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Sleep quality and morningness–eveningness of shift nurses

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Aim and objective. The aim of the study was to analyse, while controlling for identified covariates, the effects of morningness–eveningness on sleep quality for shift nurses.

Background. Shift nurses had greater difficulty falling asleep or staying asleep, thus resulting in higher rates of retiring from hospital. Existing research has addressed the effects of manpower demand and personal preferences on shift assignment; however, the concept of endogenous rhythms is rarely considered.

Methods. This analysis included 137 nurses between the ages of 21–58. Nurses completed the Horne and Ostberg questionnaire to assess morningness-eveningness and the Pittsburgh Sleep Quality Index (PSQI) questionnaire to measure self-reported sleep quality over the last month. The 18-point Chinese version had a Cronbach's reliability coefficient of 0·79 overall and 0·86 respectively. This study analysed correlates of sleep quality by comparing the groups with better or worse sleep quality according to the median of PSQI. Univariate and multivariate analyses were used for the risk factors of worse sleep quality.

Results. The result showed that the strongest predictor of sleep quality was morningness–eveningness not the shift schedule or shift pattern for nurses under controlling the variable of age. Greater age and longer years employed in nursing significantly decreased the risk of worse sleep quality. The confounding age factor was properly controlled; evening types working on changing shifts had higher risk of poor sleep quality compared to morning types.

Conclusions. Morningness–eveningness was the strongest predictor of sleep quality under controlling the variable of age in shift nurses.

Implications for clinical practice. Our results suggested that determining if nurses were attributed to morning or evening types is an important sleep issue before deciding the shift assignment.

Key words: morningness–eveningness, nurses, nursing, shift, sleep, workforce

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Introduction

Nurses work under a shift work system (day shift, evening shift and night shift) in response to patient needs. The shift work system disturbs the natural human circadian rhythm and causes lack of sleep (Knauth *et al.* 1980), which directly or indirectly lowers work efficiency. According to the stressor model by Olsson *et al.* (1990), stressors brought by the shift system are occupational stressors, personal factors and non-occupational stressors. Occupational stressors included the shift system (speed and hours) and workload. Personal factors consisted of sex, age and circadian types. Non-occupational stressors involved the level of stress in daily living. These stressors cause tremendous pressure on shift

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workers and arouse physical and psychological reactions; furthermore, they cause sleep disturbances and circadian rhythm disorders.

Shift workers try to adjust their personal schedules to make adaptation, especially their sleep habits. However, sleep disturbance is the most common problem in the health-related effects of shift work (Akerstedt 2003). Gander *et al.* (1993) studied the shiftwork problems of pilots and indicated that age and circardian rhythm were the main factors contributing to work shift assignment and fatigue. Age, circardian type and sleep disturbance effectively influenced work performance. The circardian types could be categorised as Morning-types (M-types), Evening-types (E-types) and in between the Intermediate type. The M-types get up early and go to sleep early, while the E-types are active during the night and cannot get up early. Previous studies indicated that morningness–eveningness preference is largely independent of ethnicity, gender and socioeconomic position. E-types find adjustment to night shifts easier (Paine *et al.* 2006). These studies confirmed that sleep could be influenced by inner personal factors, such as age, circardian rhythm, work schedule and flexible sleep habits.

Shift assignement is determined mainly by the manpower demands in hospital wards and personal preferences; however, the endogenous rhythm concept is not considered. Most studies examined the effect of shift work on sleep (Coffey *et al.* 1988, Skipper *et al.* 1990, Niedhammer *et al.* 1994, Poissonnet & Veron 2000) or focused on examining the correlates of simulated shift work (Dijk *et al.* 1991, Cajochen *et al.* 1995, Finelli *et al.* 2000). Few studies focused on the effects of morningness–eveningness on sleep quality, particularly on clinical shift nurses. We studied the sleep patterns of five different work shifts, including the day shift (07:30–15:30 hours), evening shift (15:30–23:30 hours), night shift (23:30–07:30 hours), day shift to evening shift or night shift (fast clockwise) and night shift to day shift or evening shift (fast counter-clockwise). The aim of this study was to analyse, while controlling for identified covariates, the effects of morningness–eveningness on sleep quality for shift nurses. The result may serve as a reference for work shift assignment.

