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Job-related stressors and working conditions of employees in the German healthcare sector during the SARS-CoV-2 pandemic

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Zusammenfassung

Seit Ende 2019 stellt die SARS-CoV-2 Pandemie Gesundheitssysteme weltweit vor ungekannte Herausforderungen. Zum Zeitpunkt der Aufnahme dieser Arbeit (März 2020, kurz nach dem ersten Lockdown) existierten jedoch sowohl im internationalen als auch im deutschsprachigen Raum noch kaum empirische Studien, die die spezifischen beruflichen Stressoren bedingt durch die Pandemie für Beschäftigte im Gesundheitswesen aufzeigten. Ziel dieser Arbeit war es, die spezifischen, durch die Pandemie entstandenen, beruflichen Stressoren bei drei Berufsgruppen im deutschen Gesundheitswesen (medizinische Fachangestellte (MFA), zahnmedizinische Fachangestellte (ZFA), Beschäftigte im Rettungsdienst (EMS)) zu analysieren und vertieft zu verstehen. Alle diese Berufsgruppen zeichnet ein erhöhtes Risiko aus, sich am Arbeitsplatz mit SARS-CoV-2 zu infizieren.

Hierzu wurden MFA, ZFA und EMS zunächst mittels eines Online-Fragebogens zu verschiedenen pandemiebedingten Stressoren befragt. Die erhobenen Daten dienten sowohl der deskriptiven Darstellung der Häufigkeit verschiedenartiger Stressoren sowie der Ermittlung bestimmter Subgruppen innerhalb der Berufsgruppen mit besonders hoher selbstberichteter Belastung durch diese Stressoren. Als Zweites wurden im Anschluss semi-strukturierte telefonische Interviews mit MFA (n=24) geführt, um vertiefte Einsicht und Verständnis für Stressoren in Hausarztpraxen zu gewinnen.

Die Zustimmung zu den quantitativ erhobenen Stressoren unter den insgesamt 5.168 Teilnehmenden war sehr hoch, insbesondere bei MFA und ZFA. Besonders hohe Zustimmung erhielten die folgenden Stressoren: die beruflich bedingt höhere Ansteckungswahrscheinlichkeit mit dem Virus, die Unsicherheit über das zeitliche Ausmaß der Pandemie, ein Mangel an vorhandenem Schutzmaterial sowie Unsicherheit über korrektes Verhalten, die eigene finanzielle Situation und die Kinderbetreuung. MFA mit Kindern und solche, die in Facharztpraxen tätig waren, stimmten vielen Stressoren häufiger zu. Gleiches galt für ZFA, die in Zahnarztpraxen arbeiteten (im Vergleich zu Kieferorthopädie- und Mund-Kiefer-Gesichtschirurgie-Praxen). In den qualitativen Interviews berichteten MFA von einem starken Anstieg des Arbeitsvolumens im Zuge der Pandemie, Veränderung der Arbeitsaufgaben, strukturellen und personellen Herausforderungen und vermehrt problematischem Verhalten seitens der Patient*innen. Zudem wurden häufige Änderungen der Test- und Abrechnungsvorgaben sowie ein Mangel an Wertschätzung gegenüber dem Berufsstand der MFA während der Pandemie beklagt.

Diese Dissertation arbeitet erstmalig die spezifischen beruflichen Stressoren von MFA, ZFA und EMS im deutschen Gesundheitswesen während der SARS-CoV-2 Pandemie heraus und bietet direkte Anknüpfungspunkte für Interventionen sowie zur Vorbereitung auf zukünftige Pandemien. Weitergehende Forschung sollte die gewonnenen Ergebnisse für aktualisierte und detailliertere quantitative Erhebungen nutzen, um mögliche Veränderungen der Stressoren im Zuge des Pandemieverlaufs zu beleuchten.

Abstract

Since the end of 2019, the SARS-CoV-2 pandemic has posed great and unknown challenges to healthcare systems worldwide. At the time of starting this work (March 2020), empirical research on job-related stressors of healthcare personnel as result of the SARS-CoV-2 pandemic was scarce, both internationally and in Germany. Three occupational groups in the German healthcare sector are at a particularly high risk of infection with SARS-CoV-2: medical assistants (MAs), dental assistants (DAs), and emergency medical services (EMS) workers. The aim of this dissertation was to describe and understand more profoundly the specific job-related stressors during the SARS-CoV-2 pandemic of these three occupational groups.

An online questionnaire was completed by MAs, DAs, and EMS that inquired after a broad range of pandemic-related attitudes and stressors. The data were then used to describe the inquired attitudes and stressors and to detect possible subgroups within the three occupational groups especially burdened by pandemic-related stressors. Subsequently, semi-structured telephone interviews were conducted with MAs in general practices (n=24) in order to gain in-depth understanding of pandemic related stressors of that group.

Overall, the agreement to all inquired stressors was high among the 5,168 participants, especially among MAs and DAs. Particularly high agreement was observed for the feeling of being at a higher infection risk compared to the general population, uncertainty about the temporal scope of the pandemic, a lack of personal protective equipment, and uncertainty about correct behavior, about one's financial situation, and about the childcare situation. Subgroups especially burdened were MAs with children and those working in specialist practices. Likewise, DAs working in dental practices reported being burdened by pandemic-related stressors more frequently (compared to DAs working in orthodontic or maxillofacial surgery practices). Core themes that derived from the interviews with MAs were a sharp increase in workload, a shift in occupational tasks, structural and personnel challenges, and an increase in unpleasant patient encounters. In addition, frequent changes in testing and billing regulations and a lack of appreciation toward the MA profession during the pandemic were lamented.

This dissertation provides for the first time insights into job-related stressors of MAs, DAs, and EMS workers in the German healthcare sector during the SARS-CoV-2 pandemic and provides direct starting points for interventions as well as for preparing for future pandemics. Further research should expand the obtained results by conducting updated and more detailed quantitative surveys to address potential changes in stressors as the pandemic progresses.

List of abbreviations

CI	Confidence interval
COVID-19	Coronavirus disease 2019
DA	Dental assistant
DBR	Deutscher Berufsverband Rettungsdienst e.V. German Association of Emergency Medical Service
DP	Depersonalization
ECG	Electrocardiogram
EE	Emotional exhaustion
EMS	Emergency medical services
EMT	Emergency medical technician
ERI	Effort-reward imbalance
EVA	Entlastende*r Versorgungsassistent*in
GAD	Generalized anxiety disorder questionnaire
GP	General practitioner
IES – R	Impact of event scale – revised
IQR	Interquartile range
ISI	Insomnia severity index
JDC	Job demand control
JDCS	Job demand control support
MA	Medical assistant
MERS	Middle east respiratory syndrome
OJ	Organizational justice
OR	Odds ratio
PHQ	Patient health questionnaire
PPE	Personal protective equipment
PR	Prevalence ratio
RNA	Ribonucleic acid
SARS	Severe acute respiratory syndrome
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SRH	Self-reported health
VERAH	Versorgungsassistent*in in der Hausarztpraxis

VMF	Verband medizinischer Fachberufe e.V. Association of Medical Professions
WHO	World Health Organization

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1. Introduction

1.1. The SARS-CoV-2 pandemic

In December 2019, the first confirmed cases of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) were reported in Wuhan, China, among staff and visitors of a seafood market [1]. The Coronavirus disease (COVID-19) caused by SARS-CoV-2 is characterized by various symptoms. Despite most infected people only suffering from mild symptoms, some may develop more serious symptoms ranging from e.g., fever, cough, tiredness, and loss of taste or smell to chest pain and breathing difficulties [2].

SARS-CoV-2 belongs to the group of coronaviruses, single stranded RNA viruses, that are known to be able to cause severe diseases in humans, such as SARS (severe acute respiratory syndrome) in 2002-2003 or MERS (middle east respiratory syndrome) in 2012 [3, 4]. On March 11th 2020, the World Health Organization (WHO) described COVID-19 as a global pandemic and stated that is was the first pandemic to be caused by a coronavirus [5]. As of the end of April 2022, there have been over 508,498,000 confirmed cases of COVID-19 globally and over 6,000,000 deaths [6]. In Germany, these numbers amount to over 24,251,000 and 134,000, respectively [6].

To date, the exact origin of SARS-CoV-2 remains unclear, however, the most likely transmission pathways to humans are considered to be a direct zoonotic spillover (e.g., from bats) or a transmission via intermediate host animals (e.g., domestic animals such as cats) [1, 7]. With respect to human-to-human transmission, SARS-CoV-2 is transmitted via either respiratory droplets or smaller aerosols from infected individuals e.g., when coughing, sneezing, singing, heavily breathing, or talking [8]. Notably, asymptomatic individuals infected with SARS-CoV-2 can also transmit the virus. Infection occurs via virus uptake through mouth, nose, or eyes and risk of infection is especially high in indoor settings with insufficient ventilation or in crowded spaces [8].

The SARS-CoV-2 pandemic brought about serious changes in everyday life in Germany. The first case of COVID-19 in Germany was confirmed on January 27th, 2020 [9]. As the virus spread rapidly, the federal government decided on a national lockdown on March 22nd, 2020 [10]. Following this, public life was completely shut down including the closure of bars and restaurants [11], service providers (e.g., hairdressers and beauticians), and schools and daycare facilities for children [12]. Only pharmacies and grocery shops remained open [11]. Strict rules of distance applied for everyone (e.g., one was only allowed to spend time with one person at a time or with people from one's own household). These rules all still applied when the first survey was conducted as part of this dissertation in April 2020. They were only relaxed again on May 4th, 2020, when, for example, the first schools reopened [12]. The first vaccinations against SARS-CoV-2 were offered in December, 2020, mainly to

residents of retirement and nursing homes [9]. It was only until April 1st, 2021, that vaccination was taken up nationwide by GP practices [9], at the time when the second part of data collection for this dissertation was done.

1.2. Impact on the German healthcare sector

The SARS-CoV-2 pandemic placed a heavy burden on clinics. Temporarily, over 12,500 patients infected with SARS-CoV-2 were hospitalized during the pandemic in Germany at the same time and up to roughly one third of occupied intensive care beds in Germany were occupied by COVID-19 patients [13, 14]. The above-mentioned high SARS-CoV-2 infection rates among the German general population also required far-reaching changes in daily operations at many German healthcare facilities, affecting both inpatient and outpatient facilities. These included, among others, the reduction of consultation hours in order to minimize personal contact [15, 16], an intensification of hygiene measures [17–19], management of patient flows by separating potentially contagious patients from others [16], and the introduction of telephone and video consultations [20]. Many facilities experienced a sharp decline in patient numbers since the onset of the pandemic and reported appointments being cancelled or missed by patients [15, 16, 21]. A study among orthopedic and trauma surgery facilities in German university hospitals reported projected revenue losses of nearly 30% due to the pandemic [22]. In a study by Jacob et al. (2020), it was shown that the pandemic also possibly influenced the frequency of certain illnesses in patients (e.g., increase in anxiety disorders) [23]. The pandemic also affected German healthcare staff by high levels of anxiety in physicians, especially among general practitioners (GPs) compared to other specialties [24]. Healthcare personnel was overall moderately worried about their own health but had strong concerns regarding the health of both family and friends [25].

1.3. Research on the SARS-CoV-2 pandemic up to March 2020

This chapter addresses research on the SARS-CoV-2 pandemic that has been published until March 2020, when the work for this dissertation was started. Due to the topicality of the subject, many more findings have been published in the meantime and are being published on an ongoing basis. Findings that have emerged during the work on this dissertation will be addressed in the discussion section.

