
Original Article

An Investigation into Occupational Related Stress of At-Risk Workers During COVID-19

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Abstract

Objectives: Nearly all workers and industry sectors have been affected by the ongoing coronavirus disease 2019 (COVID-19) pandemic in some form since March 2020. However, the pandemic-related stressors experienced in the workplace may vary from industry to industry and may have disproportionately affected some workers. This study investigates increased stress levels, stressor events, and other perceptions of stress from at-risk workers during COVID-19.

Methods: An in-depth work-related stress survey that incorporated many aspects of work, life, work-life balance, and the health of employer-employee relationships was developed with a focus on COVID-19-related stressors. The cross-sectional survey was distributed online through professional networks from October to November 2021. The survey results were statically analyzed using Kruskal–Wallis one-way analysis of variance (ANOVA) after grouping the industry sectors into the four groups to determine trends within these groupings.

Results: The survey was completed by 670 workers in sectors such as manual labor, business/office service, healthcare, and education. A variety of trends were determined between the occurrence of COVID-19 and work stress which had, in some cases, affected some industry sectors to a larger degree than others. More than 50% of the participants reported experiencing an increased workload since the onset of the pandemic with some sectors, like healthcare, reporting an increased workload more frequently at 80%. Around 55% of respondents believed they could be exposed to COVID-19 in their workplace, ranging from 52% of business/office service workers to 77% of healthcare workers.

Conclusions: As workplaces navigate past the pandemic, occupational stress should be addressed head-on through workplaces providing expanded resources so as to assure work stress associated with future pandemics are mitigated appropriately. Whether the stressor is associated with irregular shift work or psychosocial aspects (i.e. relying on coworkers), many of these stressors have the possibility to become exacerbated by external factors such as pandemics.

Keywords: COVID-19; healthcare workers; SARS-CoV-2; workload; work-life balance

What's Important About This Paper?

Workers in nearly all industries have been affected by the ongoing COVID-19 pandemic, but they are clearly impacted in varying ways. This study used a cross-sectional survey of workers to understand increased work-related stress during the pandemic. The impacts of the pandemic on work-related stress extend beyond the healthcare industry, with most respondents reporting increased workload and potential exposures to SARS-CoV-2 at work.

Introduction

Occupational-related stress is a global public and occupational health concern, contributing to many aspects of health disparities (Wieclaw *et al.*, 2005; Soori *et al.*, 2008; Sun *et al.*, 2011; Kang *et al.*, 2015; Malamardi *et al.*, 2015). Such stress not only undermines the quality of life but is also a risk factor for hypertension, cardiovascular disease (CVD), and poor mental health outcomes (Belkic and Nedic, 2007; Sarafis *et al.*, 2016; Hasan *et al.*, 2018; Faraji *et al.*, 2019; Jin *et al.*, 2019). Occupational-related stress costs American companies more than \$300 billion per year through a combination of health costs, absenteeism, and poor performance. (Center for the Promotion of Health in the New England Workplace, 2021). According to the American Institute of Stress (AIS, 2020), experiencing occupational stress is commonly caused by an overbearing workload, interpersonal issues, poor work-life balance, and lack of job security. Occupational stress has noticeably picked up since the onset of the global coronavirus disease 2019 (COVID-19) pandemic, especially among the first responders, healthcare workers, educators, and to a lesser extent, working from home (WFH) populations (Zhang *et al.*, 2020). Additionally, a recent study found that more than half of the US workforce felt burned out and 40% were considering changing jobs to resolve stress (Talkspace, 2021). While the influence of occupational-related stress on the health of workers is increasingly being recognized (Kinnunen-Amoroso and Liira, 2014; Bruschini *et al.*, 2018; Jukic *et al.*, 2020; Doyle *et al.*, 2021), relatively little research has been conducted with a focus on how the ongoing pandemic has exacerbated these occurrences.

