Occupational cancer and use of Cancer Registries

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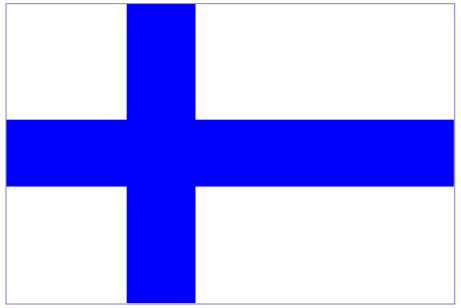
Finland



- Northernmost population of the world (5.6 million)
- 0.6 million lakes
  - 0.3 lakes per family
- 1.3 saunas per family
- Best schools
- Least corrupted
- Happiest people
- Cleanest air (WHO)
- Paradise of epidemiology

Traditional cohort studies on occupational cancer

- Quite laborious and slow
- Often low power

- Example: Cancer in airline cabin crew
  - Finland
  - Four Nordic countries

Pukkala E, Auvinen A, Wahlberg G. **Cancer incidence among Finnish airline cabin crew, 1967-92.** BMJ 1995; 311: 649-52.

Melatonin??

- 20 breast cancer cases
- SIR 1.9 (1.2-2.5)
- Cannot be explained by radiation or reproductive factors

Pukkala & al: **Cancer incidence among Nordic airline cabin crew.** Int J Cancer 2012;131:2886-97.

- 197 breast cancers
- SIR 1.6 (1.4-1.8), lag 20+ years

Why??

Data on occupation from Cancer Registry?

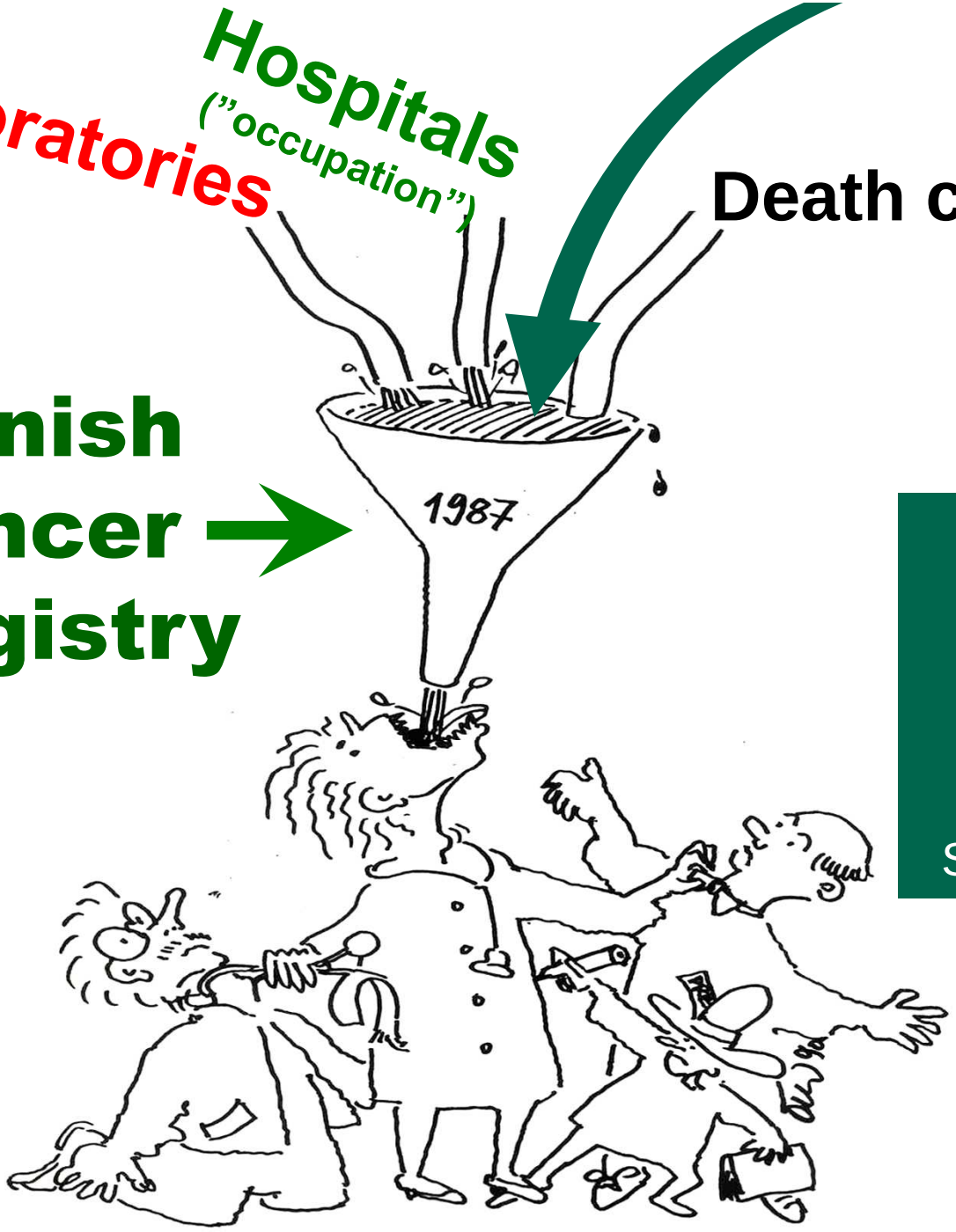
- Data from hospital notifications: low quality
- Data from census records: high quality, occupational histories
  - Routinely linked to Cancer Registry data only in Finland
- In other Nordic countries we need to create separate research data set to combine occupational histories and cancer data
  - **NOCCA study**

Laboratories

Hospitals
("occupation")

Death certificates

Finnish
Cancer
Registry



Statistics
Finland

Education

Occupation

Socio-economic status

Traditional cohort studies on occupational cancer

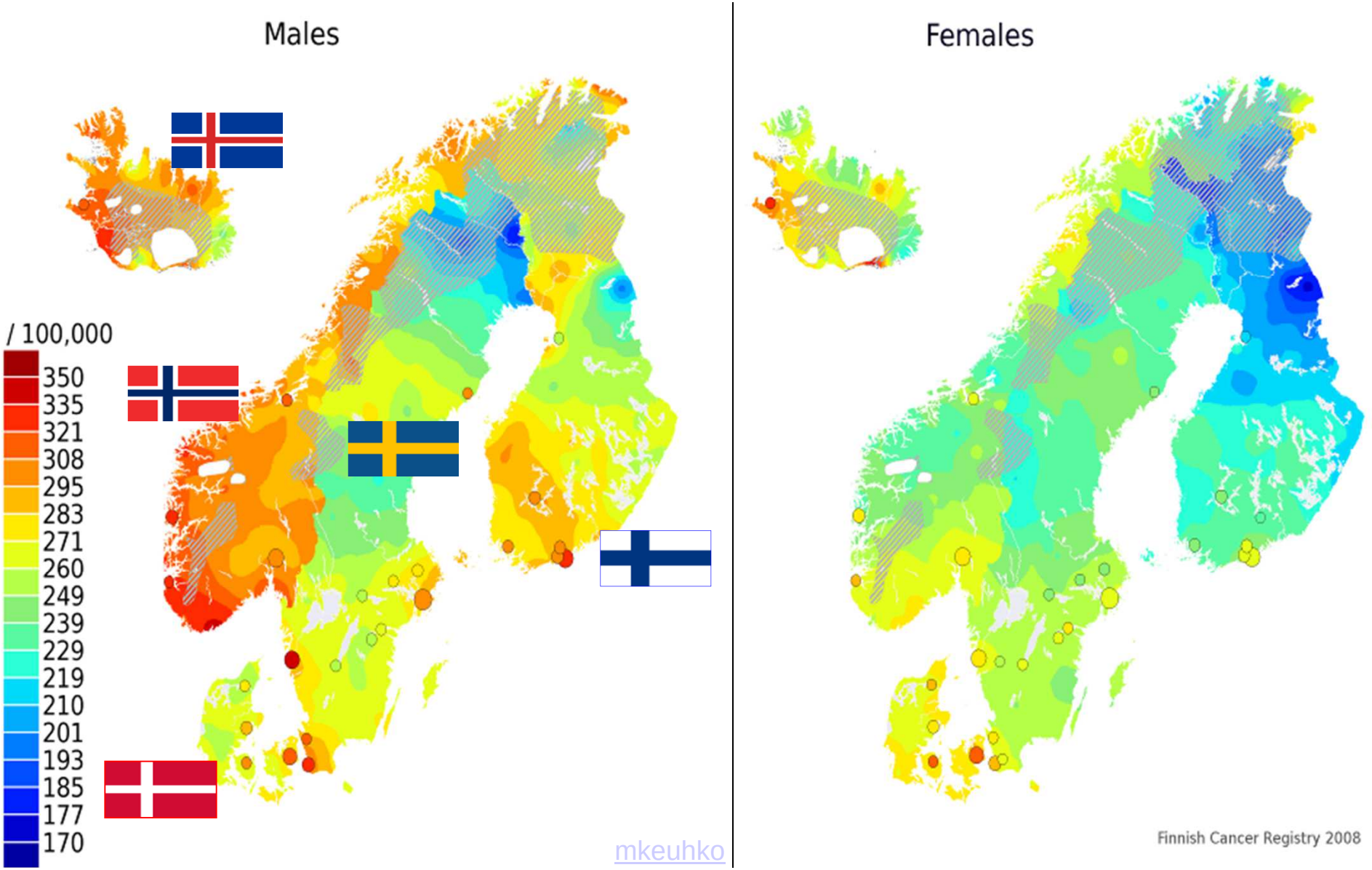
- Quite laborious and slow
- Often low power