At the time of uptake of this dissertation, the SARS-CoV-2 pandemic had just recently begun and taken up speed. As the conduct and publication of empirical scientific studies requires some time, most of the published literature up to March 2020 consisted of commentaries and letters to the editor covering

e.g., case reports of individual deaths of healthcare workers [26] or narrative descriptions of challenges faced by healthcare personnel [27–30]. Among the published commentaries, most were published from regions where the virus had predominantly spread at the beginning of the pandemic, i.e., China. The number of peer-reviewed empirical articles up to March 2020 was limited to studies with small sample sizes and a limited number of investigated constructs, such as depression and anxiety among healthcare staff [31, 32] or insomnia and other sleep problems [32, 33]. One study qualitatively studied healthcare staff in Wuhan, China, with respect to their needs and well-being during the pandemic [34].

The above-mentioned empirical studies shed light on the precarious working situation of healthcare staff during the pandemic. Lai et al. (2020) surveyed over 1,200 healthcare workers from 34 Chinese hospitals and reported that over half of them (50.4%) suffered from symptoms of depression, 44.6% from symptoms of anxiety, and 71.5% from symptoms of distress [32]. The same study found nurses to be more burdened than physicians. The same applied to female workers compared to male workers. Huang et al. (2020) also investigated mental health issues among Chinese healthcare workers and found that the incidence of anxiety during the pandemic was at 23%, however, mostly mild [31]. Again, the incidence was higher in female workers and higher in nurses. Kang et al. (2020) surveyed 994 physicians and nurses from Wuhan, China, and – after cluster analysis grouping - reported 22.4% to suffer from moderate mental health disturbances according to defined thresholds of the established questionnaires PHQ-9 (Patient Health Questionnaire 9), GAD-7 (General Anxiety Disorder – 7), ISI (Insomnia Severity Index), and the IES-R (Impact of Event Scale – Revised) [35]. Xiao et al. (2020) reported that Chinese medical staff suffered from lower sleep quality compared to the Chinese general population during the SARS-CoV-2 pandemic [33]. The sole study offering more detailed insights into daily stressors at work of healthcare staff during the pandemic was the qualitative study by Cao et al. (2020) [34]. In their study of 37 Chinese medical workers, physicians reported high workloads of up to 10 patients per hour. Nurses claimed they saw up to 200 patients a day and that there was a strong need for more staff. Furthermore, participants complained about a shortage of personal protective equipment (PPE), a low appetite, and sleeping problems. Some physicians were nervous about possibly being infected after hearing that other physicians had become infected and many nurses reported either worrying about their family members or themselves becoming infected. Overall, participants also reported bodily discomfort in forms of tiredness, throat pain, cough, neck and shoulder pain, or headache during their work during the pandemic.

The first COVID-19 case in Germany was confirmed on January 27, 2020 [9]. Accordingly, barely any studies, neither editorials, commentaries nor peer-reviewed articles originating from Germany were published up to March 2020. One letter to the editor described a case report of SARS-CoV-2 transmission to a German businessman via an asymptomatic contact [36].

Summarizing the international literature on the SARS-CoV-2 pandemic up to March 2020, it can be said that barely any empirical evidence had been published. The present evidence mainly focused on China and on physicians and nurses, hereby relying on a limited scope of investigated constructs, such as depression, anxiety, and insomnia. In addition, published literature inquired after stress among healthcare staff during the SARS-CoV-2 pandemic. It remained unclear, however, to what extent this stress already existed before the pandemic or if it had arisen only as a result of the pandemic. Studies specifically addressing the pandemic as cause of self-reported stress were needed. Furthermore, barely any empirical studies had been published describing the exact types of stressors of healthcare personnel during the pandemic in more detail (as opposed to predefined constructs such as anxiety and depression). Studies from Germany and studies focusing on healthcare personnel aside from physicians and nurses were lacking, too.

1.4. Work stress

The WHO defines work stress as a possible response to pressure and demands placed on individuals at their workplace, thereby challenging their ability to cope [37]. Several theoretical models have conceptualized work stress, among which the most renowned are the job-demand-control-model (JDC) by Robert Karasek (alternatively the job demand-control-support-model (JDCS)), the effort-reward imbalance model (ERI) by Johannes Siegrist, and the organizational justice (OJ) model by Jerald Greenberg. Conceptualized in 1979, the JDC model describes work stress (literally: job strain) to occur in cases when job demands are high and when job control is low [38]. Job control here is defined as the possibility of workers to decide on how they meet their job demands and the opportunity to use their individual skills [38]. In 1988, a third dimension, social support, was added to the model by Johnson & Hall [39], leading to the JDCS model, which describes a lack of social support likely compounding the health impact of job strain, whereas present social support may alleviate this impact. A few years later in 1987, Jerald Greenberg proposed the concept of organizational (in)justice [40]. According to his model, employees judge their organization's processes and decisions. Typically, OJ is subdivided into three dimensions: Procedural justice (organizations' processes of decision-making are deemed fair), distributive justice (distribution of decision outcomes and resources (e.g., pay or praise) are deemed fair), and interactional justice (individual employees are treated respectfully e.g., in personal interactions or in terms of a timely and adequate distribution of information) [41]. Again a few years later in 1996, Johannes Siegrist postulated a perceived lack of reciprocity between extrinsic efforts (e.g., work pressure), intrinsic efforts (e.g., individual coping patterns), and job-related rewards

(e.g., payment, promotion prospects, or job security) to cause stress [42]. This was captured in the resulting effort-reward imbalance model.

The above-mentioned models are well-established in work stress research and have been applied in a great number of studies on work stress among healthcare staff internationally [43–49]. Moreover, work stress according to the JDC, ERI and OJ model have been shown to predict a broad range of diseases such as anxiety and depression [50], insomnia [51], coronary heart disease [52, 53], and musculoskeletal symptoms [54]. Three pathways have been discussed in literature describing the physiological manifestation of stress in the body and possibly linking psychosocial stressors to adverse physical health [55–57]. Firstly, there is the activation of the autonomic nervous system. When facing an external stressor, the adrenal medulla releases the hormone epinephrine. Subsequently, fibers of the sympathetic nervous system release norepinephrine at various organ sites leading to an increase of epinephrine in the bloodstream. This again leads to e.g., an increased heart rate, an increased respiratory rate and a withdrawal of blood from organs irrelevant to the stress reaction (e.g., responsible for digestion or reproduction) [55, 57]. The second pathway describes the activation of the hypothalamic-pituitary-adrenal axis [55]. When facing a stressor, cortisol is secreted into blood, saliva, and urine as the end product of this axis. Both above-mentioned pathways directly influence the third pathway, that is, the immune system. Fibers of the autonomic nervous system that innervate immune organs lead to an altered function of immune cells [55]. Cortisol also directly affects the immune system by suppressing the effects of immunological cells. Besides this downregulation, however, the immune system may at the same time enhance processes related to inflammation in the body when facing a stressor [55].

It is conceivable that work stress levels of healthcare workers worldwide have increased during the SARS-CoV-2 pandemic. With respect to the above-mentioned work stress models, it may be speculated which model components may have changed in the course of the pandemic, leading to work stress among healthcare staff. Regarding the JDCS model, for example, workloads of healthcare personnel may have strongly increased, whereas job control may have been low (as workers could not decide when to perform which tasks). Social support by colleagues working in the same practice or working unit may have played a crucial role to cope with work stress during the pandemic. When considering the OJ-model, distribution of e.g., PPE or COVID testing material as well as possible bonus payments may have been considered as (in-)just during the pandemic. Likewise, in the ERI model, if the efforts in terms of high patient volumes or an increase in workload related to hygiene measures are not balanced by appropriate rewards (such as payments or appreciation), this may also lead to work stress among healthcare personnel. However, the suitability of the above-mentioned models to describe work stress of healthcare personnel in view of the SARS-CoV-2 pandemic may be questioned. As

described in chapter 1.3., first narrative evidence suggested specific stressors to affect healthcare staff during the pandemic that are not captured within the frame of the JDCS, ERI, or OJ model. These are, for example, the fear of becoming infected with the virus, a lack of PPE, or isolating oneself from one's family [27, 28]. Research conducted during previous pandemics as, for example, the H1N1 pandemic in 2009 also reported specific stressors to healthcare staff not captured by established work stress models. These were, among others, a lack of training of healthcare workers on how to deal with infected patients and a lack of knowledge on how to protect oneself [58]. As in-depth empirical research on stressors specific to the SARS-CoV-2-pandemic was lacking at the time of uptake of this dissertation, it remained unclear to what extent the established work stress models can adequately capture the situation of healthcare staff during the pandemic.

1.5. Focus of this dissertation

Again, summarizing the published literature up to March 2020, it can be said that most research on the SARS-CoV-2 pandemic has been performed in China and on physicians and nurses. The focus of published research has been on a limited scope of predefined concepts (e.g., depression, anxiety, and insomnia) and no clear distinction had been made with respect to whether the observed stress among healthcare staff was directly attributable to the pandemic or whether it existed beforehand.

This dissertation will address these gaps in literature by providing, for the first time, empirical data from Germany. Three occupational groups are being looked at in particular that have not received attention in research during the SARS-CoV-2 pandemic yet. These are, firstly, medical assistants (MAs), secondly, dental assistants (DAs), and thirdly, emergency medical services (EMS) workers. These occupational groups will be presented in detail in the following chapters. This dissertation will, for the first time, provide a more detailed understanding of the exact types of stressors and the extent to which healthcare personnel face these stressors during the SARS-CoV-2 pandemic aside from mental health issues such as depression, anxiety, or insomnia. Furthermore, the pandemic is directly named as the cause of the inquired stressors. Published literature suggests that certain subgroups within healthcare staff are especially burdened during the pandemic, i.e., women and nurses [31, 32]. This dissertation will, finally, investigate whether further sociodemographic characteristics - besides sex and type of occupation - are associated with an increased burden of stressors among the three investigated occupational groups during the SARS-CoV-2 pandemic.

In addressing the above-mentioned research gaps, a mixed-methods approach will be chosen, combining a quantitative and a qualitative study. Typically, quantitative methodologies are used to

estimate the extent and distribution of predefined concepts/characteristics within a studied group. By means of quantitative methodologies, findings representative of the overall population may be obtained and quantitative data may serve to determine statistical relationships between different characteristics [59]. In contrast, qualitative methodologies do not aim at a representative description of the study population, but serve to discover previously unknown stressors and to gain a deeper understanding of phenomena by uncovering underlying mechanisms [59, 60]. The chosen mixed-methods approach of this dissertation enables to more comprehensively answer the research questions than would be possible by only applying either quantitative or qualitative methodologies [61]. Within the so-called explanatory sequential design, a quantitative approach is chosen first, then followed by a qualitative approach. The main goal of this approach is to gain deeper understanding of the quantitative results through qualitative research [62].

1.6. Medical assistants

1.6.1. Overview of the profession

Medical assistants (MAs, German occupational title "Medizinische*r Fachangestellte*r") are among the largest occupational groups in outpatient care in Germany. Due to the lack of comparability of tasks and workloads of MAs across countries, this dissertation will focus solely on MAs working in Germany. Accordingly, all further information relates exclusively to them. In 2021, 421,070 MAs were employed subject to social security contributions, of which the vast majority were female (98.14%) [63]. Slightly more than half of MAs worked full-time (52.24%) and slightly less than half worked part-time (47.76%) [63]. Medical assistants typically work in inpatient settings (e.g., hospitals) and outpatient settings (e.g., medical practices of all specialties), but also in other fields such as medical laboratories and health offices [64].

Tasks typically performed by MAs include administrative tasks (e.g., appointment scheduling, ordering material, patient reception) and clinical tasks with close patient contact. These include, among others, blood sampling, preparation and administration of vaccinations, and performing standardized diagnostic procedures (e.g., ECG recordings, spirometry, and blood pressure measurement) [65].

