

New work times are here — are we ready?

The rapid changes taking place in current worklife has increased the diversity and amount of irregular workhours. In developed countries like Finland, the current prevalence of worktime models other than regular day work is about 25% (1). At the same time, the average number of weekly workhours and overtime has increased in many sectors. Although night and shift work has been acknowledged as an occupational health and safety problem since the prohibiting of women's night work (contemporary) in many European countries after the International Congress in Bern in 1906, the most recent trends in extended and irregular workhours have given birth to new concerns.

The new concerns are basically due to the extension of operating and service hours leading to more night and shift work. The factors behind the current change in worktimes are related to increased globalization, competition, and fluctuations in demand, all of which force firms to organize workhours more efficiently. The use of new technology and changes in the economy and the labor market have speeded up the process. Workers, on the other hand, give more value to longer vacations nowadays, favoring worktimes which promote the use of leisure time. As a result, the 8-hour workday has almost been relegated to history, together with traditional rigid shift systems. We are facing more complex and diversified worktime models that balance between the needs of the company and the needs of the workers. Whether the change taking place in work organization will result in healthy and safe work schedules should be questioned.

Together with the increase in night and shift work, simultaneous trends towards longer workhours in new expert groups of workers are appearing for public and private organizations. The process is related to the differentiation of the labor market with the formation of such new groups as highly educated experts, consultants, and project leaders — and, on the other hand, a marginalized sector of the population that is partly or permanently unemployed (2). In a recent survey representing evenly the entire working-age population of Finland, 24% of the sample population worked 50 hours a week or more (3). The top was probably achieved in Japan in 1989, when the weekly worktime of 24% of all the workers exceeded 60 hours — without regard for the time needed for the commute to and from work. This was also the time when *karoshi*, sudden cardiovascular death related to extensive overwork, became public knowledge. Current worklife presupposes high commitment, which, together with the increased pace and flow of work, creates pressure for high performance and, as a consequence, longer workhours. The use of portable computers and mobile phones has also given more options for working practically anywhere at any time.

New worktimes are here. But are we ready? How much do we really know about the health and safety effects of shift work and the effects of new worktime models on psychosocial health and well-being? Have society, firms, and employers acknowledged the possible health and safety hazards? Do we have feasible countermeasures to decrease the problems of unsocial and irregular worktimes?

"New Challenges for the Organization of Night and Shift Work" was the theme of the 13th International Symposium on Night and Shift Work, where these and other topical questions were debated. The Symposium was held in Finland in June 1997, and it was organized by the Finnish Institute of Occupational Health, under the auspices of the Scientific Committee on

Night and Shift Work, International Commission on Occupational Health. The present supplement of the *Scandinavian Journal of Work, Environment & Health* is a selection of peer-reviewed original contributions and invited papers presented at the Symposium. Since the scientific questions related to the worktime issues are a fascinating mixture of basic and applied, human and economic sciences, the supplement also follows an interdisciplinary line extending from laboratory studies to epidemiology and from chronobiology to sociology. Only the combination of different disciplines and views renders a comprehensive approach to the complex questions of irregular worktimes possible.

At least the basic mechanism for disturbed sleep and wakefulness during shift work is clear. The rigid endogenous circadian system of the body cannot adjust to the changing rhythm of rotating work. Since the human circadian clock, *suprachiasmatic nuclei*, are regulated by the environmental light-dark cycle, neither is it possible nor comfortable to adjust to permanent night shifts – inside society. Thus 40–50% of night and shift workers continuously complain of insomnia or insufficient sleep (4) and, what is even more important, most shift workers are severely sleepy during night and early morning shifts.

The occurrence of fatigue during night shifts is not surprising, but it is amazing how little attention society, business, and organizations have paid to it. Would we accept a bus or a train driver, or a nuclear power operator, responsible for the life of tens of thousands of people, to work in a drunken state every night? In a paper presented at the Helsinki Symposium, and published later in *Nature* (5), it was shown that, at the very end of the night shift, sleepiness responds to the effect of moderate alcohol consumption (1.0‰) for psychomotor performance. It should be remembered that this does not concern only a few “exceptional cases”; as a rule, every shift worker gets as sleepy at the end of a night shift if his or her circadian trough (occurring in the early morning hours) and a long time after wake-up (24 hours, as at the end of the first night shift if no naps have been taken before the shift) take place at the same time.

