MONASH University
Medicine, Nursing and Health Sciences

Occupational Cancer in Developing Countries

Professor Malcolm Sim

Centre for Occupational and Environmental Health
School of Public Health and Preventive Medicine
Monash University

Summary of Talk

- Increasing importance of occupational cancer in developing countries
- Changing spectrum of industry base
- Demographic and lifestyle factors
- Issues around asbestos related cancers
- Occupational cancer prevention
- Regulatory responses
- Research opportunities

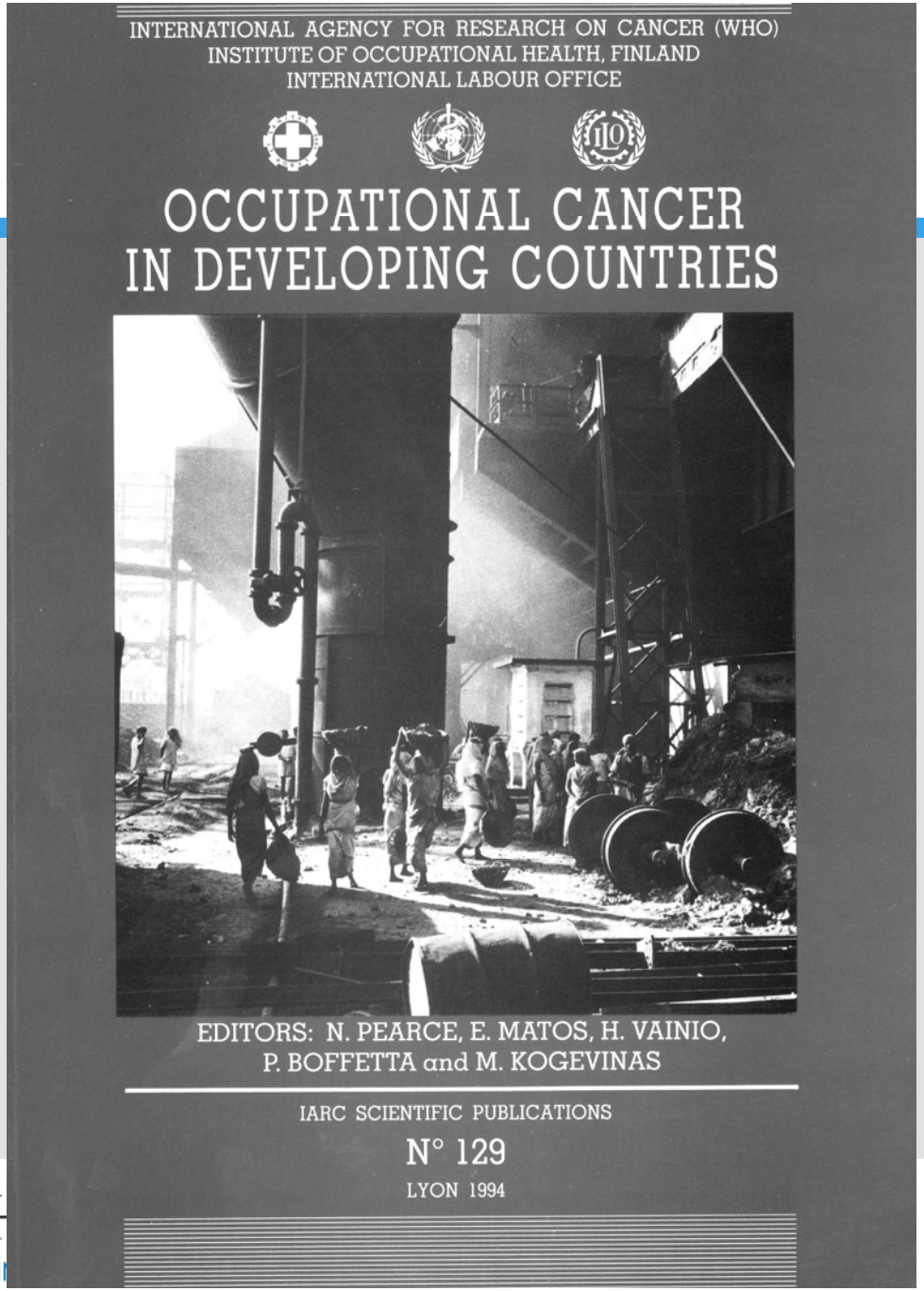

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (WHO)
INSTITUTE OF OCCUPATIONAL HEALTH, FINLAND
INTERNATIONAL LABOUR OFFICE
OCCUPATIONAL CANCER
IN DEVELOPING COUNTRIES
EDITORS: N. PEARCE, E. MATOS, H. VAINIO,
P. BOFFETTA and M. KOGEVINAS
IARC SCIENTIFIC PUBLICATIONS
N° 129
LYON 1994

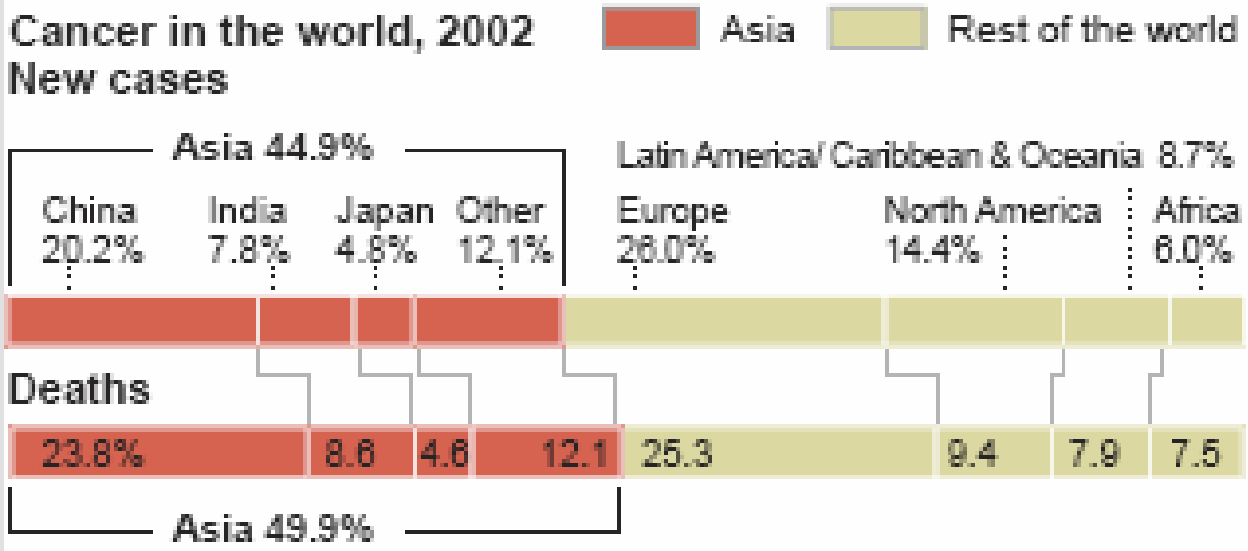
Table 5. Numbers of incident cases, percentage increase and crude rates per 100 000 person-years expected in the years 2000 and 2010 on the basis of population growth and aging

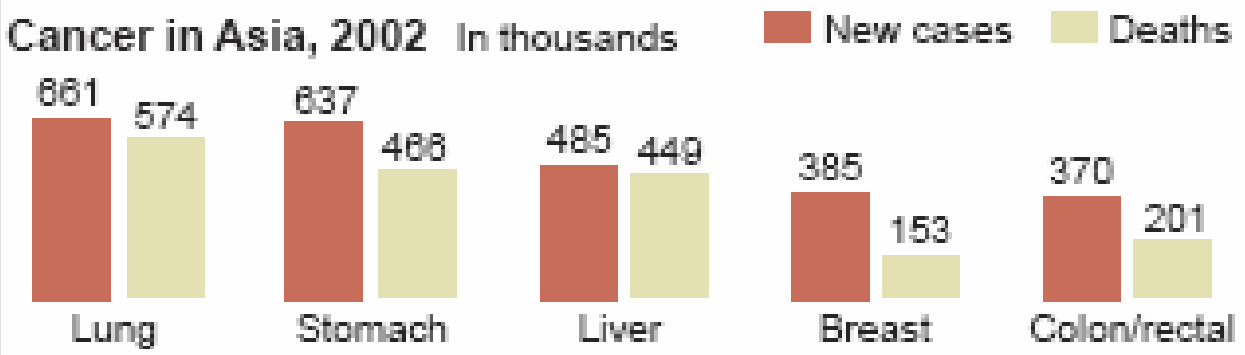
Population	Year	No. of cases	Increase (%)	Crude rate
Males in developed countries	1985	1 872 000		329.6
	2000	2 344 000	25.2	380.1
	2010	2 720 000	45.3	424.0
Males in developing countries	1985	1 977 000		105.6
	2000	2 956 000	49.5	116.5
	2010	3 916 000	98.1	131.1
Females in developed countries	1985	1 787 000		294.8
	2000	2 087 000	16.8	322.4
	2010	2 316 000	29.6	346.7
Females in developing countries	1985	1 987 000		110.1
	2000	2 959 000	48.9	120.3
	2010	3 922 000	97.4	134.9

Pearce et al (Eds). Occupational cancer in developing countries. IARC Scientific Publications 1994: No 129.

