

Industrial Injuries Advisory Council - Information Note

Lung cancer and welding

December 2013

As part of its review of occupational carcinogens, prompted by a priority list prepared by the Health and Safety Executive (HSE), the Industrial Injuries Advisory Council (IIAC) has examined the risk of lung cancer in welders. Welding is a common occupational activity in the UK and gives rise to a complex mixture of readily respirable fumes. The composition of the fume is determined by the particular welding process, by the metals (and any coating they may have) that are being fused, and by the nature of any filler material and shielding gas. Some welding fumes, such as those from stainless steel welding, contain recognised lung carcinogens (e.g. hexavalent chromium); welders may also have been exposed to asbestos and other workplace carcinogens.

The published evidence base is extensive and includes more than 100 original reports of different designs, several meta-analyses and a monograph of the International Agency for Research on Cancer (IARC) published in 1990. The last of these, Monograph 49, concluded that welding fume was *possibly* carcinogenic to humans (i.e. Group 2B); a more recent monograph on the hazards of radiation (100D, 2012) concluded that there is *sufficient* evidence in humans for the carcinogenicity of welding (i.e. Group 1). However, this was not on the basis of an increased risk of lung cancer but that of ocular melanoma (a cancer of the pigment layer in the eye).

In 2013, the Council prepared a summary of the available published evidence in relation to welding and lung cancer. The more recent meta-analysis (Ambroise et al. 2006) produced a combined relative risk estimate for all welders, based on 60 original reports, of 1.26 (95% confidence interval (CI) 1.20-1.32); this is close to the figure of 1.38 (95% CI 1.29-1.48) from an earlier meta-analysis by Moulin et al., published in 1997.

The table in this information note summarises risk estimates from 106 separate publications identified by the Council following consideration of the reviews above and a search of the literature published up to September 2013. Ninety-four of the studies reported estimates that were greater than 1.0, indicating an increase in risk; just 12, however, encompassing together 183 cases of lung cancer, were indicative of a risk that was more than doubled (i.e. greater than 2.0 and statistically significant, $p < 0.05$), the threshold the Council normally adopts when considering recommendations for prescription. Nine of the latter were case-control studies, which are more prone to bias than the cohort studies from which the remaining three estimates came. In only one of the 12 cohort studies of welders of stainless steel was there evidence of a risk that was more than doubled. Moreover, all but one of the studies that indicated a more than doubling of risk involved relatively few cases of lung cancer (<40); 28 of the 29 studies that were larger than this indicated

substantially lower risks. Finally, in an analysis of 16 European case-control studies, incorporating 568 welders with lung cancer (Kendzia 2013), the combined risk estimate was 1.44 (95% CI 1.25, 1.67).

Thus, the weight of evidence examined by the Council confirms the probable (lung) carcinogenicity of welding fume. Few, however, of the individual risk estimates, and none of those in aggregate, reached the necessary threshold. On this basis the Council has concluded that no case exists for recommending that lung cancer among welders be added to the list of prescribed occupations at this time. We will, however, continue to monitor emerging evidence on this topic.

WELDING CATEGORIES	NUMBER OF STUDIES	NUMBER OF CASES OF LUNG CANCER	RANGE OF RISK ESTIMATES	NUMBER OF RISK ESTIMATES SIGNIFICANTLY ≥ 2.0
All or unspecified				
<i>mortality and morbidity studies</i>	15	5982	0.85-3.50	0
<i>cohort studies</i>	15	396	0.76-2.73	1
<i>case control studies</i>	25	1492	0.86-7.18	5
Shipyard welding				
<i>cohort studies</i>	15	304	1.04-2.50	1
<i>case control studies</i>	5	98	0.70-2.50	1
Non-shipyard welding				
<i>cohort studies</i>	6	221	1.00-1.51	0
<i>case control studies</i>	1	13	3.80	1
Mild steel welding				
<i>cohort studies</i>	9	255	0.41-3.29	0
Stainless steel welding				
<i>cohort studies</i>	12	185	0.76-2.34	1
<i>case control studies</i>	3	60	0.90-3.30	2
All large studies	29	≥ 40	0.86-1.51	1
Total	106	9006		12

This note contains some technical terms (e.g. cohort study, case-control study, relative risk, meta-analysis), the meanings of which are defined in other reports of the Council.

Selected References

1. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Monograph 49: chromium, nickel and welding. 1990: Lyon, France

2. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. A review of human carcinogens. 100D: Radiation.2012: Lyon, France
3. Ambroise D, Wild P, Moulin J-J. Update of a meta-analysis on lung cancer and welding. *Scand J Work Environ Health* 2006;32(1):22-31
4. Moulin JJ. A meta-analysis of epidemiologic studies of lung cancer in welders. *Scand J Work Environ Health* 1997;23(2):104-113
5. Kendzia B et al. Welding and Lung Cancer in a Pooled Analysis of Case-Control Studies. *American Journal of Epidemiology*. Advance Access (online September 19, 2013)