

What do we know about wood dust exposure and non- malignant diseases – an epidemiological approach

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A very old story!

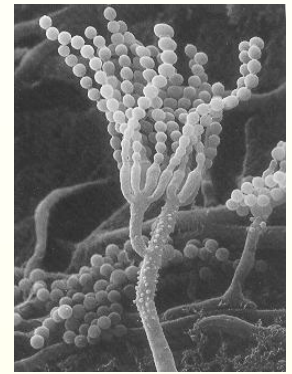
” ... rainwater that runs off cypress bark contains poison. It has been said that men lumbering in cypress forests have many sores on their feet.”

(From “Sakuteiki” by Tachibana, 1028 – 1094)

Wood dust exposure

- 2 mio. in EU employed in the wood industry
(Kauppinen 2000)
- Inhabitants DK: 5,00,0000
- Labour force DK: 2,200,000 workers
- DK: 76,000 employed in industries with wood dust exposure; 3.4 % of the workforce *(Statistics Denmark 2001)*
- Several thousand wood types, more than 1000 in production

Concurrent exposures



- Terpene exposure: well documented in saw mills (*Eriksson 1996; Teschke 1999; Rosenberg 2002*), but also seen in the "dry" wood industry (*Eriksson 1997, Mikkelsen 1998*)
- Biohazards well documented in saw mills, (*Eduard 1994; Duchaine 2000; Dennecamp 1999; Alwis 1999; Ronald 2003*) but also seen in the "dry" wood industry (*Alwis 1999; Kryszynska-Traczyk 2002*)
- Glue, formaldehyde, surface treatment (*Holmström 1989, 1995; Grandstrand 1998*)

Possible non-malignant health effects of wood dust



- Asthma
- Chronic bronchitis
- Impairment of lung function
- Rhino-conjunctivitis
- Skin problems
- Allergic alveolitis
- Pulmonary fibrosis

Mortality of obstructive lung diseases in the wood industry

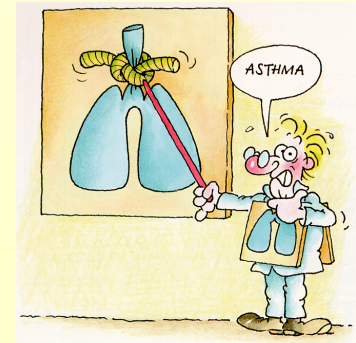
- Increased asthma mortality among woodworkers SMR 226 (108 - 334) (*Torén 1991*)
- Marginal increased mortality of obstructive lung diseases among woodworkers RR 1,5 (1,1 - 1,9) (*Demers 1998*)

