Supplemental Files

Lung Cancer Risk in Painters: Results from the SYNERGY pooled case-control study consortium

Neela Guha,[1,2] Liacine Bouaoun,[1] Hans Kromhout,[3] Roel Vermeulen,[3] Thomas Brüning,[4] Thomas Behrens,[4] Susan Peters,[3] Veronique Luzon,[1]

Jack Siemiatycki,[5] Mengting Xu,[5] Benjamin Kendzia,[4] Pascal Guénel,[6] Danièle Luce,[7] Stefan Karrasch[8,9], Heinz-Erich Wichmann,[10,11] Dario Consonni,[12]

Maria Teresa Landi,[13] Neil E. Caporaso,[13] Per Gustavsson,[14] Nils Plato,[14] Franco Merletti,[15] Dario Mirabelli,[15] Lorenzo Richiardi,[15] Karl-Heinz Jöckel,[16]

Wolfgang Ahrens,[17,18] Hermann Pohlabeln,[17] Lap Ah Tse,[19] Ignatius Tak-sun Yu,[19] Adonina Tardón,[20] Paolo Boffetta,[21,22] David Zaridze,[23]

Andrea 't Mannetje,[24] Neil Pearce,[25] Michael P.A. Davies,[26] Jolanta Lissowska,[27] Beata Świątkowska,[28] John McLaughlin,[29] Paul A. Demers,[29,30]

Vladimir Bencko,[31] Lenka Foretova,[32] Vladimir Janout,[33] Tamás Pándics,[34] Eleonora Fabianova,[35,36] Dana Mates,[37] Francesco Forastiere,[38]

Bas Bueno-de-Mesquita,[39] Joachim Schüz,[1] Kurt Straif,[1] Ann Olsson,[1]

Affiliations:

1. International Agency for Research on Cancer, Lyon, France
2. California Environmental Protection Agency; Oakland, CA, USA
3. Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands
4. Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Institute of the Ruhr University (IPA), Bochum, Germany
5. Department of Social and Preventive Medicine, University of Montreal, Montreal, Canada.
6. Center for Research in Epidemiology and Population Health (CESP), Exposome and Heredity team, Inserm U1018, University Paris-Saclay, Villejuif, France
7. Univ Rennes, Inserm, EHESP, Irset (Institut de recherche en santé, environnement et travail) - UMR_S 1085, Pointe-à-Pitre, France
8. Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, Inner City Clinic, University Hospital of Munich, Ludwig-Maximilians-Universität; Comprehensive Pneumology Center Munich (CPC-M), Member of the German Center for Lung Research (DZL), Munich, Germany
9. Institute of Epidemiology, Helmholtz Zentrum München – German Research Center for Environmental Health, Neuherberg, Germany
10. Institut für Medizinische Informatik Biometrie Epidemiologie, Ludwig Maximilians University, Munich, Germany
11. Institut für Epidemiologie, Deutsches Forschungszentrum für Gesundheit und Umwelt, Neuherberg, Germany
12. Epidemiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy
13. Division of Cancer Epidemiology and Genetics, National Cancer Institute, NIH, Bethesda, MD, USA
14. Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden
15. Cancer Epidemiology Unit, Department of Medical Sciences, University of Turin, Turin, Italy
16. Institute for Medical Informatics, Biometry and Epidemiology (IMIBE), University Hospital Essen, Essen, Germany
17. Leibniz Institute for Prevention Research and Epidemiology - BIPS, Bremen, Germany
18. University of Bremen, Faculty of Mathematics and Computer Science, Institute of Statistics, Bremen, Germany
19. JC School of Public Health and Primary Care, the Chinese University of Hong Kong, Hong Kong

20. Department of Public Health, University of Oviedo. ISPA and CIBERESP, Oviedo, Spain
21. Stony Brook Cancer Center, Stony Brook University, Stony Brook, NY, USA
22. Department of Medical and Surgical Sciences, University of Bologna, Bologna, Italy
23. Department of cancer epidemiology and Prevention, N.N. Blokhin National Research Centre of oncology, Moscow, Russia
24. Centre for Public Health Research, Massey University, Wellington, New Zealand
25. London School of Hygiene & Tropical Medicine, London, UK
26. Roy Castle Lung Cancer Research Programme, Department of Molecular and Clinical Cancer Medicine, University of Liverpool, Liverpool, UK
27. Epidemiology Unit, Department of Cancer Epidemiology and Prevention, M. Sklodowska-Curie National Research Institute of Oncology, Warsaw, Poland
28. The Nofer Institute of Occupational Medicine, Lodz, Poland
29. Dalla Lana School of Public Health, University of Toronto, Toronto, Canada
30. Occupational Cancer Research Centre, Ontario Health, Toronto, Canada
31. Institute of Hygiene and Epidemiology, First Faculty of Medicine, Charles University, Prague, Czech Republic
32. Masaryk Memorial Cancer Institute, Brno, Czech Republic
33. Faculty of Health Sciences, Palacky University, Olomouc, Czech Republic
34. National Public Health Center, Budapest, Hungary
35. Regional Authority of Public Health, Banská Bystrica, Slovakia
36. Faculty of Health, Catholic University, Ružomberok, Slovakia
37. National Institute of Public Health, Bucharest, Romania
38. Department of Epidemiology, ASL Roma E, Rome, Italy
39. Former senior scientist, Department for Determinants of Chronic Diseases, National Institute for Public Health and the Environment, Bilthoven, The Netherlands