Various industries were affected to different degrees after the onset of the pandemic, exposing some workers to different levels and types of occupational stress. For example, in addition to their regular work-related stress, home healthcare workers (HHCWs) often assume a large portion of irregular working hours, therefore their family and childcare responsibilities may be more likely to spill over into their work. Spillover of stress due to working conditions has been well documented, especially during the COVID-19 pandemic (Soubelet-Fagoaga *et al.*, 2021;

Uddin, 2021; Gerding and Wang, 2022; Karataş *et al.*, 2022). Regarding WFH populations, stress and burnout would further negatively impact those who may already be experiencing physical discomfort due to ergonomic problems, which have proven to be an issue since the onset of the pandemic (Gerding *et al.*, 2021). Research involving occupational stress experienced by those who work in atypical settings (i.e. workload, job insecurity, role conflict, and physical demands) has demonstrated that work-related stressors are associated with greater depression, anxiety, and suicidality (Quick and Henderson, 2016). Additionally, COVID-19-unit ICU nurses were more than twice as likely to report lacking sufficient sleep and 3 times as likely to be planning to leave their current department but were nearly twice as likely to feel confident in their care for patients compared to their non-COVID-19 unit counterparts (Tamrakar *et al.*, 2021). Little work-stress research has been conducted with certain sub-sectors of typically high-stressed workforces such as home healthcare workers, despite frequently experiencing a disproportionate share of exposure such as COVID-19 and annual influenza outbreaks (NIOSH, 2019). The public safety sector who works in atypical working conditions like shift work and deals with traumatic experiences regularly may also have elevated stress (NIOSH, 2019). Finally, there is a lack of understanding regarding stress for those who work from home (NIOSH, 2020).

Research examining the relationship between work stress and health across industries is limited. Knowledge of work-related stress may be particularly salient in certain industries, which can contribute to health disparities among workers who are at risk of experiencing a greater degree of occupational stress. The objective of the study was to assess increased stress and work conditions experienced by workers from different sectors during the COVID-19 pandemic through a cross-sectional survey.

Methods

Study design and survey distribution

The online survey was a cross-sectional evaluation of the subjective stressors experienced while working during

COVID-19. The study was approved by the University of Cincinnati Institutional Review Board under protocol #2021-0681. The link to access the survey was distributed via email lists within National Institute for Occupational Safety & Health (NIOSH) and American Industrial Hygiene Association (AIHA) professional networks, as well as social media (LinkedIn and Facebook), who were then encouraged to share the survey with others in their circles who may be experiencing stress due to the pandemic. The survey was developed in REDCap (Vanderbilt University, Nashville, TN) and was available to complete online from 8 October 2021 through 15 November 2021. By this time, no city/state government continued to have a stay-at-home order in place, however, employers may have continued with a work-from-home approach depending on the job or industry. Additionally, a range of employers had begun requiring COVID-19 vaccinations by this point (i.e. healthcare and government).

A majority of questions were taken from validated work-stress questionnaires used in previously published work, one from NIOSH, directly (NIOSH, 1999; Holmgren *et al.*, 2009). The survey questions were then edited to focus specifically on working conditions since the pandemic began (i.e. altering “Has your workload increased?” to “Has your workload increased since COVID-19?” with a follow-up question “If yes, do you perceive that as stressful?” appearing if the respondent answered “Yes” to the former). The full list of survey questions can be found in the [Supplementary Materials](#) online; there were up to 71 questions for participants to respond to (only if responses triggered all follow-up questions possible via branching logic). Four participants were drawn at random to receive a \$25 gift card as appreciation for completing the survey.

The survey inquired about (i) demographic information: gender, age, and race; career path, years in a career, (ii) working conditions: irregular working hours, work pace, (iii) living conditions: work/life boundaries, sleep difficulty, social time, recreation time, change in weight, and if there are children or elderly that live with the participant and receive care from the participant, (iv) how COVID-19 affected employment: loss of employment, increased workload, time to finish work assignments since beginning of pandemic and time management, workplace communication, workplace conflict, WFH, lack of commuting, access to work supplies, increased exposure potential to COVID-19, quarantine, and (v) how the employer has acted: compensated fairly, adequate COVID-19 policy, adequate personal protective equipment (PPE), and presence of a vaccination policy. Questions were then triggered

through branching logic to inquire about the level of stress experienced based on the response of the participant. For example, if a participant responded they lost or changed their job due to COVID-19, the question “Did you experience increased stress levels due to a loss or change in job?” appeared. If the participant responded they did not lose or change their job, the follow-up question did not appear and is accounted for as “N/A” within responses to follow-up questions. Possible stress-related answer options were rated “not stressful at all,” “somewhat stressful,” “stressful,” and “very stressful” as appropriate.

