HEALTH PROBLEMS IN SHIFTWORKERS

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When in 1972 a new wire mill came into operation, we took the opportunity to study a group of 104 male shiftworkers who were recruited to work in the plant on a semi-continuous four-shift system. These subjects were randomly selected out of a total work force of a few hundred workers. At the time of their first testing, they were in training and were working on normal day shifts. Forty-three of the 104 subjects had never worked in shifts before, but the remaining 61 had had various amounts of shiftwork experience. All subjects were extensively interviewed, and were asked to fill in some questionnaires and to rate themselves on various scales.

After six months in 1973, the subjects were examined a second time using the same test procedures. At that time, 96 out of the original 104 were still present, and had been working on the shift system since shortly after the time of the original examination.

A third examination took place in 1976, 4 years and 4 months after the first one. At the time of this third examination, 64 subjects were still working on the shift system. A report on the subjective health of these subjects at this stage was presented to the 4th International Symposium on Night- and Shiftwork, held at Dortmund in 1977 (Meers, Maasen, & Verhaegen, 1978).

A fourth examination was carried out in 1979, seven years after the first one. At the time of this fourth examination, only 51 subjects out of the original 104 were still working on the shift system.

These examinations form part of an ongoing longitudinal study of the health of shiftworkers in this wire mill. Our aim is to study not only those who remain on shiftwork, but also those who leave the plant. We want to know the reasons (health or other) that lead the latter to the decision to quit.

Our subjects are carefully monitored by the medical service in the plant where they are employed, and were originally recruited according to certain medical criteria. Further, they are quite young: The mean age of the 51 subjects still working on shifts presently (1979) is 32.5 years. These facts explain why objectively ascertainable health disturbances related to shiftwork are only rarely (if ever) observed (though other health problems, namely, those related to high noise levels and to the biomechanical stress of weight lifting, do in fact occur in the plant).

A consequence of this situation is that we have to study health (or rather its inverse) as subjectively experienced, and as reported in the form of health complaints for which it is not easy to observe concomitant objective symptoms. Because of this, it might be suggested that we should use the term "subjective health". We are not opposed to doing this, although for some people "subjective" has a connotation of "not really important" or even "not true". Alternatively, it would be possible to use the term "well-being", but this term makes us think of positive health, whereas the complaints of our shiftworkers clearly have to do with negative aspects of health.

In each of the four examinations, the same measuring instruments were used. As already mentioned, we tried to include in these examinations the members of our original group who had left the plant. We did not completely succeed in this objective. On our last (fourth) examination, we were able to obtain the required information from only 40 out of the 53 subjects who had left the plant. Of the remaining 13, four had become white collar workers and for that reason, we did not consider them to be relevant information sources. Others we were not able to locate; a few declined to take part in further study and in a few cases, we only got incomplete or partial information. Thus, of the original 104 subjects, we have data on 51 who are still working on shifts, and 40 who have left.

In our 1979 examination, we extended our study by giving some of our questionnaires to 72 randomly chosen shiftworkers who had also started working in the wire mill seven years ago, but who were not included in our sample at that time (although they had filled in one of our questionnaires during the selection procedure before their enrollment). The mean age of this group is 33.5 years. Since this group was originally selected for shiftwork by the plant management and further self-selected over 7 years, in the same way as the first group of 51 subjects, the two groups can be considered as quite comparable.

We also asked 79 other shiftworkers who had filled in our most important questionnaires during their selection before enrollment in 1978 (i.e., one year previously) to fill in the same questionnaires again. For this group, mean age is 26 years.

We considered that the results from these two new groups of 72 and 79 subjects would serve as a useful check on some of the results obtained from our first group of 51 subjects. Basic characteristics of the different groups are given in Table 1.