Corresponding author: Ann Olsson, Section of Environment and Radiation, International Agency for Research on Cancer, 150 cours Albert Thomas, 69372 Lyon CEDEX 08, France. Phone: 33 (0)4-7273-8152; E-mail: olssona@iarc.fr

Supplemental Table 1. Categorization for painter by industry (e.g. spray, construction, manufacture, repair) classified by ISCO and ISIC codes, grouped on chemical composition of paint, and type of application

PAINTER INDUSTRY	**ISCO**		**ISIC**		**Chemical Exposures *,****
Construction	93100	Painters, construction			1,2,4-trimethylbenzene, 2,2,4-Trimethylpentane-1,3-diol monoisobutyrate, Ammonia, **Asbestos**, Benzene, Butyl acrylate, **Cadmium**, Calcium, **Chromium**, Cobalt, **Crystalline silica**, Diethylene glycol butyl ether, Diethylene glycol methyl ether, Dipropylene glycol methyl ether, Ethylene glycol butyl ether, Ethylene glycol phenyl ether, Formaldehyde, Iron, Isobutanol, Lead, Limonene, n-Butano, n-Decane, n-Hexane, n-Nonane, n-Undecane, Propylene glycol, Solvent naphtha, Titanium, Toluene, Trichloroethylene,Triethylamine, White spirits, Xylene, Zinc
	93120	Building painter			
	93920	Brush painter			
	93XXX		9100	Public administration & defense	
	93XXX		5000	Construction	
Manufacture*	93XXX		3XXX	All manufacture (excluding ISIC 3320 – furniture & cabinet manufacture)	1-methoxypropanol- 2-ol,2-Butoxyethanol, 2-Ethoxyethanol,2-Ethoxyethyl acetate,2-methoxypropyl-1- acetate, Carbon black, C-9 Aromatic hydrocarbon,Dichloromethane, Ethanol, Ethyl acetate, Ethylbenzene,Isobutanol, Isopropanol, Isopropyl alcohol, Methyl ethyl ketone, Methyl isoamyl ketone, Methyl isobutyl ketone,Methylacetate, N,N-dimethylformamide,n-Butanol, n-Butyl acetate, n-Butyl acetone,n-Hexane, Stoddard solvent, Toluene,Trimethylbenzene (all isomers), VM&P Naphta, White spirits, Xylene
			3843	Motor vehicle manufacture	
			3845	Aircraft manufacture	
Spray painters in manufacture	93930	Spray painter	3XXX	All manufacture (excluding ISIC 3320 – furniture & cabinet manufacture)	1,3,5-Triglycidyl isocyanurate, Acetone, Benzene, Bisphenol A, glycidyl ethers, butanone, Butyl acetate, Cellosolve acetate, **Chromium,** Chromium oxide, Cyclohexanone, Dichloromethane, Diethylene triamine, Epichlorohydrin, Ethyl acetate, Ethylbenzene, Isobutyl acetate, Isobutyl ketone, Lead, Methyl ethyl ketone, Methyl isobutyl ketone, Naphtha, n-butyl acetate, **Polycyclic Aromatic Hydrocarbons**, Styrene, Toluene, Xylene, Zinc oxide
	93930	Spray painter	3843	Motor vehicle manufacture	
	93930	Spray painter	3845	Aircraft manufacture	
Repair	93XXX		3841	Ship building and repair	2-Propylacetate, Acetone, Benzene, Butylacetate,Dichloromethane, Ethyl acetate, Ethylbenzene, Hexamethylene diisocyanate (HDI), Isobutanol, Isopropanol, n-Butylacetate,n-Hexane, Toluene, Trimethylbenzene, Xylene
			9513	Motor vehicle repair	
Other	93XXX	Painters who were not included in the industries (as indicated by the combination of ISCO and ISIC codes) listed above			

* Bolded chemicals indicate IARC Group 1 lung carcinogens with sufficient evidence in humans that these chemicals cause lung cancer.

