

# Altered Mental Distress Among Employees From Different Occupational Groups and Industries During the COVID-19 Pandemic in Germany

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**Objective:** Mental distress of employees from the financial, public transport, public service, and industrial sector was examined in a cross-sectional study during the second COVID-19 (coronavirus disease 2019) wave in Germany and retrospectively at its beginning. **Methods:** Mental distress in terms of anxiety and depression symptoms was assessed with the Patient Health Questionnaire-4. High and potential occupational SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) infection risk (OSIR) was defined based on job information from 1545 non-health care workers. **Results:** The risks for more severe mental distress symptoms increased threefold and twofold, respectively, among employees with high and potential OSIR compared with employees without OSIR. Mental distress severity differed by the extent of work-privacy conflicts, perceived job protection, interactions with colleagues, and overcommitment. **Conclusions:** Reducing COVID-19 exposure through workplace protective measures, strengthening interactions among colleagues, and supporting employees with work-privacy conflicts could help better protect employees' mental health.

**Keywords:** depression and anxiety, education and social work, financial sector, occupational SARS-CoV-2 infection risk, overcommitment, public service sector, work-privacy conflicts

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in December 2019 and has been a major threat to global public health, challenging also employees and businesses around the world. To minimize transmission when worldwide vaccination is still incomplete, nonpharmaceutical interventions have been implemented, including social distancing, stay-at-home requirements, travel bans, and closures of educational institutions and nonessential businesses.<sup>1,2</sup> Depending on the occupational group and industry, new employment formats were introduced and mobile work models implemented.<sup>3</sup>

Early in the pandemic, it became apparent that the risk of SARS-CoV-2 infection varies by industry. Undoubtedly, health care workers are among the occupational groups most affected by the pandemic.<sup>4,5</sup> However, increased rates of COVID-19 cases and deaths have also been observed in other occupational sectors. A study in Norway showed increased risks of COVID-19 infections among bus, streetcar, and cab drivers during both the first and second SARS-CoV-2 waves, as well as elevated risks for food counter attendants, child care workers, and preschool and primary school teachers in the second wave.<sup>6</sup>

Other publications also reported increased SARS-CoV-2 infection risks and risks for severe COVID-19 courses in the retail sector,<sup>7</sup> for educational and social work professionals,<sup>8</sup> as well as teachers in schools that were not closed because of the pandemic.<sup>9</sup> Although analysis of routine data from a German statutory health insurance fund at the beginning of the pandemic did not find evidence of increased COVID-19 cases among workers in supermarkets or public transport,<sup>10</sup> fear to contract SARS-CoV-2 at the workplace, reorganization of daily work schedules due to the preventive measures initiated, mobile work, short-time work, fear of job loss, or new requirements for reconciling work and family life may prove burdensome to workers in all industries.<sup>11,12</sup>

Negative psychosocial consequences of COVID-19 in the general population have been discussed.<sup>13</sup> In addition, mental distress (MD) that may accompany work during the COVID-19 pandemic is of great public-health interest.<sup>14</sup> In particular, health care workers have reported increased anxiety and depressive symptoms during the COVID-19 pandemic, with a pooled prevalence of 40% for anxiety and 37% for depression.<sup>15</sup> In comparison, the prevalence in a cohort of retail workers in the United States at the beginning of the pandemic was 20%.<sup>7</sup> To date, there have been only few studies examining the risk of MD in different industries during the coronavirus crisis. Therefore, we aimed to compare MD in the form of anxiety and depressive symptoms among employees from different occupational groups and industries at the beginning of the COVID-19 pandemic and during the second wave in Germany. In collaboration with the relevant Social Accident Insurance institutions in Germany, we launched an online survey of employees from the industrial, financial, public transport, and public service sectors. Health care professionals were not examined. In parallel, we surveyed occupational safety and health (OSH) professionals from the same sectors on the implementation of the SARS-CoV-2-related OSH measures.<sup>16</sup> This showed that the vast majority of companies and institutions in Germany implemented the required occupational safety and infection control measures during the pandemic and that it is important to adapt protective measures to the respective sectors.

