JAMDA 24 (2023) 164–170

JAMDA

journal homepage: www.jamda.com

Original Study

Risk Factors Surrounding an Increase in Burnout and Depression Among Health Care Professionals in Taiwan During the COVID-19 Pandemic

Wei-Min Chu MD, PhD [a,b,c,d,e,f], Hsin-En Ho MD [g,h,i], Yu-Li Lin MD [b,c,f], Jhih-Yan Li MS [j], Cheng-Fu Lin MD, MS [f,k], Cing-Hua Chen RN [l,m], Gow-Jen Shieh PhD [m,n], Wei-Cheng Chan MS [f], Yu-Tse Tsan MD, PhD [d,f,m,*]

[a] *Department of Family Medicine, Taichung Veterans General Hospital, Taichung, Taiwan*
[b] *School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan*
[c] *Department of Post-Baccalaureate Medicine, College of Medicine, National Chung Hsing University, Taichung, Taiwan*
[d] *School of Medicine, Chung Shan Medical University, Taichung, Taiwan*
[e] *Education and innovation Center for Geriatrics and Gerontology, National Center for Geriatrics and Gerontology, Aichi, Japan*
[f] *Division of Occupational Medicine, Department of Emergency Medicine, Taichung Veterans General Hospital, Taichung, Taiwan*
[g] *Department of Family Medicine, Taichung Armed Force General Hospital, Taichung, Taiwan*
[h] *Institute of Medicine, Chung Shan Medical University, Taichung, Taiwan*
[i] *National Defense Medical Center, Taipei, Taiwan*
[j] *Ming Crown Industry Company, Changhwa, Taiwan*
[k] *Center for Geriatrics and Gerontology, Taichung Veterans General Hospital, Taichung, Taiwan*
[l] *Department of Nursing, Taichung Veterans General Hospital, Taichung, Taiwan*
[m] *Department of Occupational Safety and Health Office, Taichung Veterans General Hospital, Taichung, Taiwan*
[n] *Department of Top Hospital Administration, Taichung Veterans General Hospital, Taichung, Taiwan*

ARTICLE INFO

Article history:
Received 2 April 2022
Received in revised form
18 November 2022
Accepted 6 December 2022

Keywords:
Burnout
depression
health care professionals
COVID-19

ABSTRACT

Objectives: This study aimed to investigate the risk factors surrounding an increase in both burnout levels and depression among health care professionals in Taiwan through use of a longitudinal study design.
Design: This is a 2-year observational study that took place from January 2019 to December 2020.
Setting and Participants: Data among health care professionals were extracted from the Overload Health Control System of a tertiary medical center in central Taiwan.
Methods: Burnout was measured through use of the Chinese version of the Copenhagen Burnout Inventory (C-CBI), whereas depression was ascertained by the Taiwanese Depression Questionnaire. Each participant provided both burnout and depression measurements during a nonpandemic period (2019) as well as during the COVID pandemic era (2020). Risk factors surrounding an increase in burnout levels and depression were analyzed through a multivariate logistic regression model with adjusting confounding factors.
Results: Two thousand nineteen participants completed the questionnaire over 2 consecutive years, including 132 visiting doctors, 105 resident doctors, 1371 nurses, and 411 medical technicians. After adjustments, sleeplessness, daily working hours >8, and stress due to one's workload were all found to be risk factors for an increase in depression levels, whereas sleeplessness, lack of exercise, and stress due to one's workload were all found to be risk factors for an increase in personal burnout level. Being a member of the nursing staff, a younger age, sleeplessness, and lack of exercise were all risk factors for an increase in work-related burnout levels.
Conclusions and Implications: Poor sleep, lack of exercise, long working hours, and being a member of the nursing staff were risk factors regarding an increase in personal burnout, work-related burnout levels and depression among health care professionals. Leaders within the hospital should investigate the working conditions and personal habits of all medical staff regularly and systematically during the

Ethics approval and consent to participate: This study was approved by Institutional Review Boards I and II of Taichung Veterans General Hospital (Case number: CE20343B-1).

The authors declare no conflicts of interests.

* Address correspondence to Yu-Tse Tsan, MD, PhD, Division of Occupational Medicine, Department of Emergency Medicine, Taichung Veterans General Hospital, 1650 Taiwan Boulevard Sect. 4, Taichung, Taiwan 40705.
E-mail address: janyuhjer@gmail.com (Y.-T. Tsan).

https://doi.org/10.1016/j.jamda.2022.12.010

COVID-19 pandemic and take any necessary preventive measures, such as improving resilience for nursing staff, in order to best care for their employees.

Since the first case of SARS-CoV-2 was discovered in Wuhan, China, in December 2019, the rapidly spreading virus was officially named as COVID-19 and the pandemic has affected millions of the world's population because of its highly contagious characteristics.[1,2] As of February 2022, COVID-19 has infected 392,145,701 people, leading to 5,724,353 deaths globally.[3] During the last 48 months from 2019 to 2021, health care professionals have acted as the first line of responders facing the pandemic and have been working under extremely high pressure, whether it be physically or psychologically, or both.[4] Health care professionals in Taiwan had the same experience. Initially, we thought the pandemic would be over in months; however, as the battle prolonged, our physical and psychological burden got heavier day by day, and we could not see the end of it. In a meta-analysis conducted by Hill et al, mental disorders, including post-traumatic stress disorder, anxiety disorder, and depression have been affecting health care workers both during and after infectious disease pandemics.[5] Thus, subsequent burnout and the emotional distress phenomenon has been seen in many countries during the pandemic.[6,7]

Numerous risk factors have been identified that could lead to both burnout and emotional distress during the COVID-19 pandemic, including high compassion fatigue and emotional depletion,[8] younger-aged employees with fewer years of work experience,[9] high anxiety or high depression scores, shifts lasting $\geq$8 hours, and being redeployed.[10] Additionally, health problems due to direct contact with infected people as well as higher levels of stress and depression in frontline workers are also significantly associated with being more susceptible to extreme burnout.[11] Another study also discovered that both job category and site of practice played a significant role in employment burnout among health care professionals.[12] In a Japan study, being a nurse, laboratory medical technologist, radiological technologist or pharmacist, as well as years of experience, anxiety due to unfamiliarity with personal protective equipment, a decrease in sleep, desire for a reduced workload, and desire for expectations of appreciation and respect were all significantly associated with burnout.

