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SCIENTIFIC INVESTIGATIONS

The effects of COVID-19 stay-at-home order on sleep, health, and working patterns: a survey study of US health care workers

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Study Objectives: By March 2020, COVID-19 forced much of the world to stay at home to reduce the spread of the disease. Whereas some health care workers transitioned to working from home, many continued to report to work in person as essential employees. We sought to explore changes in sleep, health, work, and mood in health care workers during the stay-at-home orders.

Methods: We developed a cross-sectional online survey administered to health care workers. The survey assessed changes in sleep, work, screen time, media exposure, diet, exercise, substance use, and mood. The survey data were collected between March 28, 2020, and April 29, 2020.

Results: A total of 834 of 936 individuals completed the entire survey. Respondents were from 41 US states. Mood after the stay-at-home orders worsened, and screen time and substance use increased. Total sleep time shortened in those continuing to work in person ($P < .001$), whereas it was unchanged in those working from home ($P = .73$). Those working from home went to bed later, woke up later, and worked fewer hours. Reduced total sleep time and increased screen time before bed were associated with worse mood and screen time. Longer sleep time was associated with better mood.

Conclusions: Health care workers' mood worsened regardless of whether work was in person or remote, although total sleep time was shorter for those working in person. Those working from home may have shifted their sleep time to be more in line with their endogenous circadian phase. Peer or other support services may be indicated to address sleep, mood, and health behaviors among health care workers during these unprecedented times.

Keywords: COVID-19, sleep, anxiety, depression, screen time, mood, circadian timing, alcohol use

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Previous studies conducted across the globe have shown higher stress, worsening mental health, and worsening sleep patterns in frontline health care workers during the COVID-19 pandemic. The rationale for this study was to examine whether sleep-, mood-, and health-related behaviors might differ between health care workers who transitioned to conducting care from home and those who continued to report in person to their respective hospitals or health care facilities.

Study Impact: This study shows worsening mood across health care workers, regardless of whether they were working from home or continuing to report to work. Our findings highlight the need for support programs to monitor mood and health during the COVID-19 pandemic.

INTRODUCTION

At the time this manuscript was drafted, more than 4.5 million patients with COVID-19 were identified in the United States, and > 150,000 lives were lost related to complications of the virus. In addition to morbidity and mortality on a massive scale, the stay-at-home order issued for most of the United States by the end of March 2020 created a naturalistic change in lifestyle during a time of significant protracted psychological stress. Health care workers represent a unique population because their essential work has continued after the stay-at-home order, with frontline workers facing increased hours and potential exposure to the SARS-CoV-2 virus. Conversely, ambulatory care providers have continued to care for patients with chronic illnesses but with a dramatic change in their practice as telemedicine has been rapidly adopted.

The psychological impacts of the COVID-19 pandemic have already been identified in health care workers in Wuhan Province, China, the epicenter of the pandemic. As early as January 2020, a high symptom prevalence of depression, anxiety, and a combination of depression and anxiety (48.3%, 22.6%, and 19.4%, respectively) was identified by an online survey of 5,000 health care workers.[1] Increased social media exposure was identified as a potential factor in worsening mood disorder symptoms.[1] Lai et al[2] found that severe depression was more common in nurses compared with physicians, and anxiety was higher in women than in men during this time. Although the prevalence of insomnia was overall low, slightly more frontline workers than second-line workers (10.5% vs 4.0%; $P < .001$) had moderately severe insomnia as calculated using the Insomnia Severity Index.[2] Similar results were found in Oman, where as many as 30% of physicians and nurses

who treated patients with COVID-19 experienced moderate to severe anxiety.[3]

These findings, combined with the well-known relationships between sleep, mood disorders, and stress, highlight the need for further exploration of sleep and mood changes in health care workers during the COVID-19 pandemic. To date, the United States has the highest burden of patients infected with SARS-CoV-2, and the mental health ramifications in this population have not yet been evaluated. Therefore, the objective of this study was to identify associations between sleep, health behaviors, and mood in health care workers during the COVID-19 pandemic. Because health care providers span diverse work environments and roles, from nurses on the frontline to ambulatory care clinicians, they provide a unique opportunity to evaluate the effects of COVID-19 on mental health and sleep in different occupational circumstances. We were particularly interested in whether sleep-, mood-, and health-related behaviors might differ between health care workers who transitioned to conducting care from home and those who continued to report in person to their respective hospitals or health care facilities. Our hypotheses were as follows: (1) in general, sleep, mood, and health behaviors would worsen because of the psychological stress of living life during a pandemic, and (2) the decrement in sleep, mood, and health behaviors would be less pronounced in health care workers working from home. In addition, given the contribution of sleep to mood, the association of sleep with mood changes during the pandemic were assessed.

