



# best

1|2000

*EUROPEAN STUDIES ON TIME*

## Shiftwork and Health

Chapter 1 Introduction p1 | Chapter 2 General surveys of health p3 |  
Chapter 3 Long-term health effects p9 | Chapter 4 Sleep and sleep  
disturbances p11 | Chapter 5 Digestive problems p17 | Chapter 6 Cardiovascular  
problems p21 | Chapter 7 Women's problems p23 | Chapter 8 Social problems  
p25 | Chapter 9 Psychological problems p29 | Chapter 10 Medical surveillance and  
health education p31 | Chapter 11 BEST solutions p35 | Chapter 12 Conclusions  
p37 | Bibliography p39 | **on time** p45



EUROPEAN FOUNDATION  
*for the Improvement of Living and Working Conditions*



1|2000

# best

*EUROPEAN STUDIES ON TIME*

## Shiftwork and Health

Chapter 1 Introduction p1 | Chapter 2 General surveys of health p3 |  
Chapter 3 Long-term health effects p9 | Chapter 4 Sleep and sleep  
disturbances p11 | Chapter 5 Digestive problems p17 | Chapter 6 Cardiovascular  
problems p21 | Chapter 7 Women's problems p23 | Chapter 8 Social problems  
p25 | Chapter 9 Psychological problems p29 | Chapter 10 Medical surveillance and  
health education p31 | Chapter 11 BEST solutions p35 | Chapter 12 Conclusions  
p37 | Bibliography p39 | **on time** p45



EUROPEAN FOUNDATION  
*for the Improvement of Living and Working Conditions*

Luxembourg: Office for Official Publications of the European Communities, 2000

ISSN 1017-4877

## BEST European Studies on Time

---

BEST is published by the European Foundation for the Improvement of Living and Working Conditions.

The European Foundation for the Improvement of Living and Working Conditions is an autonomous body of the European Union, created to assist the formulation of future policy on social and work-related matters. Further information can be found at the Foundation website: [www.eurofound.ie/](http://www.eurofound.ie/)

BEST presents important developments in the field of time. It is addressed to all those who are developing policies in this field in the institutions of the European Commission, national governments and social partners in the European Union. BEST is published twice a year in English, French and German.

Editorial committee  
coordinator:

Dimitrios Politis  
European Foundation for the Improvement  
of Living and Working Conditions  
Wyattville Road, Loughlinstown  
Co. Dublin, Ireland  
Tel: +353-1 204 31 40  
Fax: +353-1 282 64 56/ 282 42 09  
e-mail: [dimitrios.politis@eurofound.ie](mailto:dimitrios.politis@eurofound.ie)

You can download BEST free of charge from the Foundation website at: [www.eurofound.ie](http://www.eurofound.ie)

© European Foundation for the Improvement of Living and Working Conditions. Reproduction is authorised, except for commercial purposes, provided the source is acknowledged and a copy is sent to the Foundation.

*Printed in Ireland*

The paper used in this publication is chlorine free and comes from managed forests in Northern Europe.  
For every tree felled, at least one new tree is planted.

Cat. No. TJ-AA-00-001-EN-C

EF/00/09/EN

# Contents

|                            |                                                  |    |
|----------------------------|--------------------------------------------------|----|
| Contributors               |                                                  | iv |
| List of figures and tables |                                                  | iv |
| Chapter 1                  | <b>Introduction</b>                              | 1  |
| Chapter 2                  | <b>General surveys of health</b>                 | 3  |
| Chapter 3                  | <b>Long-term health effects</b>                  | 9  |
| Chapter 4                  | <b>Sleep and sleep disturbances</b>              | 11 |
| Chapter 5                  | <b>Digestive problems</b>                        | 17 |
| Chapter 6                  | <b>Cardiovascular problems</b>                   | 21 |
| Chapter 7                  | <b>Women's problems</b>                          | 23 |
| Chapter 8                  | <b>Social problems</b>                           | 25 |
| Chapter 9                  | <b>Psychological problems</b>                    | 29 |
| Chapter 10                 | <b>Medical surveillance and health education</b> | 31 |
| Chapter 11                 | <b>BEST solutions</b>                            | 35 |
| Chapter 12                 | <b>Conclusions</b>                               | 37 |
| Bibliography               |                                                  | 39 |
| on <b>time</b>             |                                                  | 45 |

## Contributors

*Shiftwork and Health* has been written and edited by Alexander Wedderburn, Department of Business Organisation, School of Management, Heriot-Watt University, Edinburgh, Scotland. The report is based on five paper contributions from:

iv

- Giovanni Costa, Instituto di Medicina del Lavoro, Università degli studi di Verona, Italy
- Charles Gadbois, Ecole Pratique des Hautes Etudes, Laboratoire d'Ergonomie Physiologique et Cognitive, Paris, France
- Ben Jansen, Atos Beleidsavies en-onderzoek bv, Amsterdam, the Netherlands
- Peter Knauth, Institut für Industriebetriebslehre und Industrielle Produktion, Abteilung Arbeitswissenschaft, Universität Karlsruhe, Germany
- Robert Léonard, NV Lammeken, ERGOLAM Department of Ergonomics, Knokkeheist, Belgium

Hard copies of these papers can be obtained on request from Dimitrios Politis (see contact details on p. 2).

## List of figures and tables

|          |                                                                               |    |
|----------|-------------------------------------------------------------------------------|----|
| Figure 1 | Number of health complaints by type of worker                                 | 3  |
| Figure 2 | Sleeping problems by day work and shiftwork                                   | 3  |
| Figure 3 | Number of days absent by shiftwork                                            | 4  |
| Figure 4 | Morbidity and shiftwork or night work                                         | 6  |
| Figure 5 | Incapacity and shiftwork or night work                                        | 6  |
| Figure 6 | Duration of sleep according to shift type                                     | 12 |
| Figure 7 | Sleep duration dependent on the time of sleep onset                           | 13 |
| Figure 8 | Frequent noise disturbance during sleep                                       | 14 |
| Figure 9 | Lunch and dinner times of shiftworkers                                        | 20 |
| Table 1  | Sleeping problems by day work and shiftwork                                   | 3  |
| Table 2  | Stomach problems by day work and shiftwork                                    | 4  |
| Table 3  | Irritability by day work and shiftwork                                        | 4  |
| Table 4  | Absence by shiftwork                                                          | 4  |
| Table 5  | Medical observations                                                          | 5  |
| Table 6  | Stress by education level (Belgium)                                           | 5  |
| Table 7  | Absence by day work and shiftwork (UK)                                        | 8  |
| Table 8  | Health problems of shiftworkers                                               | 10 |
| Table 9  | Known facts about the length and quality of shiftworkers' sleep               | 11 |
| Table 10 | Fatigue and quality of sleep                                                  | 15 |
| Table 11 | Main epidemiological studies on gastrointestinal disorders among shiftworkers | 18 |
| Table 12 | Prevalence of digestive disorders in different groups                         | 19 |
| Table 13 | Studies of shiftwork and cardiovascular disorders                             | 21 |
| Table 14 | Cardiovascular risk rates as a function of years of shiftwork experience      | 22 |
| Table 15 | Family and social activities                                                  | 25 |
| Table 16 | Effects of shiftwork on family shared free time                               | 26 |
| Table 17 | Prevalence of psychoneurotic troubles in different groups                     | 30 |
| Table 18 | Contraindications for night work                                              | 33 |
| Table 19 | Periodic medical surveillances                                                | 34 |
| Table 20 | Schedule of health check-ups                                                  | 34 |



## Introduction

Shiftwork and other forms of working at unusual hours, and especially working at night, have always raised some health concerns. Shiftworkers, their employers, and governments responsible for health and safety legislation, are rightly interested in some serious questions about shiftwork and health:

- does shiftwork damage health?
- in what health areas does it carry this risk?
- are the short-term and long-term effects different?
- can occupational doctors and nurses monitor and reduce these effects?
- can shiftworkers themselves reduce these effects?

This issue of BEST aims to provide help and guidance in this complex area.

### Swimming

The root of the problem is that man is primarily a day-active animal. Folkard (1996) drew the parallel of man being mainly a land animal, not designed for living in water. We are not naturally aquatic, but most people can learn to swim quite easily, and some people can even develop high levels of skill, like Olympic swimmers, divers, and synchronised swimmers, for example.

### Night activity

Similarly, we are not naturally night-active, but man can overcome his/her day-active nature, work at night, and sleep in the daytime. Unlike animals, we are greatly influenced by our brains and by what we decide to do, rather than just by light and darkness, heat and cold. The prospect of a good celebration, or a practical emergency, is usually enough to get someone wide awake at night. So, for some people, the need to carry out a real job at night, and earn real money, can be enough to make them night-active. A real job is very different in hundreds of ways - but primarily

in terms of motivation - from laboratory studies of night work.

### Body rhythms

Then the problems start. A huge number of body rhythms, from sleepiness/wakefulness to digestive enzymes, work to a basic 24-hour day-active rhythm. This is normally very useful, as we feel sleepy at night and bright in the morning. These rhythms do not (on the whole) adjust immediately to a new night-active pattern. So shiftworkers - especially night-shift ones - have to swim against this tide of biological rhythms. It is not impossible: most researchers and practitioners have met fit and contented people who have been shiftworkers for many years. But it can be difficult for others, perhaps the majority. And it can affect their health.

### Social rhythms

Shiftwork also involves being out of line with the social rhythms of society, and therefore with the rest of a normal household. This is often less emphasised than the biological desynchronisation, but seems to be more important for many shiftworkers. Here shifts that involve working in the evenings, at weekends and in the early morning are involved, as well as night shifts. A happy domestic and social life helps to keep people mentally healthy.

### Health

Health has been defined by the World Health Organisation (WHO) as 'not merely absence of disease, but also complete physical, mental and social well-being'. This is a high aim, and few studies attempt to count every shortfall from this state of perfect health.

Many studies of shiftworkers give an indication of health-related problems. The next section gives some examples of these, after a brief discussion of the difficulties in getting good information.

**Method problem 1: Shiftworkers are survivors**

The biggest problem is the 'healthy shiftworker effect'. Just as employed people are healthier than unemployed people (known as the 'healthy worker effect', because less healthy people drop out of work more often), so there is considerable evidence that shiftworkers are more healthy than day workers. Ex-shiftworkers can be expected to be less healthy than both groups, because some of them have dropped out of shiftwork because of illness, or after having been made uncomfortable by the effects of shiftwork on their body systems. This is often found to be the case.

So a cross-sectional study - a snapshot comparison at a single time - can give an underestimate of shiftworkers' problems (and an overestimate of day workers' problems, if they include ex-shiftworkers). Ex-shiftworkers on their own are, of course, more likely to produce a large overestimate of health problems.

**Method problem 2: We all age**

The other difficult research problem is that we all age. Our chances of developing health problems change, partly due to this, and partly due to a

host of other factors. As Costa (1996) writes, 'such problems are quite common among the general population as well, and other factors, including genetics, personality traits, lifestyles and social behaviour, can also influence health'.

So a longitudinal study of **any** group will find increasing amounts of illness. A good longitudinal study has to find some way to deal with this problem.

**Plan of this issue**

In spite of the methodological problems, a fair amount of knowledge has been accumulated, much of it in languages other than English. The papers of the BEST team, available in full separately, provide a huge amount of the detail on this, and give detailed references that you can look up if you want to find out more.

This issue starts with the results of general surveys on health, and studies of the long-term effects of shiftwork. It then looks in more detail at sleep, digestive, cardiovascular and maternity problems. Social and psychological problems are explored. After a chapter on medical surveillance of shiftworkers, there is a short chapter on BEST solutions.

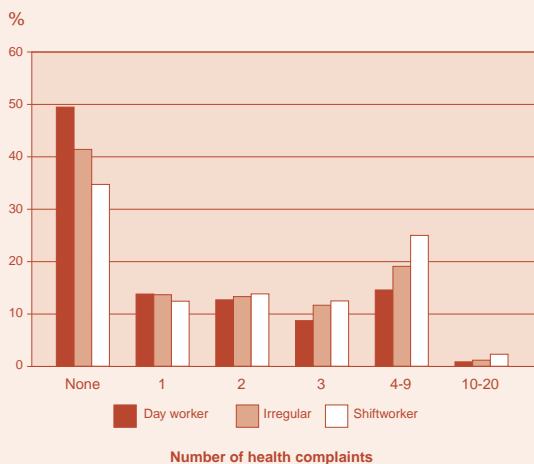


# General surveys of health

## European Survey of Working Conditions 1996

This huge survey, of 16,000 people in employment in the European Union, asked questions about shiftwork, and also about health. The analysis here excludes the self-employed.

Figure 1 Number of health complaints by type of worker



Shiftworkers reported a higher number of separate health complaints than day workers (Figure 1). This is very similar for both men and women, who were also analysed separately.

This pattern is built up from sixteen separate categories of health problems; shiftworkers report problems more often in all the categories, except eye problems.

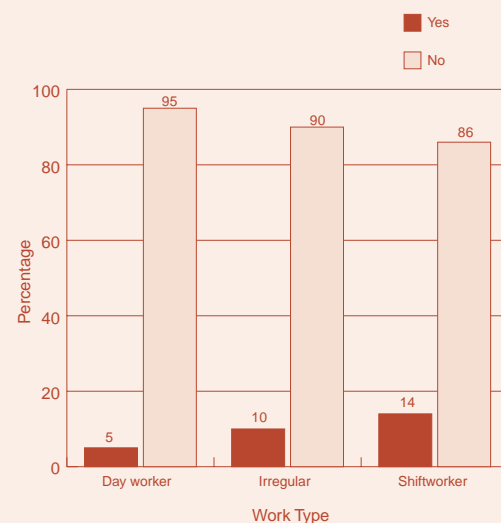
Sleeping problems, overall fatigue, stomach ache and irritability are reported below, as these are symptoms commonly associated with shiftwork.

Table 1 Sleeping problems by day work and shiftwork

|                          | Day workers | Irregular workers | Shiftworkers | Total |
|--------------------------|-------------|-------------------|--------------|-------|
|                          | %           | %                 | %            | %     |
| <b>Sleeping problems</b> |             |                   |              |       |
| Yes                      | 5           | 10                | 14           | 7     |
| No                       | 95          | 90                | 86           | 93    |
| <b>Total N</b>           | 8856        | 2010              | 1749         | 12615 |
| <b>Per cent</b>          | 100         | 100               | 100          | 100   |

14% of shiftworkers report sleeping problems caused by work, but only 5% of day workers and 10% of the irregulars. It is worth noting that some - 1 in 20 - day workers report sleeping problems, and that not all shiftworkers report them, but the difference of 14% compared with 5% is substantial, and not surprising (Figure 2).

Figure 2 Sleeping problems by day work and shiftwork





Stomach problems are not common, but have been reported in the past as a consequence of shiftwork and irregular hours. Here shiftworkers and irregular workers both report about twice as often as day workers. Over 90% of all groups do not report these as a problem.

Table 2 *Stomach problems by day work and shiftwork*

|                         |            | Day workers | Irregular workers | Shift-workers | Total |
|-------------------------|------------|-------------|-------------------|---------------|-------|
|                         |            | %           | %                 | %             | %     |
| <b>Stomach problems</b> | <b>Yes</b> | 3.7         | 6.4               | 6.5           | 5     |
|                         | <b>No</b>  | 96.3        | 93.6              | 93.5          | 95    |
| <b>Total N</b>          |            | 10682       | 3340              | 1850          | 15872 |

Irritability caused by work is reported by 16% of shiftworkers, by 13% of those on irregular patterns, and by 9% of day workers. This is equally true for men and women - women report marginally more irritability.

Table 3 *Irritability by day work and shiftwork*

|                     |            | Day workers | Irregular workers | Shift-workers | Total |
|---------------------|------------|-------------|-------------------|---------------|-------|
|                     |            | %           | %                 | %             | %     |
| <b>Irritability</b> | <b>Yes</b> | 9.1         | 13.1              | 15.6          | 10.7  |
|                     | <b>No</b>  | 90.9        | 86.9              | 84.4          | 89.3  |
| <b>Total N</b>      |            | 10682       | 3340              | 1850          | 15872 |

It is interesting that self-employed people who are shiftworkers report fewer complaints than employed shiftworkers, but still more than self-employed people who are day workers.

In the same survey, shiftworkers reported more absence days over the past year than day workers, with no real difference between men and women.

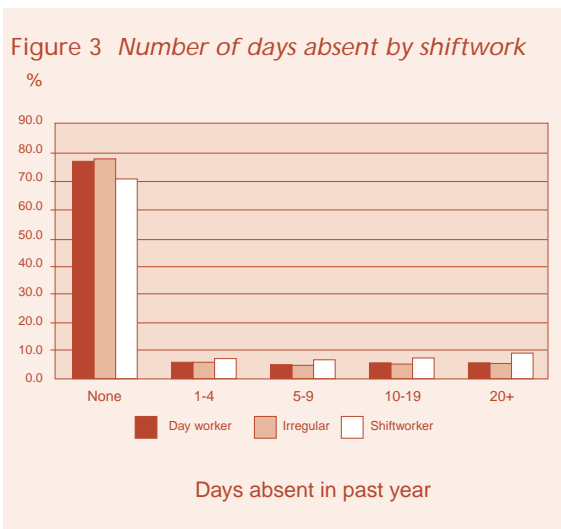
78% of day workers and 79% of irregular pattern workers, but only 71% of shiftworkers, reported no absence days in the past year. The absence

surplus is fairly evenly distributed over different amounts of absence.

Table 4 *Absence by shiftwork*

|                          | Day workers | Irregular workers | Shift-workers | Total |
|--------------------------|-------------|-------------------|---------------|-------|
|                          | %           | %                 | %             | %     |
| <b>Days absent in yr</b> |             |                   |               |       |
| <b>None</b>              | 77.6        | 78.6              | 70.8          | 77.0  |
| <b>1-4</b>               | 5.9         | 5.8               | 6.5           | 5.9   |
| <b>5-9</b>               | 5.2         | 4.7               | 6.4           | 5.2   |
| <b>10-19</b>             | 5.8         | 5.5               | 7.7           | 5.9   |
| <b>20+</b>               | 5.5         | 5.4               | 8.5           | 5.9   |
| <b>Total N</b>           | 10680       | 3338              | 1849          | 15867 |

This is slightly surprising, as there have been several studies in the past reporting that shiftworkers were less absent than day workers, partly because unhealthy people drop out of shiftwork, and partly because of the interdependence of shift teams, which puts more pressure on team-workers to attend.



In this survey, shiftworkers show up as reporting more bad health effects than day workers. Caution should be used before generalising from this. Obviously, the kind of industry and work, and the age of the individuals, can make great differences to illness patterns, and no attempt has

been made to control for these factors here. The effects are also self-reported ones, and not the result of objective diagnosis. 'Shiftwork' is also self-defined, and some patterns of shiftwork are likely to be more harmful to health than others. There is no information about this in the survey.

## Other surveys

### The Netherlands

In the Netherlands, Jansen (1996) reports on an extensive body of research into the relationship between shiftwork and health, showing that for shiftworkers, as well as their partners, shiftwork:

- causes many subjective complaints about sleep, fatigue and workload;
- leads to various nervous phenomena, such as headaches, depression, and trembling hands;
- may cause problems with appetite and increase the chance of gastrointestinal complaints;
- probably contributes to the development of cardiovascular diseases; and
- possibly has a detrimental effect on the working of the female reproductive system.

Dutch researchers point out that not all working-time arrangements (WTAs) involving work at uncommon hours cause such adverse effects. Personal characteristics of the shiftworker and his or her work experience also play an important role.

When the shiftworker begins such work, psychological patterns in particular play an important part in the perceived health condition (for example, motives and goals regarding shiftwork). Once s/he has gained more experience in shiftwork, the relative importance of somatic risk factors and of sleeping behaviour increases.

