HEALTH OF NIGHT WORKERS IN THE ELECTRONICS INDUSTRY

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SYNOPSIS

To determine if there were any health problems among night workers, a study was conducted on female electronics workers with at least one year's night work experience. These comprised 108 permanent night workers, 216 workers on weekly phase-advance (night/afternoon/morning) and 162 workers on two-weekly phase-delay (morning/afternoon/night) rotating shift schedules. 108 day workers acted as controls. The survey involved a self-administered questionnaire, blood pressure recording and analysis of sickness absence data. No increased prevalence of hypertension was found in the night workers. Although workers on night shift slept less than the day workers, the permanent night workers slept slightly better. Only the weekly rotating night group slept significantly worse. Except for more complaints of indigestion and tiredness in the weekly rotating night group, there were no significant differences in symptom prevalence between day and night workers. Sickness absence in the night workers was lower compared with the day workers.

INTRODUCTION

As at the end of 1985, over 94,000 workers in Singapore worked on shift (1). Half of them were employed in the manufacturing sector, mainly in the electronics, metalworking and chemical industries. Sixty percent were in production and related occupations.

Forty five percent of all these shift workers worked the night or third shift (i.e. beyond midnight), either on a permanent or rotating arrangement. The largest concentration of night workers (40%) was in the manufacturing sector, with permanent night shifts being more prevalent.

Many studies of shift workers seem to indicate that shift work has adverse effects on health due to disturbances to sleep and nervous and digestive disorders. However, these studies largely utilised subjective assessments of health (2). Dirken (3), in a single-blind study found no excess gastro-intestinal effects or nervous disorders in shift workers compared with non-shift workers.

It is widely accepted that about 20% of those who start shift work seem unable to continue with it, usually for social rather than medical reasons (2). For those who continue on shift work, no long-term effects on health (from the morbidity and mortality points of view) have been convincingly demonstrated (4).

In Singapore, there have been few reported studies on health effects of shift work (5,6,7). The objective of the present study is to determine if there are any significant health problems among workers who have continued in night work for a year or more and apparently have "adapted" to such work.

METHODS

A total of 594 female production operators aged between 20 and 40 years from five electronics factories was studied. The work schedules of these production operators are shown in Table 1. Factory D rotated shifts in the direction night to afternoon to morning. Factory E had the opposite arrangement (viz. morning to afternoon to night) in the initial eight years of its operation and in the last four years prior to the study. In between, for a period of six years, the direction was reversed.

All of the operators studied worked in relatively quiet air-conditioned environments, doing essentially "assembly line" work. Some were involved in microscope work. None of the "day" workers were engaged in microscope work.

The conditions of service in the factories studied (viz. wages, shift allowances, meal and transport arrangements) were comparable. All five factories were located in easily accessible districts in the central part of the island within about 5 kilometres of the city centre (General Post Office).

There were no significant changes in the work conditions and production schedules of these factories just before or during the study period (eg no unusual increase in overtime work).

The subjects in the four work schedules studied — day, permanent night, rotating night (weekly) and rotating night (every two weeks) were matched by ethnic group. It was initially planned to study at least 100 subjects from each of the four work schedules. Sample selection was intended to achieve equal distribution by ethnic group (viz. Chinese, Malay and Indian).

However, this was not possible as the day workers were predominantly Chinese and the night workers were predominantly Malays. In addition, there was the constraint of the actual number of subjects available at the time of study.

The resultant ethnic ratio obtained was 40 Malays: 34 Chinese: 34 Indians, giving a total of 108 subjects in the day and permanent night groups. Whilst still applying this ratio, and again depending on the number of available workers, more subjects were included for the rotating night groups because three shifts were involved. Table 2 shows the ethnic group distribution of the night workers.

Within the constraint of differences in the ethnic group distribution, the subjects were matched by marital status — "single" versus "married" as obtained from company records. Information on children for married workers was not available from these records.

As far as possible, local workers were selected. The only exceptions were nine work permit holders in Factory E (all Malaysian Chinese and Indians residing in Singapore for between one and seven years).

