

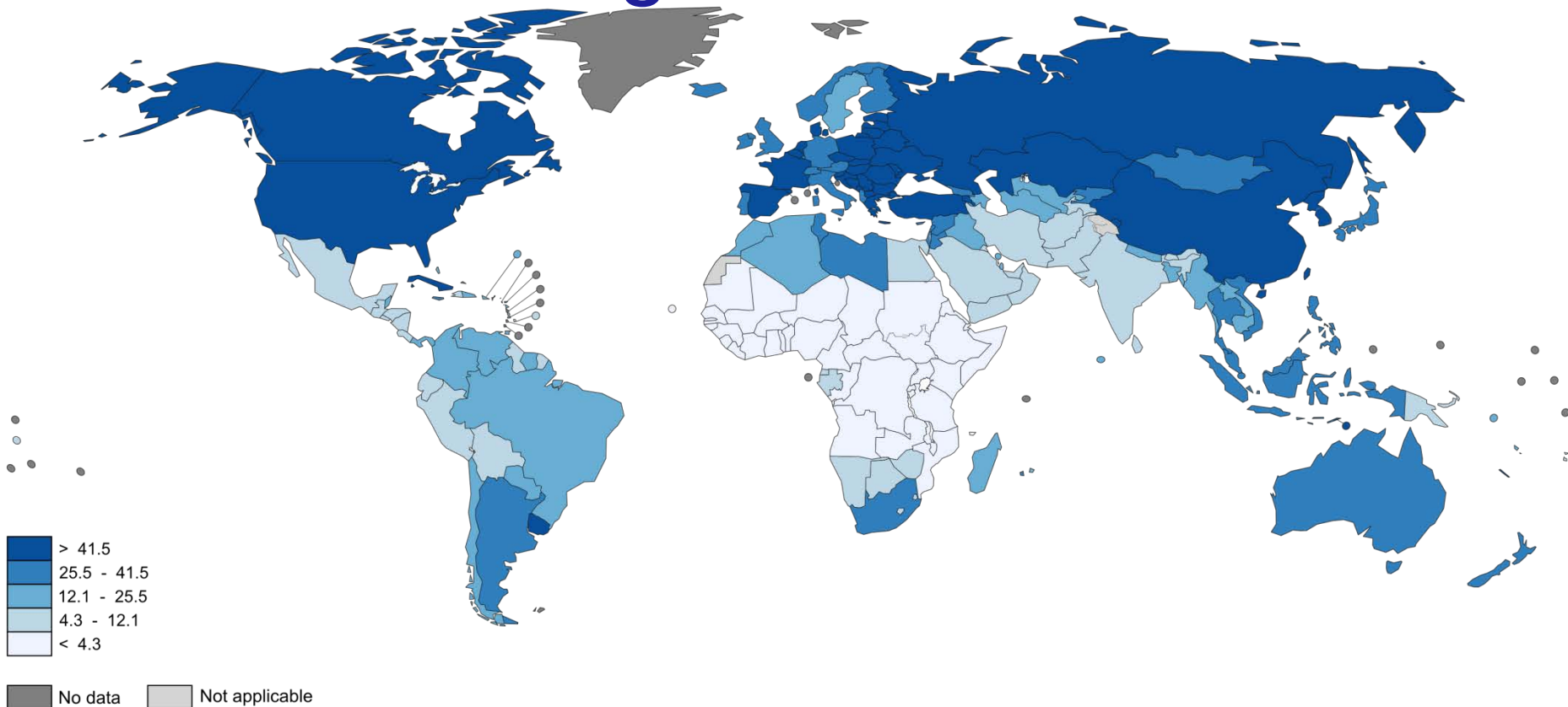


Asbestos and lung cancer in a multinational consortium of case-control studies (the SYNERGY project)

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Worldwide Lung Cancer Incidence among men in 2012



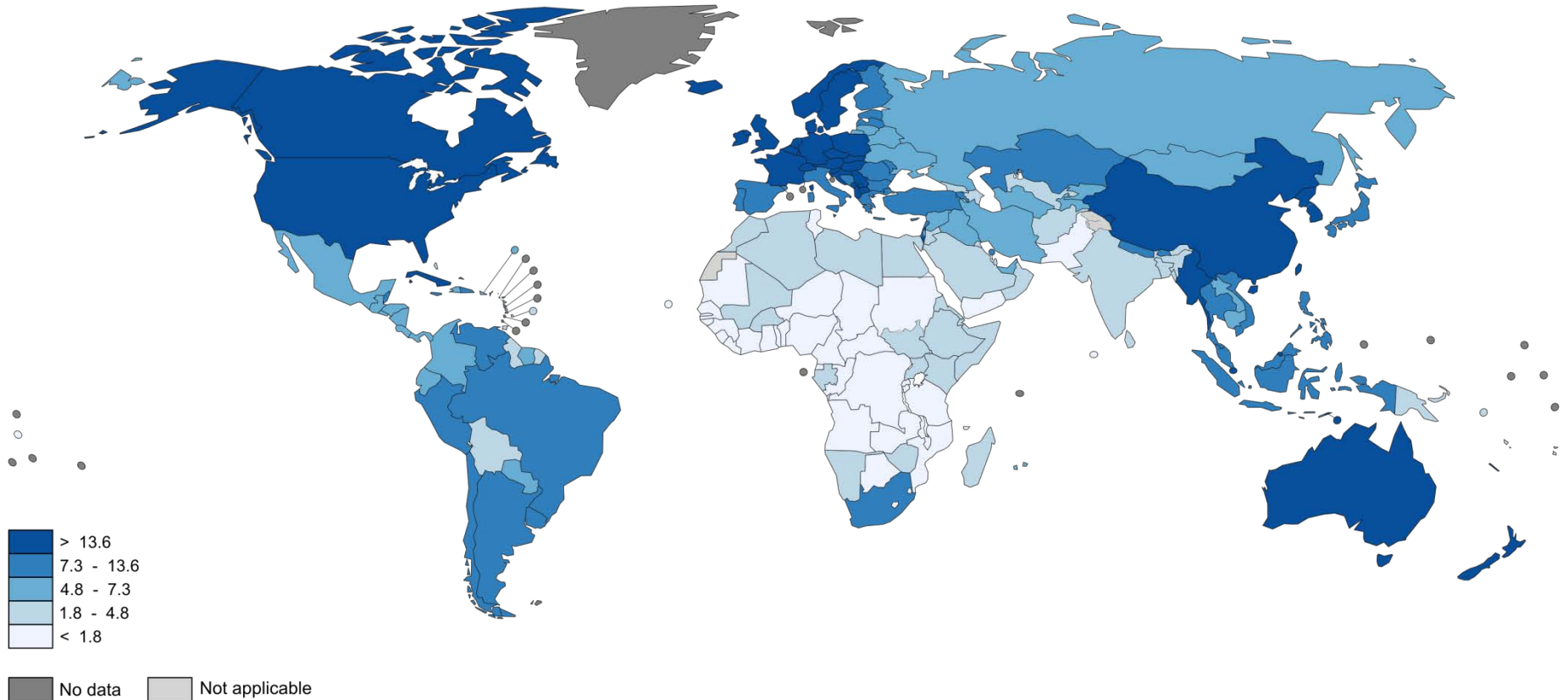
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Data source: GLOBOCAN 2012
Map production: IARC
World Health Organization



