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Psychological Impact of the COVID-19 Pandemic on Frontline Health Care Workers During the Pandemic Surge in New York City

Jordyn H. Feingold[1], Lauren Peccoralo[1,2], Chi C. Chan[3], Carly A. Kaplan[1], Halley Kaye-Kauderer[1], Dennis Charney[3,4,5], Jaclyn Verity[2], Alicia Hurtado[3], Larissa Burka[6], Shumayl A. Syed[1], James W. Murrough[3,7], Adriana Feder[3], Robert H. Pietrzak[3,8,9,10] and Jonathan Ripp[2]

Abstract

Background: This study sought to assess the magnitude of and factors associated with mental health outcomes among frontline health care workers (FHCWs) providing care during the Spring 2020 COVID-19 pandemic surge in New York City.
Methods: A cross-sectional, survey-based study over 4 weeks during the Spring 2020 pandemic surge was used to assess symptoms of COVID-19-related posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and generalized anxiety disorder (GAD) in 2,579 FHCWs at the Mount Sinai Hospital. Participants were additionally asked about their occupational and personal exposures to COVID-19. Multivariable logistic regression and relative importance analyses were conducted to identify factors associated with these outcomes.
Results: A total of 3,360 of 6,026 individuals completed the survey (55.8% participation), with 2,579 (76.8%) analyzed based on endorsing frontline responsibilities and providing information related to the three outcomes. 1,005 (39.0%) met criteria for symptoms of COVID-19-related PTSD, MDD, or GAD. 599 (23.3%) screened positively for PTSD symptoms, 683 (26.6%) for MDD symptoms, and 642 (25.0%) for GAD symptoms. Multivariable analyses revealed that past-year burnout was associated with the highest risk of developing symptoms for COVID-19-related PTSD (odds ratio [OR] = 2.10), MDD (OR = 2.83), and GAD (OR = 2.68). Higher perceived support from hospital leadership was associated with a lowest risk of all outcomes [PTSD (OR = 0.75), MDD (OR = 0.72), and GAD (OR = 0.76).
Conclusion: In this large sample of FHCWs providing care during the 2020 NYC pandemic surge, 39% experienced symptoms of COVID-19-related PTSD, MDD, and/or GAD and pre-pandemic burnout as well as leadership support were identified as the most highly associated factors. These findings suggest that interventions aimed at reducing burnout and augmenting support from hospital leadership may be appropriate targets to mitigate the risk for developing further psychopathology in this population and others working in the midst of crisis.

Keywords

COVID-19, health care workers, burnout, depression, anxiety, posttraumatic stress, psychological symptoms, frontline, well-being

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[1]Department of Medical Education, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[2]Department of Medicine, Icahn School of Medicine at Mount Sinai, Mount Sinai Health System, New York, NY, USA
[3]Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[4]Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[5]Department of Pharmacological Sciences, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[6]Department of nursing, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[7]Department of Psychiatry, Depression and Anxiety Center for Discovery and Treatment, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[8]Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[9]Department of Psychiatry, Yale School of Medicine, New Haven, CT, USA
[10]U.S. Department of Veterans Affairs National Center for PTSD, West Haven, CT, USA

Corresponding Author:
Jordyn H. Feingold, 5th Floor, 17 E 102nd St., New York, NY 10029, USA.
Email: Jordyn.feingold@gmail.com

Introduction

The novel coronavirus disease of 2019 (COVID-19) which emerged in Wuhan, China in December 2019 has swept across the globe, ravaging communities and taking the lives of millions. New York City (NYC) was the outbreak's epicenter in the United States, with a record of new daily cases reported at 12,274 on April 4, 2020.[1] In NYC and around the world, frontline health care workers (FHCWs) were exposed to an extreme and sudden rise in daily work-related stressors, witnessing severe illness and death at unprecedented rates, while experiencing threats to their own safety, leading to significant concern for the psychological impacts of this crisis within this population.

Even in non-pandemic times, health care workers are faced daily with highly stressful work, often caring for traumatized people,[2] frequently witnessing death and dying, and operating in crowded care settings[3] with the potential for frequent re-exposure to potentially traumatic situations.[4] Additionally, research has shown that health care workers, particularly physicians in training, are at a relatively high risk for the development of depressive symptoms,[5] due to factors like intense workloads, financial concerns, sleep deprivation, high rates of cynicism among mentors and colleagues, among others.[6] Finally, given the immense amount of uncertainty and unpredictability early in the pandemic, as well as fears over inadequate personal protection, lack of control, deployments to clinical settings outside of worker's regular scopes of practice, as well as isolation from families and potentially low social support, this population was at great risk for new onset or exacerbations of existing anxiety and other mental health symptoms.

Indeed, meta-analytic data following the Severe Acute Respiratory Syndrome (SARS) and Middle Eastern Respiratory Syndrome (MERS) pandemics have shown a higher frequency of anxiety (29.0%) and depressive features (26.3%) among health care workers[7] compared with the general population (14.8% and 15%, respectively).[8] Hospital staff at sites that treated SARS-infected patients in 2003 reported higher symptoms of burnout, psychological distress, and posttraumatic stress 13-26 months after the outbreak, compared with those at sites that did not treat SARS patients.[9] Early data from the COVID-19 pandemic found that among 1,257 Chinese health care workers at 34 hospitals severely impacted by COVID-19, a significant subset endorsed symptoms of distress (71.5%), depression (50.4%), anxiety (44.6%), and insomnia (34.0%).[10] These outcomes were more severe among nurses, women, frontline workers and those located in Wuhan, the epicenter of the outbreak in China. A larger study of 2,285 health care workers across 28 provinces in China found that 46.0% met criteria for anxiety (11.6% for moderate/severe anxiety) and 44.4% met criteria for depression (12.8% for moderate/severe depression), with nurses reporting the greatest levels of anxiety and public health professionals reporting the greatest levels of depressive symptoms.[11] Among 1,379 health care workers in Italy, 49.4% screened positively for PTSD symptoms, 24.7% for depression, and 19.8% for anxiety, with worse outcomes among those who were younger, female, served on the frontlines, or had a deceased, hospitalized, or quarantined colleague.[12] Finally, a meta-analysis examining psychological reactions of health care staff working with patients in several past viral outbreaks found that more contact with sick patients, more time in quarantine, perceived lack of organizational support, younger age/more junior status, being single, and having a history of mental health disorders were associated greater psychological distress, whereas adequate access to personal protective equipment (PPE), support from peers, and clear communication were associated with protection from distress.[13]

