ERGONOMICS

ISSN: 0014-0139 (Print) 1366-5847 (Online) Journal homepage: https://www.tandfonline.com/loi/terg20

Health and safety consequences of shift work in the food processing industry

MICHAEL J. SMITH , MICHAEL J. COLLIGAN & DONALD L. TASTO

To cite this article: MICHAEL J. SMITH , MICHAEL J. COLLIGAN & DONALD L. TASTO (1982) Health and safety consequences of shift work in the food processing industry, ERGONOMICS, 25:2, 133-144, DOI: 10.1080/00140138208924933

To link to this article: https://doi.org/10.1080/00140138208924933

Published online: 27 Mar 2007.

ERGONOMICS, 1982, VOL. 25, NO. 2, 133–144

Health and safety consequences of shift work in the food processing industry

By MICHAEL J. SMITH and MICHAEL J. COLLIGAN

Division of Biomedical and Behavioral Science, The National Institute for Occupational Safety and Health, Centers for Disease Control, Public Health Service, U.S. Department of Health and Human Services, Cincinnati, Ohio, U.S.A.

DONALD L. TASTO

Tasto and Associates, Palo Alto, California, U.S.A.

Both a questionnaire survey and an evaluation of health and safety records were used to characterize the health and safety consequences of day versus afternoon, night and rotating shifts for approximately 1000 food processing workers. Relative to the day workers, the results indicated that those on shift work, particularly rotating and night shifts, showed greater adverse effects. These included poorer sleep, altered eating habits, greater alcohol consumption, greater incidence of sick absence and greater incidence of work-related injuries. Shift work was not related to self-reported health complaints or self-reported chronic disease states. The impact of shift work on sick absence and work-related injuries differed depending on worker sex, age and work tenure.

1. Introduction

While there is some agreement that shift work affects the quality of sleep and increases the risk of digestive disorders, there remains disagreement about the impact of shift work on other chronic health disorders and employee accident risk. Recent reviews of literature by Harrington (1978) and by Rutenfranz *et al.* (1977) illustrates this disagreement. While a great number of shift work and health studies have been conducted in Europe, only one study (Mott *et al.* 1965) had been carried out in the United States prior to 1975. In 1975, the National Institute for Occupational Safety and Health undertook a large-scale study aimed at examining the health and safety consequences of shift work for American workers. The intent was to verify the European findings that showed increased incidence of sleep disturbances and digestive disorders for shift workers and to clarify worker accident risk due to shift work.

A first phase of this study identified the major shift work industries in the United States and the number of shift workers in each industry. (The results can be found in Tasto and Colligan 1977.) Using these findings, two of the leading shift work industries were selected for an evaluation of the health and safety impact of shift work. The industries selected were food processing and health care. Later, the health care industry was limited to just hospital nurses, who comprised the major occupation in that industry working shifts. The provision of this latter group insured a large number of female workers which enabled comparisons to be made for sex specific effects. A study plan was developed that called for both a self-administered questionnaire survey as well as an examination of health and safety records of workers engaged in different shift regimens in the two selected occupational groups. This combined data collection approach provided a number of advantages for data evaluation which have been discussed in detail elsewhere (Smith *et al.* 1979 a, Colligan 1980). The data collection

0014–0139/82/2502 0133 $03·00

methods have been reported elsewhere (Colligan *et al.* 1979 b, Smith *et al.* 1979 a) as have findings for the nurses (Colligan *et al.* 1979 a, Smith *et al.* 1979 b). The purpose of this report is to present the findings for the food processing workers studied.

2. Methods

Table 1 provides basic information about the types of shift schedules, workforce size and other information for the eight food processing work sites studied. In order to recruit work sites for the study, national organizations of food processing employers were contacted for potential participants. The work sites selected represent companies that volunteered to participate. As such, they cannot be considered to be a representative sample of the food processing industry. At each site, employees were randomly selected for participation from employment records. Equal numbers of employees were selected from all shifts. Employees had to have been on their current shift for at least 6 months to be included in the study.

