In understanding the risk factors for job-related diseases, the stress-and-strain concept may be of great heuristic value. Thus the magnitude of the effects of night- and shiftwork on any individual will be influenced by a number of 'intervening variables' acting separately or in combination. In this paper, the effects of shiftwork on well-being and disease are considered. The lowering of well-being can be seen particularly in sleeping behaviour, eating habits, and gastrointestinal complaints. The danger to health is discussed with respect to mortality, gastrointestinal diseases, and other diseases. Occupational health measures for night- and shiftworkers should include all the appropriate actions required to reduce the complaints of the workers, in order to prevent lowering of well-being and the occurrence of job-related diseases. Such measures should not be restricted only to those used in normal occupational health practice, but should also encompass activities outside the workplace such as pressing for the improvement of their social life in relation to shift systems based on physiological criteria.

The health of shiftworkers has been a concern of occupational medicine since the First World War. In the last ten years there has been worldwide discussion about whether certain diseases are actually caused by shiftwork. These discussions have focussed on the question whether the diseases observed should be declared as occupational diseases or only described as job-related diseases.

In contrast to occupational diseases, job-related diseases cannot usually be defined by simple cause-effect-relationships. Job-related diseases are mostly multifactorial in origin, the risk factors for these diseases being not only work-related, but also often related to the individual person.

For describing these latter occupational health problems, the so-called "stress and strain" concept may be of great heuristic value. COLQUHOUN and RUTENFRANZ (1980) used this concept for defining the nightwork condition as follows: "The objective stress resulting from the disruptions of physiological
rhythms by shiftwork, and from the slow rate of re-entrainment of these rhythms to be changed wake/sleep cycle, induce a state of subjective strain in the shiftworker that can potentially affect his working efficiency, his physical and psychological health and well-being, and his family and social life.

This cause and effect relationship is schematically illustrated in Fig. 1, from which it will be seen that the magnitude of the effects observed in any individual will be influenced by a number of "intervening variables" acting separately, or in combination. These variables include particular characteristics of the shiftworker such as his age, his personality, his rhythmic "type" and his physiological adaptability; factors relating to the actual job on which he is engaged, such as the physical or mental load of the task, the length of the shift, the type of shift system in operation, and the environmental conditions at the workplace; and his social and domestic circumstances such as marital state, number of children, housing conditions and community "status."

Because of the number and complexity of these intervening variables, it is not surprising that people vary widely in their tolerance of what is, essentially, an unnatural way of life. Identification of these factors which are most influential in determining successful adjustment to the shiftworking situation is, therefore, of importance not only to the individual and his family, but also to all organizations employing shiftworkers, and to the community at large. It is thus the intervening variables that explain why the same stress of nightwork may for one particular individual be a normal or even a chosen strain, and for another a possible risk or even the main cause for a job-related disease.

![Fig. 1. Model of relations between stress, intervening variables and strain in connection with shiftwork (after Rutenfranz, 1976).](image)

**EFFECTS OF SHIFTWORK ON WELL-BEING AND DISEASE**

According to modern biology, life exists in coming to terms with the environment (Üexküll and Kriszat, 1956). Man is generally in a position to adapt himself not only to natural but also to artificial environments. Occupational medicine proceeds from the fact that there is a spectrum of possible adaptations between the two extremes of complete physical, psychical and social well-being
OCCUPATIONAL HEALTH MEASURES

It is possible to think of several degrees of adaptation between the two extremes. Should well-being, for instance, not be achieved in certain spheres of life (physical, psychical or social)—the term discomfort is used in epidemiology in order to describe this—a lowering of well-being, which is not illness, becomes likely. Conditions which are outside the normal limits of adaptation capacity, and which, therefore, do not meet the criteria of long-term endurability, will, eventually, lead to illness. In this context we describe innate characteristics, acquired patterns of behavior, or pregiven conditions of daily life, all of which might decrease the physical capacity of adaptation of a person, as risk factors. This means that the presence of one or more of such factors does not at first cause any particular illness, but generally makes the eventual occurrence of an illness statistically more probable. In this sense, shiftwork may be regarded as a risk factor (RUTENFRANZ, 1967).

