Occupational cancer

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INTERNATIONAL AGENCY FOR RESEARCH ON CANCER

WORLD HEALTH ORGANIZATION

Cancer Research for Cancer Control

IARC Monographs on the evaluation of carcinogenic risks to humans

- Systematic evaluation of
  - agents
  - mixtures
  - exposure circumstances
- Agents are
  - chemical
  - physical
  - biological

Evaluation of evidence of carcinogenicity

- Human studies
  - sufficient, limited, inadequate, suggesting lack of carcinogenicity, no data
- Animal carcinogenicity studies
  - sufficient, limited, inadequate, suggesting lack of carcinogenicity, no data
- Mechanistic data
  - idiosyncratic contribution to overall evaluation

Overall evaluation

	Human		
Animal	*Suff*	*Lim*	*In/ND*
Suff.	1	2A	2B
Limited	1	2B	3
Inad./ND	1	2B	3

1: carcinogenic to humans
2A: probably carcinogenic to humans
2B: possibly carcinogenic to humans
3: not classifiable as for carcinogenicity to humans

Use of mechanistic data

		Human	
Animal	*S*	*L*	*I/N*
S	1	2A→1	2B
L	1	2B	3
I/N	1	2B	3

Evidence of mechanism operating in animals and exposed humans.
Example: TCDD (Ah receptor)

Number of agents evaluated within the IARC Monographs programme

Group	*# agents **
1 carcinogen	87 (13)
2A probable carc.	63 (4)
2B possible carc.	233 (4)
3 not classifiable	490 (7)
4 prob. not carc.	1

* In brackets, exposure circumstances (e.g., occupations)

Main source of exposure of agents classified in IARC group 1 (carcinogens)

Exposure	*#*
Occupational / env.	25
Biological	10
Medical	20
Radiation	13
Lifestyle	6

Occupational agents classified as having sufficient evidence of carcinogenicity in humans

4-Aminobiphenyl
Arsenic
Asbestos
Benzene
Benzidine
Beryllium
BCME, CMME
Cadmium
Chromium[VI] c.
Mustard gas
2-Naphthylamine
Nickel comp.
Radon decay pr.
Silica, crystalline
Solar radiation
Talc w. asb. fib.
Vinyl chloride
Coal-tar pitches
Coal tars
Mineral oil, untr.
Shale oils
Soots
Str. inorg. a. m.
Wood dust

Occupations and industries classified as entailing exposures with sufficient evidence of carcinogenicity in humans

- Aluminium production
- Auramine (mft)
- Boot and shoe (mft, repair)
- Coal gasification
- Coke production
- Furniture and cabinet making
- Haematite mining (undergr.)
- Iron and steel founding
- Isopropanol (mft)
- Magenta (mft)
- Painter
- Rubber industry

The evaluation might not apply to all exposure circumstances within the industry and it might reflect the risks from past exposure conditions

Occupational agents classified as having limited evidence of carcinogenicity in humans

Acrylamide

Acrylonitrile

1,3- Butadiene

Chlorophenoxy herbicides

p-Chloro-o-toluidine

Ethylene oxide

Formaldehyde

Polychlorophenols

Rock/slag wool

TCDD

Tetrachloroethyl.