Half of all cancer deaths in Asia

In 2002, there were 10.9 million new cases of cancer worldwide. About 45 percent of these cases and half of the 6.7 million death toll occurred in Asia.





SOURCES: World Health Organization; International Union Against Cancer AP

Numbers of Cancer Deaths and New Cases in the World as Estimated for 2000 and Predicted for 2020[1]

Year	Region	New cases (millions)	Deaths (millions)
2000	More developed countries	4.7	2.6
	Less developed countries	5.4	3.6
	All countries	10.1	6.2
2020	More developed countries	6.0	3.5
	Less developed countries	9.3	6.3
	All countries	15.3	9.8

[1]Ferlay et al, 2001

Why an increase in cancer in developing countries?

- Aging populations – increased life expectancy
- Reduction in burden of infectious diseases
- Lifestyle changes: smoking, alcohol
- Diseases of affluence
- Screening programs not fully developed
- Increasing occupational exposures

The world's labour force by region in 1995 and estimated in 2025

Region	Millions of workers 1995	2025	Growth 1995 – 2025 in %
Sub-Saharan Africa	214	537	151
East Asia and the Pacific	964	1.201	25
South Asia	440	779	77
Europe and Central Asia	239	281	18
Middle East and North Africa	80	204	155
Latin America and the Caribbean	166	270	63
High-income OECD	373	384	3
TOTAL	2.476	3.656	

World Development Report 1995: Workers in an integrating world. World Bank 1995.

The world's working-age population by sector and country income group

Sector of employment	High-income countries	Low-income countries
Services	42%	16%
Industry	19%	11%
Agriculture	3%	44%
Not in labor force	30%	27%
Unemployed	6%	2%
Total	100%	100%

Source: World Bank 1995

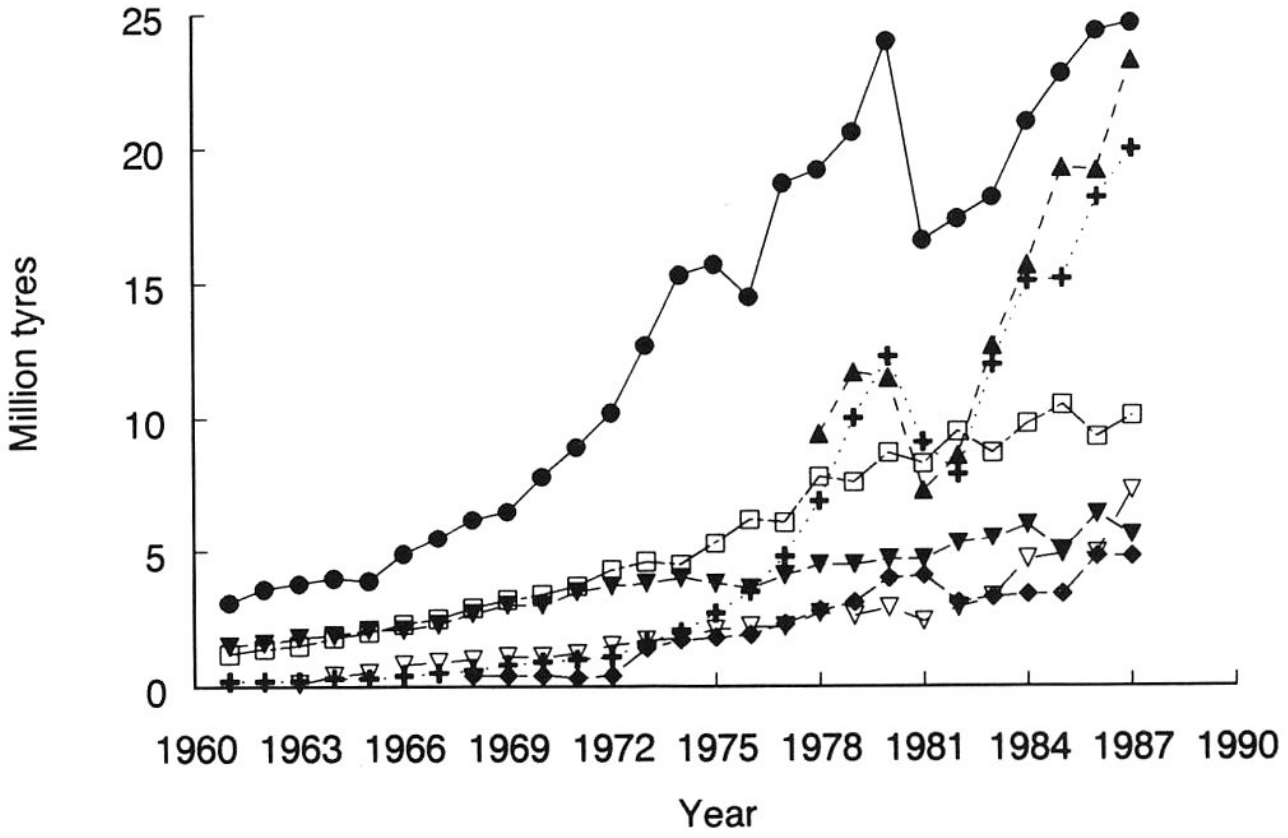


Figure 2. Tyre production in selected countries, 1961–87

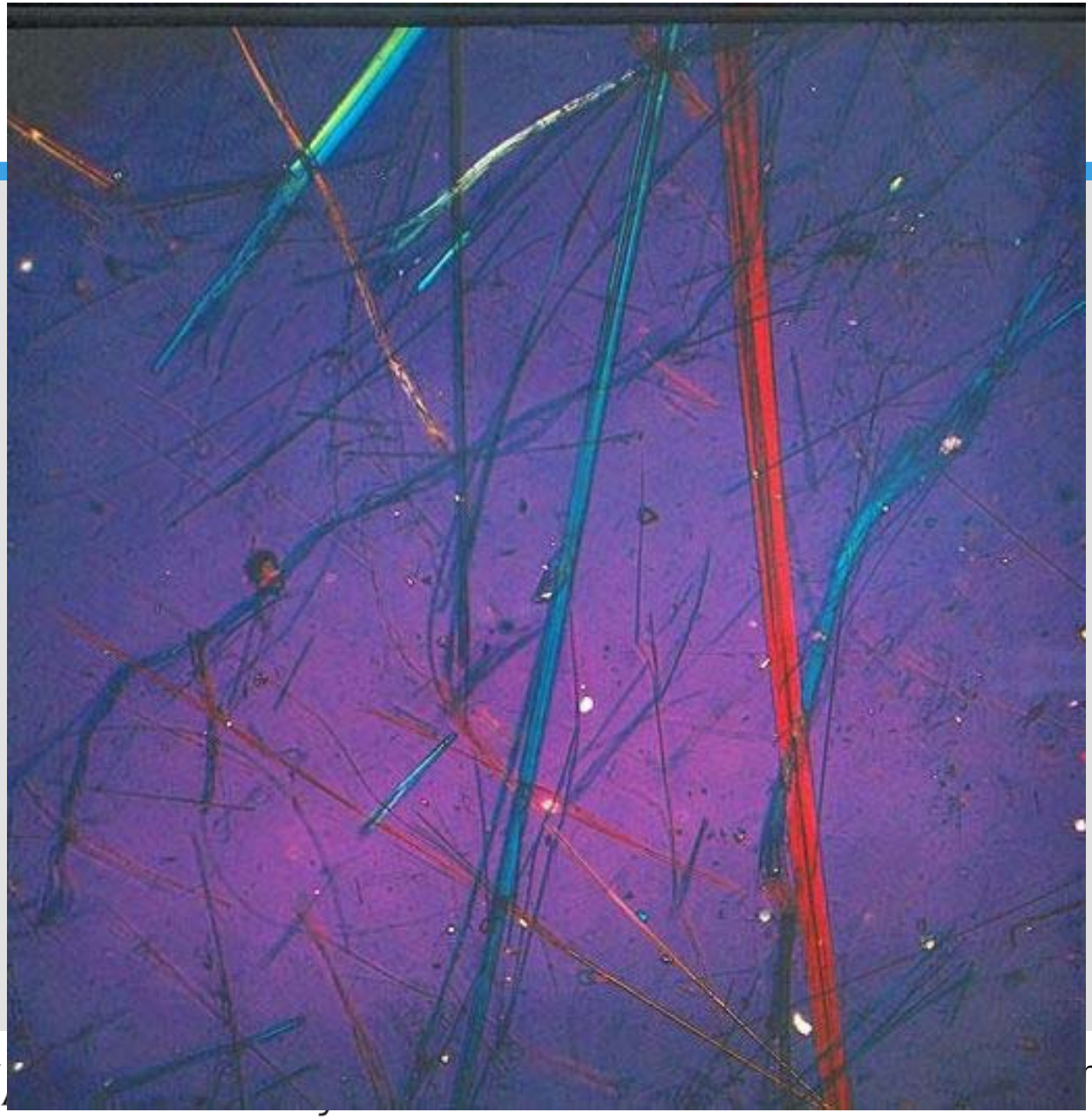
From: United Nations (1971, 1987)