- Example: Cancer in airline cabin crew
  - Finland
  - Four Nordic countries

Nordic Occupational Cancer (NOCCA) Study Group

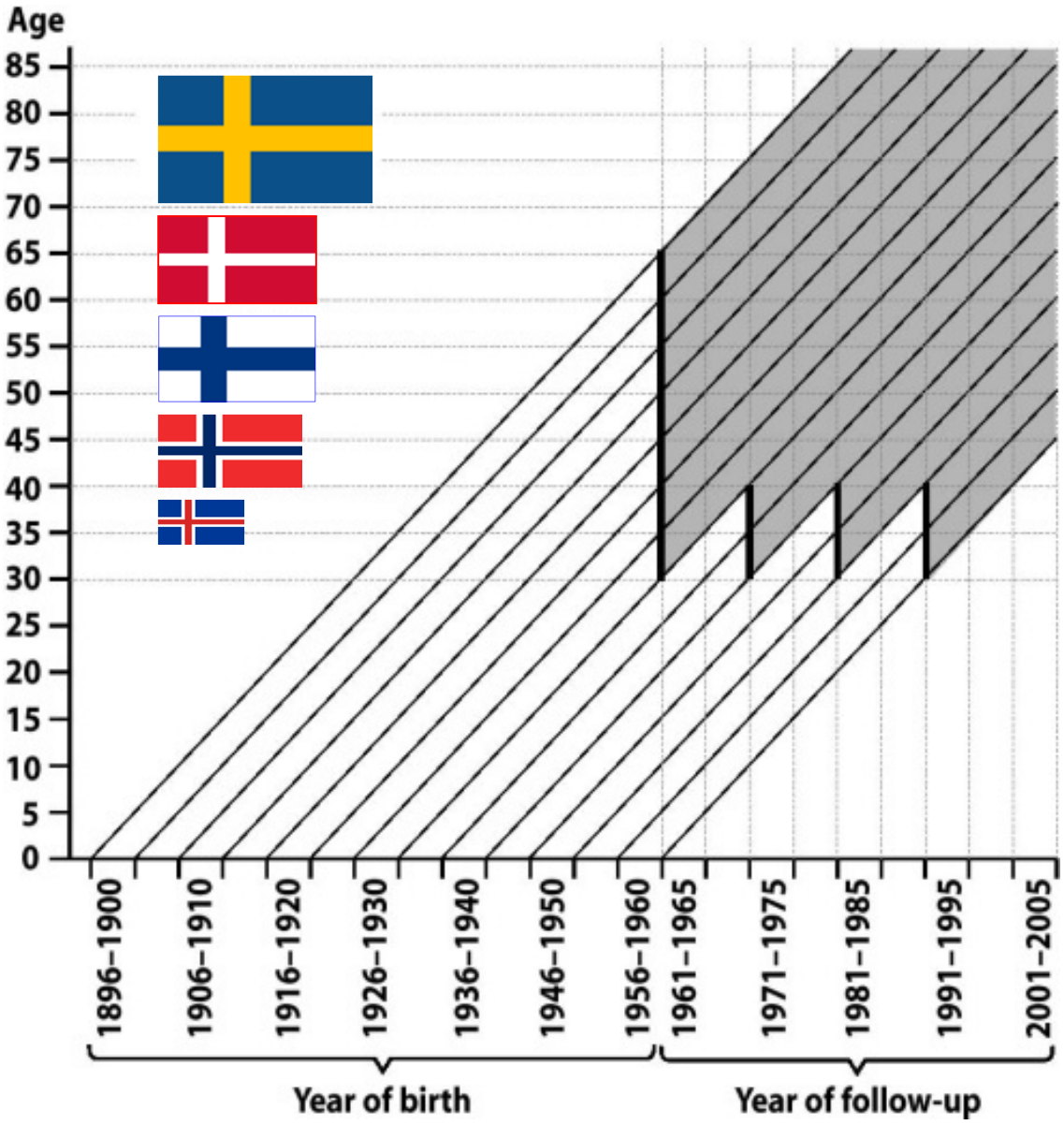
Nordic countries

Cancer incidence 1998-2003, all sites (WSR)



Study population, follow-up

- ✓ Cohort of all persons born 1896-1960 (15 million persons)
- ✓ Histories of occupational titles from censuses 1960+
- ✓Beginning of follow-up: first available census (ages 30+)
- ✓Follow-up for cancer incidence up to death, emigration or 31 Dec 2005
- ✓ Almost 3 million invasive cancer cases from **Cancer Registries**



Acta Oncologica, 2009; 48: 646–790

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ORIGINAL ARTICLE

Occupation and can
countries

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KOLBRUN GUNN
ELISABETE WEID

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Norway, [4]*University of Cop* ik,
Iceland, [6]*Karolinska Institu* alsan,
Helsinki, Finland and [9]*Uni*

Cancer risk estimates (SIR) **for any cancer and any occupation:**
http://astra.cancer.fi/NOCCA/

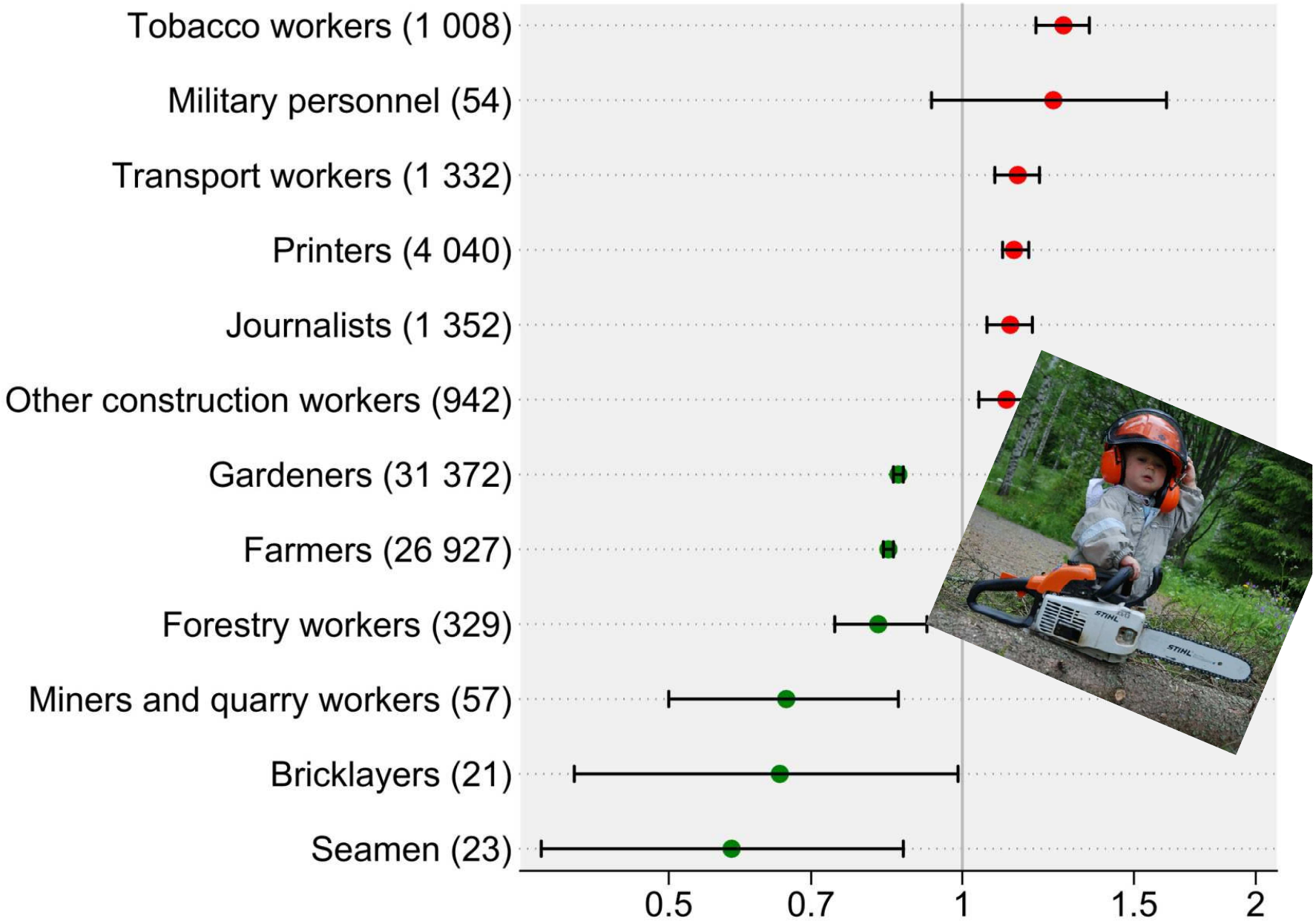
Occupational categories
- 53 major occupations
- economically inactive persons

Cancer categories
- 48 primary sites
- 27 histological/anatomical subgroups

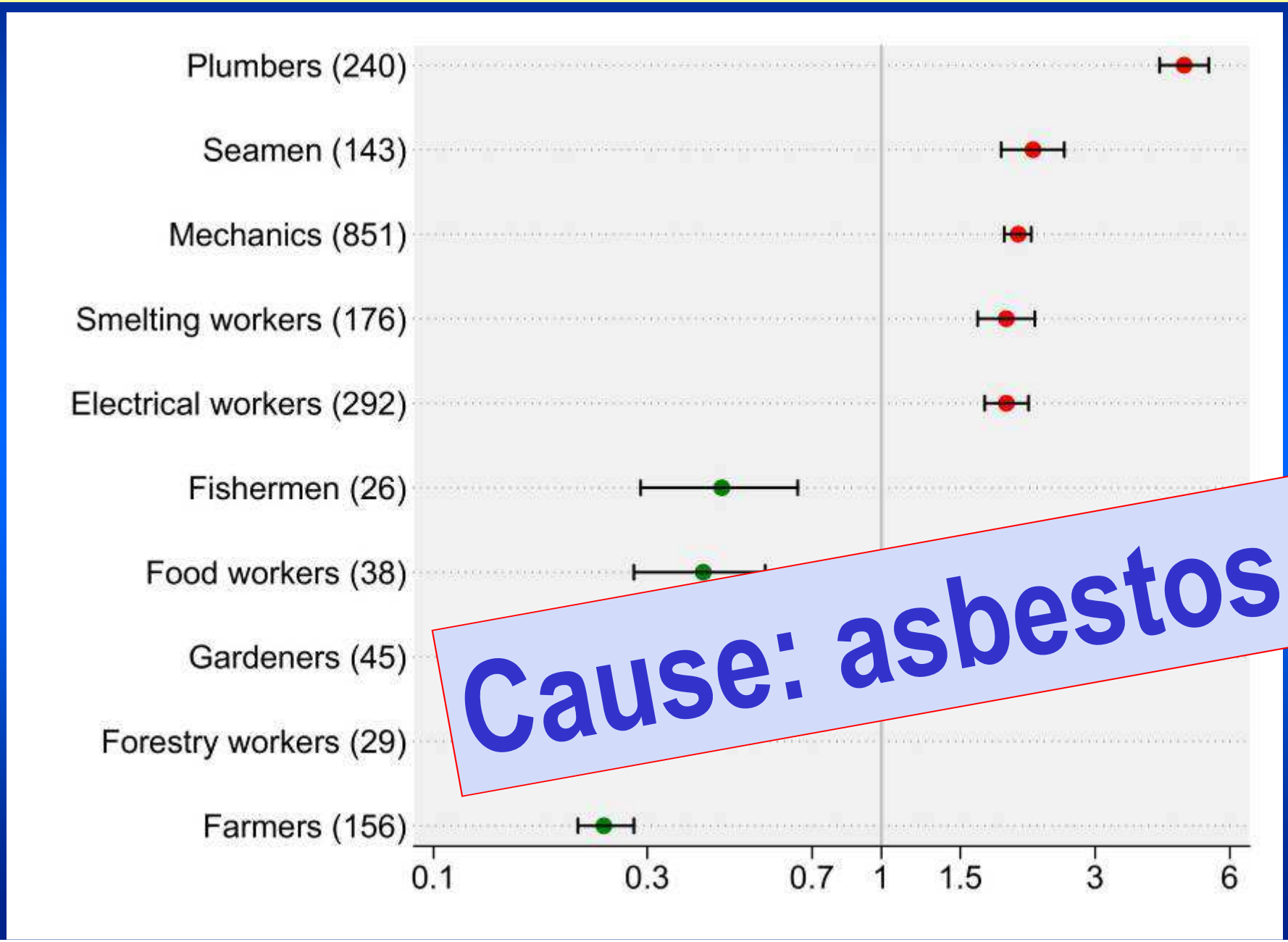
Table 141: 999. All malignant neoplasms. Women. (N=1358135). Observed number (Obs) of cancers and standardized incidence ratio (SIR), 1960-2005, by country and occupational group (95% CI= 95% confidence interval)