### Belgium

'Stress' is emphasised by Léonard (1996), and shiftwork is one of the factors that appear to be implicated in the causes of stress. 'Shiftwork, repetitive work, night work, security work, accessible alcohol, absence of direct control and social pressure are all factors that can lead to the onset of problems, particularly around the use of

drugs and alcohol. The climate in the enterprise itself, as well, is very important' (Ministry of Employment and Work (Belgium), 1994).

Léonard also reports the results of some very large surveys in Belgium on stress and stress-related illness. The word 'stress' is sometimes seen as mainly subjective, but one of his tables shows clearly how stress can spill over into conditions that are more often seen as objective. This survey, carried out through occupational doctors, sampled 22,698 male and 8,792 female workers.

Table 5 *Medical observations*

| Stress-related symptoms and/or diagnoses | Male (%) | Female (%) |
|------------------------------------------|----------|------------|
| neuropsychological                       | 15       | 19         |
| cardiovascular                           | 5        | 6          |
| respiratory                              | 4        | 5          |
| gastrointestinal                         | 10       | 8          |
| musculoskeletal                          | 18       | 21         |
| medication use                           | 6        | 7          |
| excessive use of alcohol                 | 6        | 1          |
| stress complaint without symptoms        | 10       | 16         |
| other symptoms                           | 6        | 6          |
| average number of symptoms               | 7.7      | 8.4        |

Source: Léonard (1996)

From a different survey, Léonard points out that stress symptoms appear to be associated with the level of education reached.

Table 6 *Stress by education level (Belgium)*

| Highest level of education | Stress group | Control group |
|----------------------------|--------------|---------------|
| primary                    | 57%          | 12%           |
| lower secondary            | 25%          | 55%           |
| upper secondary            | 11%          | 11%           |
| higher                     | 7%           | 22%           |

Stress is caused not only by the factors that lead to lack of education, but also by the consequences of that lack. In other words, stress is most often experienced by those in society least favoured by both nature and their environment. Their lack of qualifications places them in low-level jobs, where

they have more difficulty in dealing with problems encountered in daily living.

with some past shiftworking experience, and day workers never subjected to shiftwork.

**France**

Gadbois (1996) reports on surveys carried out recently in France which confirmed, both at the company level and also in various professional sectors, that there are significant health differences between shiftworkers, day workers

The analyses of Bourget-Devouassoux and Volkoff (1991) are based on data collected within the framework of a national survey on the conditions of life, conducted in 1987 and using a sample of 18,700 people aged 18 and over. Using morbidity and permanent incapacity indicators, these data allow us to compare, among all professional

Figure 4 *Morbidity and shiftwork or night work*

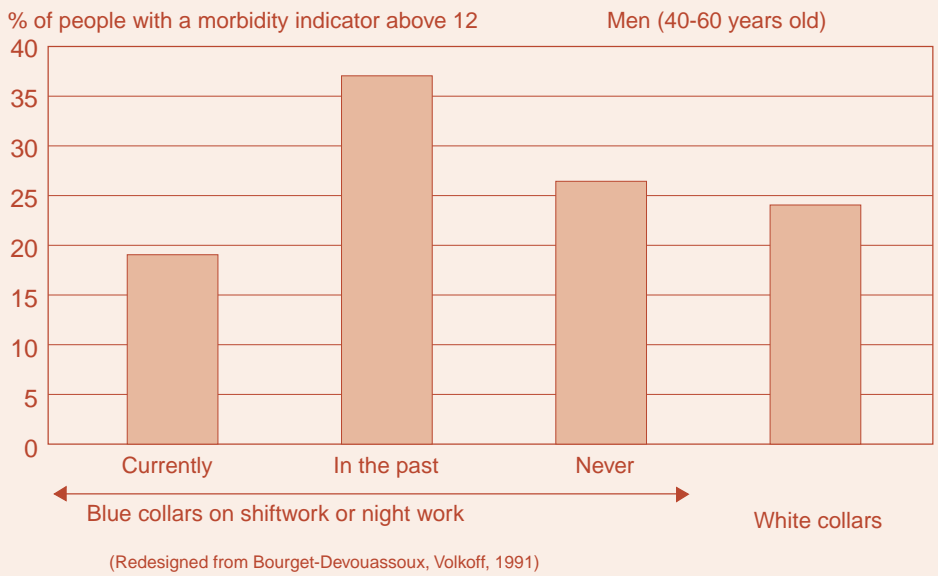
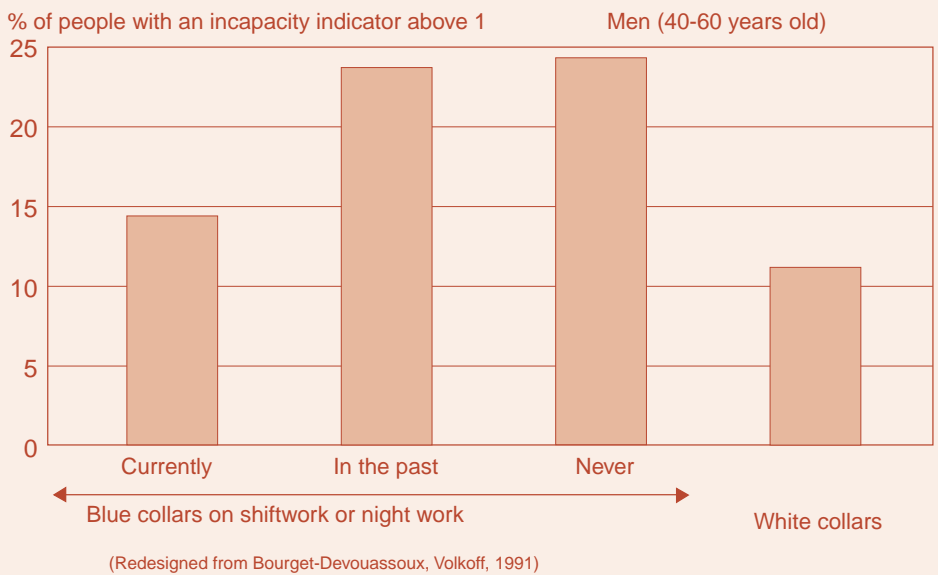


Figure 5 *Incapacity and shiftwork or night work*



sector workers in the 40-64 age range, those who are currently working shifts or nights, those who did so in the past but are no longer, and those who never have.

‘With these indicators, workers aged 40-64 subject to the hardest working conditions appear, overall, as having fewer health problems than the whole group of men of their age (Figure 4). Whether it is shiftwork or night work, the morbidity level indicator describes them as being in better health than other men of their generation, also in better health than other workers, and places them in a position very close to that of non-workers. The permanent incapacity indicator highlights the same incidence, but this time the best situation is that of “white-collar workers” (Figure 5).’

Former shiftworkers or night workers (37% of workers aged 40 to 64) and former night workers (29%) have the worst health of all men of their age, that is:

- the highest levels of morbidity (morbidity indicator greater than 12) are reached twice as often;
- a raised morbidity (indicator between 9 and 12) is clearly more frequent; and
- fewer of them show a low or null morbidity.

This is a very clear demonstration of the ‘healthy survivor’ effect mentioned in the Introduction. The remaining shiftworkers are more healthy because the people with health problems are no longer shiftworkers.

### Women

‘If we look at the morbidity indicator to evaluate health in women, the situation is quite different from that of men. Women working in teams, or in a tedious job on shifts, are, for the most part, in as poor health as those who have left these shifts, and evolution with age for them is not particularly favourable either’ (Gadbois, 1996).

### France: cohort study

Another survey (ESTEV survey, Deriennic et al., 1992) provides equally enlightening information based on data collected from four cohorts of workers aged 37, 42, 47 and 52, respectively. On health, the data allow us to compare, for each cohort and between cohorts, workers on shiftwork at the time of the survey, those who were not then on shiftwork but had been in the past, and those who had never been on shiftwork. For these four groups, health decreases

as age increases. But, at each age, problems are more noticeable in workers currently performing shiftwork, more so than for those who performed shiftwork in the past, who, in turn, are less healthy than those workers who have only worked day shifts. This phenomenon has not been verified for arterial hypertension, but has been verified for a series of other indicators constructed from the ‘Nottingham Health Profile’. These results can be summarised as follows:

- for men: sleeping problems, energy, at least one absence from work, periods of work greater than 30 days and pathogenic weight (reasonable indicators of lack of present well-being) are clearly more frequent in workers currently on a shift schedule;
- for women: problems of isolation from society, energy, emotional reactions and the incidence of more than 10 psychiatric consultations are more frequent in workers on a shift schedule, whether currently or in the past: early disturbances which persist with time despite a return to a normal schedule.

Finally, the consumption of neuropsychiatric drugs or sleeping pills is more frequent in workers having worked a shift schedule. This is an example of a problem in the past carrying on into the present (assuming that most people are better off if they can sleep without sleeping pills).

### Absence

As shiftworkers complain more frequently about their health and well-being, it might be assumed that they would always be absent due to illness more frequently than day workers. Sometimes this is found to be the case - see, for example, the European Survey of Working Conditions above.

Some other research results do not systematically support this (e.g. Taylor et al., 1972; Pocock et al., 1972; Smulders, 1984; Grosfeld, 1988; Schalk, 1989). Various factors are mentioned in the literature, which might lead to the misinterpretation of data concerning absenteeism due to illness.

- Selection effect: often, those workers unable to cope with the stress of shiftwork leave it and return to day work, while those able to cope successfully remain on shifts. Leaving shiftwork can be a process of ‘self-selection’ and/or a result of the company’s medical advice.

- Social pressure: absenteeism generally means that a call-out has to be made or that the work becomes more difficult for the rest of the team. This cohesiveness or *esprit de corps* may mean that people work on for a longer time after they become ill, or at least try to work through their illness until their days off (see for example Taylor, 1967; Åkerstedt and Fröberg, 1976).
- Underestimation/failure to report physical discomfort: Andersen (1970) observed that shiftworkers, more than day workers, regard problems with sleep, digestion, etc. as a 'natural' component of their work situation (cf. Agervold, 1976; Åkerstedt, 1977). The 'Shiftwork Committee' of the Japanese Association of Industrial Health (1979) reported that, even if not feeling well, approximately one and a half times as many shiftworkers as day workers go to work regardless.

In the first half of the 1990s a longitudinal study was conducted in Holland (Klein Hesselink et al., 1995) in which well over 3,000 employees from 85 companies and institutions participated for five years. In total seventeen forms of atypical working-time arrangements were scrutinised. After controlling for variations in personal data, the study showed that there was little or no difference in the percentages of absenteeism between shiftworkers and day workers.

Taylor, Pocock and Sergean (1972) carried out a large and careful study of absence in the UK. They initially approached 85 organisations, but were reduced to 29 in which shift and day workers were engaged in similar work and where good absence records were kept. These included

manufacturing (engineering, metal manufacture, chemicals, vehicles and food) and the service industry (public utilities and transport). The men were all manual employees, with the largest group being maintenance craftsmen.

Matched pairs were selected doing similar work and continuously employed on the same job in 1968 and 1969, born in the same five-year period, and excluding anyone transferred at any time from one system of working hours to another on medical grounds. Absence was classified as (a) medically certified lasting more than 3 days, (b) short spells of up to 3 days, and (c) other.

Other details are given in this study - of the type of illness, for example - which tend to confirm the picture that current shiftworkers are generally more healthy and less absent, with the exception of peptic ulcers.

It is worth noting that it may be better employers who keep good absence records. If the 29 organisations that took part are better employers than the 56 who did not, then the results may be biased in favour of well-cared-for shiftworkers.

### Conclusions

This wide variety of sources demonstrates the real difficulties in studying health and shiftwork. Cross-sectional studies, taking the picture at a single point in time, tend to show that shiftworkers are above average in health. But there are major exceptions, where shiftworkers from a complete population sample report more health problems. Longitudinal studies show people dropping out of shiftwork selectively, because of health concerns.

Table 7 *Absence by day work and shiftwork (UK)*

|                 | Certified sickness |       | Short sickness |       | Other absence |       |
|-----------------|--------------------|-------|----------------|-------|---------------|-------|
|                 | Day                | Shift | Day            | Shift | Day           | Shift |
| Spells/man-year | .77                | .67   | 1.7            | 1.41  | .68           | .53   |
| Days/man-year   | 12.13              | 9.54  | 2.53           | 2.11  | .93           | .71   |
| Number of men   | 965                | 965   | 812            | 812   | 643           | 643   |



## Long-term health effects

Long-term effects of shiftwork on health have to be studied with the help of epidemiological methods. However, few controlled longitudinal studies have been published (Aanonsen, 1964; Angersbach et al., 1980; Glettenberg et al., 1980; Kundi et al., 1986). Such studies are not easy, because of the losses in response over a long period.

### Retrospective studies

Aanonsen (1964) observed that employees who had worked shifts for many years had fewer absences due to gastrointestinal and nervous disorders than those employees who had always worked in day shifts or who had changed from shiftwork to day work. This result shows the effect of strong self-selection on the part of shiftworkers.

In the Angersbach et al. (1980) study of workers in the chemical industry, the incidence of sickness did not differ between shiftworkers who had always worked on shift systems and permanent day workers, but was highest in shiftworkers who had transferred to day work mostly for medical reasons. However, on average, shiftworkers were sick for longer periods than day workers. Shiftworkers who had transferred to day work had higher incidences before and after the changeover than permanent shift and day workers. The incidence of gastrointestinal diseases was found to be higher before shiftworkers had changed, and decreased after they transferred to day work. Cardiovascular and skeletal diseases, however, showed higher incidence densities after shiftworkers had transferred to day work. The process of self-selection that occurred during the study period (1966 to 1977) seemed to be incomplete, because the relative risk of suffering from gastrointestinal disease for the first time was higher in the latter years of investigation.

Glettenberg et al. (1980) analysed and compared the sickness reports of two groups of policemen seven years after their basic training. The shiftworkers, on average, had more days of absenteeism with disablement per person and year than the day workers.

### Prospective studies

The three studies cited above were all retrospective studies (i.e. looking backward, when analysing the illness reports). The only prospective follow-up studies have been published by Kundi et al. (1986) and Cervinka et al. (1986a, b). These observed, over a five-year period, the state of health of shift and day workers in the steel industry, where it is difficult to change from shiftwork to day work. The worsening of the state of health during the five-year follow-up study was more pronounced in the group of shiftworkers than in the group of day workers. The changes in the shiftworkers' health were described as evolving through four stages:

Adaptation phase (c 0-5 years of experience):

During the first 5 years of shiftwork, the average state of health was clearly impaired.

Sensitisation phase (c 5-20 years):

In this phase no specific symptoms develop. However, compensation by coping strategies may conceal the build-up of underlying problems.

Accumulation phase (c 20-40 years):

After about 20 years on shiftwork, the problems connected with shiftwork seem to accumulate.

Manifestation phase (c over 40 years).

### Stable and unstable shiftworkers

There are large inter-individual differences in the way shiftworkers are able to cope with their problems. Cervinka et al. (1986a, b) as well as Kundi et al. (1986) compared two groups of shiftworkers, so-called 'stable' and 'unstable' shiftworkers (Table 8). These authors assume that the compensatory mechanisms in the group of 'unstable' shiftworkers are impaired. It is not known how the factors mentioned in Table 8 and other factors interact, nor which are the main factors causing long-term health impairments.

| Differences of some attributes of shiftworkers and their living conditions between a group of 'stable' and a group of 'unstable' shiftworkers | Shiftworkers  |                 | Significance<br>*p<0.05<br>**p<0.01 |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|-------------------------------------|
|                                                                                                                                               | Stable (n=28) | Unstable (n=28) |                                     |
| <b>Health</b>                                                                                                                                 |               |                 |                                     |
| Health index                                                                                                                                  | 0.12          | -0.44           | **                                  |
| Frequently/nearly always complains                                                                                                            | 21%           | 54%             | *                                   |
| Tired/exhausted the whole day several times a week                                                                                            | 18%           | 39%             | *                                   |
| Complaints or diseases in the last year:                                                                                                      |               |                 |                                     |
| • digestive system                                                                                                                            | 32%           | 58%             | **                                  |
| • circulatory system                                                                                                                          | 14%           | 36%             | *                                   |
| <b>Risk factors</b>                                                                                                                           |               |                 |                                     |
| Change of weight in last 5 years (kg)                                                                                                         | 0.5           | 6.8             | **                                  |
| Cigarettes/day                                                                                                                                | 22            | 40              | *                                   |
| <b>Situational characteristics</b>                                                                                                            |               |                 |                                     |
| Frequent sleep disturbances by:                                                                                                               |               |                 |                                     |
| • light                                                                                                                                       | 18%           | 50%             | *                                   |
| • noise                                                                                                                                       | 41%           | 75%             | *                                   |
| • noise of family members                                                                                                                     | 21%           | 50%             | *                                   |
| Noise reduction measures at residence                                                                                                         | 61%           | 25%             | **                                  |
| <b>Other characteristics</b>                                                                                                                  |               |                 |                                     |
| Family has difficulties getting used to shiftwork of husband/father                                                                           | 29%           | 61%             | *                                   |
| Increase in inconvenience of work                                                                                                             | 39%           | 75%             | **                                  |
| Nutritional problems                                                                                                                          | 14%           | 41%             | *                                   |
| Source: Cervinka et al. (1986a); Kundi et al. (1986)                                                                                          |               |                 |                                     |

It is worth comparing this with the more general risk factors reported by Monk and Folkard (1992):

- over 50 years of age;
- second job;
- heavy domestic workload;
- morning type personality;
- history of sleep disorders;
- neurotic introvert;
- psychiatric illness;
- history of alcohol or drug abuse;
- history of gastrointestinal complaints;
- epilepsy;
- diabetes; and
- heart disease.

### Mortality

An almost unique study on mortality of shiftworkers, involving 8,603 male manual workers in 10 organisations in various industrial sectors in England and Wales over a period of 13 years, showed day workers had slightly fewer deaths than expected compared with the national

rates (736 vs 756.4), while shift and ex-shiftworkers had slightly more (722 vs 711.4 and 120 vs 100.9, respectively). The differences were not statistically significant, and those related to the age groups (10 years increasing) were not consistent in direction (Taylor and Pocock, 1972).

### Conclusion

The message of both this chapter and the previous one is that there is no doubt that shiftwork can cause health problems of many kinds and of several degrees of severity. However, it does not happen everywhere and in every category with an inevitability that results in statistically significant results every time.

The next chapters look in more detail at some of the routes that seem to be involved in health problems.



## Sleep and sleep disturbances

### Introduction

Numerous questionnaires in various countries and industrial sectors show that shiftworkers often suffer from sleep disturbances, especially if night work is involved. According to the results of a literature review by Knauth (1983), complaints about sleep disturbances are made by:

- 10 to 40% of day workers;
- 5 to 30% of shiftworkers without night shifts;
- 10 to 95% of shiftworkers with night shifts;
- 35 to 55% of permanent night-shift workers; and
- 70 to 90% of ex-shiftworkers (before the change to day work).

After leaving shiftwork, sleep disturbances in ex-shiftworkers were reduced by about 15%.

The known facts about the length and quality of sleep in shiftworkers are given in Table 9.

The highest frequency of sleep disturbances appears in shiftworkers with night shifts. The cases where, in spite of night shifts, few complaints about sleep disturbances were observed could have been explained by self-selection of the shiftworkers (e.g. Åkerstedt and Kecklund, 1991), i.e. those with a high frequency of sleeping problems changed to day work.