Western red cedar asthma

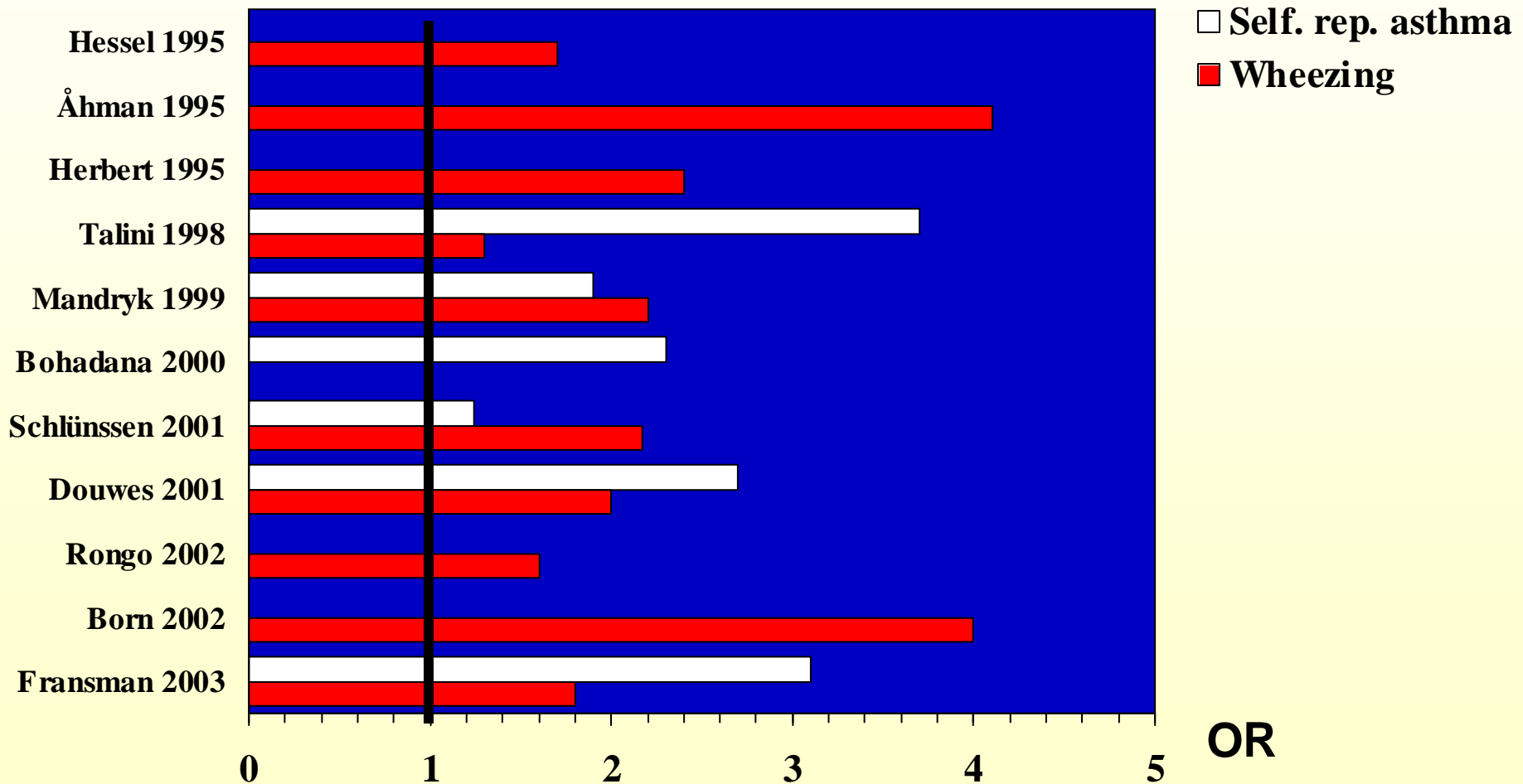
- Western Red Cedar asthma: prevalence
1 - 13% (*Ishizaki 1993, Brooks 1981, Chan-Yeung 1978, 1984*)
- Dose-response relation between exposure and prevalence of Western red cedar asthma (*Brooks 1981*)
- The diagnosis confirmed in clinical investigations
- Aetiological agent: plicatic acid (*Chan-Yeung 1973*)
- Immunological mechanism other than IgE mediated sensitisation most important (*Chan-Yeung 1994*)
- The majority of studies on saw mill workers

Asthma and other wood species

- Casuistically asthma caused by e.g. oak, beech, pine, ash, iroko, abachi, mahogany
- Self-reported asthma 4 - 11% (OR 1.0 - 3.7)
- Wheezing 10 - 28% (OR 0.7 - 4.1)
- Chest tightness 27 - 41% (OR 1.7 - 1.8)
- Few studies included objective measures for asthma
- The Immunological mechanism?



