Individual and Work Factors Associated with Psychosocial Health of Registered Nurses During the Covid-19 Pandemic

A Mixed Methods Study

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Objective: To describe the initial influence of the Covid-19 pandemic on U.S. nurses' psychosocial health, and to identify factors associated with poor psychosocial health outcomes. **Methods:** We conducted a convergent (QUAN+qual) mixed methods study. From June to August 2020, we administered surveys ($N = 629$) and conducted semi-structured interviews ($N = 34$) among nurses working across healthcare settings in 18 states. We developed separate multivariable logistic regression models for three psychosocial outcomes (anxiety, depressive symptoms, insomnia). We used content analysis to process and analyze qualitative data, and integrated results in the final analysis step. **Results:** Nurses reported high rates of depressive symptoms (22%), anxiety (52%), and insomnia (55%). Disturbances to sleep were both a contributing factor to, and an outcome of, poor psychosocial health. **Conclusions:** Evidence-based interventions addressing work stress and sleep, and proactive monitoring of nurses' psychosocial health by employers are urgently needed.

Keywords: Covid-19, mixed methods, nurses, occupational health, psychosocial health, sleep

INTRODUCTION

The organization of work[1] in healthcare has contributed to poor psychosocial health and well-being among registered nurses (nurses), documented in the extant literature for decades. Specifically, organizational stressors such as understaffing with acutely ill patients,[2–4] long work hours and overtime,[5–7] and burdensome demands from electronic health records[8] all contribute to high rates of poor psychosocial health among nurses, including anxiety, depression, and insomnia. Healthcare workers overall are *less* likely to seek mental health services and supports than other working populations.[9] The alarmingly low rates of mental health service treatment may be attributed to a combination of obstacles that cross logistical, practical, and attitudinal domains. Challenges along logistical and practical domains include psychiatric/mental health provider shortages,[10] time constraints due to shift work, on-call hours, and other unpredictability in scheduling, and competing priorities such as caregiving for children or aging family

members.[11] (Nurses are approximately 90% female[12] and over half [55%] have adult or children dependents at home).[12,13] Additionally, both direct and indirect economic costs associated with clinical treatment (ie, cost of treatment and income lost taking time off from work to receive treatment) represent a challenge for healthcare workers.[14] Finally, perceived negative stigma surrounding mental health treatment represents a major challenge in the attitudinal domain.[15,16]

Indeed, two relevant National Academy of Medicine (NAM) reports, the *Clinician Well-being and Resilience Action Collaborative* (2017) and the *Future of Nursing 2020–2030* (2021), underscored the need for rigorous research to inform interventions that will improve the work-lives and well-being of health care professionals, especially nurses.[17,18] These calls are germane to this population, given traditional mental health services are utilized at such low rates. Notably, these reports pre-dated the ongoing Covid-19 pandemic, designated by the World Health Organization (WHO) as a global pandemic in March 2020,[19] which has been devastating to the nursing workforce for nearly 2 years. As has been noted widely in the emerging empirical literature[9,20,21] and across lay media,[22,23] nurses have been at the frontlines of the pandemic, which has killed over 5 million people worldwide.[24] Limited or no personal protective equipment (PPE), acute staffing shortages during surges, and lack of coordinated communication across public health and administrative leaders have been widely reported as stressors by nurses.[25]

Most research exploring nurses' psychosocial health during Covid-19 has used cross-sectional, quantitative study designs,[26] and much of the data presented has been collected outside of the United States.[9,20,26] Less research has taken a mixed methods[27] or longitudinal approach to understand how the pandemic has been experienced by nurses under varying contexts (eg, working in hospital and non-hospital settings, direct patient care roles vs no direct patient care). These contextual differences are important to capture when crafting primary, secondary, and tertiary interventions aimed at (1) promoting nurses' psychosocial health, (2) evaluating nurses experiencing poor psychosocial health and supporting those at risk, and (3) assisting nurses' recovery and safe return to work. Thus, this concurrent mixed methods study had two objectives. Among a national sample of U.S. nurses, we sought to first document and describe the initial (first 6 months) influence of the Covid-19 pandemic on nurses' psychosocial health; and second, to identify factors associated with poor psychosocial health outcomes.

