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Attitudes, stressors and work outcomes related to the COVID-19 pandemic among dental assistants in Germany: a cross-sectional study

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ABSTRACT

Objectives The COVID-19 pandemic has posed great challenges to medical professionals worldwide. Dental assistants (DAs) are at exceptionally high risk of infection with SARS-CoV-2 due to frequent and close patient contact and involvement in various high-risk dental procedures. This study aimed to investigate attitudes, stressors and work outcomes among DAs from all over Germany at the peak of cases in spring 2020.

Design Cross-sectional study. Descriptive analysis and logistic regression.

Setting Dental, maxillofacial surgery and orthodontic practices across Germany, April 2020.

Participants Participants aged 18 years and above and currently working as DAs in Germany.

Primary and secondary outcome measures A self-devised online questionnaire was employed comprising questions on SARS-CoV-2-related attitudes, stressors and work outcomes. Validated scales assessed symptoms of depression and anxiety.

Results Among 1481 participating DAs (median age 35 years, 98.4% female, 91.8% working in dental practices), major stressors were uncertainty about the pandemic's temporal scope (97.9% agreement, n=1450), uncertainty about one's financial situation (87.8%, n=1301), uncertainty about how to act correctly (87.6%, n=1298) and thoughts about a possible infection during work (83.8%, n=1241). Forty-two per cent of DAs (n=622) felt sufficiently prepared for dealing with patients with SARS-CoV-2. Only 17.5% (n=259) agreed that material for personal protection was sufficiently available. Multivariable logistic regression analyses suggested that working in a dental practice, compared with orthodontic and maxillofacial surgery practices, was significantly associated with uncertainty about one's financial situation (OR 2.13 (95% CI 1.33 to 3.44)) and with the reported availability of personal protective equipment (PPE) (0.55 (0.36 to 0.84)).

Conclusions Training about correct behaviour of DAs during future infectious disease outbreaks is needed, especially for DAs working in dental practices. In the future, it will also be necessary to strengthen supply chains to ensure that PPE is sufficiently available in a timely manner.

INTRODUCTION

In late 2019, the SARS-CoV-2 was first described to cause respiratory symptoms in humans.[1] The disease, referred to as COVID-19, has since spread rapidly causing

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study is the first to investigate a broad range of attitudes, stressors and work outcomes among dental assistants during the SARS-CoV-2 pandemic.

⇒ It was conducted during the peak time of the SARS-CoV-2 pandemic in spring 2020 in Germany and therefore with only little potential for recall bias.

⇒ The study instrument was developed together with experts of the German Association of Medical Professionals who have not only worked as dental assistants themselves for many years but are in close and regular contact with dental assistants from all over Germany.

⇒ Nevertheless, the psychometric properties of the study instrument remain unclear.

⇒ Due to the cross-sectional design, no causal relationships can be determined.

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a worldwide pandemic.[2] By the beginning of August 2020, over 19 000 000 cases and 730 000 deaths had been confirmed worldwide including more than 210 000 cases in Germany.[3]

The SARS-CoV-2 pandemic poses new occupational health risks especially for health workers including, among others, an infection with the virus at work, skin disorders from the use of personal protective equipment (PPE) or psychological distress.[4] According to estimates of the UK Office for National Statistics, dental assistants (DAs), dental hygienists and dentists are among the professional groups with the highest risk of infection.[5] These calculations were based on DAs' daily exposure to the disease combined with close physical proximity to patients. Previous studies have suggested multiple routes of SARS-CoV-2 transmission in dental care including coughing and sneezing of patients causing droplets that might be inhaled or direct contact transmission with oral, nasal and eye mucous membranes.[6 7] Contaminated dental equipment, contaminated

surfaces and micro-injuries caused by sharps were also discussed as possible transmission routes.[8] Many dental procedures have been shown to produce aerosols and contaminated droplets,[9] in particular from periodontal treatments, which could result in possible contamination of the dental staff's faces.[10]

The SARS-CoV-2 pandemic also poses considerable financial challenges for many dental practices.[11] The National Association of Statutory Health Insurance Dentists published a statement in March 2020 according to which the assurance of dental care had to be maintained even in times of steady spread of SARS-CoV-2.[12] The statement mentioned a fundamental obligation of dentists to provide care. Practice closures ordered by health authorities were explicitly excluded. However, studies report that many dentists have either closed their practices[11 13] or considered closing their practices.[14] Some considered reducing working hours.[13] These observations go along with the observation that a high proportion of patients are anxious about the current pandemic and therefore cancel their appointments.[13 15] Consequently, the number of non-urgency visits has decreased sharply, implying a loss of an important source of income for dental practices.[16]

