Occupational Conditions Associated With Negative Mental Health Outcomes in New York State Health Professionals During the COVID-19 Pandemic

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Objective: The aim of this study was to assess occupational circumstances associated with adverse mental health among health care workers during the COVID-19 pandemic. **Methods:** A cross-sectional study examined responses to an on-line survey conducted among 2076 licensed health care workers during the first pandemic peak. Mental health (depression, anxiety, stress, and anger) was examined as a multivariate outcome for association with COVID-related occupational experiences. **Results:** Odds of negative mental health were increased among those who worked directly with patients while sick themselves (adjusted odds ratio, 2.29; 95% confidence interval, 1.71–3.08) and were independently associated with working more hours than usual in the past 2 weeks, having family/friends who died due to COVID-19, having COVID-19 symptoms, and facing insufficiencies in personal protective equipment/other shortages. **Conclusions:** Occupational circumstances were associated with adverse mental health outcomes among health care workers during the COVID-19 pandemic, and some are potentially modifiable.

Keywords: health care workers, COVID-19: mental health, occupational exposure, presenteeism

In Spring 2020, an early epicenter of the 2019 coronavirus disease (COVID-19) pandemic in and around New York City (NYC) created an unprecedented strain on health care resources. After the first laboratory-confirmed case on February 29, case counts in NYC increased exponentially during the month of March, with a case fatality rate of 32% among hospitalized patients, and over 18,000 deaths occurring before June,[1] by which point almost 6000 additional deaths had accrued in the rest of the state.[2] Frontline health care workers faced shortages of personal protective equipment (PPE), ventilators, personnel, and even beds.[3,4] Work conditions for the selected health care providers within this context included redeployment to understaffed facilities or departments other than those they typically served, and extra hours or shifts.[4] Conversely, other health care practitioners saw their hours reduced or practices closed, as social distancing and stay-at-home orders led to a drastic reduction in the utilization of routine health care.[5]

The risks posed by this situation to the mental well-being of health care professionals were brought to the forefront by the April 2020 death by suicide of a prominent NYC emergency department physician.[6] During the same month, a study of internal medicine residents from a single NYC hospital found that nearly one fourth had contemplated suicide or self-harm since the beginning of the pandemic.[7] More broadly, a meta-analysis of 65 studies of health care workers in 21 countries indicated that depression and anxiety were widespread.[8]

Occupational circumstances are a potentially modifiable means through which to address the mental health of workers during a pandemic. Previous studies during epidemics or pandemics, for example, SARS, MERS, H1N1, have identified occupational factors associated with increased psychological distress among health care workers, including being in direct contact with, or treating, infected patients; being quarantined due to potential infection; having colleagues who were infected or died due to infection; long hours; and lack of appropriate training, inadequate PPE, or lack of support.[9,10] A survey from a single NYC medical center reported that respondents endorsed facing distress due to a range of experiences, including redeployment, involvement in triage decisions, working with COVID-19 patients, patient deaths, working while symptomatic, clinical hours, the health of family/friends, and a lack of PPE.[11] However, they did not test which of these exposures were associated with adverse mental health outcomes, after adjusting for participant characteristics, and did not include providers from across the state. Such information may be critical for identifying key modifiable circumstances to address to protect health care providers' mental health. Therefore, in a sample drawn from all licensed physicians, physician assistants, and nurse practitioners in New York State (NYS), we examined the association of work-related experiences with mental health outcomes early during the COVID-19 pandemic. While we examined multiple, specific measures of mental health, our overarching concern was to understand the conditions that may negatively impact mental health in several domains as opposed to specifically identifying risk factors for individual disorders.

METHODS

Study Population

The COVID-19 Healthcare Personnel Study is an on-line survey conducted to assess the adverse health impacts of the COVID-19 pandemic on NYS health professionals and has been previously described.[12] Briefly, all 139,109 physicians, nurse practitioners, and physician assistants licensed to practice in NYS were invited to participate in

the survey by an e-mail from the NYS Commissioner of Health. The survey was open to responses between April 28 and June 30, 2020, in the immediate weeks after the pandemic crested in NYS. The survey was administered through REDCap, a secure Web application. Analyses describe the responses of $n = 2076$ participants (1.5% response rate). Relative to the sampling base, participants were more likely to be female (48% vs 34%), were more likely to be aged 60 years or older (32% vs 23%), and showed some minor geographical differences.[13] The study was approved by the institutional review boards of the participating institutions, and a waiver of documentation of informed consent was obtained. Informed consent was obtained electronically from all participants before gaining access to the on-line survey.

