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Shift work and sick leave

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Objective Shift workers working nights are known to have higher morbidity from certain illnesses than day workers. This study examined episodes of certified sick leaves of day workers and shift workers in a large industrial plant to examine whether slowly rotating shift work leads to increased risk of sick leave.

Methods In a case-base design more than 11 000 episodes of sick leave, lasting more than 3 days, were obtained from the sick-leave files of a chemical plant in Norway. The diagnoses were grouped into 5 categories according to information on their work schedules. The workers included in the study were divided into 3 groups. They worked slowly rotating 3 shifts, 2 shifts without night work, and daytime schedules.

Results For all the diagnoses the shift workers and day workers were evenly distributed among the cases and the referents, the odds ratios ranging from 0.8 to 1.2. The risk of sick leave did not change with the number of years in shift work. There was a higher risk of sick leave with musculoskeletal diagnoses among the 2-shift workers.

Conclusions In this study shift workers did not have a higher risk of sick leave for diseases that, in previous studies, have been shown to be related to shift and night work. Although bias may be present in the study, the results are in line with those of previous studies, and they suggest that even certified sick leaves are not a valid proxy for morbidity.

Key terms cardiovascular disease, case-referent study, gastrointestinal disease, morbidity, night work.

Shift workers working nights are known to have a higher morbidity than day workers, although the difference in risk has been debated for some time. Higher risks have been found for gastrointestinal diseases, heart diseases, and minor mental illnesses (1—8). A few studies have focused on musculoskeletal diseases among shift workers. One study found a higher incidence of musculoskeletal diseases for this group (9), while another did not (10), even though the shift workers had more complaints of muscular pain. One study investigated a possible relationship between night work and cancer (11), which could theoretically be explained by the influence of night work on the production of the pineal hormone melatonin, followed by a possible weakening of the immune system (12). The evidence suggests a relationship between shift work and the development of specific diseases that might lead to sick leave documented by sick leave certificates.

Differences in absence from work and certified sick leave between day and shift workers have been explored in several studies with varying results. In general no differences in sick-related absenteeism between permanent shift workers and day workers have been found (9, 10, 13—15), although ex-shift workers are reported to have higher absence rates. Some studies have found differences between shift and day workers for certain shift work systems, but others have not (16—18). One explanation may be the differences in the type of data used.

In our study we used the physician-diagnosed sick leave episodes of more than 3500 persons over a period of 11 years, including all episodes of sick leave lasting more than 3 days, in order to clarify whether (i) a slowly rotating shift system leads to increased risk for sick leave for diagnoses known to be related to shift work, (ii) there is a difference in the length of sick leave between shift workers and day workers, (iii) shift workers have a higher

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risk of further sick leaves than day workers, and (iv) sick leave caused by musculoskeletal diseases is more frequent for shift workers than for day workers.

The study focused on whether the excess morbidity risk for specific diseases found in previous studies can be also seen in certified sick leaves of shift workers within the same diagnostic groups. In this manner, the study would be able to contribute to a further understanding of the importance of sick leave data in the consideration of disease risk related to shift work.

Methods

This-Evensen studied the morbidity among day and shift workers in a Norwegian industrial plant (19, 20). He did not find any differences in mortality or morbidity except for former shift workers who had been transferred to day work for medical reasons. Our study was done at the same industrial plant, Norsk Hydro, Porsgrunn, located in the southern part of Norway. The main products of this chemical plant are fertilizers, magnesium, and polyvinyl chloride, and there are about 3500 employees in the plant today, including about 1200 3-shift workers. The plant has practiced different shiftwork systems over the years, but for the last 3 decades slowly rotating systems have been used.