Table 1

The Different Groups

104 examined in 1972 after enrollment
- 51 still in shifts; mean age: 33.5 y
  - further examined in 1973, 1976, 1979
- 40 left the plant
  - further examined in 1973, 1976, on average 2.5 y after leaving
  - mean age when they left: 27.5 y
- 13 "lost"

72 examined in 1972 before enrollment
- all still in shifts; mean age: 33.5 y
- further examined in 1979

79 examined in 1978 before enrollment
- all still in shifts; mean age: 26 y
- further examined in 1979

The wire mill produces steel cord used for strengthening tires. Our subjects' work consists of tending wire drawing machines, i.e., keeping the machines running, taking the rolls of wire on and off, etc. Noise levels are very high, so ear-plugs are worn. The work is rather monotonous. From 1972 to 1976 a complete shift cycle consisted of 6 morning shifts (0800 - 1600), followed by 6 afternoon shifts (1600 - 2400), then 6 night shifts (0000 - 0800), and finally 6 days off. In 1976, the sequence was changed and became 6 afternoon shifts, 6 morning shifts, 6 night shifts, and 6 days off. Each working week of 6 shifts runs from Monday until Saturday, and is always followed by a free Sunday.

Measuring Instruments

Besides interviews, we used questionnaires on health, on neuroticism and on fatigue; and also several rating scales.

The first questionnaire was the Inventory of Subjective Health (ISH) known in the original Dutch version used as VOEG (Dirken, 1966, 1967). It consists of 56 questions about subjective complaints, to which the subject answers 'yes' or 'no'; 48 of these questions are used to compute a score which gives an inverse index of general (subjective) health. The other 8 items serve to stimulate concentration during the filling in of the form, and to obviate the development of a particular response set. The different complaints can be analyzed separately, and any patterns in them can be determined.

The second questionnaire was the Amsterdam Biographical Questionnaire (Wilde, 1963). This is a Dutch personality questionnaire, based largely on the Maudsley Personality Inventory and the Heron Two-Part Personality Inventory. The questionnaire yields many different scores; in this study, the N score and the NS score were considered the most important of these. Both scores are alleged to measure neurotic instability; the N score by assessing the frequency of psychoneurotic complaints, the NS score by assessing the frequency of functional somatic complaints. In this study, the NS score was considered simply as a measure of functional complaints, without necessarily implying neuroticism.

The first of two short fatigue questionnaires (Quayhackx, 1967) given consists of 7 statements concerning cumulative fatigue over the day, e.g., "I feel tired in the morning before I start working." The subject has to answer with one of five alternative responses ranging from "never" to "always". It should be noted that in 1979 we tried to make the questionnaire more relevant and more appropriate to the present shift system, by making the wording of the questions more specific. For example, the statement mentioned above became: "I feel tired before I start the morning shift." The second fatigue questionnaire given is concerned with the subject's general habitual level of fatigue, alertness, etc. (chronic fatigue?). It consists of 7 bipolar six-point scales. Each scale has short self-descriptive statements at its extremes, e.g., "I'm interested in everything--I'm intersted in nothing;" "I'm usually sleepy—I'm usually wide awake."

In addition to these questionnaires, we used several five-point rating scales of various functions, of which we shall discuss only the one on which our subjects were requested to indicate how good their appetite generally was.

Finally, the subjects had to report whether they suffered from four digestive symptoms: "never", "sometimes", or "quite frequently".

There is no doubt that the content of some of these instruments overlaps to some extent, but this has the advantage of providing an internal check on the reliability of our results.

Results

Inventory for Subjective Health

The mean ISH scores obtained in the different groups after different amounts of shiftwork experience (seniority) are presented in Table 2. In this and following tables, significant differences relevant to our research are indicated by lines joining the differing values; the actual significance levels are written alongside these lines. Two-tailed tests were used unless otherwise indicated. Tests used were the Wilcoxon matched-pairs signed ranks test, the Mann-Whitney U Test, and (in Tables 8-11) the McNemar test for the significance of changes (Siegel, 1959). Where it has some importance for our argument, values that do not significantly differ are joined by a broken line. It should be noted that all tables from Table 2 on are organized in the same way. In order to keep the tables as clear as possible, the calendar years during which data were collected are given in Table 2 only.

