

Workplace Stress and Physiological Indices Correlation Study Results

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Objective: Numerous studies demonstrated that while performing diverse routines in hospitals, nurses often face overcommitment and low social support. We have aimed in this study to address work-related stress level of nurses working at referral hospitals in Mongolia through determining the stress induced changes in blood pressure as well as alpha-amylase level in saliva. **Methods:** The study involved a totally of 473 nurses from tertiary referral hospitals of Mongolia. We employed the Work Stress Profile questionnaire of Rice and Likert scale in measuring the questions. Additionally, we measured the α -amylase level in the saliva of nurses. The arterial blood pressure, level of glucose in blood and heart pulse were evaluated by a cross-sectional model. **Results:** The study was conducted by collecting an age group similar to the age pyramid of nurses working in referral hospitals. The participants illustrated low levels of work stress in 7.6%, medium levels in 27.1%, and high levels of work stress in 65.3%, respectively. When we examine whether the level of stress exposure of nurses differs between the groups by high, medium, and low levels of workplace stress, the analysis of one factor variance confirms the statistical real difference ($F = 3.071$), ($p = 0.028$). The study results revealed that long lasting accumulated work stress triggers hypertension. **Conclusion:** The workplace stress of the nurses depends on many different physiological factors.

Keywords: Nurse, Stress, Workplace, Burnout, Job Satisfaction

Introduction

Globally, the number of people working in the health sector totaled 43 million in 2018 and it is expected to reach 82 million by 2030, however, the current human resource gap is estimated at 14 million in the health sector [1]. One of the main conditions for health care development is human resources expansion

and there is still a general shortage of medical professionals, including nurses and midwives, not only in Mongolia but also internationally. In 2018, the total population of Mongolia was estimated at 3,238,479 and there are 4,343 health care organizations where a total of 11,169 doctors and 12,344 nurses' actively works. With its 38.6 nurses per 10,000 people, Mongolia has been considered lower than the world average

health worker density [2, 3].

Stress is termed scientifically as a nonspecific response of the body to any demands placed upon it. Stress has been regarded as an occupational hazard since 1950. Menzies identified four sources of anxiety among nurses: patient care, decision making, taking responsibility, and change [4]. Later these factors expanded as the health industry become more high-tech and nurses working in the medical industry have to be able to handle the new technologies. These types of occupational stresses often lead to burnout, fatigue syndrome, and lack of ability to work, which leads to emotional exhaustion, followed by an emotional numbness or a negative attitude towards oneself and others. It is impossible to wipe out work-related stress and stressors, however, effective coping techniques can help to reduce the stress caused outcomes [5, 6].

Numerous studies have been conducted to investigate nurse burnout in many countries, including the United States of America, Canada, China, and Japan. McMillan et al. reported that 56% of nurses who work in cancer care unit in Australia experienced high level of exhaustion and 55% of nurses reported high stress in terms of professional efficacy [7]. Further, studies conducted in China report that more than 50% of nurses had burnout symptoms, and almost 30% experienced moderate to high levels of burnout [8]. A cross-sectional study conducted by Lee et al. also reported that nurses working in the Korean health care system had higher levels of burnout compared in western countries. Here, about 50% of participants experienced high levels of emotional exhaustion and 76% experienced low level of personal accomplishment [9].

In recent decades, there were significant improvement in public health and environmental condition in Mongolia, but sharp socio-political as well as socio-economical changes have caused some degree of disruption of traditional patterns of living. As mentioned above, there are a number of stressors, such as emotional instability, anxiety, and worry, due to a variety of factors, including social and economic conditions, drastic changes in science, technology, information, urbanization, and overcrowding. Moreover, as a developing country, Mongolia faces an increase in competitiveness and a demand of better working conditions. The stability and improvement in social well-being mostly depend on the personnel who work in the healthcare system. As reported in 2014 Mongolian Health Indicators, the urban area had the higher number of doctors

(42.4) per 10.000 population, while this index was lower for nurses (40.9). It is worth mentioning that our previous study measured burnout and job stress among Mongolian doctors and nurses. It was shown that professional stress was significantly related to effort-reward imbalance (ERI), over commitment, marital status, income, and the number of patients [10].