METHODS

Design and participants

An online questionnaire was developed through the Qualtrics platform and consisted of 29 stem questions. After we received the University of Michigan Institutional Review Board (HUM00180147) approval, the Qualtrics survey link was sent via email to email listservs that would reach large numbers of health care providers. Although we targeted known psychology, sleep medicine, and sleep psychology listservs, the survey was also distributed widely to employees of the University of Michigan Medical Center. The link was also shared via Twitter. The survey was open for completion from March 28, 2020, to April 29, 2020. No compensation for participation was provided. After 31 days of data collection, 936 anonymous responses were identified. A total of n = 834 individuals completed the survey.

Study survey

The majority of response options were yes/no and multiple choice, with the exception of free text responses for estimated total sleep time (TST) and job title. The survey can be found in the supplemental material. Indicating yes to the stem of many of the items triggered branching logic questions about frequency and magnitude of response.

We inquired about respondents' current age, sex, residence, ethnicity, and race; whether children were home from school in the house; and if so, the number of children and their ages. There were 5 questions regarding work timing (items 10, 14, 14a, 15, 15a), 2 questions about transition of work to home (items 8, 8a), and 3 questions about telemedicine and the degree to which clinicians and patients were satisfied with this format (items 9, 9a, 9b). There were 5 questions about sleep (items 16, 16a, 16b, 17, 17a), 6 questions about substance use (items 18, 18a, 19, 20, 21, 22), 4 questions about screen time at bedtime and COVID-19-related media exposure (items 23, 24, 25, 25a), 2 questions about movement/exercise (26, 26a), 4 questions about diet (items 27, 27a, 28, 28a), and 5 questions on mood (items 29, 29a, 29b, 29c, 29d) during the stay-at-home order.

Statistical analyses

Data were assessed for normality and outliers and summarized with descriptive methods. Outcomes of interest included differences between sleep schedule, work schedule, bedtime screen time, media exposure, substance use, and mood in health care workers who reported in person compared with these differences among those who worked primarily from home. The χ^2 and t test were used to detect statistically significant differences between groups for binary and continuous variables, respectively. Questions that assessed items at the current time and in retrospect (before the start of the stay-at-home order) within participants (items 12 and 13 and 19–22) were assessed for with paired t tests. Logistic regression models were constructed to determine the association between sleep and other health behaviors on the dependent outcome of mood. Mood ratings contained 7 levels, from "much better" to "much worse." Therefore, we converted each level to a scale of –3 to 3, where –3 denoted a much worse mood and 3 denoted a much better mood. All analyses was performed using IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY).

RESULTS

Demographics

Sociodemographic characteristics of the survey respondents can be found in **Table 1.** Among the 834 participants, 656 (78.5%) were women and the mean age was 43 ± 12.9 years (range = 19–83 years). The majority of respondents were from Michigan (n = 622; 74%), but the survey was completed by respondents in 41 out of the 50 US states. Most (96%) of the participants were non-Latino and White. Approximately half (47%) of the patients were engaged in direct patient care. Respondents were psychologists (21%), physicians (18%), and nurses (10%), and the rest were a mix of advanced care practitioners (eg, physician assistants, technicians, medical assistants, physical therapists, and respiratory therapists). A total of 107 participants (12.8%) were frontline health care workers directly engaged in treating or caring for patients with or suspected to have COVID-19. Of those who were conducting their jobs mostly from home, 78% were female, 85% were White, and 40% reported having children home from school in the house.

Work schedule changes during stay-at-home order

A total of 540 (65%) respondents were currently working from home, and 294 (35%) continued to report to work in person at the

Table 1—Demographic characteristics (n = 834).