Among all the countries in the world fighting COVID-19, Taiwan possesses its own special existence because of its unique experience in fighting COVID-19, as it implemented quick proactive measures and used its advanced technology and big data analytics to play an important role in maintaining a low number of cases and fatalities.[13-15] However, despite Taiwan's positive results in fighting the pandemic, health care professionals still remain under immense pressure, with previous studies having shown the virus's negative impact of burnout and mood disorder within Taiwan's health care professional community.[16]

Although burnout and depression among health care professionals results in several negative consequences, including sickness presenteeism and related productivity loss,[17] it is also important to discover any risk factors surrounding an increase in burnout and depression. However, most of the previous studies regarding burnout and depression among health care professionals have been cross-sectional, with any evidence concerning risk factors regarding increased burnout and depression being scarce. The objective of this study was to examine the magnitude of and possible risk factors for personal and work-related burnout and depression among health care professionals during the COVID pandemic.

Methods

Data Source and Study Group

We conducted a 2-year observational study using a longitudinal design, during separate non-COVID and COVID periods. Data were extracted from the Overload Health Control System of a tertiary medical center in central Taiwan. All employees of the hospital were asked to complete a questionnaire regarding their job description, working conditions, and burnout level. We followed up on all participants who had completed the questionnaire for a period of 2 consecutive years, 2019-2020, in order to explore the effects the COVID-19 pandemic had on them, along with the risk factors responsible for any increase in burnout and depression. This study was approved by Institutional Review Boards I and II of Taichung Veterans General Hospital (Case number: CE20343B-1).

Independent Variables

In Taiwan, the publication *Guideline for Preventing Diseases Caused by Exceptional Workload* was released by the Occupational Safety and Health Administration of the Ministry of Labor in 2014. According to its guidelines, laborers must complete the overwork assessment questionnaire, which contains items related to sociodemographics (gender, age, and marital status), working conditions (current profession, length of employment and self-reported type of work), and lifestyle factors (smoking, alcohol, or betel nut use status; sleep patterns; mealtimes; frequency of eating out; exercise habits; and self-reported working hours/week). The items in the questionnaire were selected by a consensus of experts from the Occupational Safety and Health Administration of the Ministry of Labor, Taiwan. COVID-related units within the medical center were defined as the emergency department, medical intensive care units, and negative-pressure isolation wards.

Dependent Variables

Evaluation of an employee's burnout status included data regarding both personal and work-related burnout. Burnout levels were calculated using the Chinese version of the Copenhagen Burnout Inventory (C-CBI), as constructed by the Institute of Labor, Occupational Safety and Health, Ministry of Labor of Taiwan, which displays both genuine validity and reliability[18,19] (Supplementary Material 1). Questions such as "How often do you feel tired?" or "How often do you feel physically exhausted?" were asked to every employee. Evaluation of personal burnout and work-related burnout comprised 6 and 7 questions respectively, with 5 scores for each question determining the degree of personal burnout and work-related burnout (0, 25, 50, 75, and 100). Scores of 0 to 49, 50 to 70, and >70 for personal burnout indicate mild, moderate, and severe levels, whereas scores of 0 to 44, 45 to 60, and >60 indicate mild, moderate, and severe levels for work-related burnout, both respectively. The definition of an increased burnout level was ascertained if each participant's personal burnout or work-related burnout category increased from 2019 to 2020.

Evaluation of depression for each employee was conducted through the Taiwanese Depression Questionnaire (TDQ), a culturally sensitive 18-item questionnaire designed for Taiwanese people with genuine

Table 1
Demographics and Characteristics of the Participants From 2019 to 2020 (N=2019)

Variable	2019	2020
Job title		
Physician and nurses	1608 (79.64)	1608 (79.64)
Physician	237 (14.74)	237 (14.74)
Nurse	1371 (85.26)	1371 (85.26)
Medical technician	411 (20.36)	411 (20.36)
Department		
Medical unit	1995 (98.81)	1997 (98.91)
Administrative unit	24 (1.19)	22 (1.09)
Gender		
Male	320 (15.85)	320 (15.85)
Female	1699 (84.15)	1699 (84.15)
BMI		
Normal (18.5-23.9)	1086 (53.79)	1087 (53.84)
Abnormal	933 (46.21)	932 (46.16)
Waistline		
Normal	1840 (91.13)	1826 (90.44)
Abnormal	179 (8.87)	193 (9.56)
Lifestyle		
Smoking		
No	2002 (99.7)	2007 (99.75)
Yes	6 (0.3)	5 (0.25)
Drinking		
No	1972 (97.67)	1971 (97.62)
Yes	47 (2.33)	48 (2.38)
Sleepless		
No	1011 (50.07)	1042 (51.61)
Yes	1008 (49.93)	977 (48.39)
Exercise		
No	1244 (61.61)	1206 (59.73)
Yes	775 (38.39)	813 (40.27)
Eating out		
No	122 (6.04)	157 (7.78)
1 meal	489 (24.22)	556 (27.54)
2 meals	601 (29.77)	613 (30.36)
3 meals	807 (39.97)	693 (34.32)
Shift		
Day shift	1208 (59.83)	1200 (59.44)
Night shift	163 (8.07)	157 (7.78)
Shift (regular)	111 (5.5)	122 (6.04)
Shift (irregular)	537 (26.6)	540 (26.75)
Feeling workload is stressful		
No	959 (47.5)	987 (48.89)
Yes	1060 (52.5)	1032 (51.11)
Age, mean±SD	37.07±10.09	38.07±10.09
Seniority, mean±SD	12.2±9.85	11.77±10.14
BMI, mean±SD	20.41±8.62	20.73±7.72
Waistline, mean±SD	41.25±37.23	43.31±36.91
Daily working hours, mean±SD	9.02±2.18	9.27±18.66
Weekly hours of work, mean±SD	45.15±15.62	44.11±14.29
Overtime, mean±SD	2.22±10.03	1.84±8.70