Measures

Mental Health

Mental health was assessed using four dichotomous outcomes: probable depression, probable anxiety (henceforth, "depression" and "anxiety"), stress, and anger. Depression was assessed with the two depression items (Patient Health Questionnaire 2: feeling down, depressed, or hopeless; and having had little interest or pleasure in doing things that you usually enjoy) in the Patient Health Questionnaire 9, scored by participants on a 0–3 scale (not at all, several days, more than half the days, nearly every day). Participants were considered positive for depression if the sum of their responses to these two items was greater than or equal to 3.[14,15] Anxiety was assessed with the two anxiety screening items (Generalized Anxiety Disorder 2: feeling nervous, anxious, or on edge; and not being able to stop or control worrying thoughts) from the Generalized Anxiety Disorder 7, scored on the same 0–3 scale. Participants were considered positive for anxiety if the sum of their responses to these two items was greater than or equal to 3.[16] Stress and anger were each assessed on a 1 to 10 scale (1 = not at all, 10 = extremely often) based on the questions of how frequently they experience these emotions because of COVID-19. The scales were dichotomized for analysis with scores of 8, 9, or 10 coded as present.

COVID-Related Occupational Experiences

COVID-related occupational experiences were assessed based on participant responses and categorized as shown in Table 1. Participants reported whether they had redeployed to a different location or changed their functions within the same practice location since March 1, 2020, the number of hours that they had worked in the past 2 weeks (absolute work duration), and whether this was the same, less, or more than the they usually worked (relative work duration). Given the correlation between measures, relative work duration was used in the primary analyses. They additionally reported whether they had been involved in a life-or-death triage/prioritizing decision related to a COVID-19 patient; any family member or friend had died from COVID-19; whether, since March 1, 2020, any COVID-19 patients died in the facility in which they worked; they had worked in close physical contact with COVID-19 patients; and if they had experienced symptoms consistent with COVID-19 infection (fever, persistent cough, persistent sore throat, headache).

Participants were classified as experiencing PPE shortages if they responded affirmatively to questions about whether in the last week they experienced a shortage of N95 masks, had to personally use makeshift PPE, or had to reuse disposable PPE in a manner which seemed unsafe. They were classified as experiencing other shortages if they responded affirmatively to having had, in the last week, shortages of test kits, ventilators, beds, or personnel.

Participant Characteristics

Sex, age, usual practice location, profession, specialty, and whether or not they had children younger than 18 years were reported by the participants and categorized as shown in Table 1. Participants

TABLE 1. Characteristics and COVID-19 Pandemic-Related Occupational Experiences of New York State Health Care Workers Between April 28 and June 30, 2020

