



Original article

Scand J Work Environ Health [1998;24\(3\):151-155](#)

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The following article refers to this text: [2012;38\(3\):218-227](#)

Key terms: [counseling](#); [night work](#); [occupational health services](#); [shift work](#)

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/9916833



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Guidelines for the medical surveillance of shift workers

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Costa G. Guidelines for the medical surveillance of shift workers. *Scand J Work Environ Health* 1998;24 suppl 3:151—155.

Occupational health physicians should evaluate workers' fitness for shift and night work before their assignment, at regular intervals, and in cases of health problems connected with night work. The evaluation should be accompanied by a careful job analysis to ensure that shift schedules are arranged according to ergonomic criteria. This arrangement can reduce health problems and make coping with irregular workhours possible, even for people suffering from contraindicative illnesses. Both health disorders representing absolute or relative contraindication and actual work conditions should be taken into account. Health checks should be aimed at detecting early signs of intolerance, such as sleeping and digestive trouble, drug consumption, accidents, and reproductive function. Their periodicity should be set in relation to specific work conditions, individual characteristics, and social factors known to influence tolerance to shift work. Shift workers should receive clear information on the possible negative effect of shift work, and also counseling for coping with shift and night work.

Key terms counseling, night work, occupational health service, shift work.

The usefulness and necessity of preventive and periodic health assessments of shift and night workers have been stressed by many international directives and recommendations, as well as by national laws and regulations.

In particular, both convention no 171 of the International Labour Organisation (ILO) concerning night work (1) and European directive no 93/104/EC, *Concerning Certain Aspects of the Organization of Working Time* (2), state that workers should have appropriate safety and health protection, in particular the right to undergo free health assessment before their assignment to night work, and thereafter a free health examination at regular intervals and also if they experience health problems because of their night work. Moreover, night workers suffering from health problems recognized as being connected with night work should be transferred, whenever possible, to day work for which they are fit. Furthermore, employers and workers' representatives should be able to consult occupational health personnel about the consequences of various forms of night work.

In fact, shift work, in particular that including night work, is a well documented risk factor for health and well-being, as it interferes with biological functions and social life due to a mismatch between the person's circadian rhythm and environmental synchronizers. This

mismatch can have a negative influence on work performance (errors and accidents), social relations (difficulties in marital relations, care of children and social contacts) and health (mainly with respect to sleep disorders, chronic fatigue, neuropsychological problems, digestive and cardiovascular diseases, and women's reproductive function) (3—5).

Preventive and compensative measures

Occupational health physicians have the duty to protect workers' health from occupational stress factors, and they also have the responsibility of defining people as "fit" or "unfit" for shift or night work, with consequent implications on both individual life and work organization.

Therefore, the evaluation of a worker's fitness for shift and night work should be strictly connected with a careful job analysis of work organization, in particular shift systems. In fact, it appears unreasonable, and also uneconomic, to define a plan for the medical surveillance of people obliged to work in unfavorable shift systems or to declare a person "unfit" for "bad" shift systems.

On the other hand, it must be stressed that shift work cannot be a discriminating criterion for worker selection.

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Instead the primary requisite is to arrange shift schedules according to ergonomic principles and to assure suitable compensative measures for shift and night workers to avoid significant perturbations in circadian rhythm, performance decrement, accumulation of sleep deficit, and marked interference with family and social life so that almost everyone can cope with shift work without impairment to health.

Consequently, occupational health physicians should strongly advise both employers and employees to consider and implement of the best possible shift schedules according to the general recommendations given in recent years. These recommendations particularly refer to the adoption of quickly rotating shift systems with clockwise rotation (morning → afternoon → night), the reduction of night shifts in succession to the minimum, delayed starting hours of morning shifts (at 0700 or 0800), flexible worktime arrangements with some free weekends, and length of the shifts connected with work load and environmental pollution (6).

However, it should be kept in mind that there is no best shift system suitable for all workplaces; instead each shift system should be tailored according to the specific work and social conditions of the work force involved. This arrangement implies, on one hand, a precise examination and evaluation of job demands and characteristics and, on the other, a careful strategy for modifying shift schedules that requires the participation of the workers in the analysis, design, implementation and assessment of the shift system chosen (7). This is not only a basic condition of democratic participation of the persons who must bear the consequences of the decisions, but it is also the only way of properly motivating them to accept the changes and therefore the only way to develop higher tolerance to unusual workhours.