Trichloroethylene

1,3,3-Trichloropropane

Nitrogen mustard

Benzo(*a*)pyrene

Benz(*a*)anthracene

Vinyl bromide

Creosotes

Diesel eng. exhaust

Non-arsenical. insecticides

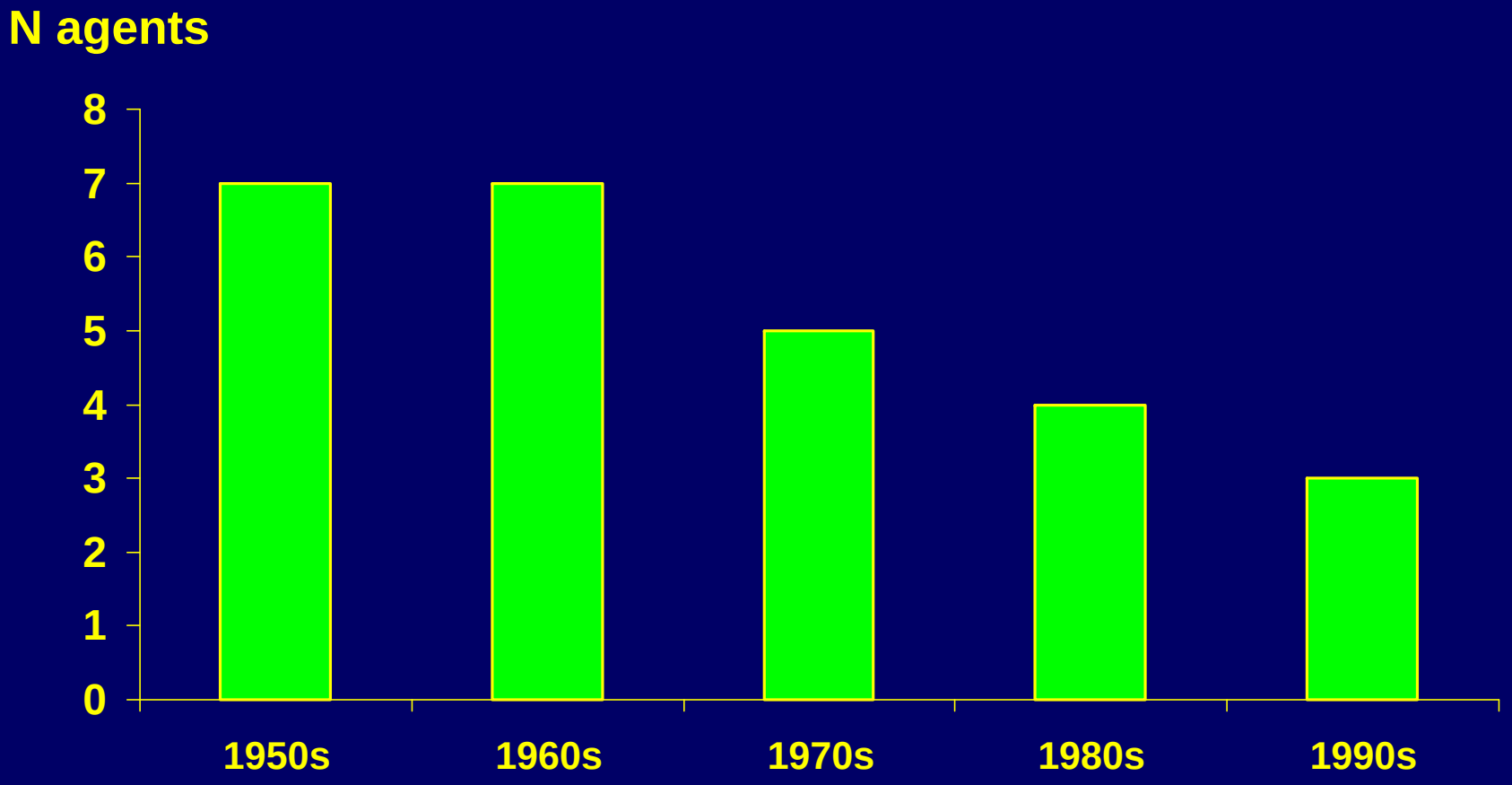
PCBs

Welding fumes

Occupations and industries classified as entailing exposures with limited evidence of carcinogenicity in humans

- Art glass (mft)
- Carpentry and joinery
- Dry cleaning
- Hairdresser, barber
- Petroleum refining
- Printing process
- Textile industry