OR for asthma symptoms from cross-sectional studies in the wood industry



Study in the Danish furniture industry 1997 – 99

54 furniture factories, 2,303 WW
3 control factories, 576 C

Lung
function
1,977 WW
507 C

Personal dust
measurements,
hygienic variables,
1,779 WW

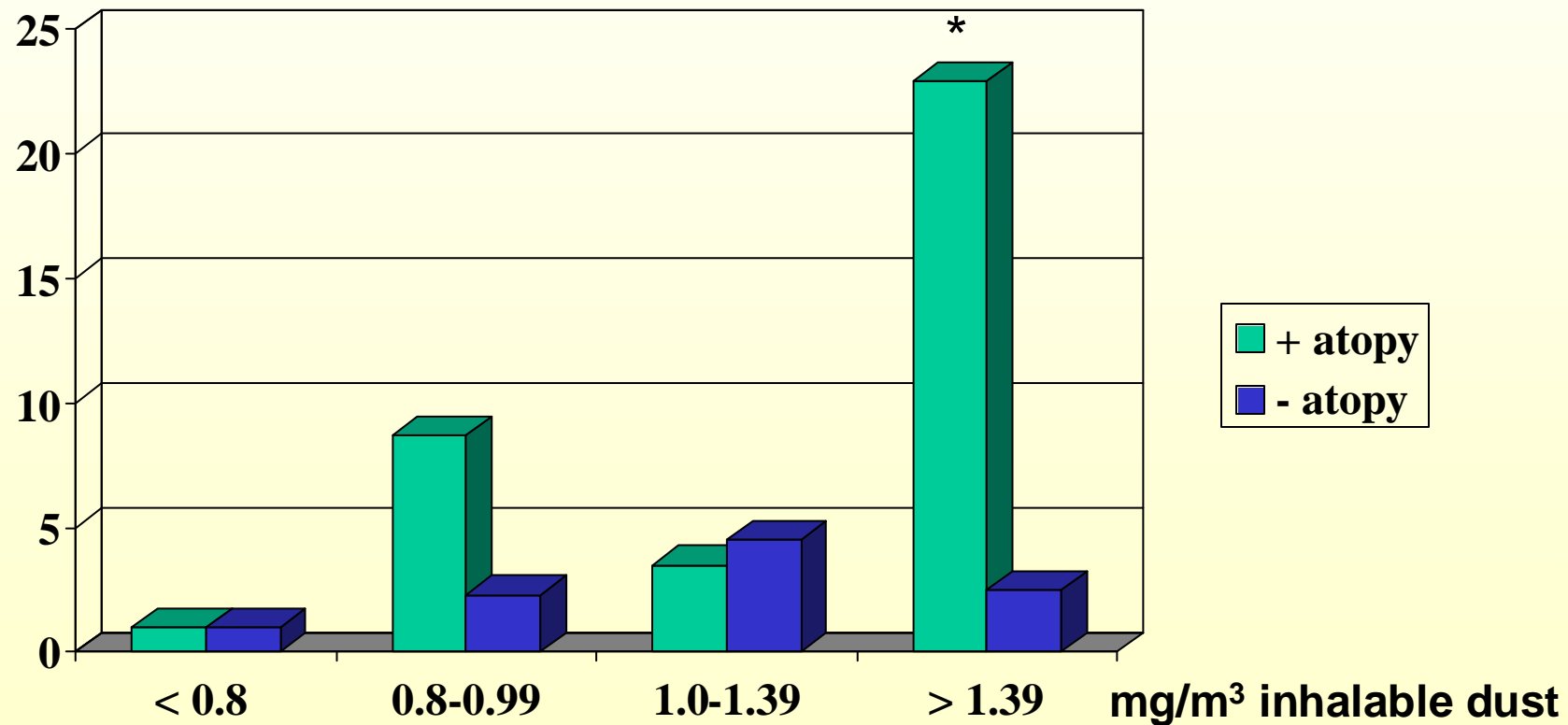
Questionnaires,
2,033 WW 474 C

Clinical investigations,
n = 453

WW = woodworkers
C = controls

Asthma symptoms + BHR and wood dust exposure, stratified by atopy.