The desynchronisation of the sleep/wake rhythm, caused especially by night shifts, results in disturbances of both the quality and quantity of sleep. Shortened sleep length is particularly linked to day sleep (Knauth and Rutenfranz, 1981; Åkerstedt and Gillberg, 1981; Knauth, 1985). This may be caused by both (1) the

| Item                              | Daytime sleep in the night-work period                                                                                                                                                                                                                                                                                                                           | Other sleeps in the work cycle                                                                                                                                                                                                     |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Duration                          | <ul style="list-style-type: none"> <li>• Shorter daytime sleep</li> <li>• The later the sleep onset (up to 15.00), the shorter the sleep</li> <li>• More frequent daytime naps</li> </ul>                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• Shorter prior to a shift starting in the early morning</li> <li>• Longer after the evening shift</li> <li>• Short night-time naps</li> <li>• 'Forbidden zones' for sleep onset</li> </ul> |
| Quality                           | <ul style="list-style-type: none"> <li>• More frequent reports of poor quality sleep</li> <li>• Increased frequency of awakenings</li> <li>• Reduced amplitude of circadian rhythms during sleep</li> <li>• Increase of REM sleep with short latency</li> <li>• Insufficient slow wave sleep</li> <li>• Insufficient recovery from night-work fatigue</li> </ul> | <ul style="list-style-type: none"> <li>• Reports about relatively poor quality of sleep taken at irregular times</li> </ul>                                                                                                        |
| Interaction with circadian rhythm | <ul style="list-style-type: none"> <li>• Disruption of circadian rhythms</li> <li>• Unequally phase-shifted rhythms</li> </ul>                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• Slight disruption of rhythms by phase-shifted sleeps</li> </ul>                                                                                                                           |

Source: Kogi (1982), modified by Knauth and Hornberger (1996)



desynchronisation of the circadian rhythm, and also (2) unsuitable living conditions (Knauth, 1985; Knauth et al., 1980).

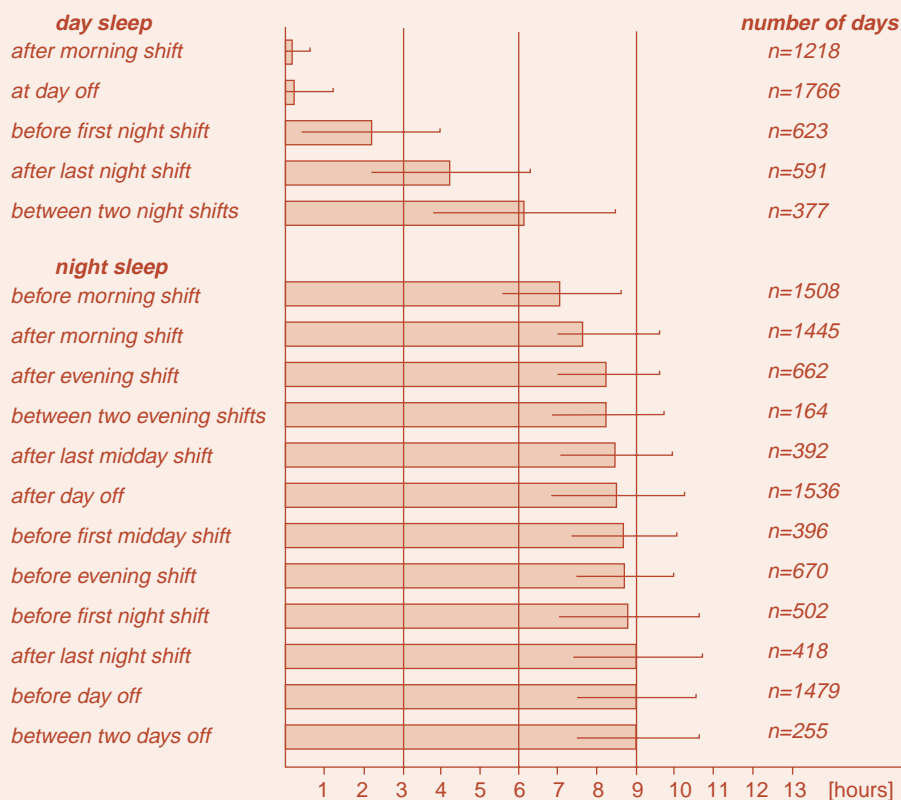
Shortened sleep lengths are also associated with morning shifts, especially if they begin too early (Tilley et al., 1981; Knauth, 1985; Folkard and Barton, 1993; Kecklund and Åkerstedt, 1995). 'Too early' is largely a matter of local custom, but 06.00 and 07.00 are 'too early' in much of western Europe. Most shiftworkers fail to go to bed earlier than normal, despite the fact that they have to get up much earlier than usual (e.g. Knauth et al., 1980; Folkard and Barton, 1993). This appears to be caused by two factors:

- social and family demands, which make wakefulness in the evening attractive, and cause the shiftworkers to accept a shortened sleep before a morning shift;
- the reduction of sleep propensity during the

'forbidden zones' (usually taken as between 20.00 and 22.00), a chronobiological explanation offered by Lavie (1986). Even if shiftworkers go to bed early enough before a morning shift, they find it difficult to fall asleep because of this natural disinclination of the body to sleep during those hours.

This provides a rational explanation for 'too early': if an effective bedtime is difficult to achieve before 22.30, then adding 7.5 hours of normal adult sleep will take the time to 06.00, and allowing for rising, washing, breakfast and travelling to work, it is easy to see how 08.00 becomes a desirable starting time. There are, interestingly, reports of some groups of shiftworkers who have a shift changeover at 04.00, but this may reflect the attractiveness in some parts of the world of finishing paid work at 12.00, to allow for some farming work on a family farm after normal work.

Figure 6 Duration of sleep according to shift type (based on diary records of 1,230 workers)



Source: Knauth et al. (1980)

### Length of sleep

In a time budget study of 1,230 shiftworkers (Knauth, 1983), sleep lengths between shifts were analysed (Figure 6). The shortest main sleep (about 6 hours) was observed during the day between two night shifts, followed by the night sleep between two morning shifts, with a length of about 7 hours. Between two afternoon shifts and between two days off, a rather long sleep of 8 to 9 hours was reported. This is important because with a higher number of consecutive night or morning shifts, sleep deficits can accumulate into a sleep 'debt'. This is a strong argument against doing four or more consecutive night shifts: some shiftworkers prefer this, but they are quite likely to be operating with a dangerous amount of accumulated sleep debt.

Horne (1985) claims that people can learn to manage with reduced sleep, even over a long time period: there is clear evidence for this, providing a certain minimum of 6 hours is maintained. However, people sleeping for shorter periods without any regularities in their sleep rhythm (e.g. shiftworkers) have problems getting used to this. They usually tend to sleep longer during days off in order to make up for their 'lost' sleep, which may make subsequent adaptation to reduced sleep more difficult. At any rate, the experiments with reduced sleep have not really

simulated the fluctuating sleep quantities of shiftworkers.

### Reasons for sleep disturbances

The reduction of sleep duration in connection with shiftwork is primarily due to shiftworkers' circadian (24-hour) rhythms. The majority of human body functions are synchronised in such a rhythm, reaching their minimum at night and maximum during the daytime (Minors and Waterhouse, 1990). This basic rhythm is quite stable under natural conditions. However, the postponing of sleep due to permanent night work or changing shifts causes changes in phases of sleep/wake rhythms and, thus, disturbances in circadian rhythms (Knauth, 1983). Even after a greater number of consecutive night shifts (e.g. 14-21 shifts in a row), no complete adaptation of biological rhythms is possible (Knauth et al., 1978; Knauth et al., 1981). Only extreme evening types are able to adapt better (Moog, 1988).

Some parallels can be found between certain circadian rhythms; for example, the rhythms of sleep, body temperature, metabolism and alertness correlate with each other (Minors and Waterhouse, 1990). In a data re-analysis (Zulley, 1993), almost all the subjects slept when their body temperature was at its minimum, which usually occurs between 03.00 and 04.00. Sleep

Figure 7 Sleep duration dependent on the time of sleep onset  
(based on a study of 304 shiftworkers)

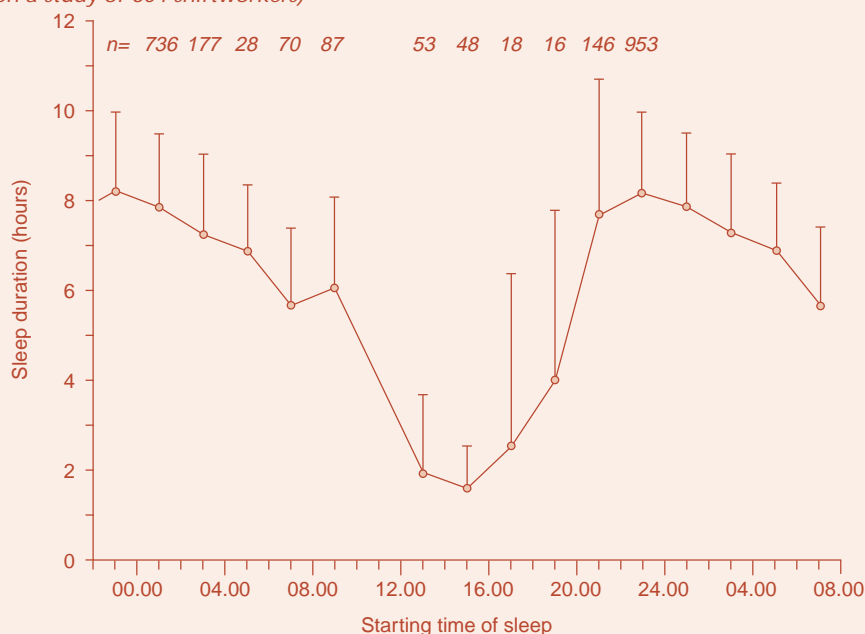
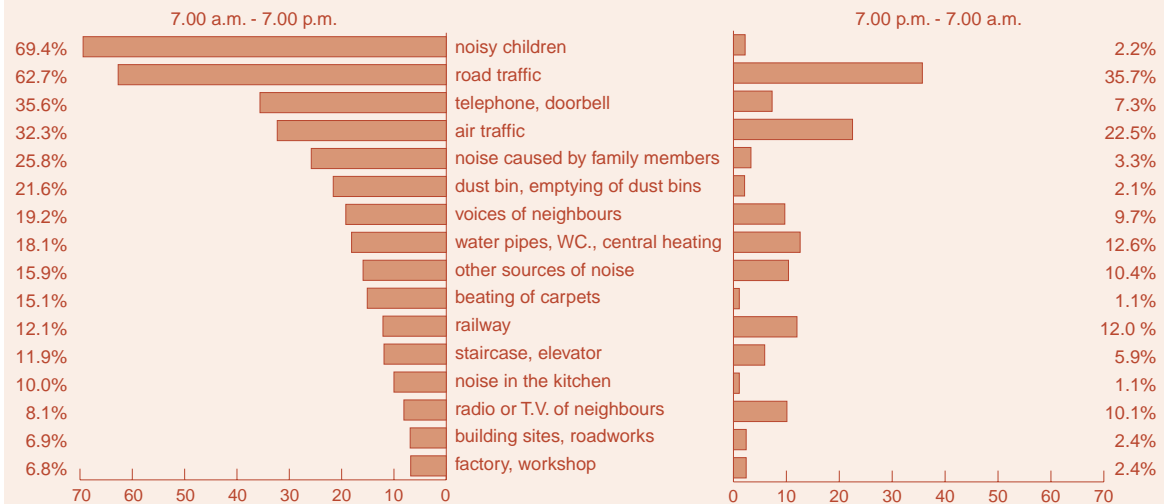


Figure 8 Frequent noise disturbance during sleep  
(Relative frequency with which different causes of sleep interruptions were mentioned by 808 shiftworkers)



Source: Rutenfranz et al. (1981)

usually ended 5-7 hours after this time period. The later the subjects went to bed, the shorter their sleep. A similar phenomenon was also observed in a study by Knauth and Rutenfranz (1981), in which sleep duration in relation to sleep onset was analysed. Sleep duration was constantly shorter for sleep beginning up to 15.00; from this time on, the length of sleep started to become more prolonged (Figure 7). This could explain why day sleep after a night shift is usually shorter than the night sleep of shiftworkers: people are trying to sleep when their temperature system is rising and waking them up (Knauth, 1983).

### Environmental disturbances

Many of the problems regarding shiftworkers' sleep also stem from environmental factors, such as noise and light, as well as family and social surroundings (Rutenfranz et al., 1981). Especially during the daytime, i.e. during day sleep after the night shift, these factors cause frequent sleep interruptions (Figure 8).

### Sleep and shift systems

The question whether permanent night work or rotating shiftwork has more negative effects on the sleep of shiftworkers is important for the design of adequate shift systems. The main problem, when comparing rotating and permanent shiftworkers, is the fact that the

groups are never completely comparable. Often they differ in age, income, responsibility for children at home, degree of self-selection, and freedom to choose the working-time arrangement or type of task. So all published results have to be interpreted cautiously.

Wilkinson (1992) reviewed a number of studies concerning day sleep after night shifts for three groups of shiftworkers. He calculated average values and found that the mean day-sleep duration for permanent and prolonged night workers (6.72 hours) was longer than that of weekly (6.31 h) and rapidly rotating shiftworkers (5.80 h). However - as Folkard (1992) pointed out - this comparison 'fails to take account of either the number of successive shortened day-sleeps or the durations of other sleeps taken within the shift cycle' and, if there are many night shifts in a row, a cumulative sleep debt on the last night shift has to be expected (Foret and Benoit, 1978; Kiesswetter et al., 1985; Folkard et al., 1990; Tepas and Carvalhais, 1990; Escriba et al., 1992). A few diary studies obtained sleep-duration estimates for all sleeps in a complete cycle of a shift system (Verhaegen et al., 1987; Folkard et al., 1990; Totterdell and Folkard, 1990; Tepas and Carvalhais, 1990). They found that the average sleep duration per 24 hours over complete shift cycles was lower for permanent night workers

than for either rapidly rotating or slowly rotating shiftworkers.

### Fatigue

Taking these results into consideration, it might be expected that permanent night workers complain more about fatigue. Alfredsson et al. (1991) found that permanent night workers had a much higher prevalence of fatigue than the rest of the working population. Patkai et al. (1977) studied permanent night workers during the first, third and fifth night shift, and observed a steady decline in subjective alertness during each night shift, with no tendency to change from the first to the fifth night shift. (Interestingly, there was a weakly significant trend towards longer reaction time from the first to fifth night.) In another study, a rather marginal adjustment was found over successive night shifts (e.g. Fröberg et al., 1972). However, the change from an old, slowly rotating (7 equal shifts) system to a shift system with a 2-to-3-day rotation improved rated alertness and general well-being in 3-shift workers (Williamson and Sanderson, 1986).

There are also considerable differences between different shiftwork arrangements. These emerge, for example, in the study by Jansen (1987) derived from data from the Dutch industrial scheduling practice, in which daytime work and various shiftwork systems were compared (Table 10).

Table 10 shows that the levels of fatigue and sleep quality are most favourable in daytime work, and least so in semi-continuous shiftwork. The discontinuous and continuous shift systems occupy an intermediate position. This last point, incidentally, also demonstrates that discontinuous shifts (mostly without night shifts) scored more favourably than is generally assumed (also see Betschart, 1989).

Table 10 *Fatigue and quality of sleep*  
(Average scores on two health-related variables in daytime working and three types of shiftwork)

|                 | Overall fatigue* | Quality of sleep** |
|-----------------|------------------|--------------------|
| Daytime working | 2.1              | 2.3                |
| Discontinuous   | 3.1              | 3.6                |
| Semi-continuous | 3.7              | 4.4                |
| Continuous      | 3.5              | 4.0                |

Source: Jansen (1987)

\* Minimum score = 0, maximum score (much fatigue) = 11

\*\* Minimum score = 0, maximum score (poor quality of sleep) = 14

Note: Semi-continuous work = usually not working at weekends  
Discontinuous work = work not covering 24 hours a day (double day shift)

### Conclusions

Sleep difficulties are often seen as the root cause of many other problems of shiftwork. A person short of sleep can be a tired and dangerous worker, an irritable and bad-tempered member of the family, and can be building up problems for himself in other parts of his system, e.g. digestive.

The positive side of this analysis, which is not always fully consistent, is that it is possible to take countermeasures against at least some sleep problems for some people.





## Digestive problems

After sleep problems, gastrointestinal disorders are the most frequently recorded symptoms among shiftworkers. According to one review, 20 to 75% of shiftworkers with night work complain of appetite disturbances, bowel irregularity with prevalent constipation, dyspepsia, heartburn, abdominal pains, rumbling and flatulence, compared to 10 to 25% of day workers and shiftworkers without night work (Rutenfranz et al., 1981).

In the long run, many shiftworkers may suffer from serious diseases such as chronic gastritis, gastroduodenitis, peptic ulcer and colitis. Costa (1996) gives an excellent short summary of the studies to date, which he has now updated in Costa (1999) (Table 11).

Twenty-six of the studies show a greater prevalence of gastrointestinal disorders in shiftworkers, ten found no difference, and one found a greater prevalence in day workers.

The reports are quite different in many ways:

1. methods of investigation (e.g. questionnaires, personal or telephone interviews, indirect medical reports, health insurance data, direct medical examinations with or without X-rays or endoscopy);
2. populations of shiftworkers examined (e.g. age, length of shiftwork experience, shiftwork schedules, working situations, job activity, socio-economic conditions);
3. kinds of study (e.g. whole population or sample, cross-sectional or longitudinal, retrospective or prospective, cohorts or case reports).

However, although the methods of investigation and groups of shiftworkers examined are quite different, the vast majority of studies show that gastrointestinal disorders are far more prevalent among shiftworkers than normal day workers.

### Peptic ulcer

The prevalence of peptic ulcers, the most severe illness, has been estimated as from 2 to 8 times higher among shiftworkers with night shifts, compared to day workers or shiftworkers without night shifts. In a group of Italian textile factory shiftworkers on a 3x8 shift system with weekly rotation, it was noted that the interval between start of work and diagnosis of peptic ulcer was significantly shorter among night workers, i.e.:

- 12.2 years on average for day workers;
- 14.4 years on average for 2-shift workers (without night shifts);
- 5.0 years on average for rotating 3-shift workers; and
- 5.6 years on average for permanent night workers.

Other groups employing fast rotating shift systems (1-1-1-1 or 2-2-2-2) reflected both lower frequencies of digestive disorders and some differences between men and women, as shown in Table 12 (p. 19).

Other earlier studies have also reported a significant decrease in problems and illnesses after transfer to day work (Thiis-Evensen, 1958; Aanonsen, 1964; Angersbach et al., 1980). On the other hand, Bruusgaard (1969) reported that shiftworkers in good housing conditions did not have significantly more ulcers or other complaints than day workers, while those in poor housing conditions had more complaints than the day workers.