		Denmark		Finland		Iceland		Norway		Sweden		Total		
No	Occupational group	Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	95% CI
40	Tobacco workers	624	**1.33**	94	1.10	–	–	139	**1.25**	151	1.14	1008	**1.26**	1.19–1.34
52	Military personnel	16	1.71	20	1.37	–	–	5	0.99	13	0.90	54	1.24	0.93–1.62
22	Transport workers	16	1.08	673	**1.17**	17	1.24	121	1.20	503	1.08	1330	**1.14**	1.08–1.20
36	Printers	546	**1.17**	1140	**1.08**	26	0.97	669	**1.20**	1664	**1.15**	4045	**1.14**	1.10–1.17
11	Journalists	95	1.16	433	**1.13**	8	0.90	159	1.14	660	**1.11**	1355	**1.12**	1.06–1.18
34	Other construction workers	12	0.98	889	**1.13**	1	1.08	15	0.81	17	0.77	934	**1.11**	1.04–1.18
29	Plumbers	6	0.75	1	0.38	–	–	6	1.42	10	1.67	23	1.10	0.70–1.66
12	Administrators	2487	**1.12**	1504	**1.15**	31	1.21	1819	**1.08**	3065	**1.07**	8906	**1.10**	1.08–1.12
44	Public safety workers	24	0.89	171	**1.25**	11	0.90	326	1.07	465	1.09	997	**1.10**	1.03–1.17
39	Beverage workers	430	**1.27**	120	**0.80**	2	1.29	34	1.22	200	0.98	786	**1.09**	1.01–1.17
13	Clerical workers	23912	**1.08**	26422	**1.11**	901	1.07	23147	**1.07**	51709	**1.09**	126091	**1.09**	1.08–1.09
4	Dentists	225	1.05	437	**1.22**	2	0.87	163	1.03	520	1.04	1347	**1.09**	1.03–1.15
47	Waiters	1322	**1.38**	3538	**1.06**	30	1.10	4209	**1.09**	7046	**1.07**	16145	**1.09**	1.08–1.11
1	Technical workers, etc	799	**1.09**	1645	**1.12**	17	0.72	443	**1.15**	3044	**1.05**	5948	**1.08**	1.05–1.10
31	Electrical workers	1486	**1.18**	760	1.02	4	1.48	708	**1.13**	2012	1.02	4970	**1.08**	1.05–1.11
10	Artistic workers	379	1.02	668	**1.10**	30	0.89	523	1.02	1386	**1.10**	2986	**1.07**	1.03–1.11
42	Packers	283	1.12	3558	**1.04**	71	1.15	2701	**1.07**	4720	**1.06**	11333	**1.06**	1.04–1.08
50	Hairdressers	1030	1.05	1357	1.06	17	**0.58**	1057	1.04	3178	**1.08**	6639	**1.06**	1.04–1.09
37	Chemical process workers	844	**1.15**	499	0.95	11	0.95	535	1.08	1174	1.04	3063	**1.06**	1.02–1.10
14	Sales agents	207	1.05	3519	**1.04**	97	1.12	3119	**1.07**	6869	**1.06**	13811	**1.06**	1.04–1.07
3	Physicians	268	1.10	436	**1.19**	6	1.06	186	0.97	706	1.01	1602	**1.06**	1.01–1.11
9	Religious workers etc.	700	0.96	4214	**1.09**	52	1.25	1764	**1.03**	3136	0.98	25855	**0.97**	0.96–0.98
28	Mechanics	1035	**1.15**	1019	**0.94**	187	0.87	3419	**0.95**	5130	0.98	36229	**0.97**	0.96–0.98
2	Laboratory assistants	3137	1.00	3780	**0.94**	73	1.10	8773	**0.96**	17904	0.99	2988	**0.92**	0.89–0.95
8	Assistant nurses	5468	0.98	4011	**0.94**	3	0.56	205	0.99	543	**0.91**	207	0.90	0.79–1.04
46	Home helpers	452	1.09	1785	**0.88**	17	1.21	80	0.89	27	1.12	31198	**0.86**	0.85–0.87
32	Wood workers	41	0.77	42	0.89	18	1.41	5832	**0.84**	6401	**0.90**	9	0.85	0.39–1.61
18	Fishermen	1136	**0.85**	17811	**0.86**	–	–	3	1.35	[0.54]	0.00	26845	**0.83**	0.82–0.84
17	Gardeners	[1.44]	0.00	6	0.93	301	**0.81**	10040	**0.87**	2328	**0.89**	329	**0.82**	0.74–0.92
49	Chimney sweeps	7771	**0.75**	6405	**0.89**	1	0.55	118	0.90	144	0.90	57	**0.66**	0.50–0.86
16	Farmers	16	1.14	50	**0.54**	[0.34]	0.00	7	0.97	19	**0.48**	21	0.65	0.41–1.00
19	Forestry workers	[0.89]	0.00	31	0.82	–	–	1	1.00	1	1.35	23	**0.58**	0.37–0.87
20	Miners and quarry workers	2	0.81	17	**0.61**	[0.06]	0.00	9	**0.42**	5	0.90			
35	Bricklayers	–	–	9	0.71									
21	Seamen				0.86	[0.30]	0.00	53	1.19	153	1.06	283	1.02	0.90–1.14
		4163	0.97	4524	**1.11**	153	0.98	3499	**0.96**	8573	1.00	20912	1.01	0.99–1.02
48	Building caretakers	16272	1.01	12767	**0.97**	463	0.98	16176	0.99	18065	1.02	63743	1.00	0.99–1.01
51	Launderers	1854	1.03	946	**0.93**	66	0.90	1334	0.95	3441	1.02	7641	1.00	0.97–1.02
										28444	**1.03**	73764	**1.02**	1.01–1.02

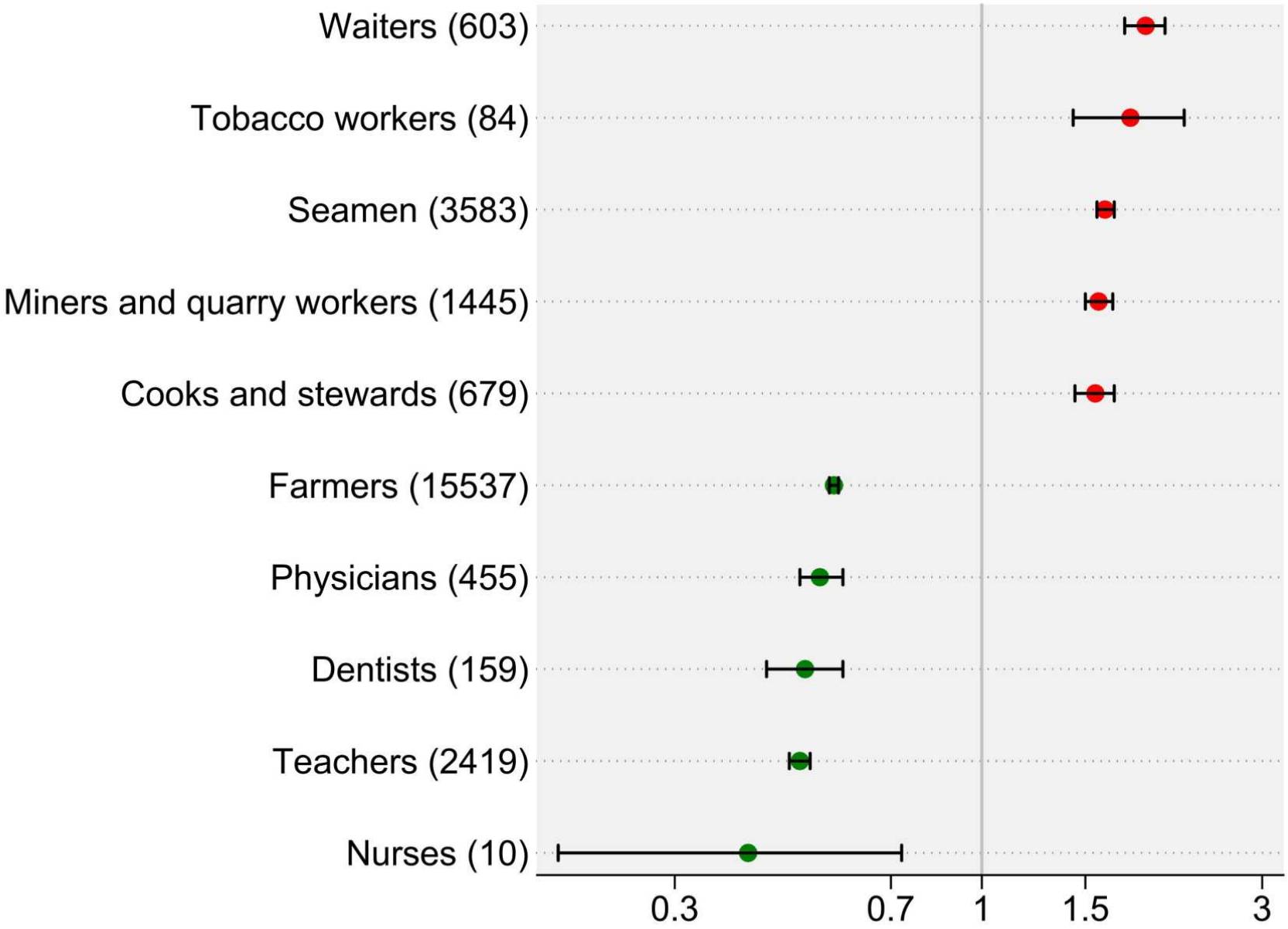
Highest and lowest **overall cancer risk, WOMEN**



Highest and lowest SIRs: **mesothelioma, men**



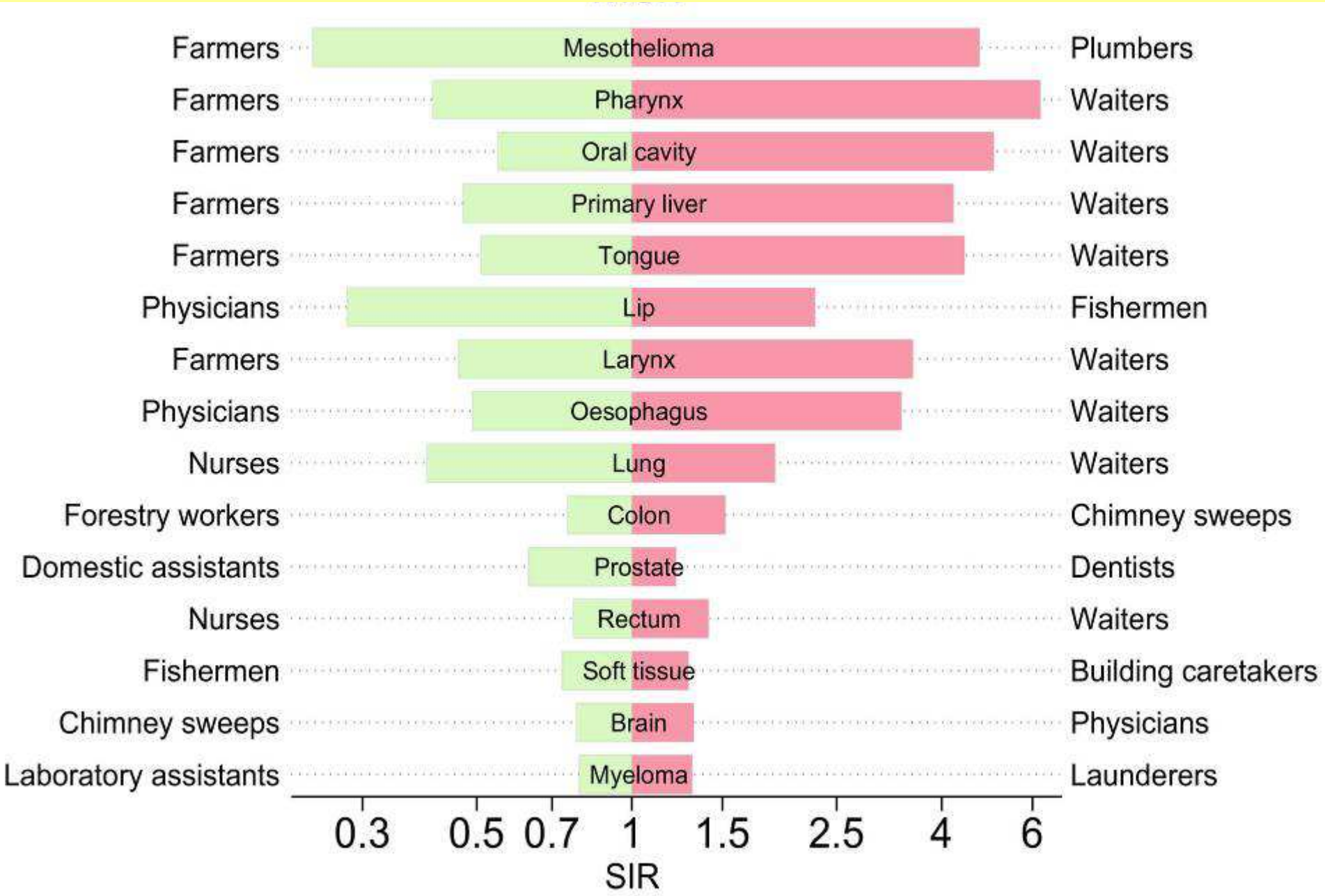
Highest and lowest SIRs: **lung cancer, men**