## METHODS

### Study Design and Study Population

This online survey is a cross-sectional study with data collected between December 7, 2020, and June 28, 2021. All employees of participating companies and facilities who are insured with the German Social Accident Insurance institution for the Raw Materials and the Chemical Industry (BG RCI), the German Social Accident Insurance institution for the Administrative Sector (VBG), the German Social Accident Insurance institution for the Trade and Logistics Industry, and the German Social Accident Insurance institution for the Public Sector in Hesse (Unfallkasse Hessen) were eligible. A link to the online survey was distributed among employees in the participating companies, which were recruited by the Social Accident Insurance institutions. Individual participation of employees was on a strictly voluntary base. All individuals were required to agree to the privacy policy. The study was approved by the Ethics Committee of Ruhr University Bochum, Germany (reg. no. 20-7072).

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Ethical Considerations and Disclosure: All participants were required to agree to the privacy policy prior to participation. Study data were collected pseudonymized based on a data protection concept, which was checked by the data protection officer responsible for the IPA. The study was approved by the Ethics Committee of the Ruhr University Bochum, Germany (reg. no. 20-7072).

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## Questionnaire Survey

Participants were asked questions about demographics, previous or current COVID-19 infection, general health, and employed occupation and industry, as well as prevention and OSH measures initiated in the workplace because of the SARS-CoV-2 pandemic. Validated instruments were used to assess psychological and occupational stress.

The brief 4-item Patient Health Questionnaire-4 (PHQ-4) was used to rate MD in terms of depression and anxiety symptoms and PHQ-4 scores categorized as normal (0–2), mild (3–5), moderate (6–8), and severe (9–12).<sup>17</sup> The “COVID-19 danger and contamination” subscale of the recently introduced COVID stress scale was used to assess COVID-19–related stress.<sup>18</sup> The 12 items of the subscale were rated on a five-point Likert scale from 0 (not at all) to 4 (extremely), leading to a score range from 0 to 48 points. Analogous to a previous work, the categories of no (0–12), mild (13–24), moderate (25–36), and severe (37–48) COVID-19–related stress were considered.<sup>19</sup> These parameters were collected at the time of the survey (T2) and simultaneously queried retrospectively for the onset of the SARS-CoV-2 pandemic outbreak in spring 2020 (T1). Work-privacy conflicts were surveyed analogously to the German version of COPSOQ (Copenhagen Psychosocial Questionnaire) using the question: “To what extent do the demands of your work interfere with your private and family life?”<sup>20</sup> The middle category (“to some extent”) was used as reference and compared with high and low work-privacy conflicts. Furthermore, the individual ability to recover from stress after difficult times was assessed with the first item of the German version of the Brief Resilience Scale at T2.<sup>21</sup>

Chronic work-related stress was assessed as imbalance between occupational effort and reward using the short version of the effort-reward imbalance questionnaire.<sup>22</sup> The short version comprises three effort and seven reward items, each on a five-point Likert scale. The higher the effort sum score, the more demands are perceived as stressful. The highest reward sum score describes the maximum reward level. Hence, an effort-reward ratio close to zero indicates a favorable state (relatively low effort, relatively high reward), whereas values greater than 1 indicate a high level of effort that is not met by received or expected rewards. Intrinsic effort was assessed as overcommitment to work using the overcommitment questionnaire comprising six items on a four-point Likert scale.<sup>23</sup> The overcommitment score ranges from 6 to 24, with higher scores indicating more likely excessive engagement. Score tertiles were determined separately for men and women, which were used to distinguish between high, moderate, and low overcommitment. As both instruments are long-term parameters, chronic work-related stress and overcommitment were only solicited at T2.

## Categorization of Occupational SARS-CoV-2 Infection Risk

In general, employees having contact with SARS-CoV-2–infected persons or the public at work are at increased risk for an occupational SARS-CoV-2 infection.<sup>24</sup> Knowing that workers in health care professionals with contact to COVID-19 patients have a very high occupational risk of SARS-CoV-2 infection, we assigned high or potential risk of infection to non–health care keyworkers based on their occupation and industry information. Following previous work, we assigned a high risk of infection to employees in retail with customer contact, driving and service personnel in public transport, firefighters, employees in building and utilities professions, security service workers, food service workers, and employees in education and social work.<sup>6,8,24,25</sup> Furthermore, we defined the group with potential risk of infection, which included in particular employees in the public or in the financial sector with potential customer contact (eg, clerks in the social welfare office or bank account managers) and OSH professionals. Participants' occupations that resulted in classification into one of the two groups at increased occupational risk for SARS-CoV-2 infection are listed in Table S1 of the Supplemental Digital Content, <http://links.lww.com/JOM/B107>. All other participants were not considered to be at

particular risk for a SARS-CoV-2 infection at work. Participants with missing or insufficient information were summarized into the group “assignment not possible.”