Decade of publication of key results on environmental carcinogens



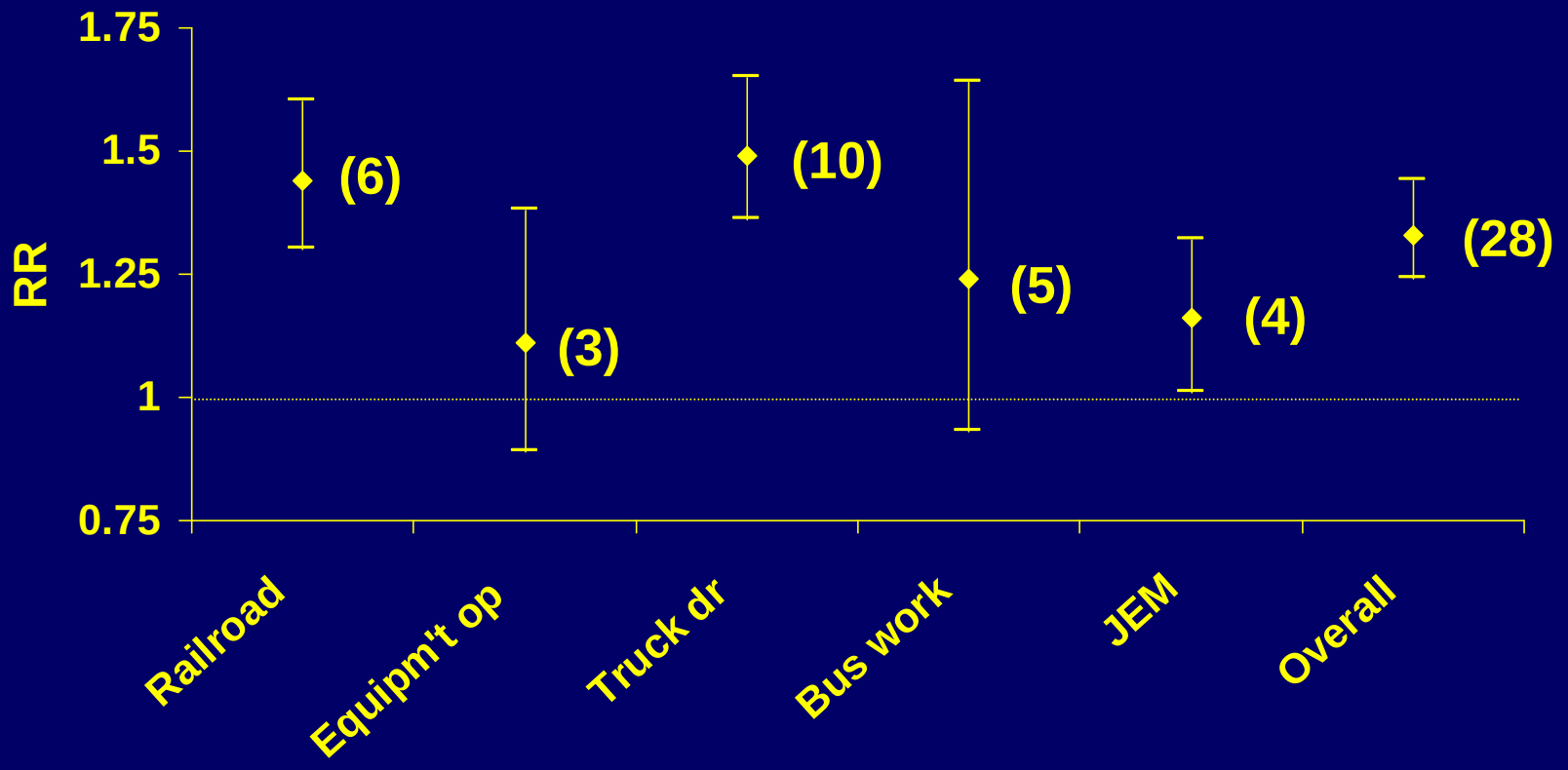
Historical and new environmental carcinogens

	Historical carcinogens	*New carcinogens*
Potency	High	Low
Exposure levels	High	Low
Co-exposures	Few	Many
Target tumour	Rare	Common

Examples of suspected carcinogens

- diesel engine emissions
  - complex exposure
  - relatively low dose
- 1,3 butadiene
  - low potency
  - rare exposure
  - uncommon tumour
- rock/slag wool
  - low dose
  - rare 'clean' exposure

Risk of lung cancer and occupational exposure to diesel emissions



Overall relative risk: 1.33 (1.24-1.44)