●, Brazil; ▲ , China; ▼, India; +, Republic of Korea; □, Mexico; ▽, Turkey

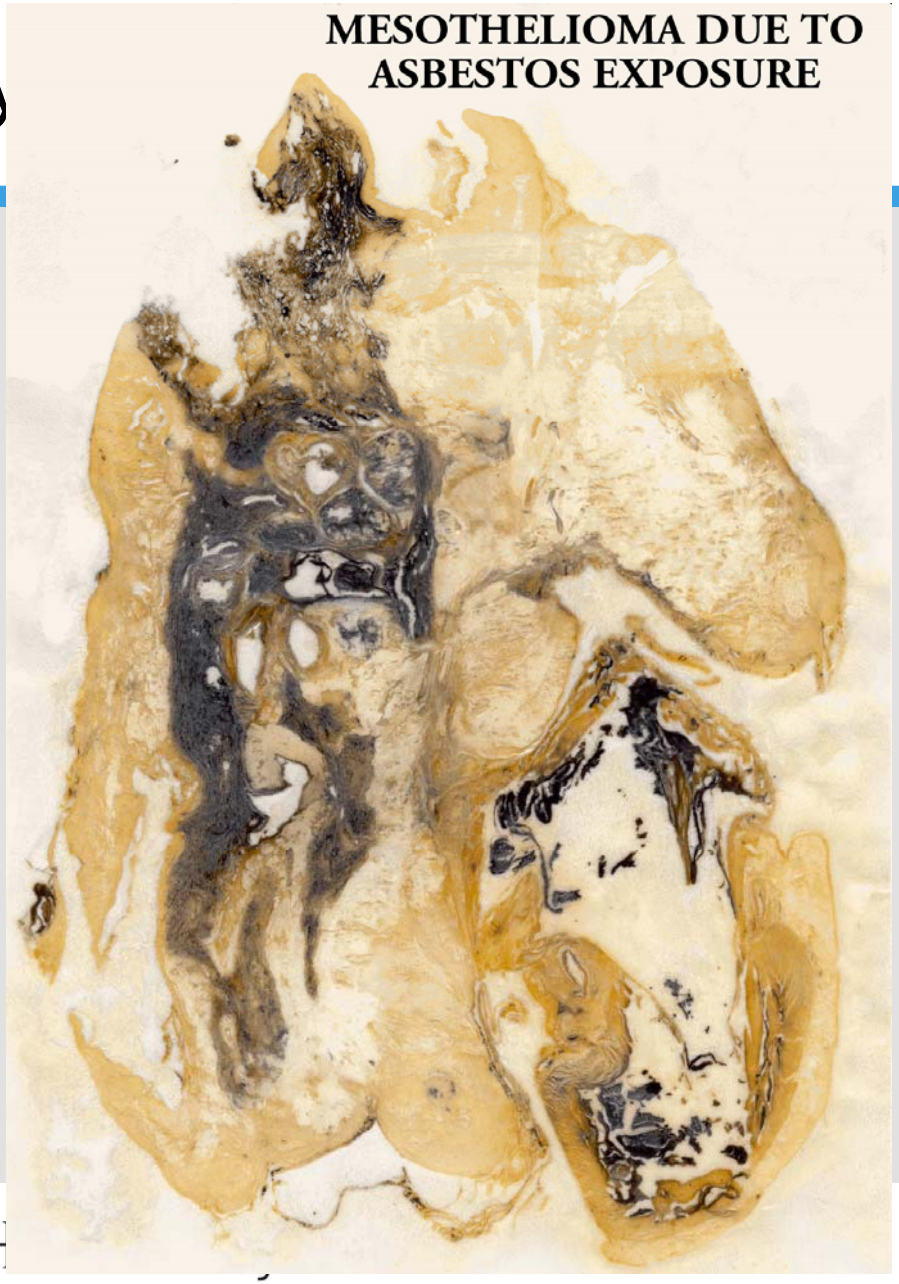
Pearce et al (Eds). Occupational cancer in developing countries. IARC Scientific Publications 1994: No 129.

Why is industry moving to developing countries?

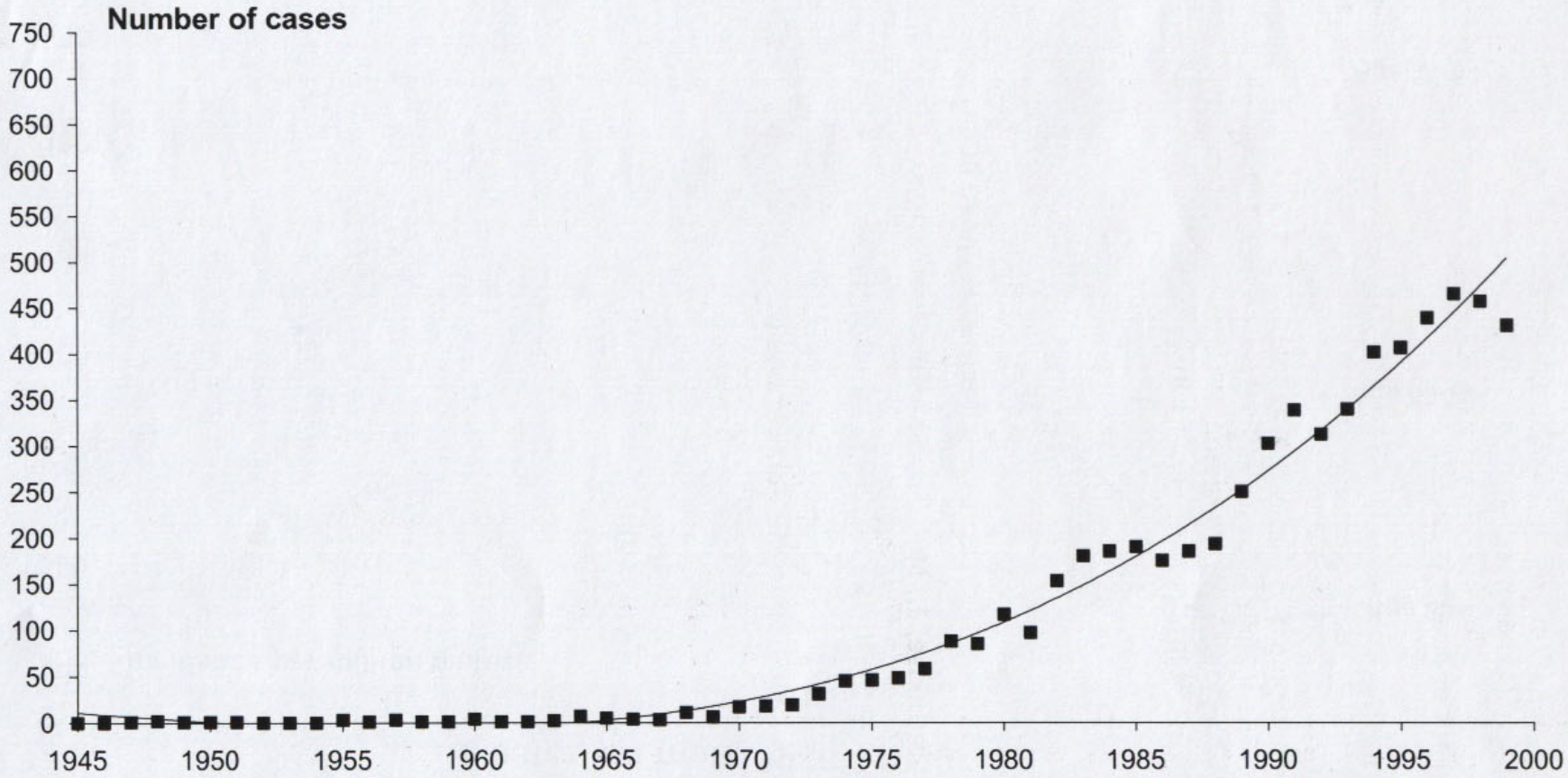
- Labour costs low
- Growing labour force as seen in previous slide
- Increasing bans or restrictions on workplace exposures in developed countries
- Inadequate regulation in developing countries
- Inadequate OHS practice to control exposure



Summary



Incident cases of malignant mesothelioma in Australia, 1945 - 1999



Australian Mesothelioma Register Report 2002
NOHSC

Table 1. Recent trend in mortality from pleural mesothelioma[a] in men.

