Health and Safety Executive

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Occupational Cancer in Great Britain

Contents

Summary

The information in this document relates to Health and safety statistics for 2017/18. The document can be found at: www.hse.gov.uk/statistics/causdis/cancer/cancer.pdf

Many work and non-work related factors can cause cancer. Furthermore, cancer cases often present themselves many years after the relevant exposure took place. Therefore, it is usually difficult to know whether workplace exposures have caused particular cases of cancer. However, it is possible to estimate in a large population the approximate number of cancer cases that could be due to work, in other words, would not have occurred in the absence of workplace exposure.

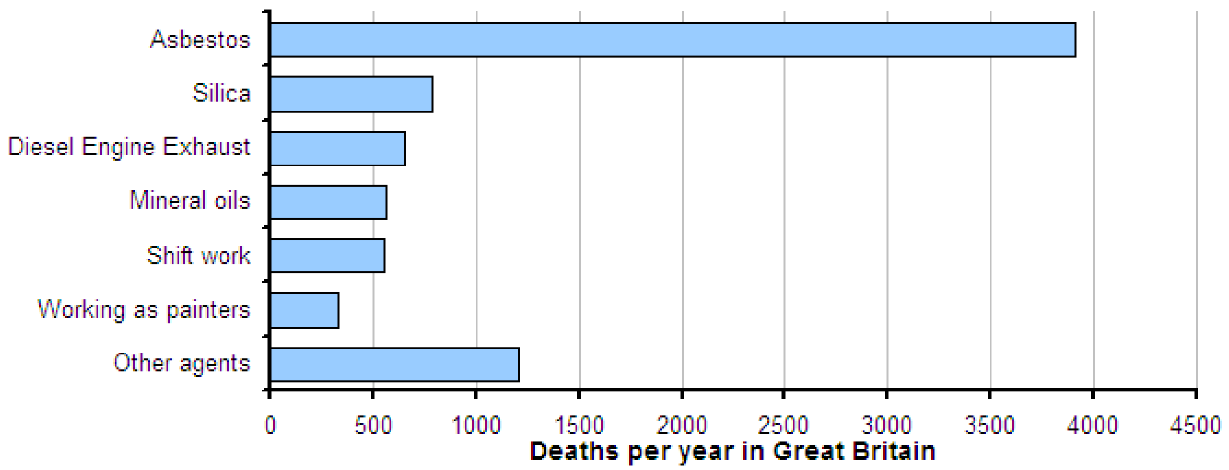
A research study on the burden of occupational cancer in Great Britain was able to estimate the proportion of all new cancer cases in the national statistics that could be due to work in Great Britain. This estimate was based on the national statistics specifically relevant to cancer registrations in 2004 and cancer deaths in 2005. This was done by looking at the number of workers who had past exposures to cancer causing agents and the risk of cancer from these exposures.

The researchers have also developed methods to estimate the number of occupational cancer cases in the future for a range of intervention scenarios. This will enable us to compare the potential impacts of these interventions on occupational cancer reduction.

Further information on occupational cancer burden research can be found at: www.hse.gov.uk/cancer/research.htm

- Key points
  - Past occupational exposure to known and probable carcinogens is estimated to account for about 5% of cancer deaths and 4% of cancer registrations currently occurring each year in Great Britain.
  - This equates to about 8,000 cancer deaths and 13,500 new cancer registrations each year.
  - Past asbestos exposure is the leading cause of deaths from occupational cancer today. Other major causes of occupational cancer include silica, solar radiation, mineral oils and shift work.
  - The construction industry has the largest estimate of occupational cancer cases, with about 3,500 cancer deaths and 5,500 cancer registrations each year from this industry.
  - Exposure to silica, Diesel Engine Exhaust, solar radiation, shift work and working as painters and welders might become the main causes of occupational cancer in the future, according to the estimate of the research study.

Figure 1: Estimated occupational cancer deaths by cause in Great Britain, 2005



These are based on many assumptions and subject to considerable uncertainty. Both known and probable occupational carcinogens have been included in the estimates.

