

Occupational Stress and its Impact on Sleep Quality Among Nurses in Macao During the COVID-19 Pandemic: A Cross-Sectional Study

Jing WANG¹, Cindy Sin U Leong², Weng Ian Phoenix PANG³, Yok Man Cymon CHAN⁴

¹Department of Operating Theater, Kiang Wu Hospital, Macao

^{2,3}Peking University Health Science Center-Nursing Academy, Macao Polytechnic University, Macao

⁴Faculty of Health Sciences and Sports, Macao Polytechnic University, Macao

Corresponding author: Jing WANG, wangjing0110@gmail.com

Abstract

Conducted during the COVID-19 pandemic, this study aimed to describe the prevalence of occupational stress and poor sleep quality among clinical nurses in Macao, identify associated factors, and examine the relationship between these variables under crisis conditions. A cross-sectional study design was employed. Data were collected from 214 clinical nurses at a hospital in Macao using a structured questionnaire that included sociodemographic information, the Chinese version of the Job Content Questionnaire (C-JCQ), and the Pittsburgh Sleep Quality Index (PSQI). The data were analyzed using descriptive statistics, t-tests, ANOVA, Pearson correlation, and logistic regression. The results indicated that 32.7% of nurses experienced high occupational stress, and 50.5% suffered from poor sleep quality (mean PSQI score 7.85 ± 3.63), figures that reflect the immense strain of the pandemic era. Occupational stress was significantly associated with age, years of work experience, job title, night shift frequency, and salary ($p < 0.05$). Poor sleep quality was significantly associated with education level, alcohol consumption, and the presence of hobbies ($p < 0.05$). A significant correlation was found between dimensions of occupational stress and sleep quality. In conclusion, the pandemic amplified the significant issues of occupational stress and poor sleep quality among nurses in Macao. Hospital management must urgently implement targeted, evidence-based strategies to mitigate job-related stress and promote better sleep hygiene, thereby enhancing nurse well-being and building a more resilient workforce for future health crises.

Keywords: occupational stress; sleep quality; nurse; COVID-19; burnout; job content questionnaire; cross-sectional study

1. INTRODUCTION

The global healthcare landscape is currently navigating a period of unprecedented challenge, largely defined by a critical and worsening nursing shortage that was dramatically exacerbated by the COVID-19 pandemic (World Health Organization, 2022). Nurses represent the largest segment of the healthcare workforce and are the cornerstone of patient care delivery. Their well-being is not merely an internal human resources issue but a direct determinant of the quality, safety, and sustainability of healthcare systems worldwide. However, the very nature of the nursing profession—characterized by immense responsibility, high stakes, and relentless demands—places its practitioners at a heightened risk for occupational stress (Waddill-Goa, 2023). This stress, if left unmanaged, initiates a cascade of negative consequences, profoundly impacting the nurses' health, their professional longevity, and the safety of the patients they serve. The financial implications are also staggering, with the cost of replacing a single nurse estimated to be tens of thousands of dollars, making retention a key economic and operational priority (Rambur, 2024).

Occupational stress in nursing is a complex, multifactorial phenomenon. Theoretical frameworks provide essential lenses through which to understand its mechanisms. The Person-Environment (P-E) Fit Theory, for instance, posits that stress emerges from a misalignment between an individual's abilities, values, and needs, and the corresponding demands and resources of their work environment (Edwards & Cooper, 1990). More recently, the Job Demands-Resources (JD-R) model has become a dominant framework for explaining nurse burnout and engagement (Bakker & Demerouti, 2017). The JD-R model categorizes all job characteristics into two broad categories: job demands and job resources. Job demands are the aspects of the job that require sustained physical or psychological effort. In nursing, these include high workloads, time pressure, and intense emotional labor. These demands were amplified to an unprecedented degree during the COVID-19 pandemic, which introduced overwhelming patient loads, critical shortages of

personal protective equipment (PPE), profound emotional distress from witnessing mass casualties, and the constant personal risk of infection (Shaukat et al., 2020). This environment also gave rise to significant moral injury, as nurses were often forced to make decisions or work under conditions that violated their professional ethics, such as rationing care or working without adequate resources (Rushton et al., 2022). When these demands are chronically high, they lead to a health-impairment process, resulting in exhaustion, burnout, and psychosomatic health complaints (Wakefield et al., 2021).