BMI, body mass index.
Values are n (%) unless otherwise noted.

validity as seen in a previous study[20] (Supplementary Material 2). Questions such as "I often felt like crying" or "I felt blue and depressed" were asked to every employee. All items used a Likert-type, 4-response category scale. The responses were rescaled to a 0-54 metric, with cut points of 0-8, 9-14, 15-18, and >19 points being used to indicate none, mild, moderate, and severe depression, respectively. The definition of worsening depression was ascertained if each participant's mental health category increased from 2019 to 2020.

Statistical Analysis

Data were expressed as numbers with percentages or an average with standard deviation for continuous variables in regard to the demographic and participant characteristics. To examine differences in personal burnout, work-related burnout and depression status among health care professionals before and during the COVID-19 pandemic, the descriptive analysis was performed by using paired *t* tests and Wilcoxon signed rank tests for continuous and categorical variables, respectively. For discovering possible risk factors relating to increased burnout and depression among health care professionals in COVID-19 pandemic, all factors with significant association to an increase in personal burnout, work-related burnout, and mental health disorders by single logistic regression were entered into multinomial logistic regression with adjustment for other factors in order to calculate the odds ratios (ORs) and 95% confidence intervals (CIs). In addition, we analyzed the relationship between baseline depression and burnout levels and depression, personal burnout, and work-related burnout in 2020 (COVID-19 pandemic) to understand if baseline depression and burnout level could predict future depression and burnout when the external environment changed. A 2-tailed *P* value <.05 was considered statistically significant. Statistical analyses were performed using SAS, version 9.4 (Statistical Analysis Software 9.4, SAS Institute Inc, Cary, NC, USA).

Results

In total, 2019 participants completed the questionnaire over a period of 2 consecutive years. In 2019, the voluntary participants included 132 visiting doctors, 105 resident doctors, 1371 nurses, and 411 medical technicians. Table 1 shows the demographics of participants in both 2019 and 2020. The average age of participants in 2019 was 37.1 years, with an average seniority of 12.2 years. The mean body mass index of all participants was 20.4. In addition, 59.8% of the participants worked the dayshift, averaging 45.1 weekly working hours.

Table 2 reveals the difference in depression and burnout levels among physicians and nurses between 2019 and 2020. Depression levels improved significantly from 2019 to 2020 among nurses not working in a COVID-related department. Personal burnout levels also improved significantly for all physicians, including those in a non-COVID-related department, as well as all nurses, including those in a non-COVID-related department. Work-related burnout levels also improved significantly for all physicians, including those in a non-COVID-related department, as well as all nurses, including those in a non-COVID-related department. For physicians and nurses working in

Table 2
Difference Between Depression, Personal Burnout, and Work-Related Burnout Among All Health Care Professionals, Physicians, and Nurses in 2019 and 2020

		Depression		Personal Burnout		Work-Related Burnout	
	n	Mean*	*P*	Mean*	*P*	Mean*	*P*
All	2019	−0.231	.17	−2.744	<.0001†	−1.833	<.0001†
Physicians	237	−0.810	.094	−4.675	<.0001†	−3.653	.0001†
In COVID-related unit	10	−1.300	.478	0.830	.795	−2.150	.525
Not in COVID-related unit	227	−0.787	.115	−4.918	<.0001†	−3.719	.001†
Nurses	1371	−0.233	.273	−2.643	<.0001†	−1.894	<.0001†
In COVID-related unit	311	0.691	.127	−1.391	.144	0.140	.867
Not in COVID-related unit	1060	−0.504	.036†	−3.010	<.0001†	−2.491	<.0001†

*Mean change between 2019 and 2020.
†$P < .05$ as significant.

Table 3
Univariate and Multivariate Logistic Regression for Risk Factors of Increased Depression, Personal Burnout, and Work-Related Burnout Among Health Care Professionals