It is quite possible that shiftwork in some circumstances can lead to ill health, for example if unsuitable food in unsuitable quantities is taken at irregular intervals. A careful British investigation of gastric and duodenal ulcers by Doll and Jones (1951) found no harmful effect of shiftwork nor any direct evidence of the harmful effect of irregular meal habits (although there

Table 11 *Main epidemiological studies on gastrointestinal disorders among shiftworkers*

| Author(s)                                             | Year | N     | Sector          | Study       | Methods     |
|-------------------------------------------------------|------|-------|-----------------|-------------|-------------|
| <b>A) Higher prevalence among shiftworkers</b>        |      |       |                 |             |             |
| Vernon                                                | 1921 |       | armaments       | cross-sec   | CE          |
| Duesberg & Weiss                                      | 1939 | 13015 | various         | cross-sec   | MR-HIR      |
| Bjerner et al.                                        | 1948 | 4607  | various         | cross-sec   | Q           |
| Bruusgaard                                            | 1949 | 1120  | paper mill      | cross-sec   | MR          |
| Bonnevie                                              | 1953 | 900   | various         | cross-sec   | MR          |
| Andersen                                              | 1957 | 897   | various         | cross-sec   | INT-Rx      |
| Graf et al.                                           | 1958 | 305   | metal, textile  | cross-sec   | Q           |
| Thiis-Evensen                                         | 1958 | 14348 | various         | retrospect  | Q-INT-CE-MR |
| Aanonsen                                              | 1959 | 1106  | metal-chemical  | retrospect  | CE-MR       |
| Stein                                                 | 1963 | 812   | various-women   | cross-sec   | Q           |
| Brandt                                                | 1969 | 5470  | various         | cross-sec   | MR          |
| Ensing                                                | 1969 | 697   | railway         | cross-sec   | MR          |
| Häkkinen                                              | 1969 | 343   | electricity     | cross-sec   | Q           |
| Lesniak et al.                                        | 1970 | 354   | coal mine       | cross-sec   | MR          |
| Godard et al.                                         | 1973 | 300   | steel industry  | cross-sec   | Q-CE-MR     |
| Kolmodin & Swensson                                   | 1975 | 183   | railway         | cross-sec   | MR          |
| Nachreiner & Rutenfranz                               | 1975 | 942   | chemical        | cross-sec   | Q           |
| Zahorski et al.                                       | 1977 | 8302  | coal mine       | cross-sec   | Q-MR        |
| Koller et al.                                         | 1978 | 260   | oil refinery    | cross-sec   | Q-INT       |
| Rietschel                                             | 1978 | 208   | metal           | cross-sec   | Q-CE-Rx-EN  |
| Léonard                                               | 1979 | 535   | metallurgy      | cross-sec   | MR          |
| Angersbach et al.                                     | 1980 | 640   | chemical        | retr-cohort | MR-HIR      |
| Werner et al.                                         | 1980 | 523   | various         | cross-sec   | Q           |
| Costa et al.                                          | 1981 | 573   | textile         | retrospect  | CE-MR       |
| Koller                                                | 1983 | 301   | oil refinery    | prospective | Q-INT-CE    |
| Segawa et al.                                         | 1987 | 11657 | various         | cross-sec   | Rx-EN       |
| <b>B) No difference between shift and day workers</b> |      |       |                 |             |             |
| Doll and Jones                                        | 1951 | 4871  | various         | cross-sec   | Q-INT-CE-Rx |
| Gauthier et al.                                       | 1961 | 16350 | metallurgy      | cross-sec   | MR-Rx-EN    |
| Jacquis                                               | 1963 | 919   | textile         | cross-sec   | MR-Rx       |
| Mott et al.                                           | 1965 | 1045  | various         | cross-sec   | Q           |
| Dirken                                                | 1966 | 1782  | various         | cross-sec   | Q           |
| Taylor                                                | 1967 | 1383  | oil refinery    | retrospect  | CE-MR       |
| Loskant                                               | 1970 | 200   | chemistry       | cross-sec   | MR          |
| Demaret & Fialaire                                    | 1974 | 2364  | various         | cross-sec   | MR-Rx       |
| Michel-Briand et al.                                  | 1981 | 192   | various         | retrospect  | INT-CE      |
| Seibt et al.                                          | 1987 | 542   | textile (women) | retrospect  | CE-MR       |
| <b>C) Higher prevalence among day workers</b>         |      |       |                 |             |             |
| Leuliet                                               | 1963 | 564   | textile         | retrospect  | CE-MR       |

Legend (Methods): CE = Clinical examinations; EN = Endoscopy; HIR = Health insurance records; INT = interviews; MR = Medical reports; Q = Questionnaires; Rx = X-rays.

Table 12 Prevalence of digestive disorders in different groups

| Sector (N. people)        | Sex                 | Shift schedule/ rotation | Digestive troubles (score) | Gastro-duodenitis (%) | Peptic ulcer (%) | Use of antacids (%) |
|---------------------------|---------------------|--------------------------|----------------------------|-----------------------|------------------|---------------------|
| Textile (573)             | men: shiftworkers   | 3x8/week                 |                            | 42.6                  | 19.4             | 24.5                |
|                           | day workers         |                          |                            | 18.3                  | 4.9              | 8.4                 |
| Food (52)                 | women               | 3x8/week                 |                            | 28.0                  |                  | 16.0                |
| Hospital (682)            | men: shiftworkers   | 2/2/2/2                  | 11.8 ± 4.2                 | 19.0                  | 5.0              | 15.1                |
|                           | day workers         |                          | 11.1 ± 2.1                 | 15.4                  | 7.7              | 8.0                 |
|                           | women: shiftworkers | 2/2/2/2                  | 12.9 ± 4.5                 | 18.7                  | 2.0              | 12.3                |
|                           | day workers         |                          | 11.9 ± 4.3                 | 4.5                   | 0.0              | 3.7                 |
| Air traffic control (762) | men                 | 1/1/1/2                  | 13.2 ± 4.2                 | 34.4                  | 9.4              | 11.7                |

Source: Costa (1996)

was some evidence in that direction). Taylor and Fairrie (1968) have shown that many middle-aged men with chronic disabling conditions, including peptic ulceration, can live and work perfectly satisfactorily on rotating shiftwork. As Costa (1999) has written recently, 'Peptic ulcer ... is an old disease that is now disappearing, thanks to its better etiopathological definition (*helicobacter pylori*) and proper therapy'. It can still be a difficult and painful condition until it has been diagnosed and treated.

### Possible causes of indigestion

Shiftwork interferes with mealtimes. Meals are an important socio-environmental synchroniser of human life, and upsets to these times can act unfavourably both on the digestion and on psychophysiological conditions.

Due to the most common hours of starting and ending shifts, one of the two main meals almost always has to be eaten either:

- (1) at home, but earlier or later than the normal time; or
- (2) at work, where the food - which is often cold and not always of good quality - is frequently consumed hurriedly and in uncomfortable rooms during a short pause in work.

And during night shifts, when canteens are often not available, shiftworkers may have no choice but to eat pre-packaged food, and tend to increase the intake of stimulating drinks (e.g. coffee, tea) and alcoholic beverages, as well as smoking tobacco.

Shiftwork's interference with mealtimes is illustrated in a group of chemical workers engaged in a 3x8 shift system (4 days on/2 days off) (Figure 9). Morning shift (06.00-14.00) upset lunch time, forcing most workers to delay their meal by 2 or 3 hours, while the afternoon shift (14.00-22.00) had the same effect on dinner time. On the other hand, workers on night shift (22.00-06.00) respected the usual mealtimes, but at the cost of interrupting their morning sleep to eat at midday with other family members. After the introduction of a restaurant service and a long break for meals, all the workers succeeded in maintaining their usual mealtimes (12.00-13.00 for lunch, 19.00-20.00 for dinner), at least during the day shifts.

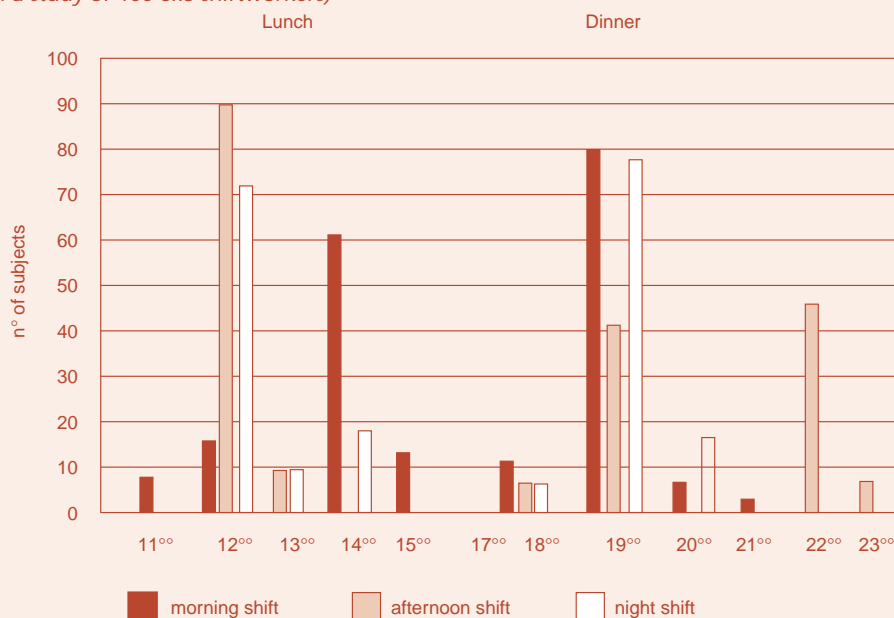
### Eating habits of shiftworkers

Léonard (1996) reports that he found in a survey that lunch is skipped by 25% of night workers, probably to avoid interrupting their sleep. 16% of the workers drink more coffee at night, while 13% smoke more. 64% of workers on three shifts smoke, compared with 44% on office schedules.

Companies only rarely offer warm meals at night. About 50% of the enterprises in Léonard's survey offer chips every day, which does not mean that they are eaten every day by the same people, but it is not an incitement to diversity. There is an insufficient consumption of starch and slow sugars (pasta and rice, for example). When fish is served, it is fried once or twice, which reduces employees' interest in it. Mayonnaise and pastries are often added to the menu, which harm the alimentary balance and can cause feelings of



Figure 9 Lunch and dinner times of shiftworkers  
(based on a study of 100 3x8 shiftworkers)



heaviness and tiredness. Fruit, a fruit salad, or salads with French dressing (a dairy product contributing calcium to the diet) should be offered. Unfortunately, most companies offer what is eaten by the greatest number of people, irrespective of the nutritional quality.

### Interaction between sleep and digestive problems

Sleep and digestive problems may also interact or share common features. For example, excessive use of caffeine can cause digestive problems, and can also carry over its effects, from keeping a shiftworker alert at night to making day sleep more easily broken. Wedderburn and Scholarios (1993) reported that most shiftworkers in one survey were opposed to complying with caffeine guidelines - i.e. to switch off caffeine intake 5 hours before sleep. Digestive pains may also disturb sleep. And for some shiftworkers, their digestive system is more problem-prone when they are sleep-deprived.

### Ulcer treatment

The treatment of stomach ulcers has changed enormously over the past 10 years. Where it once

often involved surgery, the discovery of *helicobacter pylori* has meant that many ulcers can now be cured by a week's course of three antibiotics. Even the treatment of chronic ulcers is much more drug- than surgery-based nowadays.

### Conclusion

The gloomy side of this chapter is that digestive problems, including serious ones, are the most clearly established adverse health consequence of shiftwork. The more cheerful side is that they are not universally found, and that there are some interesting examples available of how a positive intervention can greatly improve the situation. It is not easy to change people's eating habits, as they are very much built into a national culture, family lifestyle and personal preferences. For example, not everybody thinks in terms of two main meals a day: for some it may be three, for others only one. But because there are direct and often painful consequences of faulty digestion, there is at least some scope for improvement from intelligent changes and educational programmes. Developed Western economies do not seem to have completely solved all the problems of human eating.



## Cardiovascular problems

The stress connected to shift and night work may have adverse effects on the cardiovascular system through both direct and indirect means. Costa (1999) describes the peptic ulcer as an 'old' disease related to shiftwork, which is now disappearing. Cardiovascular diseases are now more prominent, perhaps because of better methods of measurement and detection.

The neurovegetative response or disruption leads to an increased hormonal response (catecholamines and cortisol in particular) with consequent effects on blood pressure, heart rate,

thrombotic processes, lipid and glucose metabolism. Less favourable living conditions, psychological troubles, eating and sleeping disorders, and tobacco smoking can also be significant risk factors for cardiovascular diseases. There are a great many possible confounding factors that can act as mediators or modifiers, such as age, smoking, diet, and social class (see Boggild and Knutsson, 1999, for an extensive review).

Table 13 shows a summary of a number of studies compiled by Costa (1999).

Table 13 *Studies of shiftwork and cardiovascular disorders*

| Author               | Year | Number  | Ass | Study                          | RR/OR   | Method  |
|----------------------|------|---------|-----|--------------------------------|---------|---------|
| Thiis-Evensen        | 1958 | 14,308  | NO  | Morbidity, manual workers      |         | ce-in-q |
| Aanonsen             | 1959 | 1,106   | NO  | Morbidity, manual workers      |         | ce-is   |
| Leuliet              | 1963 | 564     | NO  | Morbidity, 12-yr follow-up     |         | ce      |
| Taylor & Pocock      | 1972 | 8,603   | NO  | Mortality, 13 yrs              |         | dc      |
| Koller et al.        | 1978 | 270     | YES | Wh/blue collars complaints     |         | q-in    |
| Angersbach et al.    | 1980 | 640     | NO  | Morbidity, retrospect., cohort |         | mr-is   |
| Michel-Briand et al. | 1981 | 200     | YES | In transferred shiftworkers    |         | ce      |
| Alfredsson et al.    | 1982 | 14,500  | YES | Myoc. infarc., national stats. | 1.26    | db-is   |
| Koller               | 1983 | 301     | YES | With increasing age            |         | ce-in   |
| Frese & Semmer       | 1986 | 3,446   | YES | In drop-outs                   |         | q       |
| Alfredsson et al.    | 1985 | 958,096 | YES | IHD, national stats            | 1.2-1.5 | db      |
| Knutsson et al.      | 1986 | 504     | YES | IHD, histor prospect, 14 years | 1.4     | mr      |
| Knutsson et al.      | 1988 | 601     | YES | Blue collars, risk factors     |         | q-ce    |
| Kawachi et al.       | 1995 | 79,109  | YES | CHD, women, 4-yr follow-up     | 1.38    | mr-q-in |
| McNamee et al.       | 1996 | 934     | NO  | Mortality, case-control, 42 yr | 0.90    | mr-db   |
| Tenkanen et al.      | 1998 | 1,806   | YES | CHD, 6-yr cohort follow-up     | 1.3     | ce-q    |
| Knutsson et al.      | 1999 | 4,648   | YES | Men-women, case-control        | 1.3-3.0 | mr-dc-q |
| Boggild et al.       | 1999 | 5,249   | NO  | Men, prospect cohort, 22 yrs   | 0.96    | ce-q    |

*Legend (Methods): ce = clinical examinations; dc = death certificates; db = data banks; in = interviews; is = insurance records; mr = medical records; q = questionnaires; RR = Relative Risk; OR = Odds Ratio; Ass = Association*

Table 14 Cardiovascular risk rates as a function of years of shiftwork experience (day work = 100)

|                     | Years of shiftwork |       |       |       |       |        |
|---------------------|--------------------|-------|-------|-------|-------|--------|
|                     | 0                  | 2-5   | 6-10  | 11-15 | 16-20 | 21-    |
| RR                  | 1.0                | 1.5   | 2.0   | 2.2   | 2.8   | 0.4    |
| Proportion with IHD | 9/110              | 3/58  | 7/60  | 10/81 | 10/52 | 4/122  |
| Person-years        | 1414.5             | 776.0 | 751.0 | 928.0 | 647.0 | 1722.5 |
| p-values            | ..                 | NS    | NS    | 0.04  | 0.03  | NS     |

Legend: RR = Relative Risk; IHD = Ischaemic Heart Disease; NS = Not Significant  
Source: Knutsson (1989)

In recent years, some epidemiological studies reported data indicating an increased prevalence of cardiovascular complaints, particularly among shiftworkers transferred to day work for health reasons (Koller et al., 1978; Angersbach et al., 1980; Frese and Semmer, 1986); others reported a higher morbidity for hypertension (Michel-Briand et al., 1981) and ischaemic heart diseases (Knutsson et al., 1986; Koller, 1983; Alfredsson et al., 1982). Still other studies reported a higher prevalence among shiftworkers of some risk factors for cardiovascular diseases, such as alterations of lipid metabolism and smoking (De Backer et al., 1987; Thelle et al., 1976; Orth-Gomer, 1983; Knutsson et al., 1988; Knutsson, 1989; Romon et al., 1990).

Knutsson's studies have been particularly influential recently. In his first study, a 14-year follow-up study of 504 workers in a paper mill plant showed up to twice the incidence of heart disease in relation to the level of exposure to shiftwork (Knutsson et al., 1986). The results are illustrated in Table 14. For the first 20 years of shiftwork experience there was a monotonic rise in cardiovascular disease in the workers. After that time, presumably, those who could not tolerate shiftwork had either died or switched to day work; and then the remaining shiftworkers no longer had a higher incidence than the day workers (similar to the situation where digestive ailments could only be attributed to shiftwork when considering those workers who transferred out). (See also Aanonsen, 1959.)

Corroborating evidence for a direct effect of shiftwork comes also from a study by Orth-Gomer (1983), which involved a more chronologically sound schedule (e.g. phase delay rotation) that directly lowered such coronary risk factors as serum triglycerides. Sleep also improved with this schedule.

Not all studies of shiftworkers show this pattern of increased risk of heart disease (compare Taylor, Pocock and Sergean, 1972). Knutsson pointed out the risk of confounding factors, such as different rates of smoking, and attempted to control for these statistically. But, as his own writing admits, it is very difficult to do this in a completely conclusive way. It is also always possible in any single study for other unobserved lifestyle factors to carry significant causal effects.

### Conclusions

In practical terms, it is important to monitor shiftworkers' health regularly, and to promote known countermeasures for heart disease, such as healthy diet and regular exercise. One of the really useful side effects of the Directive on the Organisation of Working Time is that regular medical monitoring is required, and as a result much better information on the medium- and long-term effects of shiftwork should become available over time. Heart disease detected early can often be brought under control.



## Women's problems

As the laws on women working at night have been removed, and more women have gradually moved into shiftwork, the special issues around women's health have rightly attracted some research attention.

Menstrual disorders among women shiftworkers, particularly those on rotating shifts, have been reported by several authors.

A large Japanese study of about 2,000 women in industry recorded that women involved in night work, particularly those between 25 and 34 years of age, complained more frequently of irregular cycles and menstrual pains (Uehata and Sasakawa, 1982). The same findings have been reported from other countries and in different work activities (textile, airline, hospital, steel) (Wongphanich et al., 1982; Colligan et al., 1979; Axelsson and Molin, 1988). Pokorski et al. (1990) noted that discomfort stemming from premenstrual and menstrual phases was more marked when they coincided with the night-shift period.

On fertility, some extensive epidemiological studies in the last 15 years have recorded a significantly higher risk of miscarriage, as well as lower rates of pregnancies and deliveries (particularly in those having irregular menstrual cycles), and severe menstrual pains among those working on rotating or irregular shifts. Some main findings are worth reporting briefly.

Uehata and Sasakawa (1982) found a higher frequency of miscarriages in shiftworkers (28.1% versus 17.8% in day workers) as well as a lower rate of pregnancy (10% vs 18.1%). Axelsson et al. (1984, 1989) found that women working on rotating and irregular shift schedules had a higher risk of miscarriage than those working on day or permanent evening and night shifts.

McDonald et al. (1988a), in a large Canadian study involving more than 56,000 women in six occupational groups, found that rotating

shiftwork in health and service sectors was associated with a higher incidence of spontaneous abortions. Also, shiftwork was reported as the fourth highest risk factor, preceded by heavy weight lifting, physical effort and cold exposure, but followed by other important factors such as long working hours, standing work, and exposure to noise and vibrations. Some studies also pointed out an association between shift and night work with prematurity and/or low birthweight (Mamelle et al., 1984; McDonald et al., 1988b; Armstrong et al., 1989; Axelsson et al., 1989; Nurminen, 1989).

In a study of a group of 252 nurses, Costa (1996) reports finding a slightly higher frequency of irregular menstrual cycles among shiftworkers (22.1% vs 18.2% of day workers), and a higher prevalence of premenstrual and menstrual syndromes (24% vs 19%).

