Public Health Briefs

Rotating Shift Work, Sleep, and Accidents Related to Sleepiness in Hospital Nurses

ABSTRACT

A hospital-based survey on shift work, sleep, and accidents was carried out among 635 Massachusetts nurses. In comparison to nurses who worked only day/evening shifts, rotators had more sleep/wake cycle disruption and nodded off more at work. Rotators had twice the odds of nodding off while driving to or from work and twice the odds of a reported accident or error related to sleepiness. Application of circadian principles to the design of hospital work schedules may result in improved health and safety for nurses and patients. (*Am J Public Health.* 1992;82:1011–1014)

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Introduction

Concern for iatrogenic risks to patients caused by hospital staff experiencing sleep disruption has led to a reexamination of the work schedules and sleep patterns of physicians.[1–4] This cross-sectional study was designed to examine the impact of work schedule on the sleep schedule, sleepiness, and accident rates of female nurses in a Massachusetts hospital.

Methods

A self-administered questionnaire was distributed June through September 1986 to 878 registered nurses, licensed practical nurses, and other ancillary staff in the hospital. The nurse was asked to record, for the current week, the previous 2 weeks, and the following week, the number of shifts worked for each work-shift category (i.e., day, evening, night) at the hospital and at any other job. The nurse was also asked, "Does your job involve a variable work shift? That is, do you work the day shift sometimes and the night shift at other times?," which is a National Center for Health Statistics (NCHS) question previously used to identify shift workers in the US population.[5,6] In addition, the nurse recorded her sleep and wake times when she worked the day shift, the evening shift, the night shift, and on days off.

Information was collected regarding: quality of sleep; the use of alcohol (per month), prescription or nonprescription medication, sleeping aids, or other kinds of drugs to get to sleep; nodding off at work (per week); nodding off while driving to or from work in the past year; and accidents, errors, and "near-miss" accidents in the past year. The variable "any accident or error" included automobile accidents, medication errors, on-the-job procedural errors, and on-the-job personal injuries that the nurse reported had occurred because of sleepiness.

We used prior hypotheses based on physiologic and epidemiologic data regarding shift work and circadian disruption[7–17] in the definition of shift categories (Table 1), which were created from shift schedules for the current month. Day/evening shift work was grouped as a single category because shifting from days to evenings has not been demonstrated to disrupt circadian rhythms.

Sleep and wake times were used to determine whether a nurse obtained "anchor sleep": at least 4 hours of sleep obtained regularly during the same clock hours every night, both during work days and days off. Studies by Minors and Waterhouse[18] suggest that loss of anchor sleep may be a surrogate for circadian rhythm disruption.

The relationship between shift and outcomes such as sleepiness and accidents was explored first through univariate and then through multivariate analy-

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TABLE 1—Work Schedule Categories of Nurses Surveyed

Day/evening (n = 336): Within a month, working ≥ 4 day or evening shifts but no night shifts.
Night (n = 69): Within a month, working ≥ 8 night shifts and no day/evening shifts.
Rotator (n = 119): Within a month, working ≥ 4 day or evening shifts and ≥ 4 night shifts.
Day/evening, occasional night (n = 61): Within a month, working ≥ 4 day or evening shifts and 1–3 night shifts.
Night, occasional day/evening (n = 14): Within a month, working ≥ 8 night shifts and 1–3 day or evening shifts.
Part-time rotator (n = 17): Within a month, working 4–7 night shifts and 0–3 day or evening shifts.

ses, using EPISTAT and SAS (proc logistic). We attempted to validate the reporting of medication errors, but this was not possible because written accident reports submitted to the hospital's risk management office usually documented the nursing supervisor rather than the nurse associated with the error.

Results

Of 878 hospital employees contacted by the research assistants, 687 (78.3%) returned the questionnaire, 36 (4.1%) refused to participate, and 155 (17.7%) failed to return the questionnaire. The study cohort included 593 female registered nurses and 42 female licensed practical nurses.