Conversely, job resources are those aspects of the job that are functional in achieving work goals, reduce job demands, and stimulate personal growth. Key resources for nurses include autonomy, social support from colleagues, and effective, supportive leadership (Bakker & Demerouti, 2017; Labrague & Obeidat, 2022). These resources initiate a motivational process, leading to higher work engagement and organizational commitment. However, the pandemic also strained these resources; social distancing complicated peer support, and leaders were often overwhelmed, reducing their capacity to provide adequate support (Maben & Bridges, 2020). The central tenet of the JD-R model is that stress and burnout occur when high demands are coupled with a lack of resources, thus demonstrated on a global scale during the crisis.

The consequences of this imbalance are severe. Chronic stress is a primary driver of burnout, a syndrome of emotional exhaustion, depersonalization, and reduced personal accomplishment, which reached epidemic levels among nurses during the pandemic (Woo et al., 2020). Burnout, in turn, is a strong predictor of job dissatisfaction and turnover intention, with a significant portion of the nursing workforce reporting plans to leave their jobs or the profession entirely in the wake of the pandemic (Kenny, 2022). This "great resignation" in nursing threatens to cripple healthcare systems for years to come. Critically, the impact of nurse stress extends to patient care. Fatigued, stressed, and burnt-out nurses are more likely to make medication errors and contribute to lower overall patient satisfaction and poorer clinical outcomes (Im et al., 2023).

Among the most immediate and debilitating consequences of occupational stress is the erosion of sleep quality. Sleep is a fundamental biological process essential for cognitive function, emotional regulation, and physical restoration (Besedovsky et al., 2012). For nurses, who must maintain high levels of vigilance, adequate sleep is non-negotiable. The physiological mechanism linking stress to poor sleep often involves the hyperarousal of the autonomic nervous system (Kalmbach et al., 2018). The pandemic environment, characterized by constant anxiety about personal and family safety, hypervigilance, and the disruption of circadian rhythms from chaotic schedules, created a perfect storm for sleep disturbances (Okechukwu, 2023; Al Maqbali et al., 2021). A recent meta-analysis found that nearly 60% of nurses worldwide suffer from poor sleep quality, a figure that has likely increased during the pandemic (Zeng et al., 2020). This sleep deprivation impairs attention and memory, directly increasing the risk of cognitive failures and clinical errors (Holden et al., 2011; Weaver et al., 2020). Furthermore, poor sleep is bidirectionally linked with mental health; it is both a symptom and a cause of anxiety and depression, further compounding the psychological burden on nurses (Scott et al., 2021).

While the relationship between occupational stress and sleep quality is well-documented globally, there is a conspicuous gap in the literature concerning the nursing population in Macao, particularly during the pandemic. As a special administrative region of China with a high-density population and a unique healthcare system, Macao presents a distinct context. This study, conducted in August 2022, captures a critical moment as the healthcare system was navigating the prolonged strain of the pandemic. Understanding the specific prevalence rates, risk factors, and the nature of the stress-sleep relationship among nurses in Macao during this period is essential for developing targeted, culturally-informed interventions and for preparing for future public health crises. Therefore, this study was designed to provide a foundational analysis of this critical issue. The primary aims were: (1) to determine the prevalence of high occupational stress and poor sleep quality among clinical nurses in a major Macao hospital during the COVID-19 pandemic; (2) to identify the sociodemographic and work-related factors associated with these outcomes; and (3) to examine the specific relationship between dimensions of occupational stress and sleep quality.

2. MATERIALS AND METHODS

2.1. Study Design. A cross-sectional, descriptive, and correlational research design was utilized to investigate occupational stress, sleep quality, and their relationship among clinical nurses.