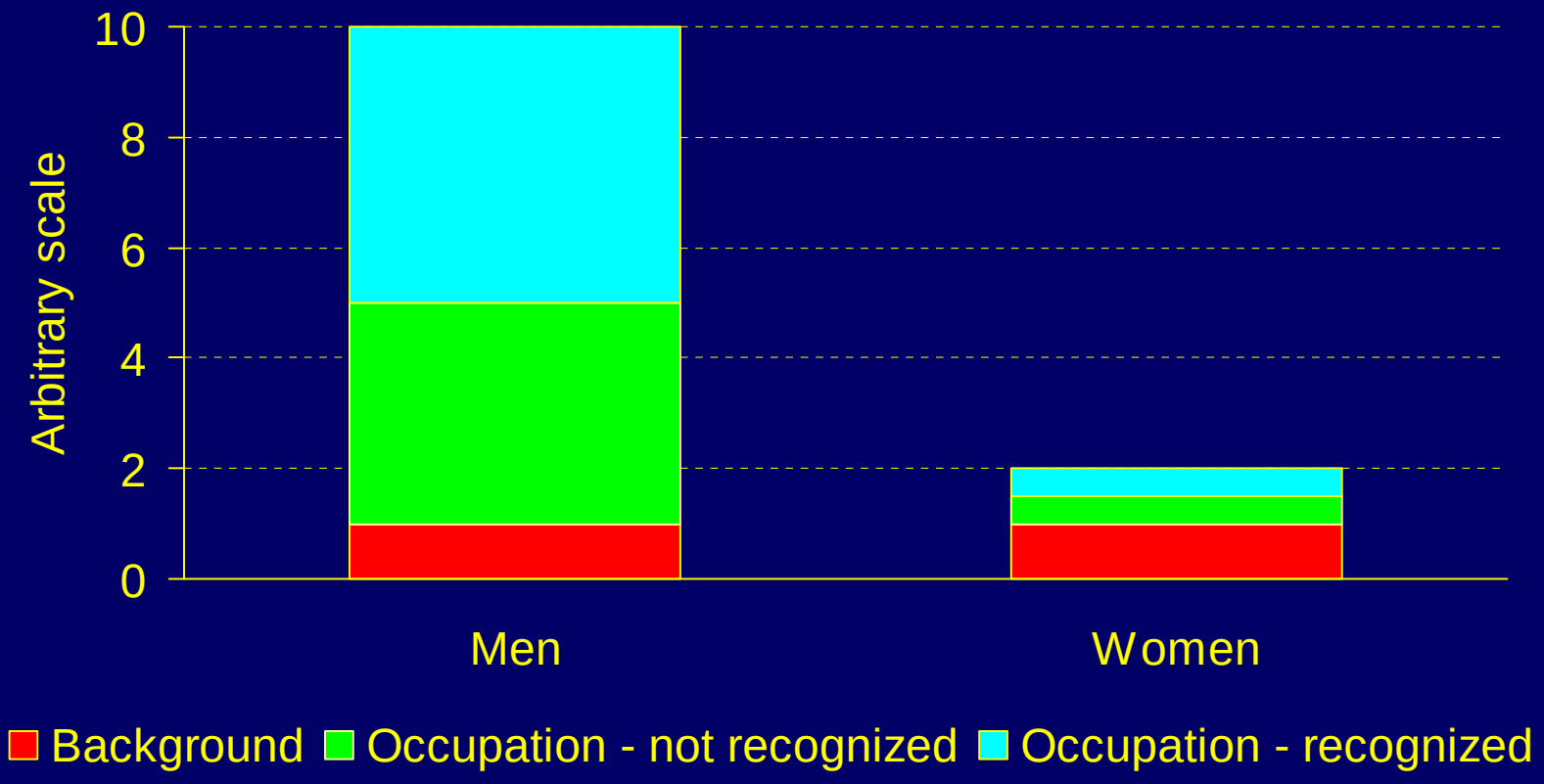
Bhatia et al., 1998; in par., number of studies