The mean age of the nurses was 33.9 years (range 21 to 65 years). When compared to day/evening nurses, more rotators were 35 years old or younger (77.8% versus 64.5%). By contract, the option of not rotating and not working the night shift was dependent on seniority. Consequently, whereas 23.7% of rotators and 22.1% of night nurses had worked at the hospital for 1 year or less, only 9.3% of day/evening nurses had done so.

During their work days, rotators and night nurses reported fewer hours of sleep than day/evening nurses (Figure 1). Of the day/evening nurses, 92.2% obtained anchor sleep regularly throughout the month. In contrast, only 6.3% of night nurses, none of the rotators, and none of the nurses in work categories 4 through 6 (Table 1) obtained anchor sleep regularly throughout the month.

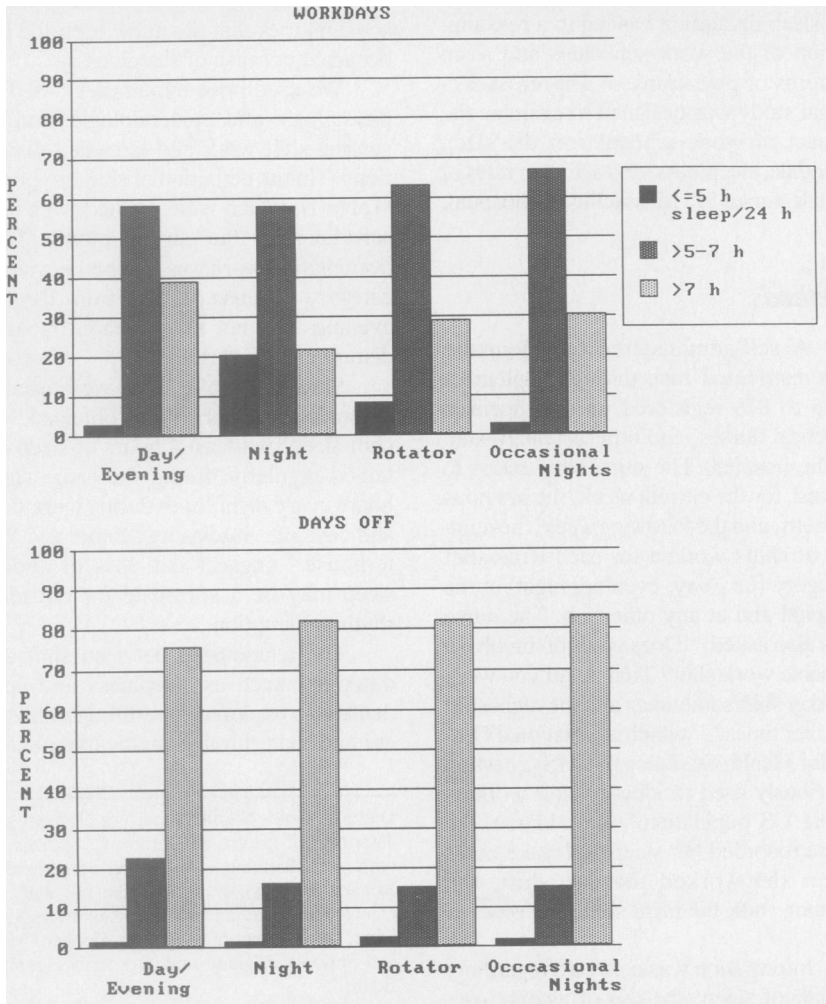
Of the nurses from all work categories who responded "yes" to the NCHS question on variable work schedules, only 53.6% experienced anchor sleep disruption. The group responding "yes" included 49.4% of the day/evening nurses, 94.1% of rotators, and 2.9% of night nurses.

In comparison to day/evening nurses, night workers had 1.8 times the odds and rotators had 2.8 times the odds of reporting poor quality sleep (Table 2). Night nurses and rotators had twice the odds of using medications to get to sleep.

