Burden of work-related cancer in Finland and two exposure information systems (CAREX and FINJEM) including estimates on occupational exposure to carcinogens

Timo Kauppinen
Estimates of work-related cancer in Finland

• 3% of incident cancers (Aitio and Kauppinen 1992)
  • men 5%, women 0.5%
  • lung cancer (300 cases), mesothelioma (100), bladder, leukemia, skin, nose, etc (<100)
  • 150-200 from past exposure to asbestos
  • based on attributable fraction (AF) estimates of Doll&Peto (1981)

• 0.6% of incident cancers (158 cases) notified to Finnish Register of Occupational diseases (Oksa et al 2011)
  • 152 due to asbestos, 6 due to other exposures
  • underreporting, particularly of non-asbestos cancers

• 8% of cancer mortality (Nurminen and Karjalainen 2001)
  • based on FINJEM exposure estimates and risk estimates of selected epidemiological studies
  • some risks not confirmed, application of exposure data debatable

• Future burden from current exposure less (Priha et al 2010)
  • silica 17 cases/y, diesel exhaust 9, welding 8, asbestos 1, benzene <1, formaldehyde <1, chromiumVI <1, nickel <1, wood dust <1
International Information System on Occupational Exposure to Carcinogens (CAREX)

- **EU/IARC** research project in the mid 90s
- numbers of workers exposed carcinogens by country and industry in 15 'old' member states of EU in 1990-93
- **carcinogen** = IARC group 1, 2A and selected 2B (ie. carcinogenic, probably carcinogenic and possibly carcinogenic to humans)
- only numbers of exposed estimated based on Finnish, US or own data on prevalence of exposure ('default method, mainly')
- **documentation** and summarised exposure measurements are in a database but the levels of exposure were not estimated due to lack of resources
Occupational exposure to carcinogens in the European Union (CAREX)

- Timo Kauppinen, Jouni Toikkanen, Anja Savela, Finland
- David Pedersen, Randy Young, USA
- Wolfgang Ahrens, Germany
- Paolo Boffetta, Dario Mirabelli, Italy, IARC
- Johnni Hansen, Denmark
- Hans Kromhout, the Netherlands
- Jeronimo Blasco, Victoria de la Orden-Rivera, Spain
- Brian Pannett, UK
- Nils Plato, Sweden
- Raymond Vincent, France
- Manolis Kogevinas, Greece
CAREX

139 carcinogens (IARC) (1,2A,2B mainly)

19 EU countries

P, prevalence of exposure (%) in 1990-93

55 industries (UN ISIC Rev. 2)
Carex - Most common occupational exposures to IARC agents in EU 15 (1990-93)

- Solar radiation
- Tobacco smoke (ETS)
- Silica, crystalline
- Diesel engine exhaust
- Radon
- Wood dust
- Lead and its compounds
- Benzene
- Asbestos
- Ethylene dibromide

TOTAL 32 million exposed workers (23% of the employed)
Carex - Occupational exposure to crystalline silica by industry in EU 15 (1990-93)

- Construction
- Mineral product industry
- Other mining and quarrying
- Pottery and china industry
- Machine industry
- Iron and steel industry
- Metal product industry
- Metal ore mining
- Glass industry
- Transport equipment ind

0 500000 1000000 1500000 2000000 2500000
Strengths and weaknesses of CAREX

- New information on the extent of exposure (overview of national situation)
- Systematic approach: similar definitions and procedures in all countries
- Consistency and comparability of the results
- Wide coverage: all industries, agent list expandable
- Easy to use: PC-version, wide selection of tables and figures (reports)
- Data not confidential and freely to be distributed (Internet etc)

- Lack of estimates on level of exposure: does not identify worker groups at high risk (prevention!)
- Lack of estimates by gender (men/women), time (trends) and region (local prevention)
- Covered only carcinogens
- Estimates partially unreliable: no company surveys made to validate the results, no confidence limits (high/low estimates)
- Construction requires competence and resources (although less than an official exposure or measurement register)
Successors of CAREX

- Extension to 4 East European countries (FIBELLC-project), the same procedure, no improvements
- Update until 2000 and regional application with estimates on exposure levels in Finland (CAREX Finland); Italian CAREX updated 2005, Spanish CAREX under update (time trends)
- Integration with company survey (reliability!), country questionnaire and exposure data of wood dust in EU-25 (WOODEX), high risk groups documented
- Costa Rican TICAREX includes non-carcinogens (pesticides), gender and low/high estimates. Extented to Panama and Nicaragua
- CAREX Canada: exposure levels, regional environmental exposures, web-data
Examples of CAREX use

- The estimation of global burden of disease due to occupational carcinogens by **WHO** (Driscoll et al 2005)
- The estimation of burden of occupational cancer in **Britain** (a series of papers by Rushton et al. in British Journal of Cancer in 2012)
- The estimation of consequences of exposure to 25 carcinogens in **EU** (SHEcan project, unpublished?)
- CAREX Finland: municipality-specific exposure estimates (prevalence and level) for a prevention campaign of regional labor safety inspection offices in **Finland**
- Priority setting for prevention of occupational cancer?
84 exposures: (chem, phys, ergo, psycho, lifestyle)

311 occupations (Finnish classification)

P, prevalence of exposure (%)
L, level of exposure (ppm, etc.)

8 periods (1945-2009)
FINJEM: Sources of information

- Labour force data by industry and occup.
- Exposure measurements (DOEM)
- Questionnaire-based surveys
- Expert judgments

Statistical analysis (mean, GM, GSD etc)
Statistical analysis (prevalence, score)

Finnish Job-Exposure Matrix (FINJEM)
Exposure profiles for agents

Painters

Aliphatic/alicyclic hydrocarbon solvents
Exposure profiles for occupations

Chemical exposure profile of painters
Past, present and future exposure and burden of disease (number of attributable cases)

- asbestos consumption and mesothelioma cases in Finland
- exposure predicts burden after a latency period
- the relationship between past and present exposure can be used to estimate future attributable cases
FINJEM-based trend estimates for 41 chemical agents

- **P** = prevalence of exposure
  - as % of the employed in Finland (and number of exposed workers \(N_{\text{exp}}\))

- **L** = average level of exposure among the exposed
  - as agent-specific units (e.g., ppm, mg/m³), weighed by the number of exposed workers

- **Phigh** = prevalence of high exposure
  - to >50% of occupational exposure limit, as % of the employed in Finland, log-normality of L within the exposed in an occupation was assumed

- **NOIE** = national occupational inhalation exposure
  - 'total' exposure in Finland, as \(N_{\text{exp}} \times L\)

- The reference year was **1990 (=100)**
41 chemical agents, median

Future burden of occupational diseases due to chemical exposure will decrease.
Asbestos

Ban of asbestos use in 1990

Preval level high total


100 9
Diesel exhaust

Bar chart showing the prevalence and level of diesel exhaust over different years.
How to improve CAREX?

- Incorporation of **levels of exposure** would enable more accurate burden assessments and identification of high risk industries and worker groups.
- Extension to important **non-carcinogens**?
- Time dimension and **trends**?
- Better use of exposure **measurement data** in estimations?
- Extension to **all EU countries**, and non-European countries?
- **Gender**-specific estimates?
- **Occupation**-specific estimates?
- Estimates of **uncertainty**?
- Default-approach complemented by **crowd-sourcing**?
- Better free **availability** through the Internet.
- **Collaboration** with safety/health authorities, IARC, unions, research institutions, forerunner companies, NGOs etc?
- Step-wise development towards global CHEMEX?
- A good plan and financing needed.