Unrecognized exposure to known carcinogens - the case of asbestos

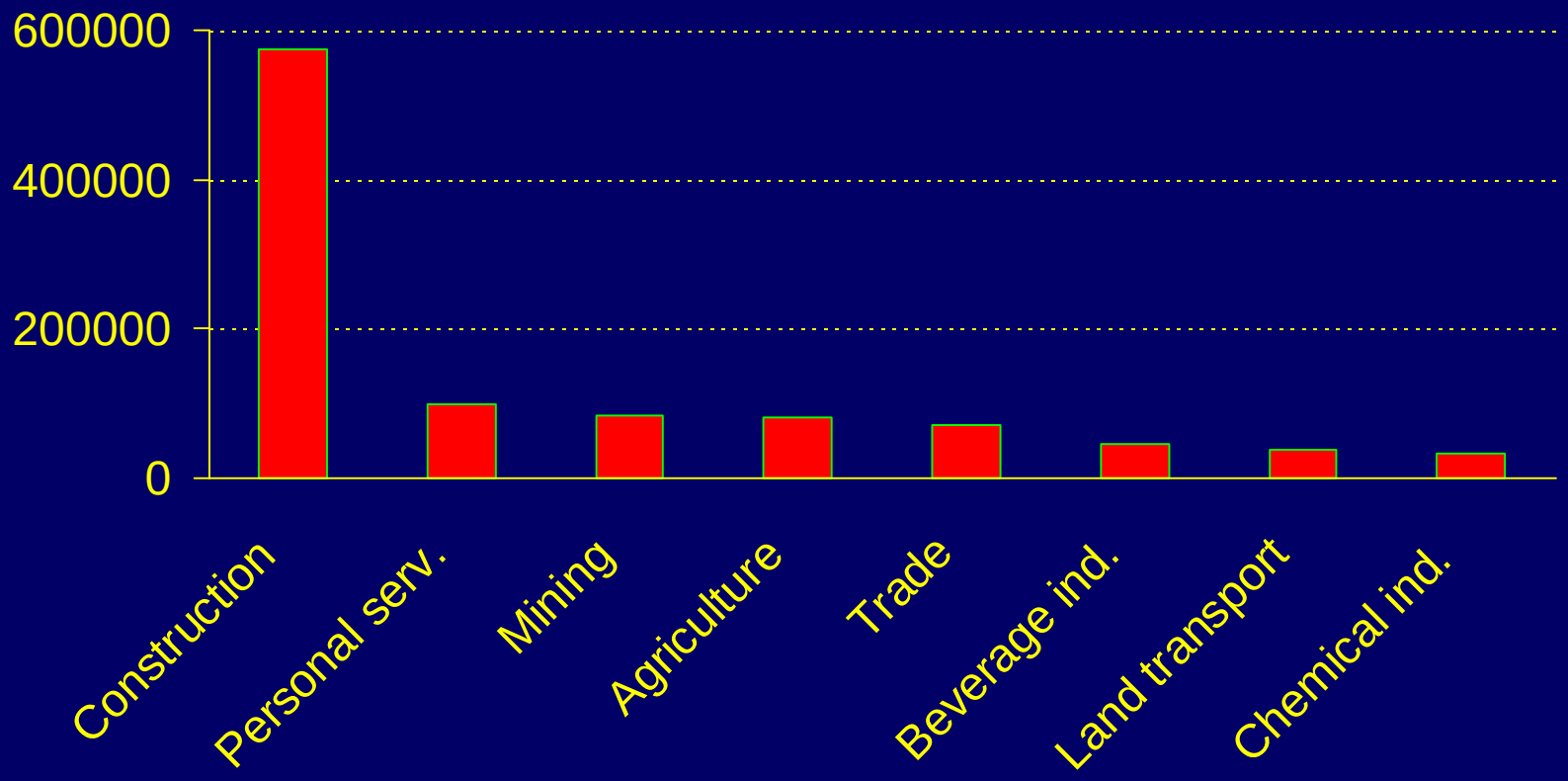
- in studies of geologic exposure circumstances, there is no difference in incidence by gender
- in population-based series of mesotheliomas, a source of occupational exposure can not be identified for 40-60% of cases
- incidence in men 3-10x incidence in women

$\rightarrow$ a large proportion of occupationally-related mesotheliomas are not identified

Attributable mesotheliomas by gender



Number of workers exposed to asbestos in EU, by industry



Total: 1,217,000

Directions for future research

- Contribution from biomarker-based and mechanistic studies
  - ethylene oxide
  - chromosomal aberrations
  - metabolic polymorphisms
- Complex exposure circumstances
- Exposures in developing countries
- Unrecognized exposure to known carcinogens

Conclusions

- Current knowledge of environmental carcinogens biased toward ‘easy to study’ exposure circumstances

- Challenges for future research
  - improvement of exposure assessment
  - better integration with mechanistic data
  - low level exposure circumstances
  - research in developing countries

How much cancer is caused by work?

