Mental/Physical Stress Levels of Female Nurses' Working Rotational Shifts

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Abstract

The mental (GHQ28 scores) and physical (urinary 8-OHdG levels) stress levels of female nurses' working rotational shifts (shift work group) and those exclusively working day shifts (regular work group) were compared.

Spot urine samples were collected from 50 nurses (shift: 34 and regular: 16) of Hospital-A to measure their urinary 8-OHdG levels before and after work. The approval of the Conflict-of-Interest Committee (approval number: 270401) and Ethics Committee (receipt number: H27-118) of the University of Occupational and Environmental Health, Japan was previously obtained.

The shift work group showed higher total GHQ28 and subscale (somatic symptoms, anxiety and insomnia, and social dysfunction) scores. The difference was particularly significant in scores related to anxiety and insomnia (p<0.05), revealing a high mental stress level of this group. Scores for <insufficient time to complete all job tasks>, <being fully occupied with duties when working>, and <under the pressure of burdensome, heavy duties> were also significantly higher in the shift compared with regular work group (p<0.01). On the other hand, <being able to consult superiors/co-workers about personal issues> were also significantly higher (p<0.01). On comparing urinary 8-OHdG levels before and after work, the values significantly decreased after a day shift in the overall (50) and shift work (34) groups (P<0.05). Such a decrease was also observed after a night shift in the shift work group (P<0.05).

The higher stress and tension levels of the shift work group before a night shift despite a higher availability of support from superiors and co-workers suggest the necessity of providing practical mental support for nurses working rotational shifts, and actively performing labor management (such as reviewing the composition of each team and the frequency of working night shifts). Comparison of urinary 8-OHdG levels revealed that nurses' stress levels markedly decrease after work, confirming that night shifts lasting for around 16 hours do not cause excessive physical stress. However, as the shift work group showed markedly high mental stress levels before a night shift, active approaches to manage mental stress may be urgently needed.

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-Key words-

female nurses working rotational shifts, urinary 8-OHdG levels, mental stress

I. Introduction

With the advancement and complication of medical services, nurses' work-related stress is intensifying¹⁻³. Although the number of male nurses is gradually increasing, their proportion to the total nursing population is still limited to approximately 6.8%⁴, and the majority of nurses are female. A large number of female nurses work while managing household affairs and caring for their children. Working rotational shifts is a requisite for their job, and 2-rotational shift work systems adopted in many facilities force them to work for 16 hours during each night shift.

To date, questionnaire surveys to examine fatigue and stress in nurses have been actively conducted[®], reporting that cumulative fatigue is more marked among those in higher positions and among younger ones in non-managerial positions[®]. Their stress levels when working 2-rotational shifts are lower than or similar to those when working 3-rotational shifts, and both systems have merits and demerits⁷. In a previous study using biological samples, blood cortisol levels were measured⁸. Female nurses' blood cortisol levels immediately after working a midnight shift were similar to those after working a day shift, but a significant increase in their values was observed on the second day after a midnight shift.

The urinary 8-OHdG level is a useful oxidative stress marker to examine the influence of work. Being measurable using spot urine samples, it is widely used for surveys. Another study compared female shift and part-time workers, and reported that the former's urinary 8-OHdG levels were significantly higher⁹. A similar tendency was observed in a study involving males working day-night shifts and those exclusively working day shifts, as the former's urinary 8-OHdG levels were higher, and it was also confirmed that prolonged work increases such levels¹⁰. Among these previous studies, only that by Ishihara et al.⁹ measured nurses' urinary 8-OHdG levels. However, it did not examine the details of rotational shifts for nurses, or compare their values before and after work.

Therefore, to objectively examine the stress levels of female nurses working rotational shifts, we conducted multifaceted stress assessment before and after work. We examined their physical stress levels by measuring their urinary 8-OHdG levels. Furthermore, as female workers' menstrual cycles have not been considered when performing such measurement, although the urinary 8-OHdG level has been reported to increase during the luteal phase¹¹, we also objectively evaluated the nurses' menstrual cycles (by measuring their progesterone and estradiol levels).

II. Objective

To examine the mental (GHQ28 scores) and physical (urinary 8-OHdG levels) stress levels of female nurses working rotational shifts (shift work group) in comparison with those exclusively working day shifts (regular work group), and to multifacetedly examine factors associated with work-related stress in their workplaces.

III. Methods

1. Inclusion criteria

Among nurses of Hospital-A (with 150 beds) using a 2-rotational shift work system, those who consented after being provided with oral and written explanations of the study, and met the following criteria were included: having a normal menstrual cycle, and currently not being pregnant. Postmenopausal nurses who consented were also included.