	MD/DO[a]		NP/CNMW[a]		PA[a]		Total[a,b]	
	%	(SE)	%	(SE)	%	(SE)	%	(SE)
Profession								
MD/DO	—	—	—	—	—	—	74.2	(1.1)
NP/CNMW	—	—	—	—	—	—	15.3	(0.8)
PA	—	—	—	—	—	—	10.4	(0.9)
Female	34.9	(1.3)	92.8	(1.4)	68.4	(4.4)	47.3	(1.2)
Age								
<40	19.5	(1.1)	25.8	(2.3)	20.6	(2.6)	20.5	(1.0)
40–59	55.7	(1.5)	48.4	(2.7)	72.5	(3.2)	56.4	(1.2)
≥60	24.9	(1.2)	25.9	(2.5)	6.9	(1.8)	23.1	(1.0)
NYC metro usual[c]	72.3	(1.2)	57.4	(2.5)	60.4	(4.2)	68.8	(1.1)
Specialty								
Primary care	29.1	(1.3)	38	(2.5)	26.4	(3.8)	30.2	(1.1)
Pediatrics	16.4	(1.1)	12	(1.7)	6	(2.3)	14.7	(0.9)
Emergency	9	(0.9)	3.1	(0.9)	16	(3.3)	8.8	(0.7)
Critical care	7.8	(0.8)	3.7	(1.0)	3.1	(1.8)	6.7	(0.7)
Non-surgical specialties	19	(1.2)	25.6	(2.3)	17.9	(3.4)	19.9	(1.0)
Surgery	12.2	(1.0)	7.9	(1.4)	26	(4.1)	13	(0.9)
Behavioral	6	(0.7)	8.9	(1.6)	3	(1.5)	6.1	(0.6)
Other	0.5	(0.2)	0.6	(0.4)	1.6	(1.5)	0.7	(0.2)
Has children younger than 18 yrs	44.4	(1.5)	39.8	(2.5)	52.8	(4.5)	44.6	(1.3)
Answered survey anonymously	33.7	(1.4)	27.2	(2.3)	22	(3.4)	31.5	(1.2)
Redeployment/function change								
None	60.1	(1.5)	56.3	(2.6)	65.7	(4.2)	60.1	(1.2)
Same location, changed function	23.5	(1.3)	24.5	(2.3)	19.8	(3.6)	23.3	(1.1)
Redeployed	16.4	(1.1)	19.3	(2.0)	14.5	(3.0)	16.6	(0.9)
Hours worked in past 2 wks, change								
Less	34.8	(1.4)	52.3	(2.6)	54.2	(4.5)	39.5	(1.2)
Same as usual	43.7	(1.5)	29.4	(2.4)	29.4	(4.1)	40	(1.2)
More	21.6	(1.2)	18.4	(2.1)	16.4	(3.4)	20.5	(1.0)
Work hours, past 2 wks								
None	4.6	(0.6)	5.4	(1.2)	7.7	(2.6)	5.1	(0.5)
1–40	21.5	(1.2)	15.4	(2.0)	10.2	(2.5)	19.4	(1.0)
41–80	42.6	(1.5)	59	(2.6)	55.1	(4.5)	46.4	(1.3)
81–100	16.5	(1.1)	15.1	(1.9)	21.1	(3.8)	16.7	(1.0)
101–280	14.8	(1.1)	5	(1.2)	6	(2.5)	12.4	(0.9)
Worked with COVID-19 patients	52	(1.5)	43.5	(2.6)	59.6	(4.4)	51.5	(1.3)
Has family/friends who died	20.9	(1.2)	22.5	(2.3)	19.3	(3.6)	21	(1.0)
COVID-19 symptoms	27.6	(1.3)	37.9	(2.5)	37.8	(4.5)	30.3	(1.2)
Patients died	61.2	(1.4)	48.3	(2.6)	54	(4.5)	58.4	(1.2)
Involved in triage decisions	13.7	(1.1)	8.3	(1.5)	6.8	(2.2)	12.1	(0.9)
PPE shortages	55.1	(1.5)	57.2	(2.6)	65.4	(4.2)	56.5	(1.2)
Other shortages	37	(1.4)	31.6	(2.4)	37.3	(4.4)	36.2	(1.2)

[a]Weighted percentages.

[b]Information was missing for variables for the following numbers of observations: sex, $n = 19$; age, $n = 113$; NYC metro area, $n = 36$; specialty, $n = 9$; children <18, $n = 3$; redeployment or change in function, $n = 52$; change in hours worked, $n = 6$; number of hours worked, $n = 43$; worked with COVID-19 patients, $n = 7$; family/friends died, $n = 5$; COVID-19 symptoms, $n = 31$; patients died, $n = 20$; involved in triage decisions, $n = 15$.

[c]Usual practice location in New York City, Long Island, Westchester, or Rockland Counties.

were classified as answering the survey anonymously if they chose not to provide contact information for follow-up.

Statistical Analysis

All analyses incorporated previously defined survey weights[12] to make the results more representative of the target population of

physicians, nurse practitioners, and medical assistants in NYS. Frequencies of participant characteristics and their COVID-related occupational experiences were tabulated, and the prevalence of each mental health outcome was examined by these characteristics and experiences.

To examine the association of characteristics and experiences with adverse mental health, we treated the four dichotomous mental health variables as a multivariate outcome with four observations (one for each outcome) per participant. Generalized estimating equations with a logit link and robust variance estimates accounted for the correlation between outcomes within individuals, and the predictors included an indicator for the specific type of mental health outcome. Thus, the exponentiated coefficients from the models can be interpreted as odds ratios for adverse mental health generally, accounting for the correlation between specific mental health outcomes within participants. We fitted a series of models as follows: (1) unadjusted associations with each participant characteristic and COVID-related occupational experience; (2) association of each COVID-related occupational experience, adjusted for the personal characteristics, which were also associated with the outcome ($P < 0.1$); and (3) to examine the independent association of COVID-related occupational experiences with adverse mental health, another model included all occupational experiences associated with the outcome ($P < 0.1$) under step 2 and personal characteristics. Missing data were addressed using listwise deletion, with $n = 1866$ participants (90% of total) contributing to the fully adjusted model,[3] and by multiple imputation.

