

Introduction: Epidemiologic Research and Prevention of Occupational Cancer in Europe

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Research on occupational cancer epidemiology has been an important area of occupational health in Europe since the early studies were conducted in the United Kingdom in the 1950s and 1960s. During the last decade, occupational cancer research in Europe has gained an international dimension and become increasingly interdisciplinary in nature. At present, occupational exposures might be responsible for 13 to 18% of lung cancers, 2 to 10% of bladder cancers, and 2 to 8% of laryngeal cancers in European men; among women these figures are 1 to 5%, 0 to 5%, and 0 to 1%, respectively. A notable aspect of current occupational cancer research in Europe is the decreasing importance of traditional circumstances of high exposure to recognized occupational carcinogens and the increasing importance of new industries, mainly in the service sector where possible cancer hazards are poorly known. In addition, the political changes in Central and Eastern Europe open new possibilities for the investigation of high-exposure circumstances and occupational cancer in women. — *Environ Health Perspect* 107(Suppl 2): 229–231 (1999). <http://ehpnet1.niehs.nih.gov/docs/1999/Suppl-2/229-231boffetta/abstract.html>

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Historical Perspective of Occupational Cancer Research in Europe

Research on occupational cancer cannot be separated from the work conducted in its parent disciplines: epidemiology and biostatistics on the one hand, and occupational medicine and industrial hygiene on the other. However, it is possible to single out some general historical features of occupational cancer research in European countries.

The tradition dates back to the description of an increased occurrence of certain neoplasms in several occupational groups, such as breast cancer among nuns, made by Ramazzini in 1700 (1), and has seen its beginning as a modern science with the description of scrotal cancer among chimney sweeps made by Pott in 1778 (2). With the rise of modern epidemiology in the 1950s, several important industry-based studies were conducted in the United Kingdom during the 1950s and the 1960s. Table 1 summarizes some of the key achievements during those years.

These studies examined the effects of high-level exposure to occupational carcinogens experienced by workers in the United Kingdom, as in other industrialized countries, during the last part of the 19th century and the first half of the 20th century. During the 1970s, the role of American research centers in occupational epidemiology became more prominent. The identification of several occupational carcinogens through epidemiologic studies during that decade was mainly the result of studies conducted in the United States; examples are vinyl chloride (10) and chloromethyl methyl ether (11). In Europe, although the tradition in the United Kingdom persisted, an impressive growth of research work took place in the Nordic countries, assisted by the availability of high-quality registries, access to industrial records, and relative availability of resources.

During the 1980s, modern epidemiologic methods expanded to additional European countries, most notably France, Germany, and Italy. The conditions in these countries were, in general, less favorable for industry-based epidemiologic studies; the collaboration of the industry was often problematic and the methodology for follow-up was complicated by legal and practical difficulties. Although some of the work conducted in France, Germany, and Italy tended to replicate well-established findings (e.g., cancer risk among asbestos-exposed workers), there

were important original contributions, for example, on cancer risk from exposure of workers to dioxin (12) and cobalt (13).

Generally, however, the 1980s were a period of crisis for occupational cancer epidemiology not only in Europe but also in America. Few new occupational carcinogens were identified, and in many instances the results of large and well-conducted studies were ambiguous, probably reflecting a lower carcinogenic potency of the agents under study (typical examples are heavy metals such as cadmium and beryllium), as well as the beneficial consequences of an increased control of exposure levels in the workplace. The widespread opinion that occupational causes of cancer play a major role in the human cancer burden, exemplified by the 1978 report from the U.S. Occupational Safety and Health Administration that estimated at 40% the fraction of total cancers attributable to occupational exposure (14), was quite rapidly replaced by the opinion that all occupational carcinogens—or at least all those with some public health importance—had been identified and that occupational cancer would concern only prevention and compensation. This view was supported by Doll and Peto in their authoritative review of the causes of human cancer (15) and has since gained widespread consensus.

