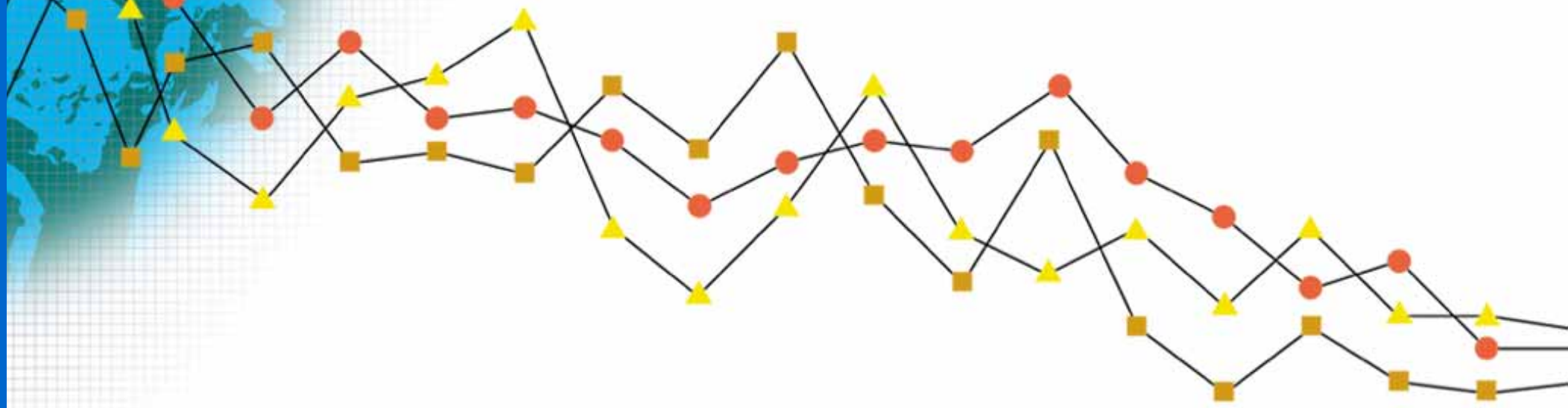
Occupational Asthma in New Zealand

Jeroen Douwes

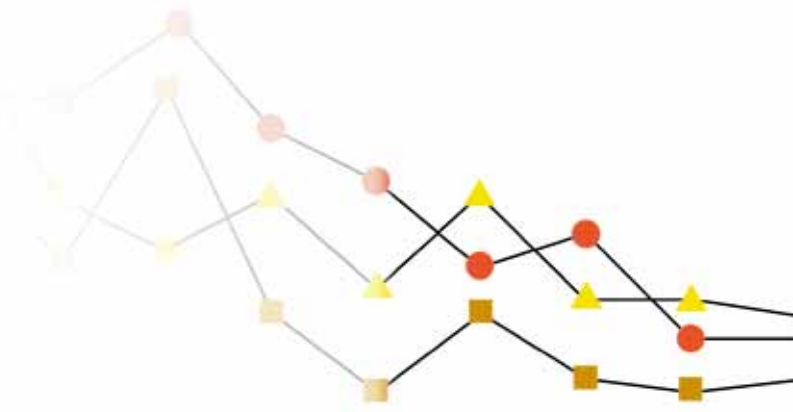


Centre for Public Health Research
Massey University
Te Kunenga ki Purehuroa

BROHNZ Building Research in Occupational Health in New Zealand

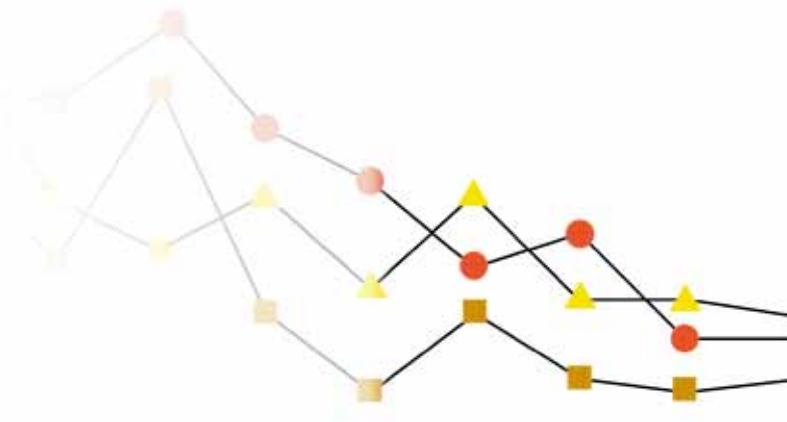
Overview

- Definition and monitoring of occupational asthma
- Occupational asthma in New Zealand
- Respiratory health in New Zealand sawmill workers



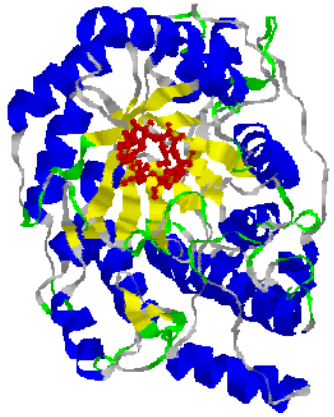
Definition of occupational asthma

- Occupational asthma:
  - Asthma caused by exposure in the working environment to airborne dusts, vapours or fumes.
- New onset asthma
  - Latency → causal agents: HMW and LMW sensitisers
  - No latency → causal agents: irritants ("asthma like syndrome")
    - Reactive Airways Dysfunction Syndrome: high exposure to irritant
- Exacerbation of pre-existing asthma
  - concurrent asthma aggravated by work
  - Irritants/allergens/other stimuli



Examples of occupational asthma

Latex allergies - asthma



Alpha- amylase, bakers' asthma

Rat and mice allergens, laboratory animal workers

Cotton - endotoxin

Organic dust - farmers

Dust - poultry processors

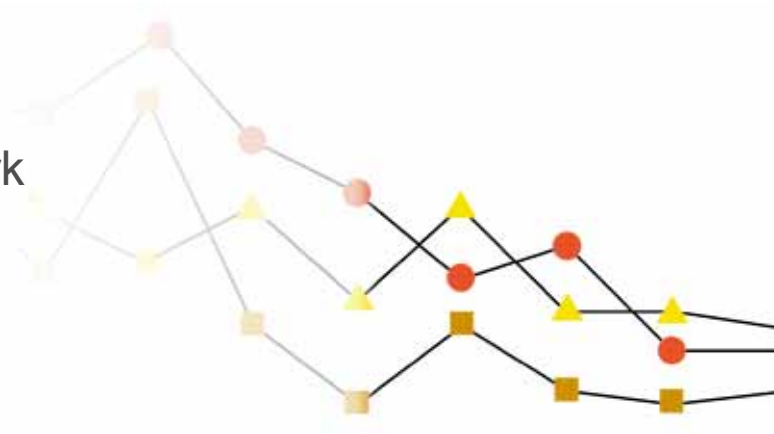
Metal working fluids - automotive industry

Spray painting - isocyanates

How to measure occupational asthma?