Lung cancer (men, Norway): **Adjusting for smoking**

Occupational category	Obs	Unadjusted SIR	Adjusted SIR	Adjusted 95%CI
Teachers	168	**0.46**	1.06	0.9-1.2
Waiters	45	**1.66**	1.08	0.8-1.4
Smelting workers	326	**1.39**	**1.63**	1.5-1.8
Mechanics	1254	**1.31**	**1.44**	1.4-1.5
Plumbers	153	**1.34**	**1.49**	1.3-1.8
Welders	211	**1.31**	**1.48**	1.3-1.7
Electrical workers	429	1.06	**1.34**	1.2-1.5
Wood workers	1118	**0.83**	**1.25**	1.2-1.3
Painters	260	**1.38**	**1.52**	1.3-1.7
Other construction workers	596	1.05	**1.28**	1.2-1.4
Bricklayers	162	**1.26**	**1.57**	1.3-1.8
Hairdressers	35	1.27	**1.64**	1.1-2.3
Gardeners	127	**0.69**	**1.54**	1.3-1.8

Risk variation in different cancer sites, MEN



Conclusions of NOCCA basic phase

- ✓ Important occupational variation associated with **life style**
  - ✓ Life style often determined by occupation

- ✓ Risk variation largest for cancers where **direct work-related exposures** play a role, e.g.
  - ✓ Mesothelioma: asbestos exposed plumbers etc.
  - ✓ Lip cancer: UV radiation exposed fishermen and other outdoor workers
  - ✓ Nose cancer: wood dust exposed wood workers

Firefighters

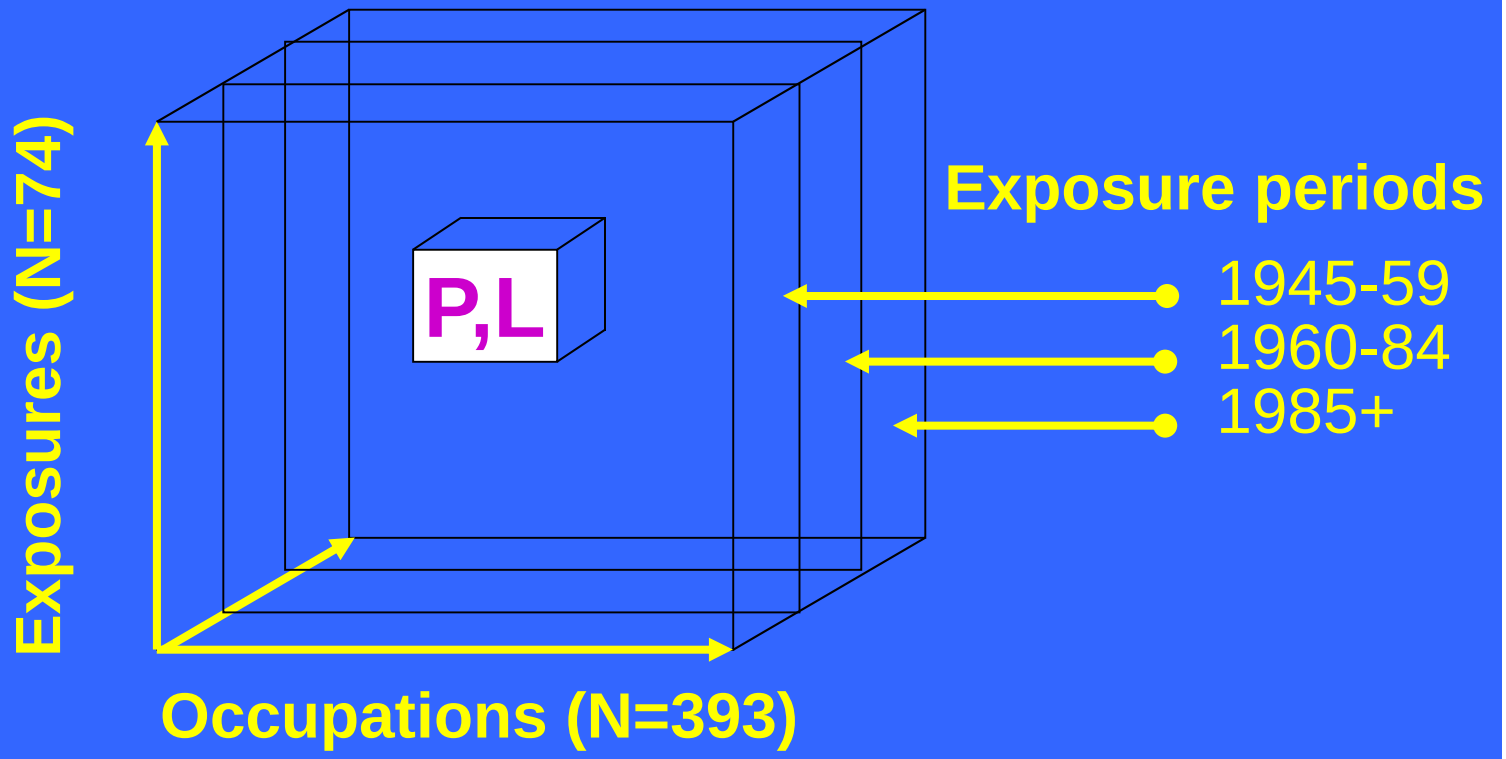
NOCCA firefighter study (Pukkala & al OEM 2014)

- Firefighting exposures ***possibly associated with cancer*** (IARC 2B).
- 16,422 male firefighters (census data) from the five Nordic countries.
- SIR for all cancer sites combined 1.06 (95% CI=1.02-1.11).
- Increased SIR for multiple myeloma (1.7, 1.1-2.5), adenocarcinoma of the lung (1.9, 1.3-2.6), and mesothelioma (2.6, 1.2-4.8) in ages 70+.
- Significant excess in prostate cancer (2.6,1.3-4.5) in the ages 30-49; no excess in older ages.
- In contrast to earlier studies, testicular cancer **decreased** (0.5, 0.2-0.98).
- Almost identical results found in a US firefighter study by Daniels & al published in the same OEM issue.
- Potential exposure to polycyclic aromatic hydrocarbons, asbestos, and shift work involving disruption of circadian rhythms may partly explain these results.

Can we estimate amount of occupational exposures for every Nordic person at any point of time?

YES WE CAN.

Job Exposure Matrix (JEM)



P = proportion of exposed persons (%)

L = mean level of exposure (ppm, etc.)

NOCCA Job Exposure Matrix

Comprises (in the first phase) job title specific estimates of exposure to following 23 agents: asbestos, crystalline silica, nickel and its compounds, lead and its compounds, chromium and its compounds, iron and its compounds, welding fumes, diesel exhaust, benzo-a-pyrene, wood dust, formaldehyde, aliphatic hydrocarbon solvents, aromatic hydrocarbon solvents, chlorinated hydrocarbon solvents, other solvents, gasoline, animal dust, bitumen fumes, sulphur dioxide, ultraviolet radiation, ionising radiation, physical workload, night work.

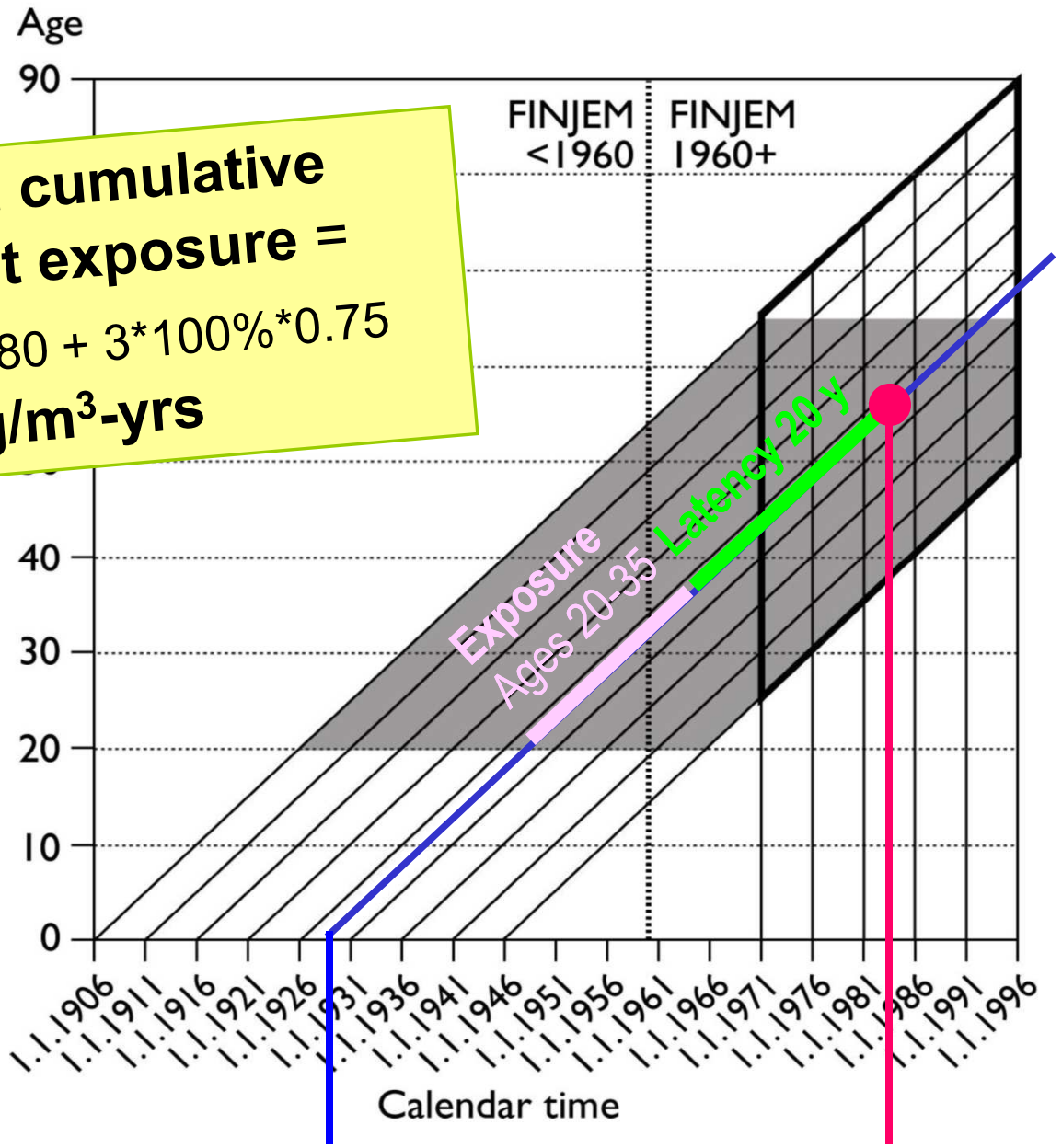
Occupations with wood dust exposure (FINJEM 1960-84)