Country (code)	Period MR[b] (no.[c]) (deaths/million/year)	APC[d] [%/year (95% CI)]	Trend[e]	Male population[f] (million)
Asia				
Israel (ISR)	5.5 (5)	6.6 (–14.9 to 33.4)	↔	3.1
Japan (JPN)	4.8 (9)	3.9 (2.6 to 5.2)	↑**	61.4
Eastern Europe and Southern Europe				
Croatia (HRV)	8.8 (9)	11.0 (2.7 to 20.0)	↑**	2.2
Czech Republic (CZE)	3.2 (9)	6.3 (–1.7 to 15.0)	↔	5.0
Hungary (HUN)	2.5 (8)	11.0 (3.3 to 19.3)	↑**	4.9
Poland (POL)	2.0 (6)	5.2 (–5.2 to 16.7)	↔	18.7
Romania (ROU)	1.9 (6)	1.2 (–11.2 to 15.3)	↔	10.9
Spain (ESP)	5.7 (6)	0.7 (–6.6 to 8.7)	↔	19.8
Northern Europe and Western Europe				
Austria (AUT)	7.8 (4)	–5.9 (–20.9 to 12.0)	↔	3.9
Denmark (DNK)	12.9 (6)	4.6 (–6.5 to 16.9)	↔	2.6
Finland (FIN)	12.6 (9)	–0.3 (–3.9 to 3.6)	↔	2.5
France (FRA)	12.7 (4)	–1.0 (–14.7 to 14.9)	↔	28.7
Germany (DEU)	12.0 (7)	3.3 (–0.8 to 7.6)	↑*	40.1
Iceland (ISL)	10.1 (7)	–1.4 (–28.8 to 36.5)	↔	0.1
Lithuania (LTU)	2.0 (5)	12.3 (–34.3 to 92.1)	↔	1.6
Luxembourg (LUX)	12.7 (7)	5.4 (–11.0 to 24.8)	↔	0.2
Netherlands (NLD)	30.0 (9)	0.0 (–1.5 to 1.6)	↔	7.9
Norway (NOR)	12.7 (9)	–2.7 (–7.5 to 2.3)	↔	2.2
Sweden (SWE)	12.8 (6)	3.5 (–2.0 to 9.2)	↔	4.4
United Kingdom (GBR)	31.1 (4)	0.5 (–4.0 to 5.3)	↔	29.1
Americas excluding South America				
Canada (CAN)	10.3 (4)	5.6 (–7.4 to 20.4)	↔	15.1
Cuba (CUB)	0.6 (4)	5.2 (–36.1 to 73.2)	↔	5.6
Mexico (MEX)	2.2 (6)	2.9 (–7.2 to 14.2)	↔	49.4
United States of America (USA)	9.0 (4)	0.8 (–2.4 to 4.1)	↔	135.1
South America				
Argentina (ARG)	2.5 (7)	8.9 (3.3 to 14.7)	↑**	18.6
Brazil (BRA)	0.5 (6)	9.0 (0.1 to 18.7)	↑**	87.3
Chile (CHL)	3.1 (7)	3.3 (–8.1 to 16.2)	↔	7.5
Ecuador (ECU)	0.5 (4)	16.4 (–37.5 to 116.7)	↔	6.3
Uruguay (URY)	2.3 (5)	13.6 (–43.7 to 129.2)	↔	1.6
Oceania				
Australia (AUS)	25.5 (6)	4.6 (–0.6 to 10.1)	↑*	9.5
New Zealand (NZL)	20.5 (4)	10.4 (–10.3 to 35.7)	↔	1.9

[a]See "Materials and Methods" for our definition of mesothelioma. [b]Period MR from 1996 to 2005, age-adjusted to the world population of 2000. [c]Number of years with available data. [d]APC, together with its 95% CI and *p*-values, were calculated with Joinpoint software. [e]Trend: ↑ when APC > 0 ($p < 0.10$); ↓ when APC < 0 ($p < 0.10$); ↔ when $p > 0.10$ for APC. [f]Average of male national population from 1996 to 2005. *Marginally significant ($0.05 < p < 0.10$). **Statistically significant ($p < 0.05$).

Nishikawa et al. *Recent Mortality from Pleural Mesothelioma, Historical Patterns of Asbestos Use, and Adoption of Bans: A Global Assessment. Environ Health Perspect* 116:1675–1680 (2008)

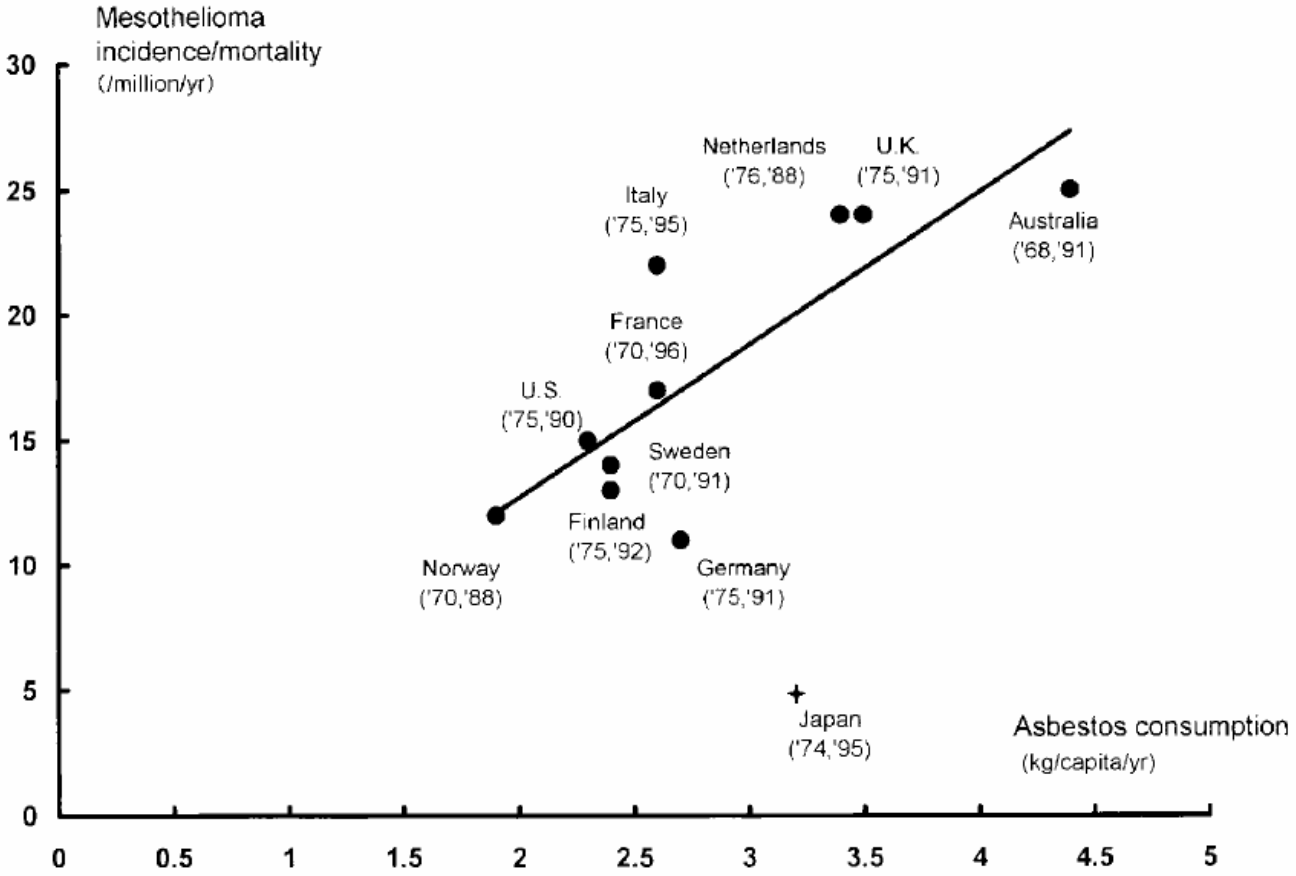


Figure Geographical correlation between per capita asbestos consumption and mesothelioma incidence/mortality (Figures in brackets indicate reported year of asbestos consumption and mesothelioma incidence/mortality, respectively).

