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Prevalence and consequences of sleep disorders in a shift worker population

Maurice M. Ohayon[a,*], Patrick Lemoine[b], Véronique Arnaud-Briant[c], Martine Dreyfus[c]

[a]*Stanford Sleep Epidemiology Research Center, School of Medicine, Stanford University, 401 Quarry Road, Suite 3301, Stanford, CA 94305, USA*
[b]*Unite clinique de Psychiatrie biologique, Centre Hospitalier Le Vinatier, Bron, France*
[c]*Centre Hospitalier Le Vinatier, Bron, France*

Abstract

Introduction: Irregular work schedules often results in a disruption of the normal circadian rhythm that can causes sleepiness when wakefulness is required and insomnia during the main sleep episode. **Method:** Two physicians using the Sleep-EVAL system interviewed 817 staff members of a psychiatric hospital. The interviews were done during the working hours. In addition to a series of questions to evaluate sleep and mental disorders, the evaluation included a standard questionnaire assessing work conditions, work schedule and their consequences. Three work schedules were assessed: (1) fixed daytime schedule ($n=442$), (2) rotating daytime shifts ($n=323$) and (3) shift or nighttime work ($n=52$). **Results:** Subjects working on rotating daytime shifts were younger than the two other groups and had a higher proportion of women. Participants working on rotating daytime shifts reported more frequently than the fixed daytime schedule workers to have difficulty initiating sleep (20.1% vs. 12.0%). The sleep duration of shift or nighttime workers was shorter than that of the two other groups. Furthermore, subjects working rotating daytime schedule reported to have shorter sleep duration of about 20 min when they are assigned to the morning shift. Work-related accidents were two times more frequent among the rotating daytime workers (19.5%) compared with the fixed daytime schedule workers (8.8%) and the group of nighttime or shift workers (9.6%). Sick leaves in the previous 12 months were also more frequently reported in the rotating daytime schedule group (62.8%) as compared with the daytime group (38.5%, $P<.001$); 51.9% of nighttime or shift workers took sick leave. **Conclusions:** Working on a rotating daytime shifts causes significant sleep disturbances. As consequences, these workers are more likely to feel sleepy at work and are more likely to have work-related accidents and sick leaves.

Keywords: Epidemiology; Daytime sleepiness; DSM-IV diagnoses; Insomnia; Work conditions

Introduction

A well-known risk factor for insomnia and excessive daytime sleepiness complaints are working conditions, especially shift work. The rate of sleep complaints in this specific population is higher than rates found in the general population. These problems are mainly due to a disruption of the normal sleep/wake rhythm, of the normal circadian REM sleep rhythm and of the rhythm of REM/non-REM sleep patterns. Thus, the sleep problems of shift workers are partly a circadian one. Several studies have reported that the total sleep duration is related to the body temperature rhythm at bedtime [1–3]. Studies using a sleep diary of workers as well as laboratory studies have shown that the main sleep period at an unusual time is 1–4 h shorter than night sleep [4,5]. However, other factors are also involved in the deterioration of sleep quality: fatigue, stress, daylight, health and age.

Whether these disorders are causing more sick leaves in shift workers is unclear: Previous studies have reported contradictory results in this respect. Some found a lower absence rate in shift workers than in day workers [6,7], while others found higher rates of sick leave and a higher number of visits to work site clinics in shift workers [8].

These contradictory results have lead some researchers [9,10] to hypothesize that there may be a natural selection process among shift workers: Those having difficulties adapting to shift work usually transfer to day work. The rare studies that have tested this hypothesis tend to confirm it. The results of the Lavie et al.'s study [9] indicated that the

* Corresponding author. Tel.: +1-650-725-5920; fax: +1-650-725-8910.
E-mail address: mohayon@stanford.edu (M.M. Ohayon).

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occurrence of sleep disturbances appeared to be a good marker of the adjustment level to shift work.