A psychosocial questionnaire survey of a randomly selected sample of food processors was conducted at each work site. This survey examined the impact of shift work on health complaints, life-style, psychological status (McNair *et al.* 1971, Eysenck and Eysenck 1963) and worker behaviour (eating patterns, sleep, use of alcohol, use of tobacco). The questionnaire covered areas that were identified from previous shift work studies as important concerns in evaluating shift worker health. The frequency of 43 separate health complaints within the last year were examined using a four point scale ranging from 'never' to 'constantly'. The presence or absence of 21 disease states, such as stomach ulcers or insomnia, within the previous 5 years was asked. Questions about the consumption of alcohol, eating and sleeping had four and five point scale responses to examine a range of behaviour. There were also scaled questions concerning life style, job information, worker demographics and mood states.

A complete description of the methodology used in this survey can be found in Smith *et al.* (1979 a). Briefly, a random sample of employees at each work site was mailed a questionnaire along with a cover letter explaining the purpose of the study and indicating that he/she would be paid $5 for completing the questionnaire. Also

Table 1. Descriptive characteristics of food processing plants studied.

Site	Total food processors*	Turn-over rate	Fixed, rotating or both	Annual sick leave policy
01	553	5 in last year	R	No sick days—Disability programme
02	725	No longer take %	B	No sick days
03	666	10% per month	B	No official sick days
04	1100	20%	F	1 week/each year worked
05	455	No figures taken	F	No sick days given
06	484	No figures taken	R	40 hours/year
07	980	18%	B	1 week/each year worked
23†	1100	20%	B	1 week/each year worked

* The size of the population surveyed for the three fixed shifts was determined by the total number of shift food processors employed at a site; day and afternoon sample sizes were then set at approximately this number.

† No record evaluation was made for this site.

provided was a postage-paid return envelope. Completed questionnaires were obtained from 885 food processing workers, which was a 60% response rate. Only one mailing was undertaken, with no follow-up to non-respondents.

The second method of data collection was a review of health and safety records and sick absences for a random sample of employees at each site. Cases of work-related injury and disease as well as sick absences were recorded from company report forms (for sick absences) and special injury forms which are required under the federal Occupational Safety and Health Act of 1970 (U.S. Congress 1971). The OSHAct provides uniformity in definition and reporting for occupationally-related diseases and injuries. Such uniformity was not obtained for the sick absences records as their recording and reporting is not dictated by federal law and each company studied used its own methods for recording and reporting.

In addition, workplace clinic, dispensary and personnel records were examined to gather health information not contained in other records, such as physical examination results. A complete description of the methods used to collect and evaluate these data can be found in Colligan *et al.* (1979 b). Data from health and safety records for 1298 food processing workers were collected for a 6-month period during 1976. The 6-month period varied from site to site since the record evaluation team travelled from site to site and collected the most current 6-month period at each site. For the purposes of this report, all records for seasonal employees (those only working part of a year) were dropped from the data evaluation which left 1009 subjects for which records were available.

3. Results

3.1. *Demographics*

The day workers comprised 60% males and 40% females; the afternoon shift workers 53% males and 47% females; the night shift workers 48% males and 52% females; and the rotators 82% males and 18% females (the rotators had 96% males and 4% females for the injury and health record data). The mean ages were 42 years for day workers, 36 years for afternoon shift workers, 36 years for night shift workers and 38 years for the rotators. For the rotating shift workers, over 85% rotated shifts monthly or longer and only 8% rotated weekly or less.

3.2. *Questionnaire survey*

The data from the questionnaire survey were obtained from 885 food processing workers (238 day shift, 181 afternoon shift, 181 night shift and 285 rotating shift) at eight sites. The results below are categorized into four major types of effect: (i) sleep disturbances, (ii) impact on psychological mood, (iii) health complaints and (iv) effects on behaviour.

3.2.1. *Sleep disturbances.* As tables 2 and 3 show, except for one factor (the percentage of workers who awakened two or more times per night), all sleep characteristics showed a significant shift schedule effect. Night shift workers averaged the least amount of sleep per 24 hours (6·4 hours), while afternoon shift workers reported the most sleep per 24 hours (7·4 hours). Table 3 shows the percentage of shift workers reporting certain sleep characteristics. In terms of sleep patterns, a much higher percentage of day workers and afternoon shift workers reported uninterrupted sleep per 24 hours than night or rotating shift workers. In terms of sleep quality, a greater percentage of night and rotating shift workers frequently had trouble getting back to sleep once awakened;

Table 2. Percentage of shift workers that report getting at least 1 hour less sleep per day than desired, and average number of hours slept per 24 hours.