2.2. Participants and Procedure. The study was conducted over a three-month period from August to October 2022 at a major hospital in Macao. This data collection timeframe is particularly significant as it occurred in the immediate aftermath of a major local COVID-19 outbreak and city-wide lockdown in mid-2022. As such, the data reflect a period when the healthcare system and its nursing staff were managing the prolonged strain of the pandemic and navigating the initial phases of recovery. A convenience sampling method was used to recruit participants. The target population consisted of all full-time registered nurses who had been employed at the hospital for at least one year. Nurses on sick leave, maternity leave, or who had experienced a major stressful life event in the past three months were excluded. A total of 225 questionnaires were distributed, and 214 were returned complete, yielding an effective response rate of 95.1%.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Prior to commencing data collection, the research protocol was reviewed and received full ethical approval from the Research Ethics Committee of Macao Polytechnic University. Additionally, permission to conduct the study on-site was secured from the administration of the participating hospital. Data were collected using anonymous, paper-based questionnaires, and all procedures adhered to the prevailing institutional infection control protocols. Informed consent was obtained from each participant before they completed the questionnaire. They were provided with a clear explanation of the study's purpose and assured of the confidentiality of their data and their right to withdraw at any time without consequence.

2.3. Measures. The survey instrument consisted of three parts. The selected measures, the C-JCQ and PSQI, are well-established instruments that have been previously validated for use in Chinese and healthcare populations.

2.3.1. Sociodemographic and Work-Related Questionnaire. This self-designed section included 17 items covering personal details (e.g., age, gender, education), family information (e.g., marital status), and work characteristics (e.g., department, years of experience, job title, salary, night shift frequency).

2.3.2. The Chinese Version of the Job Content Questionnaire (C-JCQ). Occupational stress was measured using the C-JCQ, a 49-item scale based on Karasek's (1979) demand-control-support model. This instrument has demonstrated good psychometric properties in previous studies with Chinese medical staff (Sha et al., 2003; Tsai & Liu, 2012). In the current study, the scale showed strong internal consistency, with a Cronbach's α coefficient of 0.836.

2.3.3. The Pittsburgh Sleep Quality Index (PSQI). Sleep quality over the past month was assessed using the PSQI, a widely used 18-item self-report questionnaire (Buysse et al., 1989). The Chinese version of the PSQI has been extensively validated and is considered a reliable tool for assessing sleep quality in Chinese populations, including nurses (Liu et al., 1996; Liu et al., 2020). The measure demonstrated high reliability in this study's sample, with a Cronbach's α coefficient of 0.842.

2.4. Data Analysis. Data was analyzed using SPSS version 27.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize participant characteristics and the main variables. Independent t-tests and one-way analysis of variance (ANOVA) were used to compare mean scores across different groups. The relationship between occupational stress and sleep quality was examined using Pearson correlation analysis. Binary logistic regression was performed to identify predictors of high occupational stress and poor sleep quality. A p-value of <0.05 was considered statistically significant.

3. RESULTS

The results of the data analysis are presented in the following tables. The section begins with the demographic and professional characteristics of the participants, followed by the prevalence rates of occupational stress and poor sleep quality. Subsequently, the results of the inferential statistical analyses are presented, detailing the factors significantly associated with occupational stress and sleep quality. Finally, the correlation between the primary variables is shown.

3.1. Participant Characteristics and Prevalence Rates. The sociodemographic and professional characteristics of the 214 participants are detailed in Table 1. The sample was predominantly female, with a wide distribution across age and experience levels.

Table 1: Demographic Characteristics of Study Participants (N=214)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	22	10.28
	Female	192	89.72
Age (years)	30 or under	92	42.991
	31-40	63	29.439
	41-50	50	23.364
	51 or over	9	4.206
Education Level	Bachelor's Degree	176	82.243
	Master's or above	27	12.617
	Specialty Degree	5	2.336
	Associate or below	6	2.804
Work Department	Surgical Ward	34	15.888
	Medical Ward	25	11.682
	Maternity Ward	25	11.682
	ICU	25	11.682
	Operating Room	25	11.682
	Emergency	25	11.682
	Hemodialysis	25	11.682
	Outpatient	17	7.944
	Pediatric Ward	13	6.075

The prevalence of occupational stress and poor sleep quality are summarized in Table 2a and Table 2b, respectively. A substantial portion of the nursing staff was found to be experiencing high stress and poor sleep.