First studies have shed light on the psychological effects of the COVID-19 pandemic on dental staff. An Italian study by Consolo et al[13] among staff in the areas most affected by the pandemic found that 85% were worried of contracting the infection during their working time. Almost half of the dental staff reported feelings of anxiety and fear. In a study of 338 dentists and dental hygienists from Israel, elevated levels of psychological distress during the COVID-19 pandemic were found among 11.5% of participants and were associated with having an underlying disease and a higher subjective overload.[17] Being in a relationship and high self-efficacy were associated with less psychological distress from the COVID-19 pandemic.[17]

Outside of these few studies, there is very little research on COVID-19-related distress among dental staff. The above-mentioned studies focused on dentists and dental hygienists, yet no studies have investigated such stressors among DAs. In Germany, over 215 000 DAs work in dental, orthodontic or maxillofacial surgery practices.[18 19] DAs carry out, among others, reception tasks, are responsible for the cleaning of instruments and assist during dental procedures.[20] Involvement in dental procedures such as the use of ultrasonic scales, air water syringes or high-speed hand pieces puts DAs at exceptionally high risk of contraction of SARS-CoV-2 as these procedures commonly generate aerosols[21] and SARS-CoV-2 has been found to be viable in aerosols for at least 3 hours.[22] Furthermore, the published studies on stressors among dental staff have been of limited scope. They offer little potential for interventions because the causes and types of stressors have not been investigated in detail.

This study therefore aimed to first, investigate a broad range of pandemic-related attitudes, stressors and work outcomes among DAs in Germany; and second, to identify possible determinants. Along with assessing determinants included in previous studies, this study also included determinants that have not been investigated in this context so far (eg, caring for underage children, level of education, place of work).

METHODS

Study design

A cross-sectional study was conducted. The study was conducted in accordance with the Declaration of Helsinki. All participants gave electronic consent to participate in the study.

Study procedure and population

An online questionnaire for DAs was posted by the Association of Medical Professionals (Verband medizinischer Fachberufe e.V.) on their web page and social media from 7 April to 14 April 2020. The questionnaire had the potential to reach out to members and followers of the association from all over Germany. Currently, approximately 12 000 people follow the social media channels of the association, but the exact number of addressees could not be determined. Participant inclusion criteria for all further analyses were age of majority (18 years and older) and current employment as a DA.

Questionnaire

No validated questionnaires on stressors and attitudes of medical staff during a pandemic situation were available at the time of study conception. Therefore, the authors of this study developed a questionnaire comprised of items on sociodemographic characteristics and three pandemic-related topics: pandemic-related attitudes (five items), pandemic-related stressors (eight items) and pandemic-related work outcomes (three items) (see online supplemental file).

Participants were asked to express their agreement to given statements using a 4-point Likert scale. Depression and anxiety were measured using the German-language two-item versions of the Patient Health Questionnaire (PHQ-2)[23] and the Generalized Anxiety Disorder Questionnaire (GAD-2),[24] respectively. These tools have demonstrated sufficient internal consistency (PHQ-2 α=0.83,[23] GAD-2 α=0.77[25]) and convergent validity with established measures such as PHQ-7 or the Hospital Anxiety and Depression Scale depression score[23] and GAD-7,[24] respectively. While both instruments' ability to differentiate between specific diseases patterns may be limited, they are sufficient for screening for any depressive disorder and any form of anxiety disorder.[23 24] Pandemic-related items were discussed and refined together with experts of the Association of Medical Professionals that represents DAs in Germany and acts nationwide. The association's head office is located in Bochum, North Rhine-Westphalia. Experts of the association have not only worked as DAs themselves for many years but are in regular and close contact with DAs all over Germany through educational

events, phone calls and their own previous surveys among members. Items on the perceived risk of infection compared with the general population were modified from Liao *et al*[26] and de Zwart *et al*,[27] and items on preparedness and availability of PPE were adapted from Hu *et al*.[28]