	Shift				
	Day	Afternoon	Night	Rotating	Duncan range test
Per cent getting less sleep than desired*	52	32	52	47	
Average hours slept per day†	7·0	7·4	6·4	6·8	$A > D$ and $R > N$

* Significant difference at 99% level of confidence using χ-square test for homogeneity.
† Significant difference at 99% level of confidence using analysis of variance for unequal cell sizes.

Table 3. Percentage of shift workers reporting select sleep characteristics.

	Shift			
	Day	Afternoon	Night	Rotating
Sleep problems				
Require 40 min or more to get to sleep*	2	9	5	11
Awaken two or more times per sleep	35	35	47	46
Have trouble getting back to sleep once awakened*	8	7	25	18
Awaken tired or sleepy frequently†	22	33	38	35
Feel tired or sleepy at work two or more times per week*	29	36	43	40
Feel tired or sleepy after work two or more times per week*	46	51	65	52
Feel job does not allow time to rest, relax or catch some sleep while at work*	20	30	38	21
Sleep pattern*				
Sleep a few hours at a time	10	6	33	3
Take naps in addition to a longer sleep	18	9	17	8
Sleep just one long sleep a day	68	79	45	32
Different pattern for each shift	4	6	5	57
Quality of sleep rating*				
Excellent	20	17	6	9
Good	55	56	42	38
Fair	22	21	28	42
Poor	3	6	24	11

* Significant difference at 99% level of confidence using χ-square test for homogeneity.
† Significant difference at 95% level of confidence using χ-square test for homogeneity.

and a greater percentage of workers on all shifts awakened tired or sleepy frequently more often than day workers.

In rating the quality of their sleep, more rotating and night shift workers rated their sleep fair to poor than afternoon shift or day workers. Table 3 also shows that a greater percentage of shift workers felt tired or sleepy at work two or more times per week, and a much higher percentage of night shift workers felt tired or sleepy after work every day.

In addition, a higher percentage of night shift workers reported that their job did not allow them time to rest, relax or catch some sleep while at work.

Specific problems dealing with sleep adjustment were evaluated for just the rotating shift workers. These included the length of time to adjust their sleep pattern after rotation, and difficulties with adjusting to a particular shift. The results showed that 44% of the rotators took at least 1 week to adjust their sleep pattern. They also indicated that the most disruptive shift in terms of sleep problems and tiredness was the night shift.

3.2.2. *Effects on mood states.* Only the afternoon shift workers showed any differences in mood states from the day workers or other shift workers. Specifically, the afternoon shift workers showed more:

(1) Depression–Dejection than day or rotating shift workers.
(2) Anger–Hostility than day workers.
(3) Confusion–Bewilderment than day workers.

3.2.3. *Health Complaints.* Only 4 of the 43 health complaints yielded a statistically significant difference in the percentage of shift workers reporting a complaint. Specifically, male night shift workers more frequently reported gas pains than male day or male workers on other shifts; female day and female rotating shift workers more frequently reported blood in their bowel movements than afternoon or night female shift workers; male rotating shift workers more frequently reported constipation than male day or male workers on other shifts; and female rotating shift workers more frequently reported a tight feeling in their stomach than female day or female workers on other shifts. For self-reported disease states, male day workers indicated a greater frequency of arthritis and high blood pressure than the male workers on any of the shifts.

3.2.4. *Behavioural effects.* A number of questions were asked of the workers dealing with how shift work affected non-work behaviours such as eating, alcohol consumption, medication usage and smoking. Table 4 shows that the shift workers reported different eating patterns from each other and from day workers. When asked to rate their appetite, the day workers reported the best appetite with over 93% reporting good to excellent. Afternoon and rotating shift workers had the poorest appetite with about 16% in each reporting fair to poor appetite. Twelve percent of the night shift workers reported fair to poor appetite.

The shift workers all reported about equal percentages of being moderately to very satisfied with their eating habits, but all were less satisfied than day workers.

Rotating shift workers were asked if their appetite was worse when working on a particular shift. Fifty-three percent indicated that night shift produced the worst appetite, 33% no difference, 4% day shift worst and 5% afternoon shift worst. Rotators were asked how long it took them to get used to new meal times and 51% indicated that they adjusted in 1 day or less, 35% took 2 days to 1 week to adjust, and 14% took 2 weeks or more to adjust.

