

# Perceived effects of rotating shift work on nurses' sleep quality and duration

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## Abstract

The aim of this longitudinal study was to assess the effect of rotating shift work on perceived sleep quality and sleep duration of nurses at Queen Elizabeth Central Hospital, Blantyre, Malawi. Twenty four female nurses were recruited at random from among personnel engaged in rotating shift work. The nurses worked a three-phase schedule: five day shifts (7.00 – 17.00) followed by three night shifts (17.00 – 7.00) and five days off. Controls were 22 female nurses who did not perform night duties. Sleep quality and duration was assessed using standardized and validated questionnaires on sleep duration and subjective sleep quality (SSQ). One-way analysis of variance revealed a significant effect of shift phase on total sleep duration ( $F = 36.8$ , d.f. = 8,  $P < 0.000$ ) and perceived sleep quality ( $F = 8.81$ , d.f. = 3,  $P < 0.000$ ). Night shift work was associated with reduction of sleep quality and duration. The after effects of night shifts persisted during days of the recovery period indicating accumulation of fatigue.

## Introduction

It has been well documented that shift work results in psychosomatic disorders, decreased alertness, increased tiredness, changes in mood and motivation, malaise and irritability, decreased safety and productivity of work, gastrointestinal and musculoskeletal disorders<sup>1-3</sup>. However, sleep disturbances are among the most frequent complaints reported by shift workers<sup>4,5</sup>. Impaired sleep pattern and alertness of shift workers have been attributed to the conflict between circadian rhythms and working irregular hours<sup>6</sup>. During prolonged periods of shift work circadian rhythms gradually adapt to the new schedule but adaptation is not complete especially when shift work is irregular<sup>6</sup>.

The effects of shift work on sleep behaviour have been studied for workers of various professions in natural environment as well as in laboratory conditions<sup>5-8</sup>. There are very few studies which involved medical personnel<sup>9-11</sup> and most of them were conducted in western countries. Real-life settings in Africa are different from those in developed countries with augmented disadvantages of shift work and minimal advantages such as increased pay or increased time for education. Therefore it is reasonable to suggest that shift work might have considerable adverse effects on sleep behaviour of Malawian nurses.

The aim of the present study was to assess the effect of rotating shift work on perceived sleep quality and sleep duration of nurses at Queen Elizabeth Central Hospital, Blantyre, Malawi.

## Materials and methods

The survey was conducted at Queen Elizabeth Central Hospital, Blantyre, Malawi. Twenty-nine female nurses were recruited using systematic random sampling from among the personnel involved in rotation shift work. Workload of the nurses varied from shift to shift and from ward to ward. However, nurses working in very busy units such as labour ward and intensive care unit were not included into study population in order to increase homogeneity of the sample. 24 of them completed all questionnaires and were included in study population. The nurses worked a three-phase schedule: five day shifts (7.00 – 17.00) followed by three night shifts (17.00 – 7.00) and five days off. The nurses were followed for one entire shift cycle, which lasted 13 days. All nurses in the study group have been doing shift work for at least one month. Controls were recruited from among female nurses working day time only and who were not performing night time duties for at least 4 months prior to the study in order to reduce long-term effects of night work<sup>12</sup>. Control group was matched with study group by age and length of service.

The participants filled in standardized questionnaires concerning their sleep duration and sleep quality<sup>5</sup>, which were locally validated. The nurses reported duration of night sleep and daytime naps. The subjective sleep quality (SSQ) questionnaire included 14 items, which covered various sleep complaints such as trouble with falling asleep (2 items), insufficient sleep (3 items), general sleep quality (3 items), tossing and turning (1 item), trouble with sleeping on (3 items), waking up unrefreshed (2 items). The items were grouped in ascending order of severity of sleeping complaints. The higher score on the scale corresponded with lower subjective quality of sleep. High reliability of the SSQ questionnaire has been demonstrated by several international studies (Cronbach coefficient alpha was 0.89)<sup>5,13</sup>. We tested the instrument for content or face validity to determine if it still measures what it was intended to test. To carry out this procedure the instrument was initially reviewed by 10 nurses. They were asked to comment and to clarify confusing items, to update terms, and to comment on the apparent validity of each item. No items were changed, which indicated the high validity of the instrument in local setting<sup>14</sup>.

There are two response variables for this study and these are total sleep duration (minutes) and sleep quality. Sleep quality is measured by the sleep quality score (SSQ). These outcome variables are quantitative. There are two independent variables and these are shift phase and study group. Shift phase has three levels namely day shift, night shift and days off. There are two study groups. Both shift phase and study group are nominal variables. Other variables are age and length of service. These two were used to match study and control subjects. The effect of shift phase on total sleep duration was examined using one-way analysis of variance. The total sleep duration for the three shift phases were also compared. These multiple comparisons were performed using the Bonferroni correction<sup>15</sup>. All tests were conducted at the 5% level of significance.