While the studies reviewed above provide important insights into psychological impact of the COVID-19 pandemic in FHCWs, little is known about the burden and risk factors associated with COVID-19-related mental health outcomes in U.S.-based FHCWs. To address this gap, we conducted the largest known study of FHCWs who worked during the spring 2020 surge of the COVID-19 pandemic in New York City, the area hardest-hit in the U.S. during the height of the pandemic. Specifically, we aimed to assess the prevalence of symptoms of COVID-19-related posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and generalized anxiety disorder (GAD) in a diverse sample of FHCWs in a single NYC hospital at the height of the pandemic, and to identify demographic, and COVID-19-related personal and work-related factors associated with these outcomes. Given our focus on frontline workers specifically and the magnitude of the crisis at the time of study, we hypothesized that the prevalence of PTSD, MDD, and GAD symptoms would be higher in our sample than those seen among general health care workers managing past pandemics and comparable to those observed in Wuhan FHCWs at the peak of the pandemic in China. Further, we expected that mental health history, higher medical risk, more occupational and personal exposures to COVID-19, and lower work-related support would be linked to increase likelihood of screening positive for these symptoms.

Methods

Sample

Data were collected between April 14th and May 11th, 2020 through an electronically-administered anonymous

survey delivered to a purposively-selected sample of FHCWs working at The Mount Sinai Hospital, an urban tertiary care hospital in NYC. This period corresponded with the peak and downward slope of the epidemic curve at this hospital, as defined by COVID-19 inpatient census data. Participants provided consent within the survey and were eligible to receive a $25 gift card after survey completion, based on filling out a separate form to endorse study participation that was not linked to the study survey. The study was approved by the Institutional Review Board at the Icahn School of Medicine at Mount Sinai.

The eligible study population included health care workers most likely to be directly involved in the care of patients infected with COVID-19, either as a result of their standard practice or anticipated redeployment within the study period. The research team worked with hospital and administrative leaders to identify those most likely to be involved in frontline care prior to procuring contact information for study invitation. The sample was comprised of attending-level physician faculty and house staff from several departments, including Internal medicine and surgical subspecialties, Anesthesiology, Emergency Medicine, Pediatrics, and Psychiatry, as well as all patient-facing nurses, physician assistants, hospital chaplains, social workers, and dietitians. Participants were excluded if email invitations went undelivered to addresses on file. The total number of eligible participants included 6,026 presumed FHCWs.

Study Instrument

The survey instrument included brief, validated instruments to assess psychological distress (Table 1), as well as questions about sociodemographic characteristics, occupational factors, and personal exposures to COVID-19 (Table 2). Additional questions were included to ascertain satisfaction with hospital-specific resources, policies and procedures, communication preferences, and availability of supplies in order to inform the institution of potential areas for intervention in real-time.

Outcome Measures. COVID-19-related PTSD Symptoms. Symptoms of PTSD were assessed using a 4-item PTSD-Checklist (PCL4-5),[15] an abbreviated version of the PTSD-Checklist-5 (PCL-5),[16] which has been validated against the gold-standard Clinician-Administered PTSD

Table 1. Screening tools to assess COVID-19-related PTSD, MDD, and GAD.

PCL-4-5 (Modified to ascertain COVID-19-specific PTSD symptoms; Answer choices: Not at all, a little bit, moderately, quite a bit, extremely)

In the past two weeks, how often were you bothered by:

1. Repeated, disturbing, and unwanted memories of your experiences related to the COVID-19 pandemic
2. Avoiding external reminders of your experiences related to the COVID-19 pandemic (for example people, places, conversations, activities, objects, or situations)
3. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)
4. Feeling jumpy or easily startled

PHQ-8 (Answer choices: Not at all, several days, more than half the days, nearly every day)

Over the last two weeks, how often have you been bothered by the following problems?

1. Feeling down, depressed, or hopeless
2. Having little interest or pleasure in doing things
3. Trouble falling or staying asleep, or sleeping too much
4. Feeling tired or having little energy
5. Poor appetite or overeating
6. Feeling bad about yourself, or that you are a failure, or have let yourself or your family down
7. Trouble concentrating on things, such as reading the newspaper or watching television
8. Moving or speaking so slowly that other people could have noticed. Or the opposite–being so fidgety or restless that you have been moving around a lot more than usual

GAD-7: (Answer choices: Not at all, several days, more than half the days, nearly every day)

Over the last 2 weeks, how often have you been bothered by the following problems?

1. Feeling nervous, anxious, or on edge
2. Not being able to stop or control worrying
3. Worrying too much about different things
4. Having trouble relaxing
5. Being so restless that it's hard to sit still
6. Becoming easily annoyed or irritable
7. Feeling afraid as if something awful might happen

Table 2. Variables examined in relation to positive screens for psychological outcomes (COVID-19-related PTSD, major depressive disorder, generalized anxiety disorder).

Sociodemographic characteristics

Age, sex, relationship status, past history of mental health diagnosis (yes/no), level of perceived personal medical risk (high, medium, low)

Professional characteristics

– Profession: Nurse Practitioner or Physician Assistant, Attending MD/DO, House staff, Other (social worker, chaplain, clinical dietitian, psychologist, other)
– Number of years in practice: Report of number of years in clinical practice
– Burnout: Experience of Burnout based a rating of $\geq$4 (at least once a week) on either item of 2-item Maslach Burnout Inventory (MBI) specifically worded to ascertain the experience of burnout "before the onset of the COVID-19 pandemic." Together, questions measure emotional exhaustion and depersonalization with responses ranging from 0 ("Never") to 6 ("Every day")[14]

Exposure to COVID-19

Personal exposure sum score

Number of items endorsed on a question asking whether friends, family, colleagues, and self have been sick, required hospitalization, ICU stay, or died due to COVID-19.