The study was guided by the *Work, Stress, and Health* framework.[28] The framework describes the relationship between organizational work stressors, such as major acute events and the adverse consequences on worker health, both short-term responses like elevated blood pressure as well as enduring outcomes like disease, disability, or injury.[28] Exposure to work stressors may have a direct effect on health outcomes or can be buffered by the individual's response through appraisal of the stressor and the coping response as well as individual or organizational resources, such as knowledge/expertise or social support.

METHODS

Design

We conducted an exploratory, descriptive study with a convergent mixed methods design (QUAN+qual), in which the quantitative data were prioritized and qualitative used to explain and augment findings.[29] The quantitative data were captured in a survey of nurses' work environment, Covid-19 related experiences, and psychosocial health outcomes using REDCap, a secure cloud-based platform for data collection and management.[30] Qualitative data were captured in semi-structured interviews conducted through audio only Zoom meetings, a cloud-based audio/video conferencing platform. The purpose of the qualitative data in this study was to deepen our understanding of factors associated with nurses' psychosocial health outcomes.

Sample/Sampling

Recruitment was completed electronically through several channels. First, email recruitment letters were sent to nursing program directors at National Institute for Occupational Safety and Health-funded Education and Research Centers (ERCs) and regional professional nursing organizations, who then sent the letters to member list servs. The locations of the ERCs and organizations allowed us to recruit a diverse geographic sample experiencing differing degrees of Covid-19 infections and hospitalizations in their communities during the initial period of the pandemic (June–August 2020). Second, we recruited on major social media platforms (Facebook, Instagram, LinkedIn, and Twitter) on the authors' individual and university accounts. Eligibility criteria included: (1) being a registered nurse, (2) currently working in the United States, and (3) have at least 6 months of work experience since initial nursing licensure.

Following completion of the survey, participants were asked if they were willing to take part in an individual interview, scheduled at a day and time of their choosing. For the subset of participants completing the qualitative interviews, we used maximum variation sampling techniques,[31] purposively selecting a sample of nurses of diverse age, race/ethnicity, and geographic location, which was monitored by the principal investigator. Following each form of data collection, participants were entered into a random drawing for one of ten $50 e-gift cards.

Quantitative Data Collection and Analysis

Our survey was composed of three sections. First, we collected participant demographics (eg, age, gender, education) and work characteristics (eg, job position, unit type). The questions were based on the National Sample Survey of Registered Nurses,[12] a survey conducted every 4 years by the Health Resources and Services Administration. Next, we used investigator-developed questions to assess Covid-19 response and organizational resources and support (eg, PPE shortages). Lastly, we assessed psychosocial health using valid and reliable tools for anxiety, depressive symptoms, and insomnia. The *Patient Health Questionnaire (PHQ-9)* is a 9-item survey measuring depressive symptom severity,[32] the *Generalized Anxiety Disorder (GAD-7)* measures anxiety using 7 items,[33] and the *Insomnia Severity Index (ISI)* measures insomnia symptoms and also has 7 items.[34]

Data analysis included inspection of all variables for distribution, outliers, and missing data. Missing data did not exceed 5% for any of the included variables. Following data cleaning, descriptive statistics were calculated. Next, we conducted bivariate and then multivariable logistic regressions using work and Covid-19 characteristics to predict psychosocial outcomes, controlling for demographics. Separate models were developed for the three outcomes: anxiety, depressive symptoms, and insomnia.

Qualitative Data Collection and Analysis

Data about the experience of nurses working during the initial period of the Covid-19 pandemic, with a focus on psychosocial health, were collected through semi-structured individual interviews lasting 30 to 60 minutes. Interviews were conducted by three authors. An interview guide based on the conceptual framework guiding this study *(Work, Stress, and Health)*[28] consisted of a series of theoretically derived open-ended questions and probes that focused the interview while allowing the participant to speak freely. Examples from the interview guide include, "Tell me about your experience or your colleague's experience with Covid-19" and "Tell me what a good day looked like on your unit."