In fact, from the individual point of view, changes in worktime arrangements often clash with living habits, in particular with domestic (meal and sleep times, housework, relationships with other members) and social (leisure-time activities, involvement in social groups, commuting times, etc) life (8).

Moreover, according to chronobiological and physiological principles, "ergonomic" shift schedules certainly have less negative effects on health and well-being and thus reduce medical problems and needs for control or intervention. Such schedules can make coping with irregular workhours possible even for people suffering from illnesses that may be, in principle, contraindicative for shift and night work.

In addition to the organization of shift schedules, other useful countermeasures that have proved beneficial for tolerance to shift work should be supported by occupational health physicians.

According to Thierry (9) intervention that is apt to compensate for the inconveniences of shift and night

work can be represented by "counterweights" and "counter values". The first forms of compensation are only aimed at providing a reward for the troubles caused. One good example is monetary compensation, which is a simple translation of the multidimensional aspects of the problem into money. Its value varies according to several factors, some of which may not be strictly related to the seriousness of the inconvenience (eg, union power, economic conditions, productive needs). Another counterweight is, for example, intervention aimed at improving general work conditions (work environment, job enrichment). The second forms of intervention are aimed at reducing or eliminating the inconveniences. They can be directed towards both the causes and the consequences, such as the reduction of workhours, the restriction of night shifts, more compensative rest days or extra time off, additional pauses for meals and naps, sleep and canteen facilities, social support (eg, day nursery, transportation, extended school and shop hours), physical and psychological training, transfer to day work after a certain number of years, early retirement, counseling, and health surveillance (10). Obviously, the second types of intervention should be preferred and adopted according to the particular conditions and characteristics of the work groups.

Criteria for medical surveillance

Occupational health physicians should evaluate workers' fitness for shift and night work before the workers are assigned to shift work, and also at regular intervals thereafter. They should also make such evaluation in cases of health problems connected with night work.

On the basis of earlier proposals (11—15), derived from epidemiologic studies concerning the possible short- and long-term effects of shift and night work and the related physiopathological pathways, it appears reasonable to consider exemption from night work for people suffering from severe disorders and diseases that can be either directly connected to or worsened by irregular workhours; of particular concern are (i) chronic sleep disturbances, as they are the main consequence of disrupted sleep-wake cycles; (ii) severe gastrointestinal diseases such as chronic gastritis and peptic ulcer (as their prevalence among shift and night workers is 2 to 6 times higher), as well as chronic active hepatitis, cirrhosis and chronic pancreatitis, due to the necessity of proper diet and life regimen; (iii) ischemic heart disease (eg, myocardial infarction up to 12 months after the event or with impaired heart function, angina pectoris), hyperkinetic syndromes and severe hypertension, both for the direct negative influence of the disruption of hormonal, neurovegetative and biochemical homeostasis and for the "indirect" effect connected with more stressful work and

living conditions; (iv) insulin-dependent diabetes, as regular and proper food intake and correct therapeutic timing is needed; (v) severe thyroid (thyrotoxicosis and thyroidectomy) and suprarenal pathologies, since they require regular drug consumption strictly connected with the activity-rest cycles; (vi) epilepsy requiring medication, as the seizures can be favored by sleep deficit and the efficacy of the treatment can be hampered by irregular wake-rest schedules; (vii) brain injuries with sequelae and severe nervous disorders, in particular chronic anxiety and depression, as they are often associated with a disruption of the sleep-wakefulness cycle and can be influenced by light-dark periods; (viii) spasmophilia, as temporal changes can be a promoting factor of tetanic crisis; (ix) chronic renal impairment, as the disruption of circadian rhythms can further impair renal function; (x) malignant tumors, to avoid further stress and facilitate medical treatment; and (xi) pregnancy, because of the possible increased risk of abortion or abnormal fetal development.