Statistical analysis

Due to the exploratory nature of this study, no a priori hypothesis was established before the analysis. To address the first research aim, describing SARS-CoV-2-related attitudes, stressors and work outcomes among DAs in Germany, descriptive analyses were run for all variables. Absolute numbers and percentages were displayed for categorical variables, and median and IQR for the numerical age variable (as age was not normally distributed). To examine determinants of SARS-CoV-2-related attitudes and stressors and therefore to identify possible subgroups at increased risk of feeling burdened, that is, the second research aim, logistic regression analysis was performed to investigate possible associations with sociodemographic variables, depressive symptoms and anxiety. All pandemic-related outcome variables were dichotomised from their original 4-point answer scale into either 1='agree' or 0='disagree'. As recommended, cut-off values of ≥3 were used to categorise participants' PHQ-2 and GAD-2 sum scores into 'major depression' and 'generalised anxiety disorder', respectively.[23 24] Two different multivariable models were run: for pandemic-related attitudes and stressors, the multivariable model included all sociodemographic variables except sex (see table 1) and included a binary variable for depression and one for anxiety disorder. For pandemic-related work outcomes, the multivariable model included age and place of work. For a sensitivity analysis, the multivariable models for pandemic-related attitudes and stressors were run without adjusting for depression and anxiety disorder. Sex was excluded from all regression analyses due to the small proportion of non-female participants (n=24, 1.7%). Associations were reported as ORs with respective 95% CIs. All analyses were carried out using IBM SPSS Statistics V.25.[29]

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

A total of 1487 DAs participated in the survey. Six DAs had missing information on their year of birth and were excluded, leaving a remainder 1481 DAs for statistical analysis (median age 35 years (IQR: 28–42), 98.4% female). The majority worked in dental practices (91.8%). As much as 13.4% reported suspected or confirmed SARS-CoV-2 cases among their friends and family, 11.3% among their colleagues and only four participants (0.4%) reported having been infected themselves. The variable 'having been infected oneself' was therefore excluded as determinant from the logistic regression modelling due to too few cases. Characteristics of the study population are displayed in table 1.

Table 1 Sociodemographic characteristics of participating dental assistants (n=1481)

Characteristics	n (%)
Sex	
Male	23 (1.6)
Female	1457 (98.4)
Non-binary	1 (0.1)
Age, median (IQR)	35 (28–42)
18–30	513 (34.6)
31–40	506 (34.2)
41 and older	462 (31.2)
Permanent partner	
Yes	1239 (83.7)
No	242 (16.3)
Children under care in same household	
Yes	578 (39.0)
No	903 (61.0)
Highest level of education	
Low*	156 (10.5)
Intermediate†	1065 (71.9)
High‡	258 (17.4)
Other	2 (0.1)
Place of work	
Dental practice	1360 (91.8)
Other§	121 (8.2)
Self-rated health	
Very good	380 (25.7)
Good	856 (57.8)
Moderate	225 (15.2)
Bad	18 (1.2)
Very bad	2 (0.1)
Suspected or confirmed SARS-CoV-2 cases among friends and family	
Yes	198 (13.4)
No	1283 (86.6)
Suspected or confirmed SARS-CoV-2 cases among colleagues	
Yes	167 (11.3)
No	1314 (88.7)
Own previous infection with SARS-CoV-2	
Yes	4 (0.4)
No	1477 (99.7)
Major depression¶	
Yes	580 (39.2)
No	901 (60.8)
Generalised anxiety disorder**	
Yes	723 (48.8)

Continued

Table 1	Continued
Characteristics	n (%)
No	758 (51.2)

*Low: secondary modern school qualification ('Haupt-/Volksschulabschluss').
†Intermediate: secondary school level I certificate ('Mittlere Reife', 'Realschulabschluss' or 'Fachschulreife').
‡High: general qualification for university entrance ('Abitur') or entrance qualification limited to universities of applied sciences ('Fachhochschulreife').
§Other individual responses, mainly orthodontic practices and maxillofacial surgery practices.
¶According to the Patient Health Questionnaire-2.
**According to the Generalized Anxiety Disorder Scale-2.

Descriptive analysis

Absolute numbers and percentages of pandemic-related attitudes, stressors and work outcomes are shown in table 2. Most DAs (83.8%) agreed that their individual risk of SARS-CoV-2 contraction was higher compared with a person of same age and sex of the general population. Less than half of all DAs felt sufficiently informed (49.6%) and prepared (42.0%) by their employer for dealing with patients with SARS-CoV-2. Major stressors were uncertainty about the temporal scope of the pandemic (97.9% agreement), uncertainty about one's financial situation (87.8%), uncertainty about how to act correctly (87.6%) and thoughts about a possible infection during working hours (83.8%). Only 17.5% agreed that enough material for personal protection was available for them to use.

Logistic regression results
Pandemic-related attitudes

Results from the logistic regressions on pandemic-related attitudes are displayed in table 3.

Belonging to the oldest age group was significantly associated with an increased perceived risk of infection (OR 1.64 (95% CI 1.13 to 2.39)). Participants' level of education was negatively correlated with reports of an increased pandemic-related workload (intermediate education 0.68 (95% CI 0.48 to 0.98), high education 0.60 (95% CI 0.38 to 0.93)). DAs with good self-rated health were more likely to feel sufficiently prepared for dealing with patients with SARS-CoV-2 (1.54 (95% CI 1.12 to 2.12)), whereas DAs who reported suspected or confirmed cases among their colleagues felt less prepared (0.63 (95% CI 0.44 to 0.91)). An inverse association was also found between suspected or confirmed SARS-CoV-2 cases among friends or family and the feeling of being sufficiently protected by available PPE (0.61 (95% CI 0.40 to 0.93)).