COVID-19 Related Job Factors

– Number of coworkers infected: "How many of your direct co-workers would you estimate have gotten ill with suspected or confirmed COVID-19 (and been unable to work)?"
– Coworker COVID-19 illness severity level: The following questions were asked and categorized.
  "How many of your direct co-workers have been hospitalized?"
  "How many of your direct co-workers have been admitted to the ICU?"
  "How many of your direct co-workers have passed way?"
– *Patient exposure sum score:* Number of items endorsed on a question asking whether they have cared for patients who have been sick with COVID-19 or died either virtually or in person.
– Number of patients with COVID-19 treated: "What is the estimated number of patients you have treated (or consulted on) with suspected or confirmed COVID-19?"
– Access to enough Personal Protective Equipment (PPE) on your unit (yes/no/cannot assess)
– Access to sufficient coronavirus testing for staff (yes/no/cannot assess)
– Access to sufficient coronavirus testing for patients (yes/no/cannot assess)
– Redeployed (yes/no)
– Onsite hours worked per week (number)
– Difficult decisions prioritizing patients: The following question was asked:
  "In the last week, have you or your team had to make a difficult decision (or decisions), involving prioritizing the health/survival of one patient over another, due to limited equipment/resources?" (yes/no)

Work/life balance challenges: The following questions were asked and an average of scores on the following questions were standardized with response options ranging from 0 ("None of the time") to 4 ("all of the time"):

  "In the last week, how often have you felt torn between your desire/duty to help your patients and your desire/duty to loved ones (family, friends, etc.)?
  "In the last week, how often have you felt that those who live with you are fearful to be near you due to your possible COVID exposure at work?"

Protective Occupational Factors

Perceived preparedness

Sum of "yes" responses to the following yes/no questions:

  "My work and activities before the coronavirus pandemic provided me with helpful training to perform my current clinical work."
  "In my current clinical setting, I am adequately informed about my clinical duties and the role I am expected to play."
  "At present, I have a good idea of how long (weeks) my current level/volume of work will last."
  "I am adequately trained to perform the professional tasks required of me during this pandemic."

Feeling valued/supported at work

Standardized average of scores on the following items:

  "In your opinion, what is the current level of camaraderie/ team spirit among your group of co-workers, in your own clinical practice team or setting?" (low/medium/high)
  "In your opinion, what is the current level of support from your hospital leadership?" (low/medium/high)
  "In your opinion, to what extent do you feel valued by your immediate supervisors (team leader, service chief, etc.)?" Scores range from 0 ("Not at all valued" to 3 ("Very much valued")
  "In your opinion, to what extent do you feel valued by hospital leadership)?" Scores range from 0 ("Not at all valued" to 3 ("Very much valued")

Work-related pride, meaning, inspiration

Standardized average of scores on the following items: "To what extent do you agree with the following statements? Since the start of the pandemic. . ..." (Disagree/neutral/agree)

  "I have felt more pride than usual to be a health care worker"
  "I have derived more meaning from my clinical work than during life as usual"
  "I have been inspired by colleagues who I consider to be role-models"

Scale for DSM-5, with questions modified to ascertain symptoms related to COVID-19 exposure (e.g., "Over the past two weeks, how often were you bothered by repeated, disturbing, and unwanted memories of your experiences *related to the COVID-19 pandemic*?") A positive screen for significant COVID-19-related PTSD symptoms was defined by a score $\geq$8, which has shown the highest efficiency (90.4%; sensitivity = 0.81, specificity = 0.94) in diagnosing PTSD.[15] In the current sample, internal consistency was good ($\omega = 0.85$).

Major Depressive Disorder Symptoms. Symptoms of MDD were assessed using the Patient Health Questionnaire-8 (PHQ-8),[17] an eight-item measure that assesses symptoms of MDD experienced over the previous 2 weeks. A positive screen for significant MDD symptoms was defined by a score $\geq$ 10, which yields comparable estimates of the prevalence of current major depressive or other depressive disorders relative to diagnostic interviews. In the current sample, internal consistency was excellent ($\omega = 0.90$).

Generalized Anxiety Disorder Symptoms. Symptoms of GAD were assessed using the Generalized Anxiety Disorder-7 (GAD-7),[18] a seven-item measure that assesses symptoms of GAD experienced over the past 2 weeks. A positive screen for significant GAD symptoms was defined by a score $\geq$10, which has a sensitivity of 0.89 and specificity of 0.82 in diagnosing GAD.[18] In the current sample, internal consistency was excellent ($\omega = 0.92$).

Statistical Analysis

Data analyses proceeded in five steps. First, we computed descriptive statistics to summarize study variables, and computed the prevalence of positive screens for significant symptoms of COVID-19-related PTSD, MDD, and GAD. Second, we conducted a series of independent-sample Welch's t-tests and X^2 tests to compare personal history, COVID-19 exposures, and protective work-related variables by positive screen for the three outcome variables. Third, we conducted three multivariable binary logistic regression analyses to identify personal history, COVID-19 exposure, and protective work-related variables that were independently associated with the outcome variables. All variables were included in the regressions. Fourth, for multi-component variables (e.g., sum of personal COVID-19 exposures, perceived preparedness) that emerged as statistically significant in multivariable models, we conducted post-hoc analyses to identify specific components of these variables that were significantly associated with symptoms of COVID-19-related PTSD, MDD, and GAD. Fifth, we conducted relative importance analyses[19] to identify the relative proportion of variance in each of these outcome variables that was explained by each of the significant independent variables in multivariable analyses. Missing data were imputed prior to analysis via multiple imputation by chained equations.[20] This approach was selected because it accounts for statistical uncertainty when imputing data, and can handle different variable types, and data complexities such as bounds and survey skip patterns.[20,21] All analyses were completed using IBM SPSS Statistics for Windows, Version 25.0. IBM Corp. Released 2017 (Armonk, NY).