Sensitivity Analyses

Additional analyses were conducted as follows. To test sensitivity to the definition of work duration, absolute rather than relative work duration was substituted into the adjusted model. To address potential temporal variation, an analysis was limited to 1748 participants responding within the first 72 hours after the initial invitation. To further address missing data, the fully adjusted model was re-fit and estimates pooled from 10 imputations using multiple imputation by chained equations with augmented regression and including all independent and dependent variables in the imputation model. To further assess aspects related to experiencing COVID-19 symptoms, which may have been related to mental health, we re-fit the adjusted model using a 4-level variable related to the concept of "presenteeism," that is, working "despite complaints and ill health that should prompt rest and absence from work."[17] Indicators for no symptoms, experienced symptoms but did not work, worked while sick but not in direct patient care, or worked while sick in direct patient care, were used in place of the dichotomous variable for COVID-19 symptoms. To examine whether the observed association with "other" shortages was related to specific factors, the dichotomous term for other shortages was replaced with dichotomous terms for each of the 4 specific types of other shortages.

To test for heterogeneity by mental health outcome for each COVID-related occupational experience, experience × outcome type product terms were added to the adjusted model separately for each experience variable, and heterogeneity was then evaluated based on a test of the joint hypotheses that all interaction terms were equal to 0. When this joint hypothesis test indicated statistically significant evidence for heterogeneity ($P < 0.05$), mental health outcome–specific adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated from the models including product terms.

All analyses used Stata 16.0 (StataCorp LLC, College Station, TX).

RESULTS

Population Characteristics

Characteristics and distribution of the COVID-19 pandemic-related occupational experiences of the study population, overall and by profession, are shown in Table 1 and Table, Supplemental Digital

Content 1, http://links.lww.com/JOM/B86. Just under half were female, the majority between the ages of 40 and 59 years, and two thirds had their usual practice location in the NYC metropolitan area. Approximately three quarters were physicians (MD or DO), with primary care (30.2%), non-surgical specialties (19.9%), and pediatrics (14.7%) representing the most prevalent specialties. Forty-five percent reported having children younger than 18 years, and 32% answered the survey anonymously.

Regarding occupational experiences, 40% were redeployed or had a change of function. Reporting both increases (20.5%) and decreases (39.5%) in the number of hours worked in the past 2 weeks was common. Approximately half had worked with COVID-19 patients, and nearly one third (30.3%) had experienced symptoms themselves. One fifth reported that family or friends had died of COVID-19, and over one half were affected by PPE shortages.

Overall, the prevalence of negative mental health was presented as follows: depression, 13.4%; anxiety, 26.5%; stress, 29.3%; and anger, 7.7%. The counts and stratum-specific prevalence of each mental health outcome by pandemic-related occupational exposures are shown in Tables (Supplemental Digital Content 2, http://links.lww.com/JOM/B87 and Supplemental Digital Content 3, http://links.lww.com/JOM/B88).

Relationship of Participant Characteristics to Negative Mental Health

The unadjusted associations between participant characteristics and odds of negative mental health are shown in Table 2. Odds of negative mental health were higher among females than males, among younger versus older health care professionals, among those with usual practice locations in the NYC metropolitan area, among physician assistants and nurse practitioners/certified nurse midwives versus physicians, and among those specializing in critical care versus those in primary care. Having children younger than 18 years or answering the survey anonymously was not associated with the odds of negative mental health.

Association of COVID-19 Pandemic Occupational-Related Exposures With Negative Mental Health

The unadjusted and covariate adjusted associations between COVID-19 pandemic-related occupational experiences and negative mental health are shown in Table 3. Working in the same location but changing function and working with COVID-19 patients were each associated with increased odds of negative mental health in unadjusted models, but associations were no longer statistically significant after adjustment for participant characteristics. Involvement in triage decisions was associated with increased odds of negative mental health after adjustment for participant characteristics, but not after adjustment for other pandemic-related occupational experiences. Adjusting for participant characteristics and other pandemic-related occupational experiences, the odds of negative mental health outcomes was significantly increased among those who reported working more hours than usual in the past 2 weeks, who had family or friends who had died due to COVID-19, and who had COVID-19 symptoms, insufficient PPE, or who experienced other shortages. A model including the absolute rather than relative time worked over the past 2 weeks showed similar results for overwork (see Table, Supplemental Digital Content 4, http://links.lww.com/JOM/B89); restricting observations to responses received in the first 72 hours or addressing missing data with multiple imputation produced consistent findings (see Table, Supplemental Digital Content 5, http://links.lww.com/JOM/B90).