Moreover, particular attention should also be paid to specific work groups or conditions since shift and night work may represent a possible risk factor under certain circumstances, in particular (i) for women with menstrual disorders, or who have small children, as they suffer from shorter sleep duration and poor sleep quality; (ii) for workers exposed to toxic substances, as a desynchronization between times of exposure and the circadian rhythm of metabolic functions can make them more vulnerable to xenobiotics (16); (iii) for people with mild digestive disorders (eg, gastroduodenitis and colitis) as the disorders can be chronicized and aggravated; (iv) for persons suffering from asthma and chronic obstructive bronchitis, as crises are influenced by circadian fluctuations of cortisol levels and bronchial patency; (v) for people with a high intake of alcohol or other drugs affecting the central nervous system (eg, benzodiazepines), for their negative influence on vigilance and performance efficiency; (vi) for persons afflicted by marked hemeralopia or visual impairment, which can make night work difficult or dangerous in cases of reduced illumination; and (vii) for people with unsatisfactory housing conditions (particularly as concerns noise in bedrooms) and with long commuting times, as they can suffer sleep deprivation and chronic fatigue. All these conditions may represent, in principle, absolute or relative contraindications to night and shift work and thus require a temporary or permanent transfer or assignment to day work, and physicians should point out the contradictions to the worker and the employer. However, occupational health physicians should evaluate each case very carefully in light of actual work situations, the perspectives of the worker, and the specific health conditions of the worker.

Nevertheless, it cannot be directly assumed that the sole removal of such risk factors can be certainly or

totally beneficial to a worker's health. In fact, most of the health disorders reported by shift workers pertain to the psychosomatic domain and often have a multifactorial origin related to family heritage, life-styles, general social conditions, other occupational risks, and intervening illnesses. In this context, shift work may represent an additional stress factor due to both conflicts between endogenous rhythms and external synchronizers and to greater interference and difficulties in family and social life.

Consequently, maladaptation and intolerance to shift work are the result of sometimes complex interactions. In fact, they can act differently on shift workers, both in terms of severity and appearance in the course of work-life and according to the specific personal and social situations (16).

Therefore, it is possible that, for some persons, positive results can be obtained more through intervention with shift schedules and compensative measures than with simple transfer to day work.

Moreover, advances in clinical diagnosis, pharmacology and rehabilitation now offer better possibilities for treating some illnesses (eg, peptic ulcer, some forms of insulin-dependent diabetes, hypertension and myocardial infarction) and, therefore, may permit workers to continue in shift work when a transfer to day work is problematic, due either to other risk factors or to personal resistance to job change.

The situation as a whole must be evaluated very carefully by occupational health physicians, who, on the other hand, also have to remember that sometimes shift workers do not completely report their health problems as considered "part of the job", or they even mask them since they are more afraid of losing the economic benefits connected with shift and night work.

Factors influencing tolerance to shift and night work

Occupational health physicians should also pay particular attention to individual factors dealing with physiological functions, personality traits, and behavioral characteristics that may influence adaptation and tolerance to shift work (17).

Aging can favor progressive intolerance, as it is generally associated with an instability of circadian rhythms, sleep disturbances, depression, and a decline in physical fitness and health. On the other hand, young people can find it difficult to adapt to night work either because they are more sensitive to acute sleep loss or because it hampers the possibility of participating in and integrating to social groups.

Women can be more vulnerable to shift and night work because of their more complex circadian and

infradian hormonal rhythms connected with reproductive function and the extra demands related to family life and domestic commitments. Perturbation of the menstrual cycle, more sleep problems, cumulative fatigue, and negative effects on pregnancy (lower rates, higher frequency of miscarriages, preterm deliveries, and child's low birthweight), have been recorded for some groups of female shift workers (18).

People with higher levels of neuroticism, rigid sleep habits or difficulty to overcome drowsiness have also been reported to have more difficulties in adapting to irregular work schedules, as do persons who show a less stable circadian structure and proneness to internal desynchronization (19). Moreover, the characteristics of "morningness", based on advanced phases of circadian rhythms and the sleep-activity cycle, generally induce more difficulties with short-term adjustment to night work, whereas "evening" types may have more trouble on early morning shifts.

On the other hand, good physical fitness can favor tolerance to shift work, as it can increase performance efficiency, lessen fatigue, and improve sleep and recovery mechanisms (20). Another important factor in this sense is "commitment to shift work", as in cases of workers willing and able to schedule their daily activities, in particular their sleep habits, according to irregular workhours. It is desirable that such factors or characteristics be considered not only in the evaluations of negative effects, but also in the positive sense, both in respect to the primary assignment (when possible) to night work for those expected to be more adaptable and to combining shift scheduling with individual preferences deriving from both the psychophysiological characteristics and living conditions of workers (eg, morning types and elderly people can cope better with morning shifts). However, occupational health physicians must proceed carefully in order to avoid a risky attitude towards a-critical selection that would reduce workers' possibility or probability of finding a job (a situation that could be more dangerous for their health and well-being).