Study population

The survey was available to individuals currently employed and 18 years of age or older. The job options included in the survey were determined to be too numerous, and were consolidated into four categories: business/office service, manual labor, education, and healthcare for analysis. Business/office services included: sales, real estate, finance and insurance, software or IT service, telecommunications, broadcasting, publishing, legal services, scientific or engineering services, religious, and arts, entertainment, and recreation. Labor included: agriculture, forestry, fishing, and hunting, mining, construction, manufacturing, utilities, transportation and warehousing, military, and hotel/food services.

Data analyses

Descriptive statistics were computed for each survey question, including the number and percentage of individuals who responded. Statistical analyses consisted of univariate correlations of all occupational stressors and their respective responses and a Kruskal–Wallis one-way analysis of variance test to determine whether responses about stressors varied between job categories. All statistically significant relationships found through the Kruskal–Wallis test, as defined by a P -value ≤ 0.05 , were then developed into frequency charts and are presented within the results section.

Finally, the overall degree of stress the entire study population reported was compared using the composite scoring methodology. For instance, in a follow-up question asking the participant if they viewed a workplace change due to COVID as stressful, answer options were listed as “not stressful at all,” “somewhat stressful,” “stressful,” and “very stressful” which were then coded as 1, 2, 3, and 4, respectively. The number of responses selected in a given option was then multiplied by the associated number, and the four products were then added together and divided by the total sample population asked this question.

Results

Survey respondents

In total, 676 individuals completed surveys about their occupational stress in relation to the ongoing COVID-19 pandemic (see [Table 1](#)). Most respondents were either within the business/office service ($n = 298$) or manual labor industries ($n = 252$), followed distantly by education ($n = 69$), healthcare ($n = 51$), and “other” ($n = 6$), which accounted for anyone not working in the four former options. Due to the extremely small sample size in the “other” category, these respondents were omitted from frequency analysis, resulting in 670 total submissions. A majority of the respondents were male ($n = 444$, 66.3%). A large majority of the survey population was 39 years of age or under ($n = 551$, 82.2%). Regarding race, a large majority of respondents were white ($n = 457$, 68.2%), followed distantly by American Indian/Alaska Native ($n = 78$, 11.6%), black or African American ($n = 53$, 7.9%), Hispanic/Latino ($n = 35$, 5.2%), Asian ($n = 24$, 3.6%), Native Hawaiian/Pacific Islander ($n = 18$, 2.7%), or multi-racial ($n = 2$, 0.3%).

Participants’ number of years of experience in their career showed a large majority of respondents were

either in a manual labor or business/office service-related industry with 15 years of experience or less (31.3% and 39.3%, respectively). The overall number of individuals sharply waned as the years of experience in their industry increased as 8.5% reported 16–25 years, 5.7% reported 26–35 years, and 0.6% reported more than 35 years of experience. Within each industry category, workers were predominantly more concentrated at 25 or less years of experience with only 6.3% of individuals with 26–35 years of experience.

Survey response frequencies

The Kruskal–Wallis test identified fourteen questions related to stress that had statistically significant differences among the job categories ([Supplementary Table S1](#)).

Irregular working hours or working night shift was concentrated among manual labor and business/office service workers, but a majority of each type of industry involved irregular hours or night shifts at least sometimes: manual labor (86.9%), business/office service (72.5%), education (56.5%) and healthcare (84.3%). Overall, 77.2% of all individuals surveyed worked irregular hours or night shifts at least sometimes.

Table 1. Demographic information of survey respondents.

	Manual labor	Business/office service	Education	Healthcare	Overall
Total	252	298	69	51	670
<i>Age</i>					
18–29	56	95	12	13	176
30–39	151	156	40	28	375
40–49	36	34	12	6	88
50–59	7	11	1	3	22
60–69	1	2	3	1	7
70+	0	0	1	0	1
No response	1	0	0	0	1
<i>Gender</i>					
Male	176	194	45	30	445
Female	74	100	24	20	218
Other	1	3	0	1	5
No response	1	1	0	0	2
<i>Race and ethnicity</i>					
American Indian/ Alaska Native	39	23	8	8	78
Asian	6	9	8	1	24
Black or African American	23	19	5	6	53
Hispanic/Latino	13	18	2	2	35
Native Hawaiian/Pacific Islander	8	8	1	1	18
White	160	220	45	32	457
Multi-racial	2	0	0	0	2
N/A	1	1	0	1	3

As shown in Figure 1A, roughly one-half of the entire study population reported an increase in workload since COVID-19 started, but this was not reported equally among the job categories. Eighty percent of respondents in healthcare reported an increased workload, while only 44% of respondents in business/office service reported an increased workload.