Table 2a. Occupational Stress Classification (n=214)

Occupational Stress Classification	Frequency (n)	Percentage (%)
Low Stress	144	67.3
High Stress	70	32.7

Table 2b. Sleep Quality Classification (PSQI) (n=214)

PSQI Classification	Frequency (n)	Percentage (%)
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Good Sleep Quality (PSQI \leq 7)	106	49.5
Poor Sleep Quality (PSQI $>$ 7)	108	50.5

3.2. Factors Associated with Occupational Stress and Sleep Quality. Table 3 presents the results of the one-way ANOVA and independent t-tests examining the influence of various demographic and work-related factors on occupational stress. Significant differences were observed for age, work experience, job title, night shift frequency, and salary.

Table 3. Analysis of Factors Affecting Occupational Stress

Variable	Category	n	Mean	SD	t/F	p
Age	30 or under	92	0.997	0.135	4.026	0.008**
	31-40	63	0.966	0.103		
	41-50	50	0.937	0.105		
	51 or over	9	0.901	0.080		
Work Experience	1 to <3 years	31	1.002	0.091	3.738	0.003**
	3 to <6 years	48	0.995	0.161		
	6 to <9 years	35	1.011	0.124		
	9 to <12 years	22	0.946	0.091		
	12 to <15 years	16	0.930	0.086		
	\geq 15 years	62	0.931	0.095		
Job Title	Level III Nurse	52	0.992	0.082	5.701	0.000**
	Level II Nurse	82	0.994	0.149		
	Level I Nurse	64	0.948	0.098		
	Specialist Nurse	5	0.905	0.051		
	Head/Assoc. Head	11	0.844	0.058		
Night Shift Freq.	0 / month	16	0.878	0.070	2.742	0.030*
	1-2 / month	59	0.972	0.092		
	3-4 / month	32	0.980	0.188		
	5-6 / month	32	0.989	0.120		
	\geq 7 / month	75	0.976	0.105		
Salary (MOP)	20000-30000	9	1.049	0.087	5.465	0.001**
	30001-40000	106	0.988	0.133		

40001-50000	75	0.958	0.095
≥50001	24	0.899	0.107

*p < 0.05, **p < 0.01

** = p<0.01

Table 4 presents parallel analysis for factors influencing sleep quality (PSQI score). Education level, alcohol consumption, and the presence of hobbies were found to have a significant impact.

Table 4. Analysis of Factors Affecting Sleep Quality (PSQI)

Variable	Category	n	Mean	SD	t/F	p
Education Level	Bachelor's Degree	176	8.330	3.540	6.489	0.000**
	Master's or above	27	5.704	3.111		
	Specialty Degree	5	4.600	4.980		
	Associate or below	6	6.000	2.280		
Alcohol Use	Yes	31	8.806	2.509	-2.120	0.036*
	No	183	7.683	3.769		
Hobbies	Yes	110	7.255	3.572	-2.479	0.014*
	No	104	8.471	3.604		

*p < 0.05, **p < 0.01

3.3. Relationship Between Occupational Stress and Sleep Quality. Table 5 details the results of the Pearson correlation analysis between the dimensions of the C-JCQ and the global PSQI score. The analysis revealed weak but statistically significant relationships between sleep quality and physical demand, psychological demand, and macro-level decision authority.