Results

Sample

Of the 6,026 health care workers eligible to complete the survey, 3,360 (55.8%) responded. Of those, 497 (14.8%) were excluded on the basis that they endorsed "no" to the question: "Are you currently directly engaged in clinical activities, either full or part-time, involving diagnosing, treating, or providing clinical care to patients with suspected or confirmed COVID-19?" Another 284 (10.0%) were excluded because their surveys lacked sufficient information related to the outcome variables, because they did not answer any items on the PCL4-5, GAD-7, and the PHQ-8. The final sample included 2,579 FHCWs. A total of 1,407 (54.6%) were under 35 years-old and 1,897 (73.6%) were women. 1,082 (42.0%) were registered nurses (RNs), 541 (21.0%) were house staff, 394 (15.3%) were physician assistants (PAs) or nurse practitioners (NPs), 398 (15.4%) were attending-level physicians, and 164 (6.4%) were chaplains, dieticians, social workers, or others. Data that were missing were subsequently imputed for <5% of outcome variables data and <10% of predictor variables.

Prevalence of Significant COVID-19-Related PTSD, MDD, and GAD Symptoms. A total of 1,005 healthcare workers (39.0%, 95%CI = 37.1–40.9%) met the pre-specified cutoff values for significant symptoms of COVID-19-related PTSD, MDD, and/or GAD. A total of 403 (15.6%) workers screened positively for one of these outcomes, 285 (11.1%) for two outcomes, and 317 (12.3%) for three outcomes. 599 (23.3%, 95%CI = 21.7–25.0%) screened positively for significant COVID-19-related PTSD symptoms, 683 (26.6%, 95%CI = 24.9–28.3%) for significant MDD symptoms, and 642 (25.0%, 95% CI = 23.3–26.7%) for significant GAD symptoms.

Bivariate Associations

Table 3 contains results of bivariate analyses examining associations between personal history, COVID-19 exposure, and protective work-related factors with the three outcome variables.

Table 3. Results of bivariate model examining personal factors, COVID-19 exposures, and protective work-related factors associated with positive screens for significant symptoms of COVID-19-related PTSD, MDD, and GAD.

	Total	PTSD Screen+	PTSD Screen–		MDD Screen+	MDD Screen–		GAD Screen+	GAD Screen–	
	N* or mean	n (%) or mean (SD)	n (%) or mean (SD)	P-value	n (%) or mean (SD)	n (%) or mean (SD)	P-value	n (%) or mean (SD)	n (%) or mean (SD)	P-value
	2579	599 (23.3)	1975 (76.7)		683 (26.6)	1888 (73.4)		642 (25.0)	1930 (75.0)	
Personal factors										
Age				p = .001			p < .001			p < .001
<35	1407	361 (25.7)	1042 (74.3)		417 (29.7)	986 (70.3)		389 (27.7)	1014 (72.3)	
≥35	1172	238 (20.3)	933 (79.7)		266 (22.8)	902 (77.2)		253 (21.6)	916 (78.4)	
Gender				p < .005			p < .001			p < .001
Female	1897	467 (24.7)	1426 (75.3)		553 (29.2)	1338 (70.8)		518 (27.4)	1373 (72.6)	
Male	682	132 (19.4)	549 (80.6)		130 (19.1)	550 (80.9)		124 (18.2)	557 (81.8)	
Relationship status				p < .001			p < .001			p < .001
Single/divorced/ widowed	741	217 (29.4)	521 (70.6)		255 (34.5)	485 (65.5)		219 (29.6)	521 (70.4)	
Married/partnered	1776	369 (20.8)	1405 (79.2)		411 (23.1)	1365 (76.9)		407 (22.9)	1369 (77.1)	
Profession				p < .001			p < .001			p < .001
Registered nurse	1082	354 (32.8)	724 (67.2)		361 (33.5)	716 (66.5)		337 (31.3)	741 (68.7)	
Residents/Fellows	541	73 (13.5)	467 (86.5)		104 (19.3)	435 (80.7)		91 (16.9)	448 (83.1)	
Attending MD/DO	398	40 (10.1)	358 (89.9)		65 (16.4)	332 (83.6)		59 (14.9)	338 (85.1)	
PA/NP	394	86 (21.8)	308 (78.2)		102 (25.9)	292 (74.1)		103 (26.1)	291 (73.9)	
Other	164	46 (28)	118 (72)		51 (31.1)	113 (68.9)		52 (31.7)	112 (68.3)	
Years in practice	9.3	8.5 (8.1)	9.6 (9.4)	p = .006	8.0 (7.2)	9.8 (9.7)	p < .001	8.2 (7.6)	9.7 (9.6)	p < .001
Medical risk				p < .001			p < .001			p < .001
Low	1559	275 (17.7)	1282 (82.3)		342 (22)	1212 (78)		313 (20.1)	1242 (79.9)	
Medium	734	224 (30.6)	509 (69.4)		239 (32.7)	493 (67.3)		216 (29.5)	516 (70.5)	
High	286	100 (35.2)	184 (64.8)		102 (35.8)	183 (64.2)		113 (39.6)	172 (60.4)	
History of mental disorder				p = .647			p < .001			p < .001
No	2067	484 (23.5)	1579 (76.5)		494 (24)	1566 (76)		466 (22.6)	1595 (77.4)	
Yes	512	115 (22.5)	396 (77.5)		189 (37)	322 (63)		176 (34.4)	335 (65.6)	
Past-year burnout				p < .001			p < .001			p < .001
No	1490	214 (14.4)	1273 (85.6)		225 (15.1)	1261 (84.9)		212 (14.3)	1275 (85.7)	
Yes	1079	382 (35.5)	695 (64.5)		456 (42.4)	619 (57.6)		428 (39.8)	647 (60.2)	
Covid-19-related exposures										
Number of hours working on-site	37.1	38.3 (16.5)	36.7 (18.3)	p = .041	38.1 (17.1)	36.77 (18.2)	p = .083	37.3 (17.3)	37.1 (18.1)	p = .736
Redeployed				p = .780			p = .658			p = .389
No	1631	376 (23.1)	1251 (76.9)		437 (26.9)	1190 (73.1)		397 (24.4)	1230 (75.6)	
Yes	948	223 (23.5)	724 (76.5)		246 (26.1)	698 (73.9)		245 (25.9)	700 (74.1)	
Number of COVID-19 patients treated	55.2	62.6 (96.1)	53 (79.8)	p = .026	61.4 (93.8)	52.9 (79.8)	p = .034	59.3 (97.0)	53.8 (78.9)	p = .191
Enough access to PPE				p < .001			p < .001			p < .001
Yes	1794	333 (18.6)	1457 (81.4)		401 (22.4)	1388 (77.6)		365 (20.4)	1424 (79.6)	
No or cannot assess	780	265 (34)	514 (66)		281 (36.2)	496 (63.8)		277 (35.6)	501 (64.4)	