		Wood dust exposure	
Code	Occupation	P (%)	L (mg/m3)
8312	Charworkers, wood industry	80	4.00
6770	Woodworking machine operator	100	2.35
6760	Cabinetmakers, joiners	100	1.25
6750	Bench carpenters	100	1.11
6720	Plywood, wooden board makers	66	1.02
6710	**Sawmill workers**	**100**	**0.75**
6700	Timber workers	56	0.34
0540	Vocational teachers	3	0.25
6740	Boatbuilders etc.	90	0.20
6780	Wooden surface finishers	80	0.10
6790	Woodworkers NEC	100	0.10

Estimated cumulative wood dust exposure =

12*100%*0.80 + 3*100%*0.75

= 11.9 mg/m^3-yrs



Sawmill worker, born 1928

Observation 1983, age 55

Dose-response
Wood dust - Nasal cancer
(FI-ICE-NO-SWE)

Exposure	n	HR	95% CI
Highest 10%	35	2.1	1.4-3.1
Moderate	179	1.9	1.6-2.3
Low	214	1.3	1.1-1.5
None	4158	1.0	reference

Dose-response
Wood dust - Nasal adenocarcinoma

(FI-ICE-NO-SWE, lag 10 years)

Exposure	n	HR	95% CI
High	24	31	11-91
Moderate	77	11	7.6-17
Low	37	3.0	2.0-4.6
None	255	1.0	reference

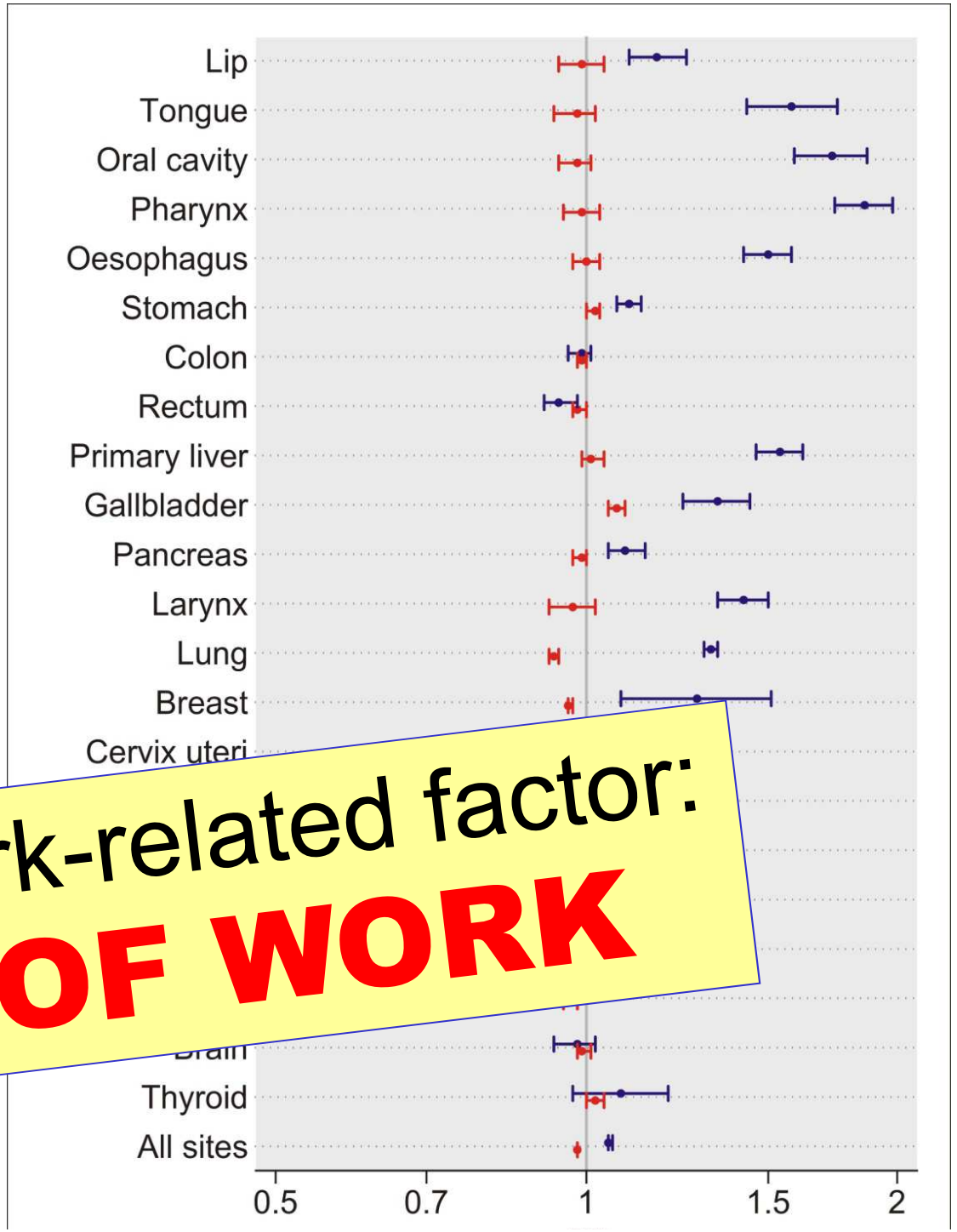
Dose-response RR

Wood dust - Nasal non-adenocarcinoma

(FI-ICE-NO-SWE)

Exposure	n	HR	95% CI
High	20	1.2	0.7-2.0
Moderate	96	1.1	0.9-1.4
Low	180	1.2	1.0-1.4
None	3897	1.0	reference

Cancer among ECONOMICALLY INACTINE **men** and **women**



Worst work-related factor:

LACK OF WORK

Jorma Sormunen

Physical workload and colorectal cancer incidence

Physical activity at work and colon cancer

Physical activity	Number of subjects		Males		Females	
	Case	Control	HR	95% CI	HR	95% CI
None	83769	399234	1.00	ref	1.00	ref
Low	50906	252728	0.92	0.90-0.94	0.98	0.96-0.99
Medium	38255	204637	0.82	0.80-0.83	0.95	0.93-0.97
Highest 10%	8779	51946	0.74	0.72-0.77	0.87	0.81-0.95

Physical activity at work and colon cancer, by subsite

Cancer location	Number of subjects		Males		Females	
PPWL Class	Case	Control	HR	95% CI	HR	95% CI
Ascending colon						
None	29857	143861	1.00		1.00	
Low	17726	88084	0.92	0.89-0.95	0.99	0.96-1.02
Medium	13276	69896	0.84	0.81-0.86	0.97	0.94-1.01
High	3008	17494	0.76	0.73-0.80	0.90	0.79-1.03
Transversal colon						
None	12236	58083	1.00		1.00	
Low	7407	37635	0.92	0.87-0.97	0.93	0.89-0.97
Medium	5758	30190	0.84	0.80-0.88	0.96	0.91-1.02
High	1280	7497	0.76	0.71-0.82	0.83	0.67-1.03
Descending colon						
None	4192	19253	1.00		1.00	
Low	2490	12490	0.86	0.79-0.94	0.94	0.87-1.01
Medium	1789	10007	0.73	0.67-0.79	0.89	0.81-0.99
High	392	2565	0.61	0.54-0.69	0.99	0.69-1.40

”Emergency epidemiology”

Cholangiocarcinoma among workers in the printing industry: Using the NOCCA database to elucidate a cluster report from Japan

International Agency for Research on Cancer
Lyon, France

Background

- A cluster of 11 cases of cholangiocarcinoma observed among 62 male (former) employees in an offset colour printing plant in Osaka, Japan (Kumagai et al, OEM-online 3/2013)

  > 2000-fold risk!

- IARC informed by Japanese Ministry of Health, Labour and Welfare via WHO HQ, August 2012

- Can the finding be generalized to:
  - Printing industry at large?
  - Exposure to the specific, suggested chlorinated solvents?

Printers in NOCCA

	Men		Women	
Country	Persons	Pyrs	Persons	Pyrs
Finland	12 065	275 698	8 395	204 060
Iceland	528	10 495	246	4 800
Norway	10 551	282 002	2 921	78 730
Sweden	30 730	805 745	9 513	248 536
Total	53 874	1 373 940	21 075	536 126

Results, printers & lithographers combined

	Men		Women	
Cancer site	SIR	95% CI	SIR	95% CI
Liver	2.26	1.58-3.13	0.99	0.32-2.39
Intrahepatic cholangiocarcinoma	3.63	1.68-6.89	2.44	0.44-8.05

Consistent results across countries and genders

Actions by the Ministry

- To amend Ordinance by October 2013
  - To prevent occupational cancer caused by the exposure of 1,2-dichloropropane.
- Announcement of guidelines, 14 March 2013
  - To refrain from the usage of 1,2-dichloropropane until the amendment,
  - Reduce workers' exposure when using organic solvents for cleaning machines or degreasing parts,
  - Reaffirm the engineering measures required by the ordinance when utilising dichloromethane.

厚生労働省
Ministry of Health, Labour and Welfare

World Health Organization

Conclusion

- The results are in accordance with the finding of excess risk of cholangiocarcinoma among workers in a small Japanese printing firm
- This excess cancer risk thus appears to extend beyond this specific firm and country
- Exposure to chlorinated solvents seems to be related to an excess risk of cholangiocarcinomas
- Focus on specific exposures in the printing industry needed
- **NOCCA proved to be a useful tool in investigating an occupational cancer cluster in another geographical region**

ORIGINAL ARTICLE

Testicular germ cell tumours and parental occupational exposure to pesticides: a register-based case–control study in the Nordic countries (NORD-TEST study)

Charlotte Le Cornet,[1,2] Béatrice Fervers,[2,3] Susanne Oksbjerg Dalton,[4] Maria Feychting,[5] Eero Pukkala,[6,7] Tore Tynes,[8,9] Johnni Hansen,[4] Karl-Christian Nordby,[9] Rémi Béranger,[1,2,3] Timo Kauppinen,[10] Sanni Uuksulainen,[10] Pernilla Wiebert,[5] Torill Woldbæk,[9] Niels E Skakkebæk,[11] [illegible] Joachim Schüz[1]