A majority of respondents (85.8%) had the ability to decide their work pace at least sometimes. When stratified by industry, the largest portion of workers who never had the ability to decide on their work pace were those in healthcare at 35.3% of healthcare workers while the smallest portion belonged to education (10.1%). As shown in Figure 1B, an overwhelming majority reported they had enough time to finish work assignments since COVID-19 started, at least sometimes (85.5%). Upon stratification, only about half of all survey participants reported always having enough time to finish work assignments, with 56.0% of manual labor workers, 55.1% of education workers, 49.6% of business/office service workers, and 29.4% of healthcare workers.

Video conferencing software usage for work was reported to be frequently utilized by the majority of respondents (68.5%), and the software identified included Zoom, WebEx, or Microsoft Teams. Differences between industries were found with manual labor at 64.3%, business/office service at 71.1%, and education at 85.5% rating “frequently used video conference software,” only 51.0% of those in healthcare stated the same.

The percentage of respondents in each job category who worked from home varied (Figure 2A). Overall, 37.8% of respondents were required to work from home, while 23.6% voluntarily worked from home, and

38.7% did not work from home at all. Nearly half of the healthcare workers (45.1%) volunteered or were required to work from home during COVID-19. Among manual labor workers, half (50.4%) were able to work from home while more than two-thirds of business/office service workers (70.1%) were able. Only one-quarter of education workers (24.6%) did not work from home due to the pandemic.

If the respondents stated they worked from home, they were then asked if they felt their job performance changed since beginning to work from home (Figure 2B). Overall, 22.1% stated they experienced an increase in job performance since beginning to work from home. Alternatively, 23.7% experienced decreased job performance while 9.4% did not experience any change. Industry fluctuations included 22.2% of manual labor workers experiencing increased performance, while 19.4% had decreased performance. Additionally, 23.5% of business/office service workers experienced an increase while 28.9% experienced a decrease. Respondents who worked from home were also asked if they felt their time management abilities suffered while WFH. A majority of those who work from home (59%) reported finding task management difficult while WFH. Finally, while examining each industry individually, a majority of those asked this question in each industry found time management harder while WFH besides healthcare (manual labor: 68.4%, business/office service: 57.9%, education: 59.5%, and healthcare: 23.5%).

Unsurprisingly, the only industry in which a majority of respondents stating their job directly involved dealing with COVID-19 was healthcare. Here, 70.6% of healthcare workers responded their job involved

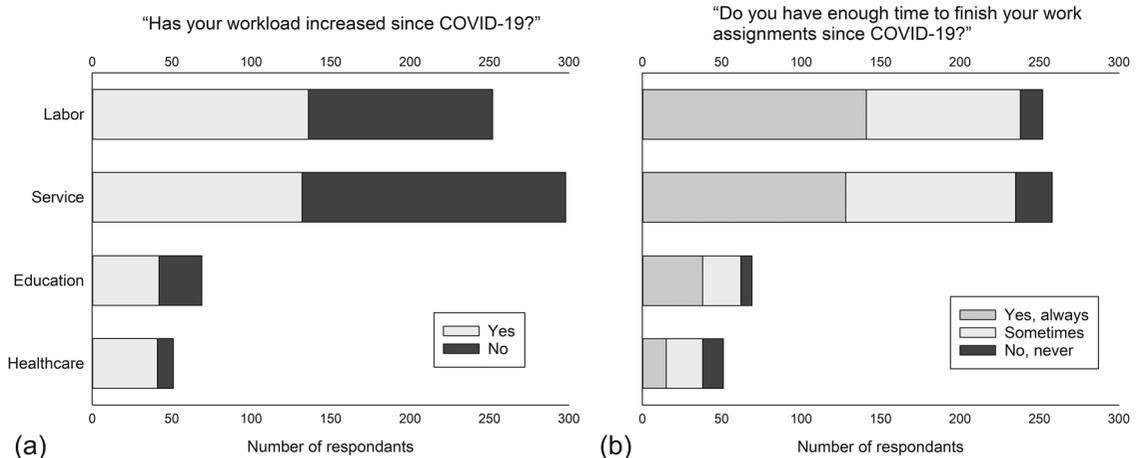


Figure 1. Responses to (A) “Has your workload increased since COVID-19?”; (B) “Do you have enough time to finish your work assignments since COVID-19?” as a function of industry sectors.