According to Norwegian legislation, workers must obtain a sick-leave certificate from a physician after 3 calendar days of absence from work. Through 1979—1989 the Department of Occupational Health at the plant obtained information from the National Insurance Fund authorities about the causes of sick leaves lasting for more than 3 days and documented by a physician's diagnosis for all the workers in the plant. In 1990 the transfer of such information was stopped for legal reasons. This information was computerized in the Department of Occupational Health, and the physician's diagnoses were translated to WONCA-codes (World Organization of National Colleges, Academics and Academic Association of General Practitioners), according to the International Classification of Health Problems in Primary Care (ICHPPC), developed in 1977 (21). This work was done by the same person during the whole period. In the plant's administrative computer system, the date of starting work at the plant, the dates of starting and ending work in different departments, department codes, and worktime systems have been registered since the mid-1970s, and data from about 1950 have been computerized later.

Our study base was defined as all employees in the parts of the plant where shift work was done in 1979—1989. Daywork and shiftwork schedules co-existed in all these areas. Persons who worked in sections of the plant without shiftwork systems were excluded.

Because information about earlier engagements in the plant was only complete for workers still working in the plant in the mid-1970s, when the administrative computer system was introduced, it was not possible to follow a cohort before this time, and the study was therefore designed as a case-base study in order to obtain potential long exposures.

In the computer-system of the Department of Occupational Health all sick-leave episodes in the period were identified and transferred to an independent data base with information on personal identification number, date of sick leave, length of absence, diagnosis, and the WONCA code of the diagnosis. From the administrative system 2 referents were chosen for each case. The randomization of these referents was achieved by choosing the 2 persons with the birth dates closest to the cases, independent of whether or not they had had a sick leave in the same period (22).

Some episodes of sick leave lasting less than 3 days were coded with diagnoses, but since the diagnoses were only complete for sick leaves of more than 3 days, all certified sickness absence for less than 3 days was excluded from the study.

For each sickness episode information on year of birth, gender and work commencement date was added from the administrative system. Finally, from the administrative system, information was added about all work in different sections of the plant with the starting and stopping dates, department code, and work system. For the cases this information was given from the date of starting work until the date of sickness episode, and for the referents there was information from the date of starting work until the date of the sickness episode of the paired case. Therefore the information on worktime, for both the cases and the referents, consisted of the worktime system at the time of the relevant episode of sickness and information on the worktime system from the start of work in the plant until the sickness episode.

For several periods of work there was no information about the work system at the time of the sickness absence (or the case person's absence). These episodes (N=862) have been excluded from the study. Furthermore, 13 080 (14.7%) posts were not coded with information on worktime arrangements. These episodes occurred especially before 1970 and were included with missing values. The final data base was thereafter anonymized by eliminating the personal identification numbers.

With the use of the information on birth date and the date of sickness absence, the age at the time of the sickness absence was calculated, and the period of work was calculated as the difference between the date of starting work in the plant and the date of the sickness absence.

The WONCA diagnoses were aggregated into 5 groups for neoplasms, minor mental illnesses,

gastrointestinal diseases, coronary heart diseases, and musculoskeletal diseases. The first incidence of a diagnosis with a WONCA code within each of these groups was registered as the first sick leave, and information on later episodes within the same group (even if there were different diagnoses) were aggregated.

The computer system registered 14 different work systems. According to experience within the plant, they were aggregated into the following 3 main types of systems: day work, 2-shift work (day and afternoon), and 3-shift work (primary slowly rotating, including day, afternoon and night work, 7 days a week). With the use of this aggregation the number of years of work within each group was calculated until the time of the sick leave. Ex-shift workers were defined as persons who were day workers at the time of the sickness absence, but who

Table 1. Median and interquartile range (IQR) of the age and worktime of the cases (N=3580) (first-time sick leave) and referents (N=7582), as well as the proportion of men.