Fifty percent of the population experienced symptoms, but did not work while sick, 15% worked while sick but not in direct patient care, and 35% worked in direct patient care while sick. Relative to not reporting symptoms, and after adjusting for participant characteristics

TABLE 2. Prevalence of Anxiety, Depression, Anger, and Stress, and Crude Odds Ratios (ORs) and 95% Confidence Intervals (CIs) of Negative Mental Health According to Participant Characteristics Among New York State Health Care Workers Between April 28 and June 30, 2020

Characteristic	Anxiety[a]		Depression[a]		Anger[a]		Stress[a]		OR	95% CI	P
	%	SE	%	SE	%	SE	%	SE			
Female	30.6	[1.5]	15.1	[1.2]	9.9	[1.0]	34.2	[1.5]	1.52	(1.26, 1.85)	<0.001
Male	22.4	[1.6]	12.1	[1.3]	5.8	[0.90]	24.6	[1.7]	1	Ref	—
Age category											
<40	34.1	[2.4]	15	[1.7]	10.1	[1.5]	36.8	[2.4]	1.28	(1.03, 1.60)	0.03
40–59	26.8	[1.7]	14.6	[1.4]	7.5	[1.0]	31.5	[1.7]	1	Ref	—
≥60	20	[1.9]	10.2	[1.4]	5.9	[1.1]	18.7	[1.8]	0.59	(0.46, 0.75)	<0.001
NYC metro usual											
Yes	28.8	[1.5]	14	[1.1]	7.9	[0.9]	30.3	[1.5]	1.28	(1.05, 1.55)	0.01
No	21.7	[1.6]	11.7	[1.3]	6.5	[1.0]	27.4	[1.8]	1	Ref	—
Profession											
MD, DO	24.6	[1.3]	11.6	[0.9]	6.8	[0.7]	26.3	[1.3]	1	Ref	—
NP, CNMW	33	[2.4]	16.8	[1.9]	10.1	[1.6]	34.8	[2.5]	1.51	(1.22, 1.86)	<0.001
PA	30.4	[4.2]	21.3	[4.0]	10.4	[2.8]	42.1	[4.5]	1.73	(1.22, 2.45)	0.002
Specialty											
Primary care	25.9	[2.0]	11.2	[1.4]	7	[1.1]	27.8	[2.0]	1	Ref	—
Pediatrics	28.3	[2.9]	11	[1.9]	4.6	[1.3]	32.8	[3.0]	1.16	(0.88, 1.54)	0.30
Emergency	24	[3.7]	13.3	[3.0]	11.1	[3.0]	29.1	[4.0]	1.03	(0.70, 1.50)	0.89
Critical Care	35.9	[4.9]	20.8	[4.2]	14.5	[4.0]	39.9	[5.0]	1.74	(1.17, 2.57)	0.01
Non-surgical specialties	27.6	[2.5]	14.8	[2.0]	6.8	[1.3]	30.1	[2.6]	1.14	(0.87, 1.48)	0.35
Surgery	26.9	[3.3]	18.7	[3.0]	9.9	[2.3]	29.8	[3.4]	1.17	(0.84, 1.63)	0.35
Behavioral	18.4	[3.7]	8.8	[2.8]	4.8	[2.0]	16.2	[3.5]	0.59	(0.39, 0.89)	0.01
Other	0	[0.0]	0	[0.0]	6.7	[6.6]	5.7	[5.7]	0.06	(0, 1.16)	0.06
Has children younger than 18 yrs											
Yes	27.4	[1.8]	13.3	[1.3]	7.4	[1.0]	32.5	[1.9]	1.17	(0.97, 1.42)	0.1
No	25.8	[1.4]	13.5	[1.2]	7.9	[0.9]	26.6	[1.4]	1	Ref	—
Answered survey anonymously											
Yes	25.8	[2.0]	13.8	[1.6]	7.5	[1.2]	30.1	[2.1]	1.01	(0.83, 1.24)	0.91
No	26.8	[1.3]	13.2	[1.0]	7.8	[0.8]	28.9	[1.4]	1	Ref	—