Takahashi K et al. Ecological Relationship between Mesothelioma Incidence/Mortality and Asbestos Consumption in Ten Western Countries and Japan Ken Journal of Occupational Health Vol.41 , No.1(1999)pp.8-11

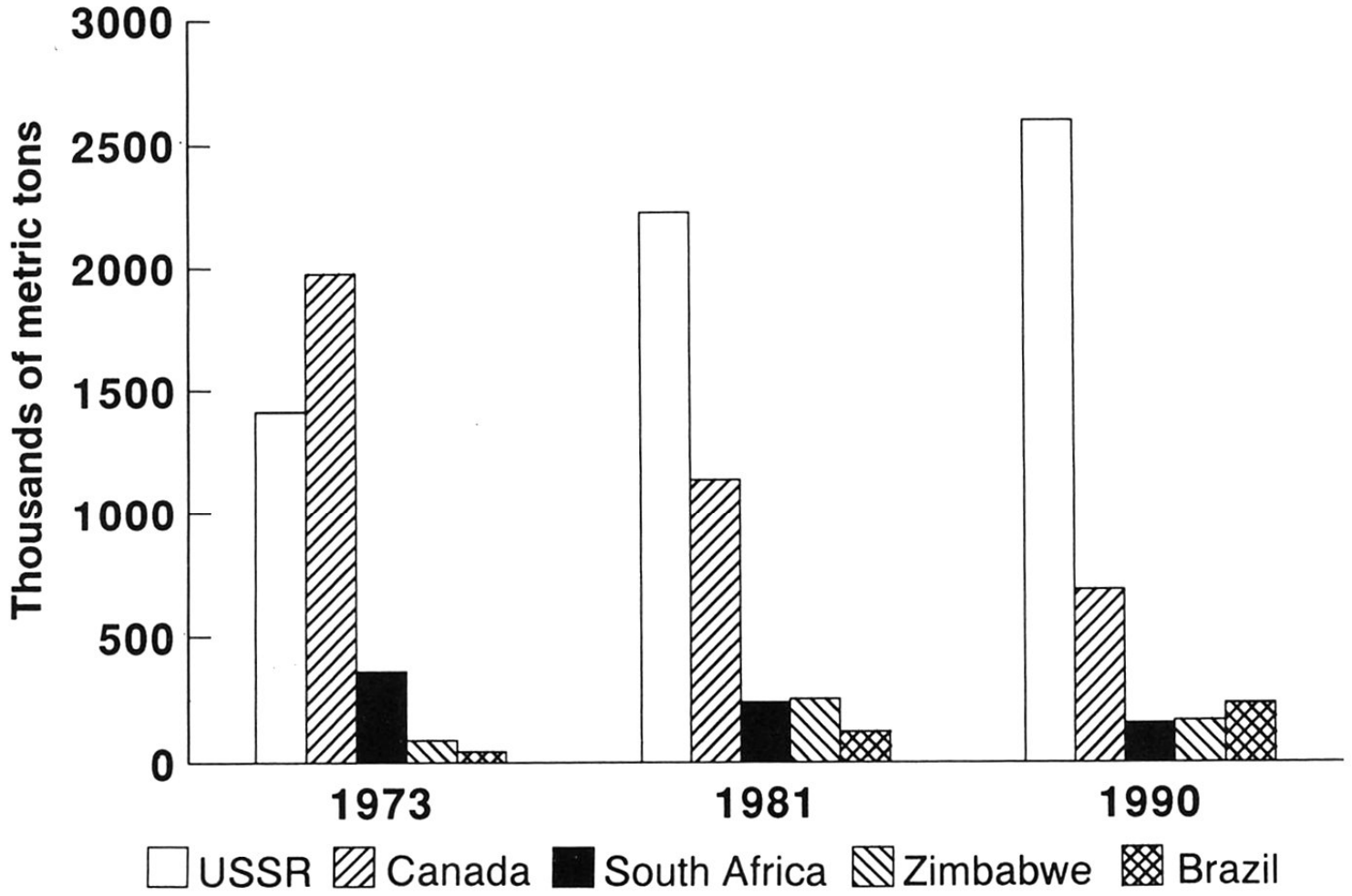


Figure 1. Production of asbestos in selected countries, 1973, 1981 and 1990

From United Nations (1975, 1983); International Asbestos Institute (personal communication)

Pearce et al (Eds). Occupational cancer in developing countries. IARC Scientific Publications 1994: No 129.

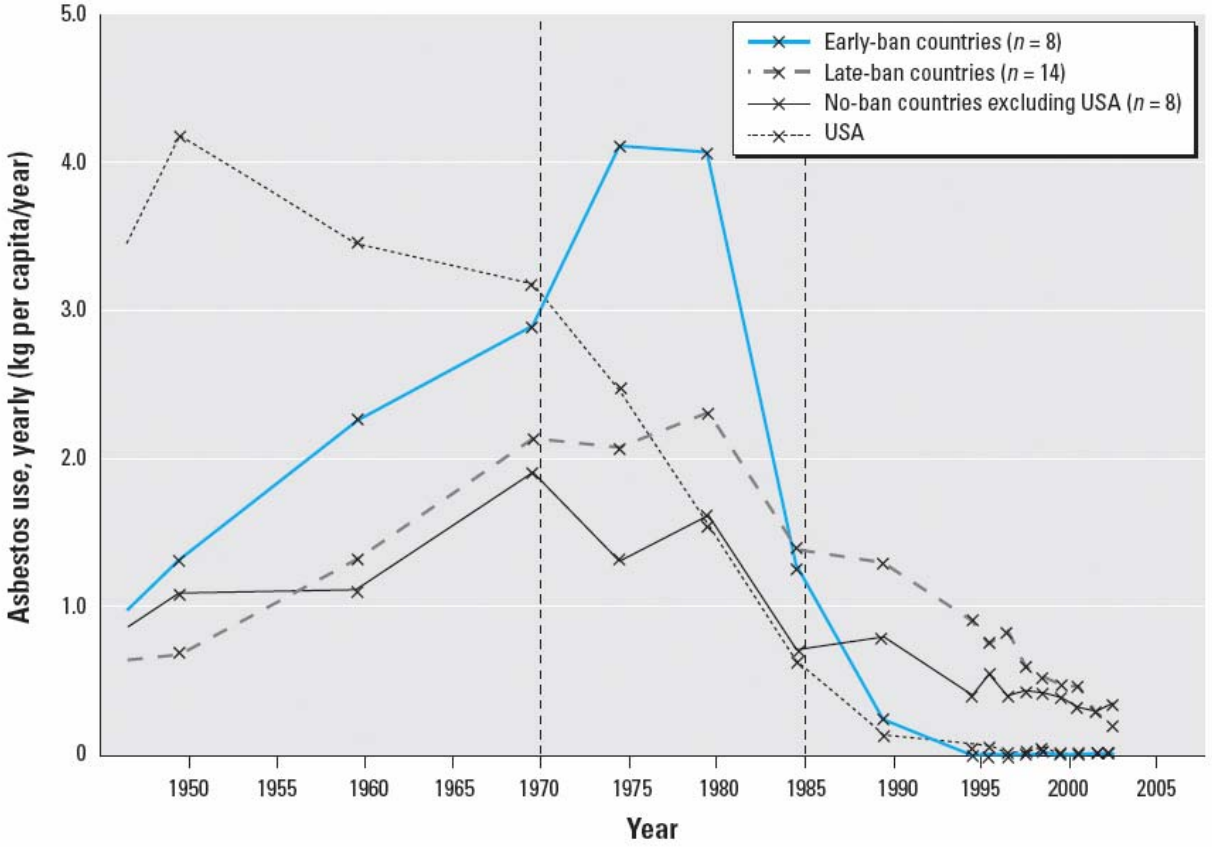
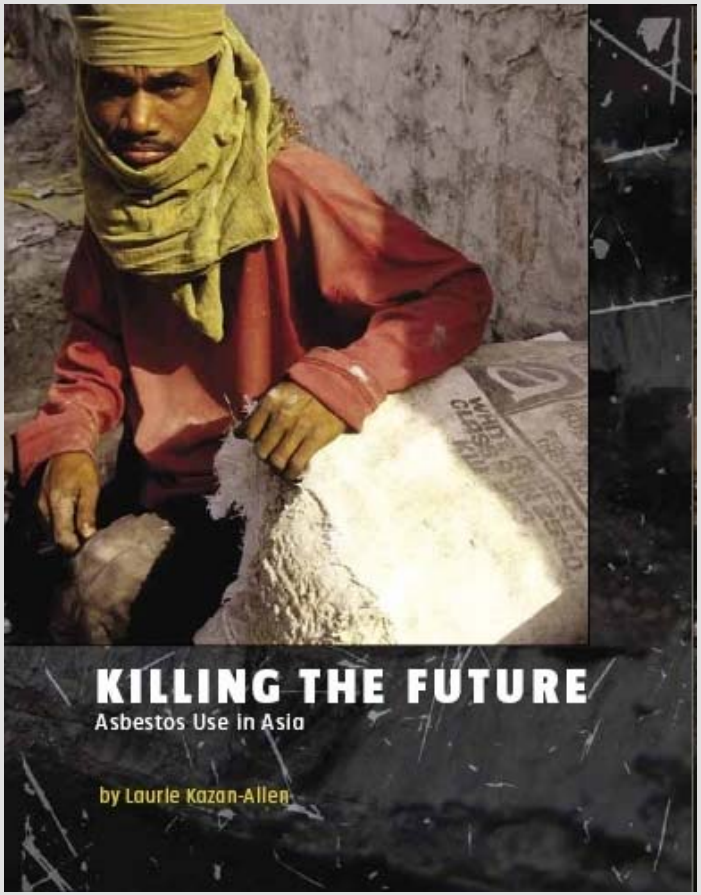


Figure 1. Historical trends in use of asbestos from 1950 to 2003 grouped by status of national bans. Early-ban countries are countries that adopted bans in 1995 or before (n = 8); late-ban countries adopted bans from 1996 to 2006 (n = 14); no-ban countries, excluding the United States, did not adopt bans until 2007 (n = 8). Asbestos use (y-axis) is per capita yearly use (averages weighted by the sizes of national populations). The USGS (Virta 2006) database provides data only sparsely in 10-year intervals up to 1960, 5-year intervals from 1970–1995, and annually for 1996–2003. Straight lines connect available data.