While there are a number of stress markers that have been recognized to be reliable indicators, salivary amylase is being considered as a good biomarker for acute stress level [9]. One study revealed that in nurses with high scores for job demands, the activity of salivary alpha-amylase during the working period was significantly higher than that in nurses with low scores. The baseline amylase activity was positively correlated with workload, role conflict, and role ambiguity. However, the average activity of amylase was negatively correlated with task control, decision control, resource control, technology utilization, opportunity for participating in decision-making, and promotion [11-14]. Further, stress biomarkers such as cortisol and salivary amylase activity have been measured among shift-working health care professionals in other research. Ninety-five professionals who work in high job strain and low job strain participated. The results revealed a larger increase in the cortisol concentration of participants in the high job strain group compared to the low strain group. Participants in the high job strain group also had higher salivary AA levels 30 min after awakening on the morning-shift day than those in the low job strain group [15].

There is an increasing interest in whether stress can cause an abnormal activation of the sympathetic nervous system which in turn interferes with blood pressure. Spruill et al. found that blood pressure did not depend on genes or lifestyle alone; in some cases, the psychosocial issues have become more influential. Many factors, such as work stress, social stress, and low socioeconomic status, have been linked to hypertension, suggesting that chronic stress over a period of time is a major factor in high blood pressure [10]. Another study indicated that stress in the workplace has special significance for the prediction of cardiovascular health risk, and that catecholamine excretion at work is significantly associated with increased blood pressure variability during the day [11]. The cross-sectional study conducted in Southern Brazil showed that the prevalence of systemic arterial hypertension was 32% in nursing staff working at an emergency care hospital. An association was shown between systemic arterial hypertension and being considered

overweight/obese, having a larger waist circumference, age, and self-reported skin color, while there was also an association found between psychosocial stress and systemic arterial hypertension [12]. Moreover, higher weekly workload, shift work as well as shorter training and work time at the institution was reported to be highly associated with blood pressure [16-18].

In our previous study, we analysed the job-related burnout of 180 doctors and 212 nurses who worked at referral hospitals in Ulaanbaatar, 2009. It has been confirmed that the participants had relatively higher level of burnout, especially in terms of ERI and over-commitment. We also found that the profession could influence personal burnout which is characterized by the two factors (ERI and over-commitment), and these factors were significantly different between female doctor and female nurses. Female nurses were more over-committed than female doctors [19]. Even though, nurses work together with doctors as a team in hospitals, patients always have higher expectations from nurses on medical service delivery, which results a significant amount of challenge and responsibility in nurses.

Performing diverse routines in the hospitals, nurses often face overcommitment and low social support. Moreover, due to the shift work, work-load demand, and the nature of caring service, nurses could be suffering from a variety of health problems and, subsequently poor health resulting in low performance of nurses in their clinical practices. Therefore, in the present study, we have aimed to describe the work-related stress profile of 473 nurses working at a referral hospital in Mongolia by analyzing alpha-amylase level in their saliva, and to emphasize the impact of work-related stress of nurses on cardiovascular parameters such as blood pressure.

Materials and Methods

The study was conducted at the Mongolian National Centers of Traumatology and Orthopedics (1), Infectious Diseases (2), Cancers (3) and Mental Health (4) in February through April 2020, by a cross-sectional model of research involving 473 nurses. We employed a Work Stress Profile (WSP) questionnaire of Rice having 57 questions in 3 domains. The questions aim to assess the co-workers' relations (1-26), the working environment (27-48) and the personal attributes (49-57). This questionnaire aimed to describe how nurses perceive and accept the stress. The Likert scale was used in measuring the questions. The indicators

were evaluated by a cross-sectional model.

Statistical analysis

Frequencies, percentages, and independent t-tests were used to examine the difference among groups. Multiple logistic regression was performed to identify work place stress predictors. A p-value of < 0.05 was used as the cut-off point for determining the statistical significance. The data were collected using quantitative methods and were analyzed using Statistical Packages for Social Sciences (SPSS) version 20 statistical software.

Ethical statement

The study was approved by the Research Ethics Committee of Mongolian National University of Medical Sciences on June 12, 2020 (No. 2020/3-05).

Results

A total of 473 nurses were included in the study, including 121 NCTO, 89 NCMH, 146 NCID, and 117 NCC. Meanwhile, 46 administrative workers, 75 doctors, 208 nurse-midwives, 105 cleaners, and 46 organizational workers participated in our study, too. The general information of the study participants is demonstrated in Table 1.

In our study, 97.3% of the participants were female and 2.7 % were male. We have observed statistically different work experience and place of the duty as well as education of nurses. Moreover, compared with morning blood pressure, there was a statistical difference in evening blood pressure ($p = 0.036$). The nurse stress level is unified in Table 2.

