

# A review of the impact of shift work on occupational cancer



# Our research and development programme

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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 the Institute of Occupational Medicine and Heriot-Watt University, *A review of the impact of shift-work on occupational cancer*.



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## What's the problem?

In 2007, the International Agency for Research on Cancer (IARC) classified shift work that causes disruption to the body's natural circadian rhythm as probably carcinogenic to humans (Group 2A)<sup>1</sup>, with the main risk being an increase in the incidence of breast cancer in women working night shifts. This conclusion was based on a review of all the available scientific research, which showed "limited evidence in humans for the carcinogenicity of shift work that involves night work", and "sufficient evidence in experimental animals for the carcinogenicity of light during the daily dark period (biological night)". The evaluation highlighted the limitations in the available epidemiological evidence, with inconsistencies in the definition of shift or night work used by different researchers.

The proportion of the working population engaged in shift work in the UK and elsewhere in the EU is around 15 per cent, but this varies between countries (ranging from 6 to 30 per cent) and within different industrial sectors, with the occurrence being higher in the healthcare, industrial manufacturing, mining, transport, communications, leisure and hospitality sectors.

Definitions of night work and night worker differ in different countries which makes interpretation of the epidemiological studies more difficult. For example, in the UK night work is a period lasting not less than seven hours, and which includes the period between midnight and 05.00. A night worker is a worker who, as a normal course, works at least three hours of his/her daily working time during the night time.

Men are more than twice as likely to work shifts compared to women and shift workers are more likely to report that shift work has a negative impact on their health.

We commissioned Professor Damien McElvenny and his team at the Institute of Occupational Medicine (IOM) to review this issue. The aim of the review was to provide an update of the epidemiological and mechanistic evidence (how the cancer could be caused) in relation to the carcinogenicity of shift work published in the ten years from 2005 to 2015, and to identify ongoing research and potential workplace interventions to support the long-term health of people working shifts.

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<sup>1</sup> IARC, 2010. Painting, firefighting, and shiftwork.

## What did our researchers do?

The research team took a number of different routes to identify relevant literature and research. A systematic search of publications was undertaken to identify research covering the epidemiology of different cancers associated with shift work. The titles and abstracts of the papers were screened and data were extracted from included papers. Papers presenting mechanistic evidence were further identified through additional searches. To identify any relevant policies, the research team searched the internet to identify health and safety policies relating to shift work to identify how, if at all, cancer risks were taken into consideration.

The researchers also examined the current research landscape by identifying current, ongoing and planned research. The research team wrote to key researchers identified from the reviewed publications. In addition, funding bodies potentially active on this topic were contacted to find out if they were currently funding research or planning to fund research into shift work and cancer.

## What did our researchers find out?

In total, 36 scientific papers were identified that examined the epidemiological evidence relating to shift work and cancer and a further 50 were identified that looked at the potential process of causation for specific cancers. A further eight papers examined potential interventions to improve health and wellbeing for those undertaking shift work.

Fifteen reviews and meta-analyses were examined in relation to breast cancer occurrence in women working shifts. Overall, the majority of studies showed an increased risk of breast cancer in relation to shift work and an increased risk when shifts had been worked for longer periods. However, many of the studies had limitations because of the lack of clear descriptions of the shift systems used. The review also examined more recent studies of breast cancer from night work where other risk factors were better controlled. In these studies the association between shift work and breast cancer was still apparent, but the magnitude of the relative risks was reduced from around 1.5 to 1.2, that is, from 50 per cent higher than expected to 20 per cent higher.

A recent study assessed the risk of breast cancer in three prospective cohort studies – the Million Women Study, the EPIC-Oxford Study and the UK Biobank Study that controlled for body mass and other potential confounding factors, along with a meta-analysis of the available prospective studies. None of the three studies gave a raised relative risk for breast cancer and the meta-analysis suggested that breast cancer risk was not influenced by shift working. Overall, our researchers have concluded that the measured relative risk of breast cancer in well-conducted epidemiological studies of female night workers is lower than originally identified and may not

be significantly raised. Further prospective studies with well-defined shift work data and well controlled for potential confounding factors are still required.

