^2(8) = 3.452$, $p = 0.750$, AUC: 0.581 with 95% CI of 0.540–0.623, $p < 0.001$.

Table 5. Independent risk factors for COVID-related absenteeism of more than 5 days from multiple logistic regression analysis

Predictor	Coefficient	Odds ratio	95% CI of odds ratio		p value
			lower	upper	
Age and gender reported (n/y)	1.011	2.749	1.386	5.454	0.004
Employed in a high-risk area (y/n)	0.042	1.043	0.655	1.662	0.859
Occurrence of COVID-19 (y/n)	6.038	419.260	126.591	1,388.554	<0.001
Fear of long-term effects of vaccination (y/n)	-0.114	0.892	0.530	1.500	0.666
Fear of COVID-19 late effects (y/n)	0.547	1.728	1.119	2.671	<0.014

The model showed good fit between predicted and observed outcomes: $\chi^2(8) = 3.002$, $p = 0.885$, AUC: 0.701 with 95% CI of 0.651–0.750; $p < 0.001$.

ultimately did not have a positive test reported quarantine-related absenteeism with a median time of 14 days per person, which was however heavily skewed as the upper quartile and maximum were 7 and 14 days, respectively.

The second relevant factor that contributed to absenteeism during the survey period was vaccination. The reported side effects of vaccination were mainly flu-like symptoms in 53%, as well as local reactions in the area of the injection site (41.2%). Three participants (0.4%) reported severe allergic reactions, while thromboembolic events or haemorrhagic stroke described in connection with mRNA vaccines [15] were not reported. Overall, vaccine reactogenicity was a relevant factor since 32% of those vaccinated reported a median time of absence of 2 (1–3) days due to reactogenicity. At the time of the survey, significantly more employees had already been vaccinated and only a minority reported infection. Although the duration of vaccine-related absences was significantly shorter than absences due to COVID or quarantine, they still accounted for a significant proportion of total absences. A high absenteeism rate due to vaccine reactogenicity has also been found in other analyses. In a staff survey conducted by Helios, a private hospital operator in Germany, of 8,375 participants, 73% of respondents reported reactogenicity following COVID vaccination (Biontech/Pfizer [BNT162b2], Moderna [mRNA-1273], and AstraZeneca [ChAdOx]). In 23% of cases, the ability to work was limited. Multivariable analyses identified the factors older age, male gender, and vaccine BNT162b as independently associated with lower odds ratio for reactogenicity and incapacity to work [12].

In our survey, age and gender had no influence on the number of pandemic-related days of absence in the multivariable analyses. However, gender should be viewed critically when surveying HCWs from different occupational groups as its distribution across occupa-

tional groups is often very uneven [10]. Ultimately, the high absenteeism due to reactogenicity as found in the survey well reflects the challenges and uncertainties reported by clinics during the pandemic [16]. In addition to the logistical problems, unexpected staff absences also have an economic impact. Both factors highlight the need to reduce absenteeism among HCW.

In addition to restrictions related to illness and infection prevention, concerns regarding long-term consequences as a result of either COVID or vaccination were a relevant and independent risk factor for absenteeism. Our analyses revealed that these concerns were not related to the severity of a previous coronavirus infection or to the acute side effects experienced with the vaccine. In general, it is known that stress among HCW during the COVID pandemic was associated with an increased tendency for sick leave [17]. Our survey shows that special concerns related to the long-term impacts of infection as well as vaccination added to this burden. A survey of HCW in the USA found that concerns about the pandemic can manifest themselves in measurable psychological symptoms as a large proportion of respondents suffered from significant psychological symptoms 8 months after the outbreak of the pandemic, with 14.2% reporting depression, 22.3% post-traumatic stress symptoms, 21.6% depersonalisation, 46.0% emotional exhaustion, and 23.1% lower resilience. More time spent on care for COVID patients and greater COVID-related concerns were consistently associated with poorer mental health [4]. The pandemic situation has led to high occupational stress among HCW due to the high workload [18]. In order to avoid a chronification with corresponding staff absences and to maintain patient care in the long term, these alterations should be carefully addressed.

Although our survey was anonymous and designed not to allow conclusions to individual participants, these were rather reluctant to provide personal information: Almost

a third did not state their gender, age, and/or the clinic where they were employed, and 35% refused to state their department. The fact that we found significant differences in the reporting of absenteeism among respondents who did not want to provide personal information may cast doubt on the validity of the data. However, we decided to evaluate the information provided by these employees as well. We interpret this mistrust as a very informative sign that staff members had concerns about openly expressing their attitudes about the pandemic and the vaccination campaign. In light of this, a more open communication about these uncertainties could have been important.

