The effects of shift work on health

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Research summary

Our research and development programme

IOSH, the Chartered body for safety and health professionals, is committed to evidence-based practice in workplace safety and health. We maintain a Research and Development Fund to support research, lead debate and inspire innovation as part of our work as a thought leader in safety and health.

In this document, you'll find a summary of the independent study we commissioned from researchers at the International University of Monaco, Toulouse University, University of Swansea and Simon Folkard Associates Ltd, 'Longitudinal study of the effects of shift work on health. Analyses of VISAT (ageing, health and work) data'.

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The effects of shift work on health

What's the problem?

Recent studies have tended to agree that shift work has an effect on the risk of injury. They show that working night shifts has about a 25–30 per cent higher risk of injury than working day shifts. They also show that working on 12-hour shifts rather than on eight-hour shifts increases the risk of injury, again by 25–30 per cent. Risk increases evenly over the first four shifts in a row, with larger increases on night than day shifts.[1]

However, it's not so clear how abnormal work patterns affect health. The disturbance of biological rhythms over many years may have negative long-term effects, which is a potential workplace concern, given the trend towards later retirement. Shift work is thought to disrupt the body clock, sleep, and family and social life. The disruptions can result in acute effects on mood and performance, which may lead to long-term effects on mental health. Together, these may have an impact on both safety and health.

We commissioned Dr David Ansiau from the International University of Monaco, Dr Jean-Claude Marquié from the Université de Toulouse Le Mirail, Dr Philip Tucker of the University of Swansea and Dr Simon Folkard of Simon Folkard Associates Ltd to look into these issues. The project focused on the long-term effects of shift work and the implications for safety and health management, especially job design and work organisation.

The project had several key objectives:

- to determine the long-term effects of shift work on sleep quality, quality of life, physical health ("metabolic dysfunction") and cognitive functioning
- to develop a model showing how all the variables associated with shift work interact over time and affect safety and health at work – a model that could be helpful in designing environments adapted to an ageing workforce
- to examine the root causes of the cognitive deficits associated with long-term shift work and improve understanding of the related safety problems.

[1] Folkard S and Tucker P. Shift work, safety and productivity. *Occupational Medicine* 2003; 53 (2): 95–101.

What did our researchers do?

The researchers used a variety of statistical techniques to analyse data on shift work and health that had been collected in France over a ten-year period (the VISAT study, 1996 to 2006). The data were obtained by occupational physicians during yearly health examinations of a large and representative sample of participants from a range of occupations and socio-cultural backgrounds. The sample comprised 3,237 employees who were 32, 42, 52, and 62 years old when the data were first collected in 1996. Data were collected twice more, in 2001 and 2006, enabling the researchers to follow the same cohorts at five-year intervals. The number in the test population naturally dwindled over the ten years of data collection. Despite this, data were available for 1,257 of the participants for the whole study period.

On each of the three occasions when data were collected, participants completed a questionnaire giving information on current and past working conditions, as well as about their personal lives (their health, and life outside work). The occupational physicians recorded participants' medical condition and carried out cognitive tests. Finally, participants performed respiratory, visual and auditory tests.

On each occasion, participants were asked if they were current shift workers (for more than 50 days a year), or had been in the past, or never. They were also asked whether they were rotating shift workers, whether their work schedule prevented them from going to bed before midnight or resulted in their having to get up before 05.00 or prevented them sleeping during the night. Those who answered 'yes, currently' or 'yes, in the past' to any of these questions were considered by the study to be shift workers or former shift workers. Because some of the workers changed their work patterns during the ten-year period, the researchers were able to review how a change in shift pattern might affect sleep, quality of life, metabolic dysfunction and cognitive functioning.

What did our researchers find out?

Sleep

Unsurprisingly, the researchers' data analysis indicated that those who had never done shift work reported the least disturbed sleep patterns. Those who gave up shift work in late middle age (around 52 years or later) enjoyed a subsequent improvement in their sleep. On the other hand, participants who had given up shift work earlier (before the age of 52) continued to report poor sleep – in fact, the same level of sleep problems as current shift workers.

The researchers could find no obvious reasons why the sleep problems caused by shift work would persist in the 'early-quitting' group, but not in the 'later-quitting' group. One possible explanation is that the 'early-quitting' group were poorer sleepers when they entered shift work, or were especially intolerant of its disruptive effects, which led them to giving it up quite quickly. On the other hand, those who stayed in shift work until relatively late in their working lives did so because they were more tolerant of shift work and did not experience such negative effects on their sleep.

The researchers found that there is an underlying trend for sleep quality to get worse with ageing. However, they were also able to conclude from the data analysis that leaving shift work tends to offset this decline: sleep problems remain at the same level rather than worsen.