In light of this fact, it is not surprising that there is now much investigative evidence showing that fatigue due to night work increases incidents and accidents in industrial operations and nuclear power plants and that it contributes to virtually all modes of transportation disasters, including rail, marine, aviation, and motor accidents (6). In this issue, Hänecke et al (pages 41–46) analyzed 1.2 million accidents in the German manufacturing industry. An exponentially increasing accident risk was found beyond the 9th hour at work, the effect of which was accentuated in shifts with later starting times. In the United States, the total costs of fatigue-related accidents and loss of performance was estimated to be some 40 billion US dollars (7). In Finland, the total costs of sleep deprivation and sleep disorders to society were estimated to be about 5 billion Finnish marks in 1997 (8).

Irregular workhours may also be related to occupational health hazards other than fatigue and accidents — but the effects on chronic health are less well known. Earlier epidemiologic studies, done 20–50 years ago, linked night and shift work only to gastrointestinal diseases and symptoms. However, the “exposure” — total weekly worktime, shift systems, psychosocial factors — and the understanding of the pathophysiology of gastric disease have changed greatly since then, and whether current worktimes also induce similar risk for gastrointestinal diseases is not known. More epidemiologic research has focused recently on the relationship of shift work to coronary heart disease (CHD), and the best prospective studies indicate that the risk estimate for shift work is about 1.5 when compared with day work. Even if the relative risk is not high, the high prevalence of shift work itself (20% in this calculation) yields a population etiologic fraction of 7% and makes shift work one of the major work environmental factors related to cardiovascular disease (9).

The different mechanisms by which shift work could cause chronic diseases should be clarified. Whether the mechanisms are related to the circadian disturbance of specific gastrointestinal or hormonal functions, sleep deprivation, or some other factors would help to launch new practical research projects and to plan recommendations for optimal shift characteristics. For example, permanent night

work seems to induce more sleep deprivation but less circadian disturbance than rapidly rotating shift schedules do. With peptic ulcer, some of the accelerating or effect-modifying factors of night work are related to the marked decrease in gastrointestinal motility and digestive enzyme secretion during the night shift (10). Peptic ulcer may also be aggravated by factors like altered sleep patterns, changes in adrenal secretory patterns, and changes in eating habits. The mechanisms for the increased risk of CHD are still open, but perhaps one of the most promising theories is related to the well-known decrease in fibrinolysis during the early morning hours. Recently, a serum lipid-modulating drug called gemfibrozil, which may also enhance fibrinolysis by the direct diminution of endogenous PAI-1 synthesis, was indirectly shown to decrease the CHD risk of shift workers more than that of day workers, although there were no baseline differences in serum lipids between the groups (11). Another mechanism for the increased risk of CHD in shift work could be related to the observed changes in postprandial glucose and lipid metabolism after a simulated workshift (12).

There is also growing evidence that shift work affects reproductive health, for example, in the form of an increased risk for spontaneous abortion (Nurminen, this issue, pages 26—32). Whether shift work increases breast cancer risk should also be studied. Significant excesses of breast cancer have been shown for at least some shift working populations, for example, nurses and airline cabin attendants (13). It is well known that both bright room light (during night shifts) and bright environmental light (during days) have a major impact on the melatonin secretion of night workers. On the other hand, melatonin has been shown to induce a constant production of prolactin and estrogen, the total lifetime exposure of which (bioavailable estrogens) is related to the risk of breast cancer (13).

There thus seems to be no lack of relevant research issues related to the health and safety aspects of unsocial and irregular worktimes. Since it is clear that we are facing a major occupational health and safety problem, research should also be focused on the possibilities to prevent the observed difficulties. It is well known that many characteristics of shift schedules (like the speed and direction of rotation, the length of shifts, timing of days off) greatly influence the fatigue, performance, and well-being of workers. The significance of these shift system characteristics, the possible existence of other, unknown characteristics, and the interactions of the factors concerning health and safety are still unknown to a great extent.

In Europe, the application of the new *Directive of Working Time* (93/104/EC) has enhanced possibilities for local agreements on worktimes and has thus made the growth of different shift systems possible. The increase of new, occasionally hazardous shift systems creates a need for scientific evaluation and follow-up with respect to the effects on health, safety, performance, well-being and productivity. A major effort is currently being made to study the effects of long workshifts and compressed workhours, as indicated also by six new studies in this issue. Since intervention studies in firms are difficult to conduct, many answers still have to wait. Some other practical questions, like the suggested long-term advantages of 6-hour and part-time systems on the health and work ability of aging workers, are also still waiting for answers.