All subjects were asked to complete a simple self-administered questionnaire and their casual blood pressure taken. These were conducted before or soon

TABLE 1: WORK SCHEDULES OF PRODUCTION OPERATORS STUDIED

Factory	Work Schedule	No. of Years in Operation	Days Worked per Week	Work Hours	Total Production Operators[a]	No Studied
A	Day	16	5	0800 – 1745	1213	108
B	Permanent night	7	5	2300 – 0700	142	73
C	Permanent night	17	6	2300 – 0700	44	35
D	Rotating night[b] (weekly)	17	6	M: 0700 – 1500	896	55
			6	A: 1500 – 2300		54
			6	N: 2300 – 0700		107
E	Rotating night[b] (every 2 weeks)	18	6	M: 0700 – 1400 (Days 1-5) 0700 – 1630 (Day 6)		55
			5	A: 1400 – 2300	235	55
			6	N: 2400 – 0700 (Day 1) 2300 – 0700 (Days 2 – 6)		52

a: Local female production operators with one or more years in company excluding supervisors, quality control & technical staff.
b: Three shifts: Morning (M), Afternoon (A) and Night (N).

TABLE 2: ETHNIC GROUP DISTRIBUTION OF NIGHT WORKERS

Ethnic Group	Workers		
	Permanent Night[b]	Rotating Night (weekly)	Rotating Night (two-weekly)
No. of shift workers studied (Universe population[a])	108 (186)	216 (896)	162 (281)
Chinese	34 (58)	68 (145)	51 (80)
Malay	40 (92)	80 (577)	60 (129)
Indian	34 (36)	68 (174)	51 (72)

a: Local female production operators with one or more years' experience in night work excluding supervisors, quality control & technical staff.
b: Comprises workers from 2 factories.

after the beginning of the relevant shift, the subjects having worked at least three days/shifts in the week they were studied. Only one contact was made with each subject selected. Chinese and Malay translations of the questionnaire were used where preferred.

All subjects were told that they had been randomly selected for a "general health survey" and the questions were to be completed anonymously. They were not informed that night work was the subject of study.

These conditions were applied in order to minimise any bias in the responses of the subjects. Discreet arrangements were made to enable the observers to determine the identity of the subjects for the purpose of analysis of the data.

Sickness absence data (excluding maternity and hospitalisation leave) for the 3 months just preceding and during the survey period was obtained from company records in respect of the subjects studied.

RESULTS

Study Subjects

Out of an initial 111 day workers covered, 18 (or 16.2%) indicated in the questionnaire that they left a previous job because of "working hours". Three of these 18 also indicated "health" as another reason for leaving. As it was likely that these three workers had left night work for health reasons, they were excluded from the present analysis.

Subsequent analyses of blood pressure, sleep experience, symptom prevalence and sickness absence showed no significant differences between the remaining 15 workers (who indicated "working hours" but not "health" as a reason for leaving previous jobs) and other day workers. If the three workers were included, the 18 would have more complaints of headache and tiredness compared with other workers ($0.025 > p > 0.01$).

As with the day workers, the night workers had between 6.8% and 13.9% workers leaving previous jobs because of working hours, with between 0.6% and 1.9% leaving because of working hours and health reasons. It is possible that some of these night workers actually find day work unacceptable to them! Generally, these workers did not differ from other night workers in the various parameters studied, although among the two-weekly rotating night group, they seemed to have more complaints of diarrhoea or constipation ($0.05 > p > 0.025$).

Compared with the day workers, the night workers were older and a greater proportion of them married with older children (Tables 3 and 4).

The rotating night workers had longer night work experience than the permanent night group, although all groups (day and night workers) had some subjects with 16 or more years' employment in the factories studied (Table 5).

