

What should we tell shift workers to do to reduce their cancer risk?

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Two articles published in 2001 in the same issue of the *Journal of the National Cancer Institute* drew attention to possible cancer risks from night work. One concluded that ‘women who work on rotating night shifts with at least three nights per month ... appear to have a moderately increased risk of breast cancer after extended periods of working rotating night shifts’ [1] and the other found that there were indications that ‘... exposure to light at night may be associated with the risk of developing breast cancer’ [2].

These studies prompted the British Health and Safety Executive (HSE) to commission a critical review of the epidemiological evidence, which found that ‘... the evidence for an association of breast cancer risk with shift work is appreciable but not definitive, and it remains unclear whether any association is causal or a consequence of confounding’ [3]. A report of a subsequent meeting arranged by the UK government concluded that further research on this topic should investigate more holistically the relationship between shift working and susceptibility to disease [4].

In 2007, the International Agency for Research on Cancer (IARC) examined the carcinogenicity of shift working as part of its monograph programme. Shift work that involves circadian disruption was classified as probably carcinogenic to humans on the basis of limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals [5]. Members of the IARC working group subsequently described details of non-day shifts and shift schedules that should be captured in future epidemiological studies: (i) shift system (start time of shift, number of hours per day, rotating or permanent, speed and direction of a rotating system, regular or irregular); (ii) years on a particular non-day shift schedule (and cumulative exposure to the shift system over the subject’s working life); and (iii) shift intensity (time off between successive work days on the shift schedule) [6].

A year later, the Danish National Board for Industrial Injuries elected to offer compensation to women who developed breast cancer following 20 years or more of night shift working and otherwise at low risk [7]. However, the UK Industrial Injuries Advisory Council, which looks for evidence of a doubling of relative risk before recommending a disease be prescribed on the basis of epidemiological evidence, decided that robust evidence was lacking and so did not recommend adding breast cancer as a result of night shift working to the UK list of prescribed diseases [8].

Since these developments, the scientific evidence on cancer risks from shift working has continued to accumulate, but there is little practical advice for workers and employers about steps that should be taken to reduce risks. The Institution for Occupational Safety and Health (IOSH) has identified night shift work and occupational cancer as one of the priorities for its ‘No Time to Lose’ campaign [9]. In order to inform that part of their campaign they commissioned a review of the epidemiological, mechanistic and health and safety information published since the IARC meeting [10–12]. The epidemiological review concluded that the relative risk of breast cancer among night shift workers is lower in more recent epidemiological studies than when it first came to our attention 15 years ago. The relative risk from the 2001 studies was around 1.5 and is around 1.1 to 1.2 in more recent studies. The recent research has generally been well conducted, accounting for a large number of potential confounding factors and often describing shift working in the manner suggested by the IARC working group. A recent meta-analysis of prospective studies concluded that ‘night shift work, including long-term shift work, has little or no effect on breast cancer incidence’ [13]. However, there are several shortcomings with this study, including exclusion of all retrospective studies as uninformative, inclusion of studies where the assessment of shift work fell below the standards called for by the

IARC working group and which often relied on self-report (and so was not collected prospectively), and the heterogeneity in definitions of shift work that contraindicate the data being combined in a meta-analysis.

Due to the heterogeneity of shift working it is difficult to come to a clear conclusion about the risk of breast cancer associated with night shift work. Although some epidemiological studies provide evidence of an increased risk for long duration of shift working [14], there is no robust evidence of an exposure threshold. Further high-quality epidemiological research is still needed and the number of presentations at the recent Epidemiology in Occupational Health Conference (EPICOH) examining the health effects of shift working suggests that this is happening [15].

The main candidate mechanism for the increased breast cancer risk is the suppression of nightly melatonin production, with its known anti-carcinogenic properties, from exposure to light at night. However, there are no epidemiological studies where the levels of light at night have been quantified, and there is evidence that many night workers are exposed to low levels of light that may be insufficient to affect melatonin production [16,17]. An alternative explanation for observed breast cancer risks is poorer opportunities for night workers to choose healthy lifestyles, resulting in higher prevalence of obesity and other factors known to be associated with breast cancer. In the more recent epidemiological studies, where the association is often equivocal, there are generally attempts to adjust for such lifestyle risk factors. However, if these are risks that are a consequence of night working, then they are occupational risks that employers should address.

A number of interventions have been tried out in practice, none of which appears to have been properly evaluated for efficacy or effectiveness in relation to reducing breast cancer risk [11]. These include melatonin supplementation, attempting to cause a phase shift in melatonin production, design of shift systems to reduce fatigue and pharmacological interventions such as the use of psychostimulants.