## Statistical Analysis

Boxplots with median and interquartile range (IQR) were used to show the distribution of continuous variables. Whiskers represent the 2.5th and 97.5th percentile. Score values assessed at both time points were compared using Wilcoxon signed-ranks tests. Chi-square test, or alternatively, Fisher exact test if the expected frequencies were too small, was used to test whether there are dependencies between two categorical characteristics. McNemar test was applied for paired data (eg, when comparing data from T1 and T2). Mental distress assessed with the four-category PHQ variable was modeled with ordinal random-intercept logistic multinomial regression models using SAS procedure PROC GLIMMIX, accounting for the dual measurement per participant (mixed models). Possible factors influencing MD were first examined using univariate mixed models and presented with odds ratios (ORs), 95% confidence intervals (95% CIs), and *P* values. Variables statistically significantly associated with the PHQ-4 score that might be potential mediators of the relationship between occupational SARS-CoV-2 infection risk (independent variable) and MD (dependent variable) based on theoretical considerations were further analyzed. A mediator model assumes that the independent variable influences the mediator variable, which in turn influences the dependent variable. Thus, mediator variables serve to highlight the nature of the relationship between the independent and dependent variables. A total mediator effect exists when the effect of the independent variable on the dependent variable is fully intervened by the mediator, and there is no longer a direct effect between the independent and dependent variables. In a partial mediator effect, there remains a direct effect that is not intervened by the mediator. All regression models were adjusted by time of the survey (T1: spring 2020; T2: interview time). Statistical analyses were performed using SAS software, version 9.4 (SAS Institute Inc, Cary, NC). Graphs were prepared with GraphPad Prism, version 9 (GraphPad Software, La Jolla, CA).

## RESULTS

### Study Population

Data from 1545 participants from industrial enterprises (*n* = 606), the public sector (*n* = 538), financial sector (*n* = 165), local public transport (*n* = 37), and a mixed group of other sectors (*n* = 199) were analyzed. Table 1 depicts the sociodemographic characteristics of the study population. Overall, 516 participants (33.4%) were determined to be at increased occupational SARS-CoV-2 infection risk. At the time of the survey, 27 participants reported that they already had COVID-19 (1.7%), and 62 considered infection likely (4.0%). As the pandemic progressed, severe COVID-19–related stress increased slightly (T1: 5.1% vs T2: 7.2%,  $P_{\text{McNemar}} = 0.0002$ ). An increasing proportion of workers suffered greatly from reduced interactions with colleagues in the workplace (T1: 10.9% vs T2: 22.3%,  $P_{\text{McNemar}} < 0.0001$ ). On the other hand, most workers received instruction on SARS-CoV-2 occupational health and safety standards (96.4%), and perceptions of adequate protection at work increased slightly over the course of the pandemic (T1: 70.6% vs T2: 75.1%,  $P_{\text{McNemar}} < 0.0001$ ). However, approximately only half of the educational and social work professionals and other employees with high occupational SARS-CoV-2 infection risk felt adequately protected from SARS-CoV-2 infection at their workplace (T1: 58.8% vs T2: 52.9%,  $P_{\text{McNemar}} = 0.2230$ ). For none of the participants, chronic work-related stress was identified as imbalance between high work effort and low reward. The effort-reward ratio was less than 1 for all participants (median, 0.21; range, 0.05–0.73). The median overcommitment score was 15 (IQR, 13–18).