	Depression*				Personal Burnout†				Work-Related Burnout‡			
	Crude		Adjust		Crude		Adjust		Crude		Adjust	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Unit												
Non−COVID-related unit	Ref.		Ref.		Ref.				Ref.		Ref.	
COVID-related unit	1.33 (1.00, 1.76)	.049§	1.15 (0.85, 1.56)	.354	1.11 (0.8, 1.56)	.513	—	—	1.39 (1.10, 1.76)	.005§	1.02 (0.78, 1.35)	.839
Profession												
Physicians	Ref.				Ref.		Ref.		Ref.		Ref.	
Nurses	1.42 (0.97, 2.10)	.076	—	—	1.87 (1.14, 3.06)	.012§	1.36 (0.74, 2.50)	.312	1.99 (1.49, 2.66)	<.0001§	1.54 (1.02, 2.32)	.037§
Other medical technician	1.10 (0.71, 1.73)	.665	—	—	1.39 (0.80, 2.44)	.238	1.41 (0.77, 2.60)	.261	1.06 (0.76, 1.48)	.71	1.26 (0.84, 1.88)	.256
Gender												
Male	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Female	1.86 (1.30, 2.67)	.001§	1.45 (0.99, 2.12)	.053	1.57 (1.05, 2.34)	.026§	1.07 (0.66, 1.75)	.76	1.99 (1.55, 2.55)	<.0001§	1.21 (0.86, 1.69)	.268
Age group												
21-30 y	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
31-40 y	0.89 (0.68, 1.18)	.423	0.85 (0.63, 1.13)	.277	0.72 (0.52, 1.00)	.053	0.71 (0.51, 1.00)	.053	0.91 (0.73, 1.12)	.391	0.83 (0.63, 1.09)	.191
41-50 y	0.96 (0.71, 1.30)	.786	0.90 (0.65, 1.24)	.529	1.02 (0.73, 1.43)	.881	1.05 (0.73, 1.50)	.78	0.98 (0.77, 1.25)	.907	0.84 (0.55, 1.29)	.448
≥51 y	0.64 (0.44, 0.95)	.026§	0.75 (0.49, 1.14)	.18	0.55 (0.34, 0.87)	.011§	0.65 (0.40, 1.06)	.089	0.47 (0.35, 0.63)	<.0001§	0.50 (0.28, 0.90)	.021§
Seniority												
1-10 y	Ref.				Ref.				Ref.		Ref.	
11-20 y	1.22 (0.92, 1.62)	.165	—	—	1.05 (0.75, 1.46)	.776	—	—	1.08 (0.85, 1.36)	.509	1.09 (0.78, 1.53)	.599
≥21 y	0.81 (0.60, 1.10)	.173	—	—	0.86 (0.61, 1.20)	.391	—	—	0.74 (0.59, 0.92)	.009§	1.09 (0.67, 1.77)	.72
BMI												
Normal	Ref.				Ref.				Ref.			
Abnormal	0.97 (0.76, 1.24)	.828	—	—	0.75 (0.56, 1.01)	.066	—	—	0.99 (0.82, 1.20)	.962	—	—
Waistline												
Normal	Ref.				Ref.				Ref.			
Abnormal	0.78 (0.48, 1.26)	.304	—	—	0.67 (0.37, 1.21)	.188	—	—	1.05 (0.74, 1.49)	.752	—	—
Lifestyle												
Smoking												
No	Ref.				Ref.				Ref.			
Yes	0.96 (0.32, 2.86)	.944	—	—	0.30 (0.04, 2.30)	.252	—	—	1.80 (0.75, 4.31)	.186	—	—
Drinking												
No	Ref.				Ref.				Ref.			
Yes	1.00 (0.48, 2.08)	.996	—	—	1.11 (0.49, 2.52)	.786	—	—	1.02 (0.57, 1.81)	.936	—	—
Sleepless												
No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Yes	2.62 (2.07, 3.31)	<.0001§	2.08 (1.62, 2.67)	<.0001§	1.85 (1.42, 2.41)	<.0001§	1.49 (1.13, 1.98)	.005§	3.79 (3.15, 4.55)	<.0001§	2.76 (2.25, 3.37)	<.0001§
Exercise												
No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Yes	0.71 (0.56, 0.90)	.004§	0.80 (0.62, 1.02)	.08	0.60 (0.45, 0.79)	.0004§	0.65 (0.49, 0.87)	.004§	0.59 (0.49, 0.71)	<.0001§	0.68 (0.55, 0.83)	.0002§
Eating out												
No	Ref.				Ref.				Ref.		Ref.	
1 meal	0.90 (0.57, 1.44)	.663	—	—	0.99 (0.56, 1.76)	.989	—	—	1.45 (1.00, 2.11)	.045§	1.13 (0.74, 1.70)	.56
2 meals	1.13 (0.72, 1.79)	.59	—	—	1.18 (0.67, 2.06)	.554	—	—	2.15 (1.49, 3.10)	<.0001§	1.28 (0.84, 1.93)	.238
3 meals	1.16 (0.74, 1.81)	.526	—	—	1.62 (0.94, 2.78)	.08	—	—	2.28 (1.59, 3.28)	<.0001	1.19 (0.78, 1.80)	.40
Shift												
Day shift	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Night shift	1.16 (0.76, 1.78)	.493	0.95 (0.60, 1.50)	.827	1.06 (0.64, 1.78)	.8	0.88 (0.51, 1.51)	.643	1.75 (1.25, 2.46)	.0011§	1.30 (0.87, 1.93)	.189
Shift (regular)	1.46 (0.94, 2.29)	.096	1.06 (0.66, 1.70)	.806	1.43 (0.85, 2.40)	.177	1.12 (0.65, 1.94)	.671	1.42 (0.98, 2.07)	.062	0.90 (0.58, 1.39)	.639
Shift (irregular)	1.37 (1.07, 1.77)	.014§	1.03 (0.78, 1.36)	.798	1.61 (1.21, 2.14)	.001§	1.29 (0.94, 1.78)	.107	1.46 (1.19, 1.8)	.0002§	0.95 (0.74, 1.23)	.744
Feeling a bad work environment												
No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Yes	0.65 (0.50, 0.85)	.001§	0.82 (0.62, 1.09)	.178	0.68 (0.50, 0.92)	.014§	0.80 (0.58, 1.10)	.177	0.43 (0.34, 0.54)	<.0001§	0.56 (0.43, 0.73)	<.0001§

(*continued on next page*)

Table 3 (*continued*)