Table 2

Mean ISH-Scores in the Different Groups

Seniority	51 Workers	40 Workers	72 Workers	79 Workers
0 y	6.55 (1972)	7.25 (1972)		3.16 (1978)
	.01	.03 one tailed		.001
6 m	8.10 (1973)	9.74 (1973) (N = 34)		
1 y	.001			6.72 (1979)
		.05 one tailed		
4y 4m	12.35 (1976)	19.00(1976) (N = 7)		
	.0002		.002	
7y	16.92 (1979)	.05	12.84 (1979)	
	.005	10.53		

In Table 2 we see that the first group of 51 workers shows a regular increase over time in the mean ISH score. The increase from each examination to the next is significant at at least $p < .01$. For the group of 40 workers who left the plant, the table shows mean scores computed from those still in service at the times the different examination took place, namely on 34 subjects in 1973 and on 7 in 1976. The increase from 1972 to 1973 (6 months seniority) is significant ($p < .05$, one-tailed) as is also the increase from 1973 to 1976 (after a further 3 years 10 month experience) ($p < .05$, one-tailed). At the

bottom of this '40 Workers' column is the mean score obtained in these 40 subjects at an average time of 2 years 6 months after they had left the plant. This score is significantly lower than the present (1979) score of the 51 workers ($p < .005$), but it is higher than the first (1972) score of the group itself ($p < .002$). When we compare the last score obtained from this group of 40 subjects when they were still working in the wire mill with their score after having left the plant, we find no difference. [This last score obtained when still in the plant is not shown in the table: It is the mean of the scores of 34 minus 7 subjects examined in 1973 and of 7 subjects examined in 1976.] We may perhaps conclude that leaving this work situation leads to some stabilization of the level of complaints.

Turning now to the group of 72 subjects who started work 7 years ago in 1972, but who were given the Inventory for Subjective Health for the first time only this year (1979), we see that their mean score is 12.84. This score is significantly lower ($p < .05$) than that of the 51 workers having the same seniority in the same work situation. A possible explanation for this is that repeated exposure to a list of complaints increases the tendency to acquiesce and hence increases the number of complaints admitted to. [It must be remembered that there is some difference between answers to questionnaires and actual physical measurements.]

Finally, we have to consider the results of the 79 workers who started work in 1978, one year ago. At that time, they filled in the ISH as one of their selection tests. The mean score obtained then was 3.16. This value is significantly lower than the value obtained by the 51 workers when they also had 0 years seniority. But the latter filled in the ISH during an interview by a scientific researcher, whereas the former were probably not very inclined to complain about their health during a selection procedure, and moreover, some candidates who scored high on this test were probably not enrolled. The mean score obtained by these 79 workers after one year's experience has increased to 6.72, which is not significantly different from what the score of the 51 workers after 6 months was, namely 8.10.

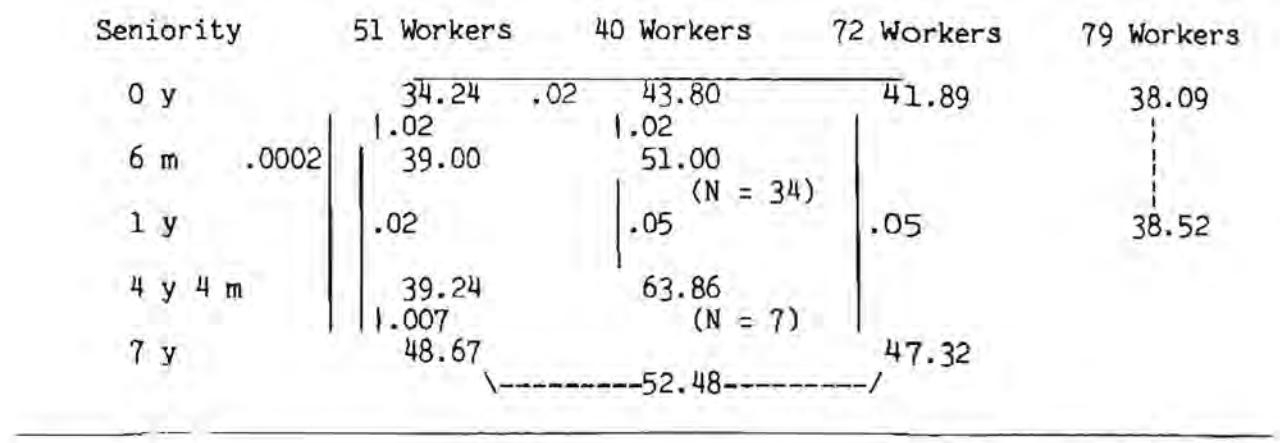
We may conclude that the results from the two "new" groups of 72 and 79 workers confirm those obtained from our first group.