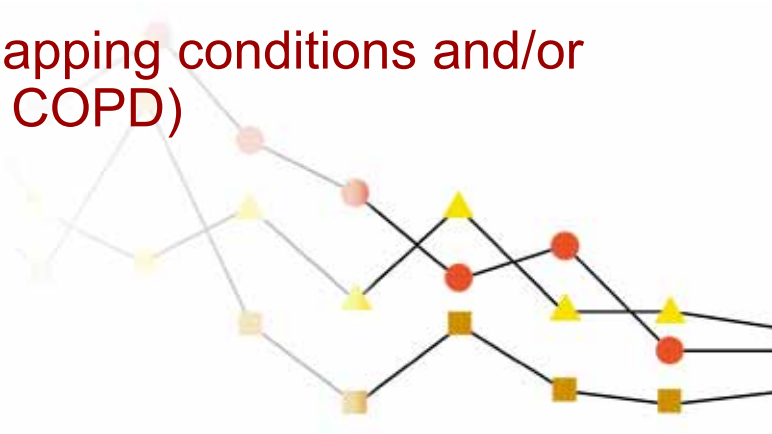
- Current asthma
  - Clinical diagnosis (reversibility testing, BHR, asthma medication, etc)
  - Epidemiological definition (Burney et al., 1994)
    - Have you been woken by an attack of shortness of breath at any time in the past 12 months? OR
    - Have you had an attack of asthma in the past 12 months? OR
    - Are you currently taking any medicine for asthma?

- Work relatedness
  - Asthma onset after entering workplace
  - Symptoms related to work
  - Known exposures
  - Measuring personal exposure levels
  - FEV_1 or PEF shift change
  - FEV_1 or PEF change at work and away from work
  - Work related changes in BHR
  - Specific antigen challenge positive



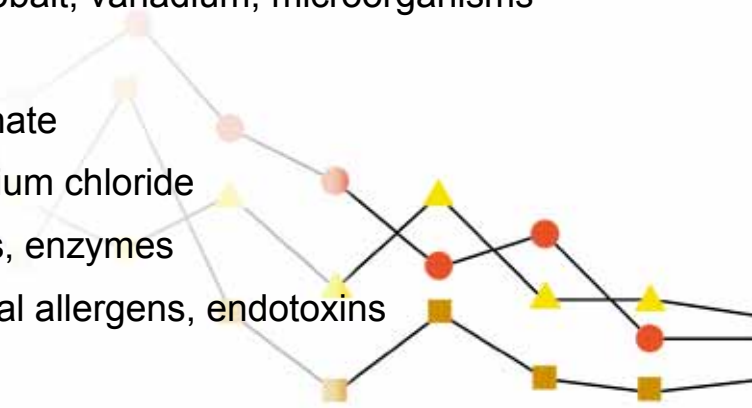
Other potential respiratory co-morbidities

- Chronic Obstructive Pulmonary Disease (COPD)
  - Chronic bronchitis
  - Fixed airflow obstruction
- Chronic restrictive airway disease
  - Fibrosis, hypersensitivity pneumonitis
- Mucous Membrane Irritations (MMI)
- Organic dust toxic syndrome (ODTS)
  - Airway symptoms
  - Fever
  - Airway obstruction
- Diagnosis is often not clear due to partially overlapping conditions and/or similar symptoms (e.g. Non-allergic asthma and COPD)



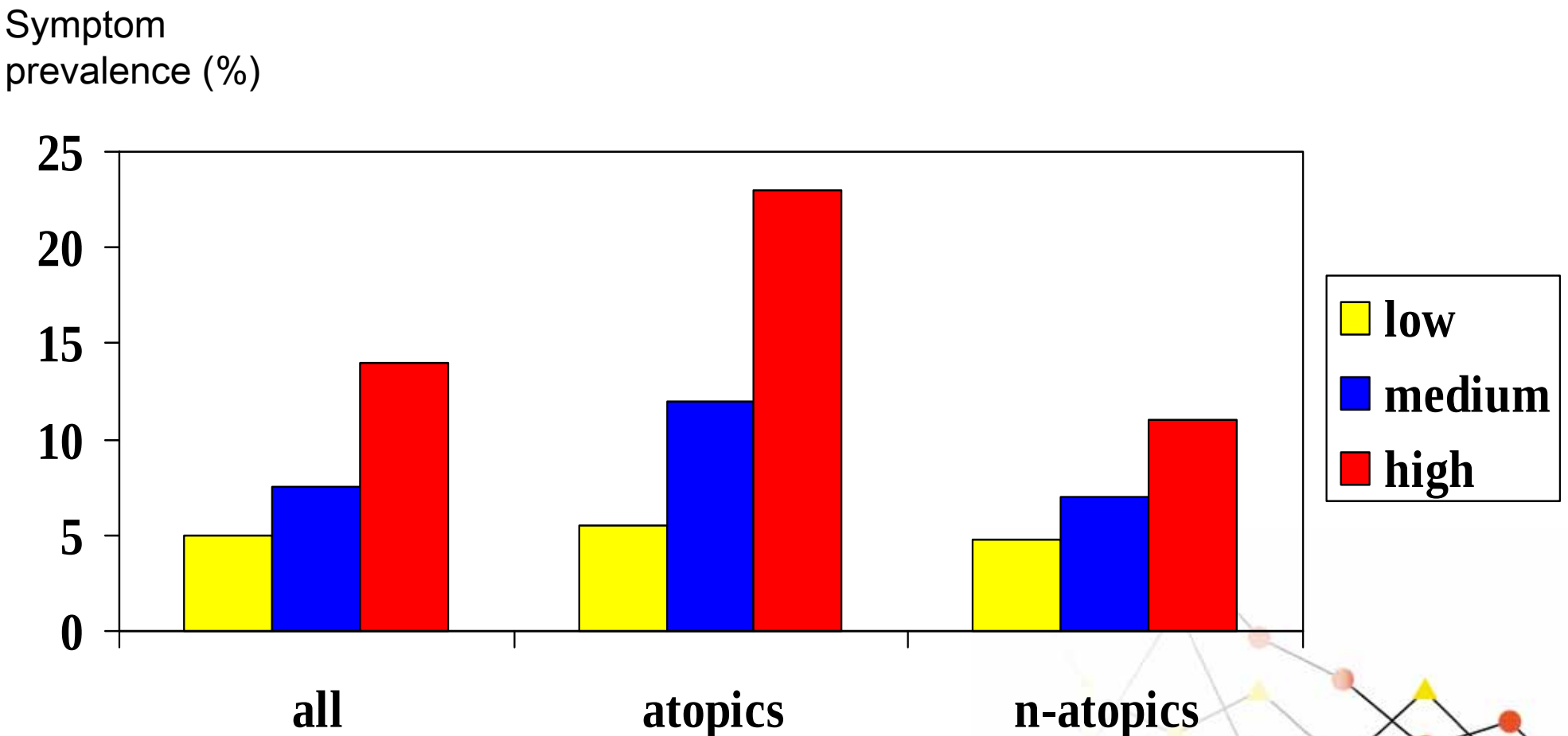
Occupational Asthma

High-risk occupations	Exposures (>250 known asthmagens)
Laboratory workers	Laboratory animals (animal urine & allergens)
Bakers	Flour dust, enzymes
Chemical processing workers	Enzymes, dyes
Rubber & plastics workers	Isocyanates, phthalic anhydride
Electronic assembly workers	Soldering, resins, welding fumes
Printers	Vegetable gum
Nurses	Formaldehyde, enzymes, latex, glutaraldehyde
Spray painters	Isocyanates, solvents
Sawmill workers, woodworkers	Wood dust, Western red cedar dust, pine, acids, glues
Metal treatment workers	Platinum salts, nickel, chromium, cobalt, vanadium, microorganisms
Food processors	Grain dust, flour dust
Hairdressers	Ammonia, dyes, enzymes, persulphate
Cleaners	Ammonia, solvents, benzyl ammonium chloride
Textile workers	Textile dust, solvents, reactive dyes, enzymes
Farmers	Grain dust, biologic enzymes, animal allergens, endotoxins