	Depression*				Personal Burnout†				Work-Related Burnout‡			
	Crude		Adjust		Crude		Adjust		Crude		Adjust	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Daily working hours												
≤8	Ref.		Ref.		Ref.				Ref.		Ref.	
>8	1.68 (1.34, 2.10)	<.0001§	1.62 (1.12, 2.35)	.009§	1.28 (0.99, 1.65)	.058	—	—	1.86 (1.56, 2.22)	<.0001§	1.13 (0.82, 1.56)	.429
Weekly hours of work												
≤40	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
>40	1.35 (1.08, 1.69)	.009§	0.74 (0.52, 1.08)	.122	1.31 (1.01, 1.70)	.035§	1.17 (0.88, 1.54)	.259	1.73 (1.45, 2.07)	<.0001§	1.20 (0.88, 1.64)	.239
Overtime												
No	Ref.				Ref.		Ref.		Ref.			
1-10 h	0.98 (0.74, 1.29)	.882	—	—	0.81 (0.60, 1.10)	.192	—	—	1.05 (0.85, 1.31)	.603	—	—
11-20 h	0.74 (0.40, 1.38)	.343	—	—	0.78 (0.38, 1.6)	.504	—	—	1.28 (0.8, 2.074)	.298	—	—
>20 h	0.47 (0.06, 3.74)	.477	—	—	0.61 (0.07, 4.96)	.651	—	—	2.52 (0.64, 9.89)	.183	—	—
Daily stressful workload												
No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Yes	2.07 (1.64, 2.61)	<.0001§	1.54 (1.20, 2.00)	.0008§	1.69 (1.3, 2.20)	<.0001§	1.38 (1.03, 1.85)	.026§	3.12 (2.60, 3.74)	<.0001§	2.14 (1.74, 2.63)	<.0001§

BMI, body mass index.

*Adjusted for COVID-related unit, Gender, Age, Sleepless, Exercise, Shift, Feeling a bad work environment, Daily working hours, Weekly hours of work, Feeling a stressful workload. The definition of worsening depression was ascertained if each participant's mental health category increased from 2019 to 2020.

†Adjusted for Job, Gender, Age, Sleepless, Exercise, Shift, Feeling a bad work environment, Weekly hours of work, Feeling a stressful workload. The definition of an increased burnout level was ascertained if each participants' personal burnout category increased from 2019 to 2020.

‡Adjusted for COVID-related unit, Job, Gender, Age, Seniority, Sleepless, Exercise, Feeling a bad work environment, Eating out, Shift, Daily working hours, Weekly hours of work, Feeling a stressful workload. The definition of an increased burnout level was ascertained if each participants' work-related burnout category increased from 2019 to 2020.

§$P < .05$ as significant.

COVID-related departments, there was no significant difference between 2019 and 2020 for depression level, personal burnout level, or work-related burnout level.

Table 3 shows univariate and multivariate analysis regarding risk factors for increased depression, personal burnout, and work-related burnout levels during the COVID pandemic. After adjustments, risk factors surrounding increased depression levels during the COVID pandemic were sleeplessness (OR: 2.08), daily working hours >8 (OR: 1.62), and a stressful feeling regarding one's workload (OR: 1.54). Risk factors surrounding increased personal burnout levels during the COVID pandemic were sleeplessness (OR: 1.49), lack of exercise, and a stressful feeling regarding one's workload (OR: 1.38) after adjustments. Risk factors surrounding increased work-related burnout levels during the COVID pandemic were being a nurse (OR: 1.99), a younger age, sleeplessness (OR: 3.79), and lack of exercise. We found that baseline depression/burnout level all significantly predicted depression and burnout level in the COVID pandemic after adjustment of other confounding factors (Supplementary Table 1).

Since January 2020, COVID pandemic occurred globally and affected Taiwan as well. Cases of COVID-19 surged in Taiwan since February 2020. Table 4 reveals the difference in depression levels, personal burnout levels, and work-related burnout levels between different job categories during 2020. In 2020, residents experienced higher depression levels, personal burnout levels, and work-related burnout levels, when compared with visiting staff. Personal burnout and work-related burnout were both significantly higher among nurses in COVID-related departments. There was no difference between physicians, whether working in a COVID-related department or not.

Discussion

This 2-year observational study that aimed to explore the risk factors surrounding increased depression levels, personal burnout levels, and work-related burnout levels discovered that sleeplessness, daily working hours >8, and a stressful feeling about one's workload are all risk factors for an increase in depression levels, whereas sleeplessness, lack of exercise, and a stressful feeling about one's workload are all risk factors for an increase in personal burnout levels. Furthermore, nurses, younger-aged employees, sleeplessness, and lack of exercise were all risk factors surrounding an increase in work-related burnout levels.

Nurses have been identified as those having a job with a high risk of burnout among all health care professionals,[21,22] particularly so during the COVID-19 pandemic.[23,24] We observed similar findings after analyzing the baseline depression and burnout level among different professions (Supplementary Table 2). Our results show that working as a nurse is one of the risk factors of an increase in work-related burnout. Considering that the battle against COVID-19 remains ongoing, it is now even more important to discover any possible risk factors for burnout among nurses. In a meta-analysis, risk factors for burnout among nurses include a younger age, decreased social support, a low readiness in family and colleagues to cope with the COVID-19 outbreak, an increased perceived threat of COVID-19, longer working times in quarantine areas, working in a high-risk environment, working in hospitals with inadequate and insufficient material and human resources, an increased workload, and a lower level of specialized training regarding COVID-19.[25] Another study also showed that nurses who were younger and had fewer years of work experience felt inadequate about their nursing care abilities, and therefore had higher levels of stress and burnout.[9] Understaffing is also a possible risk factor, as one study conducted by Lasater et al[26] discovered that each additional patient per nurse increased the odds of nurses experiencing burnout.