COVID-19, such as taking care of “high-risk” patients or entering “high-risk” places, followed by 39.7% of manual labor workers, 36.9% of business/office service workers, and 30.4% of education workers. Overall, 39.9% of all survey respondents chose “yes” to this question.

As shown in Figure 3A, healthcare had a large majority of participants responding in the affirmative in that they believed they could potentially be exposed to the SARS-CoV-2 virus at their workplace. In fact, all industries had at least a slim majority of respondents stating they believed they could be exposed to the virus (manual labor: 54.0%, business/office service: 51.7%,

education: 53.6%, and healthcare: 76.5%). When examining the entire study population as a whole, 54.6% believed they could be exposed to COVID-19 in their workplace.

More than two-thirds of the respondents stated there was a mandated vaccination policy in place (70.6%, Figure 3B), and the percentage of respondents reporting this was similar across the job categories (62.7–73.9%).

A majority of all participants in each industry stated it was difficult to spend time with friends and relatives due to social distancing and travel restrictions at least sometimes. As a whole, 36.6% stated it was always hard to find time, 39.6% stated it was sometimes hard to

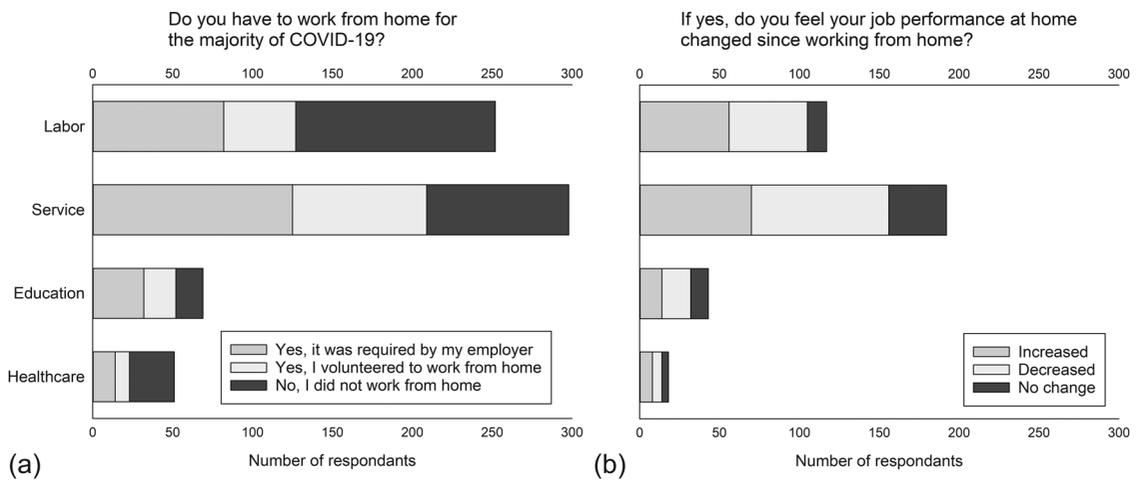


Figure 2. Responses to (A) “Do you have to work from home for the majority of COVID-19?”; (B) “If yes, do you feel your job performance at home has changed since WFH?” as a function of industry sectors.

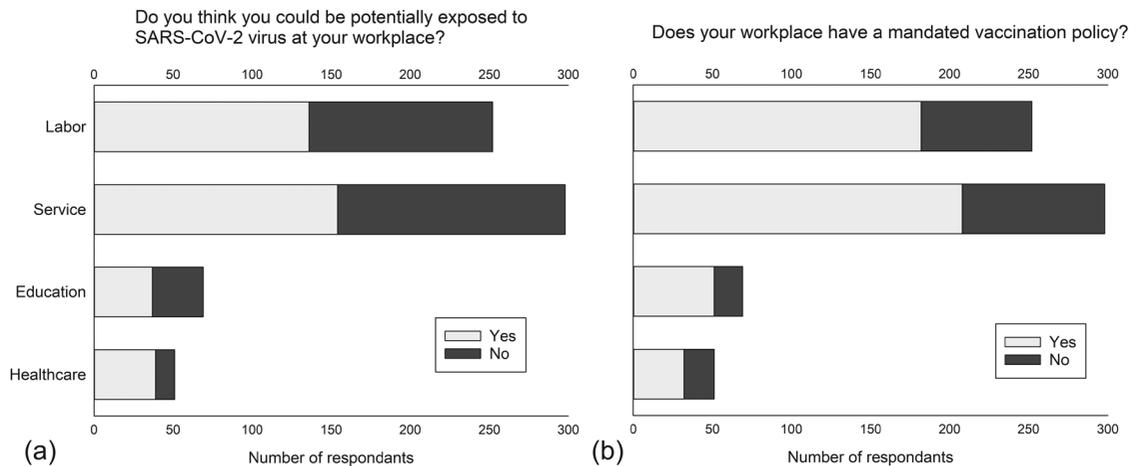


Figure 3. Responses to (A) “Do you think you could be potentially exposed to SARS-CoV-2 virus at your workplace?”; (B) “Does your workplace have a mandated vaccination policy?” as a function of industry sectors.