The processing and analysis of the qualitative interview data was completed using content analysis.[35] Following professional transcription of the interviews, the three authors read through the interview transcripts, post-interview notes, and memos. The preliminary analysis of the data included a line-by-line review that yielded clusters of data that were labeled into short headings, using ATLAS.ti software.[36] Codes derived from these data, informed by the conceptual framework, were linked to interview sections and questions, resulting in coding categories. Lastly, we identified themes from the codes and categories. We reached data saturation after 34 interviews, which was established through consensus of the research team.[37]

Rigor was ensured by addressing transferability, credibility, dependability, and confirmability.[38] The interprofessional researchers met frequently throughout the analysis process to discuss coding and theme identification. Use of direct quotes and inclusion of the research context in the analysis reflect transferability. The researchers included a practicing nurse practitioner (also PhD prepared), two academic nurses (PhD prepared), and a licensed clinical psychologist, to promote objectivity, reduce researcher bias, and enhance credibility of the data. A codebook was kept, ensuring conceptual accuracy and clarity, as well as an audit trail of coding notes/memos and meeting notes for dependability. Every interview was coded independently twice; first by one researcher; next, a second researcher reviewed and confirmed the codes. If discrepancies arose, they were resolved through consensus with a third researcher. Last, confirmability was achieved by discussing the findings with a nursing workforce expert who was not part of the study team.

Integration of Quantitative and Qualitative Data

To integrate the quantitative and qualitative data, we used joint analysis displays.[31,39] The statistically significant variables in the multivariable logistic regression models were compared with the codes and themes emerging from the qualitative data; confirmation, discordance, or expansion of the two types of data were identified. In this manner, the results from the quantitative results were enhanced through the findings from the qualitative data to yield a more detailed understanding and perspective of the nurses' experiences working during the pandemic.

Institutional review board approval was obtained at the researchers' university (IRB#2020-4460).

RESULTS

We present the participants' demographic characteristics, work characteristics, and psychosocial health outcomes in Table 1. The table shows characteristics of the entire sample as well as only the participants who completed interviews in an abbreviated format to preserve anonymity. Overall, the sample (*N* = 629) represents a similar profile to that of the National Sample Survey of Registered Nurses (NSSRN).[12] Compared to the NSSRN representative sample, our full sample and subsample completing the interviews (*n* = 34) is slightly younger (average age of 43 compared to 48 in NSSRN) and a greater proportion were employed in the hospital

TABLE 1. All Participant Characteristics

	Entire Sample (N = 629)	Subsample of Qualitative Interviews (n = 34)
	M ± SD	
Sociodemographic characteristics		
Age	42.94 ± 12.58	43 ± 13
Gender	n (%)	
Female	575 (92.30)	31 (91)
Male	45 (7.22)	3 (9)
Nonbinary	0 (0)	0 (0)
Prefer not to answer	3 (0.48)	0 (0)
Ethnicity		
Latinx or Hispanic	45 (7.26)	1 (3)
Race		
African American/Black	50 (7.95)	1 (3)
Native American	6 (0.95)	0 (0)
Pacific Islander	5 (0.79)	2 (6)
Asian	49 (7.79)	2 (6)
White	506 (80.45)	28 (82)
Mixed race	24 (3.82)	1 (3)
Marital status		
Never married/single	140 (22.36)	
Married/domestic partnership	405 (64.70)	
Divorced/widowed/separated	81 (12.94)	
Highest nursing degree		
Nursing diploma	12 (1.91)	
Associate's degree	118 (18.79)	
Bachelor's degree	376 (59.87)	
Master's degree	104 (16.56)	
Doctorate degree	18 (2.87)	
Children		
No children/no children at home	307 (49.36)	
Children at home	315 (50.64)	
Work characteristics		
Job title		
Staff nurse	480 (76.56)	
Advanced practice nurse	18 (2.87)	
Administrator	46 (7.34)	
Nurse educator	36 (5.74)	
Other	47 (7.50)	
Shift length		
8h	154 (24.48)	
10 h	57 (9.06)	
12 h	370 (58.82)	
Flexible schedule	35 (5.56)	
Other	13 (2.07)	
Schedule		
Days	436 (69.87)	
Evenings	30 (4.81)	
Nights	123 (19.71)	
Other	35 (5.61)	
Status		
Full-time	517 (82.32)	
Part-time	87 (13.85)	
Per diem	24 (3.82)	
Work setting		
Hospital (inpatient)	482 (76.63)	
Hospital (outpatient)	77 (12.24)	
Nursing home	7 (1.11)	
Nursing education program	11 (1.75)	
Community health setting	6 (0.95)	
School health	1 (0.16)	
Ambulatory care (non-hospital)	21 (3.34)	
Occupational health	5 (0.79)	
Home health care	9 (1.43)	
Other	10 (1.59)	
Unit setting		
Intensive care	68 (10.81)	