Nishikawa et al. *Recent Mortality from Pleural Mesothelioma, Historical Patterns of Asbestos Use, and Adoption of Bans: A Global Assessment. Environ Health Perspect* 116:1675–1680 (2008)

Asbestos use in asia

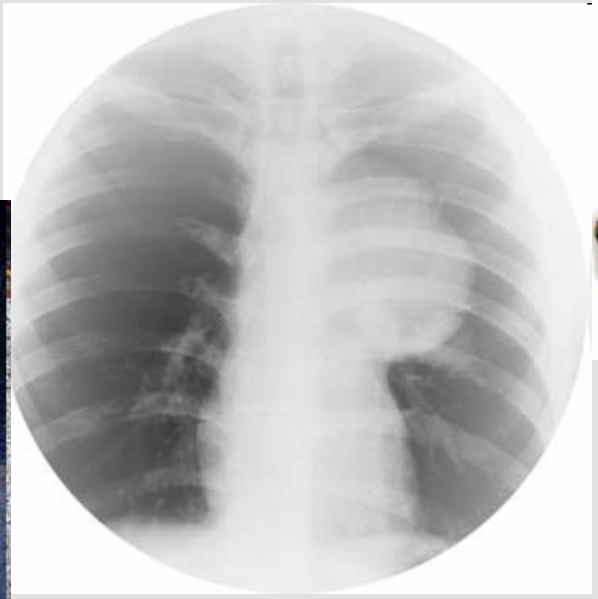


- **Asbestos bans in developed countries have lead to increased marketing of asbestos in developing countries, especially china and India**
- **Highlights misinformation about dangers of chrysotile asbestos**
- **Highlights lack of exposure data and data on asbestos related disease in these countries**
- **Advocates for a total worldwide ban on asbestos use**

The politics of asbestos use

- 2000: EU Ban on asbestos use
- 2003: UN proposal to ban importation of chrysotile asbestos
- Canada and other countries continue to block proposal because of strong asbestos lobby

Lung cancer



Multiplicative relationship between occupational asbestos exposure and cigarette smoking

Men's smoking rate halved since '80s, figures show

Nick Miller
December 8, 2008 - 11:28AM

Men are lighting up far less than they were, but are still more likely to smoke than women. Photo: *Lee Besford.*

Smoking rates among Australian men have almost halved since 1980, new figures released today show.

Today's Coverage

Australia not prepared for 21st century: Murdoch

Plan welcome but more could be done: RACV

US hits back at Bra Boy's claims

Police clear cattle from Western Port Highway

Woman dies in smash with semitrailer

More tolls possible as transport plan unveiled

Simpsons cartoon rip-off is child porn: judge

Latest Videos | Most Read Articles

00:00 | 00:14

Tunnel vision for Brumby's billions
Victorian Premier John Brumby announces $38 billion transport plan, with tunnels getting priority

More video: National News

March 21, 2008

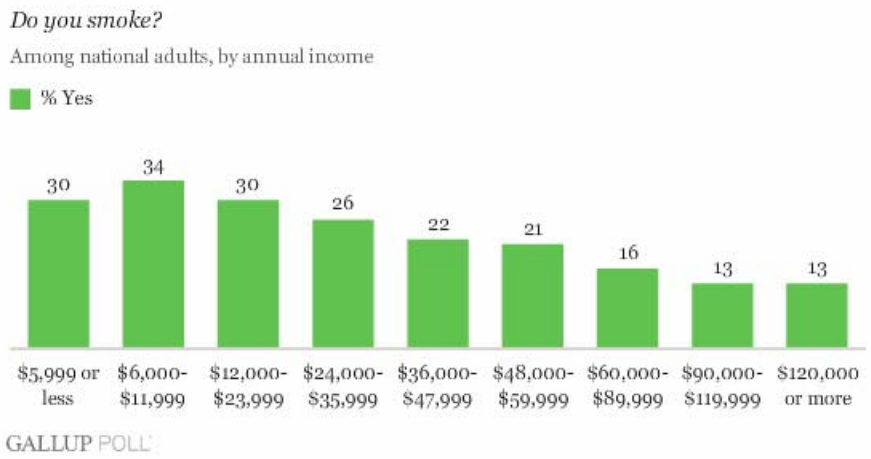
Among Americans, Smoking Decreases as Income Increases

Gradual pattern is consistent across eight earnings brackets

USA | Health | Smoking | Social Issues | Well-Being Index | Americas | Northern America

by Rob Goszkowski

Washington, D.C. -- The Gallup-Healthways Well-Being Index is helping to crystallize the relationship between income and smoking in the United States.



While researchers for Gallup and the Centers for Disease Control have previously documented higher smoking rates among lower-income Americans, the current results based on interviews with more than 75,000 individuals across the United States allow for a closer examination of the relationship between household income and smoking behavior.

Nationwide, the Gallup-Healthways Well-Being Index reveals that 21% of Americans say they smoke. As the accompanying graph illustrates, the likelihood of smoking generally increases as annual incomes decrease. One exception to this pattern occurs among those making less than $6,000 per year, an income bracket often skewed because many in that bracket are students.

The Power to Know - And Act On - What the World Is Thinking

RELATED ITEMS

Three in 10 Households Still Deferring Medical Care
December 5, 2008

Americans Rate National and Personal Healthcare Differently
December 4, 2008

Most Americans Consider Smoking Very Harmful
July 28, 2008

U.S. Smoking Rate Still Coming Down
July 24, 2008

Impact of Smoking, Being Overweight on a Person's Image
July 21, 2008

Gallup-Healthways Well-Being Index

Cold Turkey for Turks
January 14, 2008

Smoking Rates Around the World -- How Do Americans Compare?
August 17, 2007

Who Smokes Most?
August 17, 2007

Tobacco and Smoking

GALLUP POLL
Election 2008

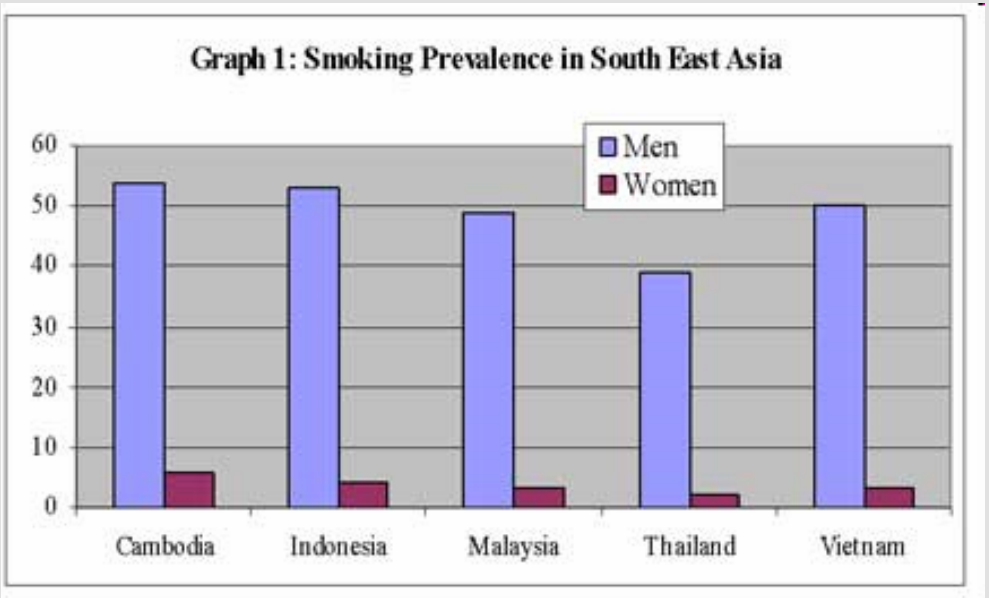
similar to the prevalence measured in the United States in the 1970s and 1980s. Forty percent of Cubans smoke, as do 37% of Kuwaitis, Chileans, Russians, Belarusians, and Bangladeshis.

Highest Incidence of Smoking, by Country

Did you smoke yesterday, or not?