TABLE 3: AGE DISTRIBUTION OF DAY AND NIGHT WORKERS STUDIED

Age (Years)	Day	Workers		
		Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108 (100%)	108 (100%)	216 (100%)	162 (100%)
20 —	62 (57.4%)	45 (41.7%)	88 (40.7%)	73 (45.1%)
30 – 40	46 (42.6%)	63 (58.3%)	128 (59.3%)	89 (54.9%)
Age: $\bar{X}$ (SD)	28.8 (4.8)	30.5 (5.8)	31.0 (4.9)	30.2 (5.2)

TABLE 4: MARITAL STATUS DISTRIBUTION OF DAY AND NIGHT WORKERS STUDIED

Marital Status	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108 (100%)	108 (100%)	216 (100%)	162 (100%)
Single	45 (41.7%)	34 (31.5%)	68 (31.5%)	71 (43.8%)
Married (no children)	19 (17.6%)	1 (0.9%)	32 (14.8%)	11 (6.8%)
Married with older children[a]	9 (8.3%)	36 (33.3%)	40 (18.5%)	31 (19.1%)
Married with young children[b]	35 (32.4%)	37 (34.3%)	76 (35.2%)	49 (30.2%)

a: All children aged 6 years or older.
b: One or more children under 6 years of age.

TABLE 5: DISTRIBUTION OF DAY AND NIGHT WORKERS STUDIED BY EMPLOYMENT DURATION[a]

Years Employed	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108 (100%)	108 (100%)	216 (100%)	162 (100%)
1 —	10 (9.3%)	43 (39.8%)	8 (3.7%)	25 (15.4%)
3 —	6 (5.5%)	34 (31.5%)	17 (7.9%)	11 (6.8%)
5 —	61 (56.5%)	17 (15.7%)	37 (17.1%)	42 (25.9%)
10 —	29 (26.9%)	11 (10.2%)	113 (52.3%)	49 (30.2%)
15 —	2 (1.9%)	3 (2.8%)	41 (20.0%)	35 (21.6%)
Range	1 – 16	1 – 16	2 – 17	1 – 17
$\bar{X}$ (SD)	7.9 (3.7)	4.6 (4.0)	10.4 (3.9)	9.2 (4.8)

a: Durtion of employment in relevant work schedule in factory (as obtained from company records). Production operators who changed work schedule were excluded.

Blood Pressure

There were no significant differences in the prevalence of hypertension between the day and night workers (Table 6). The night workers seemed to have higher systolic and diastolic blood pressures than the day workers, possibly because they were older. Age was significantly correlated with blood pressure ($p < 0.01$) in the day workers. There was no correlation between blood pressure and duration of employment in night work.

Sleep Experience

Workers on the night shift slept less than the day workers, between 6.40 and 6.75 hours as against 7.36 hours (Table 7). The differences were significant in the case of the permanent night and weekly rotating night workers (both: $p < 0.001$). There were no significant differences betwen the three groups of night workers in terms of length of sleep while on night shift.

Despite the shorter sleep, the permanent night workers slept slightly better than the day workers. Only the weekly rotating shift workers on night slept significantly worse compared with the day and permanent night workers (both: $p < 0.001$). The proportion of night workers needing sleeping pills was not significantly different from that in the day workers.

"Sleeping well" was significantly correlated with sleep length only in the case of day workers, weekly rotating shift workers on night and two-weekly rotating shift workers on morning shift (all $p < 0.001$).

As expected, among the rotating night workers, sleep length was related to the shift — being longest for the afternoon shift and shortest for the night shift ($p < 0.005$ in both groups).

It was interesting that while on the morning and

TABLE 6: BLOOD PRESSURE IN DAY AND NIGHT WORKERS

Blood Pressure	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108	108	216	162
SYSTOLIC PRESSURE				
$\bar{X}$	113.6	116.7	112.9	117.7
(SD)	(14.77)	(12.72)	(14.22)	(12.38)
150 — 159	1 (0.9%)	1 (0.9%)	6 (2.8%)	4 (2.5%)
$\geqslant$ 160	1 (0.9%)	1 (0.9%)	1 (0.5%)	0 (0%)
DIASTOLIC PRESSURE				
$\bar{X}$	73.7	78.5	74.8	77.3
(SD)	(10.20)	(9.82)	(8.66)	(8.87)
90 — 94	6 (5.6%)	9 (8.3%)	14 (6.5%)	11 (6.8%)
$\geqslant$ 95	4 (3.7%)	7 (6.5%)	3 (1.4%)	7 (4.3%)

Systolic Hypertension (8): — Borderline: 150 — 159; Definite: $\geqslant$ 160
Diastolic Hypertension (8): — Borderline: 90 — 94; Definite: $\geqslant$ 95