Amsterdam Biographical Questionnaire

The mean N-scores from this questionnaire are given in Table 3 and the NS-scores in Table 4. The N-score has significantly increased over the 7 years in both the 51 workers and the 72 workers, but for the group of 79 there has been no increase after one year, although their score is comparable to the score of the 51 workers after 6 months. The subjects who left the plant show a comparable increase. There is no significant difference between their last scores in the plant and their scores some time after leaving it. There are no signigicant differences between the last scores of the different groups. The N-score is not particularly relevant for our study, although there are reasons to think it has some small value in predicting the probability of leaving this work (and possibly other similar work). When we analyzed our 1976 data, we computed a point biserial correlation coefficient between the N-scores obtained in 1972 and presence or absence (having left) in 1976. The correlation was .169, which is significant at the .05 level.

Table 3

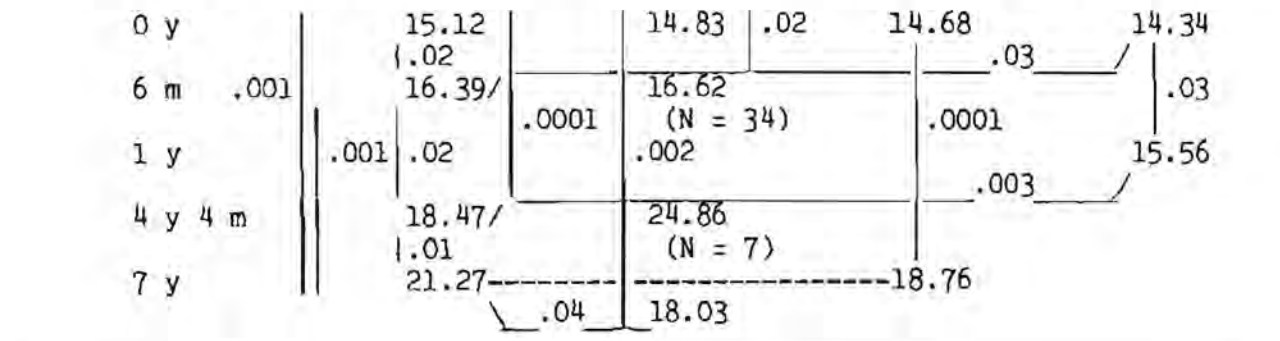
Mean N-Scores in the Different Groups



The NS-score pattern is very similar to that of the ISH scores. The 40 subjects who left the plant show, some time after leaving, a significantly lower score than the 51 who are still in the plant. The 72 workers with 7 years seniority do not differ from the 51 with the same seniority. The 79 workers with one year seniority yield a mean score that has increased by an amount that is about what would be expected from the others groups' trends.

Table 4

Mean NS-Scores in the Different Groups



Fatigue Questionnaires

The scores obtained from the first fatigue questionnaire are given in Table 5, and those from the second in Table 6.

Table 5

Mean Scores on the First Fatigue Questionnaire in the Different Groups (Fatigue Over the Day)

Seniority	51 Workers	40 Workers	72 Workers
0 y	14.75	15.15	
	.002	.002	
6 m	16.14	17.24	
	.0002	.05 one .02	(N = 34)
4 y 4 m	17.02	tailed 18.86	
	.0001	.0002	(N = 7)
7 y	19.53		18.71
	\----------	16.88	---------/

Table 6

Mean Scores on the Second Fatigue Questionnaire in the Different Groups (Chronic Fatigue)

Seniority	51 Workers	40 Workers	72 Workers
0 y	13.20	14.15	
		.05	
6 m	13.20	15.29	
			(N = 34)
4 y 4 m	13.80	18.86	
	.04	.05	(N = 7)
7 y	15.63----------	----------	----------16.14
	\----------	13.98	

On the first questionnaire, which assessed fatigue cumulation over the day, the 51 workers show significantly increasing scores from each examination to the next. The 40 workers show a significant increase from 0 to 6 months, and also a significant difference between baseline score and score obtained after they left the plant. There are no significant differences between the three groups on their latest examinations. These results suggest that there is perhaps somewhat more "fatigue over the day" than 7 years ago. But it must be remembered that we changed the wording of the questionnaire for the last examination of the 51 and 79 workers, so that we have to be somewhat cautious in comparing the scores from this examination with those from earlier ones.