From the employees' point of view, the advantages of the new worktime models on leisure time and psychosocial factors are often the most important, while the employer is most interested in increasing production by extending operating hours or in adjusting production to fluctuations in demand by adding flexibility to worktime. Since the effect of a new worktime model on psychosocial factors is often critical for the approval of the system, scientific research on the social dimensions of the worktime models is necessary. As reviewed by Nachreiner in this issue (pages 33—40), the existing literature on the individual and social determinants of shiftwork tolerance is still surprisingly inconclusive due to deficiencies in study designs, concepts, the psychomotoric properties of measuring instruments, and even problems with statistical treatment. In that respect, the quality of the scientific literature should be improved by increasing the critical evaluation and review of new studies, their design and methods.

We will never be rid of unsocial and irregular workhours. To improve the situation, new guidelines for the medical surveillance of shift workers have to be developed (Costa, in this issue, pages 151—155), and new information on practical countermeasures for night and shift workers are needed. These countermeasures include factors such as the use of optimal sleeping strategies (Åkerstedt, in this issue, pages 16—25), the use of bright light to synchronize shift workers' circadian rhythms (Foret et al, in this issue, pages 115—120) and napping. The use of short naps during breaks in night shifts seems to decrease fatigue and attention lapses at work, as shown recently for process operators in a paper presented in the Helsinki Symposium (14). In fact, planned napping during work breaks seems to be one of the most promising but also most challenging countermeasures with which to reduce sleepiness on night shifts. There are still many prejudices against "sleeping while at work", but they should be considered in light of the present alternative of workers falling asleep unintentionally, as shown by some on-site studies.

In conclusion, unsocial and irregular workhours seem to be a rapidly growing occupational health and safety risk that is closely bound to employee performance and production, but also to private and public safety. New research on the chronic health effects and their mechanisms, work scheduling questions, and countermeasures to alleviate the observed problems is urgently needed. Combined with the general trends of late leisure-time activities, both at home and outdoors, there are some serious concerns that society as a whole is becoming sleep deprived.

References

1. Kauppinen T, Aaltonen M, Lehtinen S, Lindström K, Näyhä S, et al, editors. Työ ja terveys Suomessa [Work and health in Finland]. Helsinki: Finnish Institute of Occupational Health, 1997. English summary.
2. Johansson AL. Introductory remarks on social responsibility and the future of the labor market. *Scand J Work Environ Health* 1997;23 suppl 4:7—9.
3. Kalimo R, Toppila S. Työuupumus Suomen työikäisellä väestöllä [Burn-out among the Finnish work-aged population]. Helsinki: Finnish Institute of Occupational Health, 1997.
4. Härmä M, Tenkanen L, Sjöblom T, Alikoski T, Heinsalmi P. Combined effects of shift work and life-style on the prevalence of insomnia, sleep deprivation and daytime sleepiness. *Scand J Work Environ Health* 1998;24:300—307.
5. Dawson D, Reid K. Fatigue, alcohol and performance impairment. *Nature* 1997;388:235.
6. Dinges D. An overview of sleepiness and accidents. *J Sleep Res* 1995;4 suppl:4—14.
7. Leger D. The cost of sleep-related accidents: a report for the National Commission on Sleep Disorders Research. *Sleep* 1994;17:84—93.
8. Hyypä M, Kronholm E. Unettomuus ja univaje tulevat kalliiksi [Insomnia and sleep deprivation are expensive]. *Sosiaalivakuutus* 1997;1:34—7.
9. Åkerstedt T, Knutsson A. Cardiovascular disease and shift work. *Scand J Work Environ Health* 1997;23:241—2.
10. Vener K, Szabo S, Moore J. The effect of shift work on gastrointestinal (GI) function: a review. *Chronobiologia* 1989;16:421—39.
11. Tenkanen L, Sjöblom T, Kalimo R, Alikoski T, Härmä M. Shift work, occupation and coronary heart disease over 6 years of follow-up in the Helsinki Heart Study. *Scand J Work Environ Health* 1997;23:257—65.
12. Hampton S, Morgan L, Lawrence N, Anastasiadou T, Norris F, Deacon S, Ribeiro D, Arendt J. Postprandial hormone and metabolic responses in simulated shift work. *J Endocrinol* 1996;151(2):259—67.
13. Welp EA, Weiderpass E, Boffetta P, Vainio H, Vasama-Neuvonen K, Petralia S, Partanen TJ. Environmental risk factors of breast cancer. *Scand J Environ Health* 1998;24(1):3—7.
14. Sallinen M, Härmä M, Åkerstedt T, Rosa R, Lillqvist O. Promoting alertness with a short nap during a night shift. *J Sleep Res*. In press.

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