TABLE 7: SLEEP EXPERIENCE OF DAY AND NIGHT WORKERS

Sleep Experience	Workers							
			Rotating Night (Weekly)			Rotating Night (Two-weekly)		
	Day	Permanent Night	Morning	Afternoon	Night	Morning	Afternoon	Night
No. of subjects	108 (100%)	108 (100%)	55 (100%)	54 (100%)	107 (100%)	55 (100%)	55 (100%)	52 (100%)
Hours slept[a]								
< 4	0 (0%)	4 (3.7%)	0 (0%)	0 (0%)	3 (2.8%)	0 (0%)	0 (0%)	3 (5.8%)
4 —	9 (8.3%)	23 (21.3%)	11 (20.0%)	3 (5.6%)	34 (31.8%)	3 (5.5%)	3 (5.5%)	15 (28.8%)
6 —	57 (52.8%)	60 (55.6%)	34 (61.8%)	28 (51.9%)	45 (42.1%)	28 (50.9%)	20 (36.4%)	18 (34.6%)
8 —	42 (38.9%)	21 (19.4%)	10 (18.2%)	23 (42.6%)	25 (23.4%)	24 (43.6%)	32 (58.2%)	16 (30.8%)
$\bar{X}$	7.36	6.51	6.79	7.23	6.40	7.64	7.89	6.75
(SD)	(1.05)	(1.48)	(1.00)	(1.13)	(1.71)	(1.45)	(1.22)	(2.21)
No. slept well[b]	80 (74.1%)	85 (78.7%)	34 (61.8%)	42 (77.8%)	54 (50.5%)	42 (76.4%)	44 (80.0%)	32 (61.5%)
No. needing sleeping pills[c]	4 (3.7%)	5 (4.6%)		4[d] (1.9%)			1[d] (0.6%)	

a: Reckoned in the previous 24 hour period; inclusive of naps
b: Reckoned in the week of study
c: Positive or significant if needed almost every week in the past few months
d: Three rotating shifts combined

afternoon shifts, the two-weekly rotating shift workers slept longer than the weekly rotating shift workers (morning: $p < 0.001$; afternoon: $0.01 > p > 0.001$). The former group also slept better than the latter for all three shifts although the differences were not significant.

Generally, marital status did not influence sleep experience (Table 8). However, married females without children or with young children in the day group slept less well ($0.01 > p > 0.001$). In the two-weekly rotating shift group, they had shorter sleep while on night shift ($0.05 > p > 0.025$).

As almosi all the subjects lived in flats, it was not possible to demonstrate any effects of living conditions on sleep experience.

Symptom Prevalence

There were no significant differences between day and night workers in the prevalence of symptoms (Table 9). The only exception was in the case of weekly rotating night workers who, when compared with day workers, had more complaints of "indigestion" ($0.01 > p > 0.001$) and "feeling very tired" ($p < 0.001$). However, there was no significant association between these complaints and duration of employment in night work.

It was interesting that the permanent night workers had the lowest prevalance for all complaints. The prevalence was significantly less for the following complaints:

TABLE 8: SLEEP EXPERIENCE BY MARITAL STATUS IN DAY AND NIGHT WORKERS

	Workers							
			Rotating Night (Weekly)			Rotating Night (Two-weekly)		
Marital Status	Day	Permanent Night	Morning	Afternoon	Night	Morning	Afternoon	Night
No. of subjects	108 91.7% (74.1%)	108 75.0% (78.7%)	55 80.0% (61.8%)	54 94.4% (77.8%)	107 65.4% (50.5%)	55 94.5% (76.4%)	55 94.5% (80.0%)	52 65.4% (61.5%)
Single:	45 97.8% (86.7%)	34 73.5% (76.5%)	16 87.5% (62.5%)	17 100% (82.4%)	35 68.6% (42.9%)	31 93.5% (83.9%)	21 95.2% (81.0%)	19 84.2% (63.2%)
Married: (no children)	19 89.5% (57.9%)	1 0% (100%)	7 85.7% (28.6%)	7 85.7% (71.4%)	18 83.3% (61.1%)	4 100% (75.0%)	3 100% (100%)	4 50.0% (75.0%)
Married with older children:	9 100% (88.9%)	36 75.0% (80.6%)	10 60.0% (50.0%)	12 100% (75.0%)	18 61.1% (66.7%)	9 100% (77.8%)	12 83.3% (75.0%)	10 70.0% (60.0%)
Married with young children:	35 82.9% (62.9%)	37 78.4% (78.4%)	22 81.8% (77.3%)	18 88.9% (77.8%)	36 55.6% (44.4%)	11 90.9% (76.4%)	19 100% (78.9%)	19 47.4% (57.9%)