Pandemic-related stressors

Caring for children was positively associated with uncertainty about correct behaviour (1.52 (95% CI 1.04 to 2.21), see table 4).

In contrast, DAs with good self-rated health felt less uncertain about correct behaviour (0.35 (95% CI 0.18

to 0.69)). DAs older than 41 years (0.63 (95% CI 0.43 to 0.93)) and those with better self-rated health (0.39 (95% CI 0.22 to 0.70)) were less likely to feel burdened about thoughts of contraction at their workplace. DAs working in dental practices were more likely to report feeling burdened by uncertainty about their financial situation (2.13 (95% CI 1.33 to 3.44)) and the temporal scope of the pandemic (2.56 (95% CI 1.01 to 6.50)) than those working for other employers. The feeling of not being able to let patients down was significantly associated with suspected or confirmed SARS-CoV-2 cases among friends and family (1.56 (95% CI 1.07 to 2.29)).

DAs who screened positive for major depression or generalised anxiety disorder almost consistently showed worse outcomes, for example, greater odds of feeling uncertain about how to act correctly (depression 2.27 (95% CI 1.45 to 3.56), anxiety 2.26 (95% CI 1.53 to 3.36)) and lower odds of feeling sufficiently prepared for dealing with patients with SARS-CoV-2 (depression 0.62 (95% CI 0.49 to 0.80), anxiety 0.62 (95% CI 0.49 to 0.79)).

Pandemic-related work outcomes

DAs within the age group of 31–40 years had lower odds of reporting that enough materials were available for personal protection for them to use (0.71 (95% CI 0.51 to 0.98)). Working in a dental practice was significantly associated with a feeling that care for patients with other diseases is suffering (1.99 (95% CI 1.36 to 2.90)) and decreased odds of available materials for personal protection (0.55 (95% CI 0.36 to 0.84)).

Sensitivity analysis

When models were not adjusted for anxiety/depression, similar results were observed for almost all outcomes. The effect estimates for self-rated health were the only ones that constantly decreased by 0.1–0.2 points for all SARS-CoV-2-related stressors and increased by 0.1–0.2 points for the feeling of being sufficiently prepared and informed about dealing with patients with SARS-CoV-2.

DISCUSSION

This study presents the results of a cross-sectional investigation of attitudes, stressors and work outcomes among DAs in Germany during the first peak of the SARS-CoV-2 pandemic in spring 2020. It is the first study to investigate a broad range of stressors among DAs during the SARS-CoV-2 pandemic. This study found very high agreement with many stressors (eg, uncertainty about contact persons, uncertainty about the childcare situation), with major stressors being the uncertainty about the pandemic's temporal scope and financial implications. The data suggest a low level of preparedness of DAs who experienced great uncertainty about how to act correctly, an alarming lack of PPE and frequent worries about a possible own infection.

The great uncertainty about their financial situation may stem from the commonly low wages among DAs in Germany: DAs' median monthly wage in Germany before

Table 2 Prevalence of SARS-CoV-2-related attitudes, stressors and work outcomes among n=1481 dental assistants