TABLE 1. (Continued)

	Entire Sample (N = 629)	Subsample of Qualitative Interviews (n = 34)
Step-down/transitional	61 (9.70)	
General/specialty	201 (31.96)	
Operating room	18 (2.86)	
Post-anesthesia care	20 (3.18)	
Labor/delivery	14 (2.23)	
Emergency room	65 (10.33)	
Home health care	12 (1.91)	
Physician's office	13 (2.07)	
Ambulatory care	11 (1.75)	
Outpatient	32 (5.09)	
Nursing home	7 (1.11)	
Non-clinical	25 (3.97)	
Not specific/float pool	14 (2.23)	
Other	68 (10.81)	
Psychosocial health outcomes		
Depressive symptoms (PHQ-9)		
Mild	26 (4%)	
Moderate	44 (7%)	
Moderately severe	51 (8%)	
Severe	18 (3%)	
Anxiety (GAD-7)		
Mild	186 (30%)	
Moderate	80 (13%)	
Severe	58 (9%)	
Insomnia (ISI)		
Mild to moderate	231 (37%)	
Moderate	97 (15%)	
Severe	17 (3%)	

N = 629. N (%) may not sum to 100 due to missing data or multiple categories selected, for example, race.

setting (77% vs 60% in NSSRN). The nurses who were interviewed were not substantially different in sociodemo-graphic characteristics from the entire sample. Most participants were staff nurses (77%) working 12-hour day shifts (59%) in a fulltime position (82%). Finally, we present the psychosocial health outcomes of our participants using the scoring criteria for each measurement tool. In sum, across our sample 22% had at least mild depression symptoms, 52% had at least mild anxiety, and 55% had at least mild to moderate insomnia

In Table 2, we present the integration of our quantitative and qualitative data in a joint display. The quantitative column indicates the statistically significant variable associated with the psychosocial outcome with an arrow indicating the direction of the relationship (ie, an arrow up indicates increased odds ratio while an arrow pointing down represents a decreased odds ratio). The next column includes exemplar quotes from our qualitative data that support, contradict, or expand the regression results. Finally, the last column indicates our conclusions and interpretations gathered from these two data sources, described through confirmation, discordance, or expansion.[39]

Our regression models revealed significant variables associated with increased odds of each psychosocial health outcome; the only work and Covid-19-related variable that predicted poor outcomes across all three models was shorter total sleep time before work, that is, 5 hours of sleep or less (see Table 2; Quantitative Results columns). The variable associated with increased odds of depressive symptoms was shorter total sleep time before work (odds ratio [OR] 1.63, 95% confidence interval [CI] 1.40, 2.03), while

TABLE 2. Joint Display of Nurse Experiences and Psychosocial Health Outcomes

Psychosocial Health Outcome	Quantitative Data (Logistic Regressions)			Qualitative Data (Nurse Semi-Structured Interviews)	Mixed Methods Meta-Inferences
	Variable	OR	95% CI		
Depressive symptoms	Shorter total sleep time before work (5 h or less) (↑)	1.63	1.40, 2.03	Even now, because of the screening process that we have, I'm getting less sleep I feel too because I'm up and I have to be at work by 4:00 am. whereas I never did that before. So, I do think that I have definitely lost sleep. I feel like there's been like times where you felt sad or you felt helpless and I think it kind of all comes in the midst of this 57—watching numbers just skyrocket how they have—and not really being able to do anything but on an individual basis is scary. I've always suffered with anxiety and depression my entire life so I've always been—I need to sleep a lot on my days off, but I don't sleep well on the days I go to work. I would just say that's all normal for me, but I feel like it's just I don't know magnified, amplified, whatever you want to say, more intense, worse than usual. But when I had reached out to the therapy app, I was just in a place where I was like—I think I signed up for that app at 3:00 am in the morning, I just couldn't fall asleep because that's when I felt like I was like, "Okay, this is what depression feels like and I should probably do something about it before it starts to spiral" which is when I signed up for the app.	*Confirmation* Participants described sleep patterns congruent to the bidirectional sleep and depressive symptoms relationship.
	Being married/ partnered (↓)	0.72	0.57, 0.92	My husband would actually drag me outside to go for walks and things like that because I just felt like I didn't have the capacity to do anything other than be at work. And I'm lucky, because my husband was very supportive. He got it. He saw the change in me and what my day was like, and what my head was like, and he was supportive. So, thank goodness, because it's just the two of us home, so I was lucky in that regard.	*Confirmation* Participants described situations where having a partner at home, or being married, served as a buffer against experiencing depressive symptoms.