Introduction

Cancer starts when abnormal cells in the body grow out of control. There are different types of body cells that can become abnormal and develop into different types of cancers. Many risk factors can cause cancer, including ageing, exposure to radiation, chemicals and other substances at work and in the environment, family history of cancer, and many behaviours and lifestyle factors such as tobacco smoking, poor diet, lack of physical activities and being overweight. Very often, it is difficult to assess the role of occupational exposure in the development of cancer. Furthermore, many cancer cases present themselves many years after the relevant exposures took place (usually at least 10, but in some cases over 35 years). This makes it particularly difficult to link individual cases of cancer to the associated work exposures. As a result, national cancer registrations and other data sources such as cancer cases reported by specialist physicians as part of the occupational ill health surveillance system, or cancer cases assessed for the Industrial Injuries Disablement Benefit scheme, do not allow an accurate assessment of the overall number of occupational cancers. However, it is possible to estimate the proportion of all cancer cases in a population that are due to work, and use this to estimate the number of occupational cancer cases currently occurring

In 1981, in their report to the US Congress, Doll & Peto estimated that 4% of cancer deaths in the US were attributable to occupation[1]. For over 25 years since the report, this occupational proportion had been used as the basis to estimate the burden of occupational cancer in Great Britain. In order to obtain an updated estimate to inform the development and prioritisation of occupational cancer control, the Health and Safety Executive commissioned a research study in 2005 to estimate the burden of occupational cancer in Great Britain. The study was led by Dr Lesley Rushton and experts from the Imperial College London, the Institute of Occupational Medicine, the Institute of Environment and Health, and the Health and Safety Laboratory.

The final burden estimates would be influenced by the criteria used to include the carcinogens in the analysis. The cancer burden study considered both the known and the probable carcinogens classified by the International Agency for Research on Cancer (IARC)[2]. For example, the study included shift work, a probable carcinogen, even though its causal link to female breast cancer has not been confirmed. A recently published independent research study, commissioned and funded by HSE and conducted by the University of Oxford, concluded that “night shift work has little or no effect on breast cancer incidence”[3]. It is unclear if IARC will revisit the classification for carcinogenicity of night shift work in the near future, which would have implications for revising the current burden estimates.

Forty-one carcinogens relevant to occupational exposures in Great Britain were included in the burden estimates[4]. The study has also developed methods to estimate the possible number of occupational cancer cases in the future and to compare the potential impacts of different interventions on occupational cancer reduction[5]. The number of occupational cancers occurring now is the result of past exposures to cancer causing agents in the workplaces whereas future cases of occupational cancer will be the consequences of current and future exposure situations.

Estimated cases of occupational cancer

Estimated current cases

The cancer burden estimates have shown that about 8,000 cancer deaths and around 13,500 cancer registrations per year in Great Britain could be attributed to past occupational exposure. These represented 5.3% (8.2% for men and 2.3% for women) of all cancer deaths in 2005 and 4.0% (5.7% for men and 2.1% for women) of all newly diagnosed cancers in 2004 in Great Britain national cancer statistics[6], see Table **CAN01A** (www.hse.gov.uk/statistics/tables/can01A.xlsx). This estimate has included both established and probable carcinogens and has been used in most of the published results. However, if the estimate were restricted only to the established carcinogens, the occupational attributable proportion would moderately reduce to 4% for all cancer deaths and 3.4% for all cancer registrations, see Table **CAN01B** (www.hse.gov.uk/statistics/tables/can01B.xlsx).

The cancer burden study has shown that past occupational exposure to asbestos is the leading occupational carcinogen, accounting for around 4000 deaths (2000 of mesothelioma and 2000 of lung cancer) in 2005, equivalent about half of all occupational cancer deaths in 2005 and a third of occupational cancer registrations in 2004. However, asbestos-related cancer deaths have since increased by about 25% to around 5000 per year: there are now over 2500 annual deaths from the mesothelioma (one of the few kinds of cancer where deaths can be directly counted) and a similar number of lung cancers estimated to be due to past asbestos exposure. The latest projections suggest that there will continue to be around 2,500 mesothelioma deaths per year for the rest of this current decade before annual numbers begin to decline.

Other major occupational carcinogens include silica, diesel engine exhausts (DEEs), mineral oils in terms of their contribution to cancer deaths (Figure 1); and shift working, mineral oils and solar radiation in terms of their contribution to cancer registrations[6], see Tables **CAN02** (www.hse.gov.uk/statistics/tables/can02.xlsx) and **CAN03** (www.hse.gov.uk/statistics/tables/can03.xlsx).