Country	% Yes, Smoked	GDP (PPP) Per Capita	GDP Rank
Cuba	40	4,000	146
Kuwait	37	23,100	49
Chile	37	12,700	78
Russia	37	12,200	82
Belarus	37	8,100	106
Bangladesh	37	2,300	174
Estonia	36	20,300	55
Latvia	36	16,000	64
Azerbaijan	36	7,500	113
Indonesia	36	3,900	148
Kazakhstan	35	9,400	90
Lithuania	34	15,300	66
Argentina	33	15,200	67
China	33	7,700	109
Ukraine	32	7,800	108
Vietnam	32	3,100	160
Cyprus	31	23,000	50
Slovakia	31	18,200	61
Mauritania	31	2,600	169
South Africa	30	13,300	76
Burundi	30	700	224

Interestingly, the countries with the highest rates of smoking among respondents age 18 and older span the globe, and have annual GDPs (at Purchasing Power Parity) that range from $700 per capita to $23,100. In other words, there appears to be no consistent relationship between the prevalence of smoking in a country and its location or its residents' relative wealth.



Source: Tobacco Control Country profiles, SEATCA & NIS Tobacco survey, 2004

Lung cancer and asbestos exposure

- Males more likely to work in asbestos related occupations
- Considerably higher smoking rates in males than females
- Inadequate government regulation
- More difficult to relate lung cancer to asbestos exposure, than for mesothelioma
- So may be a greater, but less recognised, problem than mesothelioma

Occupational exposure limits (OELs) for workplace carcinogens in 15 Asia Pacific countries

Carcinogen	% Countries with an OEL	Range of OELs
Asbestos Chrysotile Crocidolite	 **87%** **87%**	 **0.1-5 fibres/ml** **0.1-5 fibres/ml**
Crystalline Silica	**67%**	**0.1-10mg/m^3**

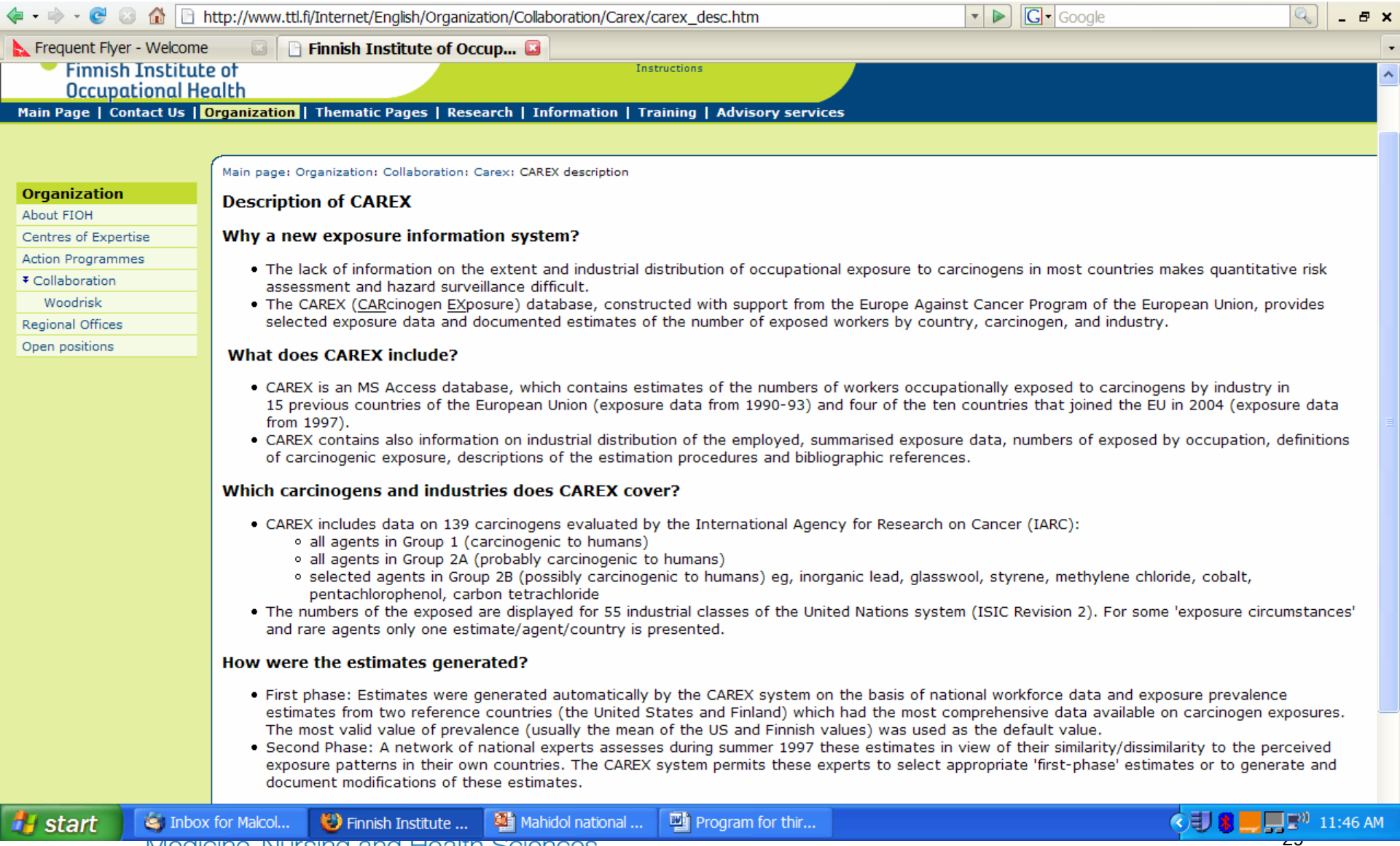
tic tumor [33]. tional health in developing countries. According to WHO

Table 4. Operation-wise average fiber concentration in processing plants in Rajasthan [27]

S. No.	Operation	Average fiber concentration (f/cc)	8 h exposure concentration (f/cc)	Annual exposure concentration (f/cc)
1	Feeding	2.69	2.37	1.94
2	Bagging	6.42	5.65	4.63
3	Carrying	2.83	2.49	2.04
4	Miscellaneous			
	– Office	0.20	0.18	0.14
	– Rest room	0.75	0.66	0.54
	– Outside plant	0.61	0.54	0.44

Joshi and Gupta. Asbestos in developing countries: magnitude of risk and its practical implications. Int J Occ Med Environ Health 2004; 17:179-85

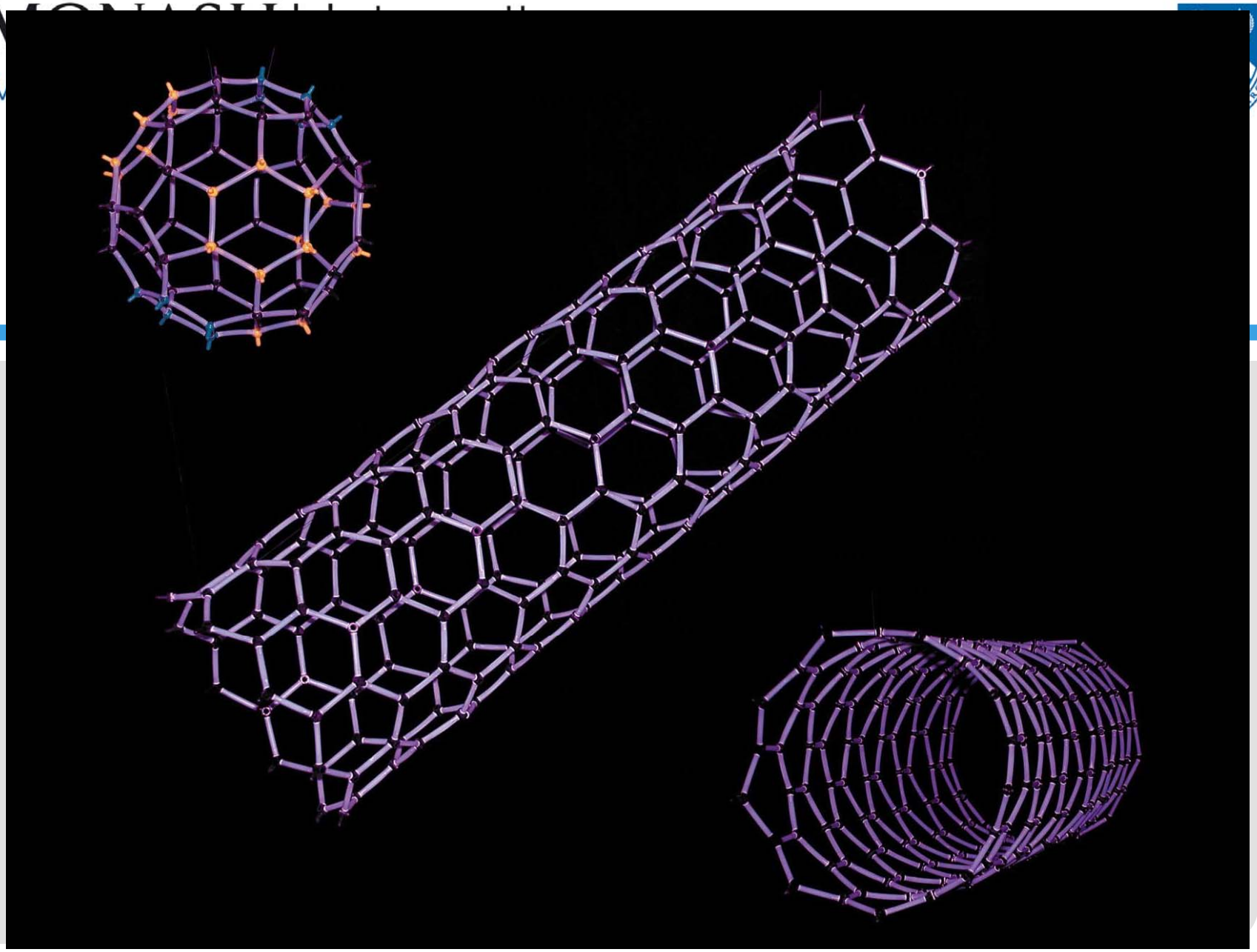
Occupational exposure surveillance



IARC Group 1 occupational carcinogens

- Asbestos
- Benzene
- Beryllium
- Cadmium
- Hexavalent chromium
- Vinyl chloride
- Silica
- Formaldehyde
- About 30 more