Methods

The present analysis included 137 female nurses between the ages of 21 – 58. Seventy-four subjects were in their twenties, 42 subjects were in their thirties and 21 subjects were between the ages of 40 – 58. The sample had a mean work experience of 7·9 years employed in nursing (SD = 7·5). Most clinical nurses were from medical-surgical wards (59·1%). Most subjects were currently unmarried (59·1%). The mean systolic and diastolic blood pressure was 113·5 and 67·7 mmHg respectively. The body mass index (BMI) of these subjects fell between 19 – 25 in 73·7% of the total. The majority of subjects drank tea (62·3%) and coffee (61·3%) in one week before data collection. Less than half (31·4%) took health supplements. Most subjects were involved in rotating shift work (65·7%) with the fast-clockwise (morning–evening–night shift) shift pattern (38·0%). All subjects were screened clear of any personal history of psychiatric, neurological or medical disorders. The subjects read and signed an informed consent that provided detailed information about the nature, propose and risks of this study.

The investigator contacted the head nurse in each ward to explain the purpose of this study and obtained their permission. In addition, the head nurse was asked to announce this study and introduce the researcher to the nurses. The personnel in each ward were informed about the study verbally by one of the authors at three different personnel meetings. After completing the questionnaire, the researcher would check for missing data and ask the requisite nurses to complete the missing data. The PSQI (Buysse *et al.* 1989) is a questionnaire that measures self-reported sleep habits over the last month. It is a global measure with seven components; perceived sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction. The score for each component ranges from 0–3 and the sum is a global score that ranges from 0–21. Higher scores indicated poorer sleep quality. Both the global PSQI and the component subscale scores were analysed so that the effects of individual elements on sleep quality could be determined.

A score of 5 (indicating poor sleep) yielded a diagnostic sensitivity of 89·5% and a specificity of 86·5%, with an internal consistency of $\alpha = 0{\cdot}83$ and test–retest reliability, $r = 0{\cdot}85$ (Buysse *et al.* 1989). The Chinese language PSQI had $\alpha = 0{\cdot}72$ and a split half reliability of 0·84 (Wang 1997). In this study, the 21-point Chinese version had a Cronbach's reliability coefficient of 0·76 overall and a split half reliability of 0·72 for the seven component scores. Using this instrument translated into Chinese, several variables were measured on their duty to determine whether they would confound the effects of morningness–eveningness on sleep.

Participants were asked whether or not they had a bedtime routine, napped after lunch, used herbal tea to sleep. Heart rate and blood pressure were measured by the investigator in the first visit. Subjects completed the Horne and Ostberg (1976) questionnaire to assess the morningness–eveningness. This questionnaire establishes five behavioural categories (English version scoring):

definitively morning types (score = 28–32), moderately morning types (score = 23–27), neither types (score = 16–22), moderately evening types (score = 11–15) and definitively evening types (score = 6–10). For the purpose of this study, we reduced the categories from five to three: morning type (score = 23–32), neither type (score = 16–22) and evening type (score = 6–15).