Presotto et al. [10] showed that in particular, the fear of both COVID late effects and vaccination late effects had an influence on the vaccination-related behaviour of the survey respondents of the first questionnaire. In our second survey, these two factors also had an impact on staff absenteeism. As previously shown in the context of influenza vaccines, psychosocial factors and positive or negative framing of the risk-benefit ratio influence the perceived side effects and absenteeism due to vaccination [19]. Regarding COVID, studies have suggested that pre-vaccine side effect expectations, worry about COVID, and depressive symptoms were related to vaccine side effects, and that psychosocial variables could improve the prediction of vaccine side effects compared to demographic and clinical variables alone [20]. Absenteeism during the COVID pandemic due to psychological factors was not a topic of our study as this would have exceeded the limits of acceptability in the framework chosen. Irrespective of this, our results underline that concerns related to late effects of COVID disease or late effects of vaccination did play a significant role in absenteeism.

Limitations

A limitation of our survey is that family or similar social factors could not be analysed as potential causes of absenteeism. With the closure of schools and childcare facilities during the lockdown in Germany, professional childcare was not available for many HCW. Unavailable childcare has probably increased absences. Additionally, the response rate of the survey could not be precisely determined because of different distribution modes of the study participation request, e.g., flyers, posters, and e-mails. We would have liked to include more respondent information in the analyses, but hospital works councils were reluctant. They were afraid that information about personal, family, and social factors could be used to identify individual employees. We see this as a limitation

of the study, which we had to accept in the interest of data protection regulations.

Nevertheless, this survey provides detailed insights into the situation of healthcare staff in German pulmonology hospitals during the pandemic, and these results should be considered when evaluating the mentioned events. In particular, the surprisingly high number of employees who chose not to provide detailed information about themselves or their vaccination status, even though the survey was anonymous, suggests that they experienced significant uncertainties and concerns at the time of the survey, especially regarding vaccination. For future pandemic events, it is hence important to pursue an improved and open dialogue involving all HCW groups, so that staff members feel confident to ask unpopular questions and express concerns that can be rationally addressed. Independent of these suggestions, our results provide numerical estimates for a number of factors responsible for COVID-related absenteeism a year after the beginning of the pandemic, in late 2021.

Conclusions

Our study identified multiple pandemic-related risk factors for absenteeism among HCW in specialized pulmonology clinics in Germany during the SARS-CoV-2 pandemic. Quarantine and COVID led to significant absenteeism. Furthermore, a large number of absences during the survey period were due to vaccine reactogenicity or side effects. In addition to that, concerns about the long-term effects of both vaccination and COVID were independent risk factors for prolonged absences.

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Statement of Ethics

The first SARS-CoV-2 online survey conducted by Presotto et al. [10] in March 2021 was approved by the Ethics Committee of the Medical Faculty of the University of Heidelberg (# S-042/2021) and agreed upon by all Regional Ethics Committees. For the second survey, ethical approval was achieved in form of an amendment including approval by the committees of the participating institutions. The questionnaire was also submitted to the workers' councils of the participating clinics for review; their annotations and requests for alteration were taken into consideration and implemented. The e-mails sent to the participants

provided information on data processing and it stated that the participants agreed to the anonymous processing of the data upon clicking on the provided web link and filling out the questionnaire. Written informed consent to participate was not directly obtained but inferred by completion of the questionnaire.

Conflict of Interest Statement

Stella Piel states that she has received support for attending meetings and/or travel by Grifols and study funding by DZL Germany. Maria A. Presotto and Stefan Karrasch state that they have received study funding by DZL Germany. Wolfgang Gesierich states that he has received payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events by Olympus, PulmonX. Klaus F. Rabe states that he has received payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events by AstraZeneca, Boehringer Ingelheim, Chiesi Pharmaceuticals, Novartis, Sanofi & Regeneron, GlaxoSmithKline, Berlin Chemie, Roche Pharma, he also states participation on a Data Safety Monitoring Board or Advisory Board of AstraZeneca, Boehringer Ingelheim, Sanofi & Regeneron, and he also states leadership or fiduciary role in German Center for Lung Research (DZL), German Chest Society (DGP), American Thoracic Society (ATS). Franziska C. Trudzinski states that she has received payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from Boehringer Ingelheim, Chiesi, GlaxoSmithKline, Grifols, Novartis, CSL Behring, Streamed up, RG Gesellschaft für Information und Organisation mbH, she also states participation on a Data Safety Monitoring Board or Advisory Board of CSL Behring, GlaxoSmithKline. Michael Kreuter states that he has received grants or contracts by Boehringer Ingelheim, Roche, consulting

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Author Contributions

S. Piel, M.A. Presotto, and F.C. Trudzinski: investigation, formal analysis, data curation, and writing – original draft and visualization; R.A. Jörres: formal analysis, methodology, supervision, and writing – review and editing; S. Karrasch, W. Gesierich, J. Bullwinkel, K.F. Rabe, M.C. Hayden, F. Kaestner, D. Harzheim, B. Joves, A.T. Kempa, A. Ghiani, C. Neurohr, J.D. Michels, M. Kreuter, F.J.F. Herth – recruiting participants, review, and editing. All authors have reviewed and approved the final version of the manuscript.

Data Availability Statement

Data are not publicly available due to ethical reasons. Further enquiries can be directed to the corresponding author.

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