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Worldwide Lung Cancer Incidence among women in 2012



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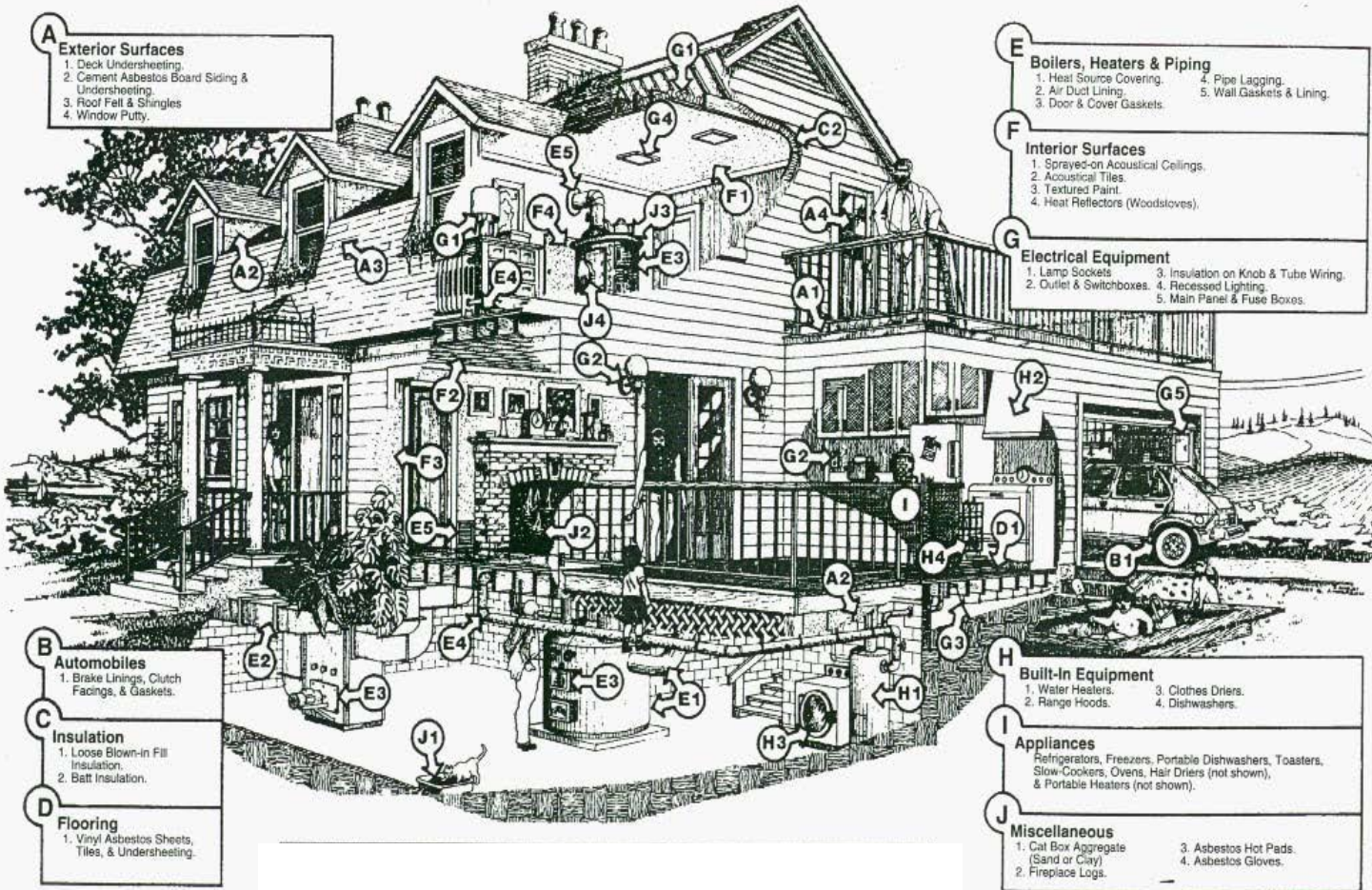
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Asbestos

- Group of mineral silicate fibres (serpentine, amphiboles), which are strong, flexible, stable, heat-resistant, and durable
- IARC evaluated asbestos in 1973, 1977, 1987, and concluded in Vol. 100C (2012) that all forms of asbestos cause mesothelioma and cancer of the lung, larynx, and ovary

Where asbestos might be



A Exterior Surfaces
 1. Deck Undersheating
 2. Cement Asbestos Board Siding & Undersheating
 3. Roof Felt & Shingles
 4. Window Putty.

E Boilers, Heaters & Piping
 1. Heat Source Covering.
 2. Air Duct Lining.
 3. Door & Cover Gaskets.
 4. Pipe Lagging.
 5. Wall Gaskets & Lining.

F Interior Surfaces
 1. Sprayed-on Acoustical Ceilings.
 2. Acoustical Tiles.
 3. Textured Paint.
 4. Heat Reflectors (Woodstoves).

G Electrical Equipment
 1. Lamp Sockets
 2. Outlet & Switchboxes.
 3. Insulation on Knob & Tube Wiring.
 4. Recessed Lighting.
 5. Main Panel & Fuse Boxes.

B Automobiles
 1. Brake Linings, Clutch Facings, & Gaskets.

C Insulation
 1. Loose Blow-in Fill Insulation.
 2. Batt Insulation.

D Flooring
 1. Vinyl Asbestos Sheets, Tiles, & Undersheating.

H Built-In Equipment
 1. Water Heaters.
 2. Range Hoods.
 3. Clothes Driers.
 4. Dishwashers.