N = 118



*: $p < 0.05$

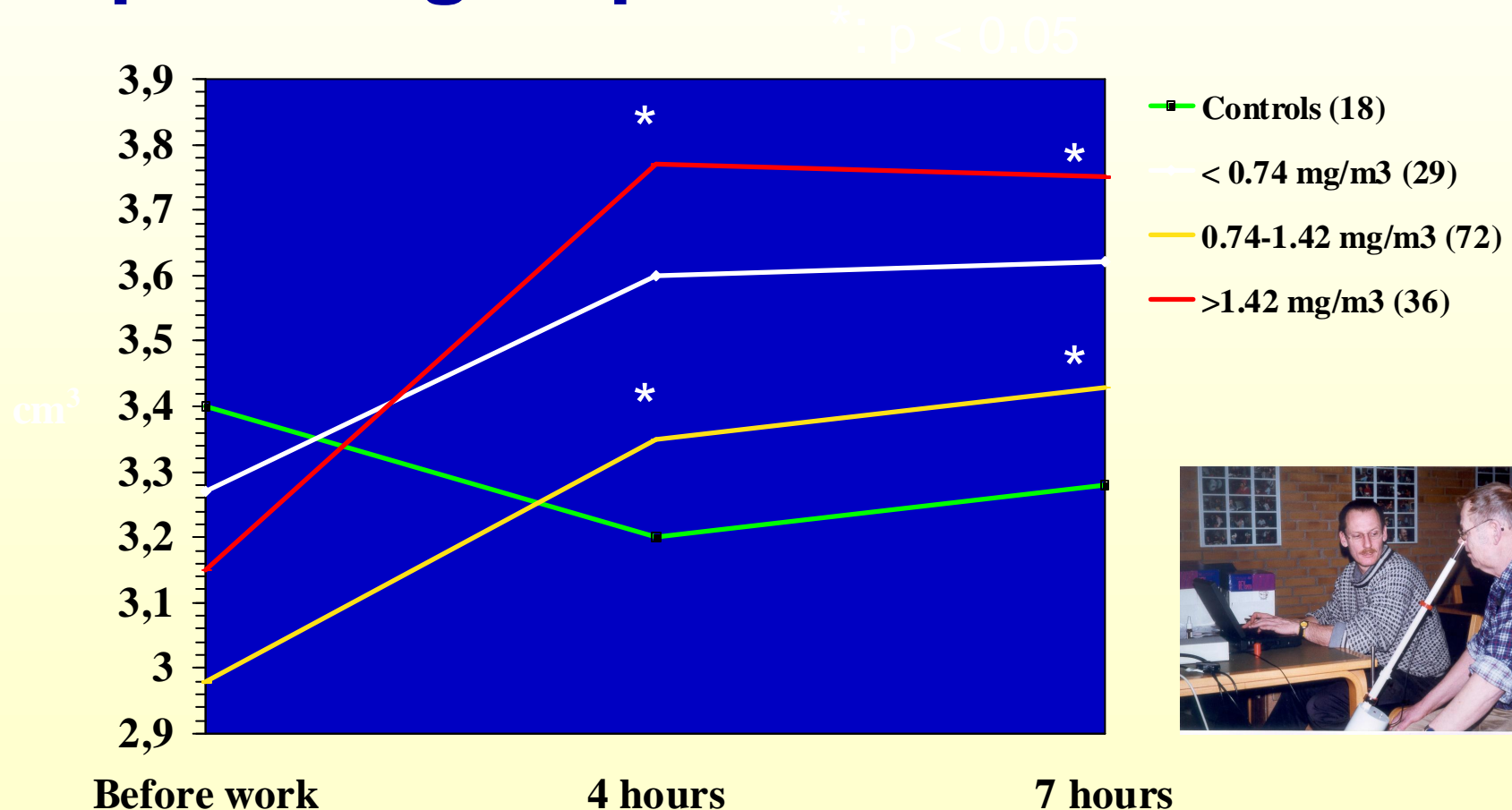
Schlünssen et al, in press



Rhino-conjunctivitis

- Nasal symptoms (*itching, blocking, sneezing, and dripping nose*) 7 - 77% (OR 0.8 - 12.1)
- Eye symptoms (*itching, burning, tearing, and swelling eyes*) 20 - 46 % (OR 1.4 - 5.9)
- Decreased mucociliar clearance (*Wilhelmsson 1984*)
- Objective measurements for nasal impairment: nasal peak flow (*Åhman 1996*), rhinomanometri (*Wilhelmsson 1984*), acoustic rhinometri (*Schlünssen 2002*)

Mucosal swelling (vol2 - 5cm) before and at 4 and 7 hours of work for four exposure groups. N = 175



IgE mediated sensitisation to wood dust

- Case reports (*i.e. beech, oak, pine, mahogany, iroko*)
- Clinical investigations for occupational asthma or rhinitis (*Oertmann 1993, Kanerva 1993*)
- Epidemiological studies: sensitisation of minor importance (*Åhman 1995, Wilhelmsson 1984, Carosso 1987, Dutkiewicz 2001, Cormier 2000; Skovsted 2003*)