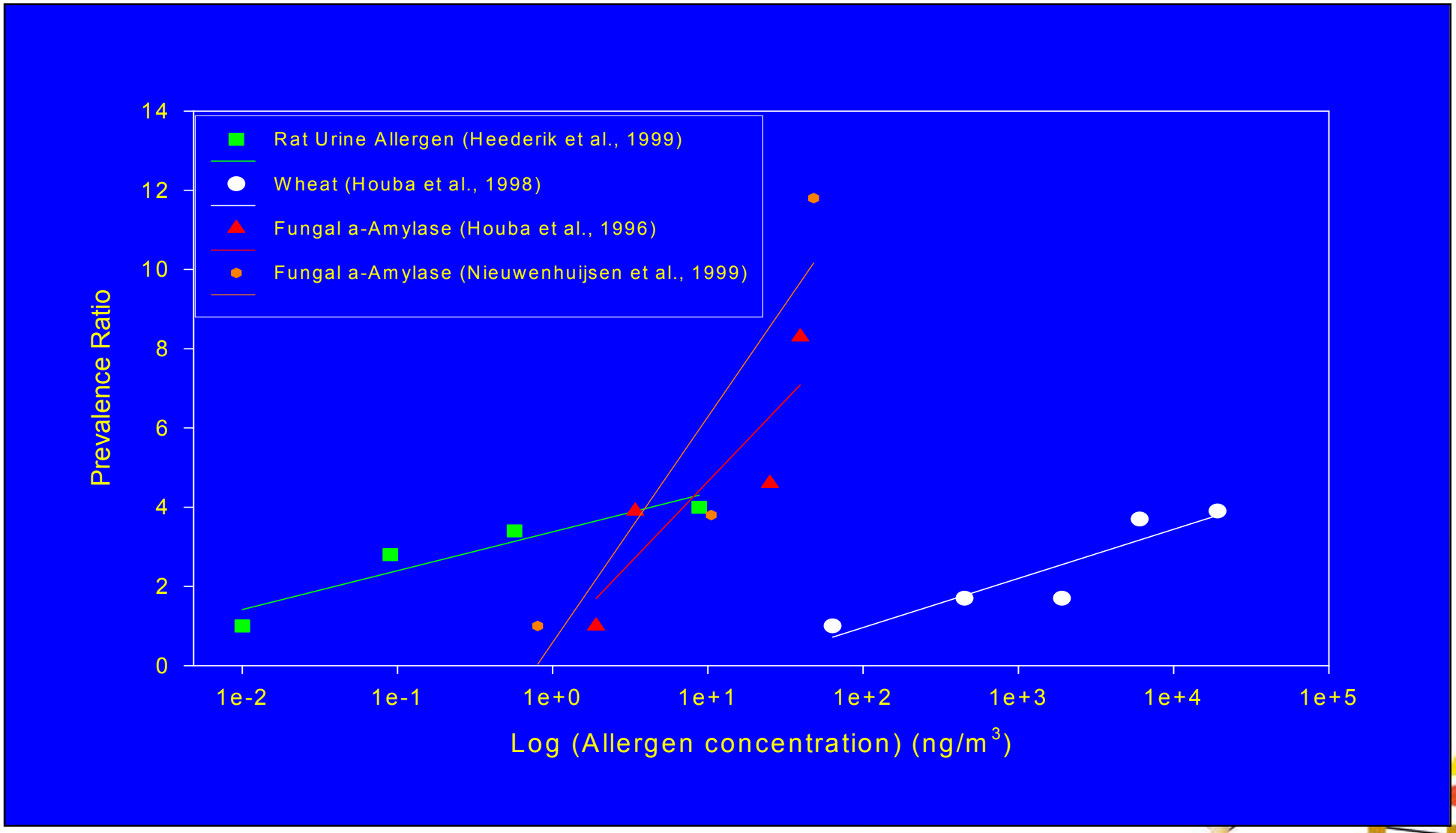


Exposure response relationships: wheat allergen exposure in bakers

(Houba et al., Am J Resp Crit Care Med 1998)



Exposure response relationships for rat urinary proteins, fungal α-amylase and wheat allergens (Heederik et al., 1999)



New and emerging “high risk” industries

- Waste recycling industry
  - Waste sorting
  - Composting
- Biotechnology industry
  - e.g. production and use of highly purified enzymes for the food/detergent industry
  - Production of Bio-proteins used in animal feeds
- Biopesticide industry
  - moths, spiders, microorganisms, etc
- Cleaning industry

Surveillance systems such as SWORD in the UK play an important role in the identification of high risk occupations

Table 5 Agents reported by chest physicians in occupational asthma, 1992–2001

Agent	1992–95		1996–2001		1992–2001	
	Estimated total reports	Annual average (%)	Estimated total reports	Annual average (%)	Estimated total reports	Annual average (%)
Organic						
Flour/grain	251	63 (9)	293	49 (9)	544	54 (9)
Wood dusts	124	31 (4)	213	36 (6)	337	34 (6)
Solder/colophony	124	31 (4)	126	21 (4)	250	25 (4)
Lab animals	88	22 (3)	77	13 (2)	165	17 (3)
Other animals	44	11 (2)	98	16 (3)	142	14 (2)
Latex	21	5 (1)	110	18 (3)	131	13 (2)
Enzymes	33	8 (1)	63	11 (2)	96	10 (2)
Vegetable dusts	33	8 (1)	51	9 (2)	84	8 (1)
Fish/crustaceans	18	5 (1)	51	9 (2)	69	7 (1)
Other organic substances	178	45 (6)	148	25 (4)	326	33 (5)
Subtotal	914	229 (33)	1230	205 (37)	2144	214 (35)
Chemical						
Isocyanates	400	100 (14)	443	74 (13)	843	84 (14)
Glutaraldehyde	123	31 (4)	90	15 (3)	213	21 (3)
Irritant gases	68	17 (2)	75	13 (2)	143	14 (2)
Pharmaceuticals	51	13 (2)	37	6 (1)	88	9 (1)
Formaldehyde	30	8 (1)	34	6 (1)	64	6 (1)
Other specified chemicals	304	76 (11)	325	54 (10)	629	63 (10)
Subtotal	976	244 (35)	1004	167 (30)	1980	198 (32)
Metallic						
Metals/metallic compounds	128	32 (5)	146	24 (4)	274	27 (4)
Welding fume, incl steel	87	22 (3)	93	16 (3)	180	18 (3)
Subtotal	215	54 (8)	239	40 (7)	454	45 (7)
Miscellaneous						
Epoxy/other resins	119	30 (4)	86	14 (3)	205	21 (3)
Cutting oils/coolants	75	19 (3)	50	8 (1)	125	13 (2)
Paints	65	16 (2)	41	7 (1)	106	11 (2)
Glues	74	19 (3)	29	5 (1)	103	10 (2)
Cleaning products	30	8 (1)	58	10 (2)	88	9 (1)
Acrylics	27	7 (1)	39	7 (1)	66	7 (1)
Inks	27	7 (1)	32	5 (1)	59	6 (1)
Other specified agents	107	27 (4)	189	32 (6)	296	30 (5)
Subtotal	4	131 (19)	524	87 (16)	1048	105 (17)
Unknown/unspecified	182	46 (7)	356	59 (11)	538	54 (9)
Total	2811	703 (100)	3353	559 (100)	6164	616 (100)