I Appliances
 Refrigerators, Freezers, Portable Dishwashers, Toasters, Slow-Cookers, Ovens, Hair Driers (not shown), & Portable Heaters (not shown).

J Miscellaneous
 1. Cat Box Aggregate (Sand or Clay)
 2. Fireplace Logs.
 3. Asbestos Hot Pads.
 4. Asbestos Gloves.



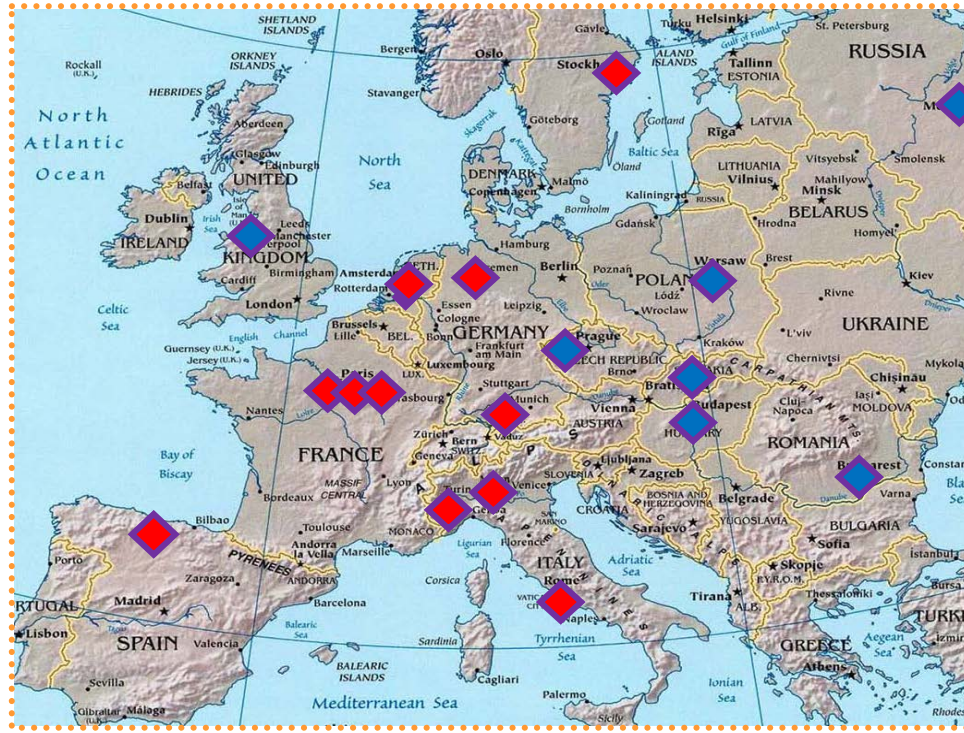
The SYNERGY project

- Estimate joint effects of asbestos, respirable crystalline silica, polycyclic aromatic hydrocarbons, chromium/nickel and smoking in the development of lung cancer
- Includes 14 pooled case-control studies, conducted in Europe and Canada between 1985 and 2010
- Complete occupational (ISCO 1968) and smoking history, including start and stop dates
- In this presentation I'll focus on our results for asbestos and smoking

Geographic representation of studies

Lung cancer cases: 17,700

Controls: 21,800



Study population

Cases were recruited from hospitals or cancer registries, and in most studies eligible if:

- 1) < 75 years
- 2) resident for at least one year
- 3) confirmed diagnosis by histology or cytology

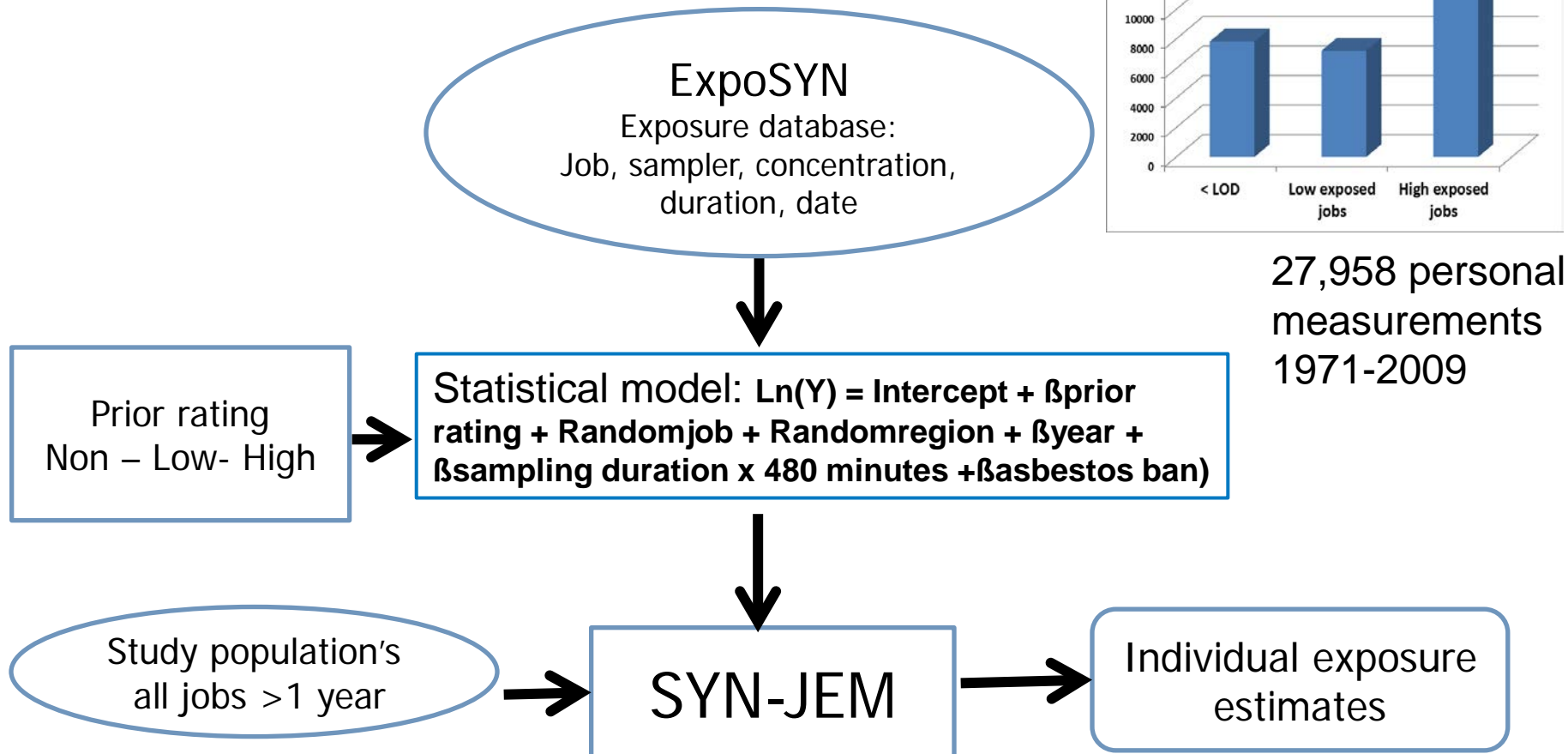
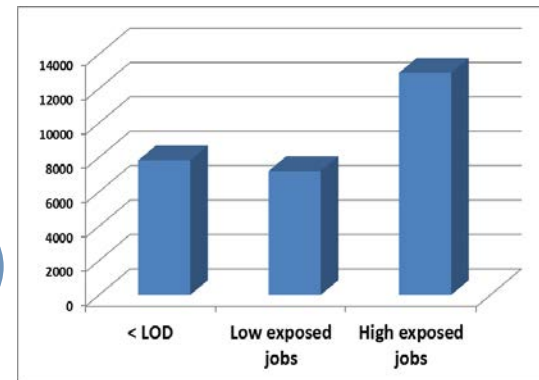
Controls were recruited from the general population (81%) or hospitals (19%), and were individually or frequency matched to cases by sex and age