Table 1. Means ( $\pm$ SD) of reported sleep duration (minutes) and mean ( $\pm$ SD) scores on the subjective sleep quality scale of group of nurses during day shift (days 1 to 5), subsequent night shifts (days 6 to 8) and days off (days 9 to 13).

	Shift Phase												
	Day Shift					Night Shift			Days Off				
Day of Shift Phase (i)	1	2	3	4	5	6	7	8	9	10	11	12	13
Sleep duration (mins)	384 $\pm$ 66	402 $\pm$ 54	396 $\pm$ 73	390 $\pm$ 68	407 $\pm$ 64	228 $\pm$ 58	232 $\pm$ 49	241 $\pm$ 55	597 $\pm$ 88	582 $\pm$ 106	586 $\pm$ 111	562 $\pm$ 84	538 $\pm$ 79
Sleep quality (SSQ)	3.2 $\pm$ 1.6	3.0 $\pm$ 1.5	3.1 $\pm$ 1.4	3.2 $\pm$ 1.7	3.1 $\pm$ 1.6	6.2 $\pm$ 1.8	6.5 $\pm$ 1.7	6.7 $\pm$ 1.8	4.1 $\pm$ 1.7	4.3 $\pm$ 1.5	4.1 $\pm$ 1.5	3.9 $\pm$ 1.6	3.2 $\pm$ 1.3

Table 2. Means and SD of reported sleep duration (minutes) and scores on the subjective sleep quality scale of control group of nurses during week days (1-5) and weekends (6 and 7).

	Days of week						
	1	2	3	4	5	6	7
Sleep duration	410 $\pm$ 69	398 $\pm$ 76	367 $\pm$ 58	413 $\pm$ 67	407 $\pm$ 79	469 $\pm$ 79	451 $\pm$ 84
Sleep quality	2.7 $\pm$ 1.1	3.1 $\pm$ 1.2	2.6 $\pm$ 1.1	3.0 $\pm$ 1.1	3.2 $\pm$ 1.3	2.4 $\pm$ 1.2	2.5 $\pm$ 1.0

## Results

Twenty six nurses were approached, 22 returned completed questionnaires. The mean age of nurses in the study group was 40.0 $\pm$ 7.4 years and in the control group it was 41.4 $\pm$ 7.9 years. The mean length of medical service was 14.3 $\pm$ 5.7 years and 15.1 $\pm$ 6.1 years in the study and control groups, respectively. All subjects gave informed consent to participate in the survey and permission was also obtained from hospital management.

Table 1 shows the mean values and SD of self-reported total sleep duration (night sleep plus day time naps) of a group of rotating shift nurses during three phases (day shift, night shift and days off) of a shift cycle. One-way analysis of variance revealed a significant effect of shift phase on total sleep duration ( $F = 36.8$ , d.f. = 8,  $P < 0.000$ ). Comparison of means total duration of sleep of the 3 phases of shift cycle showed that total duration of sleep was significantly lower during days of night shifts ( $t = 2.84$ ,  $P < 0.01$ ) and significantly higher during days off ( $t = 2.58$ ,  $P < 0.02$ ). However no significant difference was observed between various days of the same shift phase. The average duration of naps during night shifts and days off was not significantly different (84 $\pm$ 66 minutes and 96 $\pm$ 77 minutes, respectively). The mean duration of night time sleep during night shifts (151 $\pm$ 52 minutes) was significantly shorter ( $t = 16.09$ ,  $P < 0.000$ ) than during days off (477 $\pm$ 87 minutes). None of the participants napped during day- shift phase.

The mean values of perceived sleep quality scores for the study group are shown in Table 1. Shift work had a significant effect on SSQ score ( $F = 8.81$ , d.f. = 3,  $P < 0.0001$ ). The difference in subjective sleep quality between various days within one phase of shift cycle was not significant.

Table 2 shows the mean sleep duration and SSQ scores of the control group of nurses. There was no significant difference in total sleep duration and SSQ scores between work days and days off in this group. Comparison of the study and control groups indicated that nurses on rotating shift system slept significantly less than nurses in the control group during night-shift phase ( $t = 10.91$ ,  $P < 0.000$ ) but significantly longer during days off ( $t = 6.92$ ,  $P < 0.000$ ). The mean duration of total sleep time during day- shift phase of rotating shift system was similar to that of the control group. SSQ score in the study group was higher than in the control

group during night shifts and days off ( $t = 2.34$ ,  $P < 0.05$ , and  $t = 2.86$ ,  $P < 0.01$ , respectively) and it was similar to the control group during day-shift phase.