McDonald et al., 2005

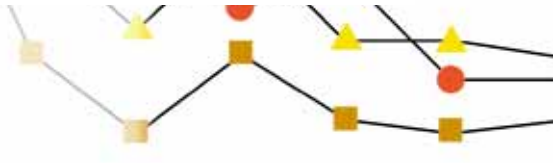
- Surveillance of Work-related and Occupational Respiratory Disease project (SWORD)
- 476 respiratory physicians
  - 20 core reporters who report every month
  - Sample reporters reporting for one month each year

Asthma represents ~25-30% of all chest referrals in the UK SWORD 1992-1999

Table 3. Distribution of new cases of respiratory disease reported by chest physicians to SWORD, 1992–1999

Diagnosis	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Occupational asthma								
Cases	312	257	279	284	229	274	204	259
%	26	23	28	29	26	27	22	25
Mesothelioma								
Cases	146	178	172	126	136	203	190	213
%	12	16	17	13	15	20	21	20
Benign pleural disease								
Cases	337	355	300	317	312	331	306	371
%	28	31	30	32	35	32	34	35
Other diagnoses								
Cases	424	350	248	267	221	214	208	203
%	35	31	25	27	25	21	23	19
All reports[a]	1219	1140	999	994	898	1022	909	1046

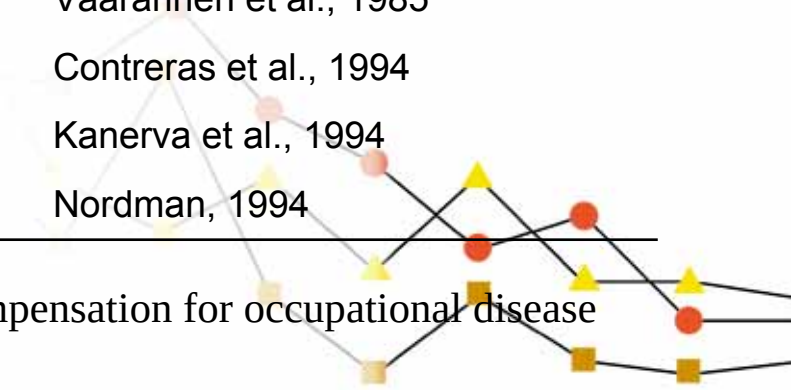
[a]Core and sample cases combined.



Occupational asthma incidence

Country	Incidence (per 100,000)	Reference
UK	2.0	Meredith, 1993
USA (Michigan)	2.9	Rosenmann et al., 1997
UK (West Midlands)	3.0	Gannon et al. 1991
Finland	3.6*	Keskinen et al., 1978
UK	3.7	Meredith et al., 1996
Germany	4.2*	Baur et al., 1998
UK (West Midlands)	4.3	Gannon et al., 1993
Canada (Quebec)	6.3	Provencher et al. 1997
Sweden	8.1*	Toren, 1996
Finland	8.1*	Vaarannen et al., 1985
Canada (British Columbia)	9.2	Contreras et al., 1994
Finland	15.0*	Kanerva et al., 1994
Finland	15.2*	Nordman, 1994

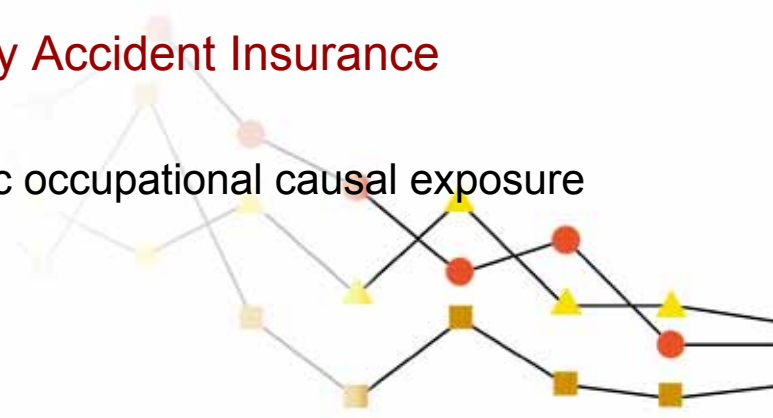
* Incidence rates are calculated based on registries for the purpose of compensation for occupational disease



Asthma registration in Finland

- In Finland asthma is classified as a chronic disease for which the cost of medication can be reimbursed at a higher than ordinary level (Social Insurance Institution).
- Criteria to receive reimbursement
  - Medical history of asthma AND
  - At least one of the following criteria:
    - A variation of ≥ 20% in diurnal PEF recording
    - An increase of ≥ 15% in PEF or FEV1 with ß2-agonist
    - A decrease of ≥ 15% in PEF or FEV1
  - AND a continuing regular use of asthma medication that has lasted for 6 months at the time of decision

- Occupational asthma is compensated by the Statutory Accident Insurance
  - Diagnosis of asthma made by pulmonary specialist
  - Evidence provided by pulmonary specialist of a specific occupational causal exposure



Occupational asthma incidence in wood workers and blue-collar workers in Finland (Heikkila et al., 2008)

Table 4. Estimated work-related asthma cases and reported occupational asthma cases among the workers in the 10 wood industry sectors in the Finnish Register on Occupational Diseases in 1986–1998.

Industrial sectors [a]	Cases (N)	Estimated work-related cases [b] (N)	Finnish Register on Occupational Diseases	
			Cases (N)	Coded causative agent
Forestry, logging and related services (02.0)	328	99	1	Animal epithelium
Sawmilling and planing of wood and impregnation of wood (20.1)	228	107	18	Spruce; wood not specified
Manufacture of wooden and fiber boards (20.2)	131	52	39	Isocyanates; formaldehyde; molds; pine; spruce; birch; glues
Manufacture of builders carpentry and joinery (20.3)	148	58	28	Isocyanates; formaldehyde; pine; obeche; wood not specified
Manufacture of wooden containers (20.4)	12	6	–	
Manufacture of other products of wood (20.5)	18	4	9	Formaldehyde; pine; obeche; wood not specified
Building and repairing of ships and boats (35.1)	22	–	1	Teak
Manufacture of furniture (36.1)	91	4	13	Formaldehyde; spruce; beech
Building of complete constructions (45.2)	474	123	10	Isocyanates; paints; pine; obeche
Building completion (45.4)	23	10	1	Epoxy paints; obeche
Woodworkers	1 475	468	119	.
Other blue-collar workers	2 599	745	98	.