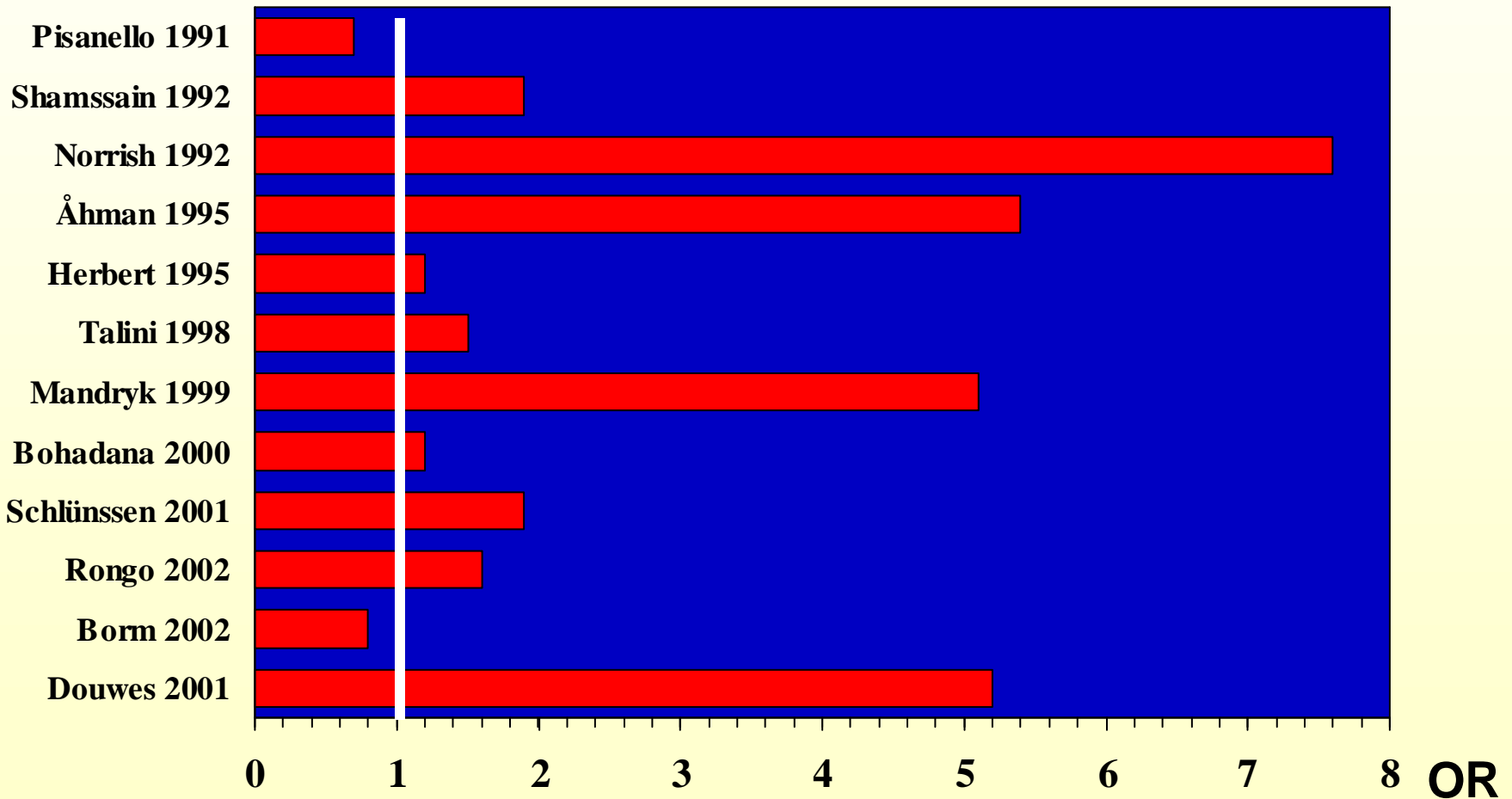


Chronic bronchitis

- Chronic bronchitis 8 - 30% (OR 1.0 - 14)
- Coughing 27 - 50 % (OR 0.8 - 8)
- Expectorations 10 - 61% (OR 1.2 - 8)



OR for coughing from cross-sectional studies in the wood industry



Acute decline in lung function

Dose-response relations between wood dust exposure and acute decline in lung function (FEV_1 , FVC) during a work day

(Mandryk 1999; Beritic-Stahuljak 1988; Schlünssen et al, submitted)



Linear regression on cross-shift fev₁ and dust exposure. N = 639

	RES cross-shift fev ₁		
Exposure estimates	Coef.	SE	P-value
Individual, all measurement	0.792	0.34	0.02
Grouping, 12 categories	1.636	0.77	0.03
Weighted estimate	1.336	0.53	0.01
Mixed Model	1.248	0.56	0.03

GM (GSD): 1.0 (2.1) mg/m³ inhalable dust

Chronic impairment in lung function

- Annual dose-response related decline in FEV₁ and FVC among Western red cedar workers.