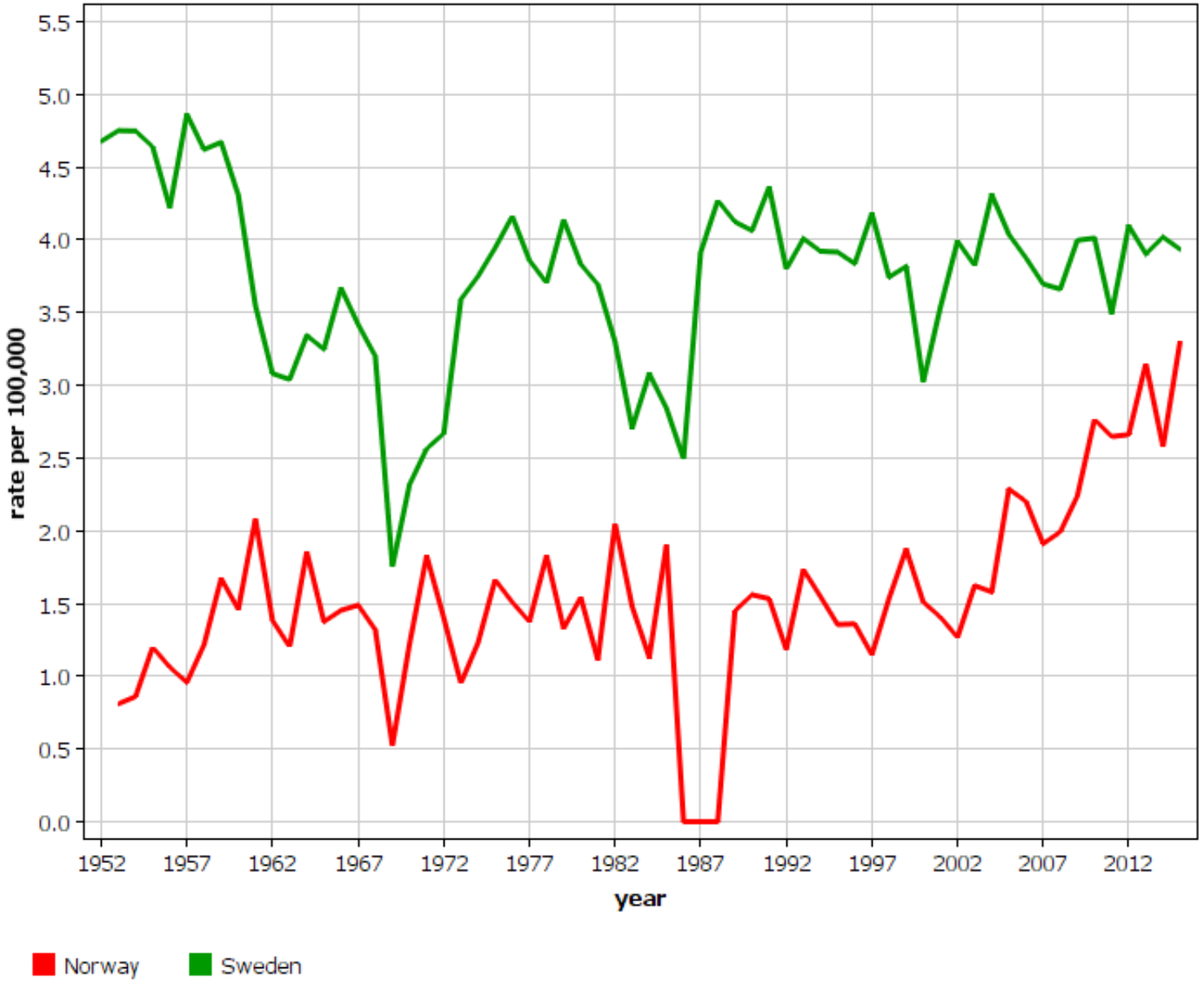
9569 cases and 32 028 controls

no evidence of an association

Could we get same results with cancer mortality statistics?

- Wrong topography in cause of death (liver, lung, brain, …)

Liver
Mortality: ASR (World), Male age 0-85+



Could we get same results with cancer mortality statistics?

- Wrong topography in cause of death (liver, lung, brain, …)
- No morphology information
- Different survival between occupations?

British Journal of Cancer (2010) 103, 1109 – 1114

www.bjcancer.com

Education, survival and avoidable deaths in cancer patients in Finland

A Pokhrel*[,1], P Martikainen[2], E Pukkala[1], M Rautalahti[3], K Seppä[1] and T Hakulinen[1]

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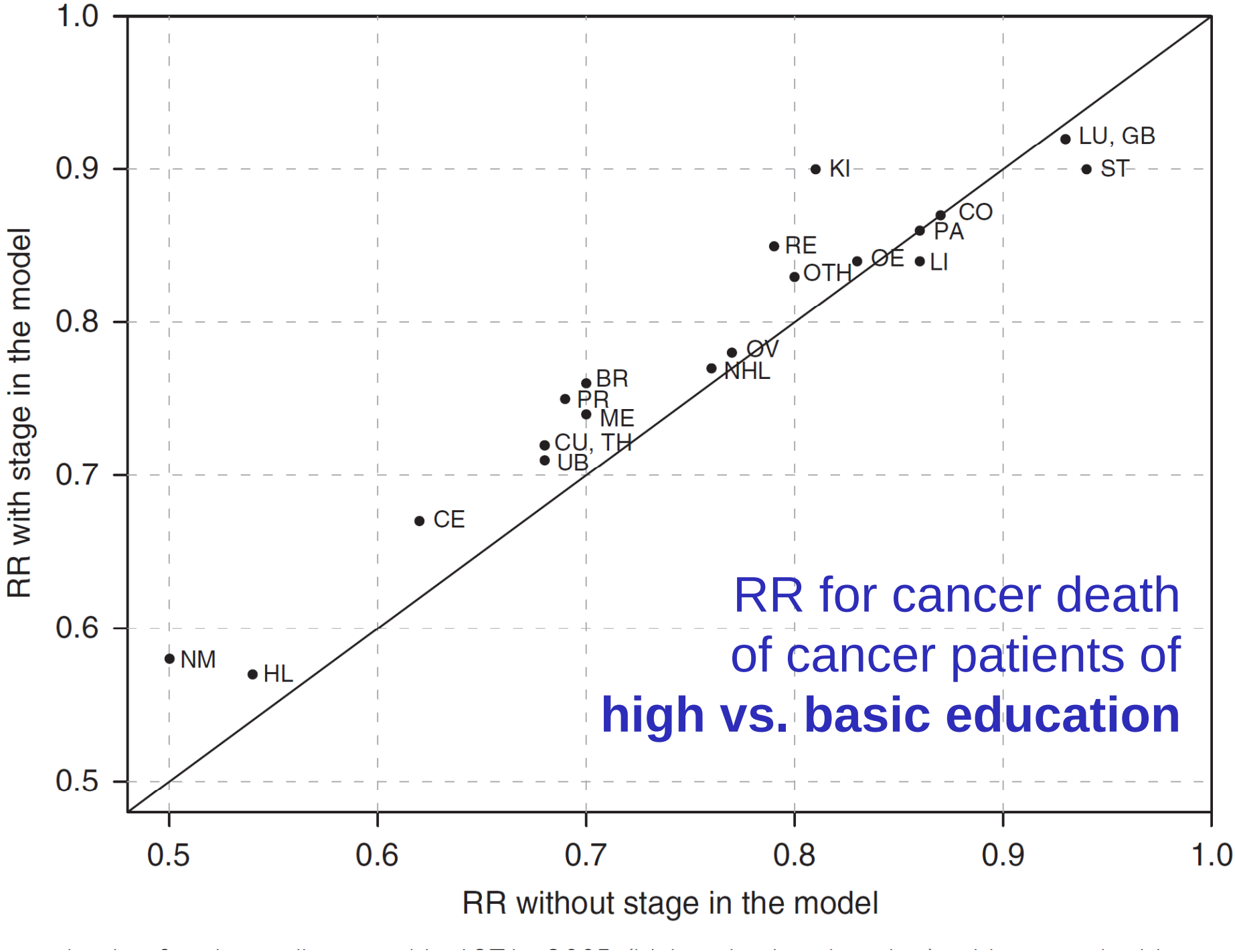
1.0
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0.8
0.7
0.6
0.5
RR with stage in the model
0.5
0.6
0.7
0.8
0.9
1.0
RR without stage in the model
LU, GB
ST
KI
CO
PA
RE
OE
LI
OTH
OV
NHL
BR
PR
ME
CU, TH
UB
CE
NM
HL
RR for cancer death
of cancer patients of
high vs. basic education

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SPECIAL ARTICLE

Nordic Cancer Registries – an overview of their procedures and data comparability