Quality of life

Five aspects of well-being were examined: (i) chronic fatigue (feeling tired all the time); (ii) emotional reactivity; (iii) social isolation (difficulties forming and maintaining relationships); (iv) stress; and (v) overall health.

The researchers found that participants who were working on shifts reported more chronic fatigue than the day workers. Results indicated some evidence that fatigue declined after workers ceased to do shift work. On the other hand, fatigue increased or remained unchanged for those who did not change work pattern.

On the remaining four aspects of quality of life, the researchers did not observe any statistically significant improvements after leaving shift work. This suggests that the negative effects of shift work do not immediately disappear after workers stop doing shift work – with the exception of chronic fatigue.

Physical health

The researchers found that shift workers or former shift workers are more likely than workers who have never worked shifts to show symptoms of metabolic syndrome – a range of physical health problems such as obesity, cardiovascular disease, peptic ulcers, gastro-intestinal problems and failure to control blood-sugar levels. The analysis took into account possible differences between the two groups in terms of age, sex, socio-economic status, smoking, alcohol intake, perceived stress and sleep difficulty.

Participants who had been working on rotating shifts for more than 10 years were found to be more likely to exhibit symptoms of metabolic syndrome than participants with no exposure to any form of shift work, even after controlling for age and gender.

Cognition

Each time the data were collected, the results of neuropsychological tests (speed, attention, verbal episodic memory) showed a clear and independent association between shift work and cognitive performance. This finding was statistically significant for those who had been working on shifts for ten years or more, but not for those working on shifts for less than ten years.

Current shift workers tended to have the same cognitive performance as former shift workers who had returned to normal day work hours less than five years ago. In contrast, those who had quit shift work more than five years ago and those who had always been day workers exhibited higher cognitive performance.

The researchers found no statistically significant relationship between cognitive ability and either sleep quality or measures of physical health, two variables which are associated with unusual work schedules.

Conceptual model

Using their findings, our researchers further developed a model (Figure 1) that some of them had originally produced with other researchers. The model shows how features of abnormal work schedules potentially disrupt the body clock, sleep, and family and social life (shown as Level 3). Although individual, situational and organisational factors (Level 2) may moderate these disruptions, there may still be acute effects on mood and performance (Level 4), which may also be affected by job demands and workload. These acute effects may in turn feed back to Level 3, and result in chronic effects on mental health and in decreased safety (Levels 6 and 7). Individuals may adopt coping strategies (Level 5) to moderate the impacts on mental health and the ways in which these in turn affect mood and performance.

The researchers point out that features of abnormal work schedules have differing effects in determining how fatigue can accumulate – whether in a single shift or over multiple shifts. Fatigue can be reduced by controlling the following factors:

- frequency and duration of breaks
- start times and duration of shifts
- start times and duration of off-duty periods following shifts
- number of successive shifts of a given type
- sequencing of spans of successive shifts
- number of successive work days
- start time of a period of rest days
- number of successive rest days
- frequency and duration of longer periods of rest days such as annual leave.

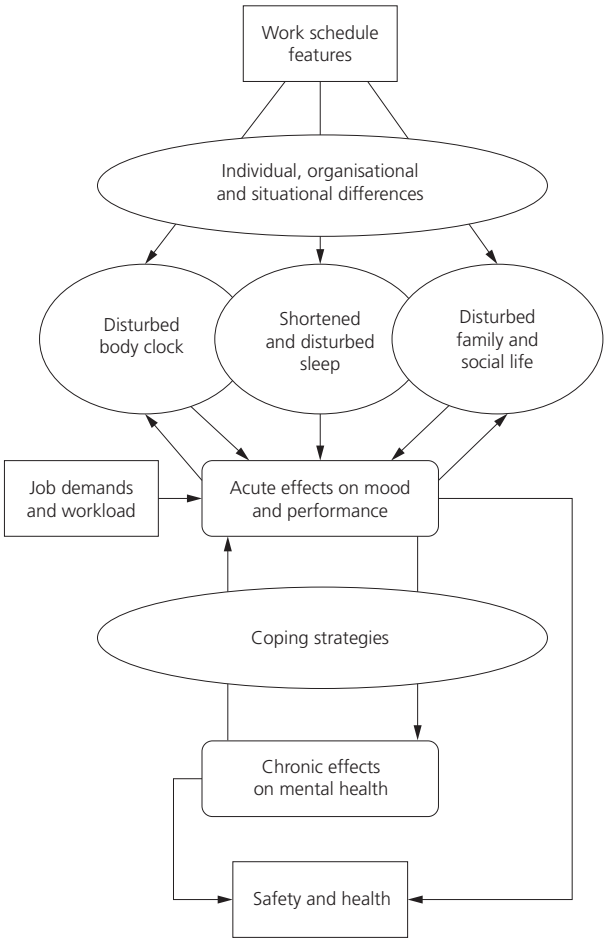

Figure 1
Conceptual model originally proposed by Folkard[2] and Barton, Spelten, Totterdell, Smith and Folkard.[3] This model has received support from many studies (see review by Tucker and Knowles[4]) and has been modified to take account of various findings from the VISAT study.