TABLE 2. (Continued)

Psychosocial Health Outcome	Quantitative Data (Logistic Regressions)			Qualitative Data (Nurse Semi-Structured Interviews)	Mixed Methods Meta-Inferences
	Variable	OR	95% CI		
	Having at least 1 PPE shortage (↓)	0.24	0.10, 0.61	I mean we are told to reuse our N-95 mask three times before we get a new one but—after each use—you put it in a bin. It goes down to get cleaned with the ultraviolet light and then it will be clean and ready for you to use. And on your third use, you just say like, "I need a new mask" and they will provide you with a clean mask. There was in the beginning, specifically with hand sanitizer and then also with masks. We had patients that were coming in that were helping themselves to 20 or 30 of masks, and we had to put them out of the way so that we could monitor it... .So, probably the hand sanitizer was the one that we kind of felt the most and we were most irritated with. I mean we barely had any N-95s. We would have to go to our manager's office and sign out an N-95 and give them a reason why we needed it—like if we needed a new one. I think I went usually seven to eight shifts with the same N-95 the whole time. .. So, that was a little bit scary. We ran out of foot cover, like shoe covers. We never ran out of gowns, but we did run out of a certain type of gown. So, then we had to use ones that were like garbage bags. They weren't garbage bags, but they were just like a different material than the ones that we're used to and so you would be in a room and within probably 15 min, you'd just be drenched in sweat. It was horrific.	*Discordance* The qualitative data, while describing the PPE shortages or needing to conserve or reuse PPE, were not concordant in supporting the quantitative findings of at least one PPE shortage being associated with reduced depressive symptoms.
Insomnia	Having to relocate (↑)	1.66	0.08, 2.54	Once I got to New York [from Louisiana], I had issues sleeping. I had worked the night shift so flip flopping from working days to nights was hard for me. But even after being there for a week a, week and a half, I still had problems going to sleep. I'm older so I actually moved out of the house...I'd lived there by myself for probably about six weeks—six to eight weeks—before I moved back home. I could fall asleep fine, but then if I woke up it was just kind of constant worry. Did I touch that nurse with that hand or did I catch something on the floor or did I wash my hands before I ate? So, even for a while, I had to self-quarantine. So, I definitely saw a significant change in how I slept because I couldn't sleep in the same bed as my husband, which sounds corny, but overall I think I would say that, yes, I do sleep a little bit less soundly I think just because overall I'm just anxious about everything.	*Confirmation* Participants' statements regarding difficulty falling asleep or staying asleep due to relocating because of Covid-19 explained the relationship observed with insomnia in the regression models.

TABLE 2. (Continued)