X : No. of subjects
Y% : % slept $\geq$ 6 hours in previous 24 hour period
(Z%) : % slept well in week of study

TABLE 9: SYMPTOM PREVALENCE IN DAY AND NIGHT WORKERS

	Workers			
Symptoms[a]	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108 (100%)	108 (100%)	216 (100%)	162 (100%)
Abdominal pain:	16 (14.8%)	7 (6.5%)	34 (15.7%)	26 (16.0%)
Indigestion:	2 (1.9%)	2 (1.9%)	26 (12.0%)	10 (6.2%)
Diarrhoea/ Constipation:	9 (8.3%)	6 (5.6%)	14 (6.5%)	11 (6.8%)
Poor appetite:	13 (12.0%)	12 (11.1%)	39 (18.1%)	20 (12.3%)
Headache:	45 (41.7%)	27 (25.0%)	102 (47.2%)	48 (29.6%)
"Very tired":	58 (53.7%)	45 (41.7%)	167 (77.3%)	71 (43.8%)

a: Symptoms considered positive or significant if occurring almost every week in the past few months

a) Abdominal pain (compared with rotating night workers, both groups: $0.05 > p > 0.025$);

b) Indigestion (compared with the weekly rotating night workers: $0.01 > p > 0.001$);

c) Headache (compared with day and weekly rotating night workers: $0.025 > p > 0.01$ and $p < 0.001$ respectively); and

d) Tiredness (compared with weekly rotating night workers: $p < 0.001$)

Among the rotating night groups, the two-weekly rotating workers has less complaints of headache and tiredness than the weekly rotating workers (both: $p < 0.001$).

Sickness Absence

The sickness absence experience of the day and night workers are shown in Tables 10 and 11. They were found to be comparable with the sickness absence profiles in the respective factories.

The night workers seemed to have lower sickness absence than the day workers in terms of total days absence, total spells as well as one-day spells. The day workers had significantly more one-day spells than the night workers (against weekly rotating night workers: $0.025 > p > 0.01$; against permanent night and two-weekly rotating night workers: $0.05 > p > 0.025$).

The two-weekly rotating night group had the lowest mean days absence, total spells and one-day spells, significantly lower than the day workers (all $0.025 > p > 0.01$) and weekly rotating night workers (all $0.05 > p > 0.025$).

Sickness absence was generally not well correlated with symptoms. There were a few exceptions viz.:

a) In the day workers, total spells increased with increasing prevalence of headache ($0.025 > p > 0.01$), abdominal pain and poor appetite (both: $0.05 > p > 0.025$).

b) In the permanent night and two-weekly rotating night groups, the number of one-day spells increased with increasing prevalence of headache (both: $0.05 > p > 0.025$).

c) In the weekly rotating night workers, the prevalence of abdominal pain and headache was associated with increasing days absence (both: $p < 0.001$) as well as increasing total spells ($0.01 > p > 0.001$ and $p < 0.001$ respectively).

Marital status did not seem to influence sickness absence (Table 12). However, among the day workers, married females with young children had the highest sickness absence ($p < 0.001$ for days absence and total spells; $0.01 > p > 0.001$ for one-day absence), while single females in the two-weekly rotating night group had the lowest sickness absence (days absence: $0.025 > p > 0.01$; total spells; $0.01 > p > 0.001$; one-day spells: $0.05 > p > 0.025$).