Possible associations between night shift work and prostate cancer, ovarian cancer, colorectal cancer, endometrial cancer and non-Hodgkin's Lymphoma were also examined. The evidence for prostate and ovarian cancer is strongest, but still insufficient to allow any firm conclusions to be made. Further research is necessary to clarify whether there is any risk of night work for these cancers.

When examining the possible mechanisms for an increased breast cancer risk in night workers, the suppression of melatonin from exposure to light at night has been proposed. Melatonin is a hormone produced by the pineal gland in the brain and is associated with control of sleep-wake cycles (circadian rhythms). Melatonin production is reduced in humans when they are exposed to light and it is known to have anti-carcinogenic properties. The increased cancer risk could also be due to the known association between obesity and breast cancer since it is known that shift workers may have a poorer diet than day workers and may be more likely to be obese or have other lifestyle factors associated with cancer.

The use of bright white light at night within workspaces was seen as positive in maintaining alertness at night and improving sleepiness levels during the day. However, exposure to bright light during the night causes circadian disruption and further research is required to find out if it is preferable to increase wakefulness at night or minimise circadian disruption using lower intensity (blue) lighting. It is agreed that reducing exposure to light at the end of shift using dark glasses (weather and light intensity permitting), and using black-out blinds at home may improve the quality of sleep after shifts.

Research into shift design over the last 40 years has suggested that forward rotating shift systems (day, evening and night shifts) are preferable as a means of reducing circadian disruption. In addition, ensuring no more than four night shifts are worked at a time, adequate recovery rest after shifts and adequate rest breaks during the shifts worked have positive impacts. Adopting best practice in design of shift patterns is recommended, although its impact on cancer risk has not been evaluated.

Strategic napping has also been examined as a means of improving alertness. Naps taken before starting a night shift and naps taken during a night shift have been found to reduce sleep deprivation. However, it is not always possible to take naps, depending on the impact of sleep inertia (going from sleep to wakefulness) and the requirements of the work. The effect of strategic napping on cancer risk has not been evaluated.

Individuals working shifts are significantly less likely to attend screening for breast or colorectal cancer than day workers, although there is no difference in relation to cervical cancer. Sectoral differences were also identified where those working in manufacturing, transportation and material moving and food preparation, servicing and production were less likely to attend screening appointments. Employers should facilitate shift workers to attend screening appointments.

Some have advocated the use of melatonin as a supplement to attempt to adjust sleep time, although the available research studies do not show an improvement in daytime sleepiness levels and an effective dosage is difficult to calculate. A number of other pharmacological interventions have been evaluated, including the use of stimulants to reduce sleepiness. In a small research study the use of Modafinil, which promotes wakefulness, showed improvements in measures of sleepiness and later sleep onset compared to the control group. The use of caffeine has also been examined where having a nap before night shift followed by 300 mg of caffeine (around three cups of coffee) improved vigilance performance, but daytime sleep length was reduced. Using hypnotics to improve daytime sleep has also been examined. While improving sleep length initially, the effect of using tamazepam was reduced after a number of night shifts. At this time the evidence for the use of pharmacological interventions is limited and they are not recommended as a strategy to reduce cancer risks in shift workers.

Lifestyle factors have also been examined in relation to shift work. Shift workers are more likely than other workers to be overweight or obese, and they are at increased risk of diabetes and cardiovascular disease. It is not properly understood why shift workers gain more weight, although it may be due to poor diet (lack of opportunities at night for healthier eating options) or it may be a consequence of eating food at the wrong time to allow it to be metabolised. While further research into the diet of shift workers is warranted, there is sufficient evidence to recommend that employers should help encourage better eating habits among shift workers.

While there is some evidence of an exposure-response relationship between the occurrence of breast cancer and the length of time working night shifts, it is probably not sufficiently strong to suggest limiting the length of time that individuals continue to work night shifts.