	Dichotomised scale for regression analysis		Original 4-point Likert scale			
	Agree n (%)	Disagree n (%)	Strongly agree n (%)	Agree n (%)	Disagree n (%)	Strongly disagree n (%)
SARS-CoV-2-related attitudes						
The risk of contracting SARS-CoV-2 is higher for me than for a person of same age and sex from the general population	1263 (85.3)	218 (14.7)	870 (58.7)	393 (26.5)	166 (11.2)	52 (3.5)
I feel sufficiently informed about dealing with patients with SARS-CoV-2 by my employer	735 (49.6)	746 (50.4)	160 (10.8)	575 (38.8)	488 (33.0)	258 (17.4)
I feel sufficiently prepared for dealing with patients with SARS-CoV-2 by my employer	622 (42.0)	859 (58.0)	99 (6.7)	523 (35.3)	520 (35.1)	339 (22.9)
My workload has increased due to the SARS-CoV-2 pandemic	382 (25.8)	1099 (74.2)	119 (8.0)	263 (17.8)	694 (46.9)	405 (27.3)
I can use materials for personal protection at my work so that I feel sufficiently protected from contracting SARS-CoV-2	336 (22.7)	1145 (77.3)	65 (4.4)	271 (18.3)	491 (33.2)	654 (44.2)
SARS-CoV-2-related stressors						
I am burdened by uncertainty about the temporal scope of the crisis	1450 (97.9)	31 (2.1)	1021 (68.9)	429 (29.0)	29 (2.0)	2 (0.1)
I am burdened by uncertainty about my financial situation during the crisis	1301 (87.8)	180 (12.2)	852 (57.5)	449 (30.3)	141 (9.5)	39 (2.6)
I am burdened by uncertainty about how to act correctly during the crisis	1298 (87.6)	183 (12.4)	617 (41.7)	681 (46.0)	158 (10.7)	25 (1.7)
I am burdened with thoughts of a possible infection with SARS-CoV-2 during working hours	1241 (83.8)	240 (16.2)	602 (40.6)	639 (43.1)	196 (13.2)	44 (3.0)
I am burdened by the care situation of my children*	479 (82.9)	99 (17.1)	314 (54.3)	165 (28.5)	67 (11.6)	32 (5.5)
I am burdened by uncertainty about contact persons during the crisis	1124 (75.9)	357 (24.1)	480 (32.4)	644 (43.5)	324 (21.9)	33 (2.2)
I am burdened by a feeling of not being able to let patients down during the crisis	1072 (72.4)	409 (27.6)	449 (30.3)	623 (42.1)	342 (23.1)	67 (4.5)
I am burdened by the crisis-related shortfall of colleagues/staff at work	915 (61.8)	566 (38.2)	348 (23.5)	567 (38.3)	421 (28.4)	145 (9.8)
SARS-CoV-2-related work outcomes						
Due to the SARS-CoV-2 pandemic, the care for patients with other diseases has been suffering	901 (60.8)	580 (39.2)	241 (16.3)	660 (44.6)	459 (31.0)	121 (8.2)
My employer takes the SARS-CoV-2 pandemic seriously	843 (56.9)	638 (43.1)	324 (21.9)	519 (35.0)	459 (31.0)	179 (12.1)
At my work all necessary materials for personal protection from SARS-CoV-2 are sufficiently available for me	259 (17.5)	1222 (82.5)	55 (3.7)	204 (13.8)	527 (35.6)	695 (46.9)

*Only for n=578 dental assistants with children under care in their household.

taxes for full-time employment equals €2123 which is substantially lower than the cross-professional median monthly wage in Germany before taxes for full-time employment (€3401).[30] Any shortage in payment either resulting from reduced working hours or dismissals is thus highly critical to DAs in making their living. This study also found DAs to feel insufficiently prepared for the SARS-CoV-2 outbreak: only half of the participants reported to feel prepared and not even one in five

agreed that there was enough PPE available for them to use in early April 2020, an early stage of the SARS-CoV-2 outbreak. In Germany, employers are responsible for the implementation of infection control measures at the workplace according to the Federal Ministry of Labor and Social Affairs.[31] Specifically for health workers in the context of COVID-19, the WHO recommends employers to carry out workplace risk assessments and to provide timely and accurate information to staff in order

Table 3 Multivariable logistic regression results for SARS-CoV-2-related attitudes among female dental assistants (n=1457)

	SARS-CoV-2-related attitudes									
	Higher perceived risk of contraction		Feeling of sufficient protection from infection		Feeling sufficiently prepared		Feeling sufficiently informed		Increased workload due to pandemic	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age										
31–40 (vs 18–30)	1.55	1.06 to 2.28	0.73	0.52 to 1.01	0.88	0.66 to 1.17	0.97	0.73 to 1.27	0.97	0.71 to 1.33
41 and older (vs 18–30)	1.64	1.13 to 2.39	0.75	0.54 to 1.03	1.03	0.78 to 1.35	1.10	0.84 to 1.44	1.18	0.87 to 1.60
Permanent partner										
Yes (vs no)	0.96	0.64 to 1.44	0.99	0.70 to 1.39	1.00	0.74 to 1.34	0.96	0.72 to 1.29	1.12	0.80 to 1.56
Children under care in same household										
Yes (vs no)	1.33	0.94 to 1.89	0.85	0.64 to 1.13	0.91	0.71 to 1.16	0.92	0.72 to 1.17	1.05	0.80 to 1.37
Highest level of education										
Intermediate* (vs low†)	1.35	0.85 to 2.13	0.77	0.52 to 1.13	0.94	0.66 to 1.33	0.94	0.67 to 1.32	0.68	0.48 to 0.98
High‡ (vs low†)	1.15	0.67 to 1.99	0.75	0.47 to 1.20	0.94	0.62 to 1.43	0.90	0.60 to 1.35	0.60	0.38 to 0.93
Place of work										
Dental practice (vs other)	1.16	0.67 to 1.99	0.69	0.45 to 1.06	0.82	0.55 to 1.21	0.88	0.60 to 1.30	0.74	0.49 to 1.12
Self-rated health										
Good (vs bad)	0.78	0.50 to 1.23	1.38	0.94 to 2.03	1.54	1.12 to 2.12	1.50	1.11 to 2.02	0.98	0.71 to 1.36
SARS-CoV-2 cases among friends and family										
Yes (vs no)	1.13	0.71 to 1.79	0.61	0.40 to 0.93	0.75	0.54 to 1.05	0.82	0.60 to 1.12	0.98	0.69 to 1.39
SARS-CoV-2 cases among colleagues										
Yes (vs no)	1.08	0.66 to 1.76	1.11	0.73 to 1.65	0.63	0.44 to 0.91	0.76	0.54 to 1.07	1.23	0.85 to 1.79
Depression										
Yes (vs no)	1.39	0.97 to 2.00	0.74	0.55 to 1.00	0.62	0.49 to 0.80	0.70	0.55 to 0.90	1.16	0.88 to 1.52
Anxiety disorder										
Yes (vs no)	1.44	1.03 to 2.01	0.63	0.48 to 0.84	0.62	0.49 to 0.79	0.78	0.61 to 0.98	1.22	0.94 to 1.60