Of all industry sectors, exposures in the construction industry accounted for the largest proportion (over 40%) of the occupational cancer deaths and cancer registrations. In total, about 3,500 cancer registrations per year in this industry are attributed to the past exposure to asbestos and silica, mostly causing lung cancer and mesothelioma. An additional 1,300 cancer registrations per year in this industry are attributed to solar radiation, coal tars and pitches, mostly causing non melanoma skin cancer (NMSCs), see Tables **CAN04** (www.hse.gov.uk/statistics/tables/can04.xlsx) and **CAN05** (www.hse.gov.uk/statistics/tables/can05.xlsx).

Estimated future cases

Estimates of the current burden can only be a starting point for the consideration of priorities for prevention activity. The cancer burden research study has also developed methods to estimate the number of occupational cancer cases that may occur in the future based on what is known about the current exposed population, the exposure level and the associated risk of cancer, assuming that current exposure and employment trends continue without additional intervention to actively reduce particular risks[5]. Due to the lack of information on the current exposure situation and the uncertainties caused by the many assumptions used, it is difficult to know with any reliability the estimated number of occupational cancer cases in 2060. However, the statistical model that has been developed may allow us to test out the possible future impact of different intervention options. The research provides a framework for refining and improving these assessments in the light of new information about interventions and workplace exposures as it becomes available.

The results suggest that the number of occupational cancers associated with asbestos exposure may drop by more than 90% and the numbers associated with silica exposure are estimated to halve by 2060[7]. On the other hand, the numbers associated with Diesel Engine Exhaust (DEE) are estimated to remain the same, and the numbers associated with solar radiation, shift work, PAHs and working as painters might increase.

A ranking of the estimated future cases attributed to the leading carcinogens by industry suggests that the construction industry will probably continue to account for the largest number of occupational cancer cases in the future, though the total number is estimated to reduce by a third by 2060, See Tables **CAN06** (www.hse.gov.uk/statistics/tables/can06.xlsx). Occupational exposures to silica, DEEs, solar radiation, shift work and working as painters and welders are estimated to become the main causes of occupational cancers in the future, see Tables **CAN07** (www.hse.gov.uk/statistics/tables/can07.xlsx).

Intervention scenarios have been used to test out their possible impact on reducing occupational cancer cases in the research study, see Tables **CAN08** (www.hse.gov.uk/statistics/tables/can08.xlsx). However, the interventions tested, for example lowering exposure standards, have demonstrated only limited impacts on further reducing the number of cancer cases associated with asbestos and DEEs. This is because the research study estimates that most of the future occupational cancers due to these causes will be attributed to large numbers of exposed workers at low levels of exposure[7].

The study to estimate the future occupational cancer cases included only the 14 leading carcinogens and work activities that contributed more than 100 occupational cancer registrations per year. Together, they account for 86% of the total number of occupational cancer cases currently occurring. Other carcinogens, including mineral oils, chromium VI, wood dust, benzene and rubber manufacturing, were not included in the estimate, but are potentially important for cancer prevention.

The number of future cases is estimated based on the assumptions that the current trends of exposure and employment will continue up to 2030 and remain constant thereafter. The estimate is a combined effect of predicted falling occupational exposures, which largely contributes to the reduction of the overall cancer numbers, and the ageing population and population growth, which, on the other hand, contribute to the rising cancer numbers. The future burden estimation did not consider the potential impacts of lifestyle changes on cancer risk in the population[5].

The estimated figures on the current and future number of occupational cancers should be used with care because they are based on many assumptions and subject to considerable uncertainty[8]. The model to estimate future cases may be more useful for comparing the effects of different interventions for particular carcinogens rather than across different carcinogens. The major sources of uncertainty in estimating the occupational cancer cases include: the choices of risk estimates from literature for an occupational exposure, the imprecision of the risk estimates, the misclassification of workers in different exposure categories, the lack of reliable information on both the exposure levels and the exposure trends in the GB workforce. More information on the statistical methods used to estimate the future cancer cases is available from previous publications.

Known carcinogens

The International Agency for Research on Cancer (IARC) is part of the World Health Organization. IARC runs a monograph programme evaluating evidence of the carcinogenicity of specific exposures in order to identify environmental factors that can increase the risk of cancer in humans. The monographs published by IARC are recognised as an authoritative source of information on the carcinogenicity of a wide range of human exposures, including chemicals, complex mixtures, occupational exposures, physical and biological agents and lifestyle factors.