For maximising the statistical power, worse sleep quality was defined by being higher than the median of PSQI (8). For basic comparisons, socio-demographic characteristics, nursing work features (years of duty, shift schedule and shifting pattern), blood pressure, tea/coffee drinking habit and morningness–eveningness type were statistically examined by using *t*-tests for continuous variables and chi-squared tests for categorical variables. The major area of interest for worse sleep quality was the morningness–eveningness type for nurses with shifting work hours. Other factors were considered as potential confounders in the advanced statistical explorations in this study. Afterwards, we used univariate logistic regressions to estimate the relative risk of each variable on worse sleep quality. After that, potential confounders were involved in constructing the final model of detecting the effect of morningness–eveningness type for sleep quality among nurses. To explore which components would be sensitive to individual morningness–eveningness types of the nurses, we performed linear regressions by separating PSQI components to detect the effect of morningness–eveningness type for each component. SPSS 12·0 for Windows was used to perform all the statistical analyses and the significance level (*p*-value) was set as 0·05 (SPSS Inc., Chicago, IL, USA).

Results

A total of 137 nurses were enroled for the analysis in this study. Table 1 presented the results from comparing the baseline of two groups. Age, years of duty and morningness–eveningness types were significantly different between the groups with and without worse sleep quality. Specifically, older nurses and longer years employed in nursing showed decreased risks for worse sleep quality (OR = 0·93, 95% CI: 0·89–0·98; OR = 0·95, 95% CI: 0·90–0·99 respectively). It was noteworthy that E-types revealed a significantly increased risk of worse sleep quality (OR = 6·56, 95% CI: 1·89–22·88). None of the other risk factors showed a significant effect on sleep quality, in terms of PSQI (Table 2). For a precise estimation of the effects in our study (morningness–eveningness type), the confounding control was achieved for age and years of duty. Because of the collinearity between age and years of duty, their 95% CIs were widened and the statistical significance lost in multivariate analyses. Thus, in Table 3, we decided to control for the age as the only confounder and achieved the best relative risk estimation for morningness–eveningness types (evening type OR = 3·88, 95% CI: 1·01–14·90, relative to morning type). Consequently, when age was properly controlled, E-type nurses working on changing shifts had a higher risk for poor sleep quality. To further explore the PSQI components, the scores of component 1 (subjective sleep quality) and component 3 (sleep duration) were significantly raised for E-type nurses. Namely, E-type nurses had apparent poor subjective sleep quality rating and their percentage of sleep time within the total number of hours in bed was significantly lower than that for M-type shift nurses Table 4.

Discussion

This study employed questionnaires to measure morningness–eveningness and sleep quality in shift nurses. The sleep quality correlates were analysed by comparing these groups with better or worse sleep quality according to the median of PSQI (8). Univariate and multivariate analyses were used to identify the risk factors for worse sleep quality. The result showed that the strongest predictor of sleep quality was the subject's natural morningness–eveningness sleep pattern and not shift schedule or shift pattern. Although this result could not confirm the cause and effect relationship in sleep quality, we indicated that considering morningness–eveningness type of nurses was an important issue for sleep quality in rotating shift nurses.

The study found a significant change in age and years of duty on sleep quality in shift nurses (Table 1). This result was consistent with previous studies (Carrier *et al.* 1997). After further analysing the results, we found that older age and longer years of duty decreased the risk for worse sleep quality. This result was not in line with that increasing age associated with less time asleep or increased number of awakenings during the sleep period (Carrier *et al.* 1997). However, this result was consistent with no age effect on habitual sleep length, bedtime or wakening (Ishihara *et al.* 1992). According to Harma (Harma 1993) greater tolerance to shift work was related with more control hours of work through individual choice with regard to shift system acceptability. This study may imply that more experienced nurses could have greater tolerance to shift work, which allows them to sleep well.