*Intermediate: secondary school level I certificate ('Mittlere Reife', 'Realschulabschluss' or 'Fachschulreife').
†Low: secondary modern school qualification ('Haupt-/Volksschulabschluss').
‡High: general qualification for university entrance ('Abitur') or entrance qualification limited to universities of applied sciences ('Fachhochschulreife').

Table 4 Multivariable logistic regression results for SARS-CoV-2-related stressors among female dental assistants (n=1457)

	SARS-CoV-2-related stressors															
	Thoughts about contraction at workplace		Shortfall of colleagues		Childcare situation*		Not being able to let patients down		Uncertainty about acting correctly		Uncertainty about contact persons		Uncertainty about financial situation		Uncertainty about temporal scope	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age																
31–40 (vs 18–30)	0.68	0.46 to 1.01	0.9	0.71 to 1.25	1.84	0.88 to 3.84	1.33	0.97 to 1.81	1.09	0.70 to 1.70	1.25	0.90 to 1.73	1.14	0.75 to 1.72	0.9	0.32 to 2.56
41 and older (vs 18–30)	0.63	0.43 to 0.93	1.3	0.95 to 1.67	0.59	0.29 to 1.21	1.09	0.81 to 1.47	0.64	0.43 to 0.96	1.12	0.82 to 1.54	1.22	0.81 to 1.84	0.41	0.17 to 1.02
Permanent partner																
Yes (vs no)	1.3	0.87 to 1.93	1	0.72 to 1.31	1.78	0.83 to 3.81	0.75	0.54 to 1.06	0.87	0.54 to 1.38	1.08	0.77 to 1.52	0.79	0.50 to 1.26	1.54	0.63 to 3.73
Children under care in same household																
Yes (vs no)	1.35	0.96 to 1.88	1	0.81 to 1.33	–	–	0.94	0.72 to 1.22	1.52	1.04 to 2.21	0.93	0.70 to 1.23	1.28	0.88 to 1.85	1.33	0.58 to 3.03
Highest level of education																
Intermediate† (vs low‡)	0.91	0.55 to 1.51	0.6	0.43 to 0.90	1.02	0.51 to 2.06	1.13	0.78 to 1.64	0.94	0.54 to 1.63	0.81	0.53 to 1.23	0.77	0.44 to 1.37	0.95	0.28 to 3.29
High§ (vs low‡)	0.59	0.34 to 1.05	0.7	0.45 to 1.07	1.11	0.46 to 2.68	1.15	0.73 to 1.81	0.78	0.42 to 1.48	0.72	0.44 to 1.18	0.7	0.37 to 1.33	0.62	0.16 to 2.43
Place of work																
Dental practice (vs other)	1.34	0.81 to 2.20	1.3	0.89 to 1.95	1.05	0.45 to 2.43	1.24	0.82 to 1.88	0.97	0.54 to 1.74	1.09	0.70 to 1.70	2.13	1.33 to 3.44	2.56	1.01 to 6.50
Self-rated health																
Good (vs bad)	0.39	0.22 to 0.70	1	0.73 to 1.37	0.7	0.34 to 1.43	1.08	0.77 to 1.51	0.35	0.18 to 0.69	0.67	0.45 to 0.99	0.73	0.444 to 1.21	0.66	0.19 to 2.28
SARS-CoV-2 cases among friends and family																
Yes (vs no)	1.44	0.89 to 2.35	1.3	0.95 to 1.86	1.49	0.75 to 2.99	1.56	1.07 to 2.29	0.98	0.59 to 1.60	1.03	0.71 to 1.49	0.73	0.47 to 1.14	1.4	0.41 to 4.79
SARS-CoV-2 cases among colleagues																
Yes (vs no)	1.04	0.63 to 1.72	1.8	1.23 to 2.63	0.92	0.45 to 1.89	1.37	0.91 to 2.05	0.84	0.50 to 1.43	0.94	0.63 to 1.40	1.1	0.65 to 1.85	0.81	0.27 to 2.44
Depression																
Yes (vs no)	2.62	1.73 to 3.97	1.5	1.17 to 1.96	1.57	0.89 to 2.77	1.08	0.81 to 1.43	2.27	1.45 to 3.56	1.56	1.15 to 2.12	1.69	1.13 to 2.52	1.24	0.48 to 3.22
Anxiety disorder																
Yes (vs no)	2.89	2.01 to 4.16	1.6	1.22 to 1.98	1.3	0.79 to 2.13	2.06	1.58 to 2.70	2.26	1.53 to 3.36	2	1.50 to 2.65	1.3	0.91 to 1.87	2.94	1.14 to 7.54