[a] Code of the economic activity (see the Classification of Occupation of the Persons and the Economic Actvitiy of their Employers) in parentheses.
[b] The estimated cases have been calculated on the basis of the work-related attributable fractions and the numbers of cases in table 3.

How much adult-onset asthma is work related? (Karjalainen et al., 2001)

- In Finland all individuals with clinically well-established asthma are registered for reimbursement of medication
- Follow-up study of the entire employed population of Finland in 1986-1998
- Population census data was used to assess occupation
- 49,575 incident cases (25-59 yr)
- Relative risks were estimated in comparison to those employed in administrative work.
- The attributable fraction of adult-onset asthma due to occupation was 29% (95% CL 25-33%) for men and 17% (95% CI 15-19%) for women

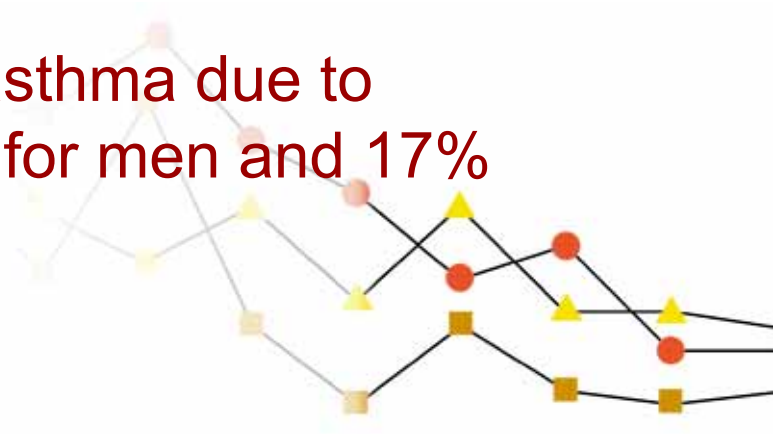
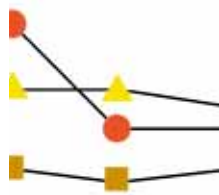


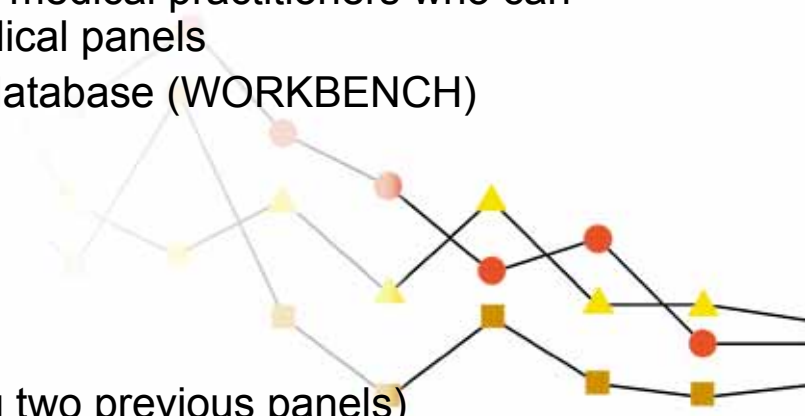
TABLE 2. EMPLOYED FINNISH POPULATION UNDER FOLLOW-UP IN 1986–1998, NUMBER OF INCIDENT CASES (N), AND AGE-ADJUSTED RELATIVE RISK (RR) OF ASTHMA*

		Men			Women		
		Population	N	RR (95%CI)	Population	N	RR (95%CI)
1	**Administrative, managerial, and clerical work**	**79,087**	**1,275**	**1.00 ref.**	**202,751**	**5,235**	**1.00 ref.**
0	**Technical, physical science, social science, humanistic, and artistic work**	**214,450**	**3,369**	**1.05 (0.98–1.12)**	**262,063**	**7,024**	**1.06 (1.03–1.10)**
03	Medical and nursing work	13,199	224	1.18 (1.03–1.36)	86,894	2 435	1.11 (1.06–1.17)
06	Religious work	2,834	61	1.37 (1.06–1.77)	2,888	97	1.30 (1.06–1.59)
2	**Sales work**	**66,541**	**1,106**	**1.14 (1.05–1.23)**	**79,116**	**2,429**	**1.13 (1.08–1.18)**
20	Wholesale and retail dealers	11,636	223	1.17 (1.02–1.35)	9,878	363	1.31 (1.18–1.46)
23	Other sales work	35,093	548	1.12 (1.02–1.24)	61,722	1,894	1.12 (1.06–1.18)
3	**Agriculture, forestry, commercial fishing**	**97,052**	**3,670**	**2.12 (1.99–2.26)**	**58,617**	**3,279**	**1.84 (1.76–1.92)**
30	Farmers and managerial work in agriculture, forestry, and horticulture	71,227	2,972	2.25 (2.11–2.41)	35,471	1,964	1.89 (1.79–1.99)
31	Agricultural and horticultural work, animal husbandry	9,670	324	2.12 (1.88–2.40)	22,623	1,298	1.81 (1.70–1.92)
4	**Mining and quarrying work, etc.**	**3,028**	**93**	**1.95 (1.58–2.40)**	**69**	**2**	**1.01 (0.25–4.02)**
5	**Transport and communications work**	**94,398**	**1,938**	**1.31 (1.22–1.40)**	**23,331**	**796**	**1.22 (1.13–1.31)**
54	Road transport work	61,837	1,321	1.35 (1.25–1.46)	2,452	89	1.34 (1.08–1.65)
55	Transport service work	5,837	134	1.47 (1.23–1.75)	998	38	1.49 (1.08–2.05)
58	Postal services and couriers	10,532	192	1.27 (1.09–1.47)	7,156	277	1.37 (1.21–1.54)
6/7	**Manufacturing and related work**	**334,935**	**7,836**	**1.56 (1.47–1.65)**	**88,555**	**3,270**	**1.33 (1.27–1.39)**
60	Textile work	1,607	38	1.49 (1.08–2.06)	4,433	176	1.34 (1.15–1.56)
61	Cutting, sewing, and upholstering work, etc.	1,844	42	1.44 (1.06–1.95)	18,849	567	1.09 (1.00–1.19)
63	Smelting, metallurgical, and foundry work	6,451	171	1.70 (1.45–2.00)	638	30	1.63 (1.14–2.33)
65	Iron and metalware work	99,540	2,295	1.58 (1.48–1.70)	5,850	207	1.26 (1.10–1.45)
66	Electrical work	39,017	690	1.26 (1.14–1.38)	6,974	223	1.28 (1.12–1.46)
67	Woodwork	43,847	1,109	1.62 (1.49–1.75)	4,570	206	1.57 (1.37–1.81)
68	Painting and lacquering work	10,609	324	1.92 (1.70–2.17)	843	34	1.45 (1.03–2.02)
69	Other construction work	26,502	713	1.69 (1.54–1.85)	909	42	1.58 (1.17–2.14)
72	Food and beverage work	7,689	273	2.47 (2.17–2.82)	9,291	476	1.80 (1.64–1.98)
73	Chemical processing and related work	13,767	283	1.36 (1.19–1.55)	2,768	111	1.43 (1.18–1.72)
75	Other manufacturing work	10,283	230	1.54 (1.34–1.77)	6,211	238	1.36 (1.20–1.55)
76	Packing and wrapping work	2,691	73	1.74 (1.38–2.21)	7,427	271	1.24 (1.09–1.40)
77	Stationary engine and machine work	34,053	827	1.53 (1.41–1.67)	2,209	99	1.58 (1.30–1.93)
78	Dock and warehouse work	16,546	380	1.54 (1.37–1.73)	4,627	201	1.55 (1.35–1.79)
79	Other manual work	4,834	127	1.62 (1.35–1.95)	821	42	1.80 (1.33–2.43)
8	**Service work**	**51,982**	**1,177**	**1.53 (1.42–1.66)**	**169,193**	**6,475**	**1.41 (1.35–1.46)**
80	Watchmen and security guards	20,593	451	1.48 (1.33–1.64)	1,524	72	1.91 (1.51–2.41)
81	Housekeeping and domestic work	4,476	83	1.61 (1.29–2.01)	72,448	2,442	1.28 (1.22–1.34)
83	Building caretaking and cleaning	17,730	465	1.61 (1.45–1.79)	58,771	2,611	1.51 (1.44–1.58)
84	Hygiene and beauty treatment work	423	11	2.02 (1.12–3.67)	12,085	465	1.54 (1.40–1.69)
85	Laundering, dry cleaning, and pressing work	370	16	2.85 (1.74–4.67)	2,666	98	1.24 (1.02–1.52)
9	**Military work**	**9,243**	**112**	**0.95 (0.78–1.15)**	**121**	**2**	**0.82 (0.21–3.28)**
	Unknown	**9,781**	**201**	**1.36 (1.17–1.58)**	**8,535**	**286**	**1.27 (1.13–1.43)**
	All	**960,497**	**20,777**		**892,351**	**28,798**	