The nurses who are older than 35 years had higher stress level compared with younger than 35 year (OR, 1.16, $p = 0.048$). Interestingly, participants with over 10 years of working experience also had higher level of stress (OR, 1.68, $p = 0.001$). As seen in the Table 2, workplace noisiness, job fulfilment in 30 minutes, over time working as well as job satisfaction resulted in high level of stress in nurses.

Table 3 demonstrates the nurse stress levels corresponding to their physiological indicators. The stress level groups were classified by the hospitals: nurses from National Center of Traumatology and Orthopedics occupied the most percentage in the low stress group as well as in the normal stress group - their stress level was at 13.2% and 33.1%, correspondingly.

Table 1. Participants general information.

Variables	Number	Percentage (%)
Age		
18-24	34	7.2
25-30	139	29.4
31-40	99	20.9
41-50	169	35.7
>51	32	6.8
Gender		
Male	13	2.7
Female	460	97.3
Educational level		
Diploma	150	31.7
Bachelor	306	64.7
Masters	17	3.6
Working years in this sector		
≥1 year	32	6.8
2-5 years	64	13.5
6-9 years	128	27.1
10 years≤	249	52.6
Working experiences		
≥1 year	48	10.1
2-5 years	67	14.2
6-9 years	131	27.7
10 years≤	227	48.0

Cancer nurses were categorized to the group of high stress level 76.1 % (Table 3). Moreover, they (cancer nurses) occupied the least percentage in the low and normal (19.7%) stress groups. The NCTO nurses cover the least percentage in high stress levels - 53.7%. Interestingly, the findings expose the fact that the traumatology nurses’ perceived stress level is lower rather than the other hospitals. Conversely, the cancer nurses are the participants who are mostly suffering from workplace stress.

Nurse stress variability statistics also confirmed these results. For instance, the occupational stress statistics of the nurses by hospitals revealed that the NCTO nurses have a lower stress level than other hospitals with 144,471 and the National Cancer Center has a higher stress level of 154,641 than other hospitals. However, the standard deviations demonstrate that the stress levels had gone up and down: the most fluctuated group was the NCTO nurses and the least one was the National Cancer Center.

We employed a SALIVA AMYLASE MONITOR apparatus, a product of Japan; in determining the process of stress level by the participants’ salivary alpha amylase (sAA). Here, we categorized workplace stress in four levels: Using CROSSTABS analyzing method we attempted to figure out the WPS questionnaire with the participants’ sAA stress scores. Meanwhile we compiled the stress levels into three groups as they were scored.

In accordance with the salivary alpha amylase statistics, the morning sAA levels were 2-34 (at least 16,083 KU/L) and 2-105 (the highest 25,226 KU/L) in the low and normal stress groups, correspondingly. Cardiovascular parameters of the surveyed nurses were classified as high and low arterial pressure and determined by the main statistical parameters of variation at high, medium, and low levels of stress in the morning and evening.

In Table 4, we demonstrated the correlation of nurse workplace stress with their physiological indicators. It was

Table 2. Logistic regression of cardiovascular indices by the stress levels (BP morning/evening).

Variables	N	OR	95% CI	p-value
Age				
<30*	57	1.00	Reference	
>31	64	1.16	1.00-1.01	0.048
Experience				
<10*	71	1.00	Reference	
>10	50	1.68	1.12-3.54	0.001
Responsibility				
Yes*	88	1.00	Reference	
No	33	3.61	2.12-6.28	0.071
Conflict with colleague				
No*	106	1.00	Reference	
Yes	15	2.01	2.62-11.95	0.067
Lack of free time				
No*	91	1.00	Reference	
Yes	30	4.36	1.21-8.59	0.051
Work environment				
Good*	80	1.00	Reference	
Bad	41	4.24	1.49-23.7	0.038
Over time				
No*	77	1.00	Reference	
Yes	44	3.13	1.71-9.75	0.007
Challenging				
No*	102	1.00	Reference	
Yes	19	11.0	4.61-23.31	0.051
Job satisfaction				
Yes*	79	1.00	Reference	
No	42	5.51	3.43-14.9	0.032

*reference value

observed that, age was strongly correlated with job experience (0.706), while nurses with both high and low blood pressure positively correlated with total stress level. In case of amylase, it was positively correlated with parameters such as morning arterial BP (0.142), morning pulse (0.176), both high and low BP in the evening, and evening pulse (0.284).

The above demonstrated results suggested that the onset of stress in a nurse’s workplace depends on many different levels of social factors, such as age, gender, organizational characteristics, organization, place of work, and years of service. And these stressors have different impacts on individuals.