[2] Folkard S. Editorial to night and shift work. *Ergonomics* 1993; 36: (1–3).

[3] Barton J, Spelten E, Totterdell P, Smith L and Folkard S. Is there an optimum number of night shifts? Relationship between sleep, health and well-being. *Work and Stress* 1995: 9 (2–3): 109–123.

[4] Tucker P and Knowles S R. Review of studies that have used the standard shift work index: Evidence for the underlying model of shift work and health. *Applied Ergonomics* 2008; 39 (5): 550–564.

Other important factors include the regularity or irregularity of the work schedule, the amount of notice given to individuals about when they will be required to work, the extent to which individuals can choose their own schedule, or swap work periods with another, and the frequency and extent of any unscheduled overtime.

At Level 2, factors which can moderate the effects of work schedules include the characteristics of the individual such as their gender, age and personality, and whether they are by habit a long or short sleeper. Organisational factors are associated with the employer, such as availability and quality of rest areas. They may also include the level of support from colleagues and supervisors as well as physical conditions such as noise, heat, vibration and poor weather. Situational factors tend to interact between the individual's personal and professional life such as the amount of time it takes to commute to and from work – which can affect the degree to which sleep is truncated before a morning shift. Many individuals may have a second job, which adds to the complicated patterns set by a first, shift-based job, with consequently high levels of pre-shift fatigue.

The researchers point out that there is considerable evidence showing a link between work schedule features and disturbances to the body clock, sleep, and family and social life (the Level 3 variables). However, very few studies have explored how these disturbances affect workplace safety and health.

Acute effects on mood and performance shown at Level 4 may also result from workload and job demands, such as type of job being performed, pace and intensity of the work, and the predictability of the consequences of individuals' actions. Studies have shown that performance and alertness are lower at night than during the day, and lower on 12-hour shifts than eight-hour ones.

The study was unable to add to existing research on individuals' coping strategies (Level 5), which suggests that they might moderate the impact of lower-level measures (Levels 1–4) on higher-order ones (Levels 6 and 7).

In the study, shift workers reported higher levels of chronic fatigue, and those who had quit shift work relatively early reported higher emotional reactivity and stress than those who had only worked days. The researchers found that shift work was associated with impaired cognitive abilities, especially after a ten-year exposure – although it also seems that these effects are temporary and reversible.

On health (Level 7), our researchers' examination of the literature revealed that shift workers whose schedules include night work have a higher prevalence of digestive disorders than those whose schedules do not; some epidemiological studies have shown that there is an association between shift work and cardiovascular diseases. There is also some evidence relating abnormal work schedules to maternity problems, cancer and minor infections. There is considerable agreement that the risk of injuries is increased in 12-hour shifts compared to eight-hour ones (by 25–30 per cent), and is higher for night shifts than for day shifts (again by about 25–30 per cent).

What does this research mean?

This study has thrown some light on the more chronic effects of exposure to shift work and their potential recovery after quitting shift work. The research identified chronic effects of shift work on both metabolic dysfunction and cognitive performance, which appear to be unrelated consequences of abnormal work schedules. It also examined how these negative effects may increase with more exposure to shift work (for example, metabolic dysfunction, chronic fatigue and cognitive performance) and may subsequently reduce when individuals quit shift work. The evidence suggests that while some measures (for example, sleep complaints and cognitive performance) may recover when an individual quits shift work, others (for example, perceived stress and social isolation) show little evidence of recovery.

Don't forget

Like all studies, this one has some limitations. Due to an unfortunate error the number of shift workers in the VISAT sample was substantially lower than first anticipated. Therefore, there were only 131 individuals who were shift workers at all three measurement occasions.

What's next?

IOSH is commissioning the Institute of Occupational Medicine to conduct a global review of literature that explores links between shift work and occupational cancer.

Good practice in action: managing the effects of shift work on health

Based on this study, and on existing best practice, our researchers' recommendations include a mixture of common-sense changes by individuals to their lifestyles and practical measures by employers to the working environment.