## Discussion

The most striking finding of the present study is the considerably shortened duration of total sleep time and low sleep quality of nurses on rotating shift system during night-shift phase. On average, nurses on night shift slept 3 hours less than nurses of similar age who did not work during nights. This reduction in total sleep time was due to decreased duration of day-time sleep which was considerably shorter than in studies conducted in western countries<sup>9,16,17</sup>. As a result, day-time naps did not compensate for reduced night sleep and by the end of the 3-days night shift period nurses have accumulated about 10 hours of sleep deprivation. Most of our participants indicated that they do not have a place for day-time rest in their houses. Environmental noise and social demands might be also responsible for short duration of day time sleep of nurses in this study. In addition, the interval between 2 night shifts in rotating system was too short, only 10 hours. Therefore it was difficult for the nurses on night shifts in this study to find a consistent 7-hour period to sleep. It has been demonstrated that more than 16 hours between work shifts is required to allow more than 7 hours of total sleep time<sup>18</sup>. Therefore, it is not surprising that duration of sleep was prolonged during 5 days off when on average nurses slept 9 to 10 hours per day and accumulated about 15 hours of excessive sleep time, which was higher than cumulative sleep deprivation. Prolonged duration of sleep during days off indicated presence of significant after-effects of night work during the entire recovery period.

In addition to reduced sleep duration, the study group of nurses had low sleep quality during night shifts and subsequent days off compared to the control group. It has been demonstrated that under normal conditions of undisturbed night sleep, the SSQ score varies between 1 and 2 units<sup>5,9</sup>. In the present study the mean values of SSQ score were above 6 units during night shifts and between 3 and 4 units during day work and days off. Therefore, sleep quality of nurses improved during undisturbed nights – probably due to reduction in cumulative sleep deficit – but it remained lower than that of nurses who were not engaged in shift work. The presence of prolonged period of after-effects which

continued through the days off to the day shift period of the next shift cycle suggests that nurses might start their next shift period in a sub-optimal condition which could reduce adjustment to shift work and professional performance.<sup>8</sup>

Several factors can contribute to poor sleep quality of nurses on rotating shifts. First, rapid and continuous rotation of shifts leads to a lasting alteration of circadian rhythm and to a transitory increase of psychological disturbances after the night shift<sup>19</sup>. Both factors affect sleep quality and should be targeted in coping strategies with shift work. Second, sleep quality directly relates to sleep duration. For example, getting less than 6 hours of sleep significantly correlates with sleep disturbances and low sleep quality<sup>20</sup>. In the present study, sleep duration of nurses during night shifts was 4 hours and less per day. Therefore, it is not surprising that they reported low sleep quality. Longer duration of sleep during day shift and days off was also associated with better sleep quality of nurses.<sup>21</sup>

The findings of our study indicated that additional administrative and organizational interventions and coping strategies should be introduced at the hospital. In the present study the duration of shift cycle was 13 days, which indicated biweekly rotating system. This system was often altered due to insufficient staffing situation and might be considered as irregular. From the point of view of freedom from sleep deprivation, the shift system currently used at the hospital is far from being optimal. The duration of a night shift at the hospital was 14 hours. It has been demonstrated that long night shift decreases alertness of nurses during the terminal hours of work and suggests risk of compromised patient care<sup>7</sup> Long night shift can be considered acceptable provided the work load of nurses is reduced and there are sufficient rest pauses available to compensate for tiredness and sleepiness,<sup>21,22</sup> It has been suggested<sup>9</sup> that permanent or very slowly rotating shift systems might be superior to rapidly rotating and irregular shift systems used at the hospital. Therefore, the hospital should consider replacing current shift system with slowly rotating shift system.

Preservation of normal diurnal orientation is very important for good sleep quality and adequate sleep duration of nurses. From this prospective, the sleep-wake strategy with long naps during night work and short day-time sleep is more beneficial for sleep quality and readjustment to diurnal life than the strategy with long day-time sleep and preventive late afternoon naps to anticipate sleepiness during night work<sup>23</sup>. Therefore, shift-work nurses should be properly counselled on their sleep-wake strategy. It has been demonstrated that individual psychological counselling or group educational interventions can significantly reduce negative impact of shift work on nurses<sup>24</sup>.