Nodding off on the night shift occurred at least once per week in 35.3% of rotators, 32.4% of night nurses, and 20.7% of day/evening nurses who worked occasional nights. On the other hand, neither day/evening nurses nor rotating nurses reported significant problems with nodding off on the day or evening shift (rates for nodding off: 2.8% and 2.7%). When compared to day/evening nurses, rotators had 3.9 times the odds and night nurses had 3.6 times the odds of nodding off while driving to or from work in the preceding year (Table 2).

In univariate analyses two confounders of the relationship between shift and accidents were identified: working at the hospital 1 year or less was associated with medication errors, and an age of 35 years or younger predicted automobile near-miss accidents. The use of alcohol to get to sleep was an independent predictor of all categories of accidents.

Adjusting for these factors, the odds of reporting any accident or error were twice as high for rotators as for day/evening nurses (Table 3). Rotators had 2.5 times the odds of reporting near-miss accidents. After adjustment the effect of ro-



Note. Only 3% of day/evening nurses slept ≤ 5 hours/24 hours on workdays, as compared to 8% of rotators and 20% of night nurses. Less than 50% of nurses from each of the work schedules slept >7 hours/24 hours on workdays. On days-off greater than 75% of nurses from each of the work schedules slept >7 hours/24 hours.

FIGURE 1—Hours of sleep per 24 hours on workdays and on days off by category of work schedule.

TABLE 2—Differences between Categories of Work Schedules in Quality of Sleep, Sleepiness, and Use of Medications and Alcohol to Get to Sleep

	Day/Evening				Day/Evening, Occasional Night				Night				Rotator			
	n[a]	%	Odds Ratio[b]	95% CI	n[a]	%	Odds Ratio[b]	95% CI	n[a]	%	Odds Ratio[b]	95% CI	n[a]	%	Odds Ratio[b]	95% CI
Fatigue during the day	125	37.5	1.00	....	21	35.0	0.90	(0.48, 1.65)	19	27.9	0.65	(0.35, 1.19)	54	45.8	1.40	(0.90, 2.20)
Poor quality sleep	93	27.8	1.00	....	15	25.0	0.86	(0.44, 1.69)	28	41.2	1.81	(1.02, 3.22)*	62	52.1	2.82	(1.79, 4.45)*
Medications to get to sleep	55	16.5	1.00	....	15	25.0	1.69	(0.84, 3.39)	19	27.5	1.93	(1.01, 3.66)*	33	27.7	1.95	(1.15, 3.29)*
Alcohol to get to sleep	91	27.2	1.00	....	21	35.0	1.44	(0.77, 2.68)	17	24.6	0.88	(0.46, 1.65)	42	35.3	1.46	(0.91, 2.34)
Nodding off while driving to or from work	70	21.2	1.00	....	23	40.0	2.38	(1.27, 4.45)*	33	49.3	3.62	(2.02, 6.48)*	60	51.3	3.92	(2.45, 6.30)*

[a]Number of respondents answering "yes."
[b]Univariate unadjusted odds ratio.
*$P \leq 0.05$.

TABLE 3—Adjusted Odds Ratios[a] for Accidents/Errors among Nurses in Different Work Schedule Categories

	Day/Evening				Day/Evening, Occasional Night				Night				Rotator			
	n[b]	%	Odds Ratio[a]	95% CI	n[b]	%	Odds Ratio[a]	95% CI	n[b]	%	Odds Ratio[a]	95% CI	n[b]	%	Odds Ratio[a]	95% CI
Medication error	19	5.8	1.00	....	7	12.1	1.97	(0.76, 5.12)	5	7.4	1.17	(0.41, 3.34)	14	12.1	1.83	(0.86, 3.91)
Medication near miss	25	7.8	1.00	....	9	15.5	1.89	(0.82, 4.34)	11	16.4	2.10	(0.95, 4.68)	19	16.4	1.93	(0.99, 3.74)
Automobile accident	8	2.4	1.00	....	1	1.7	0.50	(0.06, 4.22)	3	4.4	2.24	(0.55, 9.07)	4	3.4	1.14	(0.33, 4.00)
Automobile near miss	65	19.6	1.00	....	16	28.1	1.47	(0.76, 2.83)	21	30.9	1.92*	(1.05, 3.52)	47	40.9	2.63*	(1.63, 4.24)
Any accident/error[c]	33	10.1	1.00	....	11	19.0	1.93	(0.88, 4.20)	11	16.2	1.88	(0.88, 4.02)	22	19.3	1.97*	(1.07, 3.63)
Any near miss[c]	86	26.8	1.00	....	22	38.6	1.57	(0.86, 2.86)	25	37.3	1.55	(0.87, 2.77)	58	50.4	2.47*	(1.56, 3.89)