find time, and 23.9% stated it wasn't hard at all to find the time. Within each industry, only a majority of those within the healthcare industry claimed that it was always hard 58.8% while the slight majority of the remaining categories claimed that it was only "sometimes" difficult to spend time with friends and family. Within the manual labor workers, 35.3% stated it was always hard while 36.5% stated it was sometimes hard. Regarding business/office service workers, 33.9% stated it was always hard while 42.3% stated it was sometimes hard. In education, 36.2% shared it was always hard while 47.8% said it was sometimes hard. Although about half the respondents did not have children living with them (49.7%), a follow-up question asking whether there were children 19 years old or older living with the individual was found to be statistically significant. When focused on the populations who had adult children living at home, healthcare workers had adult children living with them much more frequently than manual labor, business/office service, or education workers, at a rate of 9.8% with 1 adult child and 7.8% with three or more adult children living at home.

Finally, a majority of all participants with children ($n = 283$) stated childcare distracted them from their work at least somewhat (79.2%), regardless of industry. Although the majority response within each industry maintained childcare distracted from work at least somewhat, this percentage differed between each type. Regarding manual labor workers with children, 83.7% stated childcare distracted them from their work. Within business/office service workers with children, 80.6% stated childcare distracted them from their work. Nearly three-fourths of education workers with children (72.4%) stated childcare distracted them at least somewhat. Finally, a slight majority of healthcare workers with children (57.1%) responded childcare was at least somewhat distracting.

Finally, composite scores marking the degree of stress experienced related to the various workplace attributes can be found in [Table 2](#). The higher the composite score, the more individuals from the sample population experienced a greater degree of stress due to the respective attribute. The most predominant factor subjectively causing stress in the sample population was associated with working irregular hours or night shifts with a composite score of 3.05. Other experiences commonly deemed stressful in one's workplace included a loss or change in job (2.59), difficulty communicating and relying on coworkers (2.59), involvement in workplace conflicts since COVID-19 (2.59), and the perception of potentially being exposed to SARS-CoV-2 in the workplace (2.56). Alternatively, the workplace factors that

were the least frequently reported as a source of stress included both the presence and the absence of a mandated vaccination policy (1.89 and 2.14, respectively), attending many virtual meetings (1.96), decreased job performance while WFH (2.15), and working after the individual's normal working hours (2.17).

Discussion

The results show that although only about half of the respondents noted an increased workload since the pandemic began, there were noticeable trends in stress factors and COVID-related concerns correlating with stress seen in the study population. A majority within all industries accounted for reported the possibility of being exposed to COVID in the workplace. This increase in stress could certainly be explained by the strength and quantity of correlations between stress factors and various ways the pandemic has impacted workplaces of all types such as increased workloads, poor occupational autonomy, and the blurring of the line between one's work-life and home life (see [Supplementary Table S1](#)). Work conducted prior to the pandemic had already shown that a noticeable concentration of workers considered their job very or extremely stressful (40.0%), were burnt out (26.0%), or were very stressed at work (29.0%) (NIOSH, 1999). Since the onset of the pandemic, however, various reasons for stress and burnout materialized. Working irregular hours or night shift work was common in many industries, especially manual labor workers (86.9%), healthcare workers (84.3%), and business/office service workers (72.5%) although it was not inquired whether or not the irregular working hours began as a result of the pandemic. Frequent use of video conferencing was found in all industries inquired, and a third of all respondents felt time management was harder while WFH. There were trends found between the data gathered in this study as well as some of the common sources of occupational stress such as interpersonal issues, struggling to maintain a work/home life balance, or a lack of job stability (Center for the Promotion of Health in the New England Workplace, 2021; Gerding *et al.*, 2021; AIS, 2020; Gerding *et al.*, 2021).