There were no differences across shifts in the percentages of workers who drank alcohol. However, as Table 4 indicates, slightly more afternoon and night shift workers drank five or more bottles of beer per day than the day or rotating shift workers. Also, the rotating shift had a slightly higher percentage of workers drinking one or more

Table 4. Percentage of shift workers reporting food and beverage consumption patterns or satisfaction ratings.

	Shift			
	Day	Afternoon	Night	Rotating
(1) Eating pattern*				
(*a*) Light morning meal, lunch mid-way, large evening meal	67	18	30	20
(*b*) Light morning meal, large mid-way, light evening meal	3	36	13	5
(*c*) Large morning meal, light mid-way, light evening meal	4	9	10	3
(*d*) Different pattern for each shift	4	4	7	64
(*e*) Other	22	33	40	8
(2) Appetite rating*				
(*a*) Excellent	43	33	32	29
(*b*) Good	50	51	56	54
(*c*) Fair	7	14	10	15
(*d*) Poor	0	2	2	2
(3) Alcohol consumption*				
(a) 0–4 bottles of beer/day	94	86	89	93
(*b*) 5 or more beers/day	6	14	11	7
(*c*) 1 or more glass of wine/day	11	10	9	18
(*d*) 1 or more shots of liquor/day	20	21	23	19

*Significant difference at 99% level of confidence using χ-square test for homogeneity.

glasses of wine per day than the day, the afternoon shift or the night shift. The day and shift workers did not differ in the percentages who drank one or more shots of liquor per day. There were no differences in the number of cigarettes, cigars or pipefuls of tobacco smoked per day among the day and shift workers.

3.3. *Records evaluation*

The records for 1009 food processing workers were examined consisting of 273 day, 269 afternoon, 267 night and 200 rotating shift workers. As table 5 indicates, there was a significant difference among the workers on all shifts and the day workers in the percentage who had one or more sick absences in the 6-month period examined; however, analysis by worker sex indicated that this effect was significant only for male workers. There were more male rotating shift workers who were absent than male night

Table 5. Percentage of male and female shift workers with one or more sickness absence in a 6-month period.

	Shift				
Sex	Day	Afternoon	Night	Rotating	Combined for all shifts
Male*	41	61	52	71	56
Female	75	77	73	90	76*
Combined*	51	66	60	72	62

*Significant differences at 99% level of confidence using χ-square test for homogeneity.

and male afternoon shift workers, while those on the latter were absent more so than the day male workers. The sex of the shift workers had a significant association with the amount of sick absence with 76% of the females havind an absence as compared to 56% for males.

Table 6 indicates that the male workers on the afternoon and rotating shifts had a significantly higher average number of sick days in the 6-month period than the male day workers, with no difference between the male day workers and the male night workers. There were no differences in the average sick days taken across shifts for the female workers. Pearson Product–Moment correlations between the total number of sick days and selected variables showed that worker sex ($r=0{\cdot}12, p=0{\cdot}01$), employment length ($r=0{\cdot}10$, $p=0{\cdot}01$) and age ($r=0{\cdot}11$, $p=0{\cdot}01$) were all significantly associated with the number of sick days taken. Females had more sick days than males, workers with more work tenure had less sick days and older workers had less sick days. It was not possible to examine the effects of various shifts on the type of ailment since over half of the records examined did not have the type of ailment recorded.

Analysis of the work injury data indicated that the rotating shift workers had a significantly higher frequency of injuries than day, afternoon shift or night shift workers, who did not differ from each other. This effect was not due to accident repeaters since the same relationship held true for the percentage of workers on each shift having only one injury (see table 7). Pearson Product–Moment correlations between the total number of injuries and selected variables showed that worker sex ($r=0{\cdot}08$; $p=0{\cdot}01$) and age ($r=-0{\cdot}06$; $p=0{\cdot}02$) were significantly associated with the frequency of injury. Using a generalized Cochran–Mantel–Haenzel partial association statistic (Breslow and Day 1980) and controlling for sex, a significant difference in injury rate was found across shifts at the 99% level of confidence; but due to the small

Table 6. Mean number of sickness absence days for male and female shift workers for a 6-month period.

Sex	Shift				Duncan range test
	Day	Afternoon	Night	Rotating	
Males*	3·0	6·0	4·9	6·1	A and $R > D$
Females	7·6	7·8	9·5	7·1	
Combined*	4·4	6·6	6·6	6·2	

* Significant differences at 99% level of confidence using analysis of variance test for unequal cell sizes.