There are a number of policy and guidance documents available to help manage shift work and the associated health outcomes, and while they generally acknowledge the potential link between shift work and breast cancer there is very little information available on cancer prevention. This probably reflects the current lack of knowledge in this area among practitioners.

### What does the research mean?

Currently, the scientific evidence of an association between shift work and breast cancer is stronger than in 2007 when IARC carried out their evaluation. However, the magnitude of any risk from working night shifts is most probably less than was originally thought, and may even be zero. The main potential mechanism for cancer being associated with night work is the suppression of melatonin production due to exposure to light at night. However, other direct and indirect mechanisms may play a part, including the difficulty of night workers maintaining a healthy diet, which may result in obesity and may be the ultimate cause of the observed breast cancer risk. Research on the risk of other cancers such as prostate and ovarian cancer is inconclusive.

### Don't forget...

Epidemiological evidence on its own can never conclusively prove that an exposure causes a disease; it is the combination of epidemiology, experimental toxicology and mechanistic studies that must be evaluated. Further research may ultimately show that the cancer risk among night shift workers is not due to night work but to some other factor such as diet or another risk factors associated with working during the night.

## Practice points

From the research compiled in the report there are several practice points that employers should take forward in the workplace:

- develop a workplace policy for night work that informs workers about the potential cancer risks and sets out prudent strategies to minimise the impact of shift working on health
- design shift patterns around a fast forward-rotating system that helps prevent circadian disruption and ensure that the number of consecutive night shifts worked is minimised
- instigate health promotion initiatives among night shift workers to improve their diet and help them maintain a healthy body mass. Provide advice on strategies to improve sleep quality
- encourage use of dark glasses on the way home after the shift (weather and light levels permitting) to ensure melatonin levels are not reduced. In addition, promote the use blackout blinds in bedrooms to try and improve daytime sleep quality; and encourage night shift workers to attend appropriate health screening appointments.

## Other IOSH resources

We have a range of resources on some of the topics covered in this research, including:

- *The effects of shift work on health* research report: [www.iosh.co.uk/shiftworkhealth](http://www.iosh.co.uk/shiftworkhealth)
- *Wellbeing quick guide – Shift and night workers*: [www.iosh.co.uk/Membership/Our-membership-network/Our-Groups/Broadcasting-and-Telecommunications-Group/Wellbeing-toolkit/Worker-specific-wellbeing/Shift-and-night-workers.aspx](http://www.iosh.co.uk/Membership/Our-membership-network/Our-Groups/Broadcasting-and-Telecommunications-Group/Wellbeing-toolkit/Worker-specific-wellbeing/Shift-and-night-workers.aspx)
- *Working well – Guidance on promoting health and wellbeing at work*: [www.iosh.co.uk/workingwell](http://www.iosh.co.uk/workingwell)
- *A healthy return – A good practice guide to rehabilitating people at work*: [www.iosh.co.uk/healthyreturn](http://www.iosh.co.uk/healthyreturn)
- *Occupational safety and health considerations of returning to work after cancer* research report: [www.iosh.co.uk/rtwcancer](http://www.iosh.co.uk/rtwcancer)
- *The Occupational Health toolkit*: [www.ohtoolkit.co.uk](http://www.ohtoolkit.co.uk)
- *Occupational health management in the workplace guidance*: [www.iosh.co.uk/ohguide](http://www.iosh.co.uk/ohguide)
- *Developing managers for engagement and well-being* includes practical resources on developing managers in this area: [www.cipd.co.uk/knowledge/culture/well-being/developing-managers-report](http://www.cipd.co.uk/knowledge/culture/well-being/developing-managers-report)

Our review gives you all the major findings of the independent project report by the Institute of Occupational Medicine. If you want to read about the study in more depth, you can download the full report from [www.iosh.co.uk/shiftworkreview](http://www.iosh.co.uk/shiftworkreview).

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