On the second questionnaire, which assessed a sort of chronic fatigue, the subjects who were to leave the plant showed an early increase in their fatigue score. In this group, the difference between their last score in the plant and their (lower) score after leaving is significant at $p < .02$. So this "chronic" fatigue seems to disappear after leaving this work situation. By contrast, the subjects who are still in the plant have shown a significant increase in score during the last 2 years 8 months. The 72 workers do not differ from the 51, after 7 years experience.

Appetite

The mean scores from this scale are given in Table 7. High scores indicate poor appetite. For both the 51 and the 40 workers, appetite gets worse after 6 months of shiftwork, but for the 51 it is significantly better after 4 years 4 months than it was after 6 months. After 7 years, it is as good for the 51 as it was when they started working in the plant. In the 40 workers, appetite after leaving is significantly better than at the time they started shifts. The 72 workers do not differ significantly from the 51, after 7 years experience.

Table 7

Mean Scores on the Appetite-Scale in the Different Groups

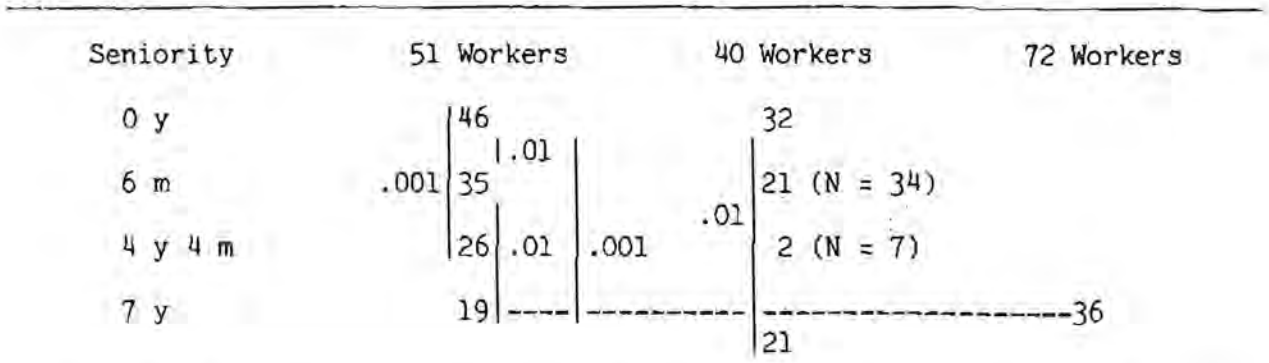
Seniority	51 Workers	40 Workers	72 Workers
0 y	2.12	2.23	
	.01	.01	
6 m	2.47	2.56	
	.001	(N = 34)	
4 y 4 m	2.20	2.00	
	.01	.01 (N = 7)	
7 y	2.13	1.75	2.04

Digestive Symptoms

To assess the prevalence of digestive symptoms, our subjects were requested to indicate by checking "never", "sometimes", or "very frequently", whether they suffered from any of the following: heartburn, stomach-ache, a feeling of oppression in the upper abdomen, and difficulties with bowel motions. In Tables 8-11, the numbers of subjects replying "never" for each of these symptoms are given. Two-tailed significance levels for the differences between different groups and examinations are indicated. McNemar's test for the significance of changes (Siegel, 1956) was used here.

Table 8

Numbers of Subjects in the Different Groups "Never" Complaining of Heartburn



In Table 8, we see that progressively fewer and fewer of the 51 workers say that they never suffer from heartburn. In the 40 workers who left, there are still more cases of heartburn than at the time they started working in the plant. The 72 workers do not differ from the 51, after 7 years experience.