Table 7. Percentage of male and female shift workers having one or more injuries in a 6-month period.

Sex	Shift			
	Day	Afternoon	Night	Rotating
Males*	18	26	15	38
Females	22	12	20	60
Combined*	19	22	16	39

* Significant difference at 99% level of confidence using χ-square test for homogeneity.

number of female rotating shift workers, the female rotators were excluded from the comparisons. The results indicated that male rotators had significantly more injuries than male day, male afternoon shift and male night shift workers; also male afternoon shift workers had significantly more injuries than male night shift workers. There were no significant shift differences for female workers. The rotating shift workers had a significantly greater proportion of sprains; superficial injuries and open wounds; and contusions, crushings and fractures than the other worker groups (see table 8).

Table 8. Average number of injuries per worker and number of cases of specific types of injury for each shift.

	Shift			
Type of injury	Day	Afternoon	Night	Rotating
Sprains	14	16	11	29
Superficial injuries and open wounds	28	30	20	53
Contusions, crushings, and fractures	12	9	12	23
Falls	3	4	5	6
Stuck by/or against	4	8	3	10
Caught in	1	2	2	1
Burns	5	7	4	2
Other	10	16	10	15
Total cases	77	92	67	139
Total number of shift workers	273	269	267	200
Average number of injuries per worker	0·28	0·34	0·25	0·69

4. Discussion

While much shift work research has been conducted in Europe regarding health and safety implications, prior to this study, only one limited shift work study had been conducted in the United States. Since shift work systems vary greatly between the United States and Europe, the current study provides the first evidence for determining the impact of shift work on American workers.

Generally, the results of this study indicated that night and rotating shift work compared to day work and afternoon shift work were associated with increased problems relative to personal behaviour of the worker, sick absence and work-related injuries.

The greatest effects on worker behaviour were on sleeping and eating patterns while there was some difference in the quantity of sleep between the day workers, the most significant differences related to sleep pattern, reflecting on the quality of sleep. In particular, the night and rotating shift workers reported a poorer sleep pattern, as reflected in the greater frequency of awaking during sleep and having trouble getting back to sleep once awakened. This type of sleep disturbance is similar to those associated with psychological mood disorders. However, generally, the shift workers did not report mood disorders as measured by standard psychological tests. Therefore, environmental factors may have been a cause of the poorer sleep patterns. Alternatively, disturbances of circadian rhythms may have been a cause.

While the influence of environmental features was not examined directly, the fact that the rotators had more sleep problems on the night shift would suggest that unique daytime sleeping features may have been responsible for the poorer sleep observed.

One significant daytime environmental feature that could account for the sleep problems observed is greater noise. However, as Rutenfranz *et al.* (1977) pointed out, shift workers tend to adapt to environmental noise. Therefore, the influence of circadian rhythm disturbances cannot be overlooked as a source of this problem.

The sleep disturbances reported by the rotators and night shift workers may be responsible for a general fatigue effect observed. The night and rotating shift workers reported feeling tired and sleepy at work and after work more often than the day workers. It is quite likely that this general feeling of tiredness is one potential factor related to the increased levels of sick absences and injuries reported by the shift workers which could be indirectly related to the sleep disturbances.

As might be expected, the meal patterns varied considerably across shifts. It was not possible to gather information about how this variation in meal pattern affected the quantity of food eaten since it was difficult for workers to report this information in a manner which could be evaluated, i.e. calories consumed per 24-hour period. Therefore only data about the quality of eating was collected. These data indicated slightly poorer appetite and more dissatisfaction with eating habits for the rotating and night shift workers. These findings could reflect worker dissatisfaction with not being able to eat major meals with family members rather than actual problems with the quality of eating. While no data were collected to confirm this, it was found that the patterns of taking snacks across all shifts were similar, which suggest that eating behaviour provided some satisfaction even for the night and rotating shift workers. Therefore, the dissatisfaction with eating habits and poorer appetite was most likely not due to a decrease in the desire to eat, but a dissatisfaction with the timing of meals, lack of social interaction and/or disruption of circadian digestive cycles.

As with the change in sleeping habits, the modification in eating behaviour reflects more than just a simple change in the timing of normal behaviour. It indicates a generalized change in basic behavioural patterns primarily influenced by changes in external methods used to time and/or control activities. This fundamental change can affect not only the circadian timing but also social and psychological timing and functioning. The influences on these latter factors may be even more serious than disturbances in circadian timing in that adjustments are more difficult to make because they are controlled by external factors more so than oneself.