**TABLE 1.** Sociodemographic Characteristics of the 1,545 Study Participants at the Time of Survey

Characteristics	n (%*)
Age, y	Median (interquartile range) 43 (34–53)
Sex	Female 813 (52.6)
	Male 684 (44.3)
	Diverse 2 (0.1)
Education	≤10 y of schooling 437 (28.3)
	>10 y of schooling 423 (27.4)
	University degree 674 (43.6)
Occupational SARS-CoV-2 infection risk	High 102 (6.6)
	Potential 414 (26.8)
	None 868 (56.2)
	Assignment not possible 161 (10.4)
Previous SARS-CoV-2 infection	Yes 27 (1.7)
	Likely 62 (4.0)
	No or unlikely 1437 (93.0)
COVID-19–related stress	Severe 112 (7.2)
	Moderate 380 (24.6)
	Mild 573 (37.1)
	None 478 (30.9)
Work-privacy conflicts	High 261 (16.9)
	Moderate 503 (32.6)
	Low 770 (49.8)
Perceived adequate protection at work	No 225 (14.6)
	Do not know 137 (8.9)
	Yes 1161 (75.1)
Suffered from reduced contact with colleagues	Suffered greatly 345 (22.3)
	Suffered a little 660 (42.7)
	Not suffered 360 (23.3)
	No reduced social interaction 176 (11.4)

\*The percentages do not always add up to 100% because not each participant answered all the questions.

During the course of the pandemic, employee’s MD increased across all groups ( $P_{Wilcoxon} < 0.0001$ ) as depicted by the boxplots of PHQ-4 score in Figure 1. In spring 2020 (T1), the median PHQ-4 score was 3 (IQR, 1–4), with 6% of participants having severe (PHQ-4 score  $\geq 9$ ) and 16% having substantial (PHQ-4 score  $\geq 6$ ) symptoms of anxiety and depression. In the second SARS-CoV-2 wave (T2), the median score was 4 (IQR, 2–6), and the proportion of participants with severe symptoms doubled to 12%. Substantial symptom severity was noted in 29% of participants at T2. Employees

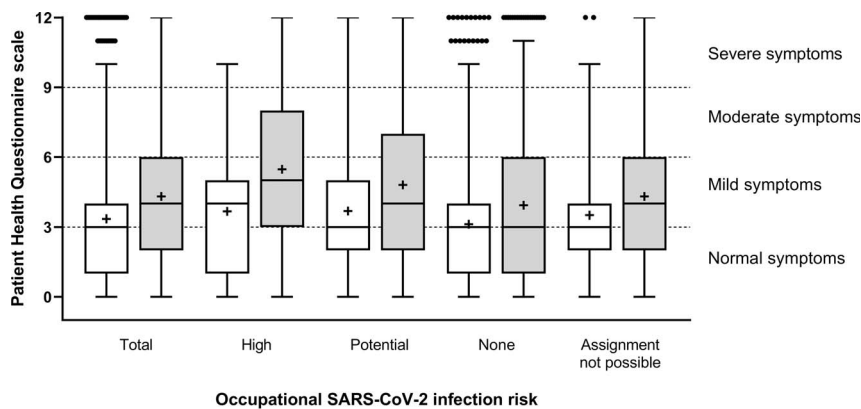
with high occupational SARS-CoV-2 infection risk showed the highest symptom burdens.

**Factors Influencing Mental Distress**

Mental distress of employees was influenced by many different factors including an increased work-related SARS-CoV-2 infection risk (Table 2). The risk for depressive and anxiety symptoms was increased threefold among employees at high risk for infection and twofold among employees at potential risk for infection compared with workers at no risk. Increased MD was also evident for women (OR, 3.44; 95% CI, 2.53–4.69), participants with a less good general health, single parents, employees with high work-privacy conflicts, more pronounced COVID-19–related stress, or above-average overcommitment to work. During the coronavirus crisis, other important risk factors for more severe depressive and anxiety symptoms included a lack of instruction on SARS-CoV-2 occupational health and safety standards, perceived inadequate protection at work, and reduced interactions with colleagues. In contrast, the risk for MD was reduced with increasing age, low work-privacy conflicts, mild overcommitment, or the ability to recover from stress quickly. No statistically significant effects were observed for previous SARS-CoV-2 infections, quarantine, or educational status. Similar results were obtained when MD was considered in two categories (participants with substantial symptom severity (PHQ-4 score  $\geq 6$ ) versus participants with mild or normal anxiety and depression symptoms (PHQ score  $< 6$ ) rather than four categories. However, ORs were comparatively lower, such as for occupational SARS-CoV-2 infection risk (high risk: OR, 2.81; 95% CI, 1.55–5.08; potential risk: OR, 1.81; 95% CI, 1.24–2.62).