(continued)

Table 3. Continued.

	Total	PTSD Screen+	PTSD Screen–		MDD Screen+	MDD Screen–		GAD Screen+	GAD Screen–	
Enough testing for staff				$p < .001$			$p < .001$			$p < .001$
Yes	668	122 (18.3)	546 (81.7)		142 (21.3)	524 (78.7)		134 (20.1)	533 (79.9)	
No or cannot assess	1905	475 (25)	1425 (75)		541 (28.5)	1358 (71.5)		506 (26.6)	1393 (73.4)	
Enough testing for patients				$p = .022$			$p = .413$			$p = .025$
Yes	1768	388 (22)	1377 (78)		459 (26)	1303 (74)		418 (23.7)	1345 (76.3)	
No or cannot assess	803	209 (26.1)	592 (73.9)		221 (27.6)	580 (72.4)		223 (27.8)	578 (72.2)	
Sum of patient exposures	1.6	1.5 (0.7)	1.6 (0.7)	$p = .024$	1.6 (0.7)	1.6 (0.7)	$p = .749$	1.6 (0.7)	1.6 (0.7)	$p = .132$
Made difficult decision in prioritizing patients				$p < .001$			$p < .001$			$p < .001$
No	1835	347 (18.9)	1486 (81.1)		425 (23.2)	1407 (76.8)		407 (22.2)	1425 (77.8)	
Yes	733	248 (33.9)	483 (66.1)		253 (34.8)	475 (65.2)		231 (31.7)	498 (68.3)	
Number of coworkers infected with COVID-19	8.5	10 (12.9)	8.1 (9.5)	$p < .001$	9.6 (12.6)	8.1 (9.5)	$p = .004$	9.4 (12.0)	8.3 (9.8)	$p = .031$
Coworker COVID-19 illness severity level				$p < .001$			$p < .001$			$p < .001$
0 coworker hosp/ICU/died	1572	309 (19.7)	1259 (80.3)		380 (24.2)	1189 (75.8)		345 (22)	1224 (78)	
≥1 coworker hosp/ICU	792	222 (28.1)	569 (71.9)		227 (28.8)	561 (71.2)		229 (29.1)	559 (70.9)	
≥1 coworker died	215	68 (31.6)	147 (68.4)		76 (35.5)	138 (64.5)		68 (31.6)	147 (68.4)	
Sum of personal exposures	1.9	2.2 (1.5)	1.8 (1.3)	$p < .001$	2.1 (1.4)	1.8 (1.3)	$p < .001$	2.2 (1.5)	1.8 (1.3)	$p < .001$
Work-life balance issues because of COVID-19	0	0.4 (0.8)	−0.1 (0.8)	$p < .001$	0.3 (0.9)	−0.1 (0.8)	$p < .001$	0.4 (0.9)	−0.1 (0.8)	$p < .001$
Protective work-related factors										
Perceived preparedness	2.8	2.4 (1.3)	2.9 (1.1)	$p < .001$	2.4 (1.2)	2.9 (1.1)	$p < .001$	2.4 (1.3)	2.9 (1.0)	$p < .001$
Work-related inspiration	0	−0.1 (0.9)	0 (0.8)	$p < .001$	−0.2 (0.9)	0.1 (0.8)	$p < .001$	−0.2 (0.9)	0.1 (0.8)	$p < .001$
Feeling valued/supported at work	0	−0.3 (0.8)	0.1 (0.7)	$p < .001$	−0.3 (0.8)	0.1 (0.7)	$p < .001$	−0.3 (0.8)	0.1 (0.7)	$p < .001$

Note: "Screen +" and "Screen –" reflect pre-specified symptom thresholds, not the presence of a clinical diagnosis.
*Includes imputed data; N may not add up to 2579 because of missing data that could not be imputed.

Multivariable Models

Table 4 shows results of multivariable binary logistic regression models examining personal history, COVID-19 exposure, and protective work-related factors associated with positive screens on the three outcome variables.

Symptoms of COVID-19-Related PTSD. Variables associated with significant COVID-19-related PTSD symptoms included younger age, non-attending MD/DO profession, medium-to-high medical risk, positive screen for past-year burnout, greater number of hours working on-site, perceived insufficient PPE, having made a difficult decision in prioritizing COVID-19 patients, experiencing death of a coworker, having more personal exposures to COVID-19, and experiencing COVID-19-related work-life balance concerns. Being married or partnered and greater feelings of value and support were associated with lower odds of this outcome.

Nagelkerke's R^2 for the multivariable model was 0.28. Relative importance analysis revealed that past-year burnout (18.7% relative variance explained [RVE]), non-attending professional status (15.7% RVE), feeling that those with whom one lives are fearful of them due to possible COVID-19 exposure at work (12.8% RVE), and feeling torn between one's desire/duty to help patients and loved ones (10.8% RVE) explained the majority of the variance in this outcome. The strongest protective factors—those most associated with a lower odds of screening positively—were perceived support

Table 4. Results of multivariable regression models examining personal factors, COVID-19 exposures, and protective work-related factors associated with positive screens for significant symptoms of COVID-19-related PTSD, MDD, and GAD.