- Estimates of the proportion of cancer deaths attributable to occupational and environmental carcinogens are complex and difficult, apart from the effect of past occupational exposure to asbestos which may account by itself for a quarter of a million deaths in Western Europe over the next three decades.

La Vecchia *et al, 2000*

Doll and Peto

4% of all deaths from cancer may be caused by work related exposures, with plausible limits of 2% to 8% .

Doll and Peto, 1981

Blue Collar workers

- 25% of cancer deaths in certain blue-collar populations are attributed to occupational exposures.

- 40% of lung and bladder cancers, in specific populations located in industrial areas, may be due to occupational exposures.

Boffetta *et al 1995*

“Hazards at Work”

- In the past some people have been exposed to high concentrations of carcinogens such as asbestos, benzene, formaldehyde and diesel exhaust in their workplace. Control measures have meant there has been a decline in the number of fatal cancers due to such workplace hazards”.

NZ Cancer Society

Daffodil Day 2000

Exposure to carcinogens in EU

- 23% (or 32 million) of the EU workforce is currently exposed to one or more agents listed by IARC as recognised (Group 1), probable (Group 2A) or (selected) possible (Group 2B) carcinogens.

Kauppinen T., OEM, 2000

US estimates

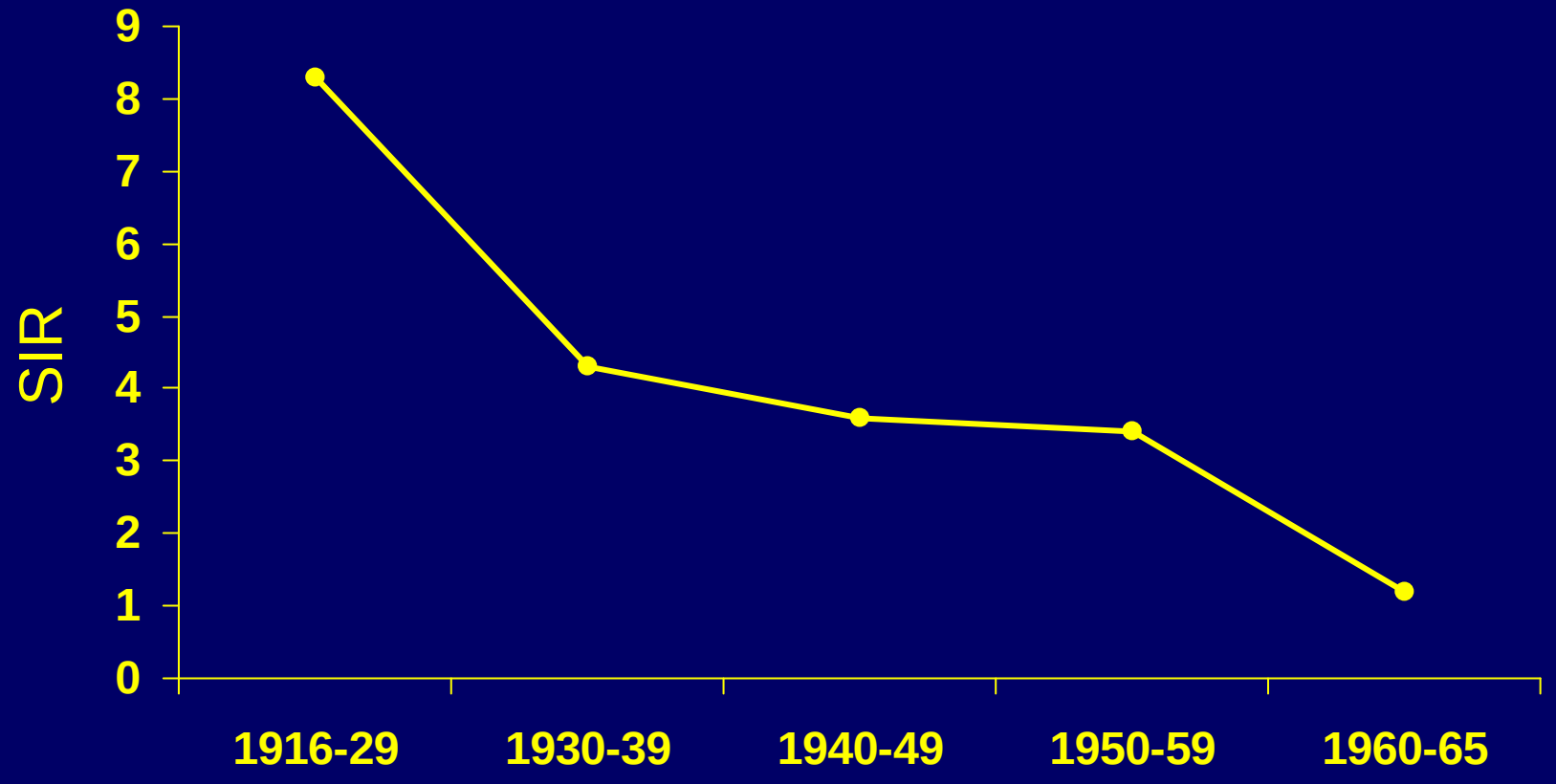
- 12,864,000 workers exposed to IARC **Group 1** lung carcinogens
- 7,849,000 exposed to IARC **Group 2A** lung carcinogens
- 46,300,000 current smokers