Data collection

- **Response rates:**
 - Cases mean 82%, range 53-98
 - Controls mean 67%, range 41-100
- **Interviews primarily with the study participants themselves**
 - Next-of-kin respondents were accepted in five studies when subjects were unavailable (9.1% of cases, 6.6 % of controls)
- **Face-to-face interviews with 87% of study population, else via mail or telephone**



Exposure assessment



Key decisions for SYN-JEM

1. Prior rating override measurements for jobs considered non-exposed
1. Job estimates only applied when based on ≥ 5 data points
2. Overall time trend for period with measurement data; exposure ceiling for earlier years ($< 1960/1975$)

Number of personal asbestos measurements included in the model

| | | |
|----------------------------|--------|---------------|
| Total | 27 958 | (80% pre-ban) |
| Region | | |
| Canada | 1077 | (100%) |
| CEE countries ^a | 297 | (90%) |
| France | 1730 | (59%) |
| Germany | 4621 | (4%) |
| Italy/Spain | 906 | (79%) |
| The Netherlands | - | - |
| Sweden | 236 | (46%) |
| United Kingdom | 19 091 | (100%) |

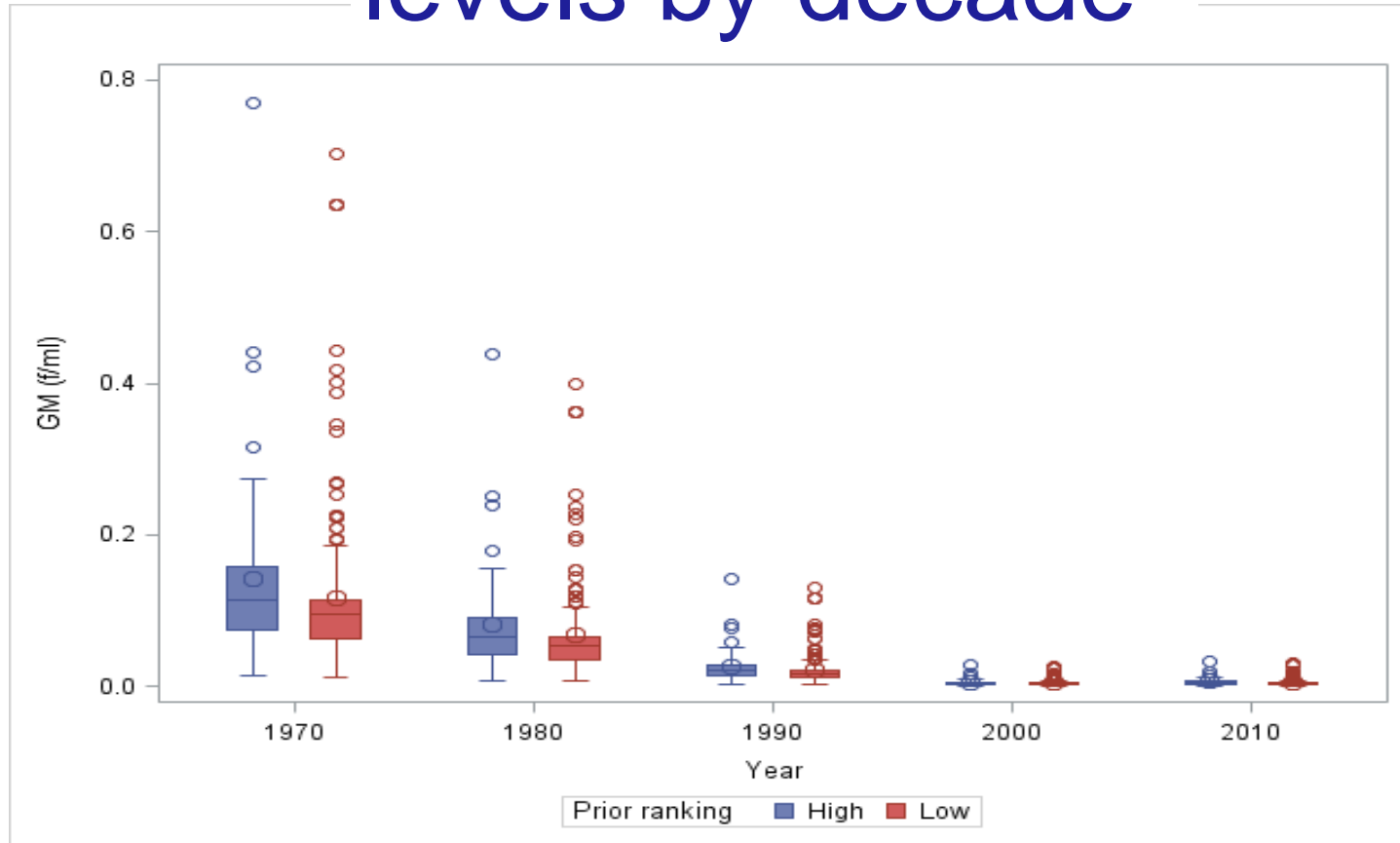
Estimates of exposure levels and the number of measurements available for the specific job title