Variable	n	%
Sex		
Male	173	20.7
Female	656	78.7
Nonbinary	2	0.2
Prefer not to say	3	0.4
Ethnicity		
Non-Latino	798	95.5
Latino	29	3.5
Race		
White	712	85.2
Asian	38	4.5
Black/African American	24	2.9
More than one race	30	3.6
Occupation		
Direct care provider (eg, doctor, nurse)	396	47.4
Health care administrator	102	12.2
Researcher	76	9.1
Frontline worker	107	12.8
Children at home		
Yes	346	41.4
No	196	23.4
Not applicable	292	34.9
More than 1 child at home	245	29.3
Children aged < 12 years at home	199	23.8

time of the survey completion. **Table 2** describes significant differences in sleep, health behaviors, and mood between those who were working from home vs those who continued to report in person to work. Of the 294 participants who continued to report to work in person, 18 (8%) reported that they were frontline providers for patients with COVID-19. Approximately one-third (29%) of the participants who were working from home at the time of the survey reported that they started working from home between March 15 and 21, 2020. Most of the participants (60.5%) reported that their work did not require them to follow a fixed work schedule while working from home. As a result, 53% reported that they had adjusted their work hours, with 36% of those respondents reporting working fewer hours. Of those who were conducting their job mostly from home, 197 (74%) reported working fewer hours. Approximately 58% of the respondents reported that they varied their work schedule, such that approximately 25% of the respondents were beginning work later and 20% were ending work later. Approximately 36% reported that they were conducting care via telehealth, and 56% reported feeling "somewhat satisfied" with this care delivery method.

Sleep schedule changes

Since the stay-at-home order was issued, most of the participants (71%) reported that their sleep patterns had changed. In the overall sample of 834 participants, a small but statistically significant reduction in TST was noted; respondents estimated their average TST to be 7.1 ± 0.9 hours (range = 4–10 hours) in January 2020 and 7.0 ± 1.4 hours (range = 3–13 hours) since the stay-at-home order (t = 2.8; P = .001).

The majority (n = 388; 72%) of participants who were conducting their job mostly from home reported that their sleep patterns had changed. Compared to those continuing to report to work, most (n = 248; 64%) of those at home reported going to bed later (χ^2 = 15.2; P = .001) and waking up later (n = 287; 74%; χ^2 = 91.2; P < .001).

Participants working from home had no significant change in TST from January (n = 540; 7.2 ± 0.9 hours [range = 5–10 hours]) to March 2020 (n = 540; 7.2 ± 1.3 hours [range = 3–12 hours]). Those who were working in person reported a shorter TST from January (n = 292; 7.1 + 1.6 hours [range = 4–9 hours]) to March 2020 (6.6 +1.7 hours [range = 3–13 hours]; t = 5.1; P < .01). Most participants did not have a change in the number of naps they were taking (n = 667; 80%), but most of those who did have a change in napping reported that they were napping more frequently (n = 139; 83%).

Media exposure/bedtime screen time

The majority of the participants (78%) were consuming more news since the end of February 2020. Most viewed between 30

Table 2—Sleep, health, and mental health by working-at-home status.