[a]Weighted percentages.

and other pandemic-related occupational experiences, those presenteeism experiences were associated with odds ratios of negative mental health of the following: 1.28 (0.98–1.67), $P = 0.07$ for those with symptoms who did not work; 1.48 (0.99–2.22), $P = 0.05$ for those who worked while sick but not in direct patient care; and 2.29 (1.71–3.08), $P < 0.001$ for those who worked in direct patient care while sick, respectively (see Fig. 1).

Adjusting for participant characteristics and other pandemic-related occupational exposures, negative mental health was increased among those who experienced shortages of personnel (aOR, 1.42; 95% CI, 1.10–1.85; $P = 0.01$), ventilators (aOR, 2.04; 95% CI, 1.05–3.96; $P = 0.04$), and beds (aOR, 2.20; 95% CI, 1.36–3.55; $P = 0.001$), but not test kits (aOR, 1.08; 95% CI, 0.85–1.38; $P = 0.52$).

TABLE 3. Unadjusted and Adjusted Associations of COVID-19 Pandemic Occupational-Related Experiences With Negative Mental Health Among New York State Health Care Workers Between April 28 and June 30, 2020

Experience	Unadjusted			Adjusted for Participant Characteristics[a]			Adjusted for Other Occupational Experiences[a,b]		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Redeployment/function change									
None	1.00	Ref	—	—	—	—	—	—	—
Same location, changed function	1.35	(1.08, 1.70)	0.01	1.22	(0.96, 1.56)	0.10	—	—	—
Redeployed	1.13	(0.87, 1.45)	0.36	1.03	(0.79, 1.35)	0.82	—	—	—
Hours worked in past 2 wks									
Less	1.10	(0.89, 1.37)	0.38	1.06	(0.85, 1.33)	0.58	1.01	(0.81, 1.27)	0.92
Same as usual	1.00	Ref		1.00	Ref		1.00	Ref	
More	1.65	(1.29, 2.12)	<0.0001	1.58	(1.21, 2.06)	0.001	1.41	(1.08, 1.85)	0.01
Worked with COVID-19 patients	1.33	(1.10, 1.61)	0.003	1.18	(0.95, 1.46)	0.13	—	—	—
Family or friends died	1.37	(1.09, 1.72)	0.01	1.51	(1.18, 1.92)	0.001	1.43	(1.12, 1.82)	0.004
COVID-19 symptoms	1.97	(1.62, 2.41)	<0.001	1.78	(1.44, 2.19)	<0.001	1.64	(1.33, 2.01)	<0.0001
Patients died	1.15	(0.95, 1.40)	0.15	1.07	(0.86, 1.32)	0.56	—	—	—
Involved in triage decisions	1.47	(1.11, 1.96)	0.01	1.36	(1.00, 1.84)	0.047	1.07	(0.78, 1.47)	0.66
PPE shortages	2.13	(1.76, 2.58)	<0.001	2.04	(1.67, 2.49)	<0.001	1.80	(1.46, 2.21)	<0.0001
Other shortages	1.67	(1.38, 2.03)	<0.001	1.62	(1.33, 1.99)	<0.0001	1.31	(1.06, 1.62)	0.01