| | | Exposure level (GM) | | Measurements in model |
|--|---|---------------------|------------|-----------------------|
| Calibrated <i>a priori</i> exposure rating | | 1980 | 2000 | N |
| Mean estimates | Low exposed jobs | 0.061 f/ml | 0.004 f/ml | 7206 |
| | High exposed jobs | 0.074 f/ml | 0.005 f/ml | 12 922 |
| Ten highest exposed jobs | | | | |
| ISCO-68 | Job description | 1980 | 2000 | |
| 0-35.50 | Heating, ventilation and refrigeration engineering technician | 0.439 f/ml | 0.029 f/ml | 159 |
| 7-52.20 | Spinner, thread and yarn ^a | 0.407 f/ml | N/A | 681 |
| 7-52.30 | Doubler ^a | 0.256 f/ml | N/A | 578 |
| 7-52.50 | Winder ^a | 0.248 f/ml | N/A | 48 |
| 9-56.20 | Building insulator (hand) | 0.244 f/ml | 0.016 f/ml | 48 |
| 9-54.45 | Ship joiner | 0.236 f/ml | 0.016 f/ml | 20 |
| 7-52.40 | Twister ^a | 0.229 f/ml | N/A | 5 |
| 7-54.25 | Loom threader (machine) ^a | 0.229 f/ml | N/A | 75 |
| 0-14.20 | Chemistry technician | 0.180 f/ml | 0.012 f/ml | 30 |
| 8-74.50 | Metal shipwright | 0.176 f/ml | 0.012 f/ml | 10 |

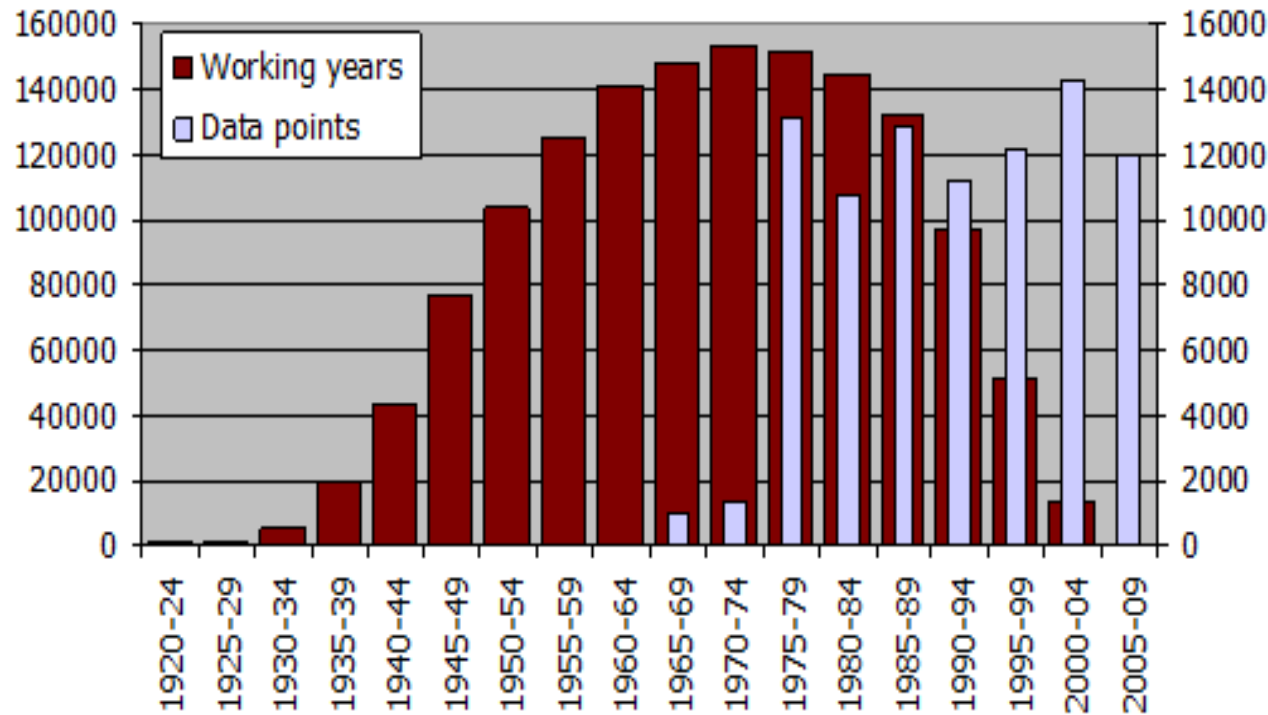
Most frequent asbestos exposed jobs among control subjects

| | <u>Men</u> | | <u>Women</u> | |
|--------|------------|------------------------------|--------------|--|
| Top 10 | ISCO-68 | | ISCO-68 | |
| 1 | 9-99.10 | labourer n.e.c. | 9-71.50 | hand packer |
| 2 | 8-43.20 | automobile mechanic | 9-99.10 | labourer n.e.c. |
| 3 | | military service | 9-71.55 | machine packer |
| 4 | 8-71.05 | plumber (general) | 5-51.30 | janitor |
| 5 | 9-31.20 | building painter | 9-71.45 | warehouse porter |
| 6 | 9-59.10 | housebuilder (general) | 8-49.90 | other machinery fitters and assemblers |
| 7 | 8-55.10 | electrician (general) | 8-49.85 | mechanical products inspector |
| 8 | 9-71.45 | warehouse porter | 8-59.20 | electronic products inspector and tester |
| 9 | 8-49.10 | machinery mechanic (general) | 9-31.20 | building painter |
| 10 | 8-41.05 | machinery fitter (general) | 8-53.40 | coil winder (machine) |