All data reported in this study are subjective and have limitations similar to other investigations where assessment of psychophysiological parameters was done using self-reports. There are many physiological and psychological events that occur during the sleep period and during the state of wakefulness that impact the individual's perceived sleep quality. These subjective aspects of sleep are difficult to examine with objective physiological measures. However, it is this subjective component of sleep that is most important to an individual.

In conclusion, night shifts were associated with decreased self-reported sleep duration and perceived sleep quality of nurses. The after-effects of night shifts persisted during days of the recovery period indicating accumulation of fatigue. We suggest that replacing current shift system with slowly rotating shift system and optimization of sleep-wake strategy could improve sleep quality of nurses.

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## References

1. Monk TH. The relationship of chronobiology of sleep schedules and performance demands. *Work Stress*, 1990; 4: 227–36.
2. Akerstedt T. Sleepiness as a consequence of shift work. *Sleep*, 1988; 11: 17–34.
3. Akerstedt T, Torsvall L. Experimental changes in shift schedules – Their effects on well-being. *Ergonomics*, 1978; 21: 849–56.
4. Vidacek S, Kaliterna L, Radosevic-Vidacek B and Folkard S. Productivity on a weekly rotating system: circadian adjustment and sleep deprivation effect. *Ergonomics*, 1986; 29: 1583–90.
5. Meijman TF, Thunnissen MJ, de Vries-Griever DGH. The after effect of a prolonged period of day-sleep on subjective sleep quality. *Work Stress*, 1990; 4: 65–70.
6. Eastman CI. Circadian rhythm and bright light: recommendations for shift work. *Work Stress*, 1990; 4: 245–60.
7. Torsvall L, Akerstedt T. Sleepiness on the job: continuously measured EEG changes in train-drivers. *Electroencephalogr Clin Neurophysiol*, 1987; 66: 502–11.
8. Bonnet MH. Dealing with shift work: physical fitness, temperature, and napping. *Work Stress*, 1990; 4: 261–74.
9. Wilkinson R, Allisom S, Feeney M, Kaminska Z. Alertness of night nurses: two shift systems compared. *Ergonomics*, 1989; 32: 281–92.
10. Poulton EG, Hunt GM, Carpenter A, Edwards RS. The performance of junior hospital doctors following reduced sleep and long hours of work. *Ergonomics*, 1978; 21: 279–95.
11. Arnetz BB, Akerstedt T, Anderzen I. Sleepiness in physicians on night call duty. *Work Stress*, 1990; 4: 71–3.
12. Dumont M, Montplaisir J, Infante-Rivard C. sleep quality of former night-shift workers. *Int J Occup Environ Health*, 1997; 3: S10–S14
13. Mokken R, Lewis C. A non-parametric approach to the analysis of dichotomous item responses. *Appl. Psych. Meas*, 1982; 6: 417–30.
14. Hunto HB, Page EB. *Statistical Methods in Health Care Research*. 2nd Ed. Philadelphia: JB Lippincott Company, 1993.
15. Armitage P, Berry G. *Statistical Methods in Medical Research*. 3rd Ed. Oxford: Blackwell Scientific Publication, 1994.
16. De Martino MM. Comparative study of sleep patterns in nurses working day and night shifts. *Rev Panam Salud Publica*, 2002; 12: 95–100.
17. Escriba V, Perez-Hoyos S, Bolumar F. Shift work: its impact on the length and quality of sleep among nurses of the Valencian region in Spain. *Int Arch Occup Environ Health*, 1992; 64: 125–9.
18. Kurumatani n, Koda S, Nakagiri S, Hisashige A, Sakai K, Saito Y, Aoyama H, Dejima M, Moriyama T. The effects of frequently rotating shift work on sleep and family life of hospital nurses. *Ergonomics*, 1994; 37: 995–1007.
19. Venuta M, Barzaghi L, Cavalieri C, Gamberoni T, Guaraldi GP. Effects of shift work on the quality of sleep and psychological health based on a sample of professional nurses. *Giornale italiano di medicina del lavoro ed ergonomia*.1999; 21:221–5.
20. Ohida T, Takemura S, Nozaki N, Kawahara K, Sugie T, Uehuta. The influence of lifestyle and night-shift work on sleep problems among female hospital nurses in Japan. *Japanese journal of public health*. 001; 48: 595–603.
21. Daurat A, Foret J. Sleep strategies of 12-hour shift nurses with emphasis on night sleep episodes. *Scandinavian journal of work, environment and health*. 2004; 30: 299–305.
22. Kilpatrick K, Lavoie-Tremblay M. Shift work: What health care managers need to know. *Health care management*, 2006; 25:160–6.