Since 1971, the carcinogenicity of more than 1000 agents has been evaluated. According to the updated information published by IARC in July 2018[2],

120 agents have been identified as established human carcinogens (IARC Group 1)

82 agents were probable (IARC Group 2A), and

302 agents were possible (IARC Group 2B) human carcinogens.

There are several new Group 1 and Group 2A classifications in the past few years that have been linked to occupational exposure.

The IARC categories of Group 1, 2A and 2B are to measure the strength of the evidence on whether an agent is carcinogenic to human. The categories do not indicate the level of the cancer risk of an agent. For example, the term "probably" carcinogenic represents a higher level of evidence of human carcinogenicity than the term "possibly".

Newly classified occupational carcinogens

A list of newly classified Group 1 (established) and Group 2A (probable) human carcinogens by IARC which are relevant to workplace exposures since 2014.

Substances/ mixture	IARC classificat -ion (year)	Occupation or industry in which the substance could be found	Cancer site potentially linked	Evidence base
1,2-dichloropropane (1,2-DCP)[9]	Group 1 (2014)	Chemical intermediate in the production of other organic chemicals and in paint stripping	Biliary-tract	Sufficient evidence from human studies
Acheson process[10]	Group 1 (2014)	Manufacture of silicon carbide (SiC)	Lung	Sufficient evidence from human studies
Silicon carbide (SiC) whiskers[10]	Group 2A (2014)	Manufacture of silicon carbide (SiC)	Mesotheliomas	Physical properties of the whiskers resemble those of asbestos and erionite fibres and evidence from animal studies

Malathion (insecticide)[11]	Group 2A (2015)	Agriculture workers and pesticide applicators (The use of pesticide products containing malathion was banned from 2008)	Non-Hodgkin Lymphoma (NHL) and prostate	Limited evidence in humans and sufficient evidence in experimental animals
Diazinon (insecticide)[11]	Group 2A (2015)	Agriculture workers and pesticide applicators (The use of pesticide products containing diazinon was banned from 2008)	Non-Hodgkin Lymphoma (NHL), leukaemia and lung	Limited evidence both in humans and in experimental animals
Glyphosate (herbicide)[11]	Group 2A (2015)	Agriculture workers and pesticide applicators	Non-Hodgkin Lymphoma (NHL)	Limited evidence in humans and sufficient evidence in experimental animals
Lindane (insecticide)[12]	Group 1 (2015)	Agriculture workers and pesticide applicators (The use of lindane was banned from 2002)	Non-Hodgkin Lymphoma (NHL)	Sufficient evidence both in humans and in experimental animals
N,N-dimethylformamide[13]	Group 2A (2016)	Workers repairing fighter aircraft and workers in the leather tannery	Testicle	Limited evidence in humans and sufficient evidence in experimental animals
2-mercaptobenzothiazole[13]	Group 2A (2016)	Workers in the rubber or tyre-manufacturing industries and in the chemical industry	bladder	Limited evidence in humans and sufficient evidence in experimental animals
Hydrazine[13]	Group 2A (2016)	Used in rocket propellant and aircraft fuel, workers in rocket testing	Lung	Limited evidence in humans and sufficient evidence in experimental animals
Tetrabromobisphenol A[13]	Group 2A (2016)	Used in flame retardant, workers in electronic product manufacturing facilities or in recycling facilities	Non-specific	Limited evidence in humans and sufficient evidence in experimental animals
Pentachlorophenol (PCP)[14]	Group 1 (2016)	Used as a wood preservative and insecticide but its production and use are now restricted	Non-Hodgkin Lymphoma (NHL)	Sufficient evidence both in humans and in experimental animals
Aldrin and dieldrin[14]	Group 2A (2016)	They are synthetic organochlorine pesticides and their use in several countries has been banned or severely restricted since the early 1970s.	Liver	Limited evidence in humans and sufficient evidence in experimental animals
3,3',4,4'-tetrachloroazobenzene (TCAB)[14]	Group 2A (2016)	Workers in herbicide manufacturing or application	Various cancer sites	Sufficient evidence in experimental animals and mechanistic evidence
Welding fumes[15]	Group 1 (2017)	Welders and other workers who are exposed to welding fumes at work	Lung	Sufficient evidence in humans
Ultraviolet (UV) radiation from welding[15]	Group 1 (2017)	Welders and nearby workers who are directly or indirectly exposed to UV radiation from Arc welding	Ocular melanoma	Sufficient evidence in humans
Styrene [16]	Group 2A	Workers in the reinforced plastics and rubber industries	Lymphohaematopoietic	Limited evidence in humans and sufficient evidence in experimental animals