Psychosocial Health Outcome	Quantitative Data (Logistic Regressions)			Qualitative Data (Nurse Semi-Structured Interviews)	Mixed Methods Meta-Inferences
	Variable	OR	95% CI		
	Having at least 1 PPE shortage (↓)	0.34	0.14,0.81	Based on the PPE shortages, in my opinion, I don't think we get enough and that's caused great concern on my end and a lot of other nurses' opinions because we feel as though we can't properly protect ourselves in order to provide patient care. . . . So, it's been a really stressful situation for us because we can't protect ourselves and then we don't know if we are are also exposing other really sick patients as well.	*Discordance* Participants described PPE shortages and how the great concern could potentially lead to difficulty sleeping, including insomnia symptoms. This is the opposite direction of the relationship found in the regression models.
				I mean, I was begging friends and family and that's how we got a lot of our PPE. It's like people made donations. So, it shouldn't be like that. That should never be. It should never, ever. . . .	
				Nobody will ever complain, but the one thing was not having protection. We have families. We have people that we're worried about bringing stuff home to. That was the biggest issue with everything and that's the biggest thing that it should never repeat itself	
				Thank God—I work for [hospital]—but thank God [hospital] didn't run out of PPE during the pandemic, but it's always in the back of your mind and there was some rationing that went on. . . And the feeling that we got—even though we never ran out of PPE—was that was always close.	
	Shorter total sleep time before work (5 h or less) (↑)	1.84	1.5, 2.23	It definitely affects I think sleep. That was probably the biggest issue I've had. It's better now, but for many months it was just not being able to sleep, not being able to fall asleep, [inaudible] waking up a lot. I never, ever, ever had a problem before ever. I don't carry a lot of stress on me. I'm not one to hold it in, but yeah I know that was probably the biggest issue I had.	*Confirmation* Similar to above related to relocation, participants' descriptions of getting less sleep before work explained the relationship observed with insomnia symptoms.
				Now sleeping is still difficult. I sleep a little better, but I wake up a lot and having a very difficult time.	
				I only slept like three hours a day and it was very, very difficult just to get out the door, personally. Then when I got to work, it was very difficult to just keep myself together, to be honest, to take care of these people and to watch these people it felt like suffocate to death on a nightly and daily basis.	
				I would close my eyes and see patients' faces and knowing that they probably weren't gonna be there the next time I went back or having very difficult phone conversations with family members and I had no answers. So, replaying the events of the day—what could I have done different—so yeah, I had a hard time shutting down at the end of the night.	

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TABLE 2. (Continued)

Psychosocial Health Outcome	Quantitative Data (Logistic Regressions)			Qualitative Data (Nurse Semi-Structured Interviews)	Mixed Methods Meta-Inferences
	Variable	OR	95% CI		
Anxiety	Working fewer hours per week (↓)	0.56	0.34, 0.94	One of my good friends... she's in a leadership position and she lost about—just in the last four months—she's lost about a third of her staff from—She had five people on her staff that contracted COVID-19 during the work. Two of them just have said, "This is not worth it and I'm not—" and just walked away and then another three who did not contract COVID-19, but are just living in the stress and anxiety and the fear of coming to work every day...actually walked away. We lost a lot of nurses. I think a lot of the older nurses were just done. It was a really, really, really anxiety-driven time for a lot of us. So, now, we're just trying to fill positions and figure out what's going to happen if there's a next wave. I think when people try and take a day for themselves schedule-wise and they try and use time off that they do have and they have accrued over time, we kind of get a little bit of pushback, which is frustrating because everybody wants to take their mental health day...and we always get pushback from it. So, they're like, "Oh, well you took a day last month" or stuff like that. "Why do you need this day?"	*Expansion* Participants described how working hours were related to anxiety and, in some cases, contributing to nurse turnover. Being unable to cope with the anxiety, stress, and fear associated with the pandemic resulted in nurses leaving their job. In addition, those who were unable to work fewer hours per week for their own mental health were at risk for poor psychosocial health outcomes.
	Shorter total sleep time before work (5 h or less) (↑)	1.65	1.37, 2.0	I had the anxiety and the constant racing of thoughts and that kind of kept me up and that didn't let me fall asleep as well. I don't know that I get a full eight hours of sleep a night. I'm always waking up. Sometimes I don't know why. Sometimes it's just my body reacting. I wasn't sleeping well. I would wake up with anxiety attacks—which I've never had in my life. My anxiety has been heightened from all of this. So I have been having trouble sleeping—getting to sleep and then staying asleep.	*Confirmation* Participants directly related their sleep and anxiety. There was also some overlap with other outcomes, including depression and insomnia.

↓ decreased odds ratio, ↑ increased odds ratio in regression models.
PPE, personal protective equipment.

being married/partnered (OR 0.72, 95% CI 0.57, 0.92) or having at least one PPE shortage (OR 0.24, 95% CI 0.10, 0.61) were associated with lower odds of depressive symptoms. Variables associated with increased odds of insomnia included shorter total sleep time before work (OR 1.84, 95% CI 1.5, 2.23) and having to relocate during the pandemic (OR 1.66,95% CI 0.08, 2.54) while lower odds of insomnia were associated with having at least one PPE shortage (OR 0.34, 95% CI 0.14, 0.81). Finally, variables associated with increased odds of anxiety included shorter total sleep time before work (OR 1.65, 95% CI 1.37, 2.0) while working less than 40 hours per week (OR 0.56, 95% CI 0.34, 0.94) was associated with decreased odds of anxiety. The sole demographic variable associated with psychosocial outcomes was race, in which those identifying as white experienced lower odds of poor psychosocial health outcomes.