[a]Odds ratio relative to day/evening workers; adjusted for age ≤ 35 yr, working at the hospital ≤ 1 yr, and the use of alcohol to get to sleep.
[b]Number of respondents answering "yes."
[c]Accidents/errors and near-miss accidents include automobile accidents, medication errors, on-the-job procedural errors, and on-the-job personal injuries that the nurses reported had occurred in the past year because of sleepiness.
*$P \leq 0.05$.

tating on medication errors was reduced from 2.2 (95% CI: 1.0, 4.9) to 1.8 (Table 3).

Discussion

The results of this study are consistent with laboratory investigations that have demonstrated that sleep deprivation and misalignment of circadian phase as experienced during rotating shift work are each associated with frequent lapses of attention and increased reaction time, leading to increased error rates on performance tasks.[7–9] These data also suggest that a record of a representative work schedule may be of greater use than the NCHS variable shift question in identifying workers with disrupted sleep/wake patterns.

Reporting bias and selection bias may have influenced the findings in this cross-sectional study. The hypotheses generated might be best tested through a case-control study design, with validation of reported accidents.

The data present a potential dilemma for hospital policymakers. Even if rotating leads to circadian rhythm disruption and accidents, nurses and hospital administrators will have to determine their priorities: the family responsibilities of nurses and the staffing requirements of hospitals may limit the potential for altering hospital schedules to improve the health of nurses and the safety of patients.[19,20] □

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Birthweight Distributions in Mexico City and among US Southwest Mexican Americans: The Effect of Altitude

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ABSTRACT

In this study birthweight distributions for Mexican Americans and Mexico City were compared. Sharp differences in the two distributions were nearly eliminated by controlling for altitude. The small remaining excess in low birthweight in Mexico City appears to be due to a slight overrepresentation of tertiary hospital deliveries, and possibly to a greater prevalence of pathological conditions. The results are consistent with the favorable low birthweight rate reported for Mexican Americans and illustrate the need to adjust for altitude in studies of low birthweight. (*Am J Public Health.* 1992;82:1014–1017

Introduction

Low birthweight rates (birthweight <2500 g) vary widely with racial or ethnic origin.[1–3] However, these differences are attributed primarily to socioeconomic conditions strongly associated with these groups,[4–6] leading to the assumption that the more socioeconomically disadvantaged groups are the most likely to have low birthweight babies. Low socioeconomic status often is associated with factors known to impair the rate of fetal growth, such as inadequate nutrition and smoking.[7] Insufficient prenatal care and other factors also may mediate between low socioeconomic status and low birthweight.[4] While the association between socioeconomic status and ethnicity appears to hold for US Blacks and Puerto Ricans, this is not so for Mexican Americans.

The low birthweight rate for Mexican Americans is similar to that of US Whites, despite low socioeconomic status and poor access to prenatal care, and is far lower than the rate for US Blacks or Puerto Ricans (Table 1). This phenomenon, described as a "public health enigma," is not readily explainable.[8] Nevertheless, the low birthweight rate of Mexican Americans is so dramatically different from other US minority groups that a verification of the accuracy of the Mexican-American rate is warranted.

One approach to verifying these data is to compare Mexican-American birthweights with those found in Mexico. If

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