*Only for n=578 dental assistants with children under care in their household.
†Intermediate: secondary school level I certificate ('Mittlere Reife', 'Realschulabschluss' or 'Fachschulreife').
‡Low: secondary modern school qualification ('Haupt-/Volksschulabschluss').
§High: general qualification for university entrance ('Abitur') or entrance qualification limited to universities of applied sciences ('Fachhochschulreife').

to reduce distress.[4] Consequently, for future outbreaks, sound education of health workers by their employers is needed about correct behaviour and employers must be able to provide sufficient protective equipment. Given this low level of preparedness, the overall high agreement to the investigated stressors is not surprising. Comparing the results of this study with those of published studies on the psychological effect of the COVID-19 pandemic on dental staff, similar degrees of agreement for being worried about contraction during work (83.8% in this sample, 85.1% in Consolo et al[13]), and similar degrees of agreement for a lack of PPE (82.5% in this sample, 86% in Consolo et al) were found.[13] The prevalences of depressive symptoms and anxiety were very high in this study. Unfortunately, comparisons with prevalences among DAs in the pre-pandemic era are not possible as such data are lacking. Nevertheless, the findings of the present study are in keeping with certain observations from other studies before and during the SARS-CoV-2 pandemic. Bäuerle et al report that the prevalence of major depression and generalised anxiety disorder among the German general population rose to 14.3% and 19.7%, respectively, during the pandemic.[32] A prospective study among DAs in Spain repeatedly investigated generalised anxiety disorder during the SARS-CoV-2 pandemic and found anxiety levels to be highest in the very first weeks of the pandemic.[33] A study among DAs in Israel from 2019 found high levels of burnout among DAs and revealed that the most stressful work-related factors were, among others, the salary and work hazards.[34] Supposedly, both conditions have worsened for DAs in Germany during the pandemic and might contribute to the observation of high depression and anxiety levels in this study. Eventually, a study among Taiwanese dental staff found DAs to present the highest values for emotional exhaustion and depersonalisation compared with other dental staff.[35]

In logistic regression analyses, a large number of possible associations were investigated and several of them were found to be statistically significant. Yet, not all significant associations can be explained plausibly, and it cannot be excluded that some significant associations are chance findings. In the following sections, the associations that will be discussed seemed plausible to the authors including after in-depth discussion with experts of the Association of Medical Professionals and with dentists. DAs with better self-rated health were more likely to feel prepared, less uncertain and less concerned about a possible infection. This may be because these DAs feel more confident about their own health and, even in case of an infection, assume milder health consequences. This observation is in line with a study among Polish university students that found about 60% of the variance of anxiety levels during the SARS-CoV-2 pandemic to be explained by factors including self-rated health.[36] DAs older than 41 years reported to feel less burdened by thoughts of an infection during working hours. According to the personal experiences of inquired experts (see the Acknowledgements section), older DAs are more likely to

spend a significant amount of their working time at the reception and with non-patient tasks compared with their younger colleagues. Anxiety was found to be consistently correlated with different types of stressors. The direction of causality yet remains unclear. A first possible explanation is that individuals who are generally anxious will also worry more about the current pandemic. In contrast, worrying about the pandemic may also lead to symptoms of generalised anxiety disorder. This is supported by the high prevalence of DAs with a screened generalised anxiety disorder (48.8%) which is manifold higher than the prevalence of this disorder in the general population.[37] A third possibility is that both constructs (GAD-2 and SARS-CoV-2-related stressors) likely measure the same phenomenon and are not causally linked. The cross-sectional study design does not allow for an examination of temporal sequences and thus it remains impossible to clarify which interpretation of findings is most likely.