1. Health-relevant types of shiftwork. One may generally assume that shiftwork, or work at constantly unusual times, is disagreeable to the majority of human beings. Shiftwork has this in common with all other forms of work which differ from our average expectations of working conditions. Despite this, however, it cannot be denied that even shiftwork is expressly sought after by a small number of persons, because they believe that only with this kind of organization of their work can they realize certain expectations or enjoy certain hobbies. The best known examples are the farmers shiftworking in the chemical industry in Germany, and the fishermen shiftworking in the paper industry in Norway. According to HARRINGTON'S (1978) findings, it generally may be assumed that 20–30% of all workers decline shiftwork, approximately 10% see certain advantages in it, and the rest simply tolerate it.

Apart from this, it may be assumed that any working at changing times of day disturbs the order of our social life, and partly the order of our biological functions as well; this does not, however, mean that in every case it entails danger to health. If we consider the various forms of shiftwork listed in the previous paper of KNAUTH and RUTENFRANZ (1982), and if we bear in mind the problems of biological rhythms, we may set up the hypothesis that all forms of shiftwork, including nightwork, deserve special attention from the point of view of occupational medicine. Irregular forms of shiftwork, “continuous” shiftwork, and “permanent” night shiftwork should be examined particularly closely, because of their special psycho-social problems; no noticeable influence on health, however, may be expected from forms of shiftwork which exclude night shifts.

In considering the health effects of shiftwork, one tends to forget that shiftwork, as a special time-oriented organization of work, is superimposed upon the most varied activities. Thus, when discussing the possibilities of harmful effects from this work-organization, it is necessary to distinguish these from the stresses and possibilities of harm caused by the kind of work in itself, in the sense of the
so-called "confounding factors" as used by epidemiology (MacMahon and Pugh, 1970). On the other hand, stresses which otherwise lie within the range of harmlessness (Hacker and Macher, 1977) as, for instance, work in climatic conditions below certain temperature figures, work with health-endangering substances within the limits of MAK, work with noise, etc., may possibly lead to health endangering situations in nightwork conditions.

In all disturbances of health caused by shiftwork, it is however, advisable to distinguish between lowering of well-being and disease proper.

2. Lowering of well-being. 1) Sleep behavior patterns in shiftwork. Numerous investigations (e.g., Menzel, 1962) have shown that average sleeping time amounts to 7.5 hr before a morning shift, 8.5 hr after an afternoon shift and approximately 4-6 hr on the day after a night shift (Fig. 2). The need for sleep, independent of the form of shiftwork, varies considerably with the individual human being and is also related to age. The amount needed is, however, definitely longer than any sleeping time which can be achieved with nightwork. This shortening of sleeping time is brought about on the one hand by the transference of sleep to a time of day which is unfavorable for it with respect to circadian rhythms, and on the other hand through disturbances of sleep during the daytime caused by noise; children and traffic are usually mentioned as most important sources of this disturbing noise (Knauth and Rutenfranz, 1972a, b).

On the basis of these facts, one would expect the frequency of sleep disturbance to be determined by the type of shiftwork. From the literature

![Fig. 2. Sleep duration by shift type from diary records of 5,926 days (after Knauth et al., 1980).](image-url)
(RUTENFRANZ et al., 1981), we may conclude that shiftwork which excludes night shift and straight daywork do not lead to sleep disturbances to any significant degree; but that shiftwork which includes night shift and continuous nightwork bring about special sleep problems for the shiftworker.

2) Disturbances of eating habits. The time changes of work, sequence of meals and sleep very probably are the causes of disturbances in appetite during nightwork. The number of investigations concerning this problem is not very large. Nevertheless the literature (RUTENFRANZ et al., 1981) shows that shift-workers doing night shift or doing continuous night shift clearly suffer more from disturbances of eating habits than dayworkers or shiftworkers not doing night
shifts (Fig. 4).