	Age (years)		Length of work in the company		Male gender (%)
	Median	IQR	Median	IQR	
Cases	39.0	29.0	11.9	19.9	91.8
Referents	38.0	29.0	12.0	20.0	91.5
P-value	0.65	0.07	0.65		

Table 2. Distribution of first-time sick leave, grouped according to the WONCA diagnoses. (WONCA = World Organization of National Colleges, Academics and Academic Association of General Practitioners)

Diagnosis group ^a	N	%
Minor mental illnesses (W3000-W3009)	116	3.2
Gastrointestinal diseases (W0080-W0090, W5300-W5360, W5640, W7841, W7855)	142	4.0
Coronary heart disease (W3900-W4290)	103	2.9
Musculoskeletal disease (W7170-W7380)	667	18.6
Neoplasms (W1510-W2390)	36	1.0
Other diagnoses (Other W diagnoses and all Y diagnoses)	2 517	70.3
All the diseases combined	3 581	100

^a The codes of the WONCA classification are given in parentheses.

Table 3. First-time sick leave for the 5 defined diagnosed groups distributed according to work system. Chi-square: 0.03

Work system	Cases (N)	Referents (N)
Day work	649	1325
Two-shift work	64	80
Three-shift work	334	639
Ex-shift work	17	29
Total	1064	2073

earlier in their work career at the plant had been registered as 3-shift workers (without regard for the duration of the work system).

The construction of the data bases was done in Paradox for Windows 1.0, and the analyses were carried out by and written out from SPSS for Windows 6.03. The material was compared using a nonparametric analysis (chi-square and Mann-Whitney U-test). As the comparison was done for pooled referents, age, period of engagement, and gender were entered together with work history into a logistic regression model in a forward stepwise selection for each diagnostic group.

Results

A total of 11 657 sick leaves was found for 3581 persons for the entire period. In addition 25 597 episodes were chosen for the referents randomly by the computer. There were no differences in age, number of years at work, or gender between the shift workers with sickness absences and the referents (table 1).

The first-time sickness absences and the grouped WONCA codes for the 5 defined groups of diseases are shown in table 2.

The distribution of the case persons and the referents according to the worktime systems at the time of the sick leave is shown in table 3. There was an excess of 2-shift workers among the case persons, when they were compared with the referents, and a smaller excess of 3-shift workers. Two-shift workers had greater odds of being cases than the day workers, the crude odds ratio being 1.63 [95% confidence interval (95% CI) 1.16—2.30]. The 3-shift workers (OR 1.07, 95% CI 0.91—1.26) and ex-shift workers (OR 1.20, 95% CI 0.65—2.19) also had higher odds ratios, but the difference did not reach statistical significance.

Table 4 presents the odds ratios of the 3-shift workers and the ex-shift workers, in comparison with the day workers. No elevated risks were seen for any of the diseases. As 3-shift workers were in general both younger with a shorter duration of employment, it was decided to regard age and employment length as potential confounder variables and to control for these factors in a logistic regression model. The interaction between age and employment length was tested, but it did not alter the odds ratios, and it was excluded from the models. The adjusted odds ratios are presented for the 3-shift workers. The odds ratio did not differ to any degree, meaning that age, employment length, and gender did not confound the results.

The 2-shift workers had an elevated risk of musculoskeletal disease (crude OR 1.91, 95% CI 1.25—2.90). The odds ratio for the remaining disease groups was 1.69 (95% CI 0.50—5.74) for minor mental diseases, 1.30

(95% CI 0.45—3.78) for gastrointestinal diseases, 1.16 (95% CI 0.43—3.78) for coronary heart diseases, and 0.45 (95% CI 0.05—4.25) for neoplasms.

The odds ratios for different lengths of employment in 3-shift work are shown in table 5. With shift work for less than 1 year as reference, the odds ratios did not differ in any of the groups. This finding suggests that the risk of sick leave did not increase with length of shift work.

The total number of sick leaves in the 10-year period within the same diagnostic group did not differ between the 3-shift workers and day workers. The length of first sick leave was also the same for all the diagnostic groups, except that shift workers with musculoskeletal diseases had a statistically significant longer first sick leave (median 12 days compared with 10 days for the day workers).