2. Study design and procedures

We asked the nurses to participate in measurement during the follicular phase of their menstrual cycle. We also asked the chief nurse on each ward to schedule shifts for the shift and regular work groups, as shown in Fig. 1. The nurses' biological samples were collected before and after work. The shift work group responded to a questionnaire before a night shift, while the regular work group responded to it before a day shift.

The questionnaire was designed to clarify the nurses' basic attributes, status of work, and scores related to mental health (GHQ28), occupational stress, mental fatigue, and sleep quality (PSQI).

3. Study period (including the period of biological sample collection)

Between June 2015 and December 2016

4. Method of biological measurement

Urinary 8-OHdG levels were measured using an electrochemical detector (ECD) after centrifugal separation from sediments and extraction by high-performance liquid chromatography (HPLC) combining 2 types of

Shift work group



 Table 1
 Basic Attributes (Total = 50)

		Ν	fean±SD
	Regular work group $n = 16$	Shift work group n =	34
Age	32.6 ± 2.0	28.7 ± 1.2	ns
Duration of nursing experience	11.3 ± 8.2	7.4 ± 6.9	ns
Duration of work in the current workplace	3.6 ± 4.6	3.0 ± 1.5	ns
Total monthly duration of out-of-hour work over the last 3 months	9.1 ± 9.9	6.6 ± 4.8	ns
Duration of actual work during a day/night shift	10.0 ± 2.1	15.4 ± 1.1	ns
Monthly frequency of working on duty/night shifts	1.1 ± 1.0	3.7 ± 0.6	ns

independent t-test

column¹². As spot urine samples were used, creatinine levels were also measured to adjust these values. In addition, blood samples of 5 mL were collected to measure progesterone and estradiol levels.

5. Ethical considerations

The study was approved by the Conflict-of-Interest Committee (approval number: 270401) and Ethics Committee (receipt number: H27-118) of the University of Occupational and Environmental Health, Japan.

IV. Results

1. The nurses' attributes

Consent to cooperate with the study was obtained from 34 shift and 16 regular work group members. The former were approximately 4 years younger, but the difference was non-significant.

One out of the 34 shift work group members was married, but she did not bear any parenting burden. Similarly, 4 out of the 16 regular work group members were married, and all of them had children, but only 1 answered: <Bearing a light parenting burden >. Furthermore, 2 answered: <Bearing a light caregiving burden >, both of whom belonged to the shift work group.

There were 4 smokers, and all of them belonged to the shift work group. Three had a history of smoking, and all of them belonged to the regular work group. All of the nurses answered that they occasionally consumed alcohol.

One nurse was receiving treatment for allergies, without any regular medications.

			Mear	n±SD
Total score	Shift work group	n=34	6.41 ± 0.85	ns
	Regular work group	n = 16	4.13 ± 1.14	
Somatic symptoms	Shift work group	n=34	2.41 ± 0.27	ns
	Regular work group	n = 16	1.94 ± 0.45	
Anxiety and insomnia	Shift work group	n = 34	2.29 ± 0.37	*
	Regular work group	n = 16	1.13 ± 0.35	
Social dysfunction	Shift work group	n = 34	1.09 ± 0.25	ns
	Regular work group	n = 16	0.44 ± 0.20	
Depression	Shift work group	n=34	0.62 ± 0.18	ns
	Regular work group	n = 16	0.63 ± 0.30	

Table 2 GHQ28 Scores of the Shift and Regular Work Groups

independent t-test *p<.05

Table 3	Urinary 8-OHdG	Levels ng/gCre	of the Shift	and Regular	Work Groups
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After a day shiftShift work group 3.12 ± 1.32 nsRegular work group 3.46 ± 1.82	Before a day shift	Shift work group Regular work group	3.33 ± 1.51 3.63 ± 1.63	ns
	After a day shift	Shift work group Regular work group	3.12 ± 1.32 3.46 ± 1.82	ns

independent t-test

2. Comparison between the shift and regular work groups

1) Mental stress scale (GHQ28) scores

The shift work group responded to the questionnaire before a night shift, while the regular work group responded to it before a day shift. The former showed higher total GHQ28 and subscale (somatic symptoms, anxiety and insomnia, and social dysfunction) scores. The difference was particularly significant in scores related to anxiety and insomnia (p < 0.05), revealing a high mental stress level of this group. The mean total GHQ 28 score of the shift work group was 6.41 ± 0.85 , which exceeded a cutoff of $5/6^{13}$.