3) Gastrointestinal complaints. Irregularities in food intake can, as experience shows, lead to digestive disorders and gastrointestinal complaints; however, the reasons for this complex of symptoms are surely manifold. Nevertheless, complaints concerning the gastrointestinal system are often named as a predominant symptom in shiftworkers. On the basis of our own investigations and those published by other authors dealing altogether with 8,060 persons, we have assembled the findings for various forms of shiftwork (RUTENFRANZ et al., 1981) (Fig. 5).

3. Dangers to health. The adaptation disturbances in shiftwork, as detailed above, show that not all forms of shiftwork are similarly problematic, but, rather, that it is mainly those forms of shiftwork which include night shift that contain special risks. In these cases, shiftwork may become a risk factor as far as health is concerned if the unaviodable adaptation disturbances resultant on changes in the biological rhythms are augmented by other personal or situational factors at home or at the working place (RUTENFRANZ, 1976). Such transgressions of the adaptability limits of the human organism should show up in an excessive mortality rate or in an increased frequency of disease.

1) Studies of mortality. Studies of mortality with shiftworkers are, so far, very rare. In an unusually careful study, TAYLOR and POCOCK (1972) compared mortality rates in shiftworkers and dayworkers in 10 factories over a 13-year period; with 1,578 deaths occurring in 8,603 persons, they found no difference in rates be-
between shiftworkers and dayworkers. Shiftworkers, however, who had given up shiftwork prematurely showed a higher mortality rate (standard mortality ratio: 118.9 against 101.5). A certain excessive mortality due to neoplasmas was found among shiftworkers and due to pulmonary complaints among the dayworkers. Further studies seem necessary here.

2) Gastrointestinal diseases. On account of the high frequency of disturbed appetite and gastric complaints, special risk to the gastrointestinal system among shiftworkers appears probable and plausible, should other aggravating factors accrue.

Gastric and duodenal ulcers are not monocausal diseases. In a review about the role of stress in peptic ulcer disease Wolf et al. (1979) concluded that there are several factors which may predict increased likelihood of developing duodenal ulcer (Fig. 7a, b). It is especially notable that these risk or health factors do not include any job-related factors. This means, in our opinion, that nightwork may
only be a minor risk factor in predicting increased likelihood of developing duodenal ulcers.

3) Other diseases. As far as other illnesses are concerned, a significant hypermorbidty caused by shiftwork would seem unlikely. So far, investigations of cardiovascular diseases, neurological disturbances and psychiatric illnesses have been made, and, as a new assembly of the facts by HARRINGTON (1978) shows, no effects of shiftwork can be demonstrated in these aspects of health.
4. Open questions. The question of whether health is damaged by shiftwork has not, as yet, been satisfactorily answered. The discussions have concentrated so far on gastrointestinal diseases; the possibility that shiftwork has a co-responsibility for other illnesses is considered by only a few authors (for instance, CARPENTIER and CAZAMIAN, 1977). The investigations published so far reveal the following deficiencies:

- the diagnosis of diseases is based on very different kinds of facts (questionnaires on subjective health, medical history, X-ray, endoscopy);
- so far, only cross-sectional studies have been made, very often without control groups.

As regards the latter, since it can be deduced from the investigation that test-groups of shiftworkers represent self-selected groups, it is clearly very difficult to answer the question by cross-sectional studies. As in epidemiology, retrospective—or better—prospective cohort studies, as well as case-control studies, are necessary.

One of the first studies using one of these techniques in shiftwork (ANGERSBACH et al., 1980) supports the assertion that health data of shiftworkers can be evaluated only in relation to time, since it was found that the process of self-selection had not come to an end even after 10 years. The group of workers who for reasons of health had changed from shiftwork to daywork, proved to be of special importance. The true reasons for the withdrawal of shiftworkers from shiftwork can only be found by a follow-up of the losses through prospective cohort studies of all workers. Such extremely work-intensive studies are especially necessary today.

SPECIAL HEALTH MEASURES FOR NIGHTWORKERS

Special health provisions for nightworkers should include:
- selection of workers;
- regular health checks;
- preventive health care;
- additional free days and other compensating mechanisms;
- providing proper meals at night;
- constructing shift schedules based on physiological criteria.