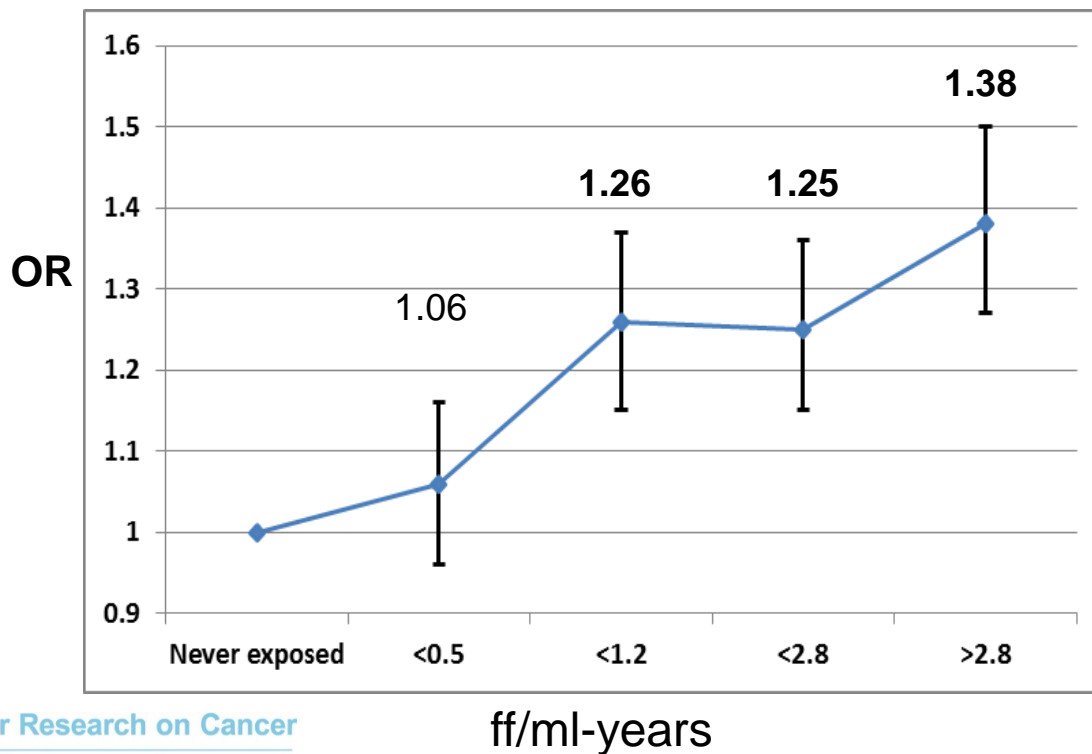
Distribution of asbestos exposure levels by decade



Data points (light purple) vs. distribution of working years (dark red) and exposure levels

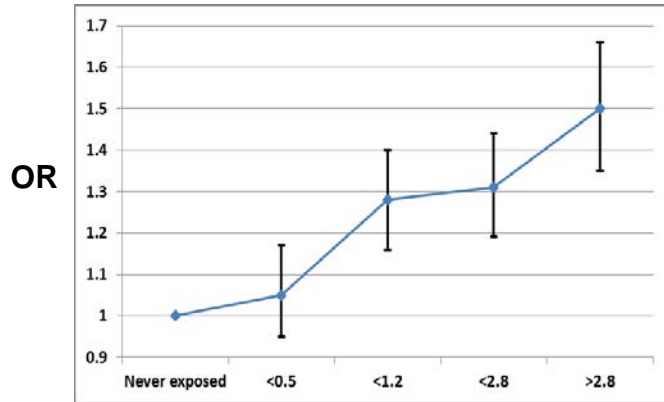


Cumulative asbestos exposure among men

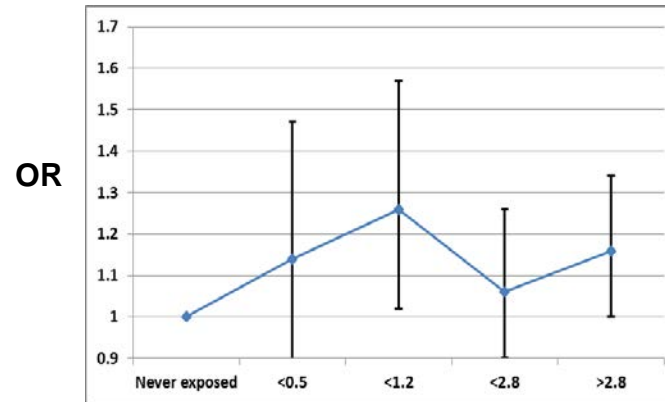


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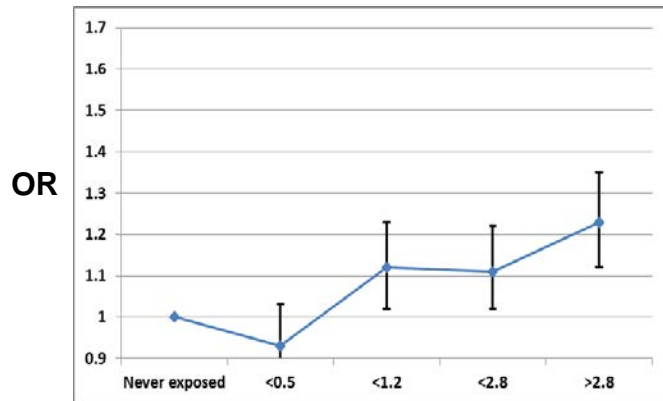
Robustness of results in men



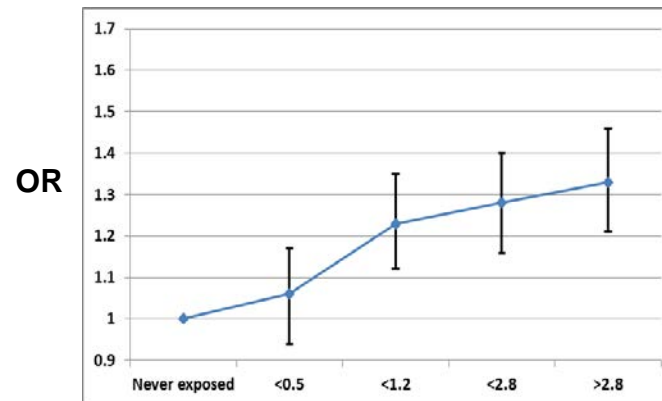
Studies with population controls



Studies with hospital controls

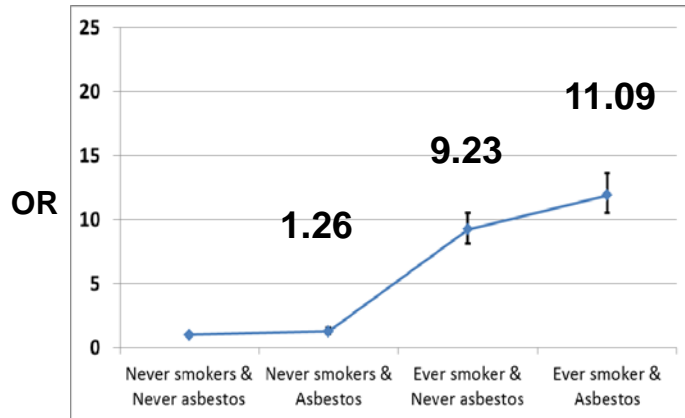


Restricted to blue collar workers



Excluding labourers n.e.c. (ISCO 9-99.10)