Disturbances in circadian rhythms have been shown to be related to loss of attention, motivation, ability to concentrate and a slowing of perceptual-motor processes (Colquhoun 1976). Such effects could be directly related to accident causation and hence account for the higher incidence of injuries for the rotating shift workers reported here. A similar finding was observed in a group of nurses by Smith *et al.* (1979 b).

Behaviour changes, such as different eating, sleeping and alcohol consumption patterns, were observed primarily in the night and rotating shift workers. These changes in behaviour are probably not a direct cause of the increased injuries and sick absence observed only in the rotating shift workers, since both the night and rotating shift workers reported significant behavioural changes. More likely, the changes in behaviour reflect a compensatory mechanism which mitigates the influence of shift work on worker health and safety. This is substantiated by the fact that these behavioural changes were more stable in the fixed shift workers than in the rotators. Since the fixed shift workers' behavioural patterns were more stable, the influence of these modified behaviours in reducing the occurrence of injuries and sick absence was greater than for the rotators who were forced to modify behaviours with each shift

rotation. It may be that an inability to establish stable behaviour patterns is a major cause of the increased incidence of injury and sick absence for the rotating shift workers.

While the results from self-reported health complaints failed to demonstrate pervasive or consistent shift differences, there was a higher incidence of sick absence observed in the objective health records for male night and rotating shift workers. One explanation for this discrepancy could be related to the long term nature of the development of the self-report health problems as opposed to the short term nature of the sick absence. Considering the young ages of the various worker groups in the study, it is not surprising that the more severe chronic health problems were not prevalent. A second explanation is that the quality of the sick absence data may have been better since this data was extracted from personnel records and therefore objective, while the health complaints data was based on self-reports. A third explanation may be that those persons who developed chronic health problems while on shift work changed employment from shift work to day work in an attempt to improve their health. Finally, it could be that the night and rotating shift workers used sick absence as a coping mechanism for adjusting to shift work. When the physical or psychological strain became too great, they may have taken a day off using sick leave.

None the less, it seems reasonable to give more significance to the objective results for sick absence than the self-reported health complaints. The data for sick absence clearly demonstrate differences between male workers on day work versus those on the other shifts.

There were a number of variables that influenced the shift effect on sick absence, in particular, sex. Female day workers did not differ significantly from their counterparts working shifts either in the percentage that had a sick absence or in the average days lost per sick absence. This may be due to the fact that the female workers on all shifts showed a consistently higher percentage of absences and days lost per absence than male workers. Since over half of the plants in the study had a limit on the number of sick days and the female employees on all shifts were closer to their limit than the male workers, the potential differences between the different shifts for the female workers may have been reduced. It was not possible to examine the differences in the number of sick days taken by female workers across the plants and therefore this assumption cannot be tested. There was no clue in the questionnaire data as to why the female workers had more sick absence but there are a number of potential reasons such as absences to care for children and other domestic responsibilities.

Employment length and age also had a limited influence on the levels of sick absence, with the older workers with greater tenure having fewer sick absences. These results indicate that it is the younger less-experienced males who are influenced the most by shift work in terms of more sick absence and suggest that there may be some accommodation to shift work with increased time on the job. However, the relationships between age, job tenure and sick absence were not very strong (even though they were significant) and this conclusion must therefore be tentative.

The injury data indicated that only the rotating shift showed a significantly higher percentage of male workers having an on-the-job injury than day workers. This finding is consistent with the findings for nursing workers as reported by Smith *et al.* (1979 b). As with the sick absence data, there were variables that influence this result such as the sex and age of the worker.

The much higher frequency of injuries and sick absence reported by the rotating shift workers implicates rotating shift work as the most detrimental to worker safety

and health for this study population. The most reasonable explanations for this result are general physical fatigue due to a permanent disruption of circadian rhythms, poorer sleep quality that may influence fatigue and/or disruption of stable behaviour patterns due to shift rotation which never allows for more than a temporary stabilization of bodily functions or behaviours. Given this reasoning, the circadian and behavioural influences would not be as great for afternoon and night shift workers since these permanent shifts allow for some long term adaptation.