Stratified analysis of associations by time of survey often showed higher risks in the second wave (T2) than at the beginning of the pandemic (T1). This was especially true for employees who did not feel protected at work (T1: OR, 1.87; 95% CI, 1.45–2.42; T2: OR, 3.89; 95% CI, 2.98–5.09), but also for employees with high SARS-CoV-2 infection risk (T1: OR, 1.49; 95% CI, 1.01–2.19; T2 OR, 2.33; 95% CI, 1.60–3.38).

The severity of anxiety and depression symptoms differed by sex. The median PHQ-4 score was higher among women (T1: median, 4; IQR, 2–5; T2: median, 4; IQR, 2–7) than men (T1: median, 2; IQR, 1–4; T2: median, 3; IQR, 1–5). Table 3 shows the impact of occupational SARS-CoV-2 infection risk on MD stratified by sex. Male employees with high SARS-CoV-2 infection risk showed the highest risk for more severe anxiety and depression symptoms (OR, 3.58; 95% CI, 0.92–14.0), although this was only marginally statistically significant. Increased risks were also observed for workers with potentially increased infection risk, again affecting males more than females compared with the sex-matched control group with no infection risk (OR, 2.07 and 1.53, respectively).



**FIGURE 1.** Mental distress by occupational SARS-CoV-2 infection risk. Higher scores of PHQ-4 indicate higher symptom burden: normal (0–2), mild (3–5), moderate (6–8), and severe (9–12). Boxplots represent medians and interquartile ranges, and whiskers represent the 2.5th and 97.5th percentiles. Boxplots with white boxes show PHQ-4 scores at T1 and grey boxes at T2.

**TABLE 2.** ORs and 95% CIs for Predictors of Increased Mental Distress Assessed With Univariate Mixed Models

		T1	T2	OR	95% CI		P
Occupational SARS-CoV-2 infection risk	High		102	3.08	1.77	5.37	<0.001
	Potential		414	2.06	1.46	2.89	<0.001
	Assignment not possible		161	1.44	0.85	2.44	0.172
Sex	None (ref)		868	1			
	Female		813	3.44	2.53	4.69	<0.001
	Male (ref)		684	1			
Age per 10 y			1463	0.84	0.73	0.96	0.012
Education	≤10 y of schooling		437	1.21	0.84	1.75	0.313
	>10 y of schooling		423	0.96	0.67	1.36	0.813
	University degree (ref)		674	1			
General health	Less good	141	329	10.9	7.43	16.1	<0.001
	Good (ref)	653	611	1			
	Very good	729	540	0.19	0.14	0.27	<0.001
Quick recovery ability after difficult times	No		225	4.20	2.72	6.49	<0.001
	Neutral (ref)		476	1			
	Yes		831	0.31	0.22	0.42	<0.001
COVID-19–related stress	Severe	78	108	114.4	55.6	235.4	<0.001
	Moderate	303	376	14.3	9.52	21.6	<0.001
	Mild	584	553	3.03	2.18	4.22	<0.001
	None (ref)	562	463	1			
SARS-CoV-2 infection	Yes or likely		89	1.32	0.67	2.61	0.422
	No or unlikely (ref)		1437	1			
Quarantine	Yes		133	1.26	0.75	2.11	0.379
	No (ref)		1390	1			
Work-privacy conflicts	High		261	4.43	2.96	6.61	<0.001
	Moderate (ref)		503	1			
	Low		770	0.32	0.23	0.45	<0.001
Single parents	Yes		59	3.32	1.50	7.35	0.003
	No (ref)		1384	1			
Overcommitment to work	Severe (≥P67)		538	5.97	4.27	8.36	<0.001
	Moderate (P33–<P67, ref)		499	1			
	Mild (<P33)		448	0.36	0.25	0.54	<0.001
Instruction on SARS-CoV-2 occupational health and safety standards	Not received		50	2.81	1.14	6.96	0.026
	Received (ref)		1490	1			
Perceived adequate protection at work	No	258	221	3.78	2.73	5.24	<0.001
	Do not know	173	135	2.25	1.47	3.46	<0.001
	Yes (ref)	1086	1125	1			
Suffered from reduced contact with colleagues	Suffered greatly	167	338	6.85	4.11	11.4	<0.001
	Suffered a little	633	646	1.42	0.92	2.18	0.110
	Not suffered	492	343	0.58	0.37	0.92	0.020
	No reduced social interaction (ref)	221	170	1			