Becoming a MA in Germany normally requires three years of full-time vocational training, which can be shortened or extended on an individual basis under certain circumstances [66]. No school diploma is necessary [67], however, the majority of apprenticeship entrants in 2020 had an intermediate level of education [68]. The gross salary of MAs largely depends on the employer and on whether the employer is a member of an employers' association that undertakes to pay standard salaries. The current wage agreement negotiated by the Association of Medical Professions provides for a starting

gross salary of full-time MAs of 2,151.05€ per month [69]. It applies nationwide across Germany for all members of the association. Compared to the German national mean gross salary across all full-time employees (3,975€ per month in 2020 [70]), MAs' salaries can be considered very low. One of the few ways MAs can supplement their salaries is through in-service training. Different training opportunities exist across the federated states of Germany, all sharing one goal: to lighten physicians' workload by delegating tasks to qualified MAs [71]. Recognized training courses are, for example, VERAH© (German title "Versorgungsassistent*in in der Hausarztpraxis") for MAs working in general practices that enables them to e.g., independently conduct home visits [72] or EVA (German title "Entlastende*r Versorgungsassistent*in") that enables MAs to e.g., perform geriatric basic assessments or wound management [73].

1.6.2. Working conditions of medical assistants

Profound research has shed light on working conditions of MAs and has highlighted both positive and negative aspects. A qualitative study by Vu-Eickmann et al. (2017) among MAs found that they enjoyed the variety of tasks their job offered (including medical, administrative, and practical tasks), the experienced freedom of action in their daily working life, and their good relations and exchange with patients [74]. Research, however, has also identified frequent challenges to MAs in daily practice. These include a high workload (resulting from high patient numbers in combination with a lack of staff, documentation efforts, or inefficient practice organization), a lack of breaks, having to work overtime, frequent work disruptions and unforeseeable events, the need for multitasking, unforeseeable and emotional behavior of the supervisor, bullying within the team, a low salary, and demanding patients [74, 75]. Scharf et al. (2019) aimed to quantify MAs' needs and found the most frequent needs to be a higher salary (87.0% agreement in their sample of 887 MAs), less documentation work (76.0%), and more recognition from society (75.4%) [76]. Dissatisfaction with income and societal appreciation were also core aspects to MAs as reported by Mergenthal et al. (2021) [77].

Despite these frequent challenges, studies report job satisfaction among MAs to be high [77, 78]. Nevertheless, other studies report poor self-rated health, high levels of burnout, anxiety, depression, and (work) stress among MAs [79–81]. Scharf et al. (2019) found that roughly every third MA considered leaving their employer and about every fourth MA considered leaving the profession entirely [82]. In the same study, about every fifth MA would certainly not choose the profession again and almost half (45.7%) would not recommend the profession to young people. All of these work-related outcomes were significantly associated with self-reported work-related intervention needs in that direction that the more needs MAs expressed (as e.g., an increase in salary or less documentation

work), the more likely they were to consider leaving their employer, leaving the profession, and not recommending their profession to young people.

1.6.3. Medical assistants in view of the SARS-CoV-2 pandemic

In view of the SARS-CoV-2 pandemic, it appears particularly interesting to investigate attitudes and challenges of MAs for several reasons. Firstly, MAs are usually the very first point of contact for patients in the healthcare system, especially in general practices where patients with symptoms similar to those caused by SARS-CoV-2 typically show up first. Secondly, MAs stand a high risk of infection due to their frequent and close work with potentially infectious patients by e.g., performing blood sampling or ECG recordings [65]. Thirdly, MAs faced high levels of work stress according to the ERI model even before the pandemic [81]. It may be assumed that precarious working conditions (e.g., high workload and low societal recognition) have worsened during the pandemic and work stress levels have increased. Finally, the few empirical studies on the pandemic's impact on healthcare personnel up to March 2020 suggested nurses to be more burdened than physicians and female staff to be more burdened than male staff (see chapter 1.3). As MAs are predominantly female and their core task is to support physicians, it may be consequently assumed that they are especially burdened by pandemic-related changes.

1.7. Dental assistants

1.7.1. Overview of the profession

Dental assistants (DAs, German occupational title "Zahnmedizinische*r Fachangestellte*r") in Germany typically work in dental practices, maxillofacial surgery practices, or orthodontic practices, but may also work in dental clinics, university institutes, and health offices [83]. In 2021, over 214,000 DAs worked nationwide in Germany, mainly full-time (59.7%) [84]. Dental assistants are typically female (98.9%) [84].

Becoming a DA usually requires a 3 year full-time vocational training [83]. No school diploma is required beforehand, however, in 2020 most first-year apprentices (44%) had an intermediate school education [85]. Tasks performed by DAs are, among others, administrative tasks (e.g., taking care of patients before, while and after dental treatment, scheduling treatment appointments, correspondence with health insurance companies), and assistance activities (e.g., assisting during dental treatments, cleaning of used instruments, preparing radiographs). Depending on DAs' individual qualification, tasks may also include prophylaxis, assistance in prosthetic or orthodontic procedures,

and preparing fillings [86]. The earning potential of DAs strongly depends on the type of employer and on whether the employer undertakes to pay standard salaries [87]. The illustrative monthly full-time gross salary of a DA stated by the federal employment agency lies between 2,182€ and 2,369€ [87]. However, the monthly gross wage of DAs working in orthodontic practices may be up to 2,961€ [88]. Similar as for MAs, DAs' salaries can be considered low compared to the national mean full-time gross salary across all professions (3,975€ per month [70]).

1.7.2. Working conditions of dental assistants

Typically, DAs work together with dentists, both simultaneously working in patients' mouths with a large amount of time spent in a sitting position [89]. In a nationwide survey of DAs in Germany, less than 30% reported to take regular breaks between treatments [89]. Most research on working conditions of DAs has consequently focused on reporting musculoskeletal disorders. The 12-month prevalences of neck pain, shoulder pain, lower back complaints and complaints in the hand among DAs have been reported to be roughly 85%, 70%, 60% and 30%, respectively [89, 90]. Little research has been performed on psychosocial working conditions of DAs in Germany and possibly resulting mental health issues. A German study investigating job satisfaction and working atmosphere among DAs was conducted in a sample of 612 DAs from 106 dental practices [91]. The authors found DAs to be highly satisfied with their colleagues and the amount of variety in their job. In contrast, DAs were less satisfied with their income and recognition for their work. A qualitative study among DAs and dentists in Germany found that DAs complained about unclear responsibilities within their practice, whereas dentists saw all tasks clearly distributed [92]. A further aspect DAs wished for was more autonomy in daily practice [92].

1.7.3. Dental assistants in view of the SARS-CoV-2 pandemic

In view of the SARS-CoV-2 pandemic, several reasons speak for taking a closer look at the situation of DAs. According to the UK office for national statistics, DAs are among the occupational groups with the highest risk of infection with SARS-CoV-2 [93]. This estimation was based mainly on their exposure to the disease and the physical proximity to patients during dental treatments. Research has demonstrated many dental procedures to produce aerosols and contaminated droplets [94]. Especially the use of ultrasonic scales, air water syringes, and high-speed handpieces have been discussed to produce aerosols [95]. This is especially relevant, because it has been shown that the SARS-CoV-2 virus mainly spreads via aerosols and remains viable for up to three hours in these [96]. Furthermore, in the

early course of the pandemic, media reports discussed practice closures of dental practices in Germany, hereby also likely causing confusion among dental staff, including DAs [97]. At the time of uptake of this dissertation, no empirical studies on stressors among DAs during the SARS-CoV-2 pandemic had been available. Similar as for MAs, DAs are also a predominantly female workforce who assist physicians (dentists) and may be additionally burdened by the pandemic as first empirical studies among healthcare staff in China showed [31, 32]. These studies suggested nurses to be more burdened by the pandemic than physicians and female staff to be more burdened than male staff (see chapter 1.3).

1.8. Emergency medical services workers

1.8.1. Overview of the profession

In 2021 in Germany, over 80,000 EMS workers (30.0% female) were employed subject to social security contributions of which the majority (84.1%) worked full-time [98]. In Germany, different levels of paramedic training allow for performing different tasks. The lowest level of training (320 hours, German profession "Rettungshelfer*in") allows for performing simple tasks (e.g., driving the ambulance, assistance activities in patient care) [99]. After 520 hours of training (Emergency Medical Technician (EMT), German profession "Rettungssanitäter*in") one may provide e.g., sole care of non-vitally endangered patients. After 3 years of training (Paramedic, German profession "Notfallsanitäter*in") one has completed the highest non-medical paramedic training and may act on sole responsibility. Up to 2014, this was possible after only 2 years of training (former profession "Rettungsassistent*in").

Some federated states require a low school education or a previously completed vocational training in order to take up vocational training to become an EMT [100]. A medical certificate confirming one's health suitability is additionally required along with a certificate of a completed first aid course. The illustrative monthly full-time gross salary of an EMT according to the federal employment agency ranges from 2,513€ to 3,104€ [101]. In order to become a paramedic, usually a low or intermediate school education is required along with a medical certificate confirming health suitability [102]. The exemplary monthly full-time gross salary of a paramedic as stated by the federal employment agency lies between 3,108€ and 3,819€, slightly lower than the German national average gross-salary across professions (3,975€ per month [70]).

1.8.2. Working conditions of emergency medical services workers

The daily work routine of EMS workers usually consists of, on the one hand, rescue operations and, on the other hand, on-call duty at the rescue service station [103]. Both of these are associated with specific stressors. With respect to rescue operations much research has been performed on psychologically stressful operations [104, 105], situations involving physical danger for EMS workers [105], and on impeding operation conditions [105]. Regarding on-call duty, literature has described stressors such as tension due to a constant state of readiness and frustration and boredom at the rescue service station [103, 106]. Other more general stressors to EMS personnel have been described to be shift work [106], time pressure [105], and problems in communication with health care providers and hospitals [105]. In line, job satisfaction among EMS personnel in Germany has been reported to be low (only 53.7% were satisfied with their current job, 33.7% with their professional status and only 24.2% were satisfied with their wage) [107]. More than half of the studied EMS workers also intended to leave their job within the next year as a result of their job dissatisfaction [107].

The above-mentioned working conditions have been associated with elevated burnout levels among EMS workers [105]. A nationwide survey among EMS workers in Germany reported that more than every fourth EMS worker suffered from high emotional exhaustion (EE) and over 40% suffered from depersonalization (DP) according to the Maslach Burnout Inventory [107]. In turn, both EE and DP were associated with an increased odds of injuries and safety compromising behavior among EMS personnel [107]. Besides burnout, EMS workers are also reported to suffer from further mental health issues. A second nationwide survey of EMS workers in Germany found 43% to screen positive for possible depression and 5% of participants screened positive for posttraumatic stress disorder [104].

1.8.3. Emergency medical services workers in view of the SARS-CoV-2 pandemic

Having a closer look at EMS workers in light of the SARS-CoV-2 pandemic seems relevant for several reasons: Firstly, as EMS workers perform pre-hospital care they may be in close contact to patients suffering from severe COVID-19 symptoms needing hospital treatment. Secondly, during transport, they stand at a high risk of aerosol exposure as a study has demonstrated a homogenous spread of aerosols within ambulance vehicles [108]. Lastly, at the time of uptake of this work no studies have investigated the specific stressors to this occupational group during the SARS-CoV-2 pandemic.

1.9. Aims of the dissertation

The specific aims of this dissertation were as follows:

1. To quantitatively describe – for the first time - stressors related to the SARS-CoV-2 pandemic among employees in the healthcare sector in Germany, using the examples of medical assistants, dental assistants, and emergency medical services workers
2. To identify possible subgroups within these three occupational groups who are especially burdened by pandemic-related stressors
3. To qualitatively gain in-depth understanding of the nature of pandemic-related stressors among employees in the German healthcare sector, using the example of medical assistants in general practices

1.10. Ethics vote

The ethics committee of the Medical Faculty of the University of Duesseldorf approved the study (study numbers 2020-899-andere Forschung erstvotierend and 2021-1370-andere Forschung erstvotierend).