Table 9

Numbers of Subjects in the Different Groups
"Never" Complaining of Stomach-Ache

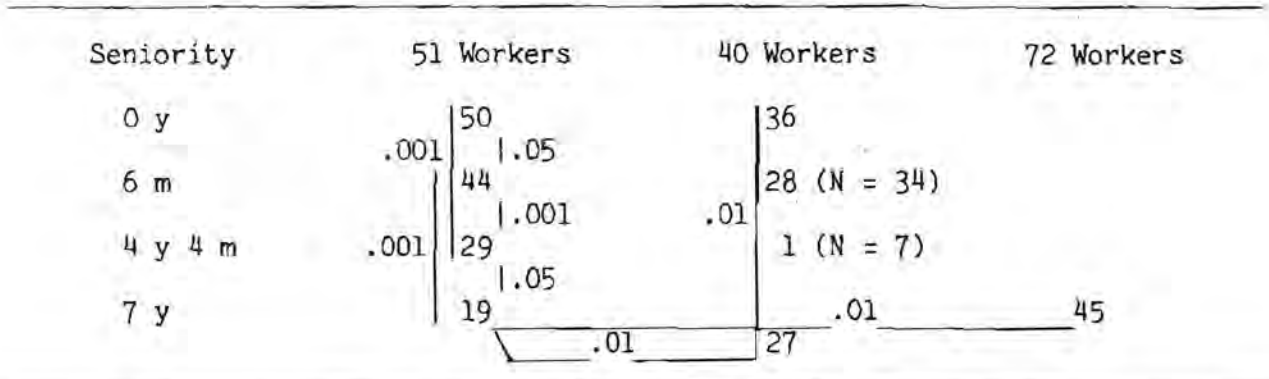


Table 9 shows the numbers of workers who never complain of stomach-ache. We see that the number progressively decreases in the 51 workers, whose situation after 7 years is worse than that of the 72 workers. In the 40 workers, there is some deterioration at first, but after leaving, their situation becomes better than that of the 51 workers.

Table 10

Numbers of Subjects in the Different Groups "Never" Complaining of a Feeling of Oppression in the Upper Abdomen

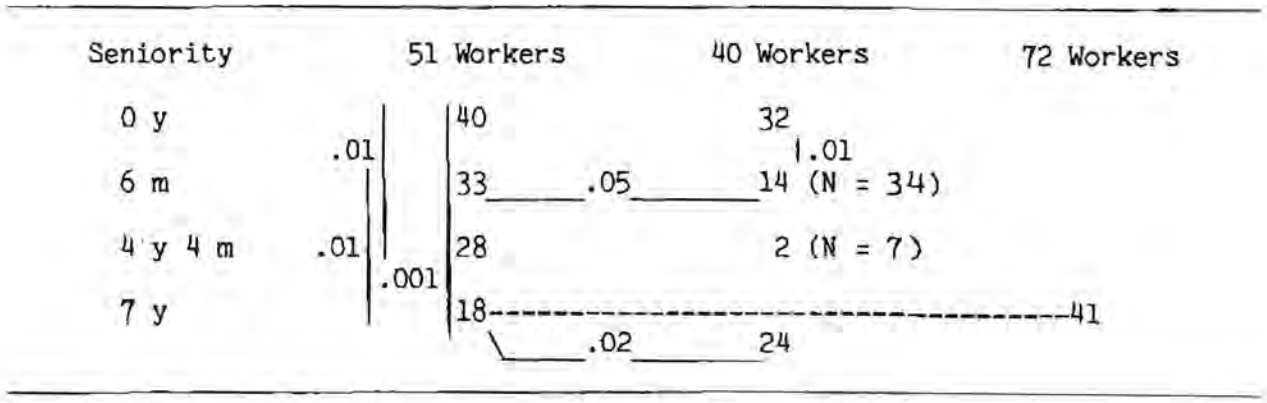
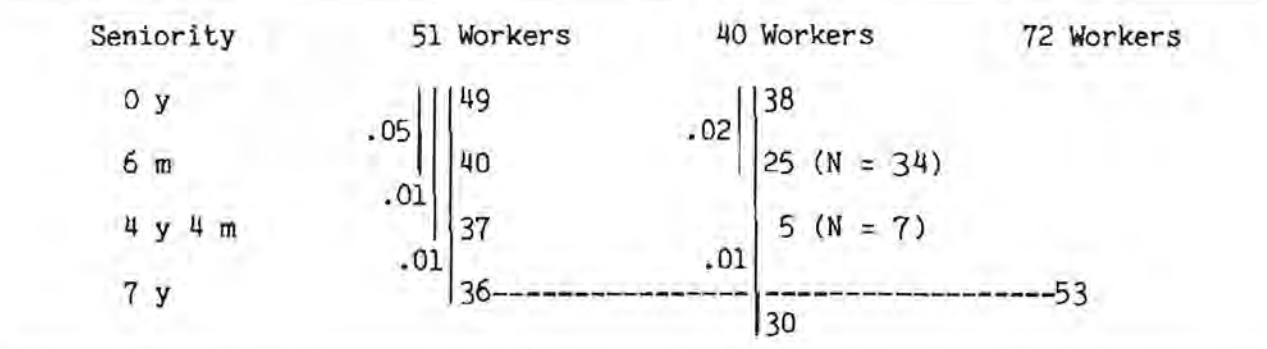