Table 5. Correlation Analysis between Sleep Quality (PSQI) and Occupational Stress Dimensions

C-JCQ Dimension	Pearson Correlation (r) with PSQI
PSD (Psychological Demand)	-0.142*
PHD (Physical Demand)	0.168*
MD (Macro-level Decision Authority)	-0.145*

* p < 0.05

4. DISCUSSION

The findings of this study, captured during the acute phase of the COVID-19 pandemic, offer a stark illustration of the profound challenges facing the nursing workforce in Macao. The data reveal a significant burden of occupational stress and disturbed sleep, providing a critical baseline for understanding the pandemic's impact and for formulating strategies to build a more resilient healthcare system. This discussion will interpret these findings through the lens of the pandemic, connect them to existing literature and theoretical frameworks, and explore their implications for nursing practice, leadership, and policy.

4.1. Interpretation of Key Findings in the Pandemic Context. The prevalence of high occupational stress (32.7%) and poor sleep quality (50.5%) are alarming figures. While direct pre-pandemic data for this specific population are unavailable for comparison, these rates are consistent with the surge in psychological distress reported among healthcare workers globally during the COVID-19 crisis (De Kock et al., 2021). It is highly probable that these figures represent a significant increase from pre-pandemic levels, reflecting the addition of novel stressors such as fear of contagion, social stigma, and the emotional toll of high patient mortality rates onto an already demanding profession. The pandemic acted as a system-wide stress test, amplifying existing vulnerabilities within the nursing work environment.

The finding that younger, less experienced nurses reported the highest levels of stress is particularly poignant in the pandemic context. The "reality shock" typically experienced by novice nurses was likely magnified into a form of crisis shock (Kam et al., 2024). These nurses were thrust into an environment of unprecedented uncertainty and acuity, often without the depth of clinical experience or the seasoned coping mechanisms of their senior colleagues. They had to navigate not only the standard challenges of their roles but also rapidly changing clinical protocols, resource scarcity, and the profound ethical dilemmas associated with the pandemic, likely contributing to higher rates of anxiety and burnout (Casella et al., 2023). The lower stress reported by senior nurses and leaders, while still significant, may reflect their greater experience in crisis management and a more established sense of professional identity and control.

The prevalence of poor sleep quality is a direct reflection of this high-stress environment. The pandemic created a state of sustained hypervigilance for many nurses, both at work and at home, making restorative sleep elusive (Al Maqbali et al., 2021). The finding that nurses with a bachelor's degree reported the worst sleep is intriguing. This group often forms the backbone of the bedside nursing workforce, and it is plausible that during the pandemic, they bore the brunt of direct exposure to critically ill COVID-19 patients, the physical burden of prolonged PPE use, and the emotional labor of supporting isolated patients and their families. This intense, frontline exposure, combined with anxieties about bringing the virus home, likely created a level of strain that directly manifested as sleep disturbance (Adeniyi et al., 2023).

The protective role of hobbies against poor sleep is a critical finding, especially given the context of lockdowns and social restrictions. The ability to psychologically detach from the immense pressures of work is a vital recovery process (Sonnentag & Fritz, 2015). During the pandemic, when external leisure activities were curtailed, having engaging at-home hobbies may have been one of the few available avenues for mental respite and stress reduction, highlighting the importance of internal coping resources when external ones are limited.

The nuanced correlations between job dimensions and sleep quality are particularly revealing. The positive link between physical demand and poor sleep was likely exacerbated by pandemic conditions, such as the physically taxing nature of wearing full PPE for 12-hour shifts and the high physical demands of ventilated patients. The negative correlations—where higher psychological demand and macro-level decision authority were associated with better sleep—strongly support the JD-R model. It suggests that even amidst the crisis, having a sense of purpose (high psychological engagement) and a sense of control or influence (decision authority) acted as powerful protective resources. Nurses who felt their work was meaningful and that they had a voice in how their unit responded to the crisis may have experienced a buffering effect against the overwhelming demands, leading to better psychological outcomes and, consequently, better sleep (Karasek, 1979; Wang et al., 2023). This underscores that empowerment is a potent antidote to stress, even under the most extreme circumstances.

4.2. Theoretical and Practical Implications. The findings of this study provide a powerful, real-world validation of the Job Demands-Resources model under crisis conditions. The pandemic drastically increased job demands while simultaneously straining or depleting job resources, creating the exact conditions the model predicts will lead to burnout and ill-health. This has profound implications for healthcare organizations.