Other review papers in this symposium are dealing with problems of shift systems such as methods of compensation. Here I would like to concentrate on the occupational medicine measures.

In spite of equal stress, it is quite apparent that workers react to shiftwork in very different ways; this fact can only be explained by individual and situational differences. If such differences could be identified and shown to be of importance for adaptation to shiftwork, it would be possible to use them as criteria for selection.
A. FACTORS WHICH MAY PREDICT INCREASED LIKELIHOOD OF DEVELOPING DUODENAL ULCER

1. MALE SEX
2. BIRTH DURING LATE 19TH AND EARLY 20TH CENTURY
3. FIRST DEGREE RELATIVE WITH DUODENAL ULCER
4. PRESENCE OF GASTRIC ULCER
5. CIGARETTE SMOKING
6. CONSUMPTION OF COFFEE OR CARBONATED BEVERAGES DURING COLLEGE
7. BLOOD GROUP O
8. LACK OF SECRETION OF ABO BLOOD GROUP ANTIGENS IN SALIVA (NONSECRETORS)
9. PRESENCE OF HLA B5 ANTIGEN IN WHITE MALES
10. INHERITED HYPERPEPSINOGENEMIA
11. ALCOHOLIC CIRRHOSIS
12. CHRONIC OBSTRUCTIVE PULMONARY DISEASE
13. CHRONIC RENAL FAILURE
14. GASTRIN-SECRETING TUMOR (ZOLLINGER-ELLISON SYNDROME)
15. EXTENSIVE RESECTION OF SMALL INTESTINE
16. ANTRAL GASTRIN-CELL HYPERPLASIA
17. RETAINED ANTRUM AFTER BILLROTH II GASTRECTOMY (RECURRENT JEJUNAL ULCER)

Fig. 7a. Fig. 7. Risk factors for duodenal ulcer

1. Criteria for the selection of nightworkers. 1) Health differences as negative criteria for the selection of nightworkers. Because it is an established fact that persons with certain diseases suffer under shiftwork more than others, the following groups of persons should be excluded from shiftwork if possible (COLLIER, 1943; RUTENFRANZ, 1977):

— People with a history of digestive tract disorders. Shiftwork produces special psychophysiological problems and also involves unusual meal times; both of which may affect gastric functions (ANDERSEN, 1958; COLLIER, 1943; DERVILLÉE and LAZARINI, 1958; MENZEL, 1962; THIIS-EVENSEN, 1958);
— Diabetics and thyrotoxicosics. Regular food intake and correct therapeutic timing can be difficult to maintain under shiftwork conditions (COOK, 1954);
— Epileptics. Reduction of sleep increases the incidence of fits (COOK, 1954);
— People with severe mental derangements involving the whole personality.
**OCCUPATIONAL HEALTH MEASURES**

B. **FACTORS WITH HIGHER FREQUENCY IN PATIENTS WITH ESTABLISHED DUODENAL ULCER**

1. INCREASED CAPACITY TO SECRETE GASTRIC ACID AND PEPSIN
2. DECREASED GASTRIN RESPONSE TO FOOD
3. INCREASED GASTRIC EMPTYING OF SOLID FOOD
4. DECREASED INHIBITION OF ACID SECRETION AND GASTRIN RELEASE AT LOW INTRAGASTRIC PH
5. INCREASED GASTRIC ACID RESPONSIVENESS TO PENTAGASTRIN
6. INCREASED SERUM PEP SIN OGEN I CONCENTRATION
7. DECREASED SERUM AND RED BLOOD CELL ACETYLOCHOLINESTERASE
8. CROSSED EYE DOMINANCE
9. INCREASED ADRENERGIC STIMULATION OF GASTRIN RELEASE

C. **FACTORS WHICH MAY PREDICT DECREASED LIKELIHOOD OF DEVELOPING DUODENAL ULCER**

1. FEMALE SEX
2. BIRTH AFTER SECOND DECADE OF THE 20TH CENTURY
3. MILK CONSUMPTION IN COLLEGE
4. ATROPHIC GASTRITIS
5. ARTERIAL HYPERTENSION