Composite score analysis presented the common mean values provided by all respondents regarding stress-related inquiries ranging from time management to childcare needs. Prior research has shown a variety of factors related to stress following the sudden work-from-home transition experienced at the beginning of the pandemic, such as the age of the worker, glare on the work surface, using laptop keyboards as opposed to external keyboards, family-work conflict, and lacking

Table 2. Composite scores marking the degree of stress related to occupational attribute.

Aspect perceived as stressful (high to low)	Composite score (±standard deviation)
Did you experience increasing stress levels due to irregular working hours or working night shifts?	3.05 (0.73)
Did you experience increasing stress levels due to a loss or change in job?	2.59 (0.53)
Difficulty communicating and relying on coworkers	2.59 (0.71)
Involved in any conflicts at your workplace since COVID-19	2.59 (0.78)
Thinking you could potentially be exposed to SARS-CoV-2 at your workplace	2.56 (0.81)
Quarantining due to either testing positive or contact with someone who tested positive	2.55 (0.80)
Enough time to finish your work assignments since COVID-19	2.51 (0.71)
Directly involved with COVID-19, e.g. caring for “high-risk” patients/entering “high-risk” places	2.49 (0.79)
Partly/not believing work conflicts were solved in a proper manner	2.49 (0.74)
Compensated inadequately for dealing with the additional risk of COVID-19 in the workplace	2.46 (0.74)
Taking care of children distracting you from your work	2.4 (0.76)
Believing your workplace inadequately provides personal protection regarding COVID-19	2.38 (0.80)
Finding time/task management harder when you work from home	2.37 (0.74)
Experiencing a change in your body weight due to less physical activity since COVID-19	2.36 (0.78)
Increased workload since COVID-19	2.36 (0.68)
Believing your workplace has an inadequate policy regarding COVID-19	2.32 (0.78)
Caring for elderly individuals on a daily basis	2.32 (0.84)
Lacking the subjectively necessary home office supplies to support your job	2.29 (0.82)
Difficulty setting a boundary between work and family life during COVID-19	2.28 (0.69)
Difficulty finding time for your hobbies or relaxing activities	2.25 (0.76)
Difficulty spending time with friends and relatives due to social distancing and travel restrictions	2.24 (0.76)
Ability to decide on your work pace on your own	2.24 (0.73)
Working after your normal hours	2.17 (0.73)
Job performance decreased due to working from home	2.15 (0.73)
Lack of a mandated vaccination policy	2.14 (0.85)
Attending many virtual meetings	1.96 (0.65)
Presence of a mandated vaccination policy	1.89 (0.89)

colleague support (Oakman *et al.*, 2020Oakman *et al.*, 2020; Galanti *et al.*, 2021Galanti *et al.*, 2021; Gerding *et al.*, 2021;). However, those who work irregular hours or the night shift were not without job stressors of their own. This question had the highest related composite score associated.

On average, nearly all of the questions related to the individual's stress had a composite score greater than 2.0 (Table 2), except for attending many virtual meetings (1.96) and stress related to the presence of a mandated vaccination policy (1.89). Many of these stressors have been recognized prior to COVID-19 (Hasan *et al.*, 2018; Zhang *et al.*, 2020; Doyle *et al.*, 2021). Finally, besides the loss of a job, other greater stressors related to COVID-19 based on the composite scores included believing you might be exposed to the virus in the workplace (2.56), stress related to quarantining due to either testing positive or being exposed to someone who tested positive (2.55), or stress related to direct involvement

with the virus through caring for “high-risk” patients or entering “high-risk” places (2.49), especially common within the healthcare sector. As the study presented here was a cross-sectional analysis investigating potential relationships between occupational stressors and pandemic-related stressors, one may not determine the causation, simply the correlation, of these factors. While it's not possible to evaluate whether those stressed due to COVID were stressed at work for other reasons prior to the pandemic, it is clear many of these stressors were felt at the present time. Determined through the statistical analysis presented, it appears if an employer were to increase their stance on COVID by requiring vaccinations and implementing preventative measures, especially protecting the elderly and immunocompromised (Patel *et al.*, 2021Patel *et al.*, 2021), workplaces may feel more secure the worker and positive effects may ripple through, improving workers' professional relationship with their supervisors and the companies with which

they work. Employers increasing the availability of PPE such as masks or cleaning materials such as hand sanitizer or surface disinfectant, may encourage workers to feel more comfortable in the workplace and less stressed. This had been seen previously where anxiety was lowest among site-based workers who felt their workplace infection control programs and PPE were adequate (Smith *et al.*, 2020).