Discussion

In 1978 Weiman and in 1990 Holmgren had separately noted that workplace or work-related stress and stressors are the major reasons for such things as sick-leave, physiological and psychological illnesses, work burnout and consequently these issues can cause the individual or organizational problems. Especially, burnout has often resulted from prolonged emotional or psychological stress on the job. It has been found to impair individual’s ability to control negative emotions. Health professionals, especially nurses, are known to be at higher risk for the development of burnout than are those in other occupations. Furthermore, nursing has been ranked as the fourth

Table 3. Correlation of nurse workplace stress with their physiological indicators.

Variables	Age	Work experience	Total stress level	Arterial BP morning high	Arterial BP morning high	BP high average	Morning pulse	Glucose morning	Amylase morning	BP evening high	BP evening low	BP low average	Evening pulse	Evening glucose	Evening amylase	Amylase average
Age	1															
Work experience	.706**	1														
Total stress level	.146**	.103*	1													
Arterial BP morning high	.166**	.113*	0.04	1												
Arterial BP morning high	.162**	.103*	.108*	.638**	1											
BP high average	.176**	.128**	0.05	.916**	.599**	1										
Morning pulse	0.08	0.08	.100*	.268**	.417**	.232**	1									
Glucose morning	.149*	.112*	-0.01	.132**	.121**	.155**	.127**	1								
Amylase morning	0.01	-0.02	0.06	0.07	.195**	0.07	.184**	-0.07	1							
BP evening high	.155**	.121**	0.05	.658**	.448**	.905**	.151**	.151**	0.07	1						
BP evening low	.156**	.112*	0.08	.427**	.637**	.546**	.285**	0.04	.295**	.571**	1					
BP low average	.176**	.119**	.102*	.591**	.909**	.633**	.389**	.092*	.269**	.561**	.900**	1				
Evening pulse	.102*	.127**	0.08	.209**	.268**	.266**	.606**	0.04	.261**	.278**	.396**	.365**	1			
Evening glucose	.166**	.123**	0.02	.169**	.170**	.220**	0.05	.605**	-0.03	.233**	.122**	.162**	0.06	1		
Evening amylase	0.04	0.01	0.05	.098*	0.04	.117*	.112*	-0.02	.456**	.115*	.128**	.090*	.221**	0.03	1	
Amylase average	0.03	-0.01	0.06	.094*	.142**	.109*	.176**	-0.06	.873**	.105*	.254**	.217**	.284**	0.01	.832**	1

**p < 0.01

most stressful profession, due to its occupation-related factors, such as job overload, conflicts of responsibilities, monotonous work, and the pressure of time limits. Additionally, insufficient support from the organization, conflicts between nurses and physicians, as well as the nurse's location in the social hierarchy also leads to increased job-induced stress. Large number of studies demonstrated that 30-50% of nursing personnel experience significantly higher levels of clinical burnouts. A multinational survey conducted by See et al. revealed that approximately 52% of the nurses from 16 Asian countries and regions had high level burnout [16]. In this study, religiosity and better work-life balance had a protective effect against burnout, while those having a higher educational status experienced high emotional exhaustion and depersonalization compared to those with only vocational training.

We employed the Rice (1999) WPS self-esteem questionnaire because we considered our study participants to be categorized as relatively healthy, i.e. they never complain of being sick and leave work. Furthermore, we decided that it would be reasonable if the participants assess themselves as to whether they are in work-related stress by reading and getting an idea what can be called workplace stress indeed. It is clear that women dominate nursing around the world, however, regardless of the work environment, requirements, or workload, and regardless of gender all are exposed to workplace stress. A cross-sectional study conducted by Wei et al. demonstrated that approximately 33.3% of the nurses who work in community hospital experienced burnout [17]. They also revealed that nurses working in the rehabilitation wards had higher odds of burnout. Another study conducted by Lu et al. also showed that 45.1% of nurses reported high levels of job-related burnout, and 55.6%, job dissatisfaction, and patient-nurse ratios of four or less were related to a decrease in the odds of job dissatisfaction [18].

It has been postulated that nurses having advanced diploma educational qualification encounter greater work responsibility, which in turn increases susceptibility to burnout. A study of El Delatony et al. found that nurses with higher education had a high level of stress due to the limited opportunities to develop skills, poor control of time as well as poor communication with administration [20]. While, on the opposite side, it could be also possible that young nurses with less job experience expect to be more vulnerable to stress, while nurses with high education have good theoretical knowledge and clinical experiences

and thus can manage stress in clinical environments. In case of the postulation about the educational status, our study shows that there is significant difference between nurses who holding master or doctoral education and those with bachelor degree (OR, 1.68, $p = 0.001$). We assume that nurses with high education levels experience burnout from the job responsibility, accountability, and a variety of tasks, even when their income is not much different than nurses with lower education.