One of the main consequences of having the main sleep period at an unusual time is an excessive sleepiness during wakefulness. This phenomenon is often evoked when attempting to explain human catastrophes occurring at night such as the Chernobyl nuclear accident, airplane crashes and road accidents. Furthermore, decreased vigilance may cause the individual to be more vulnerable to work-related accidents.

We investigated the effects on sleep of three different work schedules among the staff of a psychiatric hospital: fixed daytime schedule, rotating daytime schedule and shift or night working.

Methods

Participants

All staff members of the Vinatier Hospital, a large psychiatric institution located in Bron (France), were invited to participate in the study. There were 2007 staff members at the hospital. Overall, 817 employees volunteered to participate in the study. The distribution of the sample was quite similar to that of the entire staff of the hospital. Administrative staff members were overrepresented in the final sample (Table 1). Medical staff composed the majority of the sample. Employees were interviewed at the staff medical clinic of the hospital or at the ward during work hours. Two physicians performed the face-to-face interviews.

For the medical staff, the work schedule was mainly divided into two shifts:

- Morning shift: 6:30 a.m. to 2:30 p.m.
- Afternoon shift: 1:30 p.m. to 21:30 p.m.

About 25% of the maintenance staff worked on rotating morning and afternoon shifts or on a 24-h shift schedule.

Social services employees mostly worked on the daytime shift (8:00–9:00 a.m. to 4:00–5:00 p.m.); 7% of them were assigned to rotating morning and afternoon shifts.

Administrative staff worked only on the daytime shift.

Instrument

The interviews were done using the Sleep-EVAL system [11,12], a computer program written by M.M.O. and designed to conduct interviews about sleep habits and sleep disorder diagnoses according to two classifications: the DSM-IV [13] and the International Classification of Sleep Disorders [14].

Table 1
Distribution of the sample and hospital staff members by yards

Staff	Sample (%)	Hospital (%)
Administrative	15.9	9.3
Medical	68.7	69.2
Maintenance	7.5	11.2
Social services	3.7	5.0

The interviews began with information about sociodemographics and descriptions of the working schedules followed by sleep/wake schedule, sleeping habits, medical treatments and physical illnesses. Once these data were collected, the system used this information to formulate diagnostic hypotheses of sleep and mental disorders. Further questions were asked during this process. The inference engine (or knowledge processor) performed this dynamic reasoning process. This engine based its differential diagnosis process on a series of key rules allowing or prohibiting the co-occurrence of two (or more) diagnoses. A "neural network" managed any uncertainty in the subject's answers as well as in diagnoses. Once all diagnostic possibilities were exhausted, the system closed the interview. The system has been validated in various contexts and has been demonstrated to be reliable and valid [15,16].

Variables

The standard questionnaire was composed of (1) sociodemographic information, (2) sleep/wake schedule information, (3) sleep habits, (4) sleep symptoms (insomnia, hypersomnia, snoring, restless legs symptoms, etc.), (5) health (eating habits, diseases), (6) medical consultations and hospitalizations in the previous year, (7) medications taken at the time of the interview, (8) social network, (9) work-related injuries in the previous year and (10) DSM-IV and ICSD diagnoses.

For the purpose of this study, a questionnaire about work conditions and work schedule and their consequences on health, social and professional life was added into the Sleep-EVAL system. This specific questionnaire included (1) a description of current shift (duration, number of days worked with the same shift, number of days of rest between each shift change); (2) a description of shifts in the previous month. For each shift, the subject answered if there was more than one sleep period, the sleep duration and whether sleep problems (insomnia or daytime sleepiness) occurred; (3) a description of advantages and disadvantages of shift working; (4) those who were on a fixed schedule were asked if they ever have been shift workers and, if so, for how many years, when they stopped working on shifts and what were the reasons they stopped being shift workers.

Definition of groups

The participants were divided according to their work schedule:

1. Fixed daytime work group ($n = 442$): these employees always worked during the daytime and always kept the same work schedule;

2. Rotating daytime work group ($n=323$): worked on rotating daytime shifts. These employees rotated mainly between the morning and afternoon shifts. About a quarter of them (23.2%) also had a daytime shift.
3. Fixed or rotating nighttime work group ($n=52$): these employees worked either on a fixed nighttime shift or were shift workers.