Mental distress was measured with the four-category PHQ-4 variable. Each risk factor was modeled in a single model and adjusted by time of survey. Ref, reference; P33, 33th percentile; P67, 67th percentile; T1, numbers in spring 2020 not assessed for each parameter; T2, numbers at the time of the survey.

Work-privacy conflicts, perceived protection at work, reduced interactions with colleagues, and overcommitment to work were identified as mediators of the effect of occupational SARS-CoV-2 infection

risk on PHQ-4. Table 4 presents the multiple mixed models including mediators for men and women separately. In women, the effect of workplace SARS-CoV-2 infection risk on MD was fully intervened by the

**TABLE 3.** Modeling Mental Distress as a Function of Occupational SARS-CoV-2 Infection Risk Adjusted by Sex, Age, and Time of Survey in the Whole Study Population and Stratified by Sex

		Total			Males			Females					
		OR	95% CI	P	OR	95% CI	P	OR	95% CI	P			
SARS-CoV-2 infection risk	High	2.35	1.33	4.16	0.004	3.58	0.92	14.0	0.067	2.02	1.10	3.72	0.025
	Potential	1.70	1.19	2.43	0.004	2.07	1.05	4.06	0.035	1.53	1.01	2.33	0.045
	Assignment not possible	1.39	0.79	2.45	0.257	1.51	0.59	3.83	0.387	1.33	0.63	2.78	0.454
Sex	None (reference)	1				1				1			
	Female	3.02	2.18	4.19	<0.001	—				—			
	Male (reference)	1				1				1			
Age per 10 y		0.93	0.81	1.07	0.304	0.89	0.70	1.14	0.368	0.96	0.81	1.13	0.592
Time of survey	T2	2.63	2.23	3.10	<0.001	3.73	2.83	4.91	<0.001	2.17	1.76	2.67	<0.001
	T1 (reference)	1				1				1			

Mental distress (measured with the four-category PHQ-4 variable) was modeled with ordinal random-intercept logistic multinomial regression models.

**TABLE 4.** Risk Estimation for Mental Distress as a Function of Occupational SARS-CoV-2 Infection Risk Accounting for Mediator Variables

		Males			Females				
		OR	95% CI	P	OR	95% CI	P		
Occupational SARS-CoV-2 infection risk	High	2.06	0.49	8.77	0.327	0.97	0.52	1.80	0.927
	Potential	1.98	1.04	3.75	0.037	1.19	0.81	1.76	0.373
	Assignment not possible	1.22	0.58	2.60	0.601	1.05	0.51	2.17	0.898
Work-privacy conflicts	None (ref)	1				1			
	High	1.74	0.84	3.60	0.134	2.62	1.58	4.36	<0.001
	Moderate (ref)	1				1			
Perceived adequate protection at work	Low	0.54	0.30	0.98	0.045	0.79	0.51	1.21	0.277
	No	3.41	1.79	6.51	<0.001	3.03	2.00	4.59	<0.001
Suffered from reduced contact with colleagues	Do not know	2.36	1.07	5.21	0.034	2.34	1.32	4.14	0.004
	Yes (ref)	1				1			
	Suffered greatly	7.44	3.02	18.34	<0.001	5.65	2.98	10.7	<0.001
Overcommitment to work	Suffered a little	1.89	0.89	3.99	0.097	1.79	1.04	3.10	0.038
	Not suffered	0.89	0.41	1.95	0.773	0.79	0.44	1.41	0.420
	No reduced social interaction (ref)	1				1			
	Severe ( $\geq P67$ )	5.82	3.15	10.77	<0.001	3.31	2.14	5.12	<0.001
Age per 10 y	Moderate ( $P33$ – $<P67$ , ref)	1				1			
	Mild ( $<P33$ )	0.15	0.07	0.33	<0.001	0.65	0.40	1.06	0.088
Time of survey	0.78	0.61	1.00	0.048	0.89	0.76	1.04	0.150	
	T2	3.11	2.30	4.19	<0.001	1.90	1.52	2.38	<0.001
	T1 (ref)	1				1			

Ref, reference; P33, 33th percentile; P67, 67th percentile.

mediators. In men, the effect was less strongly influenced by the mediators. Models considering only one mediator at a time showed that the relationship between work-related infection risk and MD was in particular mediated for men by work-privacy conflicts and the subjective perception of inadequate protection at work (data not shown).