The New Zealand situation

- The Notifiable Occupational Disease System (NODS)
  - NODS was established in March 1992
  - Voluntary system whereby occupational physician specialists, general practitioners, occupational health nurses, health professionals and individuals can notify a health-related condition suspected to have arisen from work
  - Four stages:
    - Notification of a possible work-related condition
    - Assessment and/or investigation of the individual worker, their work and their workplace by the Department of labour
    - Verification of the notification by departmental medical practitioners who can request further assistance from specialist medical panels
    - Entry of the confirmed cases on the national database (WORKBENCH)
  - 1992-1998
    - Occupational asthma panel
    - Asbestos-related disease panel
  - From 1998
    - Diseases affecting the lungs panel (combining two previous panels)

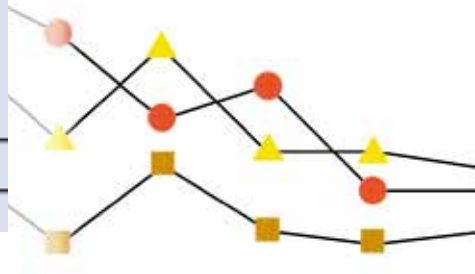


NODS 1992-1998

Table 1: Notifications received March 1992 to June 1998

Disease category	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	Total
Asbestos-related disease	383	103	132	67	71	58	814
Occupational asthma	39	60	97	81	67	61	405
Other occupational respiratory disease	7	11	34	31	24	12	119
Occupational disease due to chemical exposure	71	89	115	94	91	82	542
Chronic solvent-induced neurotoxicity	38	98	63	72	42	54	367
Occupational cancer	1	1	3	2	4	5	16
Occupational illness due to infection	28	41	49	61	45	58	282
Occupational noise-induced hearing loss	103	216	575	612	597	353	2456
Occupational overuse syndrome/ osteoarthritis	25	263	760	828	826	426	3128
Occupational skin disease	11	43	91	106	36	24	311
Total	**706**	**925**	**1919**	**1954**	**1803**	**1133**	**8440**

Only 116 confirmed cases

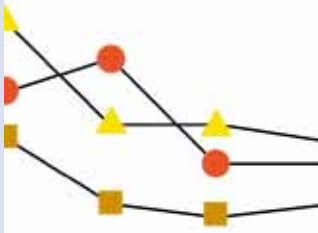


NODS 1992-1998

Confirmed cases mainly from “predictable industries”

Table 3: Occupational asthma: causative agents and occupations

Causative agent	*Cases*	*Occupations*
Organic materials	**23**	
Animal proteins	8	Poultry worker, confectionery process worker, seafood processor
Cereal dusts	6	Bakers
Wood dusts	8	Boat builders, carpenters, joiners, manager
irritant dusts	1	Fertiliser manufacturer
Chemicals	**45**	
Aldehydes	6	Boat builder, radiographers, medical technician, medical manager.
Epoxy resins	5	Painter, metal finisher, process worker, boatbuilder.
Isocyanates	27	Spray painters, painters, process workers, boatbuilders, carpenter, foundry worker, technicians, floor sander, furniture manufacturer
Chlorine-based cleaners	3	Dairy process workers
Organophosphate	1	Cleaner
Ozone	2	Moulding room assistant, office manager
Colophony	1	Baker
Metals	**29**	
Aluminium	21	Aluminium smelter workers
Welding fumes	8	Engineers, fitter welders, mechanic, metal fabrication
Miscellaneous	**18**	
Acrylates	1	Lab technician
Colophony containing solders	4	Electrical process workers
Dibutyl phthalate	1	Printer
PVC, polypropylene, fume	3	Factory manager, baker
Detergent enzymes	1	Soap manufacturer
Polyurethane foam and fumes	2	Foam manufacturer, sheet metal worker.
Triglycidylisocyanurate	1	Powder coating process worker
Unrecognised	7	Dairy process technician, assembly process worker, spray painter, oven cleaners



NODS 1996-1999

Walls et al., NZ Med J 2000

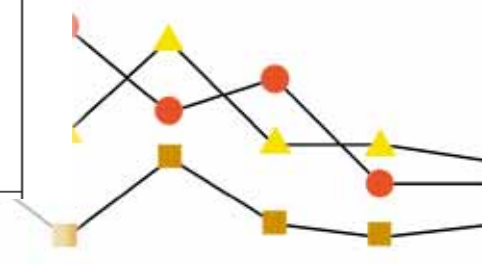
- "….NODS offers sentinel data from interested practitioners and workplaces. Occupational asthma and other occupational respiratory diseases remain poorly notified to this system. NODS confirms the presence of occupational asthma in New Zealand from predictable and preventable causes not dissimilar to other countries. This data collection system needs supplementation by other mechanisms…."