The present decade has seen a new development of occupational cancer epidemiology in Europe and in America, characterized by an increase in the application of biologic markers to industry-based studies. Schematically, such markers are intended to contribute: *a*) to improving exposure assessment by measuring the biologically effective dose, *b*) to the sensitivity of the recognition of the outcome by investigating preneoplastic conditions and by examining molecular alterations in the neoplastic tissue, and *c*) to identifying susceptible subgroups of workers. The markers would therefore help both etiologic research and its applications in the domains of prevention and compensation. This development occurred in all areas of cancer epidemiology, reflecting the dominant role assumed in recent years by molecular

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biology and genetics in cancer research and the impasse described above for occupational epidemiology but also present in other areas of cancer epidemiology.

An important characteristic of research on occupational cancer in Europe in the last decade is the increasing number of collaborative studies involving various countries. This approach has been stimulated mostly by research programs of the European Commission, which were explicitly aimed at improving the collaboration of

scientists among countries of the European Union. Such programs suffered from several limitations, including the inability to involve scientists from countries other than those belonging to the European Union the nature of the funding, which is usually intended to cover only additional costs of international collaboration and not those of the research work in each collaborating center (principle of subsidiarity), and, the short duration of contracts. However, research programs have been instrumental

in providing a European dimension to most of the biomedical research conducted today in many laboratories, and in most European projects on occupational cancer (16).

Estimates of Cancer Attributable to Occupational Exposures in Europe

Different approaches can be used to obtain an estimate of the burden of occupational cancer in Europe today (17). Table 2 presents the results for selected cancers obtained using three different approaches: *a*) the figures proposed by Doll and Peto (15), *b*) a linkage analysis of census and cancer registry data from the Nordic countries (17), and *c*) the results of pooled analyses of case-control studies (17). The global contribution of occupational exposures to cancer in Western Europe is most likely similar to the best estimate proposed by Doll and Peto (15) of 4%.

A complementary approach involves examining the data on the basis of incidence of neoplasms caused primarily by occupational exposures such as sinonasal cancer and pleural mesothelioma. Table 3 summarizes the most recent data on the incidence in men of these two neoplasms in regions of Europe included in good quality cancer registries.

The incidence of sinonasal cancer is approximately 0.6 to 0.7 per 100,000, with relatively modest local variations. This pattern probably reflects, at least in part, a similar effect of the main occupational risk factors of sinonasal cancer (exposure to wood dust, particularly hard wood, and to nickel and chromium) in different European countries.

In contrast, the incidence of pleural mesothelioma presents wide variations even in large countries with nationwide cancer registration. The reported incidence is only 0.02 per 100,000 in Sweden and 0.14 per 100,000 in Norway, whereas it is more than 0.20 per 100,000 in Denmark, Finland, England, Wales, and Scotland. This pattern is likely to reflect important quantitative and qualitative variations in the past use of asbestos in different countries and regions.

Trends in Occupational Cancer Research in Europe

The current work being done in epidemiologic and toxicologic areas of occupational cancer in Europe reflects not only the research patterns described above (increasing use of molecular biology techniques into population- and industry-based studies) but

Table 1. Examples of occupational carcinogens identified in the 1950s and 1960s mostly through studies conducted in the United Kingdom.

Exposure	Cancer	Year ^a	Main researchers	Reference
Benzidine, β -naphthylamine	Bladder	1954	Case, Scott	(3,4)
Coal gasification ^b	Skin, lung	1952	Doll	(5)
Nickel	Lung, nose	1958	Doll, Hill, Morgan	(6,7)
Wood dust	Nasal adenocarcinoma	1965	Acheson, Macbeth	(8,9)

^aYear of key publication(s) from the United Kingdom. ^bCancer risk due to exposure to polycyclic aromatic hydrocarbons.

Table 2. Estimates of the number of selected cancers attributable to occupational exposures in Western Europe.