Next, through our mixed methods analysis, we found confirmation among most of the quantitative and qualitative data sources. The only predictor that was significantly associated with the psychosocial health status of nurses working during the pandemic was shorter total sleep time before work. Throughout the individual interviews we heard from participants' descriptions of sleep as "*the biggest issue I've had*" with a mix of anxiety and insomnia co-occurring. Anxiety and ruminations about their working conditions—extreme stress, understaffing, redeployment into a Covid-19 unit, rationing/lack of PPE, high mortality—lead to night waking and/or difficulty falling back to sleep or initially falling asleep.

The nurses reported sleep problems, resulting in lower total sleep time, which was exacerbated by changes in work schedules by either extending weekly hours "*so, a lot of us were doing like 60-hour work weeks*" or more abrupt changes in shifts, such as "*they were really desperate for everyone to take turns and do night shifts. So, it didn't help flopping back and forth.*" These reports confirmed our quantitative findings in that the average number of weekly hours worked was 39 with a standard deviation of 10 hours. In addition, the nurses reported working voluntary overtime of about 3.4 hours per week with a standard deviation of over 5.5 hours.

We also found that there were cases of discordance between the quantitative and qualitative data and expansion of inferences in the integrated results. An example of discordance was that having at least one PPE shortage *decreased* the odds of both depressive symptoms and insomnia in the regression models. Although over 90% of the sample reported at least one PPE shortage in the survey, having outright PPE shortages was less described in the qualitative data. Rationing or reusing of PPE was more commonly described by our sample, for example, "*I mean we are told to reuse our N-95 mask three times before we get a new one but – after each use – you put it in a bin. It goes down to get cleaned with the ultraviolet light. . .*" This was one of the contributors of concern or rumination among the nurses, which could negatively influence sleep initiation and maintenance.

An example of expansion in the data integration was the quantitative finding that working fewer hours per week was associated with lower odds of anxiety, for example, "*. . .but I knew myself and I specifically did not pick up extra shifts because I knew that I wouldn't be able to handle it.*" The participant was referring to their mental health and associated anxiety surrounding working additional hours. Collectively, our qualitative results suggested nurses working more hours were also experiencing more anxiety and work stress. These data expanded our understanding of the effects of working hours during Covid-19, citing that the stress and anxiety associated with work were ultimately leading to some nurses quitting their job or even leaving nursing all together.

DISCUSSION

Our research identified individual and organizational work factors associated with poor psychosocial health among nurses during the first 6 months of the Covid-19 pandemic in the United States. These overlapping factors predicting insomnia, depression, and anxiety are complex. Our mixed methods approach highlights the way in which we can begin to unravel these issues, but further research is warranted to fully understand how to best support nurses and to relieve the work stress associated with these factors.

A bidirectional relationship between sleep and mental well-being (ie, depression and anxiety) has been identified by researchers in recent years.[40] While this area is still under investigation, what is known is that adequate sleep fosters both mental and emotional resilience,[41] and insufficient sleep predisposes the brain to negative thinking and emotional vulnerability.[41,42] Similarly, much of the research on nurses mental well-being involves both measures of depression/depression symptoms and anxiety.[43–48] A recent state of the science on depression in nurses revealed a multi-decade investigation into the risk factors, protective factors, prevalence, and impact on worker health and productivity. Findings noted that nurses are at nearly *twice* the risk of depression compared to other professions, with risk factors including female gender, shift work, and working in acute care setting.[49] Additional studies have documented suboptimal work design features, such as quick returns (<11 h between shifts),[50,51] lack of work breaks,[52] and shift work,[51,53] that are associated with insufficient sleep and mental well-being.[54–56]

Our results generally align with these observations in pre-Covid-19 studies. We noted across our interviews and in our three regression models that total sleep time was an underlying variable of significance. It was not only significant in predicting each of the poor psychosocial health outcomes, but we discovered that sleep problems were interwoven with anxiety and depressive symptoms among nurses in the interviews. Interestingly, we did not find that unit type or working directly with Covid-19 patients increased participants' risk of poor psychosocial health. One possible rationale for this is that the fear of the unknown and lack of clear guidance on disease management early in pandemic was so diffuse that it had a detrimental effect across the workforce, not only on those caring for known or suspected Covid-19 patients.