	PTSD Symptoms	MDD Symptoms	GAD Symptoms
	OR (95%CI)	OR (95%CI)	OR (95%CI)
Personal factors			
Age <35 (ref: 35 and older)	1.34 (1.01–1.77)*	1.15 (0.88–1.51)	1.21 (0.92–1.59)
Female gender (ref: male gender)	0.86 (0.65–1.12)	1.35 (1.04–1.75)*	1.30 (1.00–1.70)
Married/partnered (ref: single, divorced, widowed)	0.62 (0.50–0.78)***	0.57 (0.46–0.70)***	0.73 (0.58–0.91)**
Profession (ref: Attending MD/DO)			
Resident/Fellow	0.96 (0.59–1.56)	0.88 (0.57–1.34)	0.96 (0.62–1.49)
Physician Assistant(PA)/ Nurse Practitioner(NP)	2.15 (1.37–3.38)**	1.29 (0.86–1.92)	1.56 (1.04–2.34)*
RN	2.15 (1.60–3.59)***	1.32 (0.92–1.89)	1.39 (0.96–2.01)
Other	2.64 (1.53–4.57)***	1.49 (0.90–2.46)	1.93 (1.16–3.20)*
Years in practice	0.99 (0.97–1.00)	0.98 (0.96–0.99)**	0.98 (0.97–0.99)*
Medical risk (ref: No/Low)			
Medium	1.73 (1.36–2.19)***	1.56 (1.24–1.96)***	1.44 (1.14–1.82)**
High	1.88 (1.35–2.62)***	1.67 (1.20–2.31)**	2.33 (1.68–3.22)***
History of mental disorder	0.89 (0.68–1.17)	1.91 (1.50–2.42)***	1.92 (1.51–2.45)***
Past-year burnout	2.10 (1.69–2.60)***	2.83 (2.30–3.47)***	2.68 (2.17–3.30)***
COVID-19-related exposures			
Number of hours working onsite	1.01 (1.01–1.02)**	1.02 (1.01–1.03)*	1.00 (1.00–1.01)
Redeployed	0.97 (0.77–1.22)	0.91 (0.73–1.13)	0.99 (0.79–1.23)
Number of COVID-19 patients treated	1.00 (1.00–1.00)	1.00 (0.99–1.00)	1.00 (1.00–1.00)
Do not have enough PPE	1.33 (1.06–1.68)*	1.14 (0.91–1.42)	1.26 (1.01–1.58)*
Do not have enough testing for staff	0.93 (0.71–1.21)	1.06 (0.83–1.35)	0.98 (0.76–1.26)
Do not have enough testing for patients	1.17 (0.92–1.48)	0.95 (0.76–1.20)	1.08 (0.86–1.36)
Sum of patient exposures	0.88 (0.74–1.04)	1.07 (0.92–1.25)	1.19 (1.02–1.39)*
Made difficult decision in prioritizing patients	1.64 (1.30–2.06)***	1.27 (1.02–1.60)*	1.11 (0.88–1.40)
Number of coworkers infected	1.01 (1.00–1.02)	1.00 (0.99–1.01)	1.00 (0.99–1.01)
Coworker exposure level (ref: None)			
Coworker Hospitalized/ICU	1.19 (0.94–1.50)	1.03 (0.82–1.29)	1.27 (1.01–1.60)*
Coworker died	1.47 (1.02–2.12)*	1.41 (1.01–2.02)*	1.31 (0.91–1.90)
Sum of personal exposures	1.09 (1.01–1.17)*	1.07 (0.99–1.15)	1.07 (0.99–1.15)
Work-life balance challenges because of COVID-19	1.57 (1.38–1.79)***	1.39 (1.23–1.58)***	1.56 (1.37–1.77)***
Protective work-related factors			
Perceived preparedness	0.97 (0.88–1.07)	0.91 (0.83–0.99)*	0.87 (0.79–0.96)**
Work-related inspiration	0.91 (0.80–1.04)	0.87 (0.76–0.98)*	0.89 (0.78–1.01)
Feel valued/supported at work	0.75 (0.64–0.88)***	0.72 (0.62–0.84)***	0.76 (0.65–0.89)***

Note. PTSD=posttraumatic stress disorder; MDD=major depressive disorder; GAD=generalized anxiety disorder. OR=odds ratio; 95%CI = 95% confidence interval. Significant association: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

from hospital leadership (11.1% RVE) and being married/partnered (5.1% RVE).

Symptoms of MDD. Variables associated with significant MDD symptoms included female gender, medium-to-high medical risk, history of mental disorder, screening positive for past-year burnout, greater number of hours working onsite, having made a difficult decision in prioritizing COVID-19 patients, experiencing death of a coworker, and experiencing COVID-19-related work-life balance challenges. Being married/partnered, more years of practice, perceiving a higher level of preparedness, work-related inspiration, and feeling valued and supported were associated with lower odds of this outcome.

Nagelkerke's R^2 for the multivariable model was 0.27. Relative importance analysis revealed that past-year burnout (31.2% RVE), feeling torn between one's desire/duty to help patients and loved ones (13.9% RVE), history of mental disorder (5.9% RVE), and medical risk (5.3% RVE) explained the majority of the variance in MDD symptoms. Perceived support from hospital leadership (12.0% RVE) and being married/partnered (6.5% RVE) were the strongest protective factors.

Symptoms of GAD. Variables associated with significant GAD symptoms included the professions of PA/NP and others (chaplains, clinical dietitians, social workers, others), medium-to-high medical risk, history of mental disorder, screening positive for past-year burnout, perceived insufficient PPE, reporting a greater number of patient exposures, knowing one or more coworkers who were hospitalized or admitted to the ICU, and experiencing COVID-19-related work-life balance challenges. Being married/partnered, greater number of years in practice, higher levels of perceived preparedness, and feeling valued/supported at work were associated with lower odds of this outcome.