	Working From Home (n = 539), mean (± SD) or n (%)	Working In-Person (n = 290), mean (± SD) or n (%)	*t* (*P* Value)/χ^2 Test of Independence
Average sleep duration			
Before stay-at-home	7.20 h (±.84)	7.04 h (±1.5)	*t* = –0.200; *df* = 538 *P* = .842
During stay-at-home	7.21 h (±1.2)	6.58 h (± 1.52)	*t* = 5.13; *df* = 289 *P* < .001
Work hours			
More hours	n = 69 (26)	n = 67 (39)	$\chi^2(1) = 7.8$ *P* = .005 n = 440
Fewer hours	n = 197 (74)	n = 107 (62)	
Sleep schedule			
Bedtime later	n = 248 (64)	n = 116 (56)	$\chi^2(2) = 15.1$ *P* = .001 n = 595
Bedtime earlier	n = 40 (10)	n = 46 (22)	
Bedtime same	n = 99 (26)	n = 46 (22)	
Wake time later	n = 287 (74)	n = 72 (35)	$\chi^2(2) = 91.2$ *P* < .001 n = 596
Wake time earlier	n = 51 (13)	n = 85 (41)	
Wake time same	n = 50 (13)	n = 51 (25)	
Exercise/movement			
More	n = 211 (48)	n = 78 (39)	$\chi^2(1) = 4.6$ *P* = .033 n = 636
Less	n = 226 (52)	n = 121 (61)	
Diet			
More food	n = 204 (73)	n = 97 (63)	$\chi^2(1) = 4.2$ *P* = .041 n = 433
Less food	n = 76 (27)	n = 56 (37)	
More healthy	n = 146 (48)	n = 63 (36)	$\chi^2(1) = 6.4$ *P* = .012 n = 480
Less healthy	n = 159 (52)	n = 112 (64)	
Mood change			
Better/same	n = 61 (16)	n = 20 (9)	$\chi^2(1) = 7.7$ *P* = .005 n = 602
Worse	n = 308 (84)	n = 213 (91)	$\chi^2(3) = 9.2$ *P* = .027 n = 31
Much more depressed	n = 0 (0)	n = 2 (20)	
Much more anxious	n = 6 (29)	n = 0 (0)	
Much more irritable	n = 0 (0)	n = 1 (10)	
All of the above	n = 15 (71)	n = 7 (70)	

SD = standard deviation.

minutes and 2 hours of COVID-19-related news or social media per day. Most of the overall sample of participants (60%) reported that they were exposing themselves to more screen time, ie, using a smartphone or tablet around bedtime, with 37% engaged in 30 minutes to 2 hours of screen time before bedtime. Sixty-five percent (n = 317) of those working from home reported more bedtime screen time compared to 35% (n = 173) of participants continuing to report to work. Of those who were conducting their jobs from home, 64% reported more than 1 hour of exposure per day, whereas 37% of those not working from home were exposed to more than 1 hour of screen time per day.

Substance use

Most (67%) participants did not change the amount of alcohol they were consuming, but those who did report a change noted that they were drinking more alcohol. Before the stay-at-home order, in January 2020, 7% of participants consumed alcohol > 4 times per week. Since the stay-at-home order, this percentage increased to 17%. Thus, there was a significant increase in the frequency of drinking alcohol ($t = –6.59$; $P < .001$). Alcohol use was reported to have increased regardless of whether individuals were conducting their job from home or not. Eighty-four percent (n = 148) of those working from home and 89% (n = 91)

Table 3—Sleep and working patterns by mood change.

	Mood Same or Better During COVID-19 Pandemic	Mood Worsened During COVID-19 Pandemic	*t* or χ^2 (*P* Value)
Average sleep duration before stay-at-home order	n = 81 6.84 h (SD = 0.99)	n = 522 7.25 h (SD = 1.4)	*t* = 2.6 *P* = .009
Average sleep duration after stay-at-home order	n = 81 7.48 h (SD = 1.4)	n = 521 6.83 h (SD = 1.5)	*t* = –3.6 *P* < .001
Change in sleep duration after stay-at-home order	n = 81 0.64 h (SD = 1.4)	n = 521 –0.42 h (SD = 1.6)	*t* = –5.7 *P* < .001
Conducting job from home	n = 61 (17%)	n = 308 (84%)	$\chi^2(1)$ = 7.7 *P* = .005
Wake time moved later	n = 45 (78%)	n = 217 (54%)	$\chi^2(2)$ = 11.9 *P* = .003
More screen time before bed	n = 41 (51%)	n = 341 (65%)	$\chi^2(1)$ = 6.5 *P* = .011

SD = standard deviation.

of those not working from home reported increased alcohol use. Most (92%) participants reported never using marijuana before or during stay-at-home. Of the remaining 8%, most increased their use of marijuana during the stay-at-home order ($t = -1.99$; $P = .046$).

Diet and exercise

Most participants (76%) reported a change in their amount of exercise/movement during the stay-at-home order, with approximately half of respondents exercising less. More than half of participants reported eating more food each day, and approximately half were eating less healthy foods. Those who worked from home reported eating more, but healthier foods (**Table 2**).