Furthermore, our findings both quantitatively and qualitatively confirmed the importance of emotional support outside of the work environment through partners/spouses and friends/colleagues. In addition to, or due to the absence of, organizational support, the nurses in our study relied on the relationships with partners/spouses to help them cope both physically and emotionally during the peak of the first wave of the pandemic by making meals, listening to them tell stories about their workday, and encouraging them to get out of bed on days off. Participants also described various ways in which their colleagues provided support. This was demonstrated through nurses organizing Zoom sessions to de-brief, gathering in community-organized appreciation events, or simple one-on-one discussions.

Implications

Implications of these findings warrant immediate action from organizations and additional research to understand long term outcomes related to the pandemic on the nursing workforce. Our work, combined with guidance from the NAM[57] and other leading organizations like the WHO,[58] International Labour Organization,[59] and Centers for Disease Control and Prevention,[60] call for focused interventions at organizational levels to assist the healthcare workforce recover from the Covid-19 crisis. Interventions should be aimed at primary, secondary, and tertiary levels to firstly promote health and prevent work stressors leading to poor psychosocial health but to also support nurses in a safe return to work following a poor health outcome.

Examples of primary prevention efforts in the Covid-19 era include resilience building and healthy coping training (eg,

mindfulness based stress reduction practices, grounding techniques) and developing supports for flexible working arrangements for staff (eg, for those with caregiving responsibilities), prepare a clear communication plan (eg, concise email messages and in-person huddles or de-briefing), and ensure adequate human and physical resources are in place (eg, stockpiles of PPE, bed capacity, adequate staffing).[61] Secondary prevention efforts might include monitoring staff for symptoms of poor psychosocial health outcomes, including symptoms of post-traumatic stress disorder—hyperarousal/reactivity, changes to mood and cognition, flashbacks or re-experiencing, and avoidance of triggers—and ensuring appropriate referrals to mental healthcare providers are made.[62] The traumatic nature of patient deaths and unprecedented impact of a worldwide pandemic represent significant risk for nurses, in particular, especially for those with a previous mental illness or substance use disorder.[62] Ensuring nurses have time away from work, protecting staff from excessive overtime hours and quickly rotating shifts, and routinely communicating with staff about how they are doing are also secondary prevention strategies leaders at the unit level and organizational level can employ.[26] Finally, in the case of tertiary intervention, examples may include allowing for time off for treatment, using paid time off/sick leave as available. Redeployment should be minimized for staff who already experienced deployment to a new or different work setting and vacation time should be protected and prioritized for staff needing to recover from the aftermath of the pandemic.[63] Public acknowledgment from senior leadership for nurses' contributions to patient care during the pandemic should be expressed clearly.[64] In sum, ongoing efforts to integrate new evidence and effective strategies to promote the health of the existing workforce and retain them at the bedside are paramount.

Limitations

There were limitations to this work. Although the period of data collection (surveys and interviews) occurred during the summer of 2020, and was central to our aim of occurring in the initial (first 6 months of the pandemic), we have perspectives from participants at solely one point in time. While the authors were primarily nurses and could introduce researcher bias, we purposely included an interprofessional team for diverse perspectives and interpretation of the results and not all the nurse researchers were actively in clinical practice at the time of the data collection. Finally, we acknowledge that about twice as many nurses consented and/or scheduled an interview but were unable to attend the interview due to last minute work demands during the pandemic.

CONCLUSION

Nurses working during the onset of the Covid-19 pandemic faced severe work stressors affecting their psychosocial health. Our study described the initial psychosocial impact that the Covid-19 pandemic had on U.S. nurses and identified factors associated with worse psychosocial health outcomes. We add relevant information for future research and decision-making around resource allocation to support and retain adequate numbers of nurses in the workforce. These findings are critical to preparation for other pandemics or public health crises that put significant strain on frontline workers.

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