Table 10 shows a comparable result for feelings of oppression in the upper abdomen. The 51 workers have progressively more complaints. Their situation after 7 years is worse than that of the 40 workers after leaving.

Table 11

Numbers of Subjects in the Different Groups "Never" Complaining of Difficulties with Bowel Motions



In Table 11 we see that there is an increase in complaints about difficulties with bowel motions between the start and 6 months seniority, but from that point on, there is some stabilization in the different groups.

Discussion and Conclusions

In this research, we made exclusive use of subjective methods (i.e., questionnaires and rating scales), thus raising some problems in interpretation of the results. As already mentioned, we may wonder whether people who

are repeatedly requested to fill in the same health questionnaires do not become inclined to check more and more complaints. For that reason we have to be cautious when interpreting the continuous increase in complaints shown by our data. On the other hand, we have to note that there was no continuous increase in complaints about appetite, but in fact a decrease after some time; and for troubles connected with bowel habits, there was a stabilization. Another indication of the validity of our data may be found in the results obtained in the groups examined on only one or two occasions. The mean scores of these groups are roughly comparable to those of our original group if we take seniority into account.

Summarizing the data from our subjects with 7 years seniority, we may conclude that there has been a continuous increase in subjective health complaints, in neuroticism, in somatic neurotic complaints, in fatigue and in digestive symptoms. In most cases, the increases from enrollment to 6 months, from 6 months to 4 years, and from 4 years to 7 years seniority, are each statistically significant by themselves. It seems to us very difficult to give a definitive answer to the question of how seriously this continuous increase has to be taken.

Summarizing the data from our subjects who left the plant, we may conclude that during their period in the plant, their scores were in most cases not higher than those of the workers who stayed. In general, after leaving, their scores did not drop to their starting point (except for chronic fatigue and for appetite). Rather, they either decreased slightly or stayed at the level reached at the time they left. However, in many cases the scores after leaving are lower than the scores obtained from workers with 7 years seniority. [It should be mentioned that a few of the subjects who left the plant took up shift work again in other plants. But discarding the scores of these subjects from the analyses does not change the conclusions.]

Our study is meant to be a study of shiftwork. But are most complaints related to shiftwork and are people leaving because of the shifts? It is clear that a work situation is never completely defined by its shift system. In this plant some other aspects of the work are also possible stressors: physical effort in lifting, noise, monotony, work rhythm, etc. In interviews, we asked 46 subjects why they had left the plant. In only 9 cases were the first reasons mentioned directly connected with the shift system (3 subjects objected to alternating shifts; 3 suffered from sleep disturbances and digestive troubles; 2 had been counseled by their family doctor to change work; another worker's wife was afraid at night). In 7 cases, the main reasons for leaving were related to the work activity itself: monotony, too fast a work pace, etc. In 9 cases, the subjects had been dismissed by the plant management because of unsafe behavior, frequent absences, etc. Perhaps some of these cases are actually cases of difficulty in adaptation to the shiftwork. In the remaining subjects, the reasons for leaving were extremely varied. One subject had passed his exams for the Post Office before his enrollment in the plant, and only worked there because he had to wait several months for a vacancy in the office. Another subject suffered from a chronic skin disease and found it very disagreeable to have to use the common washing facilities in the plant. Some other subjects became white collar workers, and others succeeded in getting jobs for which they were trained at school and in which they expected opportunities for promotion, etc.

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PROCEEDINGS

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THE TWENTY-FOUR HOUR WORKDAY: PROCEEDINGS OF A SYMPOSIUM ON VARIATIONS IN WORK-SLEEP SCHEDULES

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