A lower rate of pregnancy was also noted among the shiftworkers (43.9% had two or more pregnancies in comparison with 60% of day workers), who also appeared to get pregnant for the first time one year later on average (25.2 vs 24.2 years), and to have the first baby 1½ years later than day workers (6.1 vs 4.5 years after the marriage, on average). This may be due to personal choices and social factors, as well as to biological factors, so is not necessarily a problem.

### Effects on maternity

Research concerning the course of pregnancy and birth is more limited and recent.

A survey of workers in the foodstuffs industry brought to light a relationship between the variability of work schedules and disturbances of the menstrual cycle, e.g. irregular cycles, amenorrhoea, or abnormally long cycles (Messing et al., 1993). A Japanese survey reported a greater frequency of spontaneous abortions in women working nights or shift schedules (Uehata and Sasakawa, 1982). A vast Canadian study concerning women working in a number of

professional sectors concluded that the working of shifts retards fetal development and increases the risk of prematurity (McDonald et al., 1988a; Armstrong et al., 1989); and a Swedish study (Axelsson et al., 1989) supported the theory that irregular working hours have a negative effect on birthweight. The Nurminen survey (1989), in a similar vein, found that alternating schedules associated with a noisy work environment were likely to increase the risk of miscarriage. In France, two surveys have been carried out, one linking shiftwork and prematurity (Mamelle et al., 1984) and the other not finding any link between night work and prematurity or low birthweight (Saurel-Cubizolles and Kaminski, 1987).

#### **Recent review**

Nurminen (1998) recently reviewed a batch of studies on waiting time to pregnancy,

spontaneous abortion, preterm birth, and intrauterine growth. She concluded that the evidence remains ambiguous in several areas, partly because of inexact definitions of what kind of shiftwork is involved, but that it would be prudent to consider shiftwork as a potential risk to reproduction.

#### **Conclusion**

The proportion of women working at night is still generally lower than that of men. Now that various European cases have made it clear that it is illegal to restrict women from working at night, it is obviously important that any effects on women's gynaecological functions should be properly and fully researched, and appropriate care taken to make sure that they and their babies are not put at risk.



## Social problems

### Well-being/social life

A healthy social and domestic life is an important foundation for good physical and mental well-being. A previous issue of BEST covered 'Social and Family Factors in Shift Design' (Wedderburn, 1993).

While the varying distribution of work at uncommon hours may not be immediately harmful, it can affect the well-being of shiftworkers and their families. Shiftworkers themselves often regard the disturbances to their social life as more serious than other effects (e.g. Wedderburn, 1967). Findings from research on which there is a considerable degree of consensus are as follows.

- Shiftwork and irregular work impose heavier demands on the organisation of household and family activities in comparison with daytime working, because various patterns (which may also be viewed as 'rhythms') have to be geared to each other:
  - the shiftworker's sexual/social role as a partner may be restricted;
  - the parental role may also be restricted;
  - extra or restricted activities in the household (e.g. more meals; no hoovering in the daytime);
  - reduced possibility of using a crèche and of the partner's having a job.
- Organising informal activities outside the family presents more problems than when work is done at 'common' hours. It requires more effort to visit relatives and friends, to participate in clubs and to go out at night. As a result, a shiftworker is more dependent on individual leisure activities.
- As a consequence of the above, a sense of alienation from society and isolation from the family may develop.

Again, these phenomena do not occur in all people working at uncommon hours. Individual differences between people play a part, as does

the degree of 'social support' which the social environment has to offer (Thierry and Jansen, 1982). There are also differences between working-time arrangements, looking again at the Dutch scheduling information. Table 15 shows that the more 'deviant' the type of work, the more complaints are expressed.

Table 15 *Family and social activities*  
(Average scores on two social variables in daytime working and three types of shiftwork)

|                 | Complaints about time for family activities* | Complaints about time for social activities** |
|-----------------|----------------------------------------------|-----------------------------------------------|
| Daytime working | 0.3                                          | 1.0                                           |
| Discontinuous   | 0.9                                          | 2.1                                           |
| Semi-continuous | 1.1                                          | 2.3                                           |
| Continuous      | 1.2                                          | 2.5                                           |

Source: Jansen (1987)

\* Minimum score = 0, maximum score (many complaints) = 4

\*\* Minimum score = 0, maximum score (many complaints) = 11

### Repercussions of shiftwork on social life

Shiftwork also brings with it a desynchronisation with the general rhythms of social life. This constitutes an important constraint which affects the social and family life of shiftworkers and could be a source of disturbance.

Shiftwork affects the quality of the shiftworker's relations with those close to him and with his wider social network. These difficulties can affect the equilibrium and health of the shiftworker in two ways.

- The concern to preserve sufficient and satisfying relationships could lead the shiftworker to organise his daily life (i.e. sleep and mealtimes) in an unhealthy manner.

- The proven difficulties in this area generate psychological tension capable of having repercussions on health, through, for example, sleep disturbances and psychosomatic processes.

The problem of social desynchronisation was pointed out long ago, and was particularly well addressed in the in-depth study by Mott et al. (1965).

The limitations imposed on family and social life by shiftwork are well documented in many surveys, such as the survey of German police personnel carried out by Knauth et al. (1983). This study, comparing 2,814 police officers working shifts and 1,182 with normal day hours, recorded that 60 to 80% of the shiftworkers reported not having enough time to participate in family life, associated activities, cultural events, get-togethers with friends, or even hobbies, compared with less than 20% of the officers with normal hours.

Restriction from participation in social life in formalised frameworks is attested to by numerous studies. The results of one of these, a survey of customs officials (Gadbois, 1996), showed a lower frequency of association membership and of taking on responsibilities in these associations, all the more noticeable since the system of shiftwork used conflicted even more than usual with typical social rhythms.

Relationships within the family are also affected by shiftwork, and this has more significant repercussions on health. The shiftworker's common free time with his children is more limited.

Nachreiner (1984) provided an eloquent illustration of this, establishing a systematic estimation of free time as a function of the age of children and the type of shiftwork (slow alternating/fast alternating).

- For a fixed alternating shift schedule, the average amount of available free time that a

| Table 16 <i>Effects of shiftwork on family shared free time</i>         |                           |                                      |          |           |                |             |
|-------------------------------------------------------------------------|---------------------------|--------------------------------------|----------|-----------|----------------|-------------|
| (a) Concomitant free time for all members of the family (hours per day) |                           |                                      |          |           |                |             |
| Family situation:                                                       | Families without children | Families whose children are between: |          |           |                |             |
|                                                                         |                           | 0 and 6                              | 7 and 15 | 16 and 19 | adult children | mixed cases |
| <i>When the father is:</i>                                              |                           |                                      |          |           |                |             |
| on morning shift                                                        | 5.6                       | 4.6                                  | 3.2      | 4.4       | 5.8            | 3.7         |
| on afternoon shift                                                      | 2.7                       | 3.2                                  | 0.4      | 0.1       | 3.5            | 0.2         |
| on night shift                                                          | 5.1                       | 5.5                                  | 3.0      | 2.0       | 5.0            | 3.3         |
| (b) Concomitant free time for father/children (hours per day)           |                           |                                      |          |           |                |             |
| Family situation:                                                       | Families without children | Families whose children are between: |          |           |                |             |
|                                                                         |                           | 0 and 6                              | 7 and 15 | 16 and 19 | adult children | mixed cases |
| <i>When the father is:</i>                                              |                           |                                      |          |           |                |             |
| on morning shift                                                        | ****                      | 4.9                                  | 3.7      | 4.8       | 5.9            | 4.2         |
| on afternoon shift                                                      | ****                      | 3.8                                  | 0.5      | 0.8       | 4.1            | 0.6         |
| on night shift                                                          | ****                      | 5.7                                  | 3.4      | 3.1       | 5.1            | 3.5         |

father could have in common with his child varied from 41 hours per week to 35 or 45 depending on whether the child is 2, 11 (primary school) or 17 (high school) years old. Compared to a worker on a normal schedule, this potential common time with one's child is three times greater when it involves a 2-year old, but almost less than half when the child is 11 or 17 years old.

A study by Pietsch and Oginska (1987) clearly supports this point. In Polish iron and steel industry workers, common free time for all members of the family tended to be even more reduced, but the families with children between 16 and 19 years of age shared the least amount of common free time.

Pietsch and Oginska also provided another concrete example of these findings through examination of the presence/absence of different members of the family when meals were taken at home by the shiftworker at times dictated by his shiftworking hours.

### Life as a couple

Relations between partners are clearly affected by shiftwork. All surveys show an insufficiency of time shared with the partner. For example, a study carried out in the British iron and steel industry reported that 40% of shiftworkers complained of not having enough time to spend with their wives (Wedderburn, 1975). Similarly, a French survey of 800 nurses reported that 60% of the nurses on fixed day shifts/fixed night shifts and 85% of the nurses on alternating morning/afternoon or night/day shifts felt that they had insufficient time to spend with their partners (Estryn-Behar et al., 1990).

But the lack of time shared with the partner is not simply a quantitative lack. The reduction in shared time also affects the content and quality of the couple's relationship.

These effects are expanded in a study carried out among 1,000 shiftworkers in five American factories (Mott et al., 1965). The comparison between types of shiftwork (continuous alternating 3x8, fixed afternoons and fixed nights) shows that, among these workers, those on alternating shifts encountered the most

difficulties regardless of the aspect of partner relations considered. For them, the greatest problem concerned their wives' safety in their absence during periods of night work. Also of great concern were obstacles encountered regarding their sex life and spending time together in other shared activities. Also affected, although to a lesser degree, were the reasons and manner in which family decisions were made, and the participation of shiftworkers in domestic tasks.

Of course, these difficulties are not always found in exactly the same way; they can vary from one situation to another according to social contexts and to specific characteristics of the shift system. But their importance remains, corroborated by other surveys, especially those regarding sex life. One out of two British iron and steel workers working a 3x8 schedule described the night shift as 'sexless' (Wedderburn, 1975). Similarly, workers in two Dutch factories complained of a restriction in their sex life.

Relationship problems between partners created by shiftwork can have more serious consequences in the long term. The study by Mott et al. mentioned above reported, for example, that the three groups of shiftworkers, regardless of their shift system (3x8, fixed night, fixed afternoon), felt less marital happiness than workers in the same companies performing normal day schedules. Similarly, an Austrian survey which questioned refinery shiftworkers twice at an interval of five years reported a decrease in compatibility in the couple (Koller et al., 1990). The question of whether shiftwork leads to a greater frequency of relational break-ups remains open due to its not having been sufficiently systematically explored by surveys carried out so far. But Mott et al. argue that social problems can lead to psychological disturbances and health problems.

### Conclusion

A happy social and domestic life is an important foundation for good mental health, and shiftwork can put strains on this. An increasing emphasis on 'family-friendly' policies among good employers may do something to improve this situation. But it is also easy for employers to forget that changing working times affect families as well as the individual shiftworker.







## Psychological problems

### Psychoneurotic disorders

Shiftworkers, in particular those with night work, have been reported to complain more frequently than day workers of symptoms related to chronic fatigue, nervousness, anxiety, sexual problems and depression, with consequent increased use of sleeping pills and tranquillisers. Such disturbances are connected in part to sleep loss and chronic fatigue (due to disruption of circadian rhythms), and in part to interference with family and social roles.

Such interference with family roles (particularly for women) and some personality traits (e.g. neuroticism) can be important factors favouring a higher vulnerability to psychological disorders in some individuals. It also has to be taken into account that they can in turn be a contributing factor in other psychosomatic complaints or diseases (i.e. gastrointestinal and cardiovascular).

It is difficult to evaluate the extent, in frequency and gravity, of such disturbances, as the methods used by authors of such studies are highly variable: some used interviews, questionnaires or health insurance data, while others carried out direct medical investigations, sometimes with psychological or psychiatric check-ups (see Costa, 1995, for a short list of papers).

Moreover, particularly in this field where the borders between 'normal' and 'abnormal' are often not well defined nor easily detectable, it is imperative to adopt standardised methods and homogeneous procedures in order to define with more exactness the effective relationship between such significant disorders and shiftwork.

A retrospective historical study of a group of 573 male Italian shiftworkers from a textile factory

found, through clinical examinations and medical reports, a far higher incidence of neurotic disorders (meaning 'anxiety or depression requiring treatment with psychotropic drugs for more than three months or hospitalisation') among rotating three-shift workers and, above all, permanent night workers, in comparison with day and two-shift workers (Table 17).

Another study reflected a very high frequency of psychological complaints in a group of women shiftworkers in the food industry after the introduction of night work. In other groups of shiftworkers (e.g. air traffic controllers and nurses), a significant correlation was recorded between minor psychological disorders (evaluated by Goldberg's GHQ) and neuroticism and cognitive anxiety. Among nurses, women shiftworkers complained more of psychological disturbances than women day workers and men (Costa, 1996).

### Conclusion

Mental well-being, expressed as positive exuberance and joy in living, with its other extreme running from neurotic upsets to major psychotic illnesses, is an under-researched area in shiftwork, but one of some importance. There is a growing amount of evidence that these states are not inevitable. A good proactive mental attitude to shiftwork (expressed as hardiness (Wedderburn, 1995) or internal locus of control (Smith et al., 1995)) is an asset in coping with unusual working hours. There is also some evidence that people can be trained and these emotionally positive outlooks can be deliberately cultivated. On the other hand, experience of night work with little choice can raise scores for neuroticism (Bohle and Tilley, 1989).

| Table 17 <i>Prevalence of psychoneurotic troubles in different groups</i> |                  |                              |                                              |                                         |                                 |
|---------------------------------------------------------------------------|------------------|------------------------------|----------------------------------------------|-----------------------------------------|---------------------------------|
| Sector (N people)                                                         | Sex              | Shift schedule/<br>rotation  | Minor<br>psychic<br>troubles<br>(GHQ scores) | Chronic<br>anxiety or<br>depression (%) | Use of<br>tranquillisers<br>(%) |
| Textile (573)                                                             | men              | shiftwork                    |                                              |                                         |                                 |
|                                                                           |                  | - permanent                  |                                              | 64.4                                    | 37.4                            |
|                                                                           |                  | - rotating (3x8)<br>day work |                                              | 22.1                                    | 17.2                            |
|                                                                           |                  | - 2 shifts<br>- normal day   |                                              | 9.4<br>3.1                              | 2.1<br>1.7                      |
| Food (52)                                                                 | women            | 3x8 / week                   |                                              | 46.0                                    | 36.0                            |
| Hospital (682)                                                            | men: shiftwork   | 2/2/2/2                      | 12.8±4.3                                     | 5.8                                     | 6.1                             |
|                                                                           |                  | day work                     | 11.7±2.6                                     | 0.9                                     | 0.0                             |
|                                                                           | women: shiftwork | 2/2/2/2                      | 15.0±4.7                                     | 6.4                                     | 10.2                            |
|                                                                           |                  | day work                     | 14.3±5.5                                     | 3.0                                     | 3.0                             |
| Air traffic<br>control (762)                                              | men              | 1/1/1/2                      | 11.6±4.3                                     | 19.7                                    | 4.9                             |

Source: Costa (1996)



## Medical surveillance and health education

### Medical surveillance of shiftworkers

As shift and night work are clearly risk factors for the health and well-being of working people, careful medical surveillance has to be carried out, aimed at giving shiftworkers information, suggestions and guidelines on how best to cope with shiftwork, as well as detecting early signs or symptoms of intolerance to night work.

Counselling should deal with improving self-care strategies for coping, particularly on sleep, diet, stress management, physical fitness, housing conditions, transport facilities, and off-job activities (see BEST 3).

Medical examinations should focus primarily on sleeping habits and problems, digestive and psychosomatic complaints, and drug consumption, preferably using standardised questionnaires or checklists in order to make possible a comparison of the worker's health over the years. Medical surveillance can combine two aims:

1. guaranteeing an appropriate screening of workers who are going to be engaged in shiftwork; and
2. carrying out careful periodic assessments of suitability for shift and night work.

For initial screening, it must be stressed that shiftwork should not be a discriminating criterion for selection of workers. If shift schedules and rotas are designed according to psycho-physiological and social criteria (BEST 5 and BEST 7) and suitable compensatory measures for shift and night workers (BEST 4) are in place, to a large extent the system should be self-correcting.

However, it is also obvious that some problems or illnesses may be a contraindication for shiftwork, particularly when associated with other stress factors (e.g. heavy work, heat, noise, high psychological demands). For this reason it is important that occupational health practitioners

carry out a preventive evaluation of both working conditions and health status before assigning persons to shift and night work.

Taking into consideration the various criteria and suggestions proposed by several authors and institutions (e.g. Ministry of Labour, France, 1978; Austrian Law, 1981; ILO, 1988), it appears reasonable to propose these strategies of intervention.

### A) Persons suffering from the following conditions, which could be connected to or worsened by shiftwork, should be exempted from night work:

- severe gastrointestinal diseases, such as peptic ulcer, chronic active hepatitis, cirrhosis, and chronic pancreatitis;
- insulin-dependent diabetes, since regular and proper food intake and correct therapeutic timing are required;
- severe thyroid (thyrotoxicosis and thyroidectomy) and suprarenal pathologies, since they require regular drug consumption strictly connected to activity/rest periods;
- epilepsy requiring medication, as sleep deficit can increase the possibility of seizures, and the efficacy of the treatment can be hampered by irregular waking/resting schedules;
- 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/wake cycle and can be influenced by light/dark periods;
- chronic sleep disturbances;
- spasmophilia, as temporal changes can be a promoting factor of tetanic crisis;
- chronic renal impairment;
- chronic heart diseases, such as myocardial infarction (up to 12 months later or while impaired heart function continues), angina pectoris, hyperkinetic syndromes and severe hypertension;

- malignant tumours;
- pregnancy, particularly when there is a risk of miscarriage.

**B) Evaluate persons showing the following conditions very carefully before assigning them to night work:**

- under 25 (especially if living alone) and over 50 years of age, particularly those without previous experience of shiftwork;
- digestive disorders, in particular chronic gastritis, gastroduodenitis and colitis;
- chronic respiratory diseases, such as asthma and chronic obstructive bronchitis;
- alcoholism and other drug addictions;
- marked hemeralopia or visual impairment, which can make night work difficult or dangerous if there is reduced illumination;
- unsatisfactory housing conditions, particularly noisy bedrooms;
- women with small children (under 6 years);<sup>1</sup>
- long commuting times.

**C) Adopt some 'positive' criteria for assignment to night work**

Since studies show that tolerance to night work can be influenced by some individual characteristics (e.g. age, sex, neuroticism, sleep habits, anxiety traits, morningness or circadian phase position, general health conditions), it may be helpful to take these characteristics into account in order to assign night work primarily to people who, on the basis of their psychophysiological characteristics, health situation and living conditions, may be expected to encounter less difficulties in coping with it.

According to the research carried out in this field in recent years, the use of some personality tests, standardised questionnaires, rating scales and autorhythmometric recordings may be helpful in this respect.

**D) Periodic health checks**

A regular health check is a further important tool aimed at protecting shiftworkers' health. This should be done in the context of periodic work fitness evaluations planned by occupational physicians. The physician must determine the frequency of such examinations, taking into account work risk factors including both working conditions (e.g. shift rotas, environmental conditions, workload) and individual characteristics.

A German study group (Herrmann, 1982) proposed the following general guideline for periodicity of health examinations:

- a second health check not later than 12 months after starting night work;
- successive health checks at least:
  - every 2 years for those aged under 25;
  - every 5 years for those between 25 and 50;
  - every 2-3 years for those between 50 and 60; and
  - every 1-2 years for those over 60.

The importance of careful control during the first year of assignment to night work, considered crucial for many workers, has also been emphasised by other authors and legal acts. For example, the Technical Instruction of the French Ministry of Labour (1978) suggested that, during the first year, a medical examination be done after 2, 6 and 12 months.