This study provides a first step for evaluating the influence of American shift systems on worker health. As the findings demonstrate, more research is necessary to clarify the shift work influences observed, such as why there are definable sickness absence and accident effects for men and not for women. It is clear that the methodology used in this study does not provide the basis for answering many of the questions raised and that what is needed is a large scale prospective longitudinal evaluation (Colligan 1980).

A partir d'une enquête par questionnaires et d'une analyse des données relatives à l'état de santé et de sécurité dans une entreprise de l'industrie alimentaire, il a été possible de caractériser, pour environ 1000 ouvriers, les conséquences du travail par équipes alternantes sur la santé et la sécurité. Les résultats montrent que par rapport aux ouvriers en poste diurne, il y a un effet adverse beaucoup plus important chez les ouvriers travaillant par équipes alternantes ou travaillant sur un poste de nuit. Ces effets se traduisent par un sommeil médiocre, par une altération des habitudes alimentaires, une plus grande consommation de boissons alcoolisées, une plus grande fréquence de l'absentéisme, ainsi qu'une plus grande fréquence des accidents de travail. On n'a pas trouvé de relation entre le travail par équipes et la fréquence des plaintes concernant la santé ou les états de maladie chronique. L'impact du travail posté sur l'absence pour raison de santé ou sur les accidents su travail dépend su sexe, de l'âge et du type de poste de travail.

References

BRESLOW, N. E., and DAY, N. E., 1980, *Statistical Methods in Cancer Research*, Vol. I (Geneva: WORLD HEALTH ORGANIZATION).

COLLIGAN, M. J., 1980, Methodological and practical issues related to shiftwork research. *Journal of Occupational Medicine*, **22**, 163–166.

COLLIGAN, M. J., FROCKT, I. J., and TASTO, D. L., 1979 a, Frequency of sickness absence and worksite clinic visits amoung nurses as a function of shift. *Applied Ergonomics*, **10**, 79–85.

COLLIGAN, M. J., SMITH, M. J., HURRELL, J. J., and TASTO, D. L., 1979 b, Shiftwork: A record study approach. *Behavior Research Methods and Instrumentation*, **11**, 5–8.

COLQUHOUN, W. P., 1976, Accidents, injuries and shift work. In *Shift Work and Health: A Symposium* (Edited by P. RENTOS and R. SHEPARD) U.S. Department of Health, Education and Welfare Publication No. NIOSH 76-203 (Washington, D.C.: GOVERNMENT PRINTING OFFICE). pp. 160–175.

EYSENCK, H. J., and EYSENCK, S. B. G., 1963, *Eysenck Personality Inventory* (London: UNIVERSITY OF LONDON PRESS).

HARRINGTON, J. M., 1978, *Shift Work and Health: A Critical Review of the Literature* (London: HMSO).

MCNAIR, D. M., LORR, M., and DROPPELMAN, L. F., 1971, *Profile of Mood States* (San Diego: EDUCATIONAL AND INDUSTRIAL TESTING SERVICE).

MOTT, P. E., MANN, F. C., MCLOUGHLIN, Q., and WARWICK, D. P., 1965, *Shift Work: The Social, Psychological, and Physical Consequences*. (Ann Arbor: UNIVERSITY OF MICHIGAN PRESS).

RUTENFRANZ, J., COLQUHOUN, W. P., KNAUTH, P., and GHATA, J. N., 1977, Biomedical and psychosocial aspects of shift work. *Scandinavian Journal of Work Environment and Health*, **3**, 165–182.

SMITH, M. J., COLLIGAN, M. J., FROCKT, I. J., and TASTO, D. L., Occupational injury rates among nurses as a function of shift schedule. *Journal of Safety Research*, **11**, 181–187.

SMITH, M. J., COLLIGAN, M. J., and TASTO, D. L., 1979 a, A questionnaire survey approach to the study of the psychosocial consequences of shiftwork. *Behavior Research Methods and Instrumentation*, **11**, 9–13.

TASTO, D. L., and COLLIGAN, M. J., 1977, *Shift Work Practices in the United States*. U.S. Department of Health, Education and Welfare Publication No. NIOSH 77-148 (Washington, D.C.: GOVERNMENT PRINTING OFFICE).

U.S. CONGRESS, 1971, *Occupational Safety and Health Act of 1970*. Public Law 91-596, 91st Congress (Washington, D.C.: GOVERNMENT PRINTING OFFICE).

Manuscript received 28 April 1981.
Revised manuscript received 20 August 1981.