Thus, it is very important for nurses to avoid burnout, as several interventions have mentioned before. One study in Turkey indicated

Table 4
Difference in Depression Level, Personal Burnout Level, and Work-Related Burnout Level Between Different Job Categories in 2020

		Depression			Personal Burnout			Work-Related Burnout		
	N	Mean	SD	*P*	Mean	SD	*P*	Mean	SD	*P*
Physicians										
Attending physician	139	5.46	7.87	.004*	33.04	18.03	.003*	33.09	15.04	<.0001*
Resident	98	8.45	9.09		39.59	18.75		40.85	16.71	
Physicians										
COVID-related unit	10	6	4.32	.553	45.42	18.9	.119	43.56	15.51	.133
Non–COVID-related unit	227	6.71	8.64		35.32	18.49		35.98	16.17	
Nurses										
COVID-related unit	311	10.61	9.78	.07	47.96	20.41	.004*	47.67	17.43	.003*
Non–COVID-related unit	1060	9.53	9.16		44.79	20.04		43.89	16.6	

*$P < .05$ as significant.

that online group emotional freedom technique sessions reduced stress, anxiety, and burnout levels in nurses treating COVID-19 patients.[27] Another study showed that there was a protective effect for emotional intelligence against the adverse effects of psychosocial risks such as burnout among nursing staff in Spain.[28] A study in North India discovered that there was a significant negative correlation identified between burnout and resilience, suggesting that interventions for improving resilience are needed to help relieve burnout in nurses.[29] When these conclusions were combined with our study results, we found that adequate sleep and exercise were 2 important factors necessary in keeping health care professionals free from personal and work-related burnout.

Poor sleep has been proven to be associated with burnout among health care professionals.[30,31] A possible mechanism between poor sleep and burnout could be a chronic depletion of energy stores, or activation of the hypothalamic-pituitary-adrenal axis and increasing levels of bodily stress.[32] During the COVID-19 pandemic, evidence also showed that burnout levels were strongly associated with sleep quality. A study in Turkey discovered that burnout levels in nurses were elevated because of insomnia during the COVID-19 pandemic.[33] Moreover, a previous study among high-risk health care workers found that longer sleep durations were associated with lower odds of contracting COVID-19, whereas greater sleep problems and high levels of burnout were associated with greater chances of becoming infected with COVID-19.[34] This evidence, together with our results, suggest that sleep is an important influencer to mental health well-being.

A lack of exercise was also a risk factor for an increase in personal burnout and work-related burnout judging from our study results. Previous studies have demonstrated that having a habit of performing regular aerobic exercise was related to less burnout and a better quality of life among medical students,[35] whereas pathologic sleepiness was significantly associated with a higher prevalence of burnout.[36] A study among student nurse interns also showed that progressive muscle relaxation exercises can relieve clinical stress and ameliorate burnout.[37] Even during the COVID-19 pandemic, there was evidence that a lack of exercise was related to burnout among doctors and nurses in the intensive care unit in China,[38] which was similar with our results. Future studies should explore the effects of exercise on burnout among health care professionals during the COVID pandemic.

Another finding within our study showed that in general, personal burnout and work-related burnout both improved during the COVID-19 pandemic, when compared with 2019, especially for health care professionals who were not working in a COVID-related department. This finding was inconsistent with most previous studies, as burnout was a phenomenon during the COVID-19 era. A study in Tehran showed that levels of stress and occupational burnout were not significantly different and existed among the members of both groups regardless of where they worked in COVID-19 wards or general wards.[39] Another research that took place in Greece discovered that nurses working with COVID-19 patients had higher rates of fatigue and burnout compared with those working elsewhere.[40] However, as we mentioned previously, Taiwan is well regarded worldwide for its medical accomplishments in fighting the COVID-19 virus through the use of proactive measures, new technology, and big data analytics. Thus, patient cases of COVID-19 have been kept under control to a relatively low number since the beginning of 2020.[41] However, COVID-19 has had an impact on medical utilization, as total ambulatory medical visits decreased in Taiwan during the pandemic.[42] This may be the reason as to why burnout levels decreased, particularly for those staff who were not working in a COVID-related department. Furthermore, gradual psychological adaptation could also have occurred.[43] A study regarding nurses responsible for COVID patients in Taiwan showed that caring for these patients was negatively associated with depression.[44]

There were some strengths within this study. First, it included >2000 health care professionals working in a tertiary hospital and having diverse specialties and job descriptions. Second, it compared burnout levels and depression between a non-COVID era and the main COVID years within each participant, which was lacking in previous studies. Third, regulations by the Occupational Safety and Health Administration of the Ministry of Labor in Taiwan made it possible to explore and trace the burnout level and depression for each individual under excellent protection of personal data. As in many countries, data like these are confidential and cannot be traced back to the individual who completed it. There were also some limitations. First, we used a questionnaire to evaluate burnout, depression, and other variables, which is a subjective tool, whereas objective measurements such as blood tests were not performed. Second, this was a single-institution study; therefore, external validity should be carefully interpreted. Third, selection bias may occur because we included those who filled in the questionnaires in both consecutive years. However, only by doing that we could compare personal burnout, work-related burnout, and depression in 2 consecutive years and explore risk factors for increased personal burnout, work-related burnout, and depression. To avoid selection bias, we performed additional analysis to demonstrate demographics and characteristics of all participants before exclusion (Supplementary Table 3). After analysis, age and gender distribution was not statistically different between the 2 groups.

Conclusions and Implications

This 2-year observational study in Taiwan showed that there were multiple risk factors surrounding an increase in person burnout, work-related burnout, and depression among health care professionals, including poor sleep, lack of exercise, long working hours, and being a member of the nursing staff. Despite Taiwan's success in fighting the pandemic, health care workers still reported considerable distress and

difficult working conditions. Managers of hospitals should investigate both working conditions and personal habits of medical staff during a pandemic and take the necessary proactive measures, such as improving resilience for nursing staff, encouraging more exercise, and adjusting fair work shift to achieve longer sleep hours.

Acknowledgments

We thank our colleagues from China Medical University, Taichung, Taiwan, for assisting with the statistical analysis.

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Supplementary Material 1. The Chinese Version of the Copenhagen Burnout Inventory

1. How often do you feel tired?
2. How often do you feel physically exhausted?
3. How often do you feel emotionally exhausted?
4. How often do you feel "I cannot take it anymore!" ?
5. How often do you feel tired out?
6. How often do you feel weak as if you are coming down with illness?
7. Is your work emotionally exhausting?
8. Does your work make you feel burned out?
9. Do you feel frustrated with work?
10. After a day of work, do you feel exhausted?
11. Do you feel tired just thinking about starting another day of work?
12. Do you feel that every moment at work is hard?
13. Do you have enough energy to spend time with family or friends while not working?