However, the employer's ability to prevent the spread of COVID-19 while working was not the only occupational factor related to careers and stress during the pandemic. For example, those who changed jobs due to a loss of employment might have also experienced an increased workload in their new position. Not only would these individuals have to experience the mental stress and upheaval of their normalcy through losing their source of income, but they then encountered a greater level of workload in the new occupation they secured. Secondly, those who were not allowed to decide on the pace of their work are also more likely to work irregular hours such as at night, and were more likely to stress over their workload which was previously commonly seen with those who worked in the healthcare industry (Kinnunen-Amoroso & Liira, 2014; Kang *et al.*, 2015; Jin *et al.*, 2019).

Finally, one must remember people experience stress over more than simply occupational factors. As the pandemic spread throughout the world towards the beginning of 2020, the social distancing and travel restrictions that were implemented overnight discouraged many from seeing friends and family without the assistance of web conference software (Burn and Mudholkar, 2020; Burn and Mudholkar, 2020; Cindrich *et al.*, 2021; Cindrich *et al.*, 2021). Worse yet, those who were already WFH were more likely to experience web conference burnout through frequent use of the software (Gerding *et al.*, 2021). Using these programs to socialize may also be part of the reason why these individuals found it hard to set a boundary between work and social time. Familial stress, such as caring for children, was also a notable distraction from work, especially if one were to work from home. These individuals struggled with time management, finding time for socializing and recreation, and struggled to create a set boundary between work and the rest of their life.

Limitations and future work

The survey utilized in this study was distributed through NIOSH professional networks such as National Occupational Research Agenda (NORA) councils, Education Research Center (ERC) network, and AIHA

Catalyst. For this reason, the findings of this study may not completely reflect general workers' perception of work-related stress, but rather provide insight into common concerns regarding stress during the time of the global pandemic. Furthermore, socioeconomic status was not inquired of within the survey which could have provided a better understanding of the occurrence of stress in our results due to variations in socioeconomic-related stressors experienced by some due to their level of income. While 676 respondents completed the survey, and this was more than initially anticipated, a greater sample size could have provided more generalizable results.

The survey captured the perceptions of the respondents, and this is thus subject to potential bias based on perceptions of occupational descriptors and the degree to which they trigger stress. Perceptions of occupational stress compared to retrospective levels of stress experienced prior to the onset of the pandemic may leave room for recall bias as it can be difficult to gauge "how much" one is stressed currently in the workplace compared to how one felt in a similar setting, albeit two years prior and no pandemic. Future work should investigate the levels to which employees may experience occupational stress during COVID through such means as collecting salivary cortisol during working days in a longitudinal format with regard to typical circadian rhythm (Hansen *et al.*, 2009; Hansen *et al.*, 2009). Through this effort, it might be more sufficiently determined who could be the most stressed working population through biomonitoring methods instead of simply relying on personal recall.

Although a majority of inquiries made were focused on what the respondent was currently experiencing, some questions asked the respondent to compare their current feelings and experiences with those prior to the onset of the pandemic. For this reason, a control group for this study could not be assigned. It is likely, however, that planned changes in employment or work arrangements would help to alleviate occupational stressors currently being experienced and including pandemic preparations in an organization's emergency action plan may prove beneficial going forward.

Conclusions

The results from this study showcase the apparent levels of stress experienced by a variety of working populations within the US during the ongoing COVID-19 pandemic. These at-risk working populations included those in manual labor, business/office service, education, healthcare, and "other" which accounted for the

remaining respondents. Noticeable levels of stress following the onset of the pandemic were reported in all industries inquired, especially in those who believed they could be exposed to COVID-19 or experienced a change in employment. In addition to the stressors already present in the workplace, the pandemic has created newfound obstacles such as increased workloads (e.g. healthcare), web conference burnout for those WFH, juggling childcare with work, especially in manual labor & business/office service, and time management issues present in all industries. Employers need to ensure their workforce has both the proper practices to combat the SARS-CoV-2 virus as well as the resources to reduce stress caused by both regular work-related and pandemic-related stress.

Supplementary data

Supplementary data are available at *Annals of Work Exposures and Health* online.

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Note: the content is solely the responsibility of the authors and does not necessarily represent the official position of NIOSH or Centers for Disease Control and Prevention.

Conflict of interest

The authors have no conflict of interest to declare.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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