[a]Adjusted for sex, age, profession, specialty, and usual work location in the NYC metropolitan area.
[b]Also adjusted for other experiences with estimates shown in the column.
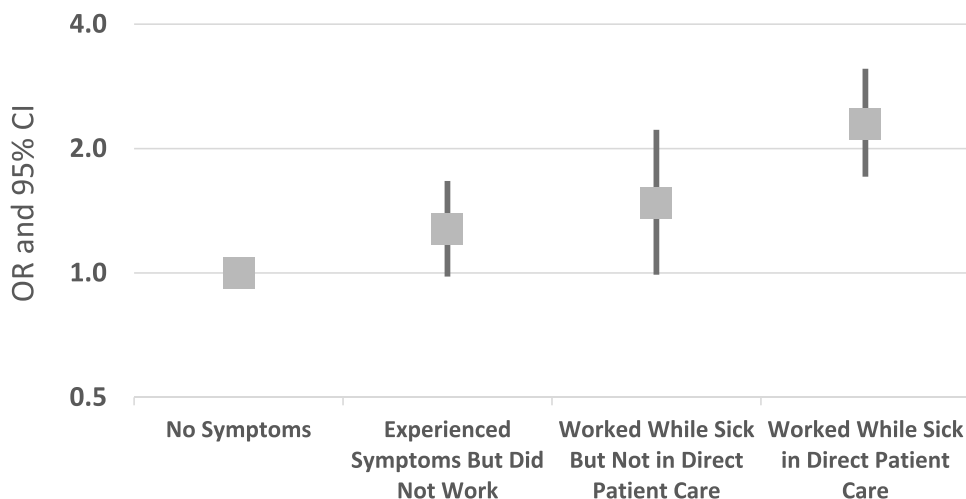
FIGURE 1. Adjusted odds ratios and 95% confidence intervals for the association between continued work in patient care while sick with COVID-19 symptoms and negative mental health, among New York State health care workers between April 28 and June 30, 2020. Estimates are adjusted for sex, age, profession, specialty, and usual work location in the NYC metropolitan area, relative number of hours worked in the past 2 weeks, having family/friends who died due to COVID-19, being involved in triage decisions, PPE shortages, and other shortages.

Heterogeneity of Association Between Pandemic-Related Occupational Exposures and Negative Mental Health by Specific Mental Health Outcomes

There was evidence for statistically significant heterogeneity of associations for involvement in triage decision ($P = 0.02$, $df = 3$) and for other shortages ($P = 0.04$, $df = 3$) but not for the other tests of heterogeneity ($P > 0.05$). Mental health outcome–specific aORs and 95% CIs from these models are shown in Table, Supplemental Digital Content 6, http://links.lww.com/JOM/B91. As was the case for negative mental health overall, being involved in triage decisions was not significantly associated with any of the specific mental health outcomes in these adjusted models; other shortages were associated with significantly increased stress only.

DISCUSSION

In an on-line survey of licensed NYS health care providers during the first peak of the COVID-19 pandemic, we found that adverse mental health outcomes related to health care providers having COVID-19 symptoms were most pronounced among those who worked directly with patients while sick.

Several other circumstances that were independently associated with negative mental health outcomes could be classified as those that are modifiable by hospital policies and those that are not. The modifiable circumstances included increased recent work duration, shortages of PPE and other resources, as well as working with patients while sick. Those not modifiable in this way were loss of family or friends to the virus and health care workers experiencing COVID-19 symptoms themselves. We did not see strong evidence of heterogeneity in associations with respect to the specific mental health outcome.

Comparison to Other Findings

The personal characteristics associated with a higher risk of negative mental health—in particular, being female, younger, and a non-physician health care professional (nurse practitioner or physician assistant)—were in accord with the preponderance of findings from prior studies across a range of outbreaks, including COVID-19 internationally (reviewed in Sirois and Owens[9]). These studies also comport with our findings of risk associated with increased work hours, bereavement related to the virus, personal illness, and resource short-

ages.[9,10] The role of working in patient care while experiencing symptoms oneself, on the other hand, has rarely been examined.

A limited number of other studies have specifically examined occupational factors related to the mental health of United States health care providers during the COVID-19 pandemic. Among faculty, staff, and fellows of a Midwestern university including clinical providers, exposure to COVID-19 and caring for patients with COVID-19 were risk factors for mental health outcomes.[18] Caring for COVID-19 patients and lower PPE adequacy were associated with higher levels of self-reported stress at a separate Midwestern university.[19] An on-line study of teaching hospitals in each of 4 US regions found that needing more social support was associated with significantly higher odds of probable psychiatric disorders in multivariable models, but that COVID-19 status, frontline status, change in roles, or change in hours is not.[20] Among US health care providers who reported that they cared for COVID-19 patients in an intensive care unit during the initial US peak, emotional distress/burnout was most strongly associated with insufficient PPE access and was also related to personnel and respirator shortages, but not to shortages of intensive care unit beds.[21] Finally, among those providing care to COVID-19 patients at a single NYC hospital, higher number of hours worked, lack of PPE, death or serious illness of coworker, and making difficult decisions in prioritizing patients were associated with increased symptoms of PTSD, depression, or generalized anxiety.[22]