Scoring: Always / To a very high degree: 100. Often / To a high degree: 75. Sometimes / Somewhat: 50. Seldom / To a low degree: 25. Never, almost never / To a very low degree: 0.

Personal burnout = (Q1+Q2+Q3+Q4+Q5+Q6)/6.

Work-related burnout= (Q7+Q8+Q9+Q10+Q11+Q12+Q13)/7.

Reference: Yeh WY, Cheng Y, Chen CJ, et al. Psychometric properties of the Chinese version of Copenhagen Burnout Inventory among employees in two companies in Taiwan. *Int J Behav Med.* 2007;14(3):126-133.

Supplementary Material 2. The Taiwanese Depression Questionnaire

1. I often felt like crying.
2. I felt blue and depressed.
3. I felt more agitated than before.
4. I had trouble sleeping.
5. I had a poor appetite.
6. I frequently had chest tightness.
7. I felt uneasy, uncomfortable.
8. I felt tired and weak.
9. I felt upset.
10. I had poor memory.
11. I could not concentrate when doing things.
12. I was slower in thinking and doing things than before.
13. I felt less confident than before.
14. I tended to look at the dark side of everything.
15. I felt miserable and even wanted to die.
16. I lost interest in everything.
17. I felt sick. (headache, dizziness, palpitation, or abdominal distress).
18. I felt worthless. 0.554 0.314

Scoring: Always, often: 3. Sometimes: 2. Seldom: 1. Never, almost never: 0.

Reference: Lee Y, Lin PY, Hsu ST, Cing-Chi Y, Yang LC, Wen JK. Comparing the use of the Taiwanese Depression Questionnaire and Beck Depression Inventory for screening depression in patients with chronic pain. *Chang Gung Med J.* 2008;31(4):369-377.

Supplementary Table 1
Multivariate Logistic Regression Exploring Risk Factors of Depression, Personal Burnout, and Work-Related Burnout in 2020 Pandemic Predicting by Depression and Burnout Status in 2019

	Depression*		Personal Burnout†		Work-Related Burnout‡	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Depression in 2019						
No	Ref.		Ref.		Ref.	
Yes	5.32 (4.08, 6.93)	<.0001§	2.32 (1.81, 2.99)	<.0001§	2.13 (1.63, 2.8)	<.0001§
Personal burnout in 2019						
No	Ref.		Ref.		Ref.	
Yes	1.73 (1.27, 2.37)	.001§	3.21 (2.41, 4.26)	<.0001§	2.21 (1.64, 2.99)	<.0001§
Work-related burnout in 2019						
No	Ref.		Ref.		Ref.	
Yes	1.53 (1.11, 2.1)	.01§	1.91 (1.42, 2.56)	<.0001§	2.91 (2.14, 3.95)	<.0001§
Unit						
Non–COVID-related unit	Ref.		Ref.		Ref.	
COVID-related unit	—	—	1.26 (0.93, 1.7)	.14	1.56 (1.13, 2.15)	.01§
Profession						
Physicians	Ref.		Ref.		Ref.	
Nurses	1.2 (0.74, 1.96)	.46	1.61 (1, 2.62)	.05	2.04 (1.24, 3.37)	.005§
Other medical technicians	1.57 (0.96, 2.56)	.07	1.67 (1.02, 2.72)	.04§	2.36 (1.42, 3.91)	.001§
Gender						
Male	Ref.		Ref.		Ref.	
Female	1.48 (0.99, 2.22)	.06	1.17 (0.8, 1.72)	.41	1.24 (0.83, 1.84)	.29
Age group						
21-30 y	Ref.		Ref.		Ref.	
31-40 y	0.94 (0.67, 1.3)	.69	0.74 (0.56, 0.98)	.04§	0.82 (0.59, 1.13)	.22
41-50 y	0.84 (0.5, 1.4)	.50	0.97 (0.7, 1.34)	.84	0.92 (0.55, 1.53)	.75
≥51 y	0.63 (0.32, 1.24)	.18	0.68 (0.46, 1.01)	.06	0.6 (0.3, 1.19)	.14
Seniority						
1-10 y	Ref.		—		Ref.	
11-20 y	1.81 (1.23, 2.68)	.003§	—	—	0.98 (0.67, 1.44)	.91
≥21 y	1.53 (0.87, 2.71)	.14	—	—	1.02 (0.58, 1.8)	.95
Sleepless						
No	Ref.		Ref.		Ref.	
Yes	1.55 (1.2, 2)	.001§	1.68 (1.32, 2.13)	<.0001§	1.28 (0.99, 1.66)	.06
Exercise						
No	Ref.		Ref.		Ref.	
Yes	0.86 (0.67, 1.1)	.23	0.84 (0.67, 1.07)	.16	0.98 (0.77, 1.26)	.90
Eating out						
No	Ref.		Ref.		Ref.	
1 meal	1.3 (0.74, 2.26)	.36	0.82 (0.48, 1.39)	.46	0.66 (0.39, 1.12)	.12
2 meals	1.35 (0.78, 2.34)	.28	0.79 (0.47, 1.34)	.38	0.68 (0.41, 1.15)	.15
3 meals	1.45 (0.83, 2.51)	.19	0.92 (0.55, 1.54)	.75	1.07 (0.64, 1.8)	.80
Shift						
Day shift	Ref.		Ref.		Ref.	
Night shift	1.08 (0.69, 1.68)	.75	0.92 (0.6, 1.41)	.71	1.11 (0.7, 1.75)	.65
Shift (regular)	1.34 (0.79, 2.3)	.28	0.55 (0.33, 0.92)	.02§	0.74 (0.44, 1.27)	.28
Shift (irregular)	1.23 (0.91, 1.65)	.17	1.1 (0.84, 1.45)	.48	1.26 (0.94, 1.68)	.12
Feeling a bad work environment						
Yes	Ref.		Ref.		Ref.	
No	0.95 (0.71, 1.28)	.75	0.96 (0.72, 1.27)	.77	0.82 (0.61, 1.1)	.19
Daily working hours						
≤8	Ref.		Ref.		Ref.	
>8	1.07 (0.73, 1.58)	.72	1.2 (0.83, 1.74)	.32	1.47 (1, 2.15)	.05
Weekly hours of work						
≤40	Ref.		Ref.		Ref.	
>40	1.01 (0.69, 1.47)	.97	0.99 (0.69, 1.41)	.94	0.93 (0.64, 1.35)	.71
Overtime						
No	—	—	Ref.		Ref.	
1-10 h	—	—	1.29 (0.99, 1.67)	.06	1.19 (0.91, 1.57)	.21
11-20 h	—	—	0.94 (0.64, 1.36)	.73	0.84 (0.57, 1.24)	.38
>20 h	—	—	1.19 (0.71, 1.99)	.50	0.91 (0.53, 1.56)	.74
Daily stressful workload						
No	Ref.		Ref.		Ref.	
Yes	1.4 (1.08, 1.8)	.01§	1.49 (1.17, 1.9)	.001§	1.34 (1.04, 1.73)	.02§