** Source: Tables 1.12-1.16 of the IARC Monograph volume 98

Supplemental Table 2. Occupations and industries known or suspected to present an excess risk of lung cancer*	
Industry	**Occupation/Process**
LIST A (excluding painters)	
Agriculture	Users of arsenic-based insecticides in vineyards
Mining and quarrying	Extraction of arsenic Extraction of uranium Extraction of iron ore Extraction of asbestos Extraction and grinding of talc. Extraction of granite
Chemical products (basic industrial chemicals)	Production of chromate pigment Manufacture of cadmium-based pigment Production of chloromethylated organic compounds and intermediates, of ion exchange resins, production of CMME (presence of BCME / CMME) Production of chlorophenols and chlorophenoxy acids Production of polyvinyl chloride
Pesticide and herbicide production	Arsenical insecticide production and packaging
Asbestos processing	Production of insulating material (products based on asbestos cement, pipes, cloths, textiles, dresses, masks)
Granite processing	Cutting, grinding, polishing, etc. of granite slabs
Ceramic industry and production of refractory bricks	Pottery workers
Metals (iron and steel basic Industries)	Iron and steel founding
Metals (non-ferrous, basic industries): smelting, alloying, refining, rolling, drawing, casting	Copper smelting Zinc smelters Production of cadmium alloys Production of aluminum Refining of nickel Production of chromium Refining and production of cadmium Refining and grinding of beryllium Production of products containing beryllium
Mechanical industry	Pickling operations Chrome plating Electroplating (cadmium) Brazing
Electromechanical industry	Manufacture of nickel-cadmium-based batteries
Shipbuilding, motor vehicle, railroad equipment manufacturing	Shipyard and dockyard, motor vehicle, and railroad manufacture workers
Gas	Coke plant workers and gas production workers
Construction	Insulators and pipe coverers, roofers, and asphalt workers
LIST B	
Agriculture	Insecticide sprayers (workers in orchards and horticulturists)
Mining and quarrying	Zinc-lead mining, metal mining
Food industry	Butchers and meat workers
Leather	Tanners and processors
Wood and wood products	Carpenters, Joiners
Printing	Rotogravure workers, printing pressmen, machine-room workers, binders, and other jobs
Chemical production	Acrytonitrile, vinylidene chloride, polychloroprene,