2. Publications

2.1. Dreher A, Pietrowsky R, Loerbroks A. Pandemic-related attitudes, stressors and work outcomes among medical assistants during the SARS-CoV-2 ("Coronavirus") pandemic in Germany: A cross-sectional Study. PLoS One. 2021;16:e0245473. doi:10.1371/journal.pone.0245473.

2.2. Dreher A, Pietrowsky R, Loerbroks A. Attitudes, stressors and work outcomes related to the COVID-19 pandemic among dental assistants in Germany: a cross-sectional study. BMJ Open. 2021;11:e045881. doi:10.1136/bmjopen-2020-045881.

2.3. Dreher A, Flake F, Pietrowsky R, Loerbroks A. Attitudes and stressors related to the SARS-CoV-2 pandemic among emergency medical services workers in Germany: a cross-sectional study. BMC Health Serv Res. 2021;21:851. doi:10.1186/s12913-021-06779-5.

2.4. Dreher A, Mambrey V, Loerbroks A. Changes of working conditions and job-related challenges due to the SARS-CoV-2 pandemic for medical assistants in general practices in Germany: a qualitative study. BMC Prim Care. 2022;23:273. doi:10.1186/s12875-022-01880-y.

3. Discussion

3.1. Summary of results

3.1.1. Short summary of quantitative findings

Data of 5,168 participants were analyzed as part of the quantitative survey. Of these, 2,150 were MAs, 1,481 DAs, and 1,537 EMS workers. Medical assistants and DAs were predominantly female (98.0% and 98.4%, respectively), whereas EMS workers were predominantly male (83.3%). Regarding the inquired SARS-CoV-2-related attitudes, all three groups largely agreed that their risk of infection with SARS-CoV-2 was higher compared to a person of same sex and age of the general population. Agreement to feeling sufficiently informed or prepared by the employer to treat SARS-CoV-2 patients was moderate across all groups. Low levels of agreement were found with respect to sufficient availability of PPE, especially among MAs (24.0%) and DAs (17.5%).

Agreement to the eight inquired SARS-CoV-2-related stressors was very high, especially among MAs and DAs. In both of these groups, over half of the participants reported each investigated stressor. Agreement to stressors was generally slightly lower among EMS workers. The most frequently reported stressor among all three groups was the uncertainty about the temporal scope of the pandemic. Other frequently reported stressors were uncertainty about how to act correctly, uncertainty about the own financial situation, and uncertainty about one's childcare situation.

The results of logistic regression analysis suggest several subgroups in each sample to feel especially burdened by pandemic-related stressors. Medical assistants with children under care and MAs working in specialist practices demonstrated higher odds of feeling burdened by several stressors. The same applied to DAs working in dental practices compared to those working in orthodontic or maxillofacial surgery practices. EMS workers with 520h of paramedic training demonstrated higher odds with respect to uncertainty about their financial situation and lower odds of reporting sufficient supplies of PPE.

3.1.2. Short summary of qualitative findings

The qualitative study was based on 24 telephone interviews with MAs working in general practices in Germany. Participants were mostly female (95.8%) and had a diverse background in terms of age, type of employment, years of professional experience, school education, geographical practice location, and practice size. According to the interviewed MAs, the SARS-CoV-2 pandemic led to a sharp increase in workload, a shift in occupational tasks, structural and personnel challenges, an increase in unpleasant patient encounters, and childcare issues. Frequent changes in billing processes were

described to present great challenges as well as tensions within the practice teams due to the increased workload. Several MAs complained about not having received sufficient acknowledgement and appreciation for their work during the pandemic from both society and their employer. A typical example mentioned here was the lack of a bonus payment, which employers voluntarily could opt in to pay. Nevertheless, some positive changes were remarked. These were, among others, advancing digitalization within general practices (e.g., the uptake of e-mail communication with patients) and a growing social cohesiveness of practice teams.

3.2. Comparison of attitudes and stressors across occupational groups – results of descriptive analyses

3.2.1. Similarities

When comparing agreement levels to the inquired attitudes and stressors related to the SARS-CoV-2 pandemic, some similarities appear between MAs, DAs, and EMS workers. All investigated occupational groups highly agreed that their personal risk of infection with SARS-CoV-2 was higher than among the general population (see Table 1). Both MAs and DAs mostly did not feel sufficiently protected by the available PPEs, which may partly be explained by a low availability of PPE (only 24.0% and 17.5% stated there was sufficient PPE, respectively). All three groups partly agreed that care for patients other than those infected with SARS-CoV-2 was suffering. This may reflect that patient care across many healthcare specialties largely focused on COVID-19 patients at the time of study conduction.

Table 1. Self-reported SARS-CoV-2-related attitudes by occupational group.

	MAs		DAs		EMS workers	
#	Item	Agreement	Item	Agreement	Item	Agreement
1	Higher risk of SARS-CoV-2 contraction	82.3%	Higher risk of SARS-CoV-2 contraction	85.3%	Higher risk of SARS-CoV-2 contraction	84.8%
2	Sufficiently prepared	60.5%	Sufficiently prepared	42.0%	Sufficiently prepared	72.5%
3	Sufficiently protected	32.7%	Sufficiently protected	22.7%	Sufficiently protected	63.2%
4	Suffering care for other patients	67.9%	Suffering care for other patients	60.8%	Suffering care for other patients	45.5%
5	Sufficient PPE	24.0%	Sufficient PPE	17.5%	Sufficient PPE	59.5%
6	Increased workload	50.0%	Increased workload	25.8%	Increased workload	34.6%
7	Employer takes pandemic seriously	77.1%	Employer takes pandemic seriously	56.9%	-*	-
8	Sufficiently informed	66.4%	Sufficiently informed	49.6%	-*	-

MA medical assistant; DA dental assistant; EMS emergency medical services; PPE personal protective equipment; *Two attitudes ('my employer takes the SARS-CoV-2 pandemic seriously' and 'I feel sufficiently informed about dealing with SARS-CoV-2 patients by my employer' were not part of the EMS workers' questionnaire)

Regarding the inquired SARS-CoV-2-related stressors, the most frequently reported stressor among all three groups was the uncertainty about the temporal scope of the pandemic (see Table 2). This observation may be explained by the fact that the German healthcare system and consequently healthcare workers of all disciplines had never been exposed to an infectious disease pandemic of similar extent. At the time of survey conduction there was neither media nor scientific consensus regarding the pandemic's potential course and duration. Uncertainty about how to act correctly was among the three most frequently reported stressors in all three groups. This is in keeping with the previous explanation of healthcare workers never being exposed to comparable challenges. In 2008, the National Association of Statutory Health Insurance Physicians (KVB), the German Medical Association (BÄK), and the Employer's Liability Insurance Association for Health Services and Welfare Care (BGW) had published a joint recommendation for influenza risk management in outpatient practices [109]. This recommendation included many measures transferable to the SARS-CoV-2 pandemic such as timely and spatial separation of infected patients, clarifying the need for a practice visit via telephone, stocking of specific quantities of protective material, and an organizational chart for responsibilities within practice teams. However, this recommendation may have not adequately been distributed and consequently known or paid enough attention by practice staff. Moreover, recommendations on some specific challenges experienced in the current pandemic would still be lacking (e.g., information on testing and billing of COVID-19 services, an unknown run on practices by patients). Recommendations for EMS workers during an influenza pandemic were published by the

Robert Koch-Institute's national pandemic plan in 2017 [110]. These included, among others, vaccination of personnel, practicing transport procedures, increasing staff numbers for increased demands, isolating potentially infected personnel, and keeping gloves and masks in stock. Again, however, these recommendations may not have been known, not transferable into daily practice (e.g., recommendation for staff vaccination although no SARS-CoV-2 vaccine was available), or too vague (e.g., by recommending to keep PPE in stock without giving precise numbers).

The pandemic-related shortfall of colleagues was the stressor least frequently reported by MAs and DAs, and second least by EMS workers. It must be kept in mind that agreement to this stressor was still high. Nonetheless, this finding may demonstrate that uncertainties within an individual (lack of knowledge regarding the pandemic, uncertainty regarding correct behavior, fear of own infection) outweigh concerns caused by lack of collegial support.

Table 2. Self-reported SARS-CoV-2-related stressors by occupational group.

	MAs		DAs		EMS workers	
#	Item	Agreement	Item	Agreement	Item	Agreement
1	Temporal scope	95.1%	Temporal scope	97.9%	Temporal scope	81.7%
2	Act correctly	77.5%	Act correctly	87.6%	Act correctly	54.1%
3	Infection at work	65.7%	Infection at work	83.8%	Infection at work	51.5%
4	Childcare situation	73.4%	Childcare situation	82.9%	Childcare situation	62.8%
5	Financial situation	67.3%	Financial situation	87.8%	Financial situation	17.3%
6	Let patients down	75.8%	Let patients down	72.4%	Let patients down	46.0%
7	Contact persons	67.2%	Contact persons	75.9%	Contact persons	43.1%
8	Shortfall of colleagues	53.6%	Shortfall of colleagues	61.8%	Shortfall of colleagues	38.6%

MA medical assistant; DA dental assistant; EMS emergency medical services

3.2.2. Differences

Despite some similarities in inquired attitudes and stressors, the results of quantitative analysis suggest several differences between the three surveyed occupational groups. Differences can be seen, for example, when having a closer look at the provision of PPE during the first wave of the pandemic. Almost 60% of EMS workers stated that enough PPE was available for them to use, whereas only 24.0% of MAs and 17.5% of DAs agreed to this item. A similar pattern can be observed regarding the feeling of being adequately protected by the provided PPE, which was twice as high among EMS workers compared to MAs and DAs. The great differences in PPE availability may account for the difference in perceived protection. Why supposedly more PPE was available for EMS can only be speculated. They may have held greater amounts of PPE in stock than MAs and DAs. The latter may in turn have had a higher demand of PPE due to higher patient numbers per day as compared to EMS workers.

A sharp difference can also be seen with respect to a burden by financial issues. The vast majority of DAs reported financial uncertainty and two thirds of MAs also agreed. In contrast, only 17.3% of EMS workers claimed they suffered from their financial situation. Possibly, for DAs and MAs a sharp reduction in patient numbers during the first pandemic wave combined with the possibility of short-time work as has been described in literature [111] may have led to a feeling of financial burden. As MAs and DAs generally earn less than EMS workers, they may be financially more affected by short-time work and therefore express more financial concern. Compared to the other two groups, DAs felt least sufficiently prepared for the pandemic by their employer and also least likely reported that they suffered from an increase in workload. As mentioned above, dental practices suffered from great declines in patient numbers, which may explain low levels of increased workload.

The highest agreement with regard to whether one felt sufficiently prepared by the employer for the pandemic was found for EMS workers. One possible explanation may be the strong differences in sex distribution between both samples with EMS workers predominantly being male, whereas MAs and DAs were mostly female. Several studies during the ongoing pandemic have reported higher anxiety and stress levels in women compared to men [112, 113]. It is also possible that EMS workers were better prepared from the outset (e.g., by having more PPE in stock or already having gained experience in transporting infectious patients).

In conclusion, it does not seem surprising that different occupational groups within the healthcare sector seem to suffer from different challenges due to the pandemic. Whereas MAs and DAs agree similarly to most attitudes and stressors, EMS workers report several attitudes and stressors to different extents. The former groups predominantly work in outpatient settings, whereas EMS workers perform pre-hospital tasks within ambulances. These two settings obviously vary in occupational tasks and working conditions which may explain different agreement to stressors. Additionally, sex

differences between the occupational groups may also account for differences in perceived stressors during the pandemic.