NODS 2000-2005

Table 4: Notifications received by injury type July 2000 to June 2005

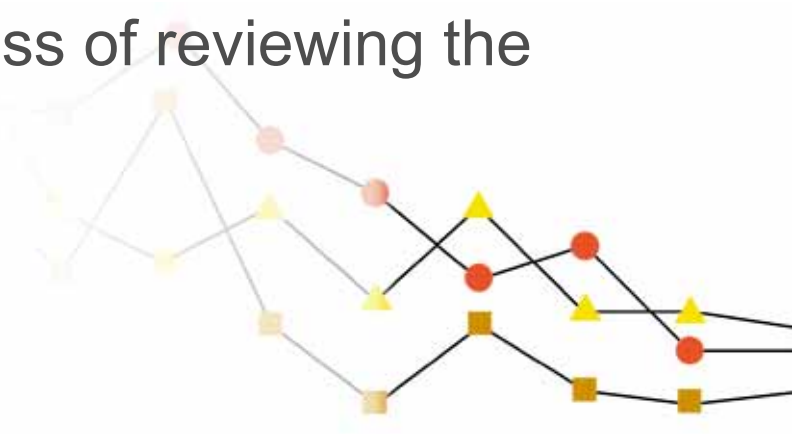
Injury type	Total	1/07/2000 to 30/6/2001	1/07/2001 to 30/6/2002	1/07/2002 to 30/6/2003	1/07/2003 to 30/6/2004	1/07/2004 to 30/6/2005
Occupationally-acquired noise-induced hearing loss	2581	441	521	860	475	284
Occupationally-caused cancer	833	29	205	120	254	225
Diseases affecting the lungs	462	109	101	100	72	80
Poisoning and toxic effects	264	70	58	63	40	33
Injury of the muscles, tendons or joints including back injury but not including bony fracture	251	81	60	66	20	24

Majority is asbestos related and only few are occupational asthma cases



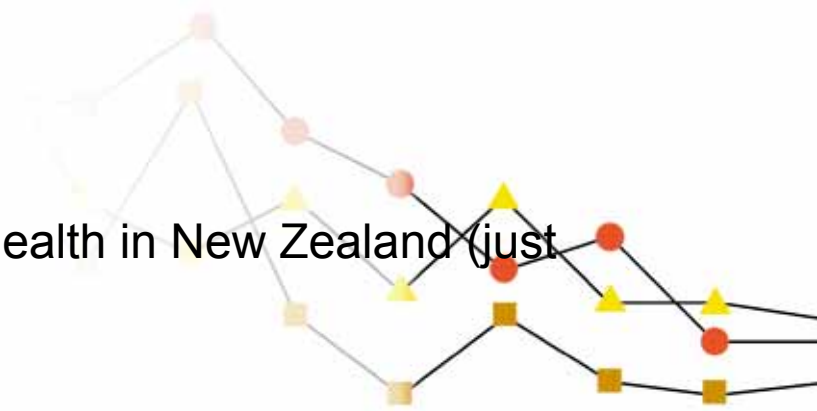
Current situation in New Zealand

- National Occupational Health and Safety Advisory Committee
  - "….notifications to the Respiratory Diseases Panel have declined in recent years, and staff turnover and vacancies at OSH are said to have resulted in the panel being poorly supported by head office. It is understood that few respiratory diseases, other than asbestos-related diseases, have been reported to the panel….."
  - "Coverage of respiratory diseases by the panel is currently very low"
- Dept of Labour is currently in the process of reviewing the panels

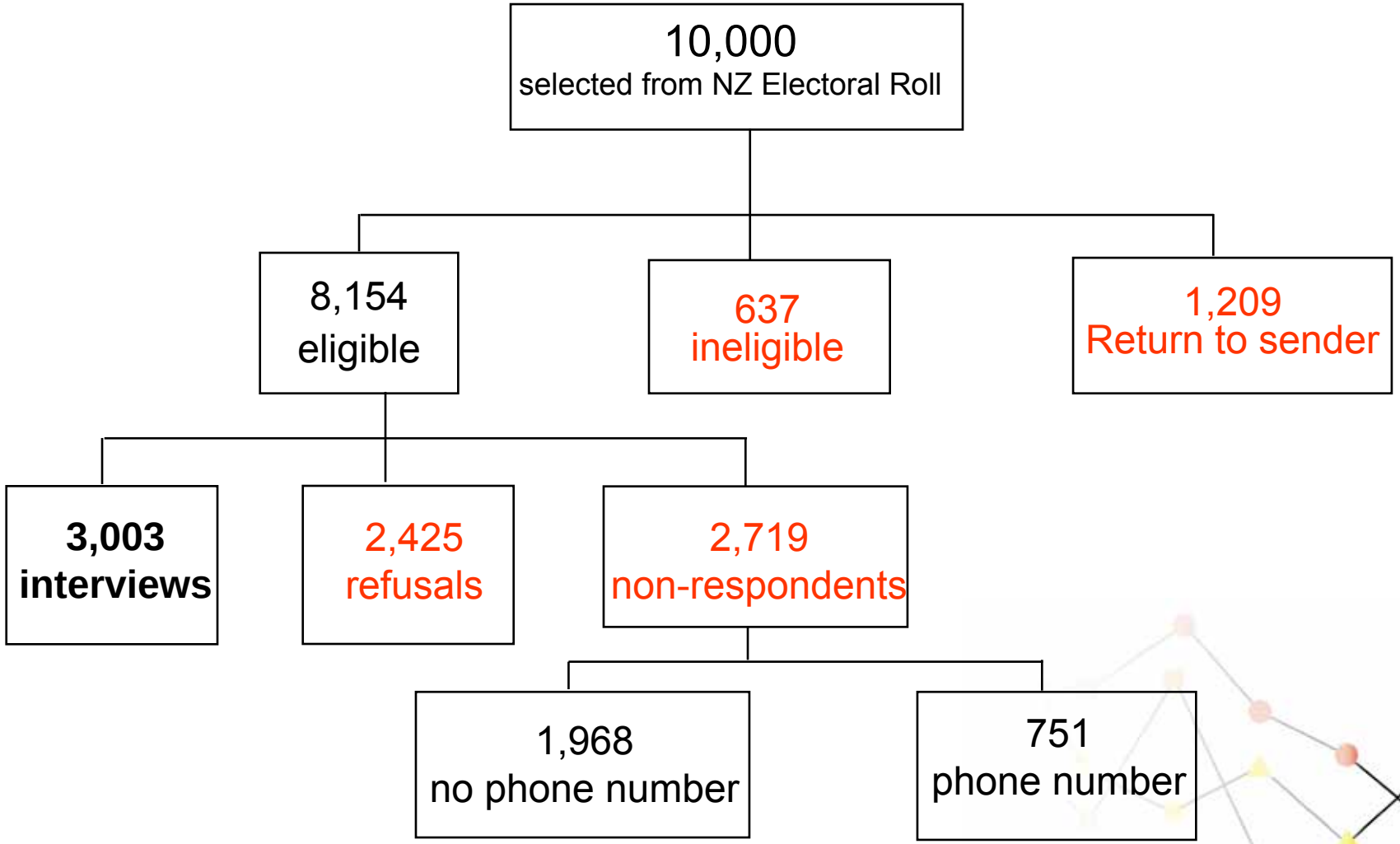


What other information is available?