4.2.1. Bolstering Workforce Resilience for Future Crises. The pandemic exposed the vulnerability of early-career nurses. Organizations must invest in robust, evidence-based nurse residency programs that include

not only clinical skills but also training in stress management, resilience, and ethical decision-making in crisis situations (Rushton et al., 2021).

4.2.2. Rebuilding and Reinforcing Job Resources. The pandemic depleted many job resources. Nurse leaders must now focus on actively rebuilding trust, fostering psychological safety, and enhancing job control. This involves creating authentic platforms for nurses to voice their concerns and contribute to solutions, thereby increasing their sense of macro-level decision authority. Investing in leadership development is crucial, as supportive and transformational leadership styles have been consistently shown to be a key resource that mitigates burnout and promotes well-being (Labrague, 2024; Wei et al., 2020).

4.2.3. Prioritizing Mental Health and Recovery. The psychological toll of the pandemic will have a long tail. Organizations must designate mental health support and provide easily accessible, confidential resources for all staff. This includes not just reactive services but proactive initiatives like mindfulness-based stress reduction (MBSR), which has a strong evidence base for improving sleep and reducing stress in healthcare professionals (Lomas et al., 2018). Fostering a culture that prioritizes rest and recovery is essential for preventing the long-term consequences of chronic stress.

4.2.4. Learning from the Crisis. The pandemic should serve as a catalyst for fundamental change in the nursing work environment. Organizations should conduct post-crisis reviews with frontline staff to identify systemic weaknesses that contributed to stress and burnout. This feedback should be used to redesign workflows, improve communication channels, and ensure adequate resource planning (including staffing and PPE) for future emergencies.

4.3. Limitations and Future Research. This study is not without its limitations. The cross-sectional design captures a single point in time and cannot establish causality. Longitudinal studies that track nurses from the pandemic's peak through the recovery phase are needed to understand the long-term trajectories of stress and sleep. The use of a convenience sample from a single private hospital in Macao limits the generalizability of the findings. Future research should aim to recruit larger, more representative samples from multiple institutions, including the public sector. The reliance on self-report measures also introduces the potential for response bias. Future studies could incorporate objective measures, such as actigraphy for sleep and physiological markers for stress (e.g., cortisol levels), to complement subjective reports.

5. CONCLUSION

This study, conducted during the crucible of the COVID-19 pandemic, provides compelling evidence that a significant proportion of clinical nurses in Macao are grappling with the dual burden of high occupational stress and poor sleep quality. These are not isolated issues but are deeply interconnected, rooted in the demanding nature of the work environment and profoundly amplified by the unique stressors of the global health crisis. The findings highlight the vulnerability of younger, less experienced nurses and underscore the critical, protective role of job resources such as autonomy and a sense of control, even in the face of overwhelming demands.

The implications of this research are clear and urgent. The pandemic served as a stress test, revealing the critical importance of a healthy and resilient nursing workforce. A passive approach to nursing stress and fatigue is untenable and poses a direct threat to patient safety and the stability of the healthcare system. Therefore, healthcare organizations in Macao must move towards a proactive, systemic approach to fostering a healthier work environment. This requires sustained commitment from leadership to not only mitigate excessive job demands but, more importantly, to invest in building the personal and professional resources of their nursing staff. By empowering nurses, prioritizing mental health and recovery, and learning the hard-won lessons of the pandemic, organizations can help alleviate the burden of stress, improve well-being, and ultimately, build a more resilient and sustainable nursing workforce capable of meeting the complex healthcare needs of the community, both in times of normalcy and in face of future crises.

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JW, CSUL and WIPP conceived and designed the study. JW acquired the data and performed data analysis, interpretation, and drafted the initial manuscript. All authors critically revised the manuscript, approved the final version, and confirmed accountability for all aspects of the work. This original manuscript is not published nor under consideration elsewhere.

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Ethical Approval and Consent to Participate

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