Mental health

Most participants (72%) reported that their mood had changed since the stay-at-home order, regardless of whether they worked from home or not. Across that sample, 2% reported that their mood was much better, 3% that their mood was moderately better, 7% slightly better, 3% about the same, 57% slightly worse, 24% moderately worse, and 5% much worse.

Contributions to mood change

When we separated the participants in the sample by mood change (same or better vs worsening), we found that in those whose mood worsened, TST was significantly shorter and they reported being exposed to more screen time before bed. Of those who reported worse mood, 111 (33%) were exposed to 1–2 hours of screen time before bedtime per night. A small percentage of those with better moods were exposed to more than 1 hour of screen time; for example, 11 (6%) reported their mood as slightly better, 1 (0.5%) as moderately better, and 3 (1.5%) as a much better mood. More participants who reported no change or better mood were more likely to report moving their wake time to a later time (**Table 3**) than those who reported worsened mood (**Table 3**).

To further understand the role of TST in mood, we ran a series of regressions controlling for age, sex, frontline worker status, working-from-home status, screen time before bed, and pre- and post-stay-at-home TST. **Table 4** shows that for every additional hour of current TST, mood was 0.161 points higher on average (on a scale of –3 to 3, where –3 denoted a much worse mood and 3 denoted a much better mood; 95% confidence interval, 0.079–0.243). Inclusion of prior TST (before stay-at-home) and current TST improved the adjusted R^2 of the model (.087) by .04—that is, it explained only 4% of the variability in mood.

DISCUSSION

This online survey study showed that during the time of the COVID-19 stay-at-home order, health care workers reported worsening mood in addition to several changes to their sleep, work, and behavior patterns. Those health care workers who continued to report to work in person during this time, permissible because of essential employee status, reported less TST and those who worked from home had no change in sleep duration. Most participants, regardless of whether they were working entirely from home or continuing to report to work in person, reported a worsening of their mood and increased bedtime screen time. Although most of the total sample of respondents reported no change in their frequency of drinking alcohol, within the 34% who reported a change, the majority of these people reported drinking more vs less alcohol. Those working from home went to bed later and woke up later. We found that additional hours of sleep were associated with better mood.

The worsening of mood in health care workers in this sample of participants is consistent with previous studies in other countries.[1–3] The etiology of the change in mood is likely multifactorial. In addition to the fear and uncertainty of living through a pandemic experienced by all workers, health care workers may be particularly affected because of the nature of their jobs as health care providers. Some may have felt limited in

Table 4—Multivariable linear regression determining the association between sleep variables and mood change during COVID-19.

	B	95% CI	Adjusted R^2	*B*	95% CI	Adjusted R^2
Intercept	–2.39	–3.36 to –1.41	0.043	–1.97	–3.37 to –0.576	0.087
Age	0.004	–0.006 to 0.014		0.004	–0.006 to 0.013	
Sex	0.151	–0.163 to 0.466		0.170	–0.139 to 0.479	
Frontline worker	0.426	0.119 to 0.734		0.298	–0.043 to 0.578	
Working from home	–0.080	–0.349 to 0.190		–0.050	–0.314 to 0.214	
Increased screen use before bed	0.232	–0.014 to 0.477		0.212	–0.027 to 0.452	
Before stay-at-home TST				–0.175	–0.308 to –0.043	
After stay-at-home TST				0.161	0.079 to 0.243	

CI = confidence interval, TST = total sleep time.

their ability to deliver direct patient care, which may have been reflected in reports of being only "somewhat satisfied" with telehealth. Also contributing may have been increased anxiety about personal exposure to COVID-19, transmitting the infection to their families at home, or "moral injury," ie, being exposed to trauma that they felt unprepared for.[4] These findings highlight the importance of deploying support programs or services to address the mental health needs of health care providers such as peer support programs, eg, Stress First Aid teams.[4] These teams may be led by peers with a background in psychological therapy through health care facilities to manage mood changes experienced by their employees.