- ACC
- Scientific research of occupational respiratory disease
  - Welders (Fishwick et al., 1997 & 2004; Bradshaw et al., 1998; Erkinjuntti-Pekkanen et al., 1999)
  - Farmers (Kimbell-Dunn et al., 1999 & 2001; Douwes et al., 2007)
  - Mussel openers (Glass et al., 1998)
  - Hairdressers (Slater et al., 2000)
  - Asbestos workers (Beasley et al., 1991; Armstrong et al., 2000)
  - Sawmill workers (Douwes et al., 2001 & 2007)
  - Plywood mill workers (Fransman et al., 2003)
  - Cleaners (currently conducted)
- General population studies
  - The current and future burden of occupational ill-health in New Zealand (just completed)



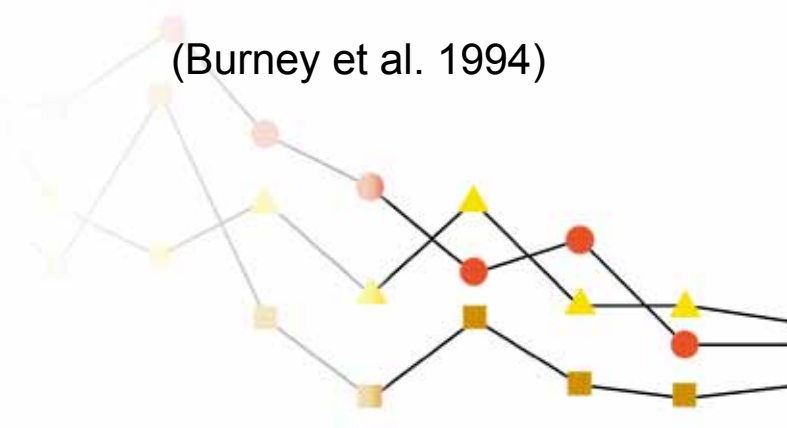
The current and future burden of occupational ill-health in New Zealand (PhD research Amanda Eng)



Current Asthma

- Have you been woken by an attack of shortness of breath at any time in the past 12 months?
- Have you had an attack of asthma in the past 12 months?
- Are you currently taking any medicine for asthma?

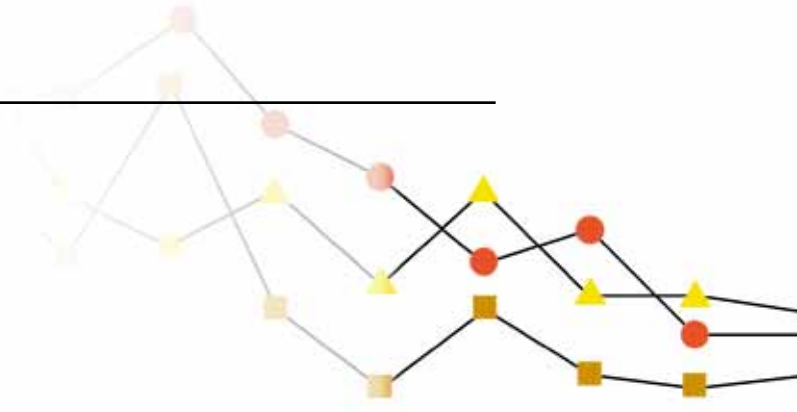
(Burney et al. 1994)



Results

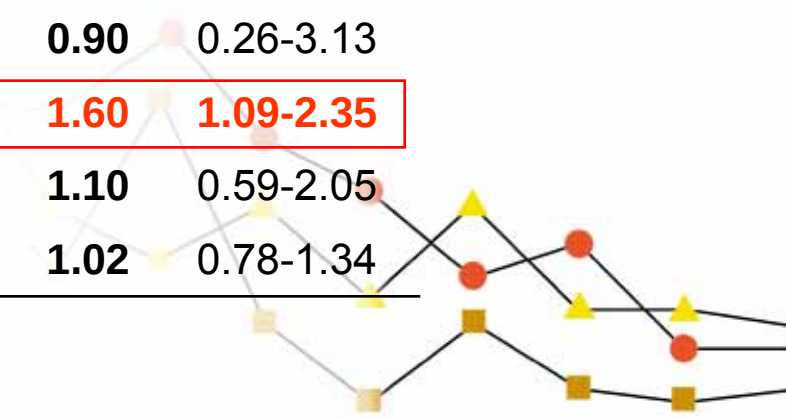
Asthma Symptoms	Male		Female		Total	
	N	**%**	**N**	**%**	**N**	**%**
Woken by an attack of SOB* in past 12mths	**139**	10.1	**142**	9.3	**281**	9.7
Asthma attack in past 12mths	**103**	7.5	**150**	9.9	**253**	8.7
Currently taking medicine for asthma	**105**	7.6	**170**	11.2	**275**	9.5
Current asthma	**220**	15.9	**276**	18.1	**496**	17.1
Ever asthma	**243**	17.6	**377**	24.8	**620**	21.4
First attack of asthma > 17 years	**83**	6.0	**183**	12.0	**266**	9.2

*SOB – Shortness of breath



A priori high-risk occupational groups

Occupation (ever)	No current asthma		Current asthma		OR	95% CI
	N	%	N	%		
Healthcare workers	153	6.4	26	5.2	0.81	0.53-1.26
Laboratory workers	27	1.1	7	1.4	1.20	0.52-2.77
Hairdressers	33	1.4	5	1.0	0.69	0.27-1.80
Woodworkers	139	5.8	32	6.5	1.21	0.80-1.83
Metal workers	107	4.5	22	4.4	1.04	0.64-1.68
Printers	24	1.0	11	2.2	2.26	1.09-4.66
Bakers & Grain millers	30	1.3	13	2.6	1.98	1.02-3.85
Rubber & plastics workers	16	0.7	3	0.6	0.90	0.26-3.13
Cleaners	113	4.7	39	7.9	1.60	1.09-2.35
Welders	57	2.4	13	2.6	1.10	0.59-2.05
Farmers	384	16.0	78	15.7	1.02	0.78-1.34



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Hairdressers	**33**	1.4	**5**	1.0	**0.69**	0.27-1.80
Woodworkers	**139**	5.8	**32**	6.5	**1.21**	0.80-1.83
7112 Carpenters & Joiners	105	4.4	22	4.4	1.09	0.67-1.76
71121 Carpenter/Joiner	40	1.7	12	2.4	**1.61**	0.83-3.13
71122 Builder	70	2.9	15	3.0	1.13	0.63-2.00
74211 Cabinetmaker	14	0.6	4	0.8	**1.53**	0.50-4.70
91513 Sawmill labourer	8	0.3	5	1.0	**3.26**	1.05-10.16
Metal workers	**107**	4.5	**22**	4.4	**1.04**	0.64-1.68
Printers	**24**	1.0	**11**	2.2	**2.26**	1.09-4.66
Bakers & Grain millers	**30**	1.3	**13**	2.6	**1.98**	1.02-3.85
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Metal workers	**107**	4.5	**22**	4.4	**1.04**	0.64-1.68
721 Metal moulders, sheet-metal workers	56	2.3	8	1.6	0.70	0.33-1.49
722 Blacksmiths, toolmakers	33	1.4	4	0.8	0.64	0.22-1.82
812 Metal processing plant operators	24	1.0	12	2.4	**2.48**	**1.22-5.05**
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74121 Baker	19	0.8	5	1.0	1.27	0.47-3.42
82742 Baker's assistant	10	0.4	6	1.2	**2.50**	**0.90-6.97**
Rubber & plastics workers	**16**	0.7	**3**	0.6	**0.90**	0.26-3.13
Cleaners	**113**	4.7	**39**	7.9	**1.60**	**1.09-2.35**
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Conclusions

- Confirmed a priori findings for:
  - Printers
  - Bakers
  - Cleaners
  - Metal processing plant operators
  - Sawmill workers
- Increased risk also found for:
  - Teachers
  - Sales representatives
  - Food processors
  - Elementary occupations including labourers