Working in a dental practice was found to be a significant predictor for uncertainty about the own financial situation during the pandemic, uncertainty about the pandemic's time scope and a lack of available PPE. Other places of work in the study sample were mainly orthodontic and oral and maxillofacial surgery practices. The greater perceived lack of PPE in dental practices compared with other practice types can be explained as follows: therapeutic and diagnostic measures regularly performed in orthodontic practices do not involve drilling with water cooling, which is known for generating aerosols. Therefore, the risk of airborne infection is lower, and less PPE is required. In maxillofacial surgery practices, the standard protective equipment is also more comprehensive than in dental practices as it includes, in addition to gloves and face masks, sterilised coats, hair caps and safety goggles. Maxillofacial surgery practices might thus have had sufficient reserve assets during the countrywide shortage of PPE in early April 2020. A German study among maxillofacial surgery practices found around 40% of private practices to be satisfied with the supply of PPE by the Federal Associations of Statutory Health Insurance Physicians during the current pandemic.[38] The differences in terms of financial worries between the different practice types can possibly be explained by wage differences. DAs in dental practices earn less than their colleagues working in orthodontic practices or in oral and maxillofacial surgery practices (gross wage difference about €500[39]). Another reason may be that the pandemic-related drop in patient numbers possibly affected dental practices to a greater extent than other practice types. Most patients confirmed that they would go to an orthodontic appointment during the SARS-CoV-2 pandemic.[15]

Strengths and limitations

This study is the first to investigate SARS-CoV-2-related stressors and attitudes among DAs in Germany and collected data during the first peak time of the pandemic, therefore likely capturing high levels of insecurity and stress with a small chance of recall bias. However, the

results present a snapshot and do not necessarily reflect the current situation (eg, related to the availability of PPE). Due to the online distribution of the study link, no exact response rate could be calculated as it remains unclear how many DAs were reached by the study invitation. A better alternative to estimate the response rate and possible selection bias would have been a defined random sample of study participants. This, on the other hand, would have not made such a timely survey possible. Furthermore, it cannot be assured that the survey link reached all DAs in Germany as it is unlikely that all of them follow the activities of the Association of Medical Professionals. When comparing age and sex characteristics of the study sample with the official numbers of the Federal Agency of Employment, the study sample comprised more participants within the ages 25–54 years and fewer in other age groups (<25, 55–64, >64 years).[18] It may be that DAs younger than 25 years who have just begun working are less likely to follow the activities of the Association of Medical Professionals and therefore less likely to receive the study link. Older DAs may not be as likely to follow online activities and participate in online research as younger DAs. For this study, a self-devised questionnaire was used. To be able to conduct the study in a timely manner, the instrument was neither piloted nor validated. The psychometric properties of the questionnaire therefore remain unknown. However, the questionnaire items were—whenever deemed suitable—based on items employed in prior research. Additional items were formulated, and the overall item pool was discussed and refined with experts from the Association of Medical Professionals. These discussions covered the comprehensibility of questionnaire item, the appropriate questionnaire length, the completeness of contents and omissible items. The experts have not only worked as DAs themselves but are in daily contact with thousands of DAs following the Association of Medical Professionals. The expert discussions therefore likely increased the items' validity. Only screening tools for depression and anxiety were used in this study that do not provide clinical diagnoses. Due to the cross-sectional design, this study does not allow to generate insights into temporal sequences and thus possibly causal relationships. Eventually, the 4-point answer scales for the outcome variables in regression analysis were dichotomised in this study. This was chosen for reasons of comprehensibility yet brings along certain loss of information. Alternatively, ordinal regression analysis could have been used without dichotomisation of answer scales. However, under consideration of the solely exploratory approach of this study, it seemed sufficient and more relevant to know whether an individual does feel burdened rather than knowing the odds of the individual belonging to the 'burdened' or 'strongly burdened' group.

CONCLUSIONS

The results of this study suggest a low level of preparedness among DAs as indicated by high agreement to a broad range of stressors, including great uncertainty about how to act correctly, an alarming lack of PPE and frequent worries about a possible own infection. DAs working in dental practices, those suffering from depressive or anxiety symptoms and those with self-reported poor health were particularly likely to feel burdened during the pandemic. Consequently, sound education about correct behaviour during the SARS-CoV-2 outbreak is needed. In the future, it will also be necessary to ensure that supply chains are secured, and that PPE is available in sufficient quantities in a timely manner.

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