*Adjusted for depression in 2019, personal burnout in 2019, work-related burnout in 2019, COVID-related unit, Profession, Gender, Age, Seniority, Sleepless, Exercise, Eating out, Shift, Feeling a bad work environment, Daily working hours, Weekly hours of work, and Feeling a stressful workload.

†Adjusted for depression in 2019, personal burnout in 2019, work-related burnout in 2019, COVID-related unit, Profession, Gender, Age, Sleepless, Exercise, Eating out, Shift, Feeling a bad work environment, Daily working hours, Weekly hours of work, Overtime, Feeling a stressful workload.

‡Adjusted for depression in 2019, personal burnout in 2019, work-related burnout in 2019, COVID-related unit, Profession, Gender, Age, Seniority, Sleepless, Exercise, Eating out, Shift, Feeling a bad work environment, Daily working hours, Weekly hours of work, Overtime, Feeling a stressful workload.

§$P < .05$ as significant.

Supplementary Table 2
Comparison Between Baseline Depression and Burnout Level in 2019 Among Visiting Staffs, Residents, Nursing Staffs and Others

Profession	Depression			Personal Burnout			Work-Related Burnout		
	Mean	SD	*P* Value	Mean	SD	*P* Value	Mean	SD	*P* Value
Visiting staff (n=132)	5.73	7.59	<.0001*	37.47	18.77	<.0001*	37.18	16.34	<.0001*
Resident (n=105)	9.30	9.91	<.0001*	44.13	18.81	<.0001*	43.44	17.09	<.0001*
Nurse (n=1371)	10.01	9.59	<.0001*	48.15	20.39	<.0001*	46.64	17.01	<.0001*
Other (n=411)	8.82	9.25	<.0001*	44.00	18.62	<.0001*	42.05	16.64	<.0001*

*t test.

Supplementary Table 3
Demographics and Characteristics of the Participants Before Exclusion From 2019 to 2020

Variable	2019	2020
Total n	3274 (100)	3483 (100)
Job title		
Physician and nurses	2073 (63.31)	2208 (63.39)
Physician and nurses	355 (10.84)	563 (16.16)
Nurse	1718 (52.47)	1645 (47.23)
Medical technician	451 (13.78)	496 (14.24)
Administrative staff	750 (22.91)	779 (22.37)
Department		
Medical unit	2769 (84.58)	2988 (85.79)
Administrative unit	505 (15.42)	495 (14.21)
Gender		
Male	631 (19.27)	802 (23.03)
Female	2643 (80.73)	2681 (76.97)
BMI		
Normal (18.5-23.9)	1675 (51.16)	1786 (51.28)
Abnormal	1599 (48.84)	1697 (48.72)
Waistline		
Normal	2983 (91.11)	3166 (90.9)
Abnormal	291 (8.89)	317 (9.1)
Lifestyle		
Smoking		
No	3232 (99.29)	3447 (99.48)
Yes	23 (0.71)	18 (0.52)
Missing data (n)	19	18
Alcohol		
No	3167 (96.73)	3360 (96.47)
Yes	107 (3.27)	123 (3.53)
Sleepless		
No	1689 (51.59)	1935 (55.56)
Yes	1585 (48.41)	1548 (44.44)
Exercise		
No	1918 (58.58)	1996 (57.31)
Yes	1356 (41.42)	1487 (42.69)
Eating out		
No	223 (6.81)	283 (8.13)
1 meal	809 (24.71)	982 (28.19)
2 meals	983 (30.02)	1075 (30.86)
3 meals	1259 (38.45)	1143 (30.86)
Shift		
Day shift	2192 (66.95)	2506 (71.95)
Night shift	218 (6.66)	188 (5.4)
Shift (regular)	139 (4.25)	136 (3.9)
Shift (irregular)	725 (22.14)	653 (18.75)
Feeling workload is stressful		
No	1747 (53.36)	1972 (56.62)
Yes	1527 (46.64)	1511 (43.38)
Age, mean±SD	38.12±10.82	38.64±10.79
Seniority, mean±SD	12.79±10.79	11.79±11.00
BMI, mean±SD	20.37±9.40	20.66±9.40
Waistline, mean±SD	39.05±42.19	40.10±37.64
Daily working hours, mean±SD	8.91±2.46	9.42±22.01
Weekly working hours, mean±SD	44.61±21.23	44.48±15.89
Overtime, mean±SD	2.02±9.03	1.5±7.39

BMI, body mass index.
Values are n (%) unless otherwise noted.