Statistical analyses

Bivariate analyses involving categorical or qualitative variables were carried out with chi-square statistics. ANOVA with post-hoc comparison tests were performed on sleep/wake schedule variables. Predictors of work-related accidents and sick leaves were analyzed using logistic regressions [17]. Reported differences were significant at .05 or less.

Results

Subjects working on a rotating daytime shift were younger (37.6 ± 8.4 years) than the fixed daytime work group (42 ± 8.3 years) and the fixed or rotating nighttime work group (41.4 ± 6.5 years) ($P<.001$). There were also more women in the rotating daytime shift group (78.6%) compared with the fixed daytime work group (68.1%) and the fixed or rotating nighttime work group (59.6%) ($P<.001$).

The interviews were done during the morning shift for 52.6% of the subjects in the rotating daytime shift group; 42.3% were interviewed during the afternoon shift and 4.3% were interviewed on a day off. The subjects in the fixed or rotating nighttime work group were interviewed during the day shift or at the end of a night shift.

Subjects were assigned to a rotating daytime schedule on average for 12.4 (± 8.5) years. The average was 11.8 (± 6.5) years for subjects with a fixed or rotating nighttime schedule. In both groups, participants worked on average 4 days with the same schedule followed by 2 days off in the rotating daytime schedule group and 3 days off in the fixed or rotating nighttime work group.

Advantages and disadvantages of rotating daytime or nighttime work schedule

Most of workers reported a greater freedom in the organization of their time (70.3%), some reported advantages in the organization of family life (3.8%) and a quarter did not see advantages in this type of working schedule.

The most frequently reported disadvantage was a negative impact on the health (51.5%). About 10% said also that rotating work schedules had a negative impact on their marital life and 5% mentioned familial difficulties related to their work schedule. Near 6% complained of having less free time and also 6% said they had experienced a deterioration of their social life.

Consequently, if they could choose, only 44% of rotating daytime or nighttime workers would keep their actual work schedule.

Sleep/wake schedule

Bedtime period

At bedtime, the staff members working with a rotating daytime schedule reported longer sleep latency than the two other groups (Table 2). Consequently, this translated into a greater number of subjects who reported having difficulties in initiating sleep: About 20% of staff members working a rotating daytime schedule had these difficulties, compared with 12% and 13% in the two other groups. Participants who were working a rotating work schedule were also asked if they experienced greater difficulties in initiating sleep when they were transitioning between two work shifts. All subjects with a fixed or rotating nighttime schedule and 44.9% of those with a rotating daytime schedule reported no change. However, among subjects with a rotating daytime schedule, 26.2% reported having a few more difficulties initiating sleep and 29.0% said they had much greater difficulty initiating sleep following a work shift.

Most of the staff members with a fixed daytime work schedule said they went to sleep practically every day at the same hour. This was the case for about one quarter of the rotating daytime work group and < 20% for the nighttime or shift workers (Table 2).

Main sleep period

The average duration of the main sleep period during the previous year is shown in Fig. 1. As can be seen, the staff members working at night or on shifts had the shortest sleep duration, even when they were on a daytime shift. The rotating daytime group had a large variation in their sleep duration depending on if they were working the morning shift or the afternoon shift.

Table 2
Bedtime characteristics by groups

	Daytime schedule		
	Fixed ($n=442$), %	Rotating ($n=323$), %	Night/shift ($n=52$), %
Sleep latency			
≤ 5 min	46.4	40.2	34.6
6–15 min	31.0	22.6	36.5
16–30 min	11.1	16.7	17.3
> 30 min	11.5	20.4†	11.5
Difficulties initiating sleep ≥ 2 evenings/week	12.0	20.1†	13.5
Regular bedtime hour ≥ 4 evenings/week	63.8	28.5†	17.3†

† $P<.001$ with fixed daytime work group.