Essential employees may be required to work longer hours to care for the surge in patients requiring health care services; there may be additional work hours, rotating shifts, or night shifts required. Health care workers who continued to report to work as essential employees during the stay-at-home order slept fewer hours. Health care workers working from home reported no change in TST during the stay-at-home order compared to during January 2020, and they reported going to bed and waking up later. Perhaps not having a morning commute and a more flexible work schedule allowed these individuals to sleep at a clock time that was more consistent with their endogenous circadian sleep phase. Although their mood was overall worse during the stay-at-home order regardless of whether they worked from home or not, the ability to sleep at a time that is consistent with one's natural endogenous circadian sleep phase may be part of an overall healthier lifestyle while working from home. It has been shown that *not* sleeping in line with one's endogenous circadian sleep phase, such as in delayed circadian sleep-wake phase disorder, can contribute to depression[5,6] and even suicidal ideation.[7] These findings are important considerations for employers of health care workers who require a fixed work time instead of flextime or "employee work-time control." Allowing flextime may improve well-being, mood,[8] job satisfaction, and job performance.[9]

Respondents reported they were more likely to engage in screen time before bed during the stay-at-home order, and this use was higher in those who reported worsening mood. Screen time before bed is not uncommon or unique to the effects of a pandemic stay-at-home order. For example, 90% of Americans use some form of electronics in the hour before bed.[10] The exposure to COVID-19-related media, however, may have been higher at this particular time given the need to stay informed with news or to engage in activities that participants typically did not have the opportunity for during a typical workweek. This behavior was also documented in Italy during its COVID-19 stay-at-home order. Cellini et al[11] showed that participants increased their usage of digital media near bedtime and shifted their sleep/wake patterns to a later time during stay-at-home. This "bedtime procrastination" (ie, going to bed later than intended despite the absence of external reasons[12]) or "shut-eye latency" (ie, the time spent using electronic devices near bedtime before attempting sleep[13]) has been associated with worsening mood. Given the cross-sectional nature of the current study, it is difficult to know the directionality of these findings. For example, it is not known whether increased screen time before bed led to worsening mood because of misinformation,[14] negative information from social media,[1] or light exposure at bedtime.[15] All of these factors could have led to changes in sleep patterns and worsening of mood, or vice versa. Health care workers may benefit from limiting screen time and media before bed, along with other sleep hygiene recommendations published when the pandemic began to unfold in Europe.[16]

Finally, although working from home was associated with some positive health behaviors such as increased movement and healthy eating, some respondents reported increasing their frequency of alcohol use. The use of substances is a common coping strategy during times of increased stress, particularly in this case with the stress of working while children are at home, financial stress, job stress, and the stress of contracting a highly communicable disease. The rise in frequency of alcohol use in this sample of participants is consistent with a 55% surge in alcohol sales in the United States at the time of the stay-at-home order.[17,18] Alcohol use patterns add another level of complexity to understanding the factors leading to mood changes in this sample of participants.

Strengths and limitations

The strength of the study was that it captured a large sample of health care workers during the pandemic. Limitations were as follows. First, the survey did not assess for sleep disturbance, eg,

insomnia, nightmares, or changes in sleep medication use before and after the stay-at-home order. Second, this group was an ethnically nondiverse sample of participants comprising mostly non-Latino White women living in Michigan and therefore does not reflect the scope of ethnographic disparities among those affected by the virus, Third, this survey was voluntary and self-reported and therefore lends itself to reporting bias for participants who may have felt more negatively impacted by the virus. In addition, we relied on retrospective self-report and did not capture historical data on most of the health behaviors, and therefore it is difficult to compare the current patterns to previous ones. Furthermore, we did not evaluate the potential impact of the participants themselves being diagnosed with COVID-19 or having a family member diagnosed with COVID-19. Finally, this group was an actively working sample of respondents, and we did not assess health care workers who had lost their jobs or had been furloughed.

CONCLUSIONS

Consistent with previous studies in other countries, this study highlights the ubiquity of a mood change in a sample of health care workers facing an unprecedented mandate of a stay-at-home order during the COVID-19 pandemic. Larger and more inclusive research studies should be conducted to delineate the differences in individuals during the stay-at-home period and the lasting impact of this change on our health care system, particularly with the increased use and promise of telemedicine.[19] Specific future directions may include the implementation of and research on support programs such as Stress First Aid, organizational peer supports, and flextime for better managing sleep, mood, and health during a time of chronic stress.

ABBREVIATION

TST, total sleep time

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