2) Physical stress (urinary 8-OHdG) levels

The nurses' female hormone levels were measured to confirm their menstrual cycles. The mean progesterone and estradiol levels of the shift work group were 0.52 ng/mL and 60.61 pg/mL, respectively. The values of the regular work group were 0.32 ng/mL and 83.0 pg/mL, respectively, indicating that all members of both groups were during the follicular phase or menopausal period. Thus, their urinary 8-OHdG levels were not influenced by menstruation.

On comparing the urinary 8-OHdG levels of the 2 groups before and after working a day shift, the shift work group showed lower values both before and after such work, although the difference was non-significant.

3. Comparison of urinary 8-OHdG levels before and after work

1) Overall comparison (n=50)

As an overall tendency, the nurses showed significantly lower urinary 8-OHdG levels after working a day shift than before it (P < 0.05).

2) Comparison of the values of the shift work group

The shift work group also showed significantly lower urinary 8-OHdG levels after working a day shift (P < 0.05).

3) Comparison of the values of the regular work group

The regular work group also showed lower urinary 8-OHdG levels after working a day shift, but the difference was non-significant.

4) Comparison of the values of the shift work group before and after working a night shift

The shift work group showed significantly lower urinary 8-OHdG levels after working a night shift (P < 0.05).

4. Association between urinary 8-OHdG levels and other factors

On examining the association between urinary 8-OHdG levels and smoking habits, the 4 smokers tended to show higher urinary 8-OHdG levels, but the difference from those of non-smokers was non-significant.

Similarly, multiple regression analysis to examine the relationships between the urinary 8-OHdG level and other factors, including alcohol consumption, the age, mental (GHQ28) and work-related stress, mental fatigue, the duration of out-of-hour work, number of hours actually worked during a day/night shift, and the duration of sleep, did not reveal significant differences.

5. Comparison between the groups focusing on other factors

1) Work-related stress

The shift work group's stress was more marked, as their scores for \leq insufficient time to complete all job tasks > (p<0.05), \leq being fully occupied with duties when working > (p<0.01), and \leq under the pressure of burdensome, heavy duties > (p<0.01) were significantly higher than those of the regular work group.

On the other hand, the shift work group also showed significantly higher scores for < being able to consult superiors about personal issues> and < being able to consult co-workers about personal issues> (p<0.01). Based on this, support may have been more easily available for this group.

2) Mental fatigue

The shift work group also showed higher scores for <restlessness>, <difficulty concentrating>, and <cumulative fatigue> than the regular work group (p<0.05), indicating that the former's mental fatigue was more marked, similarly to the case of mental stress.

V. Discussion

1. Mental stress level of the shift work group

The shift work group showed a mean total GHQ28 score of 6.41 ± 0.85 , which exceeded the cutoff, revealing their higher mental stress level compared with that of the regular work group. The difference between the groups was particularly marked in scores related to anxiety and insomnia. The shift work group only responded to the questionnaire before a night shift, and their values before a day shift remained unclear. As mental stress levels may be influenced by multiple factors⁵, it is not appropriate to generalize the results of the present study in this respect. However, the shift work group's higher scores for the 3 factors associated with work-related stress, <insufficient time to complete all job tasks> (p<0.05), <being fully occupied with duties when working> (p<0.01), and <under the pressure of burdensome, heavy duties> (p<0.01), than those of the regular group suggest that the former's stress and tension intensified before working a night shift. A similar tendency was observed in relation to mental fatigue, as the shift work group showed markedly higher scores for the 3 subscales.

These results may have reflected nurses' current situation, in which they have to work night shifts with a limited number of nursing staff. During night shifts, they tend to be forced to work under conditions that vary more markedly than during day shifts, including the management of emergencies, in addition to daily duties. Furthermore, an excessive burden may be loaded on them when working a night shift with unexperienced nurses as a team. These factors may have been associated with the shift work group's higher mental stress level before a night shift. On the other hand, support from superiors and co-workers was more easily available for the shift compared with regular work group. Therefore, it may be necessary to provide practical mental support, and actively perform labor management (such as reviewing the frequency of working night shifts and team composition), in order to promptly establish systems that allow nurses to work with a sense of security.

In 2013, the Japanese Nursing Association announced the Guidelines on Night and Rotational Shift Work¹⁴ to propose organization-wide measures to reduce the burden of working night/rotational shifts. Among these measures, organization-wide labor management, such as reviewing night shift work and personnel allocation systems, and organizational and personal approaches to improve individual nurses' skills may be particularly effective to create secure working environments for nurses.