*(after Wolf et al., 1979).*

Depression is particularly important here because this disease often starts with sleep disturbances, which indicate disruption of the sleep-wakefulness-cycle and other circadian rhythms (Tölle, 1981);

— All others suffering from chronic sleep disturbances (allegedly caused by e.g. traffic noise etc.),
— Patients with heart diseases exhibiting a significant reduction of physical performance capacity;
— Active and extensive tuberculosis patients;
— Alcoholics and other drug addicts;
— Persons with marked hemeralopia, or visual impairment that is too severe for effective compensation to be possible (because illumination of many parts of factories is normally reduced at night; therefore these persons may have an especially high risk of accident).
- SELECTION OF WORKERS
- REGULAR HEALTH CHECKS
- PREVENTIVE HEALTH CARE
- ADDITIONAL FREE DAYS AND OTHER COMPENSATING MECHANISMS
- PROVIDING PROPER MEALS AT NIGHT
- CONSTRUCTING SHIFT SCHEDULES BASED ON PHYSIOLOGICAL CRITERIA

Fig. 8. Special health provisions for nightworkers.

- PEOPLE WITH A HISTORY OF DIGESTIVE TRACT DISORDERS
- DIABETICS AND THYROTOXICOSICS
- EPILEPTICS
- NARCOLEPTICS
- DEPRESSIVES
- ALL OTHER PERSONS SUFFERING FROM CHRONIC SLEEP DISTURBANCES
- PATIENTS WITH HEART DISEASES
- ACTIVE AND EXTENSIVE TUBERCULOSIS PATIENTS
- ALCOHOLICS AND OTHER DRUG ADDICTS
- PERSONS WITH MARKED HEMERALOPIA

Fig. 9. "Negative" criteria for the selection of nightworkers.

- PHYSIOLOGICAL DIFFERENCES IN ADAPTABILITY OF CIRCADIAN RHYTHMS
- PERSONALITY DIFFERENCES (INTROVERTS / EXTRAVERTS; MORNING TYPES / EVENING TYPES)
- SITUATIONAL DIFFERENCES

Fig. 10. "Positive" criteria for the selection of nightworkers.
1. OCCUPATIONAL HEALTH MEASURES

2. RECRUITING MEDICAL EXAMINATION

3. SECOND MEDICAL EXAMINATION
   AT LEAST 12 MONTHS
   AFTER STARTING NIGHT WORK

3. REGULAR HEALTH CHECKS DEPENDING
   ON THE AGE OF THE WORKERS
   AT THE FOLLOWING INTERVALS:
   - AGE UNDER 25: 24 MONTHS
   - 25 - 50: 60 MONTHS
   - 50 - 60: 24 - 36 MONTHS
   - OVER 60: 12 - 24 MONTHS

Fig. 11. Health checks for nightworkers.

2) Positive criteria for the selection of nightworkers. (1) Physiological differences in adaptability of circadian rhythms. Various parameters of circadian rhythms have been discussed as possible physiological yardsticks for the prediction of adaptability to shiftwork. BREITHAUPT et al. (1978) used the circadian phase position and concluded that in evening types (as defined by OESTBERG, 1973), the normal maximum and minimum body temperature appear later than in morning types. Evening types also show fewer sleeping problems and better adjustment to shiftwork than morning types.

REINBERG et al. (1978, 1979) used the circadian rhythm amplitude as a measure of individual capacity to adjust to shiftwork. They combined the observations of ASCHOFF (1978), that subjects with a greater amplitude of circadian rhythms will adapt to time changes more slowly, with those of ANDLAUER (1971), that subjects with a greater amplitude tolerate nightwork better. REINBERG et al. (1978, 1979) concluded from these observations and their own experience, that in general it would be better to use wifly rotating systems, instead they found that a smaller amplitude of body temperature on normal days increased the probability of a quicker adaptation of this circadian rhythm to shiftwork but will not occur in a reasonable time.