M-types show a preference for waking at an early hour and experience alertness early in the day. E-types show a preference for sleeping at latter hours and function better in the afternoon and evening (Giannotti *et al.* 2002). Therefore, it is better to understand the effect of morningness/evening-

Table 1 Basic characteristics and comparisons of the groups with better or worse sleep quality by the median of PSQI (n = 137)

Variables	Worse sleep quality (PSQI ≥ 8) (n = 75)	Better sleep quality (PSQI < 8) (n = 62)	p-value†
Age (mean ± SD)	28·57 ± 7·28	33·05 ± 8·94	< 0·01*
Years employed in nursing (mean ± SD)	6·59 ± 6·57	9·59 ± 8·28	< 0·05*
BMI (mean ± SD)	21·22 ± 3·06	21·52 ± 2·96	0·62
Systolic blood pressure (mean ± SD)	112·69 ± 10·30	124·37 ± 10·30	0·41
Diastolic blood pressure (mean ± SD)	67·39 ± 9·28	68·08 ± 9·41	0·71
Heart beat rate (mean ± SD)	80·02 ± 10·09	77·16 ± 7·05	0·10
Marriage status			
Single	47	34	0·54
Married	26	27	
Divorced	2	1	
Wards			
Intensive care	18	25	0·12
Medical-surgical	49	32	
Psychiatric	8	5	
Frequency of tea			
Never	18	20	0·72
< Once a week	15	8	
1–2 times a week	15	11	
3–4 times a week	13	10	
5–7 times a week	14	13	
Frequency of coffee			
Never	32	21	0·26
< Once a week	13	7	
1–2 times a week	11	11	
3–4 times a week	9	6	
5–7 times a week	10	17	
Health supplement			
No	51	40	0·73
Yes	23	20	
Missing	1	2	
Shift schedule			
Fixed	23	24	0·32
Shifting	52	38	
Shifting pattern			
Fast clockwise	27	25	0·33
Fast counter-clockwise	1	3	
Slow shifting	23	12	
Others	24	22	
Morningness–eveningness type			
Morning type	8	15	< 0·05*
Neither type	46	41	
Evening type	21	6	

*Values are statistically significant.
†Independent t-tests for continuous variables and chi-squared tests for categorical variables.

ness on sleep quality for nurses before knowing their acceptability and adjustment to shift work. This study surveyed the relationship among morningness–eveningness type, shift pattern and sleep quality. We differentiated the shift schedule by checking the nurse's actual duty time to make the shift pattern parameter more precise. This result showed that shift schedule or shift pattern was not correlated with sleep quality. However, the sleep quality was correlated with morningness–eveningness. This finding may indicate that nurses working at night or arranging shift schedules

Table 2 Univariate analyses for the risk factors of worse sleep quality (PSQI ≥8) by logistic regressions (n = 137)

Variables	Odds ratio	95% Confidence interval	p-value
Age	0·93*	0·89–0·98	< 0·01*
Years employed in nursing	0·95*	0·90–0·99	< 0·05*
BMI	0·97	0·85–1·10	0·62
Systolic blood pressure	0·98	0·95–1·02	0·41
Diastolic blood pressure	0·99	0·95–1·04	0·71
Heart beat rate	1·04	0·99–1·09	0·10
Marriage status			
Single	Ref	–	
Married	0·70	0·35–1·40	0·31
Divorced	1·45	0·13–16·61	0·77
Wards			
Intensive care	Ref	–	
Medical-surgical	0·96	0·28–3·18	0·94
Psychiatric	0·45	0·12–1·60	0·21
Frequency of tea			
Never	Ref	–	
< once a week	2·08	0·72–6·07	0·18
1–2 times a week	1·51	0·55–4·14	0·42
3–4 times a week	1·44	0·51–4·09	0·49
5–7 times a week	1·20	0·45–3·21	0·72
Frequency of coffee			
Never	Ref	–	
< Once a week	1·22	0·42–3·56	0·72
1–2 times a week	0·66	0·24–1·79	0·41
3–4 times a week	0·98	0·31–3·17	0·98
5–7 times a week	0·39	0·15–1·00	0·05
Healthy supplement			
No	Ref	–	
Yes	0·90	0·44–1·87	0·78
Missing	0·39	0·03–4·48	0·45
Shift schedule			
Fixed	Ref	–	
Shifting	1·43	0·70–2·90	0·32
Shifting pattern			
Fast clockwise	Ref	–	
Fast counter-clockwise	0·31	0·30–3·17	0·32
Slow shifting	1·78	0·73–4·30	0·20
Others	1·01	0·46–2·24	0·98
Morningness–eveningness type			
Morning type	Ref	–	
Neither type	2·10	0·81–5·47	0·13
Evening type	6·56*	1·89–22·88	< 0·01*

*Values are statistically significant.