Discussion

Three-shift workers do not appear to have an excess risk of sick leave, as there were no differences in the odds ratios between the day and shift workers with respect to sick-leaves for specific diagnostic groups combined or for any single diagnostic groups. This finding might be surprising, as the diagnoses selected for grouping were those associated with shift work (ie, minor mental illnesses, gastrointestinal diseases, and coronary heart diseases). The 2-shift workers had a significant excess of sick leaves from diagnoses in the musculoskeletal group. However, the 2-shift workers in this plant mainly had heavy manual work in packaging departments and also in the handling of ship cargo, and these results can, thereby, probably not be related to the worktime system.

Several studies have been published on the sickness absence of shift workers, but few have been published during the last few years. Some concluded that day workers had a higher rate of sickness absence (14, 19, 20), others came to the opposite conclusion (9, 23), and some found no difference (10, 24). The variations may have been caused by, for example, national and cultural differences, methodological and design variations,

Table 4. Odds ratios (OR) and 95% confidence intervals (95% CI) for first-time sick leave for the current 3-shift workers and former 3-shift (ex-shift) workers in relation to day work.

Disease group	N	Crude OR ^a	95% CI for crude OR	Adjusted OR ^a	95% CI for adjusted OR ^a
Minor mental illnesses					
Day workers (referents)	203	1		1	
Current 3-shift workers	118	1.04	0.64—1.68	1.04	0.64—1.70
Former 3-shift workers	12	1.01	0.30—3.49		
Gastrointestinal diseases					
Day workers (referents)	275	1		1	
Current 3-shift workers	123	1.01	0.65—1.59	1.02	0.64—1.63
Former 3-shift workers	4	0.65	0.07—6.36		
Coronary heart diseases					
Day workers (referents)	200	1		1	
Current 3-shift workers	86	0.74	0.643—1.29	0.75	0.42—1.31
Former 3-shift workers	3				
Musculoskeletal illnesses					
Day workers (referents)	1,226	1		1	
Current 3-shift workers	615	1.16	0.95—1.43	1.14	0.92—1.40
Former 3-shift workers	12	1.01	0.30—3.49		
Neoplasms					
Day workers (referents)	70	1		1	
Current 3-shift workers	31	0.74	0.29—1.84	0.75	0.29—1.94
Former 3-shift workers	12	1.01			

^aAdjusted for age, seniority, and gender in a logistic regression model.

including or not including ex-shift workers in the day work force, the quality of the sickness reports and personnel records (25), and the like.

Angersbach et al (9) found, for instance, no differences in sick-related absenteeism between permanent shift workers and day workers, but sickness absence was twice as high among ex-shift workers. Likewise, Koller (10) found no differences between day and shift workers in the average number of days of absence due to sickness, but she found a difference for former shift workers and also an increase in the number of days of sick leave with increasing exposure to shift work. In our study, the group of ex-shift workers, although this group was surprisingly small, did not differ from the other shift workers. We were not able to distinguish between those who left shift work for medical reasons and those who left for other reasons, and the data may also have been biased by the fact that former shift workers who eventually transferred to day

Table 5. Odds ratios (OR) and 95% confidence intervals (95% CI) for the 5 diagnostic groups for current shift workers according to years in shift work.

Length of shift work	Minor mental illnesses		Gastrointestinal illnesses		Coronary heart diseases		Musculoskeletal illnesses		Neoplasms	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
0-1 years (reference group)	1		1		1		1		1	
1-5 years	0.82	0.40—1.69	1.24	0.55—2.82	5.02	0.63—40.27	0.79	0.54—1.14	1.08	0.09—12.52
6-10 years	1.18	0.50—2.84	0.76	0.32—1.74	1.22	0.44—3.33	1.13	0.79—1.62	1.90	0.37—9.80
≥11 years	0.94	0.49—1.81	1.24	0.68—2.27	1.25	0.67—2.32	0.88	0.68—1.15	1.26	0.43—3.68

work or to other departments of the plant than those integrated in the study were not included. There were no differences in the duration of sick leave between the groups.

This study used incidence sampling of all first-time sick leaves in a 10-year period, thereby minimizing selection bias. There may have been differences in sick leave by work pattern, but, for all the years studied, the national insurance or the employer paid full wages for absence days for both shift and day workers. In other words, economic incentives between the groups were not important.