(2) Personality differences. Individual differences in adaptation to shiftwork have, over the past few years, repeatedly been linked with differences in personality structure. Most of the studies in which this link is alleged take the time needed for the re-entrainment of physiological functions—usually body temperature—as a measure of the capacity to adapt to shiftwork. Thus, BLAKE (1971) found “small but significant differences in certain aspects of the mean body temperature rhythms of introverts and extraverts.” Later COLQUHOUN and FOLKARD (1978) were able to show that “neurotic extraverts exhibited the greatest degree of adjustment” as far as the trend of body temperature during night shift was concerned. OESTBERG (1973), on the basis of preferences for, and habits of, activity,
made the distinction between "morningness" and "eveningness," and stated that "the morning type of subject had the most pronounced difficulty in adapting to night work." PÁTKAI (1971) found "a significant relationship between morningness and introversion and eveningness and extraversion" so that it is probable that both factors have a common basis. The observations of FOLKARD (1975) about rhythms of subjective alertness relating to extraversion or introversion must be interpreted in the same sense. NACHREINER (1975) used the personality variables identified in these studies in order to classify attitudes towards shiftwork among groups of shiftworkers. He found that "if a shiftworker is rather introverted and tends to be emotionally unstable, the probability that he feels uncomfortable with shiftwork and would like to get out of it is fairly high."

(3) Situational differences. Living conditions are of special importance for adaptability to shiftwork. As we (KNAUTH and RUTENFRANZ, 1972b; KNAUTH et al., 1975; RUTENFRANZ et al., 1974) have shown, approximately 60–80% of shiftworkers complain of sleep disturbance by noise on the day after the night shift, the most frequent sources of noise mentioned being traffic and children. Both these kinds of noise have been shown to disrupt sleep (GRIEFAHN et al., 1976; KNAUTH and RUTENFRANZ, 1972a, 1975; WILLIAMS, 1973). It is therefore hardly surprising that people with unfavorable living conditions, especially those with badly insulated bedrooms, near roads carrying a lot of traffic, and with small children in the family, should complain more often about lowering of well-being and about health than people in more favorable living conditions (KÜPPER et al., 1980). The value of living conditions as a predictor of good or bad adaptability to nightwork so far has only been investigated by ANGERSBACH et al. (1980) in a retrospective cohort study; prospective cohort studies are also needed here.

A situational factor which has hardly been investigated so far is the family's acceptance of shiftwork. If nightwork is not accepted by the members of the family, it cannot be expected that the worker himself can adapt to nightwork conditions without at least some effect on his well-being.

3) Open questions. The facts presented here are all based on cross-sectional studies and have not been used, so far, to make any predictions about the capacity to adapt to nightwork. FOLKARD et al. (1979) have recently developed a predictive test of adjustment to shiftwork which is based on the hypotheses referred to above and NACHREINER (1975) has formulated a test of attitude to shiftwork using these hypotheses. Validation of these tests, however, will only be possible by projective cohort studies. Such studies still have to be carried out.

Since none of the aforementioned positive criteria of the capacity to adapt have been validated so far in prospective studies, they are of rather limited value for the occupational health practitioner for the selection of nightworkers. Nevertheless they are of great importance for shiftwork research.

The negative criteria for the selection of nightworkers have also not yet been
validated by prospective epidemiological studies; however, they are based on the experience of occupational medicine practitioners in fairly well controlled case-studies (LOSKANT, 1970; AANONSEN, 1964). These show that the selection of nightworkers by using such negative criteria leads to a reduction in the number of nightworkers complaining about lowering of well-being, and in the incidence of job-related proper diseases.

2. Regular health checks. According to TAYLOR (1968), standard medical examinations before starting work have only limited predictive value for sickness-absence. LOSKANT and KNAUTH (1976) have therefore proposed that shiftworkers should be subjected to a second health examination not later than one year after starting shiftwork, in order to assess their degree of adaptation to it. A special German study group including experienced occupational health practitioners as well as scientific experts in the fields of circadian rhythms and shiftwork research proposed the following procedures (HERMANN et al., in prep.):

- all persons working 6 hr on a regular shift system or at least 5 hr on an irregular shift system, during the hours from 22.00 to 6.00 should have regular health checks;
- the recruiting medical examination should exclude all persons from nightwork using the above mentioned negative health criteria;
- there should be a second health check at the latest 12 months after starting nightwork, and regular health checks depending on the age of the worker at the following intervals:
  - aged under 25: 24 months
  - 25–50: 60 months
  - 50–60: 24–36 months
  - over 60: 12–24 months.