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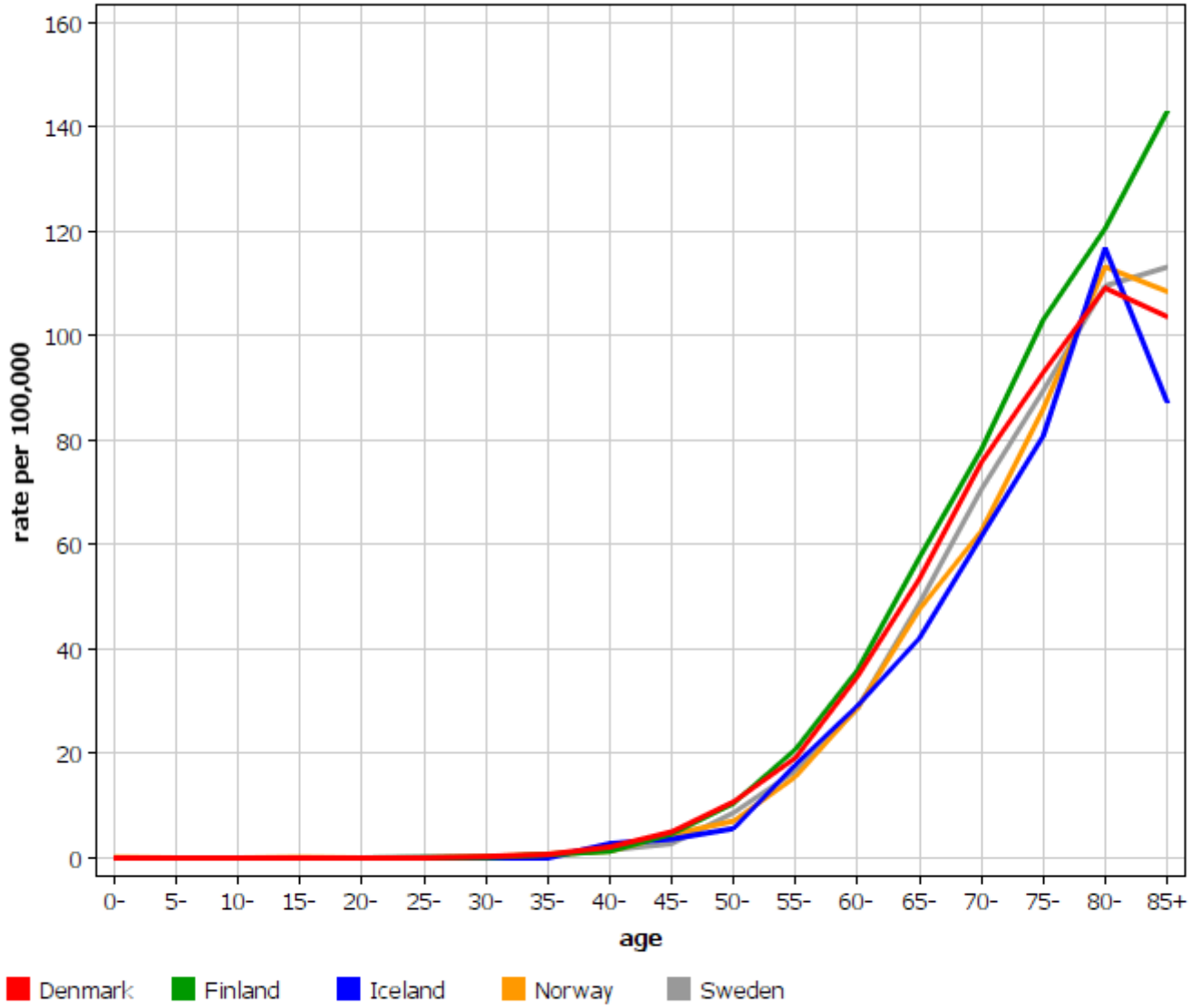
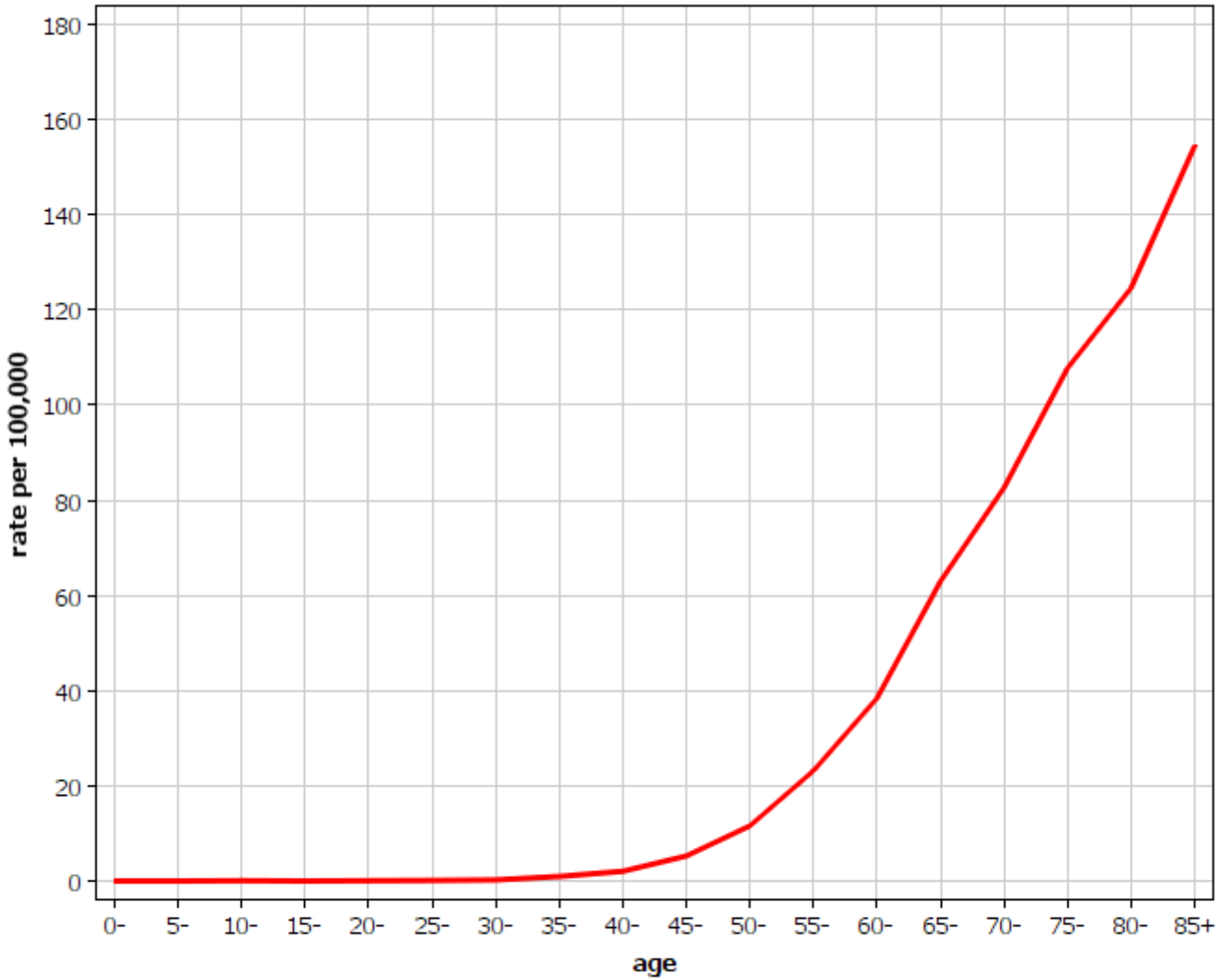
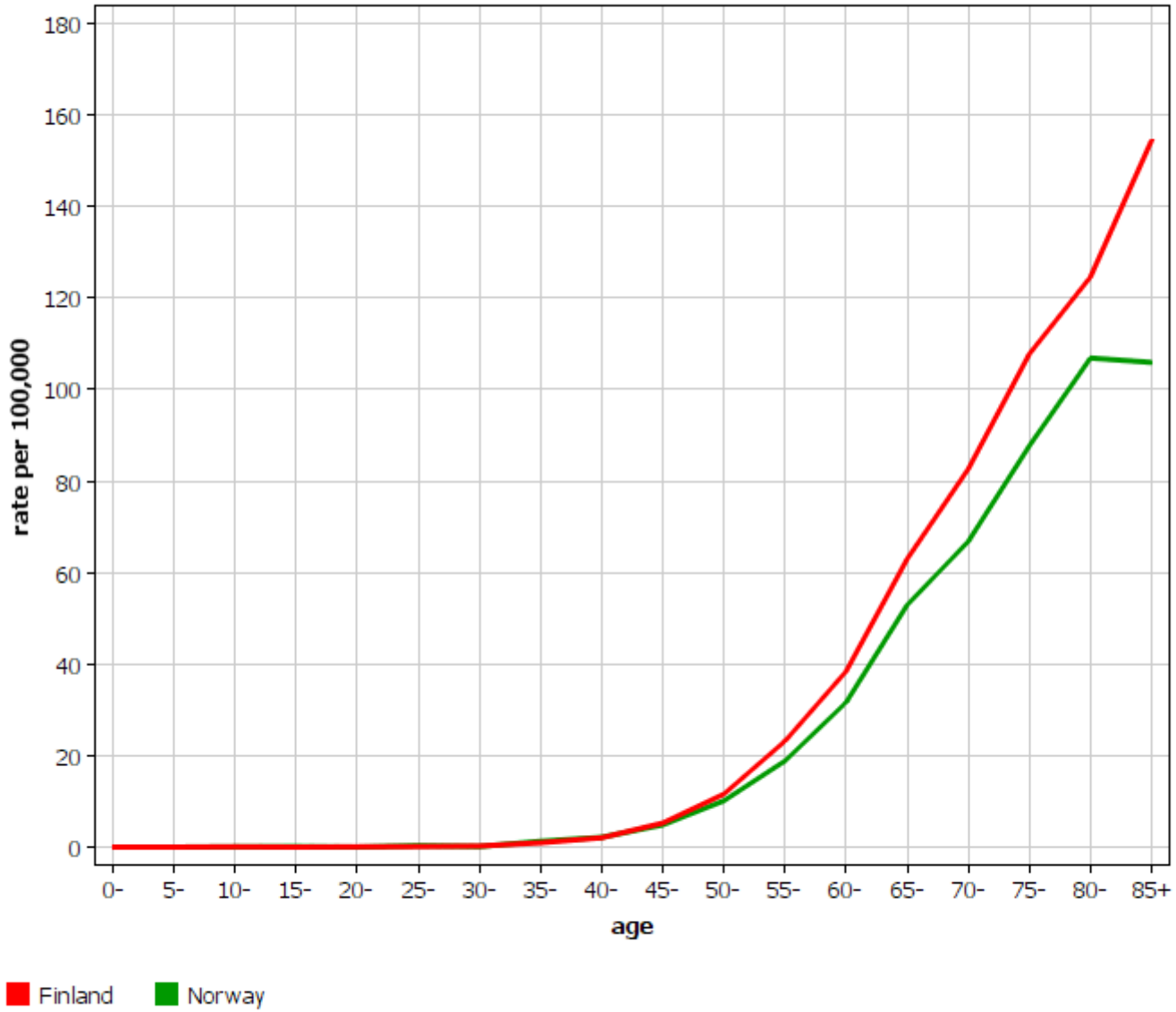
Mortality (2006-2015)
Pancreas: Male



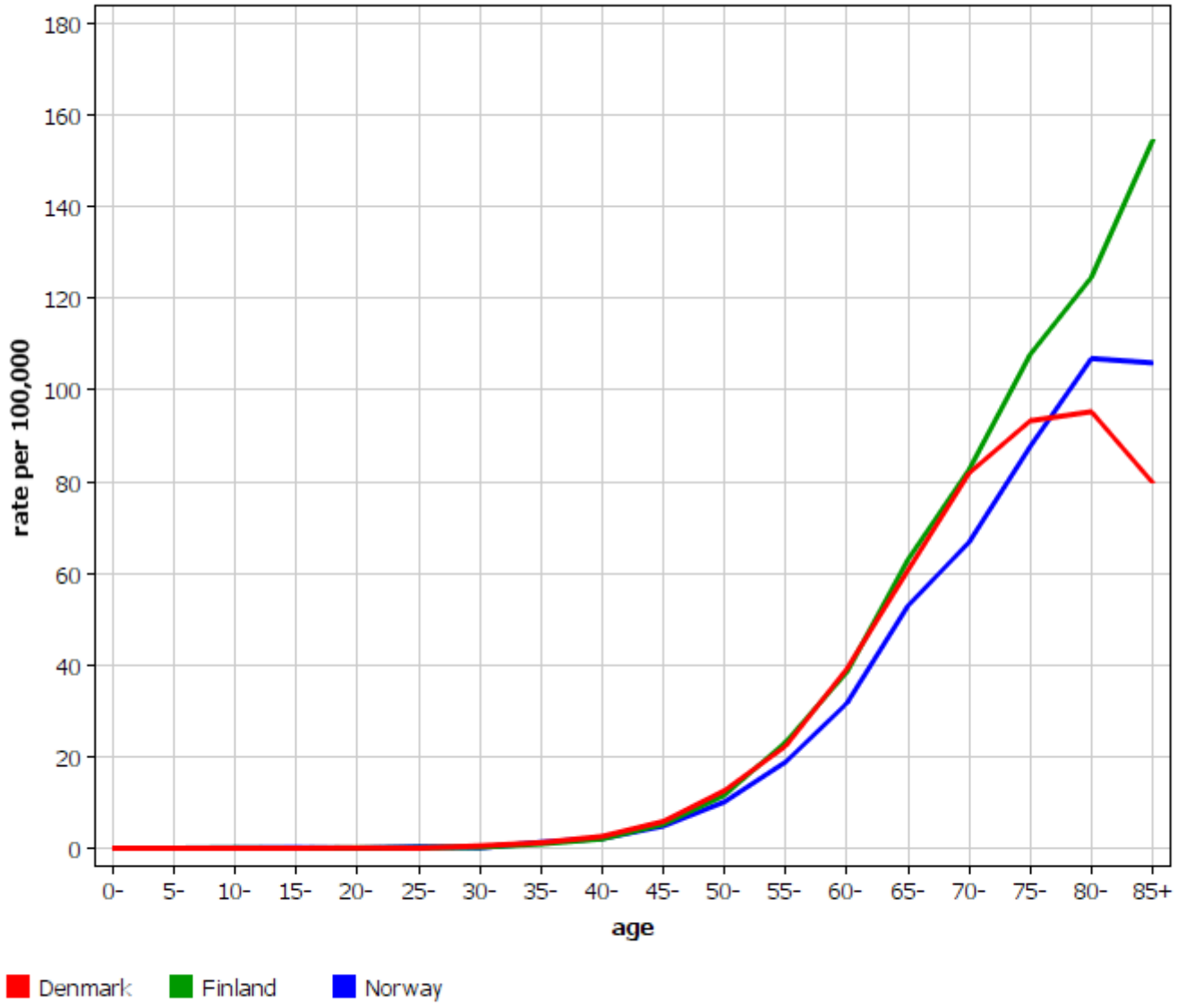
Finland-Incidence (2006-2015)
Pancreas: Male