Exposure level : < 0.2, 0.2-0.4, > 0.4 mg/m³
total dust (*Noertjojo 1996*)

- Annual increased decline in FEV₁ in wood dust exposed western red cedar asthma patients (*Fung 1996*)
- Other wood species: conflicting results, no follow up studies (*Mandryk 1999; Schlünssen 2002*)

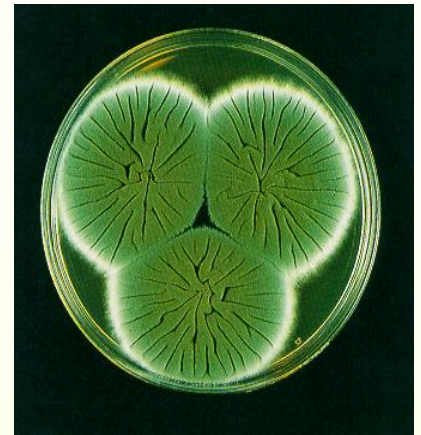


SKIN

Skin problems

- Allergic and toxic dermatitis to different types of wood and wood components, e.g. pao ferro, mahogany, Brazilian rosewood, teak, abachi, pine, oak, beech, colophonium, and terpenes
- Direct and air born exposure to wood dust
- Epidemiological studies: skin problems between 4% and 60% (*Gan 1997; Meding 1996; Oleffe 1975*)
- Urticaria has been described using abachi, mukali, or mahogany

Allergic alveolitis



- Several case reports of extrinsic allergic alveolitis among saw mill workers
- Precipitating antibodies against moulds and wood have been found (*Eduard 1994; Halpin 1994*)
- At least two cases of allergic alveolitis reported among workers in the dry wood industry (*Baur 2000; Malmström 1999*)

Pulmonary fibrosis

- Increased OR (1.7 - 2.9) among woodworkers in case-control studies

(Gustavson 2003, Scott 1990; Hubbard 1996)

- Decrease in lung diffusion capacity in wood dust exposed workers; dose-response relation between decrease in diffusion capacity and time of employment

(Carosso 1987)

Exposure level

- No simple relation between exposure and health effects
- Different exposure levels across trades, studies, countries etc.
- Different measuring strategies and equipment
- Increasing evidence for dose-response relations between wood dust exposure below 1 mg/m³ and respiratory health effects (*Noertjojo 1996; Schlünssen 2001, 2002*)

Prevention

- Several preventable determinants for dust exposure (*Sheeper 1995; Teschke 1999; Hall 2002; Mikkelsen 2002*)
- Studies to explore the effect of intervention (*Lazovich 2002*)
- Early recognition and effective treatment of workers with Western red cedar asthma improve the prognosis (*Chan-Yeung 1987; Marabine 1993*)





What do we know?

We know -

- Many subjects are exposed to wood dust
- Western red cedar asthma and rhinitis is well characterised and not uncommon among exposed subjects
- Western red cedar dust can cause an accelerated decline in lung function
- Other types of wood dust can cause asthma, rhino-conjunctivitis, chronic bronchitis, skin affection and acute decline in lung function

We know -

- Wood dust exposure may cause chronic obstructive lung disease, allergic alveolitis and pulmonary fibrosis
- Increasing evidence for dose-response relations between wood dust exposure below 1 mg/m^3 and respiratory health effects
- Prevention is possible



What do we need to know?

We need to know -

- The temporal relation between wood dust exposure and diseases with latency time (e.g. asthma, chronic obstructive lung diseases)
- Dose-response relations between wood dust exposure and health effects
- The impact of concurrent exposures, e.g. biohazards, terpenes

We need to know -

- The impact of different wood species
- The disease mechanisms
- The impact of preventive measures - does it help?





Thank you for your attention!

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