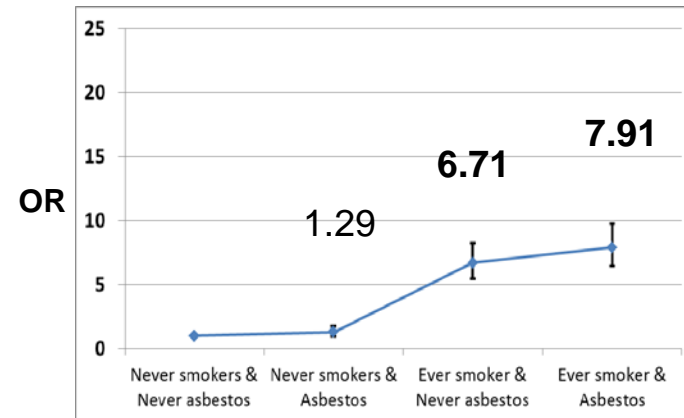
Joint effects of asbestos & smoking in men



P-value
multiplicative
interaction:
0.82

RERI: 2.44
(1.89-3.08)

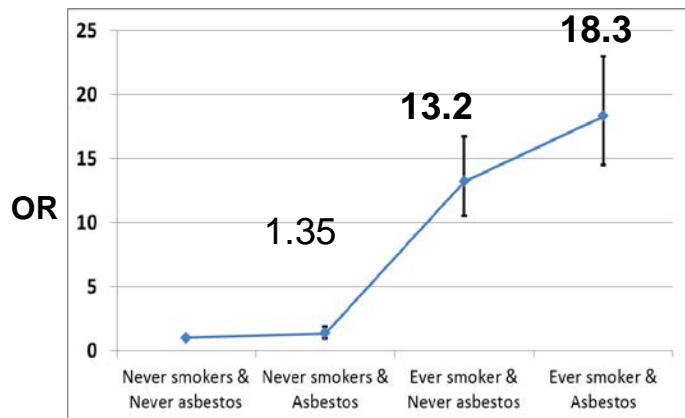
All lung cancer types



P-value
multiplicative
interaction:
0.59

RERI: 0.92
(0.16-1.59)

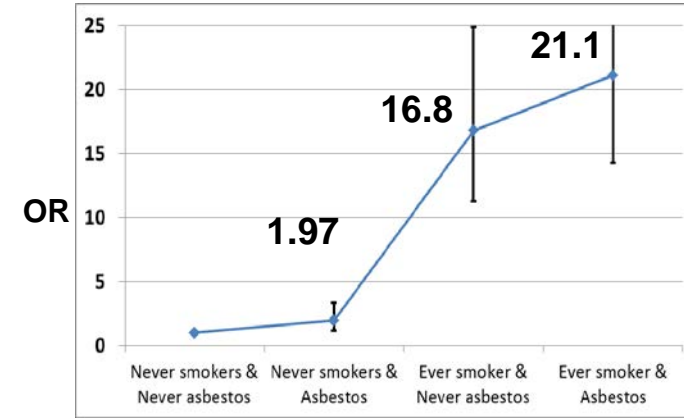
Lung adenocarcinoma



P-value
multiplicative
interaction:
0.90

RERI: 4.75
(3.57-6.55)

Squamous cell lung cancer

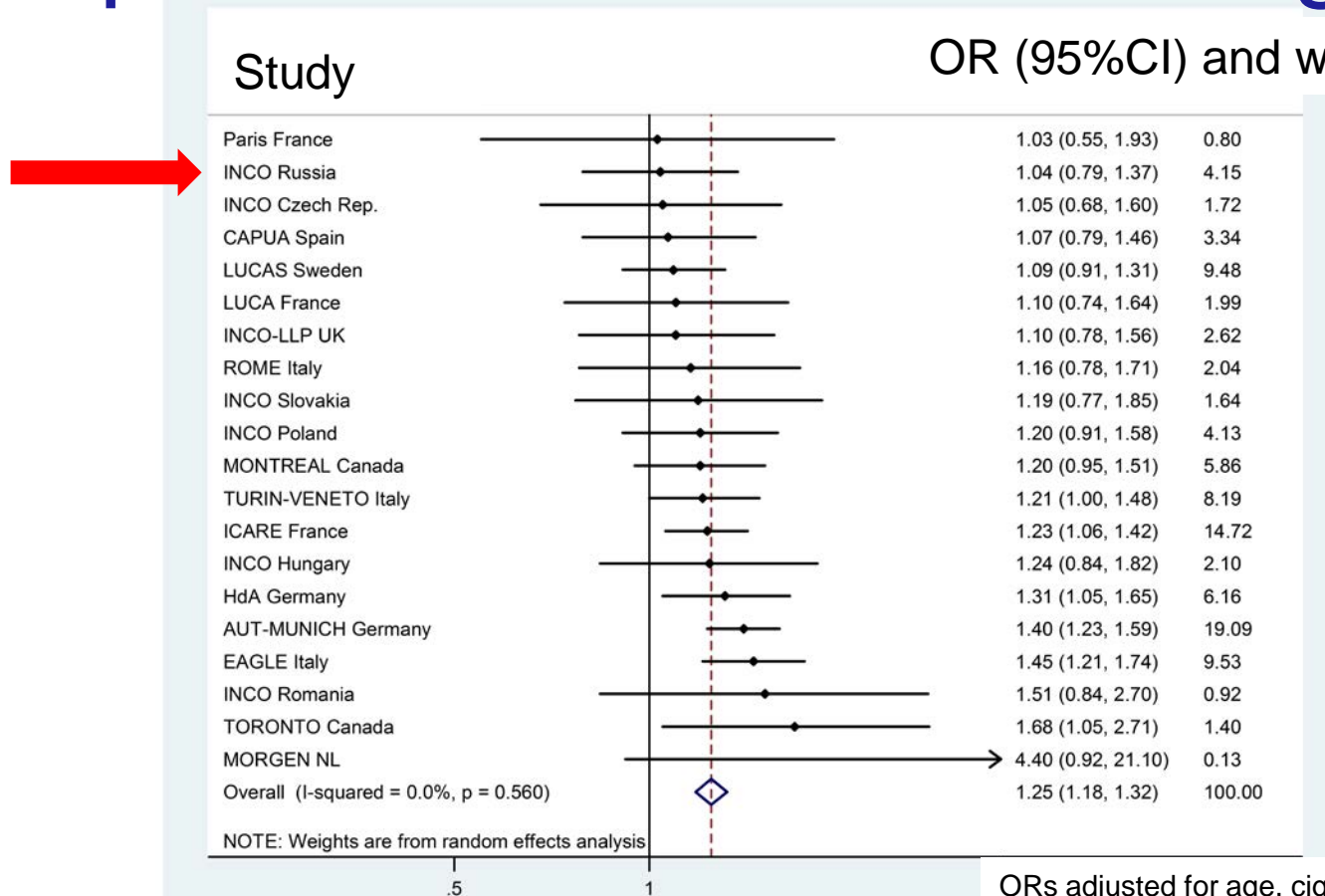


P-value
multiplicative
interaction:
0.10

RERI: 3.18
(1.29-5.92)