## DISCUSSION

Results of our study illustrate the great importance of occupational and infection protection on mental health during the SARS-CoV-2 pandemic in Germany. The COVID-19 pandemic was associated with increased MD among the surveyed non-health care employees. Educational and social work professionals, public administrative staff, bank account managers, and employees in other jobs at high or potential occupational SARS-CoV-2 infection risk were particularly affected and were at increased risks for depressive and anxiety symptoms compared with workers without occupational SARS-CoV-2 infection risk. Other influential factors that negatively impacted mental health were perceived inadequate protection against SARS-CoV-2 at work, reduced interactions with colleagues, and work-privacy conflicts.

This study had the strength of using data from a large survey of employees from different occupational sectors other than the health sector with different work-related SARS-CoV-2 infection risks. Validated scales were assessed on depression and anxiety symptoms, chronic work-related stress, overcommitment to work, or COVID-19-related stress, among others, at two time points. However, this nonrepresentative cross-sectional study also has its limitations. First, the data from the beginning of the pandemic (T1) were collected retrospectively, so this study might be subject to the known biases of retrospective studies, such as recall bias. Second, participation was voluntary so that only interested individuals took part who may have special characteristics that cannot be transferred to the general population of employees in Germany. Most participants were employed at large companies (77%), and approximately twice as many participants as in the general German population held a university degree (44%). Participation differed greatly between industries and occupational groups studied, which complicates the comparison. Despite close cooperation with the Social Accident Insurance institutions and companies, we did not succeed in recruiting bus personnel or retail workers. The study confirms that, in addition to so-

ciodemographic factors, the presence of Internet resources is crucial for participation in an online survey. Therefore, office workers or employees with higher occupational social status might have shown a higher willingness to participate in our survey.<sup>26–28</sup> Third, it cannot be ruled out that some participants assigned to an occupational group with elevated SARS-CoV-2 infection risk had only limited customer contact during the pandemic. During the study period, a second lockdown took place in Germany (December 16, 2020, to March 3, 2021). Meanwhile, businesses were expected to switch operations to home offices as much as possible, and schools and day care centers were in part open for children only on alternate days or in split learning groups. However, children of employees in professions deemed essential to maintain critical infrastructure (eg, essential personnel in public transport, public offices, grocery stores, or banks) were fully cared for. System-relevant companies and facilities also remained open, but with a limited number of customers and other restrictions. Fourth, participants were not questioned with respect to previous depressive and anxiety disorders, as well as experience of previous traumatic events, which may also have influenced resilience in this pandemic. These limitations should be considered when interpreting the results.

Most employees were instructed by their employer on SARS-CoV-2-related occupational health and safety measures, and more than 70% felt protected by these measures. This is consistent with the information provided by OSH professionals, according to which employees in almost all companies (99%) were informed about prevention and occupational safety measures.<sup>16</sup> Furthermore, a representative survey of employees in Germany found that 79% of employees were satisfied with the protective measures against SARS-CoV-2 infection at work in April 2021.<sup>29</sup> Here, however, employees in the public sector felt less protected, and employees with high SARS-CoV-2 infection risk felt less safe against a SARS-CoV-2 infection at their workplace. This is again consistent with a survey of OSH professionals, which found that the public sector was less likely than other sectors to have provided a pandemic plan and less likely to inform employees about it.<sup>16</sup> In our study, we observed more severe depressive and anxiety symptoms compared with German normative data from 2006.<sup>30</sup> We retrospectively found substantial (moderate to severe) symptom severity in 16% of participants for spring 2020 and in 29% at the time of the survey, which is consistent with observations in the German general

population and similar to a survey of hospital staff at the beginning of the pandemic.<sup>31,32</sup>

In line with a previous study from Norway,<sup>33</sup> we observed an association between occupational SARS-CoV-2 infection risk and employees' MD, which was particularly pronounced in employees with a high risk of infection (eg, educational and social work professionals) but also in employees with potential risk of infection (eg, public administrative staff or bank account managers). In contrast, other studies, for example, from China and Austria, did not find an independent industry effect on employee mental health.<sup>34,35</sup> These opposing results might be due to the different national circumstances and suggest that differences in mental health might be due to the specific work situation rather than the industry. Furthermore, this study showed an increase in MD over the course of the pandemic, so the timing of a survey should always be considered when comparing different studies.