Furthermore, fitness for shiftwork should be reconsidered whenever the worker complains of sleep troubles, gastrointestinal and psychological disorders, or other intervening illnesses that can hamper his psychophysical equilibrium and working capacity. This also applies when important changes in working activity occur, especially changes in physical workload, chemical pollution and high psychological strain. Temporary exemption from night work should be considered in cases of transient health impairments or difficulties in family or social life.

Finally, long-term medical surveillance should be arranged for people who leave night work for health reasons, in order to follow up their health status.

In June 1994, a new German law on working time (Arbeitszeitrechtsgesetz, ArbZRG) came into effect, stating that night workers have the right to a medical check-up before starting shiftwork, as well as regular check-ups every three years when shiftworking. Those who are 50 or older have a right to medical check-ups once a year (§ 6,3). All these check-ups are voluntary. The employers bear the costs, which include the direct costs of the check-up, any resulting costs, and

<sup>1</sup> This recommendation would break equal opportunity laws in some countries.

possible costs for childcare, as well as wages for the time taken, even if the night worker visits the doctor outside his working hours (Buschmann and Ulber, 1994).

In Austria, the 1981 so-called 'Night Shift - Heavy Work Law' proved to be effective in reducing some of the problems of shiftworkers. Night work in combination with heavy work (e.g. mining, heat, cold, noise, vibration, work with respiratory masks, work with display units) above specified limits gives workers a series of special rights, e.g.:

- additional paid rest periods: 10 min/night;
- additional free days;
- early retirement after 15 years of exposure within the last 20 years;
- occupational health service and medical surveillance; and
- protection from dismissal of older and long-term shiftworkers.

To avoid these additional costs, working conditions in many plants have been improved substantially to fall well within the limits defined by the law (Koller et al., 1986). In other words, the new law provided an incentive for improving working conditions.

The employer has to transfer a night worker to a suitable day-work position if:

- a medical examination shows that there is a risk to the worker's health resulting from continued night work;

- there is a child under 12 years of age at home, for whom no other care is available;
- there is a relative at home, who needs intensive care from the night worker;

provided there are no urgent requirements/objections from the employer which would be an obstacle to the transfer.

Koller (1996) has summarised the most important recommendations for medical surveillance in Tables 18 to 20.

### Conclusion

The European Directive on Working Time introduced the right for shiftworkers to have medical checks, at the start of shiftwork and at regular intervals, at no cost to themselves. This has gradually come into effect, as each country passed its own legislation. For example, in the United Kingdom, new working time regulations came into effect on 1 October 1998.

This should be a spur to much better medical support for shiftworkers, better long-term follow-up and research, and a deeper understanding of the way health evolves under different shiftworking arrangements. On the other hand, its use depends on a request from the employee, and the UK guidance notes suggest that a standardised questionnaire may be sufficient in the first place.

| Absolute contraindications                                                                          | Relative contraindications                                                   |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Severe gastrointestinal dysfunctions and diseases, including chronic hepatic and pancreatic illness | Age above 40-45 years                                                        |
| Diabetes, especially if insulin dependent                                                           | Unsatisfactory housing conditions, especially concerning sleeping facilities |
| Epilepsy and seizures of other genesis                                                              | Lack of social support within the family                                     |
| Severe hormonal irregularities                                                                      | Women with small children                                                    |
| Cardiovascular high risk factors                                                                    |                                                                              |
| Consuming diseases                                                                                  |                                                                              |
| Depressive or psychotic states                                                                      |                                                                              |
| Chronic sleep disorders                                                                             |                                                                              |

Source: Koller (1996)

| Table 19 <i>Periodic medical surveillances</i>                                                                                                            |                                                                                                                                                                                                   |                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Health advice on:                                                                                                                                         | Medical history of:                                                                                                                                                                               | Risk factor screening (EEG, RR, blood lipids, etc.)                                                   |
| <ul style="list-style-type: none"> <li>• sleep strategies</li> <li>• diet</li> <li>• fatigue and stress management</li> <li>• physical fitness</li> </ul> | <ul style="list-style-type: none"> <li>• gastrointestinal, cardiovascular and circulatory symptoms</li> <li>• obesity</li> <li>• drug and stimulant abuse</li> <li>• sleeping problems</li> </ul> |                                                                                                       |
| To give the workers <b>information, suggestions and guidelines</b> on how to cope with shift and night work                                               | To detect <b>early symptoms</b> of difficulties in adjustment                                                                                                                                     | To detect <b>signs of intolerance</b> of shift or night work (which may require transfer to day work) |

Source: Koller (1996)

| Table 20 <i>Schedule of health check-ups</i>                              |                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| First supervision no later than 1-2 months after starting night/shiftwork | Subsequent health check-ups:                                                                                                                                                                                                                                                                   |
| Careful monitoring during the first year (1-2 check-ups)                  | <ul style="list-style-type: none"> <li>• in periods of ~2 years for workers &lt; 25 years</li> <li>• in periods of 3-5 years for workers between 25-45 years</li> <li>• in periods of ~2 years for workers &gt; 45 years</li> <li>• in periods of ~1 year for workers &gt; 60 years</li> </ul> |

Source: Koller (1996)



## BEST solutions

There are many potential countermeasures, some of which have already been discussed in earlier BEST publications, including the following.

- a) Reduce night and shiftwork as much as possible (however, the actual trend is probably the opposite).
- b) Design the shift system according to ergonomic criteria. This is one of the most effective countermeasures (Knauth, 1993).
- c) Try countermeasures (see BEST 3) against:
  - sleep problems;
  - problems with appetite and digestion;
  - social problems; and
  - deficits in training and education.
- d) Learn to adopt an adequate coping behaviour (see BEST 3).
- e) Reduce the combination of additional negative working conditions, such as night work plus noise, unfavourable climatic conditions, dust and so on.
- f) Carry out regular medical surveillance and counselling.
- g) Improve laws.
- h) Pay shift premiums (see BEST 4). This is the worst and least adequate 'countermeasure', because it does not actually reduce the problems and may weaken self-selection.

### Research and interventions

Several recommendations for interventions have already been mentioned in passing. For instance, viewing WTAs as an 'additional factor' in working conditions can result in special legislation being developed and introduced. Its purpose may be to minimise the application of atypical working hours as much as possible, but it may also be used to avoid, as much as possible, the accumulation of stressful circumstances (e.g. extreme temperatures in regular work at night involving demanding tasks). If the emphasis is on adjustment, interventions may involve coping

strategies at the individual or group level, such as when bedrooms are made soundproof or relaxation techniques are used. Adjustment at the level of a department or business unit might involve the coordination of various functional groups of staff members.

One type of intervention that can be advocated, from the perspectives of both the regulation of non-work time and rhythmic processes, is changing the design of schedules so that the number of consecutive night shifts is small. Not only does this short-cycle schedule produce fewer health risks, it also has a positive effect on leisure time. Another type of intervention, developed by research on rhythmic processes, is periodic exposure of volunteers to bright daylight in order to adjust their circadian rhythms more quickly to a new sleep/work pattern (Costa et al., 1993). Interventions from the perspective of selection are generally of a medical and/or a psychological nature.

A great deal of experience has also been gained with two other types of intervention, both relating to features of schedules, described below.

### RRPA

The first, developed by Jansen (1987), is the Rota Risk Profile Analysis (RRPA). This is a computer program through which the psychosomatic and psychosocial risk of schedules may be ascertained. One of the psychosocial features is periodicity, which indicates the degree to which a consecutive period of evening and/or night work takes place per week. Another psychosocial feature is weekend recreation, i.e. the extent to which weekends are free from work. On the basis of the actual risk profile of a schedule, any necessary improvements can be made 'on paper', before a schedule is actually introduced.



### Counterweight versus countervalue

The second type of intervention - counterweight versus countervalue - was developed in the second half of the 1970s (Thierry, Hoolwerf and Drenth, 1975; Thierry, 1980). It concerns the way in which unsocial working hours are compensated for in general. Drawbacks in working uncommon hours (e.g. sleeping problems, more fatigue, less club life) are contrasted with the counterweight advantage of an allowance or bonus amount so high that enough people can be found to work those hours. The unsocial working hours mentioned do not change as a result, though. In offering countervalue, on the other hand, interventions are chosen that try to deal as much as possible with the relevant complaints. Countervalue interventions therefore involve the same themes as those in which complaints occur (see, for example, Jansen, Thierry and van Hirtum, 1986).

Van Limborgh (1996) has developed a method for measuring the degree of inconvenience of a working-time arrangement and its 'compensatability'. Appraisals of the method by respondents

from quite different companies and institutions reflect a broad consensus. The results make it possible to award the same bonus for the same uncommon time arrangement in all kinds of branches of industry. They also offer all kinds of starting points for trying to reduce unsocial working hours and risks of harmful consequences.

More research is required on the last-mentioned themes, both in preventive and in curative respects. A relatively large amount of knowledge is already available on irregular work, but several important gaps exist. This is also true of flexible working hours: a great deal less is known about its short- and long-term effects. Precisely because this set of WTAs shows many changes, and because more and more people are faced with these WTAs, this field should not be allowed to have such an underdeveloped position in research as it has at present.

\* This chapter is a revised version of a comparable chapter in the handbook of *Work and Organisational Psychology* by Hk. Thierry and B. Jansen (1982).



## Conclusions

The reader should by now have reached the stage of thinking that there certainly can be problems for shiftworkers with regard to their health, and that, if possible, something should be done about it.

The solutions in Chapter 11 are a start. There is no doubt that it is possible to make shiftwork a little better and less potentially damaging to the health of people working shifts. The solutions suggested in Chapter 11 are important.

The gigantic problem, which needs to be stated, is that it is not easy. Shiftworkers are immersed in home and work situations that demand most of their attention and energy and are mixed up together in all kinds of ways. Changing one building block in this structure creates instability, and requires other changes all over the place, including changes for other people in the family.

But there is also something about shiftwork that seems to take proactive energy away from people, so that they may experience more difficulty than most people in changing their normal habits and ways to something more healthy. Thus the history of educational

programmes for shiftworkers is rather dismal.

There are few published reports of success in persuading shiftworkers to take a healthy initiative. In one case, a major study of exercise and sleep was involved, and nurses were asked to follow an exercise programme (Härmä et al., 1988). In another, a counselling programme of three sessions was used (Taylor, 1994). Another study using three hours of counselling only produced minor effects, although the shiftworkers involved seemed to value it (McKay, King, Slawek and Wedderburn, 1995).

The lesson, then, is that a health-improvement programme for shiftworkers has to be powerfully supported at all levels. Managers, occupational health practitioners, trainers, gym instructors, cooking staff and vending machine operators can all play a part, and should be organised to work together to make real changes.

And if such initiatives are properly documented, and the health changes measured, then the rest of the world will be very interested to hear the results.



## Bibliography

- Aanonsen, A., 'Medical problems of shiftwork', *Industrial Medical Surgery*, **28**, 1959, 422-427.
- Aanonsen, A., *Shiftwork and health*, Oslo, Scandinavian University Books, 1964.
- Agervold, M., 'Shiftwork: a critical review', *Scandinavian Journal of Psychology*, **17**, 1976, 181-188.
- Åkerstedt, T., 'Inversion of the sleep wakefulness pattern: Effects on circadian variations in psychophysiological activation', *Ergonomics*, **20**, 1977, 459-474.
- Åkerstedt, T. and Fröberg, J.E., 'Shiftwork and health: Interdisciplinary perspectives', in P.Q. Rentos et al. (eds.), *Shiftwork and Health*, Washington, D.C., NIOSH, 1976.
- Åkerstedt, T. and Gillberg, M., 'Sleep Disturbances and Shift Work', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Proceedings of the Vth International Symposium on Night and Shift Work, Oxford, Pergamon Press, 1981, 127-138.
- Åkerstedt, T. and Kecklund, G., 'Stability of Day and Night Sleep: A Two-Year Follow-Up of EEG Parameters in Three-Shift Workers', *Sleep*, **14** (6), 1991, 507-510.
- Alfredsson, L., Karasek, R. and Theorell, T., 'Myocardial infarction risk and psychosocial work environment: An analysis of the male Swedish working force', *Soc. Sci. Med.*, **16**, 1982, 463-467.
- Alfredsson, L., Spetz, C.L. and Theorell, T., 'Type of occupation and near hospitalisation for myocardial infarction and some other diagnoses', *International Journal of Epidemiology*, **14**, 1985, 378-388.
- Alfredsson, L., Åkerstedt, T., Mattson, M. and Wilborg, B., 'Self-reported health and well-being amongst night security guards: a comparison with the working population', *Ergonomics*, **34**, 1991, 525-530.
- Andersen, J.E., 'The main result of the Danish medico-psycho-social investigation of shiftworkers', *XII International Congress for Occupational Medicine, Helsinki*, **3**, 1957, 135-136.
- Andersen, J.E., *Three shiftwork: A sociomedical survey*, Copenhagen, Teknisk Forlag, 1970.
- Angersbach, D., Knauth, P., Loskant, H., Karvonen, M.J., Undeutsch, K. and Rutenfranz, J., 'A retrospective cohort study comparing complaints and diseases in day and shift workers', *International Archives of Occupational and Environmental Health*, **45**, 1980, 127-140.
- Armstrong, B.G., Nolin, A.D. and McDonald, A.D., 'Work in pregnancy and birthweight for gestational age', *British Journal of Industrial Medicine*, **46**, 1989, 196-199.
- Axelsson, G., Lutz, C. and Rylander, R., 'Exposure to solvents and outcome of pregnancy in university laboratory employees', *British Journal of Industrial Medicine*, **41**, 1984, 305-312.
- Axelsson, G. and Molin, I., 'Outcome of pregnancy among women living near petrochemical industries in Sweden', *International Journal of Epidemiology*, **17**, 1988, 363-369.
- Axelsson, G., Rylander, R. and Molin, I., 'Outcome of pregnancy in relation to irregular and inconvenient work schedules', *British Journal of Industrial Medicine*, **46**, 1989, 393-398.
- Betschart, H., *Zweischichtarbeit. Psychosoziale und gesundheitliche Aspekte* (Two-shift work: psychosocial and health aspects), Bern, Verlag Hans Huber, 1989.
- Bjerner, B., Holm, A. and Swensson, Å., 'Om natt-och skiftarbete' (in Swedish) (On night and shiftwork), *Statens Offentliga utredningar*, **51**, 1948.
- Boggild, H. and Knutsson, A., 'Shift work, risk factors and cardiovascular disease', *Scandinavian Journal of Work, Environment and Health*, **25**, 1999, 85-99.
- Boggild, H., Suadicani, P., Hein, H.O. and Gyntelberg, F., 'Shift work, social class, and ischaemic heart disease in middle-aged and elderly men: a 22-year follow-up in the Copenhagen male study', *Occupational and Environmental Medicine*, **56**, 1999, 640-645.
- Bohle, P. and Tilley, A.J., 'The impact of night work on psychological well-being', *Ergonomics*, **32**, 1989, 375-376.
- Bonnevie, P., 'Gesundheitliche Schäden durch Nachtarbeit. Ergebnisse einer dänischen Untersuchung', *Ärztliche Praxis*, **5**, 1953, 10.
- Bourget-Devouassoux, J. and Volkoff, S., 'Bilan de santé et carrière d'ouvriers' (Workers' health and careers), *Economie et Statistique*, **242**, 1991, 83-93.
- Brandt, A., 'Über den Einfluss der Schichtarbeit auf den Gesundheitszustand und das Krankheitsgeschehen der Werktätigen', *Studia Laboris et Salutis*, **4**, 1969, 124-152.
- Bruusgaard, A., *Medizinske vurderinger av sakslt helses, Kadelig Arbeid, saarlig Skiftarbeid* (Medical evaluation of work associated with risk of reduced health, in particular shiftwork), Oslo, 1949.

- Brusgaard, A., 'Shift work as an occupational health problem', *Studia Laboris et Salutis*, **4**, 1969, 9-14.
- Buschmann, R. and Ulber, J., 'Arbeitszeitrechtsgesetz mit weiteren Arbeitszeitvorschriften' (Law and further regulations on working time), Köln, Bund-Verlag, 1994.
- Cervinka, R., Koller, M. and Kundi, M., 'Gesundheitliche und soziale Aspekte der Schichtarbeit - Ergebnisse einer Längsschnittstudie' (Health and social aspects of shiftwork - results of a longitudinal study), in Institut für Gesellschaftspolitik (ed.), *Schichtarbeit und Gesundheit*, Heft 29, Wien, Mitteilungen des Instituts für Gesellschaftspolitik, 1986a, 9-31.
- Cervinka, R., Kundi, M., Koller, M. and Haider, M., 'Shiftwork effects on retired workers', in M. Haider, M. Koller and R. Cervinka (eds.), *Night and shiftwork: Long-term effects and their prevention*, Frankfurt am Main, Bern, New York, Verlag Peter Lang, 1986b, 93-100.
- Colligan, M.J., Frockt, I.J. and Tasto, D.L., 'Frequency of sickness absence and worksite clinic visits among nurses as a function of shift', *Journal of Environmental Pathology and Toxicology*, **2**, 1979, 135-148.
- Costa, G., 'The impact of shift and nightwork on health', *Applied Ergonomics*, **27**, 1995, 9-16.
- Costa, G., *Shiftwork and health*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1996.
- Costa, G., 'Shiftwork and health: the heritage of the twentieth century', Paper given at the XIVth International Symposium on Night and Shiftwork, Weisensteig, 1999.
- Costa, G., Apostoli, B., D'Andrea, F. and Gaffuri, E., 'Gastrointestinal and neurotic disorders in textile shift workers', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Proceedings of the Vth International Symposium on Night and Shift Work, Oxford, Pergamon Press, 1981.
- Costa, G., Ghirlanda, G., Minors, D.S. and Waterhouse, J.M., 'Effect of bright light on tolerance to shiftwork', *Scandinavian Journal of Work, Environment and Health*, **19**, 1993, 414-420.
- De Backer, G., Kornitzer, M., Peters, H. and Dramaix, M., 'Relation between work rhythm and coronary risk factors', *European Heart Journal*, **5** (Suppl. 1), 1987, 307.
- Demaret, D. and Fialaire, J., 'L'ulcère gastroduodéal en milieu de travail: Sa relation possible avec le régime des 3 x 8', *Archives Maladies Professionnelles*, **35**, 1974, 432-438.
- Deriennic, F., Touranchet, A. and Volkoff, S., 'Age, Travail, Santé: Etude sur les salariés âgés de 37 à 52 ans' (Age, work, health: study of employees aged 37 to 52 years), Enquête ESTEV, Paris, INSERM, 1992.
- Dirken, J.M., 'Industrial shiftwork: decrease in well-being and specific effects', *Ergonomics*, **9**, 1966, 115-124.
- Doll, A. and Jones, F.A., *Occupational factors in the aetiology of gastric and duodenal ulcers with an estimate of their incidence in the general population*, Medical Research Council, Special Series Report No. 276, London, HMSO, 1951.
- Duesberg, R. and Weiss, W., *Statische Erhebungen über die Häufigkeit des Magengeschwürs unter verschiedenen Berufsbedingungen*, Reichsarbeitsblatt 3, Arbeitsschutz 8, 1939, 272-273.
- Ensing, H., 'Bedrijfsgeneeskundigen de ulciszieke', *Tijdschrift Soc. Geneesk*, **47** (6), 1969, 178-186.
- Escriba, V., Pérez-Hoyos, S. and Bolomor, F., 'Shiftwork: its impact on the length and quality of sleep among nurses of the Valencian region in Spain', *Int. Arch. Occupational and Environmental Health*, **64**, 1992, 125-129.
- Estryn-Behar, M., Gadbois, C., Peigne, E., Masson, A. and Le Gall, V., 'Impact of nightshifts on male and female hospital staff', in C. Costa, G.C. Cesana, K. Kogi and A. Wedderburn (eds.), *Shiftwork: health, sleep and performance*, Frankfurt am Main, Verlag Peter Lang, 1990, 89-94.
- European Foundation, *Second survey of working conditions in Europe*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1997.
- Folkard, S., 'Is there a "best compromise" shift system?', *Ergonomics*, **35**, No. 12, 1992, 1453-1463.
- Folkard, S., Personal communication, 1996.
- Folkard, S., Arendt, J. and Clark, M., 'Sleep and mood on a "weekly" rotating (7-7-7) shift system: some preliminary results', in G. Costa, G. Cesana, K. Kogi and A. Wedderburn (eds.), *Shiftwork: health, sleep and performance*, Frankfurt am Main, Bern, New York, Paris, Peter Lang, 1990, 484-489.
- Folkard, S. and Barton, J., 'Does the "forbidden zone" for sleep onset influence morning shift sleep duration?', *Ergonomics*, **36**, 1993, 1-3, 85-91.
- Foret, J. and Benoit, O., 'Shiftwork: the level of adjustment to schedule reversal assessed by a sleep study', *Waking and Sleeping*, **2**, 1978, 107-112.
- Frese, M. and Semmer, N., 'Shiftwork, stress and psychosomatic complaints: a comparison between workers in different shiftwork schedules, non-shiftworkers and former shiftworkers', *Ergonomics*, **29**, 1986, 99-114.
- Fröberg, J., Karlson, C.G. and Levi, L., 'Shift work: A study of catecholamine excretion self-ratings and attitudes', in A. Swensson (ed.), 'Proceedings of the Second International Symposium on Night and Shift Work', *Studia Laboris et Salutis*, **11**, 1972, 10-12.
- Gadbois, C., *Shiftwork and health*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1996.
- Gauthier, M., Housset, P. and Martin, E., 'Enquête sur les troubles observés en milieu industriel', *Archives Maladies Professionnelles*, **22**, 1961, 129-134.