Nagelkerke's R^2 for the multivariable model was 0.27. Relative importance analyses revealed that past-year burnout (30.4% RVE), feeling torn between one's desire/duty to help patients and loved ones (14.7% RVE), feeling that those with whom one lives are fearful of them due to possible COVID-19 exposure at work (9.6%), and medical risk (7.3% RVE) explained the majority of the variance in symptoms of GAD. Perceived hospital leadership support (9.4% RVE) and feeling adequately trained to perform required tasks during the pandemic (7.2%) were the strongest protective factors.

Discussion

To our knowledge, this is the largest study of the psychological impact of the COVID-19 pandemic in U.S.-based FHCWs. In our analysis of 2,579 FHCWs serving during the height of the COVID-19 pandemic in NYC, 1,005 (39.0%) screened positive for symptoms of COVID-19-related PTSD, MDD, or GAD. 599 (23.3%) screened positive for symptoms of COVID-19-related PTSD, 683 (26.6%) for symptoms of MDD, and 642 (25.0%) for symptoms of GAD. By way of comparison to a Chinese cohort at the height of the pandemic that included both frontline and non-frontline workers and that used the same instruments used here to assess symptoms of MDD and GAD, 11.6% met criteria for moderate-to-severe anxiety and 12.8% for moderate-to-severe depression.[11] Similarly, in a diverse health care worker cohort ($n = 1{,}132$) in May 2020 representing 25 medical centers throughout the United States, 14.0% had symptoms of MDD, 15.8% had symptoms of GAD, and 23.1% had symptoms of PTSD worthy of "probable diagnoses."[22] These percentages are notably higher than what has been found in the pre-pandemic United States general adult population, where the 12-month prevalence of PTSD, MDD, and GAD has been estimated to be 3.6%, 6.8% and 2.7%, respectively, as assessed using structured clinical interviews.[23] Importantly, our present findings, which rely on screening tools rather than clinical interviews, represent the presence of symptoms rather than disorders according to DSM-5 diagnostic criteria, and thereby may reflect transient stress reactions or adjustment disorders during the height of the crisis rather than fulminant psychopathology. Nonetheless, we found a greater burden of mental health symptoms in our large cohort relative to other cohorts during this crisis.

Individuals directly affected by disasters have been shown to have higher rates of post-event psychiatric disorders than those indirectly affected.[24–26] Our study found that symptoms of COVID-19-related PTSD were higher among those with greater total personal exposures to the pandemic compared to those with fewer. Factors associated with grief (e.g. number of coworkers who died) increased the likelihood of screening positively for MDD symptoms, consistent with prior studies.[24,27,28] Furthermore, knowing one or more coworkers hospitalized or in the ICU was significantly associated with screening positively for GAD symptoms, suggesting that the experience of having colleagues fall ill may intensify anxiety.

Prior to the pandemic, clinician burnout was recognized as a national crisis affecting the function of our health care system and the well-being of its workforce.[29] Large studies revealed that between 35–45% of nurses[30–32] and 40–54% of physicians[33] experience burnout, compared with less than 30% of working American adults.[34] We found that burnout in the year prior to the pandemic was the strongest predictor of COVID-19-related PTSD, MDD, and GAD symptoms, accounting for 18.7% to 31.2% of the variance in these outcomes. Here, we see the potential impact of having burnout at

baseline when layering on additional stressors, such as those experienced by FHCWs amid the COVID-19 crisis.

Additionally, feeling torn between one's desire or duty to help patients and loved ones was another strong correlate of COVID-19-related PTSD, MDD, and GAD symptoms, accounting for 10.8-14.7% of the variance in these outcomes. These challenges have been described in past pandemics[35] and may contribute to the pathogenesis of adverse mental health outcomes and the chronicity of burnout. In the months and years ahead, as focus shifts to supporting clinicians coping with COVID-19-related stress, it will remain critical to continue addressing the underlying causes of "pre-pandemic clinician burnout," and provide support for those experiencing ongoing work/home conflicts.

Perceived support is critical in protecting against the development of trauma-related disorders in times of intense stress,[36] and the loss of social connectedness is a purported driver of burnout.[37] We found that being married/partnered and feeling valued/supported by colleagues and hospital leadership were highly correlated with fewer symptoms of COVID-19-related PTSD, MDD, and GAD. It is possible that this highlights the protective role of social support, and/or that participants currently living with symptoms of PTSD, MDD, and/or GAD may have lower perceptions of support in the workplace. Directing resources to enhancing camaraderie among employees and encouraging leaders to communicate directly with FHCWs in the midst of a crisis may enhance morale and buffer individuals against adverse outcomes. In addition to ensuring awareness of and access to robust psychosocial and mental health resources, a pandemic well-being staff support model may enhance FHCW's feelings of value, address basic needs, and advance transparent, authentic communication and support. Such a model was adopted by the Mount Sinai Health System[38] and has been validated by the expressed needs of FHCWs in the midst of this crisis.[39]

Findings from an Italian study earlier in the COVID-19 pandemic suggested that FHCWs experienced high rates of death partially due to inadequate access to PPE (masks, gowns, face shields, etc.).[40] We found that perception of inadequate PPE was associated with symptoms of COVID-19-related PTSD and GAD, and that being at medium-to-high medical risk was significantly associated with all three outcomes. As such, in preparation for the possibility of additional COVID-19 waves and future pandemics, the provision of adequate PPE and support for clinicians with pre-existing health conditions may confer not only the physical, but also the psychological safety of the workforce.

Finally, nurses, PAs/NPs, and others were more likely to screen positively for symptoms of at least one of the three mental disorders compared with attending level and house staff physicians. This is consistent with meta-analytic data from the current pandemic and past pandemics showing that nurses were at a higher risk for psychological distress than their physician colleagues.[13] This might reveal that these professionals are truly at greater risk for developing psychopathology based on the nature of their work and closer direct proximity to ill and dying patients. Alternatively, physicians may have been more likely than others to under-endorse symptoms of a mental health condition due to fears of lack of anonymity and stigma. It is well-established that physicians fear repercussions of disclosing mental health diagnoses out of concern for losing their license[41] and being seen as weak by colleagues.[42] Breaking the "culture of silence"[43] around clinician distress is more critical now than ever before, and national leaders have provided guidance on how to prevent a "parallel pandemic" involving the emotional and physical harms facing FHCWs.[44] We believe our study confirms the importance and relevance of such action.