TABLE 10: SICKNESS ABSENCE EXPERIENCE[a] IN DAY AND NIGHT WORKERS

Sickness Absence	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects (Potential working days)	108 (7,128)	108 (7,402)	216 (16,632)	162 (11,759)
Days absence				
Total:	180	114	269	80
Per 100 working days:	2.53	1.54	1.62	0.68
All spells				
Total:	159	88	176	60
Per 100 working days:	2.23	1.19	1.06	0.51
One-day spells				
Total:	135	62	106	55
Per 100 working days:	1.89	0.84	0.64	0.47
Average length of spell:	1.13	1.30	1.53	1.33

a: Reckoned in 3 months prior to and during study period

TABLE 11: DISTRIBUTION OF DAY AND SHIFT WORKERS BY SICKNESS ABSENCE[a]

Sickness Absence	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108 (100%)	108 (100%)	216 (100%)	162 (100%)
Total Days absence				
< 1	41 (38.0%)	56 (51.9%)	108 (50.0%)	120 (74.1%)
1 —	40 (37.0%)	40 (37.0%)	66 (30.6%)	34 (21.0%)
3 —	21 (19.4%)	7 (6.5%)	30 (13.9%)	5 (3.1%)
5 —	6 (5.6%)	5 (4.6%)	12 (5.6%)	3 (1.9%)
Total spells				
0	39 (36.1%)	56 (51.9%)	108 (50.0%)	121 (74.7%)
1 —	46 (42.6%)	43 (39.8%)	97 (44.9%)	35 (21.6%)
3 —	19 (17.6%)	8 (7.4%)	8 (3.7%)	5 (3.1%)
5 —	4 (3.7%)	1 (0.9%)	3 (1.4%)	1 (0.6%)
One-day spells				
0	42 (38.9%)	70 (64.8%)	138 (63.9%)	125 (77.2%)
1 —	49 (45.4%)	34 (31.5%)	73 (33.8%)	31 (19.1%)
3 —	14 (13.0%)	3 (2.8%)	4 (1.9%)	5 (3.1%)
5 —	3 (2.8%)	1 (0.9%)	1 (0.5%)	1 (0.6%)

a: Reckoned in 3 months prior to and during study period.

TABLE 12: SICKNESS ABSENCE BY MARITAL STATUS IN DAY AND NIGHT WORKERS

Marital Status	Workers			
	Day	Permanent Night	Rotating Night (Weekly)	Rotating Night (Two-weekly)
No. of subjects	108	108	216	162
Single	45	34	68	71
DA	44.5%	47.1%	41.2%	15.5%
TS	46.7%	47.1%	41.2%	14.1%
DS	46.7%	26.5%	30.9%	14.1%
Married (no children)	19	1	32	11
DA	63.2%	100%	59.4%	36.4%
TS	68.4%	100%	59.4%	36.4%
DS	68.4%	100%	43.7%	27.3%

Married with older children	9	36	40	31
DA	44.4%	38.9%	50.0%	42.0%
TS	44.4%	38.9%	50.0%	42.0%
DS	33.3%	33.3%	37.5%	35.5%
Married with young children	35	37	76	49
DA	88.6%	56.8%	53.9%	28.6%
TS	88.6%	56.8%	53.9%	28.6%
DS	82.6%	43.2%	36.8%	22.8%

DA : % with one or more days absence
TS : % with one or more spells
DS : % with one or more one-day spells

DISCUSSION

The results of the study show no serious health problems in workers who continue in night work for some time, in some cases, up to 17 years. No correlation was found between duration of employment in night work and the parameters studied.

The findings with regard to blood pressure levels and prevalence of hypertension in this study are comparable with previous local data (8). Thus, contrary to a common belief among local shift workers, night work does not increase the risk of hypertension.

The sleep lengths of the day and night workers in the present study were generally comparable with those reported elsewhere (9,10,11).

Tsoi and Tay (11), in a study on newly recruited pupil assistant nurses, found that 86% indicated no sleep problems at present (i.e. within the previous 30 days), while 41% had no sleep problems either at present or in the past. The proportion of subjects taking sleeping pills was 1.1%. These findings are consistent with those in our subjects. Surveys in other countries (as quoted by Tsoi and Tay (11) report prevalence of sleep problems of between 22.2% and 25%, with 10% to 17% using sleeping pills.