Table 3 Multivariate analysis for the risk factors of worse sleep quality (PSQI ≥8) by logistic regression (Total number of subjects: 137), controlled for age

Variables	Odds ratio	95% Confidence interval	p-value
Age	0·95*	0·91–0·99	< 0·05*
Morningness–eveningness type			
Morning type	Ref	–	
Neither type	1·58	0·58–4·35	0·37
Evening type	3·88*	1·01–14·90	< 0·05*

*Values are statistically significant.

Table 4 The effect of morningness–eveningness type by each component of Pittsburgh Sleep Quality Index (PSQI) with linear regressions, adjusted by age (n = 137)

Components of PSQI	B-value	95% Confidence interval	p-value
Subjective sleep quality			
Morning type	Ref	–	
Neither type	0·32	−0·01 to 0·64	0·06
Evening type	0·65*	0·24–1·06	< 0·01*
Sleep latency			
Morning type	Ref	–	
Neither type	0·25	−0·59 to 1·08	0·56
Evening type	0·27	−0·78 to 1·33	0·61
Sleep duration			
Morning type	Ref	–	
Neither type	0·39	−0·03 to 0·81	0·07
Evening type	0·89*	0·36–1·42	< 0·01*
Habitual sleep efficiency			
Morning type	Ref	–	
Neither type	0·06	−0·46 to 0·59	0·81
Evening type	0·51	−0·15 to 1·18	0·13
Sleep disturbances			
Morning type	Ref	–	
Neither type	−0·09	−0·35 to 0·16	0·48
Evening type	0·08	−0·24 to 0·40	0·62
Use of sleep medication			
Morning type	Ref	–	
Neither type	0·11	−0·24 to 0·45	0·54
Evening type	0·21	−0·23 to 0·64	0·36
Daytime dysfunction			
Morning type	Ref	–	
Neither type	0·09	−0·32 to 0·49	0·68
Evening type	0·10	−0·41 to 0·61	0·71

*Values are statistically significant.

should assess their endogenous type (morningness and eveningness) first. The findings of this study may provide some ideas for further investigation.

We found that E-type nurses had worse sleep quality compared to M-types. Especially, nurses with evening type reflected negative extremes on two areas: subjective sleep quality and sleep duration; however, changes declined in the rest five areas: sleep latency, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. These findings may be explained as follows: Firstly, E-types tend to vary considerably in their sleep/waking time and sleep length (Kerkhof 1985, Ishihara *et al.* 1992, Monk *et al.* 1994). This study showed that E-types delayed their

sleep–wake schedules more than M-types. The timing of sleep for E-types was from 01:00 to 04:00 hours and the timing of waking up was from 10:00–14:00 hours. The timing of sleep for M-types was from 22:00–24:00 hours and that of waking up was from 06:00–08:00 hours on the day shift and days off. We confirmed that E-types had more changeable sleep–wake schedules than M-types. Secondly, E-types display a greater need for sleep (Taillard *et al.* 1999). This study indicated the length of sleep for E-types is around five to eight hours in the day shift and evening shift, but around 10–12 hours on their days off. E-types had more irregular sleep and waking time. This situation resulted in a sleep debt during their day shift and extended their sleep duration on their days off.

We analysed the correlates of sleep quality and tried to understand changes of morningness–eveningness for shiftwork nurses as a reference. A longitudinal survey would propose more efficient suggestions. We hope that shift problems of doctors and pharmacists could be examined in the future study.

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Contributions

Study design: MC; data collection and analysis: all authors and manuscript preparation: all authors.

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