In fact, it is not yet completely clear to what extent personal characteristics influence long-term tolerance to night work and, consequently, can be used as possible predictors of such tolerance. Many other factors can also play a prominent role in long-term tolerance, in particular a worker's family situation (eg, number and age of children, housing, partner's job) and social conditions (eg, socioeconomic level, community support and services, the labor market, moonlighting), in addition to the specific job demands and the organization of workhours. Such factors can explain the high interindividual variability in tolerance to shift work that has been found in epidemiologic investigations.

Of course, some factors are difficult or impossible to modify (eg, age, personality traits, family), while others

can be more easily changed to provide for better coping with shift work (eg, shift schedules or some personal lifestyle factors).

Problems connected with the short-term adjustment of circadian rhythms, including sleep, are presumably the main causes of intolerance to night work in the first 1 or 2 years of shift work, whereas long-term intolerance is more related to other personal, work and social factors. Both factors influence the process of self-selection that occurs among these workers and, due to the "healthy worker effect", sometimes masks the results of epidemiologic inquiries.

Periodic health checks and counseling

Regular health checks are also important tools aimed at protecting shift workers' health. They should be a part of periodic evaluations of fitness to work that occupational physicians have to plan in relation to different risk factors. They should be aimed at detecting early signs or symptoms of difficulty in adjustment and, consequently, intolerance to night work, which may require prompt intervention both with the organization of the workhours and with individual factors (eg, correcting or improving coping or temporary or permanent transfer to day work). Therefore, they should focus primarily on sleep times and troubles, eating and digestive problems, psychosomatic complaints, accidents, reproductive function of women, drug consumption, housing conditions, commuting problems, work loads, and leisure-time activities.

Health checks should be carried out preferably using standardized questionnaires or checklists that make possible a comparison of a worker's health with later health status and with the health of reference groups of day workers. Sleep logs, diaries of daily activities, and recordings of circadian rhythms of some physiological parameters (eg, body temperature, cortisol level, melatonin level, performance) can also be helpfully used in evaluating the level of a worker's adaptation. In cases of exposure to toxic substances, biological monitoring should also take into account both the timing of exposure and time-qualified reference values (19).

The periodicity of health checks should not be set a priori; instead it should be established in relation to several factors concerning work conditions (eg, shift rota, environmental conditions, combined risk factors, compensative measures) and individual characteristics (eg, age, health, personal characteristics).

According to some proposals (12, 14, 15), the following general scheme appears advisable: a second health check not later than 1 year after the start of night work (as the 1st year is crucial for adaptation and coping), and successive health checks every 3—5 years for those

under 45 years of age and every 2—3 years for those over 45 years of age.

Further clinical controls should be carried out whenever the workers complain of problems or disorders in relation to shift and night work or they suffer from other intervening illnesses that can hamper tolerance and work capacity. In such cases, as well in cases of severe difficulties in family or social life, temporary exemption from night work should be considered.

Moreover, fitness for shift work should be reevaluated when important changes in work activity occur, in particular when physical work load, chemical pollution and high mental strain changes. Furthermore, long-term medical surveillance should be arranged for people who quit nightwork for health reasons, as they may have a higher prevalence of sleep, gastrointestinal or cardiovascular disorders several years after the cessation of shift work.

Last but not least, it is necessary that shift workers be aware of the possible negative consequences of shift work and given useful information, suggestions, and guidelines on how to cope with shift and night work. Counseling and training should be done at the individual (before assignment to shift work and during periodic health controls) and the group (through educational programs) level (21, 22). They should deal with improving self-care strategies for coping, in particular for sleep (eg, tight scheduling of sleep hours, use of naps, arrangements to avoid disturbances, abuse of sleeping pills or caffeinated drinks), diet (eg, meal times, pauses, food quality, snacks, alcohol), stress management (eg, relaxation techniques), physical fitness (eg, regular exercise, smoking), leisure-time activities, and exposure to bright light (23—26).

Most useful solutions or coping strategies can be learned by shift workers through their own direct experience, and they should be advised and supported also from the scientific point of view in maintaining, extending, and adjusting their solutions and coping strategies to their specific problems and conditions.

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