With this study, we were able to confirm known risk factors for higher psychological distress such as female sex,<sup>36</sup> the presence of work-life conflicts,<sup>37</sup> or poor general health.<sup>38</sup> Our findings are consistent with other studies that women's mental health<sup>39</sup> and that of parents with young children<sup>40</sup> were particularly affected by COVID-19 public-health measures. Greater risks of more severe depressive and anxiety symptoms were also observed for workers with stronger COVID-19-related stress.<sup>18</sup>

It is well known that safe working conditions affect employees' psychosocial and physical health.<sup>41</sup> Studies of extrinsic and intrinsic effort and MD showed associations between depressive symptoms, chronic work-related stress, and overcommitment.<sup>42,43</sup> Stratified analyses of a prospective study of shiftworkers and nonshiftworkers in Germany revealed a strong association between overcommitment and an increased risk of depressive symptoms among shiftworking women.<sup>44</sup> Furthermore, a recent study on Greek health care workers during the SARS-CoV-2 pandemic showed an association between overcommitment to work and concern about COVID-19.<sup>45</sup> The present study confirmed that employees with excessive work engagement were at increased risks for MD. In addition, the lack of employer instruction on SARS-CoV-2 occupational health and safety standards also negatively affected anxiety and depression symptoms, being consistent with a study from the United States that identified poor managerial support as a risk factor for poor mental health among clinical and nonclinical university personnel.<sup>46</sup>

In addition to the independent risk factors mentioned previously, this study also showed that the effect of occupational SARS-CoV-2 infection risk on MD was influenced by several factors. In particular, not only work-privacy conflicts and perceived protection from SARS-CoV-2 at work, but also lack of interaction with colleagues and overcommitment to work, intervened the observed associations as shown by the mediation models. In women, the effect of occupational SARS-CoV-2 infection risk on MD was fully intervened by the mediators. Hence, the observed increased MD in women might rather be present because of the mediators that in turn were associated with occupational SARS-CoV-2 infection risk. In contrast, among men, a direct effect of occupational SARS-CoV-2 infection risk on anxiety and depression symptoms persisted when accounting for mediator variables. The studied associations were in particular mediated by work-privacy conflicts and the subjective perception of inadequate protection at work, which can be seen when using only one mediator at a time (data not shown). Thus, a negative influence of the work-related infection risk on MD can be assumed, especially among male employees, which, however, is particularly mediated by work-privacy conflicts and the subjective perception of inadequate protection at work.

Our study offers a number of opportunities for future research. It was shown that future research on MD in the work environment, and especially under particularly challenging conditions such as the SARS-CoV-2 pandemic, should consider perceived workplace safety, work-privacy conflicts, and interactions with colleagues. Further research is needed to assess MD in occupational groups that were poorly

recruited in this study such as bus personnel or retail workers. In addition, the MD of non-health care workers should be examined at later time points as well as after the SARS-CoV-2 pandemic has subsided to examine the long-term effects of the pandemic. We will survey study participants again during 2022 to explore this question.

## CONCLUSIONS

Our results provide important insights into the MD of employees from different non-health care industries during the SARS-CoV-2 pandemic in Germany. In addition to known risk factors for higher MD (eg, sex or overcommitment to work), work-related SARS-CoV-2 infection risk also had a negative impact on employee's depressive symptoms and anxiety. Other important influencing factors during the pandemic with a negative effect on depression and anxiety were the subjectively perceived inadequate protection against SARS-CoV-2 infection at the workplace, reduced interaction with colleagues, and work-privacy conflicts. Attention to these factors could be useful in managing future crises to better protect the mental health of all workers.

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