3.3. Comparison of subgroups especially burdened – results of association analyses

3.3.1. Similarities

Several sociodemographic characteristics were significantly associated with SARS-CoV-2-related attitudes and stressors across the three investigated occupational groups. In the following, similarities and patterns in this context will be discussed. First, healthcare workers with children under care were especially burdened by the pandemic. Medical assistants with children under care displayed higher odds of feeling burdened by their financial situation and by thoughts of becoming infected with SARS-CoV-2. The odds of feeling uncertain about correct behavior during the pandemic were significantly higher for DAs with children. The same applied for EMS workers with children.

Furthermore, the type of workplace demonstrated significant associations with attitudes and stressors. Medical assistants working in specialist practices felt less prepared to treat SARS-CoV-2 patients than those working in general practices. Dental assistants working in dental practices displayed higher odds of feeling burdened by their financial situation and less frequently expressed that sufficient PPE was available in comparison to DAs working in orthodontic or maxillofacial surgery practices. Differences in workplaces between EMS workers are largely explained by their qualification. While EMS workers with less training frequently man ambulances for patient transports, EMS workers with higher training man ambulances for rescue services. Again, significant associations between workplaces and attitudes and stressors were found: EMS workers with 520h of training were more burdened by a lack of PPE and their financial situation during the pandemic compared to those with 3 years of training.

Healthcare personnel with better self-reported health (SRH) were less burdened by the pandemic. Good SRH among MAs was associated with higher odds of feeling protected by PPE and knowing how to act correctly. Likewise, DAs with good SRH demonstrated higher odds of feeling sufficiently prepared to treat SARS-CoV-2 patients. Participants of all three occupational groups who reported confirmed SARS-CoV-2 infections among their colleagues demonstrated higher odds of not feeling sufficiently prepared. EMS workers additionally less likely felt protected by PPE and more likely agreed to be at a higher risk of infection compared to the general population. Lastly, depressiveness and anxiety almost consistently displayed significant associations with SARS-CoV-2-related stressors for all three occupational groups.

In summary, there are several similarities in terms of sociodemographic determinants of SARS-CoV-2-related attitudes and stressors between MAs, DAs, and EMS workers. Yet, it must be pointed out that sociodemographic factors were not always associated with the same stressors across the three groups and not consistently significant throughout all investigated items. Considering the large number of analyses, some significant findings may be at random without any underlying systematics.

3.3.2. Differences

Logistic regression results also revealed some differences between occupational groups. Whereas for DAs higher education was significantly inversely associated with a reported burden by increased workload, the opposite direction of association was found for EMS workers (i.e., intermediate education associated with burden by increased workload). In-depth discussions with experts from the German Association of Emergency Medical Service (DBR) explained this, as mentioned in section 1.8.1., with different tasks depending on EMS workers' level of paramedic training. Staff with intermediate training usually mans ambulances for patient transports that were highly demanded during the course of the pandemic, whereas EMS workers with highest paramedic training typically perform rescue services that declined during the pandemic. The association of higher education with less workload among DAs could not be explained even after discussion with experts from the Association of Medical Professions. Considering the high number of regressions that were calculated, it cannot be excluded that certain findings occured at random.

With respect to healthcare workers' age, there were several significant associations with attitudes and stressors among DAs and MAs. Older DAs were, for example, less burdened by thoughts of a possible SARS-CoV-2 infection at work, but perceived an increased risk of infection compared to the general population due to their occupation. Similar observations were made among MAs. In the sample of EMS, in contrast, solely older age was significantly associated with feeling burdened by a shortfall of colleagues. After discussion of the results with experts of the Association of Medical Professions it appears as if with increasing age, DAs and MAs perform different occupational tasks within the practice. Older DAs, for example, were reported to less likely work in close patient contact anymore and to preferably work at the reception or in administration where the risk of infection is supposedly lower. This may be one possible explanation for older DAs being less burdened by thoughts about an infection at work. For EMS, working exclusively in administration is rare. There may be changes in occupational tasks with age, however, these tasks all still involve close patient contact so that the risk of infection remains the same regardless of one's age.

3.4. Comparison of quantitative and qualitative findings among medical assistants

Before comparing results of the quantitative and qualitative study of MAs, two aspects should be kept in mind. Firstly, the quantitative survey included MAs from all possible workplaces (e.g., general practices, specialist practices, hospitals, medical care centers), whereas the qualitative study only included MAs from general practices. Secondly, the quantitative survey was conducted in April/May 2020, whereas the qualitative study was conducted one year later. Therefore, it is possible that both the setting and pandemic-related circumstances are not directly comparable and all further comparisons of results of the two studies should be made with these limitations in mind.

Overall, most themes of the quantitative survey also emerged in the qualitative study. Table 3 gives an overview of the questionnaire items of the quantitative survey and the respective correspondence with results from the qualitative study.

Table 3. Explanation of quantitative findings by findings of the qualitative study among medical assistants in context of the SARS-CoV-2 pandemic.

Findings from the Quantitative survey		Findings from the Qualitative study	
Questionnaire item	Agreement	Mentioned in interviews?	Detailed explanation
The risk of contracting SARS-CoV-2 is higher for me than for a person of same age and sex from the general population	82.3%	Yes	MAs reported general fear to contract SARS-CoV-2 due to a lack of PPE and frequent contact with infected patients, fear of infecting family members as their job posed a high infection risk, and how family members kept additional physical distance to them because of their job
I feel sufficiently informed about dealing with SARS-CoV-2 patients by my employer	66.4%	Not explicitly	MAs explained they had rather liked to receive clear action guidelines and support (e.g., in form of PPE) from the government rather than from their employer
I feel sufficiently prepared for dealing with SARS-CoV-2 patients by my employer	60.5%		
My workload has increased due to the SARS-CoV-2 pandemic	50.0%	Yes	The increase in workload predominantly came through increased telephone consultations with patients, swab tests, preparation and performance of vaccinations, and increased hygiene measures
I can use materials for personal protection at my work so that I feel sufficiently protected from contracting SARS-CoV-2	32.7%	Not explicitly	Not enough PPE was in stock at the beginning of the pandemic and if practices were equipped with PPE by the government, it was insufficient in terms of quantity and quality
I am burdened by uncertainty about the temporal scope of the crisis	95.1%	Not explicitly	MAs were rather bothered by the omnipresence of the pandemic at work and at home
I am burdened by uncertainty about how to act correctly during the crisis	77.5%	Yes	MAs complained about unclear regulations by the government, frequent changes in regulations and billing processes, patients being provided with more

			information by the media than MAs were by the government
I am burdened by a feeling of not being able to let patients down during the crisis	75.8%	Not explicitly	MAs rather expressed to worry about patients who did not show up despite emergencies; some MAs reported to be glad being able to help during the pandemic and that this helped them through
I am burdened by the care situation of my children	73.4% (among those with children)	Yes	Problematic were bureaucratic hurdles in order to use childcare services; day care centers cut hours despite MAs' entitlement for childcare due to their profession
I am burdened by uncertainty about my financial situation during the crisis	67.3%	Yes	Some MAs expressed the worry of losing their job due to pandemic-related decrease in patient numbers; some reported envy among MA teams in cases of unequal distribution of short-time work among teams
I am burdened by uncertainty about contact persons during the crisis	67.2%	Yes	MAs complained about unclear regulations by the government or that contact persons at e.g., health authorities could not provide MAs with relevant information
I am burdened with thoughts of a possible infection with SARS-CoV-2 during work hours	65.7%	Yes	MAs described this retrospectively during the initial phase of the pandemic; as sufficient PPE was available in April 2021, this theme did not emerge anymore
I am burdened by the crisis-related shortfall of colleagues/staff at work	53.6%	Yes	The crisis-related shortfall of colleagues was described as burdensome, not because of colleagues being infected with SARS-CoV-2 but because of MAs quitting the job due to the workload, mental load, or out of fear of infecting family members; MAs described how it was especially difficult to find new MA staff for GP practices during the pandemic
My employer takes the SARS-CoV-2 pandemic seriously	77.1%	Yes	Some MAs complained that GPs did not get involved in finding solutions for daily practice routines
Due to the SARS-CoV-2 pandemic the care for patients with other diseases has been suffering	67.9%	Yes	MAs explained how non-COVID patients were unable to reach the practice via phone as lines were occupied by other patients demanding COVID advice; MAs also described how regular check-

			ups were frequently cancelled by patients out of fear of infection
At my work all necessary materials for personal protection from SARS-CoV-2 are sufficiently available for me	24.0%	Yes	Many MAs described how PPE was lacking at the beginning of the pandemic and how PPE sent by the government was insufficient

As we can see in Table 3, the qualitative interviews frequently provided more in-depth insights into the pandemic-related stressors measured in the quantitative survey and offered additional explanations which our research team had not thought of when designing the questionnaire (e.g., MAs rather expecting pandemic preparation from the government than from their employers or that shortfalls of colleagues resulted more from difficulties in acquiring personnel than from colleagues being infected with SARS-CoV-2). This highlights the particular strength of conducting mixed-methods research as the understanding of the occupational challenges would have been limited without relying on the qualitative approach.

Some stressors captured in the quantitative survey were not mentioned in the qualitative study. This may be explained by the fact that our questionnaire items specifically inquired after a feeling of uncertainty and that this uncertainty existed mainly at the beginning of the pandemic, but may have decreased as the pandemic progressed. Themes that derived from qualitative data that were not captured in the quantitative survey mostly related to social interactions at work. These were interactions among MAs, between MAs and GPs and between MAs and patients. Difficult encounters with patients were reported as one of the major stressors among the pandemic including frequent insults by patients in cases where they did not receive vaccinations or test results immediately, or patients not following practice rules. Certain aspects related to daily practice routines were also mentioned in the interviews that did not appear in our questionnaire such as issues in billing processes or positive changes in daily practice due to the pandemic, i.e. digitalization.

3.5. Findings in context of published literature

As the SARS-CoV-2 pandemic is still ongoing, new research is still being published on a daily basis. For this section of the dissertation, literature published up to August 2022 was considered. It is likely that additional relevant literature will be published between the submission of this dissertation and the final completion of the doctorate. This must be accepted as a limitation in view of the current topic.

3.5.1. Medical assistants

A key underlying assumption of this dissertation was that MAs stand a higher risk of becoming infected due to their job compared to the general population and compared to other occupations. This hypothesis is strengthened by figures of a large German health insurance company (AOK). According to these figures, between March and October 2020, MAs had the second highest absenteeism from work due to COVID-19 among all occupational groups just after pre-school teachers [114].

Furthermore, according to official numbers of the Federal Employment Agency, about 2,900 general practices were on short-time work in April 2020 compared to only 900 in March [115]. As the quantitative survey of MAs for this dissertation was conducted in April 2020, this sharp increase in short-time work may be one explanation for the especially high agreement to financial worries during the pandemic.

Within the course of the ongoing pandemic, four original studies have addressed MAs in addition to the surveys presented as part of this dissertation. Among these were three quantitative studies and one qualitative study. Theiß (2022) surveyed 181 MAs from the German federated state Saarland and found 57% of them to be worried about an own infection with COVID-19 or about infecting family members [116]. This number is slightly lower than the agreement in our study with respect to worrying about an own infection at the workplace (65.7%). Eighteen percent reported to have experienced stigma due to their profession during the pandemic. This is in line with findings from our qualitative study among MAs who also reported friends and family keeping physical distance from them out of fear of infection. Finally, 17% reported financial constraints due to the pandemic. This number is much lower than the 67% of MAs that agreed to feel burdened by their financial situation in our survey. A possible explanation for the lower burden, both in terms of financial worries and in terms of fear of infection, may be the later time of study conduction. The survey by Theiß (2022) was done in August 2020, when the first pandemic wave had flattened, and PPE stocks had been filled up again. Another explanation for the difference in prevalences may be the wording of items. Our study inquired after worries about one's own financial situation during the pandemic, whereas Theiß (2022) asked whether the pandemic had actually led to financial constraints.