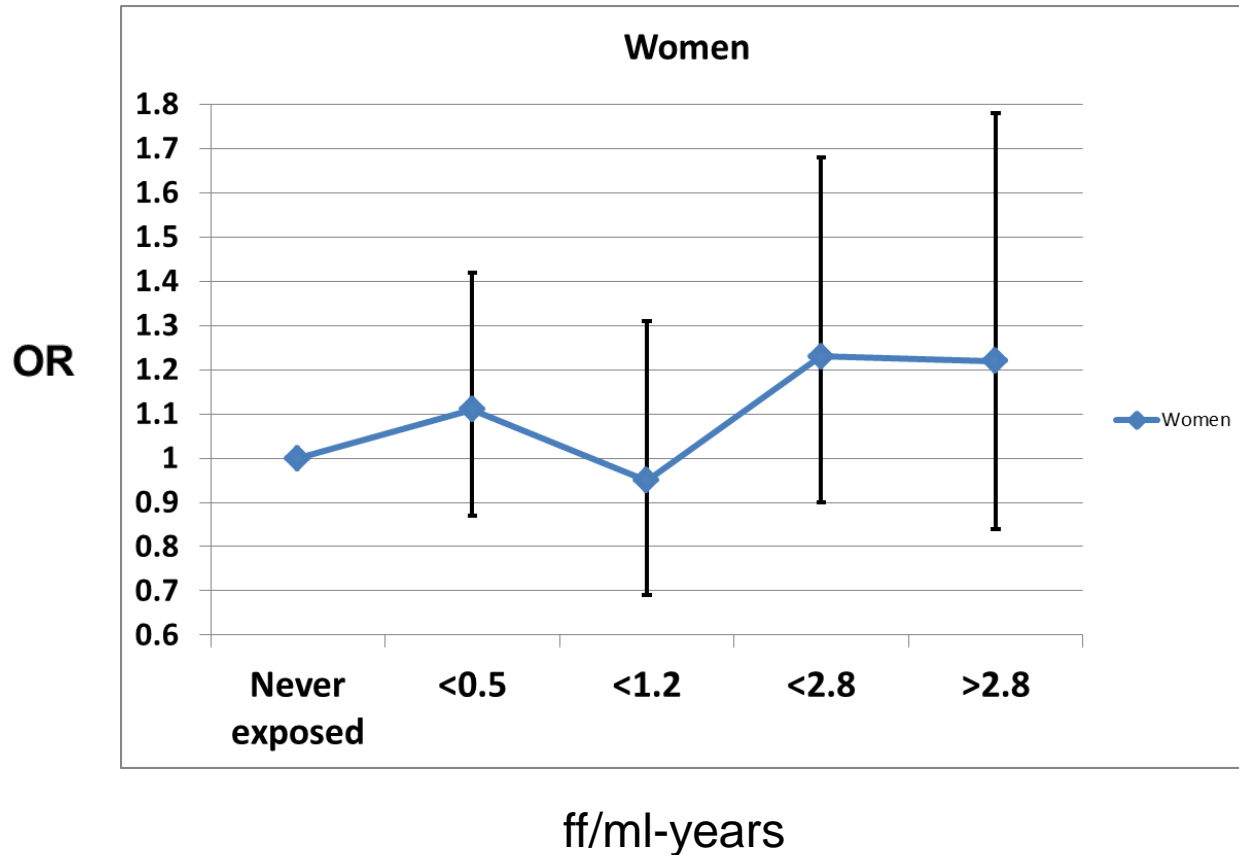
Small cell lung cancer

Forest plot by study for ever exposure to asbestos among men



ORs adjusted for age, cigarette pack-years, time-since-quitting smoking, and ever-employment in a 'List A' job

Cumulative asbestos exposure



Lung cancer risks in women, current smokers

| Lung cancer cell type | Asbestos exp. ff/ml-years | Controls | Cases | OR | 95% CI |
|-----------------------|---------------------------|----------|-------|------|-------------|
| All | Unexposed | 772 | 1405 | 1 | |
| | <1.2 | 94 | 207 | 1.22 | 0.90 - 1.66 |
| | >1.2 | 23 | 99 | 2.05 | 1.24 - 3.40 |
| Adenocarcinoma | Unexposed | 772 | 502 | 1 | |
| | <1.2 | 94 | 70 | 1.11 | 0.76 - 1.63 |
| | >1.2 | 23 | 29 | 2.08 | 1.12 - 3.88 |
| Squamous | Unexposed | 772 | 306 | 1 | |
| | <1.2 | 94 | 49 | 1.33 | 0.86 - 2.07 |
| | >1.2 | 23 | 31 | 2.20 | 1.15 - 4.21 |
| Small cell | Unexposed | 772 | 313 | 1 | |
| | <1.2 | 94 | 42 | 1.15 | 0.73 - 1.83 |
| | >1.2 | 23 | 29 | 2.15 | 1.12 - 4.12 |

ORs adjusted for study, age group, List A, and cigarette pack-years

Strengths and limitations

- Strengths
 - Large study population
 - Lifetime and detailed occupational & smoking histories
 - Quantitative exposure assessment
- Limitations
 - Asbestos fibre type and dimensions lacking

Key messages

- Exposure assessment new and innovative based on job specific quantitative measurements
- Increased lung cancer risk at relatively low levels (>0.5 fibres/ml-years) of cumulative exposures among men
- Smoking does not only add to, but also increases the carcinogenic effect of asbestos; which also was observed among asbestos exposed women



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- Susan Peters (IRAS)

All study group PI's

Thank you
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