So, what should we tell female night workers to do to reduce their cancer risks? There is no firm evidence that certain shift patterns confer a lower cancer risk than others, but measures to reduce exposure to natural light at the end of night shifts appear to improve sleep quality [18,19]. There is still some discussion over whether it is better to phase-shift the melatonin cycle or not; bright lights at work improve safety, and phase-shifting reduces sleepiness [11]. The advice from HSE is for employers to adopt good practice in shift work scheduling, to optimize the workplace environment, and to promote a healthy lifestyle among its workforce [20]. Employers should develop a workplace policy for night work that informs workers about the potential cancer risks and possible strategies to minimize risks. Employers should also help reduce the cancer risk for shift workers through

lifestyle health promotion initiatives, such as cessation of smoking and moderation of alcohol consumption. Employers could also provide healthy food alternatives and exercise regimes, and facilitate access for shift workers to national cancer screening programmes [12].

The advice for a woman who has increased risk of breast cancer from other causes, such as a genetic predisposition, obesity or benign breast disease, is no different to that given above. The same also applies to those with cancers under treatment or in remission. However, the final decision should probably come from a discussion between the employer, employee and occupational health provider.

If night shift work increases the relative risk of breast cancer, it probably does so by no more than 10 or 20%, but given the prevalence of shift working in society today, employers would be well advised to follow best practice advice on the design of shift schedules and to do their best to help their employees maintain a healthy lifestyle. This will have the added benefit of hopefully reducing risks from other disease potentially impacted on by night shift work, such as cardiovascular disease, and in preventing fatigue-related accidents in the workplace.

References

1. Schernhammer ES, Laden F, Speizer FE *et al.* Rotating night shifts and risk of breast cancer in women participating in the nurses' health study. *J Natl Cancer Inst* 2001;**93**:1563–1568.
2. Davis S, Mirick DK, Stevens RG. Night shift work, light at night, and risk of breast cancer. *J Natl Cancer Inst* 2001;**93**:1557–1562.
3. Swerdlow A. *Shift Work and Breast Cancer: A Critical Review of the Epidemiological Evidence HSE Research Report*. Sudbury, UK: Health & Safety Executive, 2003.
4. Institute for Environment and Health. *Shift Work and Breast Cancer: Report of an Expert Meeting 12 November 2004*. Leicester, UK: MRC Institute for Environment and Health, 2005.
5. Straif K, Baan R, Grosse Y *et al.*; WHO International Agency for Research on Cancer Monograph Working Group. Carcinogenicity of shift-work, painting, and fire-fighting. *Lancet Oncol* 2007;**8**:1065–1066.
6. Stevens RG, Hansen J, Costa G *et al.* Considerations of circadian impact for defining 'shift work' in cancer studies: IARC Working Group Report. *Occup Environ Med* 2011;**68**:154–162.
7. Wise J. Danish night shift workers with breast cancer awarded compensation. *Br Med J* 2009;**338**:b1152.
8. Industrial Injuries Advisory Council. *The Association Between Shift Working and (i) Breast Cancer (ii) Ischaemic Heart Disease. Position Paper 29*. 2009. London: Industrial Injuries Advisory Council.
9. IOSH. *No Time to Lose 2017*. www.notimelose.org.uk (14 November 2017, date last accessed).

10. McElvenny D, Crawford J, Davis A *et al.* A review of the impact of shift work on occupational cancer: Part 1—epidemiological evidence. *Pol Pract Health Saf* 2017; 1–38 (Epub ahead of print).
11. Crawford J, Cherrie J, Davis A *et al.* A review of the impact of shift work on occupational cancer: Part 2—mechanistic and health and safety evidence. *Pol Pract Health Saf* 2017; 1–36 (Epub ahead of print).
12. Cherrie J, Crawford J, Davis A *et al.* A review of shift work and cancer: summary of the evidence for practitioners. *Pol Pract Health Saf* 2017; 1–7 (Epub ahead of print).
13. Travis RC, Balkwill A, Fensom GK *et al.* Night shift work and breast cancer incidence: three prospective studies and meta-analysis of published studies. *J Natl Cancer Inst* 2016;**108**:169.
14. Wegrzyn LR, Tamimi RM, Rosner BA *et al.* Rotating night-shift work and the risk of breast cancer in the nurses' health studies. *Am J Epidemiol* 2017;**186**:532–540.
15. http://oem.bmj.com/content/oemed/74/Suppl_1/local/complete-issue.pdf (14 November 2017, date last accessed).
16. Papanтониou K, Pozo OJ, Espinosa A *et al.* Circadian variation of melatonin, light exposure, and diurnal preference in day and night shift workers of both sexes. *Cancer Epidemiol Biomarkers Prev* 2014;**23**:1176–1186.
17. Dumont M, Lanctôt V, Cadieux-Viau R, Paquet J. Melatonin production and light exposure of rotating night workers. *Chronobiol Int* 2012;**29**:203–210.
18. Fritschi L. Shift work and cancer. *Br Med J (Clin Res Ed)* 2009;**339**:b2653.
19. Schernhammer ES, Thompson CA. Light at night and health: the perils of rotating shift work. *Occup Environ Med* 2011;**68**:310–311.
20. HSE. *Managing Shift Work. Health and Safety Guidance. HSG256.* Sudbury, Suffolk: HSE, 2009.

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