Cancer	Gender	DP	AP/NC	PA	<i>n</i>
Lung	Men	15	18	13	146,300
	Women	5	<1	3	36,100
Bladder	Men	10	2	4-10	52,200
	Women	5	<1	0-9	14,300
Larynx	Men	2	6	8	21,600
	Women	1	<1	<1	1,700

Abbreviations: AP, proportion (%) of cancer attributable to occupational exposures; DP, figures proposed by Doll and Peto (15); NC, figures derived from the analysis of data from Nordic countries (17); PA, figures derived from pooled analyses of case-control studies (17); *n*, estimated number of incident cases in the European Union, 1990 (18).

Table 3. Age-standardized rates of sinonasal cancer and pleural neoplasms among men in European regions covered by population-based cancer registries from 1988 to 1992 (19).

Country	Region	Sinonasal cancer	Pleural neoplasms
Austria	Tyrol	0.21	0.21
Belarus	Whole country	0.55	0.15
Croatia	Whole country	0.52	0.10
Czech Republic	Whole country	0.49	0.30
Denmark	Whole country	0.85	0.23
Estonia	Whole country	0.71	0.08
Finland	Whole country	0.56	0.26
France	8 regions	0.94-1.52	0.04-0.41
Germany	Eastern states	0.60	0.37
Germany	Saarland	0.50	0.83
Iceland	Whole country	1.18	0.13
Ireland	Southern	0.26	0
Italy	13 regions	0.14-1.11	0-1.05
Latvia	Whole country	0.63	0.70
Malta	Whole country	1.17	0.82
Netherlands	Whole country	0.81	0.19
Norway	Whole country	0.72	0.14
Poland	4 regions	0.39-0.84	0.20-0.42
Slovakia	Whole country	0.69	0.25
Slovenia	Whole country	0.80	0.01
Spain	9 regions	0-1.44	0-0.45
Sweden	Whole country	0.60	0.02
Switzerland	8 regions	0.23-0.95	0-0.54
United Kingdom	England and Wales	0.63	0.29
United Kingdom	Scotland	0.52	0.24
Yugoslavia	Vojvodina	0.28	0.53

also how the direction of research is being determined by socioeconomic developments of the current history of the continent.

An important factor influencing the direction of occupational cancer research is the rise of service industries in the last decade. This is reflected in the sharp decrease in workers employed in industries and occupations in which a cancer hazard has been found in the past. A parallel trend is the decrease in exposure to potential carcinogens in most workplaces. These two parallel trends have frequently led to the conclusion that occupational cancer, in technologically advanced countries, is only a problem of historical relevance. This is probably true for the traditional large-scale industrial sector, such as the rubber industry, although surveillance of past workers must be continued to assess the impact of preventive measures and for compensation purposes. Even in highly industrialized countries, however, groups of workers exposed to known or suspected carcinogens still exist, particularly in small workshops and in the informal sector.

A related aspect of the current working conditions in Europe is the expansion of the number of unemployed subjects. The health implications of this phenomenon have not been adequately addressed by current research in Europe.

A decreasing trend in the number of workers potentially exposed to carcinogens and in their exposure levels is apparent in many European countries. Such trends, however, concern to a limited extent a large fraction of European workers. In the former socialist countries of Central and Eastern Europe, workers may still experience high exposures to carcinogens. In these countries, in which relatively little high-quality research on occupational cancer has been conducted for several decades, there is today a great need for training in modern research methodologies and for supporting research projects within the frame of cooperation programs. In some cases, workplaces in Central and

Eastern Europe are seen by researchers from Western countries as natural laboratories in which the effects of exposure to toxic agents could be ethically studied. More generally, however, the dramatic political and economic changes experienced by Central and Eastern European countries offer a major tool for the prevention and control of occupational cancer through the application of preventive measures that have been proven effective in Western countries.

This monograph presents the key aspects of the current experience of research on occupational cancer in Europe, particularly with respect to the epidemiologic and preventive aspects. It consists of a series of contributions on specific countries or groups of countries and a few additional articles discussing specific cases. It is intended to offer a composite view of the status and perspective of this discipline in a continent in economic and political transition.

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