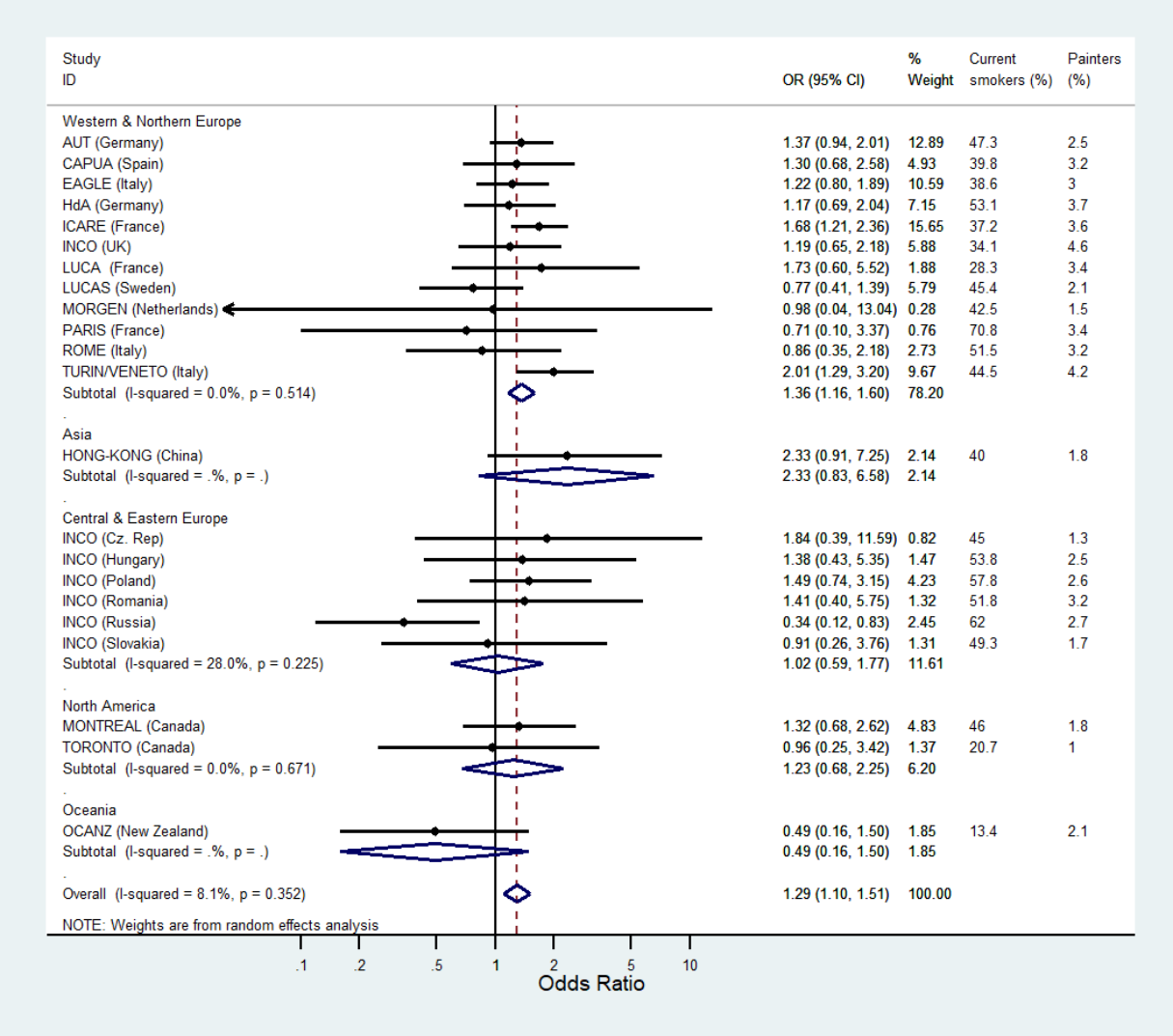
	dimethylsulfate, epichlorohydrin, benzoyl chloride, carbon black, alphachlorotoluene, 1,2 dibromo 3 chloropropane
Production of herbicides and pesticides	Production and packaging of herbicides based on 1,2 dibromo 3 chloropropane
Rubber	Various occupations in rubber manufacture, including the use of carbon black
Ceramic, refractory brick, and glass	Glass workers (glass processing, containers and moulded glass items)
Metals	Lead smelting, iron and steel founding
Motor vehicle manufacturing and repair	Mechanics, welders etc. (forging press operator. machine-tool operators, motor-vehicle mechanics)
Transport	Railroad workers Bus and truck drivers
Building	Operators of excavating machines (heavy equipment operators)
Commercial	Filling station attendants
Other	Laundry and dry cleaners

* based on Ahrens W, Merletti F. A standard tool for the analysis of occupational lung cancer in epidemiologic studies. *Int J Occup Environ Health* 1998;4(4):236-40 and Mirabelli D, Chiusolo M, Calisti R, et al. [Database of occupations and industrial activities that involve the risk of pulmonary tumors]. *Epidemiologia e prevenzione* 2001;25(4-5):215-21 as used in Lung Cancer Risk in Painters: Results from the SYNERGY pooled case-control study consortium.

Supplemental Table 3. Risk of lung cancer in painters; sensitivity analyses by characteristics of the studies included in SYNERGY

Study characteristics	OR (95% CI)	I^2	n studies
All studies	1.26 (1.09-1.44)	0%	22
Control Source			
Hospital	0.99 (0.69-1.42)	6%	9
Population	1.32 (1.13-1.55)	0%	11
Hospital+Population	1.19 (0.64-2.21)	0%	2
Region			
Western & Northern Europe	1.31 (1.12-1.52)	0%	12
Central & Eastern Europe	0.99 (0.59-1.66)	26.6%	6
North America	1.11 (0.62-1.98)	0%	2
Asia	2.19 (0.81-5.92)	NA	1
Oceania	0.77 (0.29-2.04)	NA	1
Sample Size			
≤1500	1.00 (0.74-1.35)	0%	12
>1500	1.33 (1.14-1.56)	0%	10
Year data collection ended			
<1995	1.35 (1.05-1.74)	14.7%	6
>1995	1.19 (1.00-1.42)	0%	16
Exclude studies with the largest weights			
Drop AUT, ICARE, TURIN	1.08 (0.90-1.30)	0%	19
Control participation			
>50%	1.23 (1.06-1.44)	0%	19
>75%	1.24 (0.99-1.55)	18.7%	14
>90%	1.02 (0.63-1.65)	37.3%	6

NA, not available



Supplemental Figure 1. Risk of lung cancer in painters; meta-analysis of the case-control studies included in the SYNERGY pooled analysis, stratified by geographic region. ORs displayed are adjusted for age, sex, cigarette pack-years, time since quitting smoking, and ever employment in list A and B jobs.