Another quantitative survey focused solely on 1,253 MAs in training aged 18-21 years. The study by Raecke et al. (2021), conducted in September 2020, found similar stressors as our survey: Forty-eight percent of MAs were burdened by the possibility of infecting others, 46% by getting infected themselves, and 37% by a general uncertainty about the virus [117]. More than half of MAs felt burdened by an increase in workload due to the pandemic, 60% agreed they more frequently had to

calm patients. Similar to what we found in our qualitative study, difficult patient encounters also were mentioned frequently: 56% were burdened by difficult situations with patients.

A main theme that derived from our qualitative study was the sharp increase in telephone calls in the course of the pandemic. This topic was addressed by the third quantitative survey by Kersting et al. (2022) who surveyed 128 MAs from 73 practices in Germany [118]. These MAs took notes of all incoming phone calls on one selected working day. The mean number of phone calls per day were 77.3, of which 32% were attributable to COVID-19 related issues. Nearly all MAs (97%) agreed that the volume of phone calls had increased during the pandemic. Notably, over 80% of MAs felt sufficiently prepared to answer patients' COVID-related inquires. This number is much higher than the agreement to feeling prepared to treat COVID-19 patients in our survey (60.5%). Again, the later study conduction (April 2021 versus April 2020) may explain a habituation effect to the pandemic situation and an increased feeling of preparedness.

Eventually, one qualitative study shed light on the situation of MAs in Germany during the pandemic using similar methodologies and research questions as our qualitative study [119]. This study by Ehlers-Mondorf et al. (2021) reports the same major stressors for MAs during the pandemic as we found (e.g., fear of own infection and infecting family members, difficult patient encounters, issues with billing regulations, unstructured information flow from the government, lack of PPE, and lack of appreciation of MAs' work). In keeping with the findings from our study, MAs expressed ideas for interventions. New ideas not reported in our sample were e.g., the implementation of consultation hotlines specifically for MAs and attracting more staff for health authorities to improve the information flow. The fact that the similar research methodology applied by Ehlers-Mondorf et al. among a similar population led to similar findings highlights the robustness of our findings.

Aside from these four original studies focusing specifically on MAs, there have been several studies conducted in German practices surveying GPs or overall practice staff. One qualitative study from June 2020 among GPs in Bavaria found these to express similar intervention ideas as MAs from general practices did in our qualitative study, namely, an increase in PPE stocks, better communication with health authorities, a decrease in bureaucracy for practice staff, clear official guidelines on how to proceed and an increase of financial reimbursement of COVID-related tasks [120]. Again, in accordance with our findings, a study among staff from 219 GP practices from Germany found political decisions to be incompatible with daily practice routines and patients to frequently express their incomprehension and impatience [121]. Several studies also described pandemic-related adaptions in practice flows that we also found such as splitting of practice teams for infection prevention [122].

One aspect that did not emerge, neither in our quantitative nor qualitative study, was the discussion to what extent working from home was reasonable and feasible for the MA profession. Hilbert et al. (2020) surveyed 296 physicians working in GP practices in Germany who mentioned implementing working from home as one measure for infection prevention for MAs [122]. This is in line with a statement of the VMF who claim several of MAs' tasks to be perfectly realizable from home such as billing of private services, writing letters and documents, doing patient recalls, and organizing appointments [123].

3.5.2. Dental assistants

According to the Federal Employment Agency, over 23,000 dental practices in Germany were on short-time work in April 2020 when the survey for this dissertation was conducted [115]. This number marked a sharp increase compared to March 2020 (about 4,000 practices on short-time work) and may be one possible explanation for the especially high agreement to financial worries during the pandemic.

With respect to empirical evidence from Germany, two further original studies surveyed samples of DAs in Germany during the early phase of the pandemic. Mekhemar et al. (2021) surveyed 252 DAs from entire Germany between July 2020 and January 2021 applying the Depression Anxiety Stress Scale 21 (DASS-21) and the IES-R scale to assess depression, anxiety, stress, intrusion, avoidance, and hyperarousal [124]. The authors claimed that they could not observe distressing effects of the COVID-19 pandemic in their sample. Subgroups reporting higher levels of stress, anxiety, and depression were DAs suffering either from chronic diseases or immune deficiency, those working in dental practices (compared to university clinics), those who were married, those without children, and those to whom the pandemic posed a financial threat. Especially the finding of DAs without children suffering from worse mental health seems to contrast with the findings of this dissertation. However, as in our study we surveyed pandemic-specific stressors as outcome variables whereas Mekhemar et al. (2021) applied standardized scales (i.e., the DASS-21 and IES-R), no direct comparison with our findings is feasible. The second original study published by Schlenz et al. (2021) surveyed a sample of dental staff working at the Justus-Liebig University in Gießen [125]. The sample comprised 23 DAs of which about half considered themselves as high-risk group due to e.g., age, chronic illness, or obesity. According to Schlenz et al., DAs felt sufficiently informed about the dental care concept during the pandemic, however, mainly by external sources and not by their employer. As their study was conducted in December 2020 and thus 9 months later than the uptake of this dissertation, more information on dental care during the pandemic may have been publicly available. The study by Schlenz et al. (2021)

provides additional insights into some aspects also covered in this dissertation's survey. The increase in DAs' workload, for example, was reported to be mainly due to additional safety measures. Dental assistants needed more time for administration and organization of patient care and for individual treatment. Waiting times for patients were described to be longer due to additional measures (e.g., filling out health questionnaires).

Besides these two German studies, several international studies have also surveyed DAs during the SARS-CoV-2 pandemic. A study among dental personnel from Norway, including 412 DAs, reported that over 70% of dental personnel were afraid of becoming infected, over 85% worried about infecting others, and over 76% worried about infecting family members [126]. Notably, personnel with more than 10 years of professional experience were less burdened. This is in line with findings of our survey. In contrast to our survey, however, the Norwegian study reported over 60% of personnel to claim that PPE was sufficiently available. As both our study and the Norwegian study were conducted at similar points in time, the data indicate that PPE supply may have been better abroad than in Germany. Another international study that may help understand results from our quantitative investigation better is a qualitative study from England by Plessas et al. (2021) among dental personnel, including DAs [127]. The authors describe dental staff working in urgent dental care centers to complain about poor governmental communication during the pandemic, feeling insecure about becoming infected and infecting family members, a lack of PPE, and how available PPE hampered patient-physician communication. However, participants also mentioned how they experienced their job as very meaningful in pandemic times and how their teams had grown closer together. One interesting aspect mentioned by Plessas et al. (2021) was that some participants described how their team implemented continuous mental health monitoring of their staff and provided so-called 'wobble rooms' for individuals to unwind when these felt overwhelmed in certain situations.

3.5.3. Emergency medical services workers

The SARS-CoV-2 pandemic has greatly affected emergency medical services in Germany. Several studies compared the numbers of rescue operations before and during the pandemic-related nationwide lockdown and report decreases in operation numbers ranging from 17.7% [128] to 23.0% [129]. The underlying assumption of this dissertation – EMS personnel standing at a high risk of infection with SARS-CoV-2 – is strengthened by a survey conducted in May 2020 among 1,005 EMS personnel in Germany that found 94.3% of these to report to have been in contact with suspected or confirmed SARS-CoV-2 cases during their working shifts [130]. In 41.3% of these cases, EMS personnel did not report to wear appropriate PPE.

Several empirical studies have shed light on the situation of EMS workers in Germany during the SARS-CoV-2 pandemic since March 2020. In the above-mentioned study by Friedrichson et al. (2020) [130], EMS personnel rated their own safety at work as rather good. Those who rated it as poor were predominantly EMS workers who complained about insufficient quantity and quality of PPE. The authors stated that more than half of the surveyed EMS personnel suffered from a relevant medical condition that made them more prone to a severe course of COVID-19. However, workers did not evaluate these conditions as danger to their health. This finding may highlight a perception of low personal risk and may support our findings with respect to lower levels of pandemic-related stressors among EMS workers compared to MAs and DAs.

Another study by Skoda et al. (2020) surveyed 2,224 healthcare workers including 221 paramedics and found these to show lower anxiety levels compared to nursing staff [131]. Paramedics additionally reported the best health status compared to nurses and non-healthcare professionals. In line with this, paramedics reported lower levels of COVID-19 related fear compared to nursing staff. These findings are all in line with overall results of our quantitative study in which MAs and DAs felt more burdened by the pandemic than EMS personnel.

Further empirical studies from Germany inquired after EMS personnel's compliance with PPE use and safety measures [132] (rather good) and workers' job satisfaction and mood during the pandemic [133] (60% reported a decrease in job satisfaction and 85% felt rather annoyed and tense in pandemic times). A study by Jerg-Bretzke et al. (2021) among 7,542 healthcare workers in Germany found paramedics to report a high fear of infecting others and to experience stress by the thought of patients dying before seeing their relatives [134].

No empirical studies from Germany besides our quantitative study have inquired after a broad range of specific pandemic-related stressors among EMS workers. The sole studies shedding light on stressors faced by EMS workers during the pandemic are two master theses from Austria, however, only partially comparable to our study due to a mixed study sample. Von Eberle (2021) qualitatively studied Austrian healthcare workers including 5 EMS workers, who reported the following stressors [135]: lack of resources (e.g., personnel and PPE), change of working environment (e.g., being insulted by patients, lack of social exchange, uncomfortable PPE, additional working shifts), moral injury (e.g., having to isolate dying patients from their relatives, having to use damaged PPE), and overall insecurity (e.g., no clear action guidelines, no adequate risk assessment). Fink (2021) also qualitatively interviewed healthcare workers including 7 EMS workers [136]. She found similar stressors and additionally reports displeasure with the own employer (e.g., being put on short-time work, dismissal of temporary employees) and a lack of information (e.g., media spreading false information). Notably, these emerged themes largely overlap with the results from our qualitative study among MAs

indicating that healthcare staff in Germany seemed to have faced similar challenges across different occupations. A theme that did not emerge from our interviews was the concept of moral injury that describes when an individual is forced to (not) act in a way so that it violates the own moral or ethical code [30]. This stressor may be unique to EMS personnel as these are, as compared to MAs or DAs, often additionally required to act promptly and make ethical decisions (e.g., whether to put on PPE and lose time in a life-threatening event).

3.5.4. Relevance of findings in view of the ongoing pandemic

In June 2022, the Robert Koch-Institute claimed that the risk of SARS-CoV-2 to the German general population was still high [137]. The research done for this dissertation has been performed in early 2020 (quantitative survey) and in early 2021 (qualitative study). As the pandemic is still ongoing, it is important to emphasize the continued relevance of our findings as many of our inquired stressors still persist and have an impact on healthcare staff. This is, for example, highlighted by Aksakal et al. (2022) [121]. The authors surveyed GPs from 219 practices in Germany in December 2021 and January 2022 and explored the extent to which certain stressors of the pandemic still persisted. Ongoing stressors mentioned by GPs were the education of patients after misinformation, impatience and lack of understanding of patients, lack of sufficient supply with vaccines, political decisions not being feasible in daily practice, and a continuing overload of MAs. These all were among the main themes that emerged from our qualitative study and demonstrate that the need to address these issues remains highly topical.