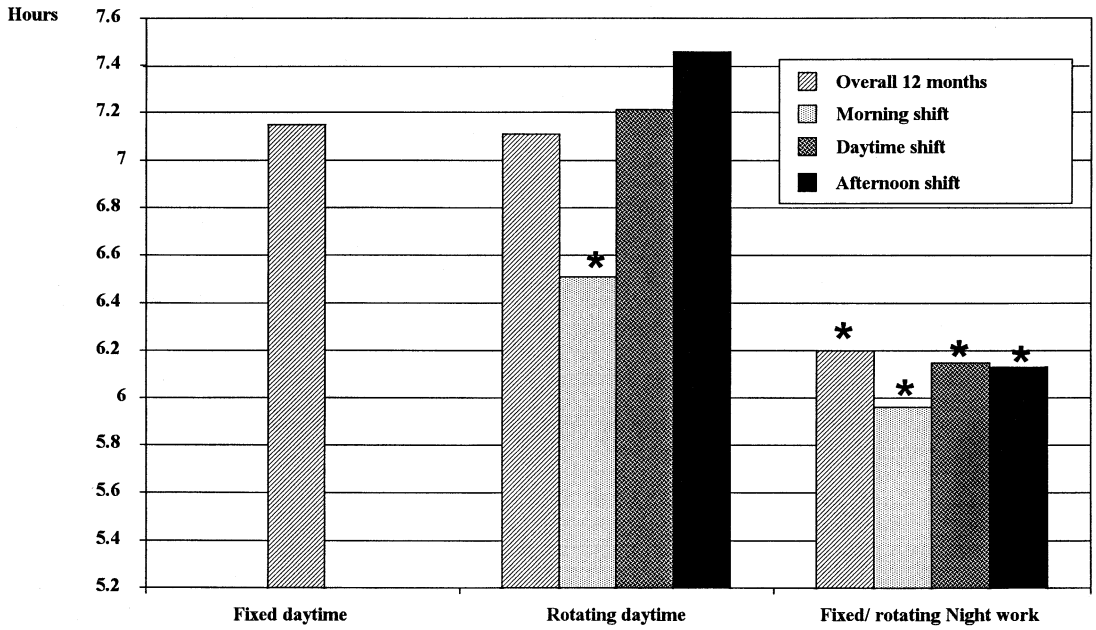

Fig. 1. Duration of the main sleep episode by groups and shifts. Legend: * $P<.05$ with fixed daytime work schedule post-hoc comparison Duncan's multiple range tests.

The proportion of subjects who reported having a disrupted sleep at least two nights per week is comparable among the three groups. However, the rotating daytime group who said they had a disrupted sleep, reported significantly more nocturnal awakenings than did the fixed daytime group (Table 3). The rotating daytime group was also more apt to report that the number of nocturnal awakenings increased following a shift change: 27.9% of them said they had one or two more awakenings and 17.3% said they had at least three more awakenings, compared with 9.1% in the fixed night/shift work group ($P<.001$).

Wake-up period

The rotating daytime work group had more difficulty in waking up at the time they wanted (23.8%) compared to staff members who worked a regular daytime schedule (13.1%) or who worked at night or on night shifts (11.5%) ($P<.01$). Furthermore, almost 90% of the staff members working a regular daytime schedule woke up practically every day at the same hour while this proportion fell to 18% ($P<.001$) in the rotating daytime group and 25% in the night or shift work group.

Table 3
Main sleep period characteristics by groups

	Daytime schedule		
	Fixed ($n=442$)	Rotating ($n=323$)	Night/shift ($n=52$)
Satisfaction sleep duration (%)			
Very satisfied	60.2	50.2	51.9
Average satisfied	29.2	28.2	32.7
Little/not at all satisfied	10.6	21.7†	15.4
Disrupted sleep ≥ 2 nights/week (%)	28.7	29.7	25.0
Number of awakenings/ night (mean ± S.D.)	$n=156$, 1.99 ± 1.0	$n=117$, 2.48 ± 1.1‡	$n=15$, 2.33 ± 1.1

† $P<.001$ with fixed daytime work group.
‡ $P<.05$ with fixed daytime work schedule post-hoc comparison Duncan's multiple range tests.