Infante, 1995

Prevention of occupational cancer

- Non-introduction of a carcinogenic agent
  - 4-aminobiphenyl: evidence of bladder cancer risk among US workers (Melick et al., 1971) ➔ never used in UK
- Disappearance of an occupation at risk
  - Manufacture of mustard gas during war time (Wada et al., 1968; Miller et al., 1988; Easton et al., 1988)
  - Gas production from coal carbonization (Doll et al., 1972)
- Decrease in exposure levels at workplace

Decrease in exposure levels at the workplace - decrease in risk by period of first employment



Lung cancer incidence of nickel refinery workers by year of hire

Magnus et al., 1982

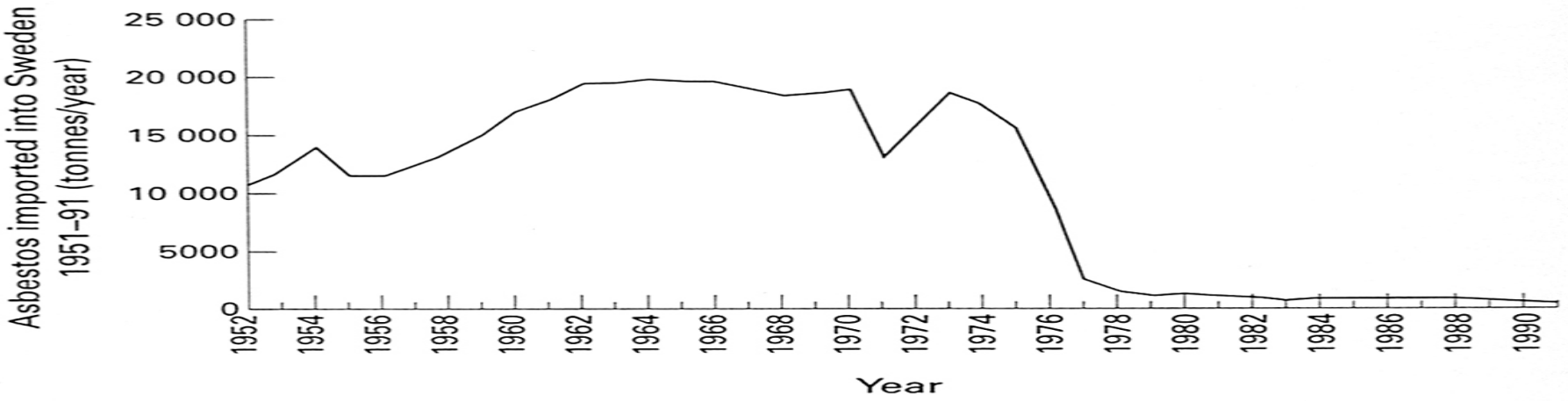


Figure 1 Imports of raw asbestos to Sweden 1952–91.