Sleep and fatigue problems

Tips for employees

- avoid caffeine, alcohol and large meals before going to sleep
- restrict energy intake on the night shift between midnight and 06.00 and try to eat at the beginning and end of the shift
- eat breakfast before your day sleep after a night shift to avoid waking up because of hunger
- make sure that family and friends are aware of and considerate of your sleep hours and needs
- ensure you have a comfortable, quiet place to sleep during the day
- air conditioning, telephone answering machine, foam ear-plugs, eye masks and good blinds/curtains can improve your sleep
- make time for quiet relaxation before bed (e.g. reading, breathing exercises, muscle relaxation techniques)
- try to establish a sleep schedule to facilitate sleeping during the day
- avoid strenuous exercise before sleeping because your body's metabolism will remain elevated for several hours and this makes sleeping difficult
- if you can't fall asleep after one hour, read a book or listen to quiet music for a while
- if you still can't fall asleep, try again later in the day
- try to quit shift work by around age 40, as that's often when shift workers' sleep problems get worse.

Tips for employers

- evaluate shift schedule design such as length of breaks, and start and finish times
- allow adequate time between shifts for sleep, meal preparation
- avoid quick returns
- schedule the most demanding work early in the shift when workers are most alert
- schedule no more than five to seven shifts in a row, and no more than two nights in a row
- ensure the workplace is brightly lit
- avoid excessive overtime, split shifts and excessive 12-hour shifts
- rotate shifts forward (morning – afternoon – night)
- provide at least 48 hours between shift changes to allow the body to adjust
- take advantage of individual differences
- provide a room with facilities for workers to lie down and rest before and after a shift
- identify and treat workers who have sleep disorders, and transfer them to day work
- evaluate sleep problems during regular health checks, and ensure that these health checks become more frequent from age 40 and in those who have been shift workers for 10 years or more.

Psychological and physical health

Tips for employees

- try to avoid doing 10 consecutive years of shift work
- maintain a healthy lifestyle with exercise, regular meal times, and good sleeping habits when not working
- stick as closely as possible to a normal day and night pattern of food intake, dividing your daily food into three main meals, each contributing about a third to your overall intake. The higher your energy needs, the more frequent your meals and snacks should be
- avoid sugar-rich products like soft drinks, bakery items, sweets, and non-fibre carbohydrate foods like white bread
- instead, choose vegetables, salads, fruit, lean meat, poultry, fish, dairy products, grains, vegetable soups, wholegrain bread, boiled nuts, green tea
- use relaxation techniques such as deep and slow breathing
- plan days off in advance if possible.
- try to prioritise tasks and tackle one at a time
- afternoon/evening shift workers should have their meal in the middle of the day rather than during their shift
- night workers should eat lightly throughout the shift, with a moderate breakfast
- relax during meals and allow time for digestion
- drink lots of water
- reduce foods high in fat and salt and avoid using fast food and vending machines
- avoid excessive use of antacids, tranquilisers and sleeping pills.

Tips for employers

- move people from shift work after 10 years of exposure
- plan shifts as far in advance as possible
- keep schedules flexible by allowing workers to trade shifts
- schedule time off over weekends
- provide workshops and information sessions on stress management
- make sure demands on workers are reasonable
- maximise worker autonomy
- include a mental health component to employee assistance programmes
- consider offering facilities for social activities such as recreation and staff social gatherings
- provide exercise facilities on site
- provide a 24-hour cafeteria where night workers can obtain a hot, nutritious meal and appropriate dining facilities that, for example, allow a meal to be eaten away from the workplace, with colleagues, in as pleasant a surrounding as possible
- schedule regular meal breaks
- provide day employment for workers who can't work shifts for medical reasons
- provide regular (annual) health checks for shift workers and transfer them to day work if required.

Social isolation

Tips for employees

- use a calendar to schedule events and activities
- establish good communication skills
- schedule at least one daily meal with the family, to keep communication channels open and promotes a good eating habit
- socialise with other shift workers and their families, to minimise the disruption that shift work can have on your social life
- keep in touch with partner and children daily
- set time aside for just you and your partner
- carefully plan family activities, as family ties are a precious commodity
- pay close attention to physical fitness, as a regular exercise programme helps the body adjust to the negative effects of shift work and can also help improve the quality and quantity of sleep
- practise stress reduction.

Tips for employers

- provide an on-site day-care facility
- offer 24-hour day-care solutions
- offer activities for employees' children, such as sponsoring sports teams, etc
- provide transportation to events
- provide workshops on communication and conflict resolution
- organise hobby or interest groups within the workplace (for example, art classes, support groups)
- sponsor employee sports teams and leagues (for example, company football league).

Our summary gives you all the major findings of the independent project report by the International University of Monaco, Toulouse University, the University of Swansea and Simon Folkard Associates Ltd. If you want to read about the study in more depth, you can download the full report from **www.iosh.co.uk/shiftworkhealth**.

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