Napping and daytime sleepiness

The group of nighttime or shift workers was more likely to report napping at least 3 days/week (34.6%) than the group with a fixed daytime schedule (6.6%) and the rotating daytime group (22.3%, $P<.001$). However, participants in the rotating daytime group napped as often as the nighttime or shift workers when they were on the morning shift (36.5%).

Another consequence is that the highest rate of daytime sleepiness (or sleepiness when wakefulness is required) was found in the rotating daytime group. About 29% of this group reported moderate or severe daytime sleepiness as compared with 19% in the group of nighttime or shift workers and 12% in the group with a fixed daytime schedule ($P<.001$).

Sleep disorder diagnoses

When examining the sleep disorders in the three groups, it can be seen in Fig. 2 that the staff members working at night or on shifts had DSM-IV circadian rhythm sleep disorders more often than those working a regular daytime schedule.

Insomnia sleep disorder diagnoses also tended to be more frequent in the night or shift working group but the differ-

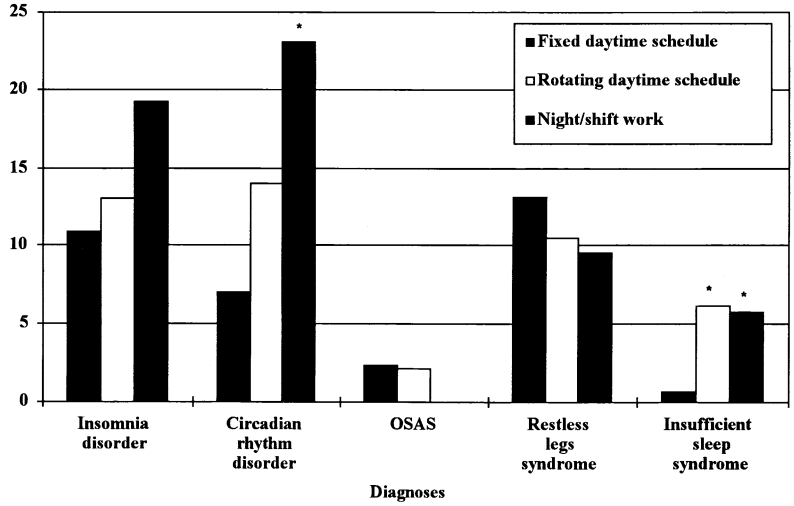

Fig. 2. Sleep disorder diagnoses by work schedule. Legend: * $P < .01$ with the fixed daytime schedule group.

ences were not significant. Obstructive sleep apnea syndrome and restless legs syndrome did not significantly differ among groups. However, an insufficient sleep syndrome was more often observed in the rotating daytime group and in the night or shift work group as compared with the fixed daytime work group (Fig. 2).

Associations with sick leaves and accidents

Subjects were asked if they had road or work accidents in the last 12 months. They were also asked if they took sick leave or were hospitalized in the last 12 months. The proportion of subjects who reported road accidents and hospitalization did not significantly vary among the three groups.

However, subjects in the rotating daytime schedule group had double the number of work-related accidents in the previous year (19.5%) as compared with the fixed daytime schedule group (8.8%) and the group of nighttime or shift workers (9.6%, $P < .001$).

A logistic regression was calculated to determine what were the factors associated with work-related accidents. Gender, age, profession, insomnia disorder diagnoses, sleep duration and excessive daytime sleepiness were not significantly associated with work-related accidents in the multivariate model. Significant predictive factors were working with a rotating daytime schedule (odds ratio (OR): 2.1), having a circadian rhythm disorder (OR: 2.1) and having obstructive sleep apnea syndrome (OR: 3.2).