According to literature, workplace stress is often influenced by the gender of nurses, but the results vary. Certain researchers noted that there is no gender difference in work stress and others claimed that female nurses are more vulnerable to various occupational stresses than men. On the other hand, Cañadas-De la Fuente et al. reported that being male, being single or divorced, and not having children is related to the highest levels of burnout in nurses [20-24]. However, in the present study, we could not confirm gender difference on work-related stress. Probably, the female nurses were dominant in this study, and only 2.7% of the participants were male. In fact, we have determined previously the stress and burnout rates of doctors and nurses in Mongolia. In the previous study of burnout and job stress among health care workers in Mongolia, it has been demonstrated that female doctors had significantly higher effort-reward-imbalance, whilst female nurses had the highest degree of overcommitment compared to female doctors. Further, doctors had relatively higher burnout rates, with personal, work-related and client-related average scores of 45.39, 44.45, and 32.46, respectively. Female nurses had higher burnout scores in personal burnout compared to the Copenhagen Burnout inventory. High ERI scores for female doctors in this study may be attributed to the domination of the health care delivery system by female professionals in Mongolia. Female nurses were more over-committed than female doctors. Perhaps nurses are caring for more patients than doctors, even though the difference was not significant [19].

In the present study, we have found that job over-load significantly related to stress levels. Nurses who experienced overtime hours duty had higher cardiovascular indices compared to nurses who work without excessive workload. It is consistent with our previous study where extra work significantly correlated with ERI and over-commitment in both doctors and nurses. We also found that nurses who are older than 35 years had higher stress level compared with younger than 35 years (OR,

1.16, $p = 0.048$). In our previous study, we had not observed the correlation between over-commitment and age. Moreover, participants with over 10 years of working experience also had higher level of stress (OR, 1.68, $p = 0.001$), in the present study.

Numerous studies revealed that job strain has been implicated in risk of cardiovascular disease, and there is evidence for increased blood pressure among men with job strain. However, there are still few studies that have measured the blood pressure and salivary alpha-amylase in order to check nursing stress. We have aimed in this study, therefore, to determine whether job stress affects blood pressure in nurses in Mongolia. It has become clear in our study that the average amylase level was positively correlated with parameters such as morning arterial BP (0.142), morning pulse (0.176), both high and low BP in the evening, and evening pulse (0.284). In the research by McKey et al. the relationship between acute stress and salivary amylase level was studied. There, a statistically significant difference in physiologic measures of stress was detected between baseline and acute levels of salivary a-amylase ($p = .017$), heart rate ($p = 0.003$), and anxiety levels ($p = 0.001$). Moreover, it has been suggested that low performers have increased stress and resulted in poor performance, whereas high performers have increased stress and perform superbly, and moderate performers have modest stress and perform moderately [25, 26]. As for the relationships between blood pressure and stress, there are several studies with different conclusions. Some of them demonstrated that there is poor or no correlation between stress and blood pressure, whilst others have reported that job-related stress can be the one of the factors that induce hypertension. In this study, we confirmed that the total stress level was positively correlated with increased arterial blood pressure in the group of nurses with low blood pressure.

Similar to other countries, when nurses face various complexities such as critical performances in critical care units, high level of work requirements, and significant amount of workload, it often leads to job dissatisfaction [27]. In our study, job satisfaction was significantly related to the cardiovascular parameters (OR, 5.51, $p = 0.032$). On the other hand, we did not observe significance related to the amount of spare time with blood pressure. Generally, when it comes to nurses spending their spare time taking care their family, one can be assumed that they would neglect their health status. Especially, female nurses have to take care of their family and at the same time

take responsibility for their own profession. However, it was not significantly related to blood pressure in the present study (OR, 4.36, $p = 0.051$).

The most important limitation of this study is the variability of educational and professional levels. Moreover, this study covered only the referral hospitals in Mongolia. Therefore, we need to clarify in the future whether parameters such as education, age, as well as working condition (for example, night shift) affect burnout and job satisfaction among nurses who work in state as well as rural hospitals in Mongolia.

Conclusion

The workplace stress of the nurses depends on many different physiological factors. Therefore, personality factors should be considered in any theory of risk profiles for developing work place stress in the nursing profession.

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