- Glettenberg, A., Undeutsch, K., Küpper, R., Schwarzenau, P., Karvonen, M. and Rutenfranz, J., 'Gesundheitliche Auswirkungen eines langfristigen kontinuierlichen Wechselschichtdienstes. Eine retrospektive Kohortstudie' (Health effects of long-term continuous shiftwork. A retrospective cohort study), in W. Brenner, J. Rutenfranz, E. Baumgartner and M. Haider (eds.), *Arbeitsbedingte Gesundheitsschäden - Fiktion oder Wirklichkeit?*, Stuttgart, Gentner Verlag, 1980, 177-183.
- Godard, J., Delambroise, A., Monnier, J.C., Durrmeyer, C.L., Moillie, C. and Colmiche, C.L., 'A propos du travail sur trois tournées dans la sidérurgie lorraine', *Archives Maladies Professionnelles*, **24**, 1973, 135-139.
- Graf, O., Pirtkien, R., Rutenfranz, J. and Ulich, I., *Nervöse Belastung im Betrieb. 1. Nachtarbeit und nervöse Belastung*, Forschungsbericht des Landes Nordrhein-Westfalen Nr. 530, Köln, Opladen, Westdeutscher Verlag, 1958, 1-51.
- Grosfeld, J.A.M., *De voorspelbaarheid van individuele verzuimduur* (The predictability of the individual duration of absenteeism), Amsterdam, Swets & Zeitlinger, 1988.
- Häkkinen, S., 'Adaptability to shiftwork', *Studia Laboris et Salutis*, **4**, 1969, 68-80.
- Härmä, M., Ilmarinen, J., Knauth, P., Rutenfranz, J. and Hänninen, O., 'Physical training intervention in female shiftworkers. II: The effects of intervention on the circadian rhythm of alertness, short-term memory, and body temperature', *Ergonomics*, **31**, 1988, 51-63.
- Herrmann, H., 'Bedeutung und Bewertung der Nachtarbeit - Gedanken zur Erstellung eines berufs-gesundheitlichen Grundsatzes', in T.M. Fließner (ed.), *Kombinierte Belastungen am Arbeitsplatz*, Stuttgart, Gentner Verlag, 1982, 61-70.
- Horne, J., 'Sleep loss: Underlying mechanisms and tiredness', in S. Folkard and T.H. Monk (eds.), *Hours of work: Temporal factors in work scheduling*, Chichester, Brisbane, New York, Toronto, John Wiley & Sons, 1985, 53-66.
- International Labour Office, *Nightwork*, Geneva, ILO, 1988.
- Jacquis, H., 'Travail posté et fatigue', *Archives Maladies Professionnelles*, **24**, 1963, 193-196.
- Jansen, B., *Dagdienst en ploegendienst in vergelijkend perspectief* (Daywork and shiftwork compared), Lisse, Swets & Zeitlinger, 1987.
- Jansen, B., *Shiftwork and health*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1996.
- Jansen, B., Thierry, H. and Hirtum, A. van, *Ploegenarbeidersroosters herzien* (Shiftwork rotas revised), Deventer, Kluwer, 1986.
- Japanese Association of Industrial Health, 'Opinion on nightwork and shiftwork', *Journal of Science Laboratory*, **55-8**, 1979, 1-36.
- Kawachi, I., Colditz, G.A., Stampfer, M.J., Willett, W.C. et al., 'Prospective study of shift work and risk of coronary heart disease in women', *Circulation*, **92**, 1995, 3178-3182.
- Kecklund, G. and Åkerstedt, T., 'Effects of timing of shifts on sleepiness and sleep duration', *Journal of Sleep Research*, **4** (suppl. 2), 1995, 47-50.
- Kiesswetter, E., Knauth, P., Schwarzenau, P. and Rutenfranz, J., 'Daytime sleep adjustment of shiftworkers', in W.P. Koella, E. Rütger and H. Schulz (eds.), *Sleep '84*, Stuttgart, G. Fischer, 1985, 273-275.
- Klein Hesselink, D.J., Verboon, F.C. and Berg, T.D.P.J. van den, *Arbeidstijden en ziekteverzuim* (Working times and absenteeism), The Hague, VUGA, 1995.
- Knauth, P., *Ergonomische Beiträge zu Sicherheitsaspekten der Arbeitszeitorganisation*, Düsseldorf, VDI-Verlag, 1983.
- Knauth, P., 'Schlafstörungen bei Schichtarbeitern' (Disturbances of sleep of shiftworkers), in V. Faust (ed.), *Schlafstörungen. Häufigkeit - Ursachen - Schlafmittel - nichtmedikamentöse Schlafhilfen*, Stuttgart, Hippokrates Verlag, 1985, 90-93.
- Knauth, P., 'The design of shift systems', *Ergonomics*, **36**, 1993, 1-3, 15-28.
- Knauth, P. and Hornberger, S., *Shiftwork and health*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1996.
- Knauth, P., Kiesswetter, E., Ottoman, W., Karvonen, M.J. and Rutenfranz, J., 'Time budget studies of policemen in weekly or swiftly rotating shift systems', *Applied Ergonomics*, **14** (4), 1983, 247-252.
- Knauth, P., Landau, K., Dröge, C., Schwittek, M., Widynski, M. and Rutenfranz, J., 'Duration of Sleep Depending on the Type of Shift Work', *International Archives of Occupational and Environmental Health*, **46**, 1980, 167-177.
- Knauth, P. and Rutenfranz, J., 'Duration of Sleep and Type of Shift Work', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Proceedings of the Vth International Symposium on Night and Shift Work, Oxford, Pergamon Press, 1981, 161-168.
- Knauth, P., Rutenfranz, J., Herrmann, G. and Poppel, S.J., 'Re-entrainment of body temperature in experimental shift-work studies', *Ergonomics*, **21**, 1978, 775-783.
- Knutsson, A., 'Relationships between serum triglycerides and gammaglutamyltransferase among shift and day workers', *Journal of Internal Medicine*, **226**, 1989, 337-339.
- Knutsson, A., Åkerstedt, T., Jonsson, B.G. and Orth-Gomer, K., 'Increased risk of ischaemic heart disease in shift workers', *Lancet*, **12**, 1986, 89-92.
- Knutsson, A., Åkerstedt, T. and Jonsson, B.G., 'Prevalence of risk factors for coronary artery disease among day and shift workers', *Scandinavian Journal of Work, Environment and Health*, **14**, 1988, 317-321.

- Knutsson, A., Hallquist, J., Reuterwall, C., Theorell, T. and Åkerstedt, T., 'Shiftwork and myocardial infarction: a case-control study', *Occupational and Environmental Medicine*, **56**, 1999, 46-50.
- Kogi, K., 'Sleep Problems on Night- and Shiftwork', in K. Kogi, T. Miura and H. Saito (eds.), *Shiftwork, its practice and improvement*, Proceedings of the 6th International Symposium on Night and Shift Work, Tokyo, Centre for Academic Publications Japan, 1982, 217-231.
- Koller, M., 'Health risks related to shift work', *International Archives of Occupational and Environmental Health*, **53**, 1983, 59-75.
- Koller, M., 'Occupational health services for shift and nightworkers', *Applied Ergonomics*, **27** (1), 1996, 31-37.
- Koller, M., Kundi, M. and Cervinka, R., 'Field studies of shiftwork at an Austrian oil refinery. I. Health and psychosocial well-being of workers who drop out of shiftwork', *Ergonomics*, **21**, 1978, 835-847.
- Koller, M., Cervinka, R., Kundi, M. and Haider, M., 'Night shift - heavy work's law in Austria: outcomes and perspectives', in M. Haider, M. Koller and R. Cervinka (eds.), *Night and shiftwork: long-term effects and their prevention*, Frankfurt am Main, Peter Lang, 1986.
- Koller, M., Kundi, M., Haider, M., Cervinka, R. and Firiza, H., 'Five-year follow-up of shiftworkers with respect to family life, job satisfaction, and health', *Le Travail Humain*, **53**, 1990, 153-174.
- Kolmodin-Hedman, B. and Swensson, A., 'Problems related to shiftwork', *Scandinavian Journal of Work, Environment and Health*, **1**, 1975, 254-262.
- Kundi, M., Koller, M., Cervinka, R. and Haider, M., 'Health and psychosocial aspects of shiftwork: results of a 5-year follow-up study', in M. Haider, M. Koller and R. Cervinka (eds.), *Night and shiftwork: Long-term effects and their prevention*, Frankfurt am Main, Bern, New York, Verlag Peter Lang, 1986, 81-92.
- Lavie, P., 'Ultrashort sleep-waking schedule III. "Gates" and "forbidden zones" for sleep', in *Electroencephalography and Clinical Neurophysiology*, **63**, 1986, 414-425.
- Léonard, R., 'Le travail de nuit et les horaires alternants', *Archives Maladies Professionnelles*, **40**, 1979, 10, 919-926.
- Léonard, R., *Health and working time*, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1996.
- Lesniak, A., Bajdur, M. and Sosnierz, O., 'Role of some ethiopathogenic factors of gastric and duodenal ulcer in miners', *Medycyna Dracy*, **12**, 1970, 201-208.
- Leuliet, S., 'Douze années de travail posté 3 x 8' (Twelve years of 3 x 8 shift work), *Archives Maladies Professionnelles*, **24**, 1963, 164-171.
- Limborgh, C. van, *Waardering van ongewone werktijden* (Assessment of unusual working times), Academic dissertation, Deventer, Kluwer, 1996.
- Loskant, H., 'Der Einfluss verschiedener Schichtformen auf die Gesundheit und das Wohlbefinden des Wechselschichtarbeiters', *Zbl. Arbeitsmed.*, **20**, 1970, 133-144.
- McDonald, A.D., McDonald, J.C., Armstrong, B., Cherry, N.M., Nolin, A.D. and Robert, D., 'Prematurity and work in pregnancy', *British Journal of Industrial Medicine*, **45**, 1988a, 56-62.
- McDonald, A.D., McDonald, J.C., Armstrong, B. et al., 'Fetal death and work in pregnancy', *British Journal of Industrial Medicine*, **45**, 1988b, 148-57.
- McKay, K.M., King, C., Slawek, K. and Wedderburn, A.A.I., 'The effectiveness of an individually tailored health education intervention for 24-hour shiftworkers', Paper presented at the XIIth Symposium on Night and Shift Work at Ledyards, Connecticut, 1995.
- McNamee, R., Binks, K., Jones, S., Faulkner, D., Slovak, A. and Cherry, N.M., 'Shiftwork and mortality from ischaemic heart disease', *Occupational and Environmental Medicine*, **56**, 1996, 367-373.
- Mamelle, N., Laumon, B. and Lazar, P., 'Prematurity and occupational activity during pregnancy', *American Journal of Epidemiology*, **119**, 1984, 309-322.
- Messing, K., Saurel-Cubizolles, M.J., Bourguine, M. and Kaminski, M., 'Factors associated with dysmenorrhoea among workers in French poultry slaughterhouses and canneries', *Journal of Occupational and Environmental Medicine*, **35** (5), 1993, 493-500.
- Michel-Briand, C., Chopard, J.L., Guiot, A., Paulmier, M. and Studer, G., 'The pathological consequences of shift work in retired workers', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Oxford, Pergamon Press, 1981, 399-407.
- Ministère du travail et de la participation (France), *Pour un meilleur travail posté* (For better shiftwork), 1978.
- Ministry of Employment and Work (Belgium), *Exploratory study on the use of drugs*, 1994.
- Minors, D.S. and Waterhouse, J.M., 'Circadian rhythms in general', in A.S. Scott (ed.), *Shiftwork. Occupational Medicine: State of the Art Reviews*, **5** (2), Philadelphia, Hanley and Belfus Inc., 1990, 165-182.
- Monk, T. and Folkard, S., *Making shift work tolerable*, London, Taylor and Francis, 1992.
- Moog, R., *Die individuelle circadiane Phasenlage - Ein Prädiktor der Nacht- und Schichtarbeitertoleranz*, thesis, Marburg/Lahn, 1988.
- Mott, P.E., Mann, F.C., McLoughlin, Q. and Warwick, D.P., *Shiftwork: the social, psychological and physical consequences*, Ann Arbor, University of Michigan Press, 1965.
- Nachreiner, F. and Rutenfranz, J., 'Socialpsychologische, arbeitspsychologische und arbeitsmedizinische Erhebungen in der Chemischen Industrie', in F. Nachreiner, F. Frielingsdorf and F. Romahn et al. (eds.), *Schichtarbeit bei kontinuierlicher Produktion*, Forschungsbericht Nr. 141 der Bundesanstalt für Arbeitsschutz und Unfallforschung, Dortmund, Wirtschaftsverlag Nordwest, 1975, 83-177.

- Nachreiner, F., Baer, K., Diekmann, A. and Ernst, G., 'Some new approaches in the analysis of the interference of shift work with social life', in A. Wedderburn and P. Smith (eds.), *Psychological approaches to night and shift work*, Edinburgh, Heriot-Watt University, 1984.
- Nurminen, T., 'Shift work, fetal development and course of pregnancy', *Scandinavian Journal of Work, Environment and Health*, **15**, 1989, 395-403.
- Nurminen, T., 'Shift work and reproductive health', *Scandinavian Journal of Work, Environment and Health*, **24** (suppl. 3), 1998, 28-34.
- Orth-Gomer, K., 'Intervention on coronary risk factors by adapting a shift work schedule to biologic rhythmicity', *Psychosomatic Medicine*, **45**, 1983, 407-415.
- Patkai, P., Åkerstedt, T. and Petterson, K., 'Field studies of shiftwork: Temporal patterns in psychophysiological activation in permanent nightworkers', *Ergonomics*, **20**, 1977, 611-619.
- Pietsch, E. and Oginska, H., 'Family life organisation in shift workers of a steel combine', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Coll. Advances in Biosciences, Oxford, Pergamon Press, 1981, 30.
- Pocock, S.J., Sergean, R. and Taylor, P.J., 'Absence from continuous three-shiftworkers: A comparison of traditional and rapidly rotating systems', *Occupational Psychology*, **46**, 1972, 7-13.
- Pokorski, J., Iskra-Golec, I., Czekaj, M. and Noworol, C., 'Menstrual rhythm and shiftwork interference - A subjective retrospective study', in G. Costa, G. Cesana, K. Kogi and A.A.I. Wedderburn (eds.), *Studies in Industrial and Organisational Psychology 10. Shiftwork: Health, Sleep and Performance*, Frankfurt am Main, Peter Lang, 1990.
- Rietschel, E., 'Magen Zwölffingerdarmgeschüre und Arbeitswelt', *Arbeitsmed, Sozialmed, Präventifmed*, **13**, 1978, 197-201.
- Romon, M., Grabiand, M.H., Nuttens, N.C., Fievet, C., Bar, J.M., Pot, P. and Furon, D., 'Plasma lipids and shiftwork', in G. Costa, G. Cesana, K. Kogi and A. Wedderburn (eds.), *Shiftwork: health, sleep and performance*, Frankfurt am Main, Bern, New York, Paris, Peter Lang, 1990.
- Rutenfranz, J., Knauth, P. and Angersbach, D., 'Shift work research issues', in L.C. Johnson, D.I. Tepas, W.P. Colquhoun and M.J. Colligan (eds.), *The twenty-four hour workday: Proceedings of a Symposium on Variations in Work-Sleep Schedules*, U.S. Department of Health and Human Services, 1981, 221-269.
- Saurel-Cubizolles, M.J. and Kaminski, M., 'Pregnant women's working conditions and their changes during pregnancy', a national study in France, *British Journal of Industrial Medicine*, **44**, 1987, 236-243.
- Schalk, M.J.D., *Determinanten van veelvuldig kortdurend verzuim* (Determinants of frequent short-term absenteeism), The Hague, Delwel, 1989.
- Segawa, K., Nakazawa, S., Tsukamoto, U., Kunta, Y., Goto, H., Fukui, A. and Takano, K., 'Peptic ulcer is prevalent among shiftworkers', *Digestive Diseases and Sciences*, **32**, 1987, 449-453.
- Seibt, A., Naumann, C. and Geist, H.W., 'On the development of health of female shift workers - findings of a retrospective longitudinal selection study', in A. Oginski, J. Pokorski and J. Rutenfranz (eds.), *Contemporary Advances in Shiftwork Research*, Krakow, Medical Academy, 1987.
- Smith, L., Norman, P., and Spelten, E., 'Shiftwork locus of control: scale development', *Work and Stress*, **9**, 1995, 219-226.
- Smulders, P.W.G., *Balans van 30 jaar ziekteverzuimonderzoek* (Balance of 30 years' research into absenteeism), Leiden, NPG/TNO, 1984.
- Stein, A., *Zur Frage der Belastung berufstätiger Frauen durch Nacht- und Schichtarbeit*, thesis, University of Munich, 1963.
- Taylor, E., *The evaluation of a counselling service for shiftworkers*, unpublished Ph.D. dissertation, University of Sheffield, England, 1994.
- Taylor, P.J., 'Shift and day work: a comparison of sickness absence, lateness and other absence behaviour at an oil refinery from 1962 to 1965', *British Journal of Industrial Medicine*, **24**, 1967, 93-102.
- Taylor, P.J. and Fairrie, A.J., 'Chronic disability in men of middle age', *British Journal of Preventive and Social Medicine*, **22**, 1968, 183-192.
- Taylor, P.J. and Pocock, S.J., 'Mortality of shift and day workers, 1956-1968', *British Journal of Industrial Medicine*, **29**, 1972, 201-207.
- Taylor, P.J., Pocock, S.J. and Sergean, R., 'Shift and dayworkers' absence: Relationship with some terms and conditions of service', *British Journal of Industrial Medicine*, **29**, 1972, 338-340.
- Tenkanen, L., Sjoblom, T. and Harma, M., 'Joint effect of shift work and adverse lifestyle factors on the risk of coronary heart disease', *Scandinavian Journal of Work, Environment and Health*, **24**, 1998, 351-357.
- Tepas, D.I. and Carvalhais, A.B., 'Sleep patterns of shiftworkers', *Occupational Medicine*, **5**, 1990, 199-208.
- Thelle, D.S., Forde, O.H., Try, K. and Lehmann, E.H., 'The Tromso heart study', *Acta Medica Scandinavica*, **200**, 1976, 107-118.
- Thierry, H., 'Compensation for shiftwork', in W.P. Colquhoun and J. Rutenfranz (eds.), *Studies of shiftwork*, London, Taylor & Francis, 1980.
- Thierry, H., Hoolwerf, G. and Drenth, P.J.D., 'Attitudes of permanent day and shiftworkers towards shiftwork - a field study', in W.P. Colquhoun, S. Folkard, P. Knauth and J. Rutenfranz (eds.), *Experimental studies of shiftwork*, Opladen, Westdeutscher Verlag, 1975.
- Thierry, H. and Jansen, B., 'Social support for night and shift workers', *Journal of Human Ergology*, **11**, 1982, 483-498.