Sick leaves in the previous 12 months were also more frequently reported in the rotating daytime schedule group (62.8%) as compared with the fixed daytime schedule group (38.5%, $P < .001$). This rate was 51.9% in the group of nighttime or shift workers. The average number of days of sick leave absence was 10.3 in the rotating daytime schedule group; 4.3 in the group of nighttime or shift workers and 3.0 in the fixed daytime schedule group. A logistic regression was also calculated to identify factors associated with sick leave in the previous 12 months. Nonsignificant variables were profession, presence of children at home, sleep duration, excessive daytime sleepiness, circadian rhythm disorders and obstructive sleep apnea syndrome. Factors significantly related to sick leaves were being a woman (OR: 1.9), age (OR: 2.2 for 31–40 years old and OR: 1.7 for 41 years and older), working a rotating daytime schedule (OR: 2.6) and having an insomnia disorder diagnosis (OR: 2.0).

Discussion

This study was conducted with 817 staff members of a psychiatric hospital. The employees were divided into three groups depending on their work schedule. One group included only daytime workers, a second group was composed of employees who alternated between morning and afternoon shifts and the last group included night workers and workers rotating between day, evening and night shifts. The results show that employees rotating between morning and afternoon shifts had greater sleep difficulties than daytime workers: more difficulties initiating sleep and more nocturnal awakenings that were worsened on shift changes. The sleep duration was shorter by about 1 h when they were working morning shifts as compared with afternoon shifts. Night or shift workers also had a shorter sleep, but the sleep duration discrepancy between shifts was not as pronounced as for the rotating daytime group. Adjustment difficulties to morning shifts have been reported by other researchers [18].

Among the rotating daytime workers, two important sleep modifications are observed related to morning shift. First, a greater number of them have difficulties initiating sleep and this is increased during the transition between the two shifts. Second, they reported a shorter sleep duration when they were on the morning shift, which they compensated for by taking naps in the afternoon.

These observations are in line with what Lavie [19] described as the "forbidden zone" for sleeping. During this period, lasting about 4 h, the sleep propensity is greatly reduced and ends with a sleep gate. That is a sudden increase in sleep propensity that occurs between 9 p.m. and 4 a.m. The existence of the forbidden zone would explain why it is so hard for many shift workers to advance the bedtime when they are on morning shifts. Therefore, longer sleep latency, greater difficulties initiating sleep and reduced sleep duration when the workers were on the morning shift are consistent with the concept of forbidden zone of sleep onset.

A consequence of shift working is daytime sleepiness or sleepiness when wakefulness is requested. In our study, moderate to severe daytime sleepiness was more frequent in the rotating daytime group followed with the night or shift-work group. Many studies have reported an increase in sleepiness in subjects working on shifts or during the night. One of the most important issues in sleepiness at work (or lack of alertness) is the safety of workers. Several studies have shown that a first peak in deteriorated performance is in the early morning and another peak is mid afternoon (between 2 and 4 p.m.). This corresponds to the time when the morning shift is ending [20]. These workers are therefore, more vulnerable to make errors of appreciation or are at greater risk to have work-related accidents. Our results also show that rotating daytime workers were more likely to have work-related accidents and to have taken sick leaves in the 12-month period preceding the interview. Interestingly, a rotating daytime schedule was an important predictor of both work-related accidents and sick leave in multivariate models. One may conclude that some professions are more at risk of having work-related accidents, especially if workers have to do physical tasks like turning a patient. However, even when we controlled for profession, a rotating daytime schedule remained a strong predictor.

Even if many nurses found there were several advantages to work in rotating daytime shifts, half of them also reported a negative impact on their health and only 44% of them expressed their wishes to keep this work schedule. In our study, however, we did not find significant difference in the health status between rotating daytime or nighttime workers and those working with fixed daytime schedule as suggested by other studies [21]. The results of our study indicate that sleep hygiene and coping strategy educational programs [22–25] will be useful for individuals working with rotating daytime or nighttime shifts to minimize the negative impacts of work schedules on sleep.

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