This study has a number of limitations. First, it was from a single hospital in NYC, limiting the generalizability of our findings to locations less affected by the pandemic. Second, as the study was cross-sectional and the COVID-19 pandemic represents a potential source of chronic traumatic exposure, continued follow-up during and after the pandemic will enable a better understanding of the distress, resilience, and recovery trajectories of individuals and groups to help distinguish acute symptoms of distress from diagnosable psychiatric conditions. Third, variables such as self-identified race and ethnicity were not included on this survey due to the potentially identifying nature of these questions; however, given the disproportionate impact of the pandemic on communities of color, this variable will be included on follow-up surveys. Fourth, symptom endorsements relied on screening instruments which tend to overestimate the rates of psychopathology compared to clinical structured interviews; as noted, the symptom prevalence reported here do not reflect diagnoses, and further research using more comprehensive measures of psychopathology are warranted. Additionally, this study was unable to distinguish preexisting symptoms of MDD and GAD with new symptoms, whereas the symptoms of PTSD were specific to COVID-19-related exposures. Finally, the response rate of 55.8% might indicate a potential response bias if those who did not complete the survey were too distressed or distracted to respond, leading to a modest underestimation of symptoms. Finally, although measures were taken to ensure participants understood that the survey was completely anonymous, including not asking questions pertaining to respondent's racial/ethnic background, it is possible that some non-respondents did not feel comfortable

disclosing sensitive mental health symptoms. This also may have led to an underestimation of symptomatology.

Conclusions

In this study of FHCWs at the Mount Sinai Hospital at the height of the surge of the COVID-19 pandemic, we found higher levels of symptoms of COVID-19-related PTSD, MDD and GAD compared with these same outcomes in all the other populations found in the present published literature. Endorsing pre-pandemic burnout was the variable most highly correlated with these unfavorable mental health outcomes, indicating that attention to clinician well-being remains paramount even in the absence of these extraordinary circumstances of the pandemic response. Furthermore, we highlight the critical nature of leadership support in the midst of crisis not as yet demonstrated in other studies of this pandemic. Additional attention to the well-being of FHCWs who are un-partnered, at higher medical risk, and are non-physicians may be warranted. Fully understanding these outcomes is essential to informing policymakers and health care systems in how to best direct resources to mitigate stress in a crisis and care for our caregivers.

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Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The authors declared the following potential conflicts of interest, none of which are directly relevant to this article. Murrough, J: In the past 5 years, Dr. Murrough has provided consultation services and/or served on advisory boards for Allergan, Boehreinger Ingelheim, Clexio Biosciences, Fortress Biotech, FSV7, Global Medical Education (GME), Impel Neuropharma, Janssen Research and Development, Medavante-Prophase, Novartis, Otsuka, and Sage Therapeutics. In the past 12 months, Dr. Murrough has provided consultation services and/or served on advisory boards for Boehreinger Ingelheim, Clexio Biosciences, Global Medical Education (GME), and Otsuka. Dr. Murrough is named on a patent pending for neuropeptide Y as a treatment for mood and anxiety disorders and on a patent pending for the use of ezogabine and other KCNQ channel openers to treat depression and related conditions.

Feder, A: Dr. Feder is named co-inventor on an issued patent in the United States, and several issued patents outside the U.S., filed by the Icahn School of Medicine at Mount Sinai (ISMMS) for the use of ketamine as a therapy for PTSD. This intellectual property has not been licensed.

Charney, D: Drs. Charney and Feder are named co-inventors on an issued patent in the United States, and several issued patents outside the U.S., filed by the Icahn School of Medicine at Mount Sinai (ISMMS) for the use of ketamine as a therapy for PTSD. This intellectual property has not been licensed. In addition, Dr. Charney is named co-inventor on several issued U.S. patents, and several pending U.S. patent applications, filed by ISMMS for the use of ketamine as a therapy for TRD and suicidal ideation and other disorders. ISMMS has entered into a licensing agreement with Janssen Pharmaceuticals, Inc. and it has and will receive payments from Janssen under the license agreement related to these patents for the treatment of treatment- resistant depression and suicidal ideation. Consistent with the ISMMS Faculty Handbook (the medical school policy), Dr. Charney is entitled to a portion of the payments received by the ISMMS. Since SPRAVATO has received regulatory approval for treatment-resistant depression, ISMMS and thus, through the ISMMS, Dr. Charney, will be entitled to additional payments, beyond those already received, under the license agreement. Dr. Charney is a named co-inventor on several patents filed by ISMMS for a cognitive training intervention to treat depression and related psychiatric disorders. The ISMMS has entered into a licensing agreement with Click Therapeutics, Inc. and has and will receive payments related to the use of this cognitive training intervention for the treatment of psychiatric disorders. In accordance with the ISMMS Faculty Handbook, Dr. Charney has received a portion of these payments and is entitled to a portion of any additional payments that the medical school might receive from this license with Click Therapeutics. Dr. Charney is a named co-inventor on a patent application filed by the ISMMS for the use of intranasally administered Neuropeptide Y (NPY) for the treatment of mood and anxiety disorders. This intellectual property has not been licensed. Dr. Charney is a named co- inventor on a patent application in the US, and several issued patents outside the US filed by the ISMMS related to the use of ketamine for the treatment of post-traumatic stress disorder (PTSD). This intellectual property has not been licensed.

The other authors have no disclosures to report.

Ethical Approvals

The study was approved and deemed exempt by the Institutional Review Board at the Icahn School of Medicine at Mount Sinai. HS#: 20-00423; GCO#1: 20-0888(0001) Icahn School of Medicine at Mount Sinai.

ORCID iDs

Jordyn H. Feingold https://orcid.org/0000-0002-4658-1520
James W. Murrough https://orcid.org/0000-0001-6286-1242

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