- Thiis-Evensen, E., 'Shift work and health', *Industrial Medical Surgery*, **27**, 1958, 493-497.
- Tilley, A.J., Wilkinson, R.T. and Drud, M., 'Night and Day Shifts Compared in Terms of the Quality and Quantity of Sleep Recorded in the Home and Performance Measured at Work: A Pilot Study', in A. Reinberg, N. Vieux and P. Andlauer (eds.), *Night and shift work: biological and social aspects*, Proceedings of the Vth International Symposium on Night and Shift Work, Oxford, Pergamon Press, 1981, 187-196.
- Totterdell, P. and Folkard, S., 'The effects of changing from weekly rotating to a rapidly rotating shift schedule', in G. Costa, G. Cesana, K. Kogi and A. Wedderburn (eds.), *Shiftwork: health, sleep and performance*, Frankfurt am Main, Bern, New York, Paris, Peter Lang, 1990, 646-650.
- Uehata, T. and Sasakawa, N., 'The fatigue and maternity disturbances of nightwork women', *Journal of Human Ergology*, **11**, 1982, 465-474.
- Verhaegen, P., Cober, R., De Smedt, M., Dirx, J., Kerstens, J., Ryvers, D. and Van Daele, P., 'The adaptation of night nurses to different work schedules', *Ergonomics*, **30**, 1987, 1301-1309.
- Vernon, H.M., *Industrial efficiency and fatigue*, London, Routledge, 1921.
- Wedderburn, A.A.I., 'Social factors in satisfaction with swiftly rotating shifts', *Journal of Occupational Psychology*, **41**, 1967, 85-107.
- Wedderburn, A.A.I., *Studies of shiftwork in the steel industry*, Report to the BSC Fellowships Committee, London, British Steel Corporation, 1975, 200.
- Wedderburn, A.A.I. (ed.), *Social and family factors in shift design. Bulletin of European Studies on Time*, **5**, Dublin, European Foundation for the Improvement of Living and Working Conditions, 1993.
- Wedderburn, A.A.I., 'Men and women who like continuous shiftwork are more "hardy": but what does it mean?', *Work and Stress*, **9**, 1995, 206-210.
- Wedderburn, A. and Scholarios, D., 'Guidelines for shiftworkers: trials and errors?', *Ergonomics*, **36**, 1993, 211-217.
- Werner, E., Borchardt, N., Frielingsdorf, R. and Romahn, H., *Schichtarbeit als Langzeiteinfluss auf betriebliche, private und soziale Bezüge*, Forschungsbericht des Landes Nordrhein-Westfalen Nr. 2974, Opladen, Westdeutscher Verlag, 1980.
- Wilkinson, R.T., 'How fast should the night shift rotate?', *Ergonomics*, **35**, 1992, 1425-1446.
- Williamson, A. and Sanderson, J.W., 'Changing the speed of shift rotation: a field study', *Ergonomics*, **29**, 1986, 1085-1096.
- Wongphanich, M., Karnasuta, K., Saito, H., Kogi, K., Temmyo, Y. and Sakai, K., *A comparative study of women workers in the textile industry of Japan and Thailand: a socio-economic profile*, Bangkok, Faculty of Public Health, Mahidol University, 1982.
- Zahorski, W., Marek, K., Kurawska, A. and Kopotowski, J., 'Epidemiological studies of peptic ulcer in coal miners, II', *Med. Pr.*, **28**, 1977, 3, 207-216.
- Zulley, J., *Schlafen und Wachen als biologischer Rhythmus* (Sleep and waking as biological rhythms), Regensburg, S. Roderer Verlag, 1993.



# on time

45

## Working time online

Working-time issues form a fundamental part of the European employment debate. They are inextricably linked to the twin goals of competitiveness and employment as well as having important implications for equal opportunities.

Time and its divisions have a large cultural dimension; working patterns vary considerably within Europe. Gaining an overview of the divergent and common characteristics that underlie the time issues requires access to industrial relations information at both EU and national levels.

EIROOnline, the industrial relations database developed and managed by the Foundation (the Foundation for the Improvement of Living and Working Conditions), tracks developments in working time in Europe and provides a comprehensive and up-to-date analysis of these issues that is both easily accessible and searchable.

The database was developed by the European Industrial Relations Observatory (EIRO), which is a network of 16 national centres and

an EU-level centre from which industrial relations information and analysis flows to a central unit at the Foundation. This information is then processed and entered on the EIROOnline database. The content includes news items, feature articles and comparative studies prepared by national and EU experts in the industrial relations field on an ongoing basis.

A simple database search gives an indication of the currency and depth of the information online. On the subject of the 35-hour working week, France dominates the coverage with the introduction of a statutory 35-hour week from January 2000: the database includes a detailed summary of the main provisions of the legislation, a commentary on the social partners' opposition to the funding of the measure, and a number of reports which describe the varied response of the social partners. In effect, it provides a clear snapshot of how the introduction of these measures has reverberated through the economy. Linked articles provide the context and development of the legislation in France.

The search on the database shows how diverse the debate on the 35-hour week is within Europe.

- A report from Germany outlines the demand by German business and employers' associations for a return to the 40-hour working week.
- In Greece, the introduction of the 35-hour week occupies a prominent and controversial place on the industrial relations agenda; EIRO articles document the position of the social partners, the fate of a private member's bill to introduce the 35-hour week - it was rejected by a large majority in parliament - and the pilot implementation of the measure in the banking sector.
- The presentation of, and opposition to, a 'popular legislative initiative' (Iniciativa de Ley Popular), supported by 750,000 people, addressed to the Spanish parliament in November 1999, providing for the introduction of a 35-hour working week is documented.

Part-time work is also high on the working-time agenda. EIROOnline covers the debate on many different levels from national and EU perspectives. The impact on equal opportunities, flexibility and collective bargaining is covered in the different national contexts and at EU level.

*cont. on p. 48*

## Weekly working hours in the EU

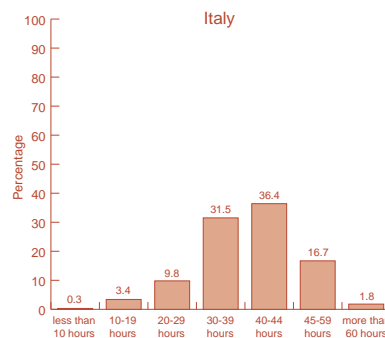
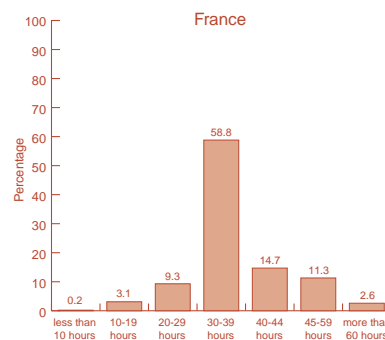
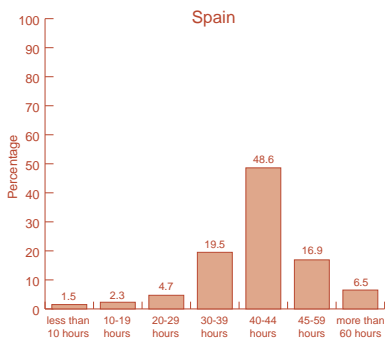
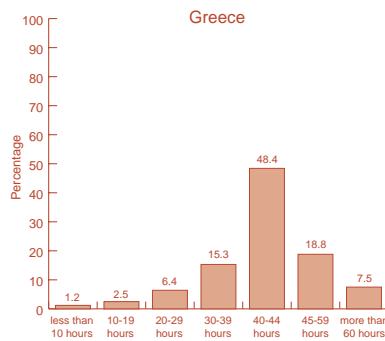
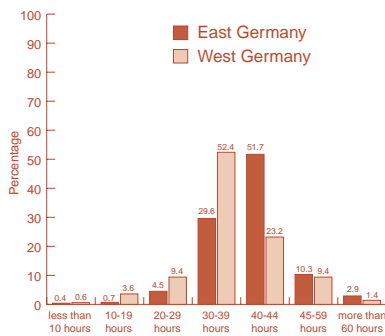
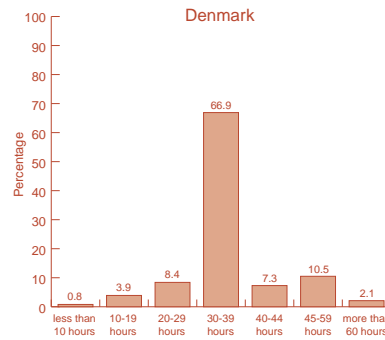
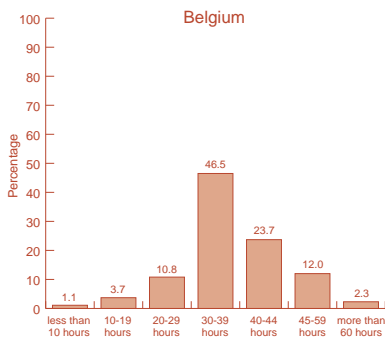
The figures in this section provide an overview of the distribution of average weekly hours worked in the 15 EU Member States. The data is sourced from the Second European Survey of Working Conditions (1996).

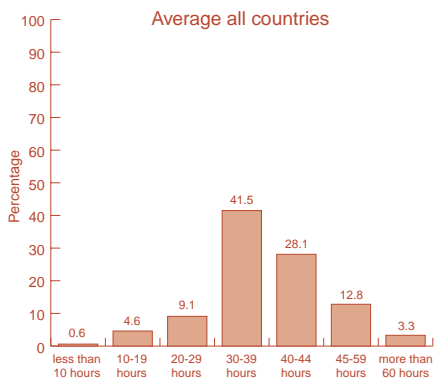
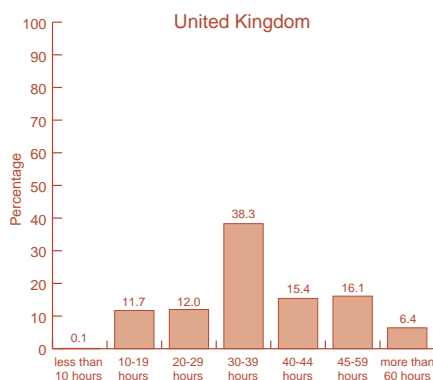
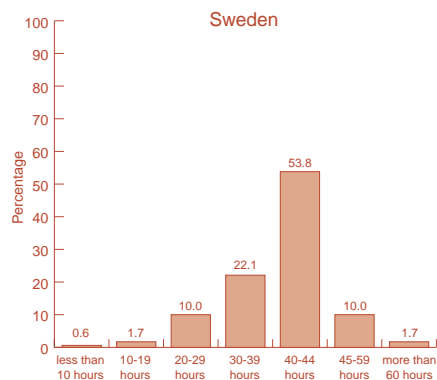
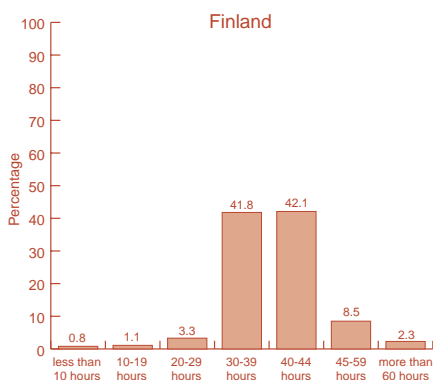
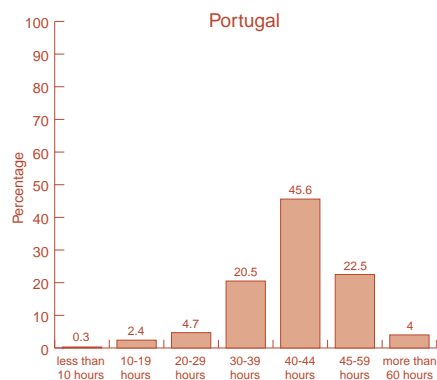
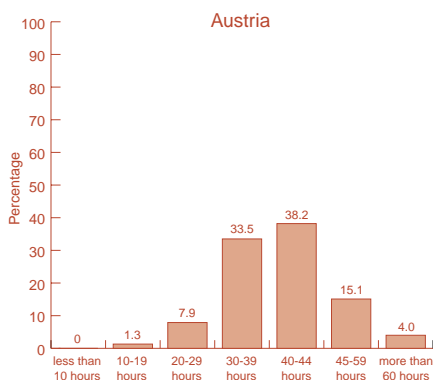
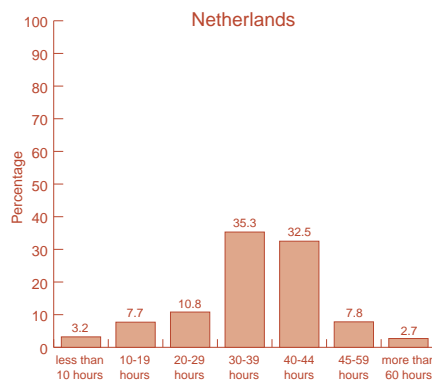
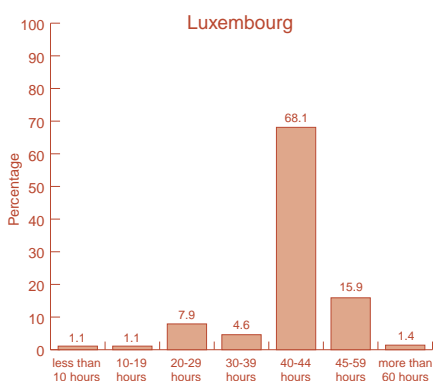
Two series of working-time patterns can be seen.

- The **flat distribution** whereby the weekly duration of work is more or less spread out evenly between the various time slots (more flexible time

patterns). Typical examples are provided by the **United Kingdom** and **the Netherlands**, both having a relatively high proportion of part-timers (over 20% under 30 h/w.).

- The **peak distribution** whereby the weekly duration of work is concentrated within one time slot (less flexible time patterns). Typical examples are provided by **Denmark** (2/3 of workers in the 30-39 h/w. slot), **Luxembourg** (2/3 of workers in the 40-44 h/w. slot), and **France** (over 50% in the 30-39 h/w. slot).





*Working time online cont.*

- In the Netherlands, a political compromise will give part-time workers the right to reduce or increase their working hours. Under draft law, trade unions and employers can make alternative arrangements in collective agreements.
- A commentary on the 'Cette Report' which examines the situation relating to part-time work in France, where part-time work is only moderately developed yet considerable public money has been allocated to promoting its growth.
- Trends in working time, including part-time, according to a study carried out by the Ministry of Labour and Solidarity in Portugal, where part-time workers account for 9.1% of workers.

The studies referred to above were posted during the period October-December 1999. Each of the articles contains links to previous or related articles so that the history and context of developments in the given area can be traced. For further information visit EIRO online at: <http://www.eiro.eurofound.ie>

### The changing use of time in changing times

The Foundation's work centring expressly on the use of time started within the context of its 1981-84 programme. Indeed, in the 1975 Council Regulation establishing the Foundation, one of the five priority areas for the Foundation's activities was given as: 'distribution of human activities in space and in time' (Art. 2).

Today, the dividing line between work and non-work time has, in

many ways, become less distinct, and the reflection on the interaction between leisure time and working time has entered a further phase. Study of working time is centred on the restructuring and increasing flexibility of the labour market. Following this early work, the Foundation got involved, with a number of other sponsors, in a project on 'Time Budget Data'. The Foundation, with the assistance of an international group of experts, collected existing time budget data from several countries and from different periods. These data sets were standardised and, in this standardised format, entered into an electronic database, known as the 'Archive of Time Budget Data'.

The establishment of this Archive was a follow-up to another path-breaking international research effort, the UNESCO/Vienna Centre collection of 1966 data from 12 countries (Alexander Szalai et al., *The use of time*, The Hague/Paris, Mouton, 1972).

All the material from this data set has been included in this Archive. The Archive is a growing one, now held under the auspices of the University of Essex. It constitutes the single most comprehensive collection of data on time use. As such, it is a hugely interesting resource for analysis of time-related issues and their social consequences and implications for social policy-making.

Professor Jonathan Gershuny, one of the original experts involved with the Foundation in the early stages of the development of the Archive, has now completed a first attempt at a holistic analysis of time use, historically and across countries

(*Changing Times: Work and Leisure in Post Industrial Society*, ISBN 0-19-8287-87-9, forthcoming, Oxford University Press). He looks at the development of a number of conflicting time uses, such as leisure, paid work time and unpaid work time, personal care and surviving (e.g. eating), thereby giving a comprehensive account of 'what we all do for a living, and for other people's living. [...] what we do in our jobs, [...] also what we do without pay, in our households, for our families and for members of the wider community'. The comparative data over time also gives an account of how our time allocation for all these activities has (or has not) changed, spanning the last 40 years or so.

The Foundation's input into the Archive has been substantial, especially in methodological terms. The Archive now contains 35 separate surveys from 20 countries, based on 120,000 respondents in all.

It is hoped that this first comprehensive analysis of the data set by Gershuny marks the beginning of an exciting use of the Archive for social policy advice on anything to do with the use of time, which indeed has become one of our most precious resources in daily life. As we all know, each day only contains 24 hours or 1,440 minutes. Individually and as societies in the EU, we are faced daily with competing demands for these 1,440 minutes, which are a limited resource that cannot be stretched under any circumstances. It is therefore very important that we make good and balanced use of our time. Gershuny's book gives a first insight into how we have fared in the quest for this balance between private, economic and social aspirations.

## About this issue

Shiftwork and health are often in the news. As each new study is published, newspapers and magazines return to the subject, because they know that somewhere between 10 and 20% of their readers will be shiftworkers.

It is not an easy subject to get into perspective. A century of research has accumulated, but much of it is still controversial. Why do some studies show that shiftwork causes digestive problems and stomach ulcers, while others do not? Is it all a matter of method? Is shiftwork a major cause of stress? Or do shiftworkers complain more than other employees?

This issue of BEST does not answer all these questions, but it does present a major quantity of research, much of it not available in English. You can follow items up for yourself, or at least put new reports into perspective against previous findings.

This report also presents the comments of six experts in the field, who have wrestled with the problems of shiftwork and health, and reviews their work in this field.

The issue covers:

- sleep and fatigue;
- digestion;
- heart disease;
- women's problems;
- social and domestic life; and
- psychological problems.

Looking at health problems without searching for positive responses would be pessimistic. The last two chapters cover the important issues of medical surveillance and other solutions.

In this issue of BEST, the supplement 'On time' highlights working-time issues as they feature in the EIROnline website and in Foundation research, and also presents a comparative overview in graphic form of weekly working hours in the 15 EU Member States.