Certain stressors, by contrast, may have lost relevance in favor of new stressors. For example, circumstances have changed in dental practices in Germany in the meantime. In June 2022 the Federal Council of Germany decided that employers could pay a tax- and social security-free bonus of up to 4.500€ to practice staff, including staff in dental practices and thus DAs [138]. However, again, this bonus is not covered by the government. With respect to the infection risk of dental personnel, the German Dental Association stated on their webpage in July 2022 that infection numbers of dental staff have been low during the pandemic [139]. According to them this was due to staff's adequate use of PPE. The Association does not see a particular risk of infection for dental staff. It can therefore be assumed that among staff, too, the fear of infection at the workplace has declined and remaining stressors in the course of the SARS-CoV-2 pandemic are more likely to be found in the actual day-to-day running of the practice. In other words, we may observe a shift from stress caused by fear/uncertainty among dental staff at the beginning of the pandemic towards stress caused by an increased workload in day-to-day business.

Having a look at the current situation of EMS personnel, a short report on the German Interdisciplinary Emergency Medicine Congress of March 2022 highlights that challenges due to the pandemic also still remain [140]. Many hospitals are reported to have reached their capacity limits so they cannot accept new COVID-19 patients. Consequently, EMS personnel have to drive longer distances. Furthermore, emergency vehicles have to be disinfected extensively after transporting COVID-19 patients and are therefore not available to service for a short time. There are also still frequent issues with staff shortages due to COVID-19 infections.

In conclusion, it can be said that the SARS-CoV-2 pandemic is ongoing and thus most inquired stressors among healthcare personnel are still showing their impact. While certain stressors related to individual risk of infection may have lost some significance, other stressors, mainly related to daily operations, may be just as present as at the beginning of the pandemic and even new stressors may emerge in the further course of the pandemic.

3.6. Strengths and limitations

3.6.1. Strengths

The data gathered for this dissertation present insights into attitudes and stressors regarding the SARS-CoV-2 pandemic among different occupational groups within the German healthcare sector. Data have been collected during the first wave of the pandemic in Germany, that is, in April 2020, which minimizes recall bias. This dissertation is the first to investigate occupational groups within the German healthcare sector that stand at a high risk of SARS-CoV-2 infection aside from physicians and nursing staff. It furthermore includes the first investigation of attitudes and stressors at two points in time (only for EMS workers) and therefore allows for insights into possible changes over time. The wording of each questionnaire item was discussed with experts of two professional associations who were also asked if any aspects were missing. As these experts mostly work or have worked in the surveyed professions themselves, they knew the target group well and could judge which stressors were relevant. This close cooperation with two professional associations during questionnaire development likely increased its face validity. Following up the quantitative survey by a qualitative study among one occupational group, MAs, greatly enriches this dissertation. As qualitative methodologies are especially suitable to give detailed explanations to observed phenomena– which is not possible using quantitative approaches – the gained insights of the qualitative study provide many starting points for specific and practice-oriented solutions to pandemic-related issues (see chapters ‘practical implications’). Within the qualitative study, participants with a great variety of sociodemographic characteristics were included (e.g., with respect to age, sex, working experience, migrant background,

practice size, and federal state). This likely increased the number of different perspectives on the pandemic during interviews.

3.6.2. Limitations

The cross-sectional design of the quantitative survey does not allow for any causal inferences but represents mere associations. The aim of this dissertation was to describe stressors among healthcare staff at the beginning of the pandemic. Therefore, in favor of a real-time inquiry of attitudes and stressors, neither any pilot testing of the study questionnaire was performed, nor cognitive testing of the instrument. Ideally, the instrument would have been piloted beforehand in a target group sample to test for questionnaire comprehensibility, acceptance, and feasibility. Despite close collaboration with two professional associations during item development it cannot be ensured that the wording of items was entirely understood by all study participants. This is because members of the professional associations have been involved in the design of previous, own inquiries and may therefore better be able to understand scientific questionnaire wordings than the target group. Furthermore, no exact response rate could be calculated due to the online distribution of the study questionnaire via social media and via website. It is likely that not all eligible participants from all three occupational groups were reached as it is conceivable that not all of these follow the activities of their professional association on social media. It was also not inquired after the federated state of participants' workplace so that possibly regional differences in e.g., legislation or distribution of working tasks for EMS could not be taken into account.

Limitations also apply to the qualitative study. During participant recruitment, selection bias cannot be ruled out as possibly people highly affected by the pandemic predominantly participated in the study. As recruitment took place via social media channels, it is conceivable that predominantly younger participants saw the study call. Nevertheless, relatively few young people participated in the study. No participants with low education were recruited who might have had a different perspective on SARS-CoV-2-related changes. However, in a previous study among MAs in Germany, the proportion of MAs with low educational background was very low, too [82]. Possibly, this group of MAs is less interested in the participation in scientific studies. Participants were asked to compare their working conditions to those of the pre-pandemic era. It cannot be ruled out that responses were affected by a certain recall bias as the pandemic had already lasted for one year. Although the interview guide was formulated using open-ended questions, a certain social desirability bias in participants' answers can also not be ruled out. During data coding, it might have been advantageous to include coders with a more diverse educational background and including coders that were trained as MAs to gain additional

perspectives. Only two rounds of coding were performed. As the coding scheme was developed by two researchers and additionally reviewed by a third person, an experienced qualitative researcher, two coding rounds were deemed sufficient. Regarding qualitative content analysis, a general limitation is that individual quotes and opinions are greatly reduced and lose detail during the formation of summary categories during the coding process for data reduction [141]. Nevertheless, it is a well-suited approach for systematically analyzing large quantities of data.

Overall, it must be kept in mind that the quantitative study was conducted in April/May 2020, whereas the qualitative interviews were conducted one year later in April 2021. Results of both studies may not directly be comparable as the circumstances greatly changed during this time period (e.g., availability of PPE and vaccinations at the latter time point).

3.7. Practical Implications

3.7.1. Implications of the quantitative survey

With respect to findings form the quantitative survey, implications at the political level arise as well as implications at a practice level. Implications for the political level result, for example, from the observed uncertainty about correct contact persons during the pandemic. Various actors (e.g., the Association of Statutory Health Insurance Physicians or the Robert Koch-Institute) should actively contact health facilities, thereby addressing MAs, DAs, and EMS workers (e.g., via fax, letter, or e-mail) and identify themselves as contacts. This could provide clarity on responsibilities. Specifically, it should be stated for which questions one can contact whom and when. Secondly, correct behavior during the pandemic was frequently unclear to healthcare staff. Behavioral regulations (e.g., how to bill for COVID-19 services, how to organize referrals of COVID-19 patients) should be communicated uniformly nationwide via one channel (always from the same source) at fixed time intervals. These regulations, again, should be actively sent to healthcare staff, which may prevent confusion when healthcare staff performs own research for regulations. It is furthermore conceivable to strengthen pandemic-related preparedness by including respective training programs in healthcare staffs' vocational training. These should be refreshed on a regular basis. Advanced trainings could be offered for staff who already completed vocational training. First private institutes now offer such trainings for healthcare staff including the possibility to e.g., become a pandemic officer (includes training on e.g., existing pandemic plans, how to deal with PPE shortage, risks and benefits of vaccines) [142], however no such trainings are officially listed by the German Medical Association so far [143].

Many participants of the quantitative survey felt uncertain about their financial situation during the pandemic. In Germany, there are statutory regulations for short-time work for workers employed on

a social security basis. These ensure payment of at least 60% of one's regular monthly salary [144]. Possibly, MAs, DAs, and EMS workers need more information regarding their entitlement for this short-time pay and on their access to this type of payment, as they may not be familiar with it. During the SARS-CoV-2 pandemic, the German government additionally facilitated access to short-time pay. In case of MAs, since January 1st 2021, there is now a collective agreement governing short-time work specifically for MAs that ensures payment of 80% of the pre-pandemic net income [145]. However, the agreement does not cover MAs still in training. Additional support is needed for this subgroup of MAs. Agreements such as the above are also conceivable for DAs and EMS workers and may foster a sense of security of one's income and job during the pandemic. Finally, many participants of the quantitative survey felt uncertain with respect to childcare. For systematically important occupational groups, which include all three groups examined in this dissertation, childcare must be provided on an unwavering basis. In early 2020, it was up to each individual federated state in Germany to define which occupational groups were to be classified as systemically relevant [146]. Some states required both parents to work in systemically relevant professions in order to be eligible for childcare. Others additionally required that there was no other possibility (e.g., through other family members, neighbors) to provide childcare in order to be eligible for emergency care.

A first implication on practice level is the need of constantly keeping sufficient amounts of PPEs in stock. The relevance of these kinds of measures may have been neglected in the past but was made clearer than ever by the current pandemic. Sufficient supplies of PPE may, in turn, reduce healthcare staff's worries of becoming infected during working hours and foster their workability. In the future, practices and EMS wards may constantly train their staff on pandemic procedures and have an action plan in place. Not least, employers should take pandemics seriously. Especially DAs stated to a large extent that their employers did not take the pandemic seriously. This attitude transfers to the employees and may create insecurity among them. It can be assumed that when established institutions such as the WHO declare a pandemic, that it indeed represents a serious threat that should by all means be taken seriously. This also applies to, for example, practitioners in specialist practices, which may have felt less likely to come into contact with SARS-CoV-2 infected individuals at the beginning of the pandemic compared to general practices (and which was reflected in the results of this dissertation saying that MAs from specialist practices felt less informed and prepared for the pandemic by their employers).

3.7.2. Implications of the qualitative study

Regarding implications from the qualitative study among MAs, these may also be divided into implications on the political level and implications on practice level. On the political level, bureaucratic hurdles for medical personnel when applying for childcare should be reduced. Likewise, bureaucracy should be simplified with respect to the billing of SARS-CoV-2-related services. For example, changes could be bundled and issued every month instead of on a weekly basis. Retrospective changes should be avoided. With respect to appreciation of MAs during the pandemic, politics should discuss bonus payments for MAs not paid by GPs but by the government in order to assure that all MAs benefit from it. Additionally, MAs should be considered eligible for early vaccination along with other health professionals. Lastly, politicians' communication with practices should be improved by engaging in direct contact with practices (via e.g., professional associations) instead of the media, involving practice staff in decision-making, and informing practices about changes in a timely manner.

On the practice level, GPs should express their appreciation for MAs verbally and financially. Personal protective equipment should always be held in stock in sufficient amounts for possible future infectious disease outbreaks. Regarding difficult patient encounters, practice teams could discuss the implementation of fixed and binding rules within the practice team e.g., the right to hang up the phone in case of patients verbally insulting MAs. Clear communication of these rules by the GP possibly lead to clarity and relief among practice staff. It is also conceivable that GPs come to the front desk and support MAs in case of difficulties.

3.8. Implications for research

This dissertation provides in-depth understanding of stressors during the SARS-CoV-2 pandemic among MAs in general practices in Germany. More research is needed, however, with respect to the nature of pandemic-related stressors among DAs and EMS workers. Again, qualitative approaches seem suitable to obtain in-depth understanding of contexts, causes, and effects of different stressors among these occupational groups in order to provide suitable support. Furthermore, as the pandemic is still ongoing, future research may focus on obtaining up-to-date data on the quantitatively inquired stressors. This may help to monitor trends in various stressors over time and see which sources of stress may have already been addressed and where support is still lacking. This future research should definitely inquire after a broader range of possible socio-demographic and work-related determinants of stressors than it was done in the course of this dissertation. These new determinants could be, among others, the completion of training (yes vs. still in training), type of employment (full-time vs.

part-time), migrant background status (yes vs. no), years of professional experience, location of practice or area of operation (urban vs. rural), practice or team size, monthly salary, holding a leadership position (yes vs. no), and sole wage earner status (yes vs. no). Finally, besides politicians, scientists could be in close contact with medical professionals to develop and offer adequate trainings for healthcare staff in the course of the pandemic and, as first pandemic trainings have already emerged, these should be scientifically evaluated.