Also, possible emerging hazards, eg nanotechnology



Factors raising importance of occupational cancer in developing countries

- Increasing age expectancy
- Decreasing influence of infectious disease
- Changing industrial patterns with more manufacturing industry
- Persisting asbestos use
- High smoking rates
- High workplace exposures
- Inadequate regulatory response

World Health Organization

WHO calls for prevention of cancer through healthy workplaces

27 APRIL 2007 | GENEVA -- Every year, at least 200 000 people die from cancer related to their workplace, according to WHO. Saturday is World Day for Safety and Health at Work. Millions of workers run the risk of developing cancers such as lung cancer and mesothelioma (a malignant cancer of the internal lining of the chest cavity) from inhaling asbestos fibres and from tobacco smoke, or leukemia from exposure to benzene at their workplaces. Yet, the risks for occupational cancer are preventable.

Lung cancer, mesothelioma, and bladder cancer are among the most common types of occupational cancers. Every tenth lung cancer death is closely related to risks in the workplace. Currently about 125 million people around the world are exposed to asbestos at work, and at least 90 000 people die each year from asbestos-related diseases. Thousands more die from leukemia caused by exposure to benzene, an organic solvent widely used by workers, including in the chemical and diamond industries.

The rates of occupational cancer exposure are highest among workers whose workplaces do not meet the requirements for health and safety protection and do not have the necessary engineering measures to prevent the pollution of air with carcinogenic substances. For example, workers who are heavily exposed to second hand tobacco smoke at their workplaces have double the risk of developing lung cancer compared to those working in a smoke-free environment.

"The tragedy of occupational cancer resulting from asbestos, benzene and other carcinogens is that it takes so long for science to be translated into protective action," said Dr Maria Neira, WHO Director of Public Health and Environment. "Known and preventable exposures are clearly responsible for hundreds of thousands of excess cancer cases each year. In the interests of protecting our health, we must adopt an approach rooted in primary prevention, that is to make workplaces free from carcinogenic risks."

WHO Call for Prevention of Cancer through Healthy Workplaces (April 2007)

- Estimates 200,000 people each year die from cancer related to their workplace
- Highlights expected increase in developing countries and less stringent standards
- Call for action:
  - Stop the use of asbestos
  - Benzene-free solvents
  - Ban tobacco use in workplaces
  - Protective clothing for workers in the sun

Need for epidemiological evidence from the developing world to know the cancer-related risk factors

ABSTRACT

The existing evidence on cancer etiology has mostly come from epidemiological studies conducted in the developed world. Now there is an urgent need to gather information on cancer risks in developing countries. Due to recent economic, demographic and health transitions, cancers are on the rise in many developing countries. Future epidemiological studies in these countries should address changing diet, level of physical activity, various environmental and occupational exposures, smoking habits and infections, relative to cancers. In many low resource settings western and conventional lifestyles can be found side by side. Therefore, epidemiological studies in such societies should determine the wide varieties of potentially dangerous exposures, examine changing patterns of related factors and should study other contributing variables as well. Apart from the advantages of such research, there are some challenges. For example, incomplete cancer and death registration, lack of documentation, only partial computerization of medical records, cultural barriers and other technical difficulties can present problems. Some strategies to meet these challenges will be discussed in this paper. There is an immediate need for more detailed epidemiological studies before these developing societies are transformed.

Ramanakumar, A. Journal of Cancer Research Therapy 2007: 3 (1) 29-33.

Occupational cancer research in developing countries

- Large populations
- High exposures
- Investigate possible smoking interactions
- Incomplete cancer registration
- Incomplete record keeping
- Infrastructure problems

Astrakianakis et al. Lung Cancer Risk Among Female Textile Workers Exposed to Endotoxin. JNCI 2007 99(5):357-364

267,000 female cotton textile workers in Shanghai, China

JNCI J Natl Cancer Inst -- Astrakianakis et al. 99 (5): 357 Table BL2 - Mozilla Firefox

http://jnci.oxfordjournals.org.ezproxy.lib.monash.edu.au/cgi/content-nw/full/99/5/357/TBL2

Table 2. Lung cancer incidence by cumulative exposure to endotoxin*

	Cumulative endotoxin exposure, EU/m^3 x year†,‡						
Exposure lag time	Unexposed	89	1627	2402	3383	24350	P§
End of follow-up							
HR (95% CI)	1.0 (referent)	1.06 (0.79 to 1.41)	0.98 (0.73 to 1.30)	0.79 (0.58 to 1.06)	0.88 (0.66 to 1.16)	**0.70 (0.52 to 0.95)**	**.02**
No. of case patients/No. of subcohort members	186/916	88/425	90/424	75/425	89/424	**74/424**	
5 y							
HR (95% CI)	1.0 (referent)	1.09 (0.83 to 1.45)	0.95 (0.71 to 1.26)	0.78 (0.58 to 1.06)	0.89 (0.67 to 1.19)	**0.68 (0.50 to 0.92)**	**.01**
No. of case patients/No. of subcohort members	186/916	94/457	87/422	74/409	90/415	**71/416**	
10 y							
HR (95% CI)	1.0 (referent)	1.08 (0.82 to 1.22)	0.91 (0.68 to 1.22)	0.77 (0.57 to 1.04)	0.88 (0.66 to 1.17)	**0.67 (0.50 to 0.92)**	**.01**
No. of case patients/No. of subcohort members	188/923	99/509	85/419	72/388	88/400	**70/396**	
15 y							
HR (95% CI)	1.0 (referent)	1.08 (0.82 to 1.41)	0.91 (0.68 to 1.21)	0.81 (0.60 to 1.10)	0.78 (0.58 to 1.05)	**0.66 (0.48 to 0.90)**	**.01**
No. of case patients/No. of subcohort members	193/965	106/557	84/399	76/369	76/370	**67/375**	
20 y							
HR (95% CI)	1.0 (referent)	1.19 (0.92 to 1.54)	0.79 (0.59 to 1.06)	0.80 (0.59 to 1.08)	0.63 (0.45 to 0.88)	**0.60 (0.43 to 0.83)**	**.002**
No. of case patients/No. of subcohort members	208/1090	122/543	81/408	75/347	57/309	**59/338**	

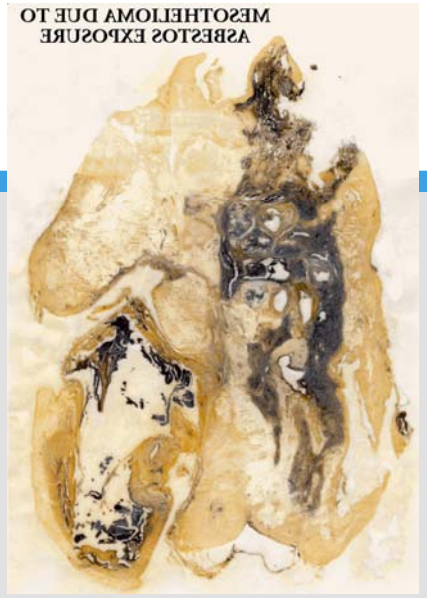
* Data were adjusted for age at baseline and smoking status (never [referent], former, or current). Analysis was based on cumulative exposure to endotoxin, excluding subjects who ever worked as machinists (n = 114), worked with wool (n = 17), or worked in sanitation jobs in production (n = 44). EU = endotoxin units; HR = hazard ratio; CI = confidence interval.

Done

start | Inbox for Malcol... | Delegation of Po... | Garrick eyes.do... | Occl cancer in d... | Lung Cancer Ris... | JNCI J Natl Canc... | cancer developi... | 10:49 PM

Challenges ahead

- Need for better recognition of individual cancers related to occupation
- Regulatory processes need to keep pace with setting effective exposure limits for carcinogens
- Require better occupational cancer registration systems to monitor trends
- Continue to push for a ban on asbestos use
- Undertake high quality research



Thank you for your attention