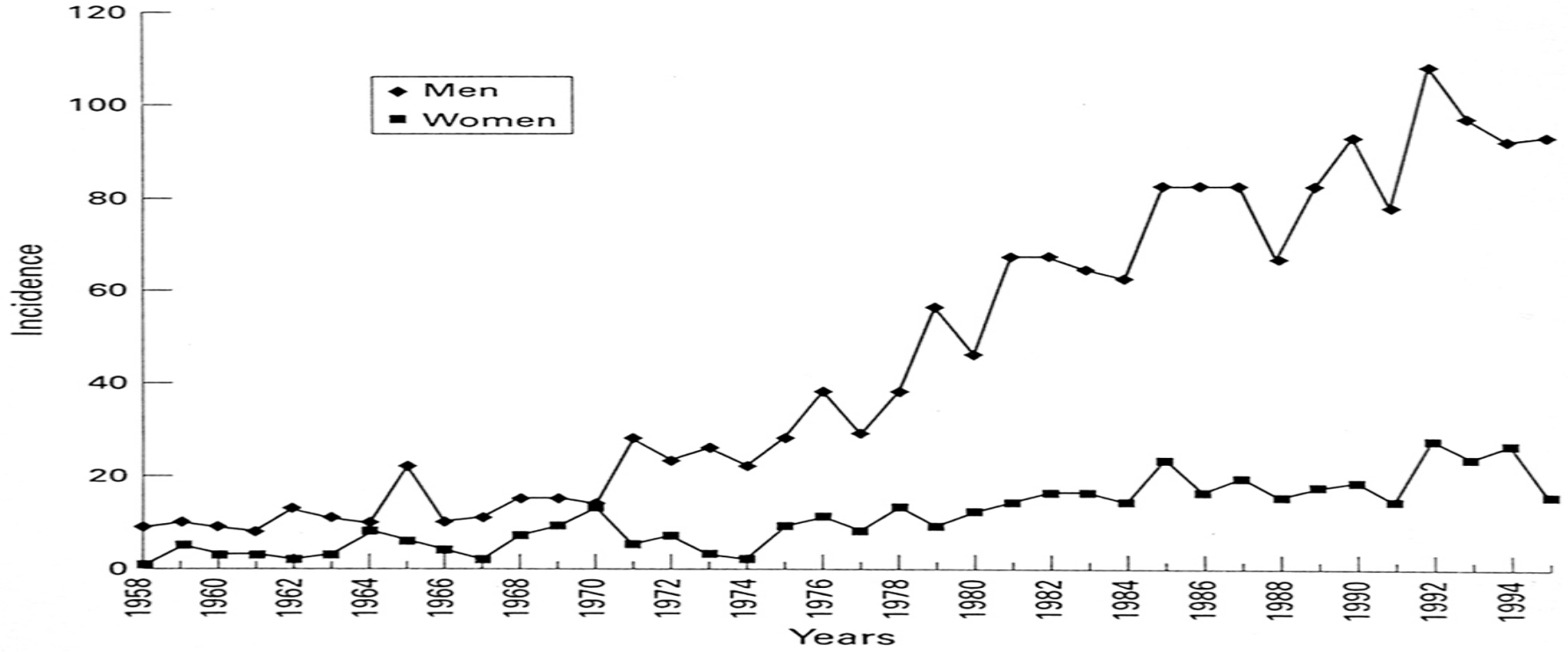


Figure 2 Annual incidence of pleural mesothelioma in Sweden 1958–95.

Conclusions

- Our current knowledge of occupational cancer is limited, and is biased toward ‘easy to study’ exposures
- Occupational cancer can be prevented.
- There is only limited evidence of this in the literature
- Decreased exposure levels at the workplace are required