3.9. Discussion of own contribution to this dissertation

The original project idea for the quantitative survey among the three occupational groups during the SARS-CoV-2 pandemic was conceived by the first supervisor, Prof. Adrian Loerbroks. Prof. Loerbroks also established contact with the professional associations for recruitment of study participants. My personal contribution to this dissertation amounts to the following points: Literature research on pre-existing quantitative survey instruments that cover the availability of PPE, the feeling of preparedness, and the subjectively assessed risk of infection during previous pandemics, the adaption of suitable questionnaire items and development of the final study questionnaire (after discussion with and supervision of Prof. Loerbroks), preparation and obtaining of an ethics approval, close communication with professional associations during questionnaire development and recruitment of participants, supervision of the implementation of the online questionnaire, data cleansing of the obtained study data in SPSS, choice of statistical methods applied, data analysis in SPSS, and drafting of the three original manuscripts of the quantitative survey. It was also my idea to follow up the quantitative survey with a qualitative study among MAs. My contribution to the qualitative part of the survey was the development of the qualitative research questions, the interview guide (after discussion with Prof. Loerbroks, Patricia Vu-Eickmann and Viola Mambrey), again the preparation and obtaining of an ethics approval, close communication with the Association for Medical Professions for participant recruitment, conduct of all telephone interviews, choice of the qualitative analysis approach, analysis of the interviews in MAXQDA (together with Prof. Loerbroks, who reviewed the final coding scheme and Viola Mambrey, who coded 5 transcripts), and drafting the original manuscript.

4. Conclusions

This dissertation provides, for the first time, insights into the specific job-related stressors faced by MAs, DAs, and EMS workers in Germany during the SARS-CoV-2 pandemic. Major reported stressors were the feeling of standing at a higher infection risk compared to the general population, uncertainty about the temporal scope of the pandemic, a lack of personal protective equipment, uncertainty about correct behavior, about one's financial situation and about the childcare situation. MAs with children and those working in specialist practices were subgroups more burdened by pandemic-related stressors. The same applied for DAs working in dental practices (compared to DAs working in orthodontic and maxillofacial surgery practices) and for EMS workers with 520h of training (compared to 3 years of training).

Key pandemic-related stressors that derived from interviews with MAs working in GP practices were a sharp increase in workload, a shift in occupational tasks, structural and personnel challenges, and an increase in unpleasant patient encounters. In addition, frequent changes in testing and billing regulations and a lack of appreciation toward the MA profession during the pandemic were lamented.

The findings of this dissertation provide starting points for interventions as well as for the preparation for future pandemics. Various actors (e.g., the Association of Statutory Health Insurance Physicians or the Robert Koch-Institute) should actively contact health facilities, thereby addressing MAs, DAs, and EMS workers, and identify themselves as contacts. Clear action guidelines for these occupational groups are needed. To address financial concerns, agreements on governing short-time work (as e.g., the newly established agreement specifically for MAs during the pandemic) should be expanded (e.g., also to MAs in training and other occupational groups) and made better known to their target groups. With respect to bureaucratic hurdles, frequent changes in testing and billing regulations should be bundled and issued every month instead on a weekly basis. Furthermore, the access to childcare for systemically relevant occupational groups should be facilitated (e.g., less bureaucracy). Pandemic-specific trainings for healthcare staff should be developed and included in vocational training and offered as advanced trainings to working staff. Finally, policy makers' communication with practices should be improved by engaging in direct contact with practices instead of the media, involving practice staff in decision-making, and informing practices about changes in a timely manner.

Future research should expand the obtained results by conducting updated and more detailed quantitative surveys to address potential changes in stressors as the pandemic progresses. Additional stratified analyses could be done by to identify further sociodemographic determinants such as MAs who are still in training, type of employment, having a migrant background, location or practice area of operation, practice team size, holding a leadership position, and sole wage earner status. Eventually,

qualitative approaches could shed more light on stressors faced by DAs and EMS workers during the pandemic. Finally, new pandemic-specific trainings for healthcare staff should be developed and existing programs should be scientifically evaluated.

5. Acknowledgement

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6. Appendix

1 Wording of items of the quantitative survey, answer scales and item origins

2 Topic guide for qualitative interviews

Appendix 1. Wording of items of the quantitative survey, answer scales and item origins

Item wording	Answer scale	Origin
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	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired by and adapted from De Zwart et al. (2010) and Liao et al. (2014)
I feel sufficiently informed about dealing with SARS-CoV-2 patients by my employer	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired and adapted from Hu et al. (2012)
I feel sufficiently prepared for dealing with SARS-CoV-2 patients by my employer	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired and adapted from Hu et al. (2012)
My workload has increased due to the SARS-CoV-2 pandemic	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
SARS-CoV-2 related stressors		
I am burdened by uncertainty about the temporal scope of the crisis	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened by uncertainty about how to act correctly during the crisis	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened by a feeling of not being able to let patients down during the crisis	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations

I am burdened by the care situation of my children (only for n= 805 MAs with children in their household)	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened by uncertainty about my financial situation during the crisis	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened by uncertainty about contact persons during the crisis	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened with thoughts of a possible infection with SARS-CoV-2 during work hours	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
I am burdened by the crisis-related shortfall of colleagues/staff at work	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
SARS-CoV-2 related work outcomes		
My employer takes the SARS-CoV-2 pandemic seriously	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the VMF
Due to the SARS-CoV-2 pandemic the care for patients with other diseases has been suffering	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired after discussion with the professional associations
At my work all necessary materials for personal protection from SARS-CoV-2 are sufficiently available for me	(1) Strongly agree (2) Agree (3) Disagree (4) Strongly disagree	Inspired and adapted from Hu et al. (2012)

Depressive symptoms		
Over the last 2 weeks, how often have you been bothered by any of the following problems?		
Little interest of pleasure in doing things	(0) Not at all (1) Several days (2) More than half the days (3) Nearly every day	PHQ-2
Feeling down, depressed, or hopeless	(0) Not at all (1) Several days (2) More than half the days (3) Nearly every day	PHQ-2
Symptoms of anxiety		
Over the last 2 weeks, how often have you been bothered by the following problems?		
Feeling nervous, anxious, or on the edge	(0) Not at all (1) Several days (2) More than half the days (3) Nearly every day	GAD-2
Not being able to stop or control worrying	(0) Not at all (1) Several days (2) More than half the days (3) Nearly every day	GAD-2

Appendix 2. Topic guide for qualitative interviews

Impact of the SARS-CoV-2 pandemic on the everyday working life of medical assistants in general practices in Germany: a qualitative study

A study conducted by the Institute of Occupational, Social and Environmental Medicine, University of Duesseldorf

institut arbeitsmedizin sozialmedizin & umweltmedizin

Interview Guide

Welcoming
Good afternoon and welcome. First of all, I would like to introduce myself: My name is Annegret Dreher and I am a research associate at the Institute of Occupational, Social and Environmental Medicine at the University of Duesseldorf.

Explain the aim of the survey
This interview is part of my doctoral thesis. I am investigating the impact of the Corona pandemic on medical assistants in Germany.

In our conversation today, I would like to learn more about how the Corona pandemic has affected and changed your personal everyday working life. I would also like to talk to you about how you personally experienced these changes. At this point, it is important to say that there are no right or wrong answers. You are completely free to reflect your personal experiences and assessments. The interview itself will last approximately 20 to 45 minutes.

Confidentiality and anonymization of data
All data collected will be handled in accordance with current data protection regulations. The conversation will be recorded on tape. I will NOT address you by name during the interview so that you remain anonymous. The tape recording will be typed up afterwards by an external service provider and then destroyed immediately. Any information you provide about places or names (e.g., from your employer) will NOT be typed up and will therefore not be included in the data analysis. The external service provider is subject to a confidentiality agreement.

You can terminate the interview at any time without giving reasons. This will not result in any disadvantages for you.

Check whether consent form is available
I have received your consent form.

Open questions
Before we start the interview, are there any open questions from your side?

Switch on tape!
I will now turn on the tape and record a code at the beginning. This code will help us later to assign the interview.

Eligibility criteria	
To get started, I'd like to ask you 3 quick questions about your employment:	
Were you continuously employed as a medical assistant in 2020?	□ Yes □ No (e.g., unemployment, maternity leave)
Have you changed employers in 2020?	□ Yes □ No
Was your employer in 2020 a general practice?	□ Yes □ No, other: _____
Interview questions	
Great, then we can continue with the content-related questions!	
Everyday work during pandemic	At first I would like to know….. □ What does a typical working day currently look like for you? ▪ What tasks do you currently typically perform at your job?
Changes	You stated earlier that you were continuously employed as MA in 2020. This means you also experienced the time BEFORE the Corona pandemic. What would you say.... □ What changes have there been at your work since the Corona pandemic began? ▪ How has your workload changed? - Do you have more work to do? - What has become more? What has become less? ▪ To what extent have work processes changed? - Opening hours changed? - Consultation hours changed? - Hygiene measures introduced? - Documentation changed? - Range of services changed? ▪ Have there been any SARS-CoV-2 cases among your practice team? ▪ To what extent has the collaboration changed? - with your boss - with your colleagues - with patients ▪ To what extent has your enjoyment of the job changed? ▪ To what extent has the appreciation towards you changed? - by society

	- by patients - by your boss □ (name an example for a change) How have you personally experienced this change? ▪ What impact did this change have on you? ▪ How did you feel about it?
Enablers	□ (If there was anything) What helped you most during this time? (Examples: What role did the team play, behavior of patients, what role did your individual tasks play?)
Barriers	□ (If there was anything) What made the situation particularly difficult for you? (Examples: What role did the team play, behavior of patients, what role did your individual tasks play?)
Further evaluation of changes	□ Assuming Corona would no longer be an issue tomorrow, which of the above-mentioned changes would you like to keep? (Give examples for changes from above if necessary!) □ Why would you keep these changes?

1. End of the interview

This is all from my side now. We've talked about a lot of things, but there may be things that haven't been mentioned yet. Is there anything from your side that hasn't come up yet but is important to you?

To conclude the interview, I would like to ask you a few questions about yourself:

We want to make sure that we include as diverse participants as possible in our study (young/old, full-time/part-time, big city/rural, etc.)

Sex	□ male □ female □ non-binary
Year of birth	_ _ _ _ (year 4 digits)
What is your highest level of education?	□ Finished school without graduation □ Secondary modern school qualification (‘Haupt- oder Volksschulabschluss‘) □ Secondary modern school level 1 certificate (‘Realschulabschluss’ / ‘Mittlere Reife’ / ’Fachschulreife‘) □ General qualification for university entrance or entrance qualification limited to universities of applied sciences (‘Abitur’/’Fachhochschulreife‘) □ Other (e.g., acquired abroad)
In which country was your mother born?	□ Germany □ Other
In which country was your father born?	□ Germany □ Other
Since when have you been working as a medical assistant?	_ _ _ _ (year 4 digits)
To what scope do you currently work as a medical assistant?	□ Full-time □ Part-time
The practice in which you work is located...	□ in an urban area (more than 100.000 inhabitants) □ in a suburban area (20.000 to 100.000 inhabitants) □ in a rural area (less than 20.000 inhabitants)
The practice where you work is located in....	□ Baden-Württemberg □ Bavaria □ Berlin □ Brandenburg □ Bremen □ Hamburg □ Hesse □ Mecklenburg Western Pomerania □ Lower Saxony □ Northrhine-Westphalia

	□ Rhineland Palatinate □ Saarland □ Saxony □ Saxony-Anhalt □ Schleswig-Holstein □ Thuringia
Number of physicians in the practice	_ _ (number, 2 digits)
Number of MAs in the practice (including yourself)	_ _ (number, 2 digits)
Have there been any confirmed cases of SARS-CoV-2 in your practice team?	□ Yes □ No
Have you already tested positive for SARS-CoV-2 yourself?	□ Yes □ No

2. End of the interview

I would like to thank you very much for the helpful interview!

I will now stop the tape recording and end the interview.

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