2. Physical stress level of the shift work group

The nurses' urinary 8-OHdG levels before and after working night and day shifts were within the range





between 3.12 ± 1.32 and 3.64 ± 1.64 ng/gCre, respectively. The standard value for urinary 8-OHdG measurement using ELISA in females is set at 10.3 ng/mL¹⁵. Considering that ELISA-based measurement values have been reported to be about twice as high as those obtained using HPLC-ECD¹⁶, all urinary 8-OHdG levels in the present study may have been within the standard range, or all subjects may have been basically healthy without any disease. Furthermore, the lower urinary 8-OHdG level of the shift work group may have been due to their mean age, which was approximately 4 years lower than that of the regular work group.

Comparison of the nurses' urinary 8-OHdG levels before and after work revealed that their stress levels significantly decreased after work (Fig. 2, 3). In the shift work group, such a decrease was also observed after working a night shift. At this point, night shifts lasting for around 16 hours were shown not to cause excessive physical stress, and the present study may have significance in obtaining such a finding. On the other hand, as it was conducted in a relatively small-scale hospital with 150 beds, it may be necessary to involve advanced treatment hospitals and acute care wards in future studies. In addition, we asked chief nurses to schedule shifts for the 2 groups, as shown in Fig. 1, but work shifts for nurses tend to be irregular, and they are likely to be different from the study protocol. Further studies may also be necessary to continue to address this issue.

Female nurses working rotational shifts did not show excessively high physical stress levels after a night or day shift, indicating that they felt secure in the current work system. However, as previously mentioned, their mental stress and tension were marked before working a night shift, and this highlights the importance of labor management and mental support.



3. Future challenges

In future studies, it may be necessary to plan questionnaire surveys that allow comparison between before and after work, and to obtain objective data using not only urinary 8-OHdG levels, but also other stress markers. Study protocols to accurately clarify the current status of irregular shift work, as well as longitudinal studies involving increased numbers of subjects, should also be considered.

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交代制勤務女性看護師の精神的・身体的ストレス状況

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交代制勤務女性看護師,尿中8-OHdG,精神的ストレス状況

本研究は交代制勤務女性看護師の精神的ストレス状況(GHQ28)ならびに身体的ストレス状況(尿中 8-OHdG)を測 定し,日勤専従看護師との比較検討を行う事を目的とした.

対象は A 病院の看護師(交代制勤務群 34 名,日勤専従群 16 名)を対象とし,仕事前後の随時尿より尿中 8-OHdG を測定した.本研究は産業医科大学利益相反委員会(承認番号:270401 号),倫理委員会(受付番号;第 H27-118 号)の 承認を受け実施した.

GHQ28の総得点,下位尺度の身体症状・不安と不眠・社会的活動障害は交代制勤務群のほうが高く,特に不安と不眠 は有意に高い結果となり(p<0.05),交代制勤務群は精神的ストレスが高い結果となった.また「時間内に仕事を処理し きれない」「勤務中は常に仕事のことを考えていなければならない」「仕事の負担が重く常に仕事に追われている」の項目 が,交代制勤務群は有意に高い結果であった(p<0.01).一方,「上司・同僚は個人的な話を聞いてくれる」は,交代制 勤務群のほうが有意に高い結果であった(p<0.01).尿中 8-OHdGの仕事前後の比較は,総数50名ならびに交代制勤務 群 34名は日勤後に尿中 8-OHdGは有意に低下した(P<0.05).また交代制勤務群の夜勤前後比較は,夜勤後も尿中 8-OHdG は有意に低下した(P<0.05).

交代制勤務群の夜勤前の仕事へのストレスや緊張状況は高く,上司や同僚からサポートを得ているとしながらもストレス状況が高い結果より,交代制勤務群への精神的サポートの具体的な取り組みや,労務管理(チーム構成や夜勤回数等)などを積極的に行う必要がある.仕事前後の尿中 8-OHdG は,仕事後のほうがストレス状況は有意に低下する結果 を得た.特に交代制勤務群の夜勤前後で仕事後のほうが有意に低下する結果を得たことは,16時間前後の実労働時間が 身体的に過度なストレスではないことが明らかとなった.しかし交代制勤務群の夜勤前の精神的ストレス状況は高いこ とから,精神的ストレスへの積極的な取り組みが急務である.

利益相反:利益相反基準に該当無し

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