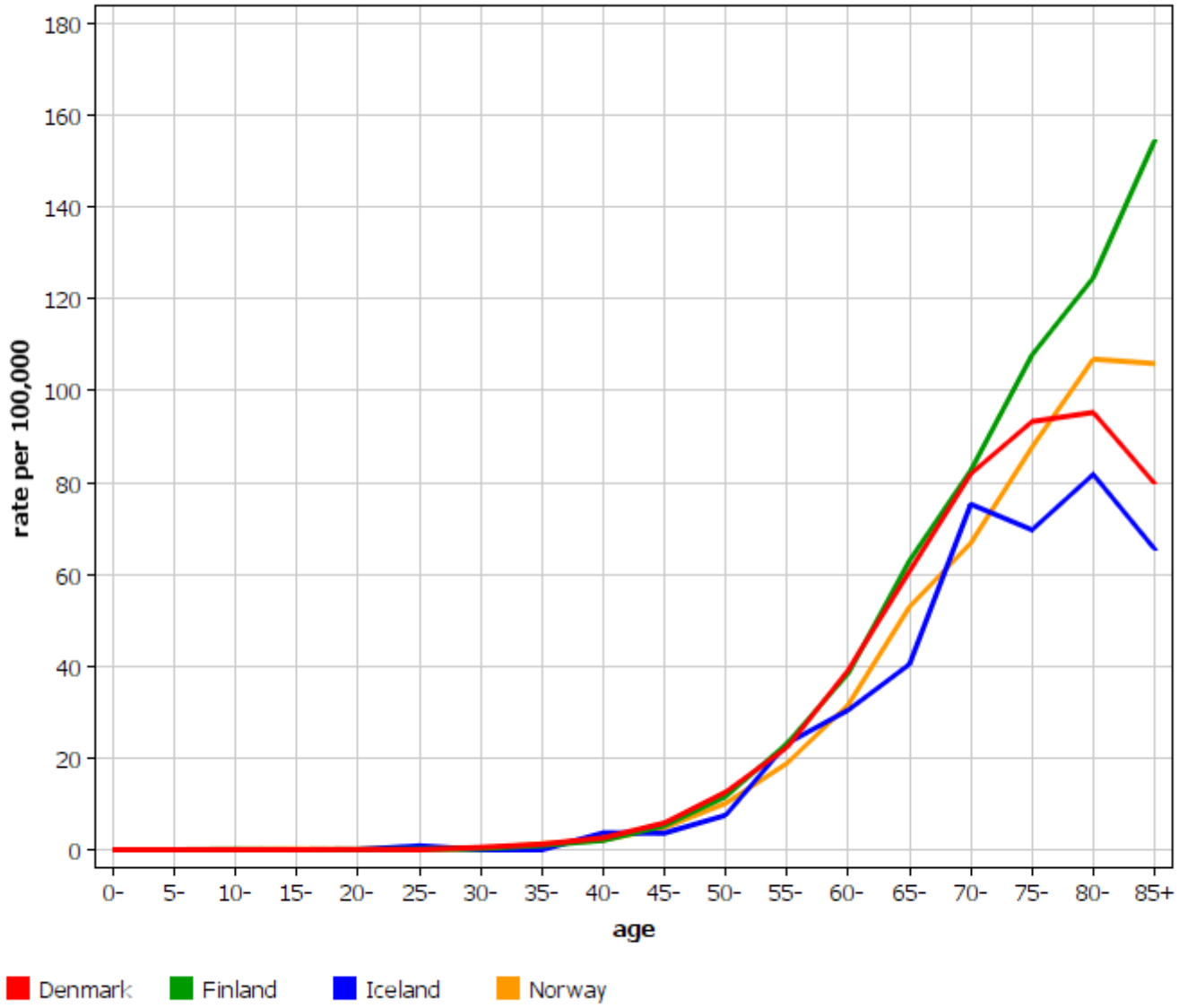
Incidence (2006-2015)
Pancreas: Male



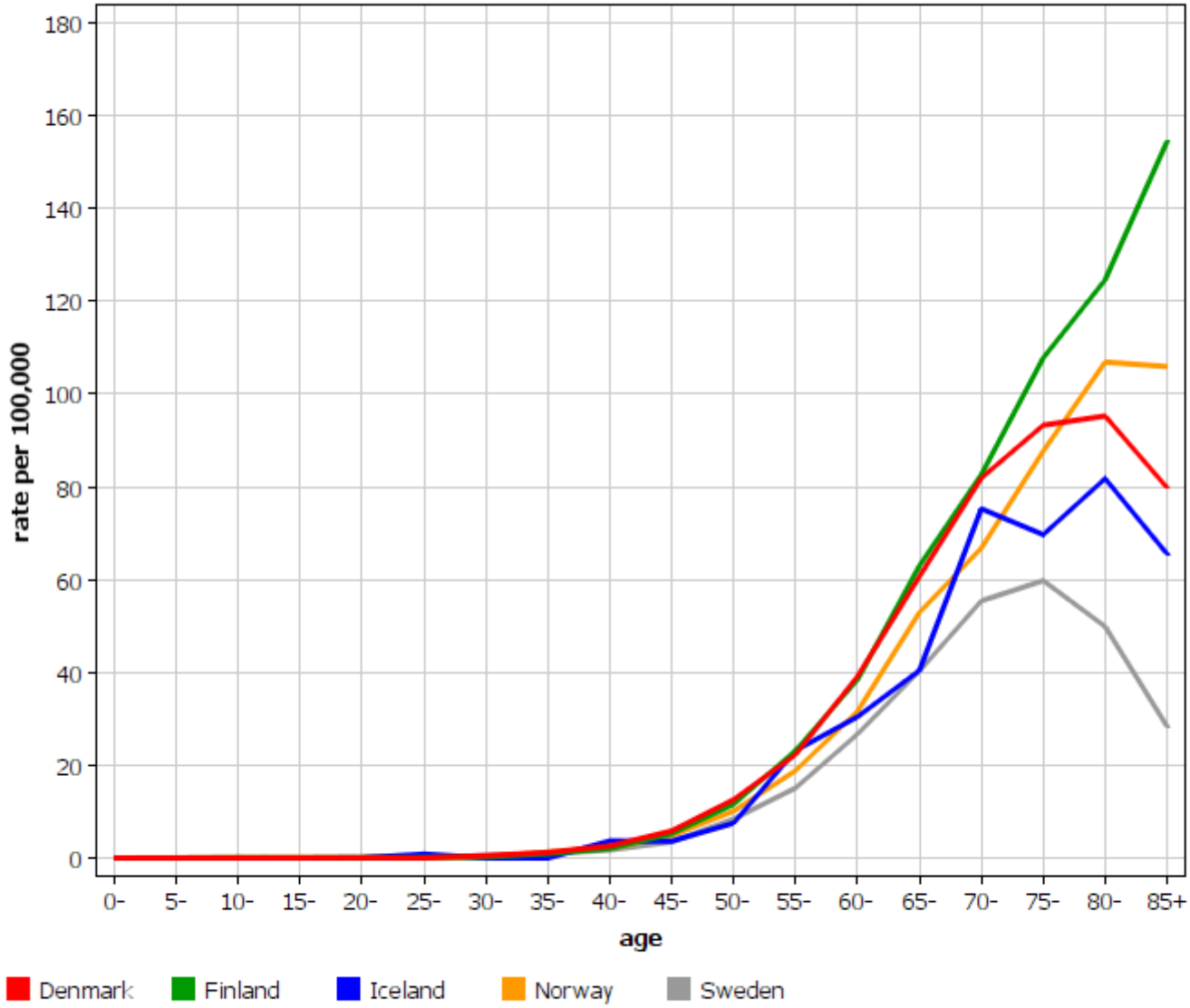
Incidence (2006-2015)
Pancreas: Male



Incidence (2006-2015)
Pancreas: Male



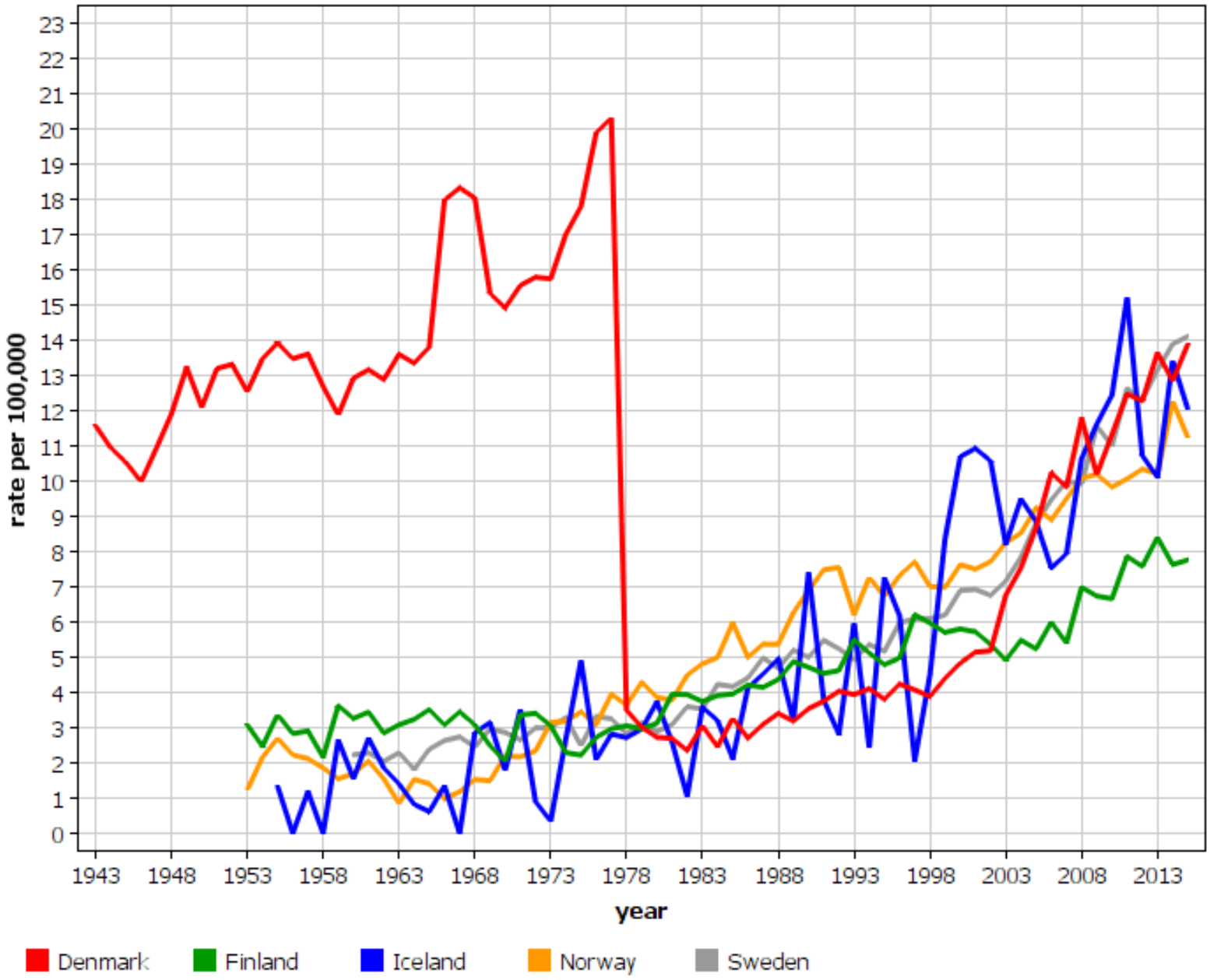
Incidence (2006-2015)
Pancreas: Male



Does it matter

(in NOCCA)?