The regular health checks may use the same negative criteria used at the first medical examination but may disregard temporary changes of health status or living conditions.

3. Preventive health measures. Preventive health measures may include the possibility of giving the shiftworker a chance to live under normal conditions with respect to circadian rhythms. Certain large German plants have recently begun to offer regular preventive treatment of this kind for shiftworkers over 50 years old in specialized hospitals (Kurkliniken) for 2 to 3 weeks at two or three-year intervals. This treatment provides the worker with a chance to normalize his circadian rhythms by following a regular sleep-wakeup routine with proper meal-times. Additionally, physiotherapeutic measures and a general health check are offered. Because they have only been given for the last two years, the effect of such treatments have not yet been proved.

4. Additional free days for nightworkers. As a result of labor disputes in recent years in many branches of industry, shiftworkers, especially those following “continuous” shiftwork systems, were awarded additional free days. The medical
support for this lies in the fact that the workers now have more "normal" days to allow the circadian system to renew. However, the efficiency of these extra rest days for health has not yet been demonstrated epidemiologically.

5. **Meals during night shifts.** Since gastrointestinal complaints are very common in shiftworkers, social backing for the provision of regular meals at night seems to be reasonable. Deby and Bleyer (1972) were able to show that the disturbances of appetite did not lead to a lessening of calorie intake; the disturbances of appetite have more to do with the dislike of having to eat at unusual times or with food that is often cold or which has to be taken outside the accustomed social environment. To offer a hot meal, that can be eaten in a near normal social situation, not later than 1 a.m. seems to be a health measure (Hohmann-Beck, 1981), which is not yet used very often even in big plants.

6. **Sleeping allowances during night shifts.** Since reduction of sleeping time and sleep quality are the main complaints of nightworkers, any measure that will improve their sleep is obviously important. Since, because of modern conditions, work consists more and more of observing machinery rather than controlling it. It might be better to allow legalized short naps at work rather than forcing people to fight for hours to avoid falling asleep. As Kogi (1981) showed, many plants in Japan have such more or less legalized sleeping allowances during night work. Andlauer et al. (1982) proposed such legalized sleeping hours for all industries where public safety is at stake.

7. **Reduction of nightwork and construction of shift schedules based on physiological criteria as health measures for nightworkers.** There are many reasons for the existence of shiftwork (technological, economical and social), so that it is unreasonable to propose its total abolition. However, nightwork in particular should be reduced to the lowest possible level. In our experience shiftwork is very often organized in such a way that day and night shifts are equally manned, because in constructing shift systems the simplest solution is to have the same number of workers on each shift. But this often leads to the situation where work must be found for night shiftworkers which could readily be done either in the morning shift or in the afternoon shift.

One of the duties of the occupational health doctor therefore should be to encourage management, trade unions and workers to offer suggestions for reducing the amount of nightwork in their particular industry, which, in consequence, would reduce the frequency of night shifts for the individual worker.

To us, this appears to be a potentially important health measure for nightworkers, but it may not always be accepted at first, because it may result in a reduction of the special night shift allowance. In the long term, however, such measures will be of great benefit for the health of workers and for their social life.

The responsibility for the construction of shift schedules should not be restricted only to trade unions, management and workers. We have demonstrated (Knauth et al., 1979) how the introduction of physiological criteria for the con-
striction of shift schedules could be used as a health measure for shiftworkers.

CONCLUSIONS

To sum up, occupational health measures for night- and shiftworkers should include all the appropriate actions required to reduce the complaints of the workers, in order to prevent lowering of well-being, and the occurrence of job-related diseases. Such measures should not be restricted only to those used in normal occupational health practice, but should also encompass activities outside the workplace such as pressing for the amelioration of housing conditions, and advising workers on the organization of their social life in relation to shift systems based on physiological criteria.

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