The variation in the significance of specific factors associated with mental health outcomes across studies is likely impacted by differences in methods, including the exact combinations of exposures examined, and the covariates included in the models. However, contextual differences may also play a role, that is, equipment shortages may be more distressing when these shortages are more severe and sustained, and this differed by locale. Notably, the first wave surge in cases in NYC was particularly rapid and dramatic.[1]

Interpretation

Our findings suggest three specific areas associated with negative mental health impact on health care providers during a pandemic. First, the impact of personal exposure is demonstrated by the associations of mental health outcomes with participants' own illness and with sickness and death of their family and friends. Second, the role of a breakdown of institutional protections is suggested by the

associations of mental health outcomes with shortages of PPE and with working longer hours and/or while sick. Presenteeism has been associated with poorer self-rated and mental health.[23] Highly prevalent among health care practitioners even before the pandemic, the reasons for presenteeism include a mix of systemic and sociocultural factors including difficulty finding coverage, concern about letting colleagues or patients down, and cultural expectations.[24] However, to be clear, this study did not assess if sick health care workers were advised to stay home by their supervisors but chose to continue working, or if their continued working was an expectation.

Third, moral injury may be another element. Moral injury results from perpetrating or witnessing actions that violate one's core beliefs and may involve a sense of betrayal by a trusted authority. Exposure to moral injury has been associated with increased risk of psychiatric symptoms.[25,26] Although most studies have been related to military experiences,[25,26] in the context of COVID, moral injury may result when, lacking sufficient material resources (ie, shortages of personnel and equipment) and with diminished personal reserves (ie, working for an increased duration and/or while ill), health care workers feel they are unable to adequately care for those for whom they are responsible.[27] Moral injury during the COVID-19 pandemic has been previously documented in small samples of US health care workers.[28] In this study, it may be an aspect of the findings that shortages of personnel and equipment, and caring directly for patients while sick themselves were related to mental health outcomes. Moral injury can be avoided or reduced by institutional policies and planning, but even when it cannot, treatment approaches may mitigate its effects on individual workers.

Strengths and Limitations

The strengths of this study include a large sample identified from a state-wide database of all licensed physicians, physician assistants, and nurse practitioners regardless of institution or practice setting; responses collected during the peak months of the first wave of the pandemic in NYS; availability of survey weights to make the findings more representative of the target population; use of validated screening instruments for depression and anxiety; and an analytic strategy to combine information across multiple mental health outcomes while accounting for their correlation within individuals.

Several limitations must be acknowledged. Although differential participation may potentially have biased results, the application of survey weights helped address the age, sex, and geographic distribution of respondents versus the target population. We were unable to address other factors that may have been associated with probability of participation. If people experiencing both mental health conditions and specific COVID-related occupational experiences were differentially more likely to participate, it may have biased our findings. However, because the survey covered a range of occupational and other factors related to the pandemic, it is unlikely that participation was driven by specific exposures. On the other hand, those more negatively impacted generally may have been more motivated to participate, therefore the prevalence of mental health conditions and COVID-related experiences may not generalize to the entire population. The study was cross-sectional, and we did not have information on preexisting mental health conditions. Therefore, reverse causation cannot be ruled out whereby professionals with underlying mental health concerns either differentially selected (eg, voluntarily changing work hours) or differentially reported their COVID-related occupational exposures. We did not have information about whether the outcomes were functionally impairing; further, stress and anger related to COVID-19 are not diagnoses. However, there was little significant heterogeneity of associations observed by the specific outcome. Finally, we had limited information on covariates, for example, race/ethnicity and income levels of participants. This may result in uncontrolled confounding; however, the concordance of key elements of our findings with those in other studies that have adjusted for these factors reduced the sway of that explanation.

Conclusions

In a sample drawn from all licensed physicians, nurse practitioners, and physician assistants in NYS during the first peak of the COVID-19 pandemic in the United States, personal exposure to infection with the virus, increased work duration, PPE/equipment shortages, and working in direct patient care while sick were associated with increased odds of negative mental health outcomes. A number of these circumstances are modifiable by changes in institutional and governmental policy. An important implication of these findings is that modifications such as stockpiling of PPE and other equipment, and maintaining adequate staffing including backup capacity may reduce the risks of adverse mental health impacts among physicians, nurse practitioners, and physician assistants in future pandemic situations. Whether these findings also extend to other categories of workers such as nurses and allied health care workers should be addressed in future research.

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