Previously, IARC classified welding fumes as possibly human carcinogen (Group 2B) in 1989 and classified Ultraviolet (UV) radiation (not specifically for welding) as confirmed human carcinogen (Group 1) in 2012. In 2017, IARC reviewed the substantial new evidence accumulated since the previous reviews and reclassified both welding fumes and UV radiation due to welding as Group 1 human carcinogens. The research study on the burden of occupational cancer in Great Britain has included both welders (welding activities) and UV radiation due to welding in the analysis and has estimated that about 200 lung cancer registrations and 200 lung cancer deaths per year could be attributable to working as welders in the past; and a few cases of ocular melanoma registrations per year due to past exposure to UV radiation in welding in GB.

The GB occupational cancer burden study recognised that welders could potentially be exposed to several carcinogens. Separate cancer burden estimates have been made for nickel, chromium, lead, polycyclic aromatic hydrocarbons (PAHs) and asbestos for which the exposed population included welders. Occupational lung cancer burden estimate has also been made for all welders because the existing evidence suggests that other unidentified carcinogenic agents in welding fumes may also be contributing to the observed increase of lung cancer risk in welders.

The remaining carcinogens that have been newly classified since 2014 are not currently included in the GB cancer burden estimates. More information is required on the use (current or in the past) of these substances in the GB workplaces and the potential level of their exposures.

Other statistical information on occupational cancers

Number of occupational cancers compensated under the Industrial Injuries Disablement Benefit (IIDB) scheme

There are specific forms of occupational cancer that are currently compensable under the Department for Work and Pensions Industrial Injuries and Disablement Benefit (IIDB) scheme [17]. The numbers of people who have been compensated in the past 10 years (2007-2016) are presented in IIDB tables (www.hse.gov.uk/statistics/tables/index.htm#iidb).

On average, about 2,329 new occupational cancer cases per year were compensated over the last 10 years, which was just under a quarter of the total cases compensated. The majority of the occupational cancer cases were asbestos-related. These include mesothelioma (about 2,000 per year on average and 2,025 in 2017, with 10% female), and asbestos-related lung cancer (about 270 per year on average and 180 in 2017, with only 2% female). The number of people compensated for non-asbestos-related cancers was much lower at around 20 cases per year on average and 10 cases in 2017. Among them, the most frequently compensated cancer was urinary tract cancer associated with workplace exposure to various chemicals.

Number of occupational cancers reported by consultant chest physicians and dermatologists

Specialist physicians in the UK have been reporting work-related ill health, including occupational cancer to The Health and Occupation Research Network (THOR www.medicine.manchester.ac.uk/coeh/research/thor/). The number of cases reported during 1998-2015 are presented in the THOR tables www.hse.gov.uk/statistics/tables/#thor.

In 2017, consultant chest physicians reported an estimated 320 cases of mesothelioma and 41 cases of lung cancer. The number of mesothelioma cases reported in 2017 was much lower than the annual average of 653 in the past 20 years (1998-2017). These figures substantially underestimate current mesothelioma incidence and this is likely to be largely due to current referral practices which mean many cases are not seen by chest physicians.

Consultant dermatologists reported an annual average 393 cases of skin cancer in the past 20 years but only reported 159 cases in 2017. Once again, there has been an observed decrease in the number of skin cancer cases reported by dermatologists since 2010. However, this may reflect systematic changes in the reporting system rather than trends in the cancer occurrence.

For most types of cancer, the number of occupational cases reported by physicians or assessed for compensation purposes is much lower than the estimates from the cancer burden study. This reflects the difficulty in attributing individual cases to occupational exposures. However, comparison of new cases across different data sources has indicated that the reporting and assessment of mesothelioma cases are more complete than other occupational cancer cases due to the strong work attribution of this disease.

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Other links in the HSE website:

This web page is to provide key statistics on occupational cancer in Great Britain. Please visit www.hse.gov.uk/cancer/ to find out more on how cancer causing hazardous substances can be controlled.

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