Thus, our subjects did not appear to suffer from serious sleep problems.

It was interesting that, although workers on the night shift slept less than the day workers, the permanent night workers in fact slept slightly better. Other investigators (9,12) also report poor correlation between sleep length and quality of sleep.

The findings that rotating shift workers on morning shift also had less sleep and slept less well is consistent with other reports (9,12). This is not surprising as workers on morning shift would have shorter night sleep because of the early start of the shift.

The sleep experience of the two-weekly rotating night workers appeared to be better than that of the weekly rotating group, both in terms of sleep length and quality. This could be attributed to two factors, viz. the direction of shift rotation and the frequency of rotation.

Recent studies indicate that work schedules that rotate by phase-delay, so that successive shifts are later (viz. morning to afternoon to night) are more favourable (4). This approach takes into account the fact that the inherent period of the human biological clock is about 25 hours (13,14).

Czeisler (14) showed that workers who changed from a weekly rotating phase-advance schedule (i.e. night to afternoon to morning) to a phase-delay schedule, preferrerd a 21-day (i.e. three weekly) rotation rather than continuing on the weekly rotation schedule. Substantial improvements in their health index and reduction in personnel turnover were noted.

Thus, our findings of better sleep experience, less complaints of tiredness and headache, and lower sickness absence in the two-weekly rotating (phase-delay) group compared with the weekly rotating (phase-advance group) would seem to be in agreement with Czeisler's results.

Taken as a whole, the findings with regard to symptom prevalence and sickness absence indicate that night work does not pose serious health problems even after a number of years.

Dirken (3), in interpreting his data, accepted complaints as being typical of shift work only when the frequency was consistently higher in the different shift groups compared with the non-shift group. Taking this approach, the isolated higher prevalence of indigestion and tiredness in our weekly rotating night group may not be very significant. Nevertheless, disorders of digestion and sleep are the most commonly observed "minor" complaints in shift workers (15).

The sickness absence in our subjects were generally comparable with previous local studies. Zee (7,16) found that the days absence per 100 work days among female workers in the electronics industry ranged from 0.46 to 1.69. No equivalent data for day workers in the electronics industry are available. Suratman and Lai (6) reported a sickness absence of 2.8 days absence per 100 work days among day refinery workers (all males).

The lower sickness absence in our night workers compared with day workers are consistent with the findings of other studies (2). In our study, day workers who were likely to have left shift work for health reasons were excluded. No significant differences in sickness absence were found between day workers who left previous jobs because of working hours (but not health reasons) and those who did not.

The mean number of one-day spells per person is thought to reflect morale (17). Our findings would seem to indicate that morale is not a problem in night workers.

Some studies (2) suggest that shift workers have 20% less absence, but during the first four years due to a higher dropout rate, sickness absence may sometimes be higher in shift workers. In our study, we found no correlation between duration of employment in night work and sickness absence.

It is of course widely recognised that sickness absence is not a reliable indicator of true morbidity as it is influenced by many factors which are not related to health (2). Thus we found no clear correlation between sickness absence and symptom prevalence.

It is generally thought that marital status may inflence the sleep experience of night workers e.g. mothers with young children may not get enough rest. This, in turn, may affect their health and sickness

absence experience. However, no clear relationships were demonstrated in this study.

Nevertheless, some of the younger females (married without children or with young children) from the day and two-weekly rotating night groups did appear to have sleep difficulties. It is possible that a "masking effect" could have resulted from confounding factors influencing other marital groups, e.g. moonlighting and studying when not working. Marital status was not found to have much influence on the symptom prevalence and sickness absence experience of our night workers.

Preventive Measures

The subjects in this study came from large, well-established electronics factories with good working conditions and facilities, enjoying low personnel turnover. Generally, the reasons given for the success of their shift systems were stringent pre-employment selection and emphasis on counselling and human relations.

Such an approach, together with other measures (e.g. adopting shift schedules aimed at minimising the disruptive effects of night work on sleep; rest periods; pre-employment and regular health checks (4,18), will go a long way in protecting and promoting the health of night workers.

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