Information on diagnosis came from different physicians, and 1 source of information bias could have been their interpretation of the patients' symptoms. Such differences could have influenced the quality of the diagnosis. If information on the work pattern influenced the diagnosis (a shift worker being more likely to be diagnosed as having a disease common among shift workers), the risk estimates would have tended to be higher. Diagnoses were interpreted and translated into WONCA codes by the Department of Occupational Health, but the same person did this job and was blind to the work pattern of the sick. Using a broadly defined diagnostic grouping might further have diluted an information bias due to diagnoses, but it could also have led to nondifferential misclassification.

Information on the work pattern was found in administrative files and was independent of sick leave. The files were, however, incomplete and could theoretically have led to differential misclassification if certain work schedules had been more likely to be missed.

As a consequence of Thiis-Evensen's research (19, 20), there had been a preemployment screening of shift workers until the early 1970s, which had excluded workers with gastrointestinal problems or sleep disorders. There is no information available on how many workers were excluded through the screening. Workers with coronary heart diseases and muscular complaints were not excluded, and, if preemployment classification led to the observed effect, lower risk estimates would have been evident only for gastrointestinal diseases and minor mental illnesses, which was not the case. The effect of this possibility leads, in addition, to the general healthy worker effect, which is known to result in self-selection among shift workers.

The data offered no possibilities of controlling for selection bias with respect to preemployment screening or changing to departments inside the company with no shift work or to day work outside the company.

Differences in other work factors might have confounded the work schedules. The shift workers were all operators of factories that had been automated for decades. The day workers comprised a large group of maintenance personnel, but also office workers and management were included so that the organizational work

conditions may have been different. The chemical and physical exposure to gases, dust, and noise was the same for all the groups of the day and shift workers, except for some white-collar workers. The 2-shift workers had handled ship cargo and packaging. Besides being engaged mainly in manual labor, these workers may have had other self-selecting mechanisms, and different reasons for quitting shift work than the 3-shift workers did.

As in several other reports, we cannot account for differences between shift and day workers that may have confounded the study, for example, eating habits, organizational and social relations, and smoking habits (17, 26).

The higher morbidity for shift workers documented in several studies (1), such as differences in sick leave between the day and shift workers, was not found in this study. An interesting topic for this discussion is, however, the meaning of absence or sickness absence, and the coherence between sick leave and morbidity. Taylor et al (15) stated that sickness absence is not synonymous with morbidity; instead it can be looked upon as a way of withdrawal from work. Several factors may explain the possible differences in sickness absence behavior between co-workers and between shift and day workers. Taylor (13) described shift workers who had a higher involvement and higher job satisfaction than day workers, and concluded that these factors may influence shift workers' experience of work stress and their threshold for sickness absence, or that they may simply represent differences in other organizational work conditions. Fisher (17) referred to a range of different connections found in studies of sick leave among shift workers, and this range represents the variations of factors that influence absence and sick leave. It has also been stressed that shift workers' concept of symptoms may differ from the day workers' because shiftwork problems are looked upon as natural a priori conditions linked to shift work, and they do not qualify as reasons for sick leave (27). Furthermore, there may be intergroup relations among shift workers, such as work group coherence and loyalty, which differ from that of day workers and which may affect sickness absence behavior.

As in most studies of sick leave among shift workers, this study showed that the incidence of sick leave is not higher among shift workers than among day workers. The results must be seen in relation to the conclusions of earlier studies, and they point towards the fact that the level of sick leave among employees cannot be related to morbidity (10, 14, 18), and that the coherence between shift work and sick leave is still unclear. We do not question the fact that shift work is a risk factor for disease (28). It would be important to verify the assumptions that shift work implies work culture and attitudes which differ from those of day work and that these factors are expressed in sickness-absence behavior.

Knowledge about this subject would increase our understanding of the dynamics of shift work in relation to health and later risk of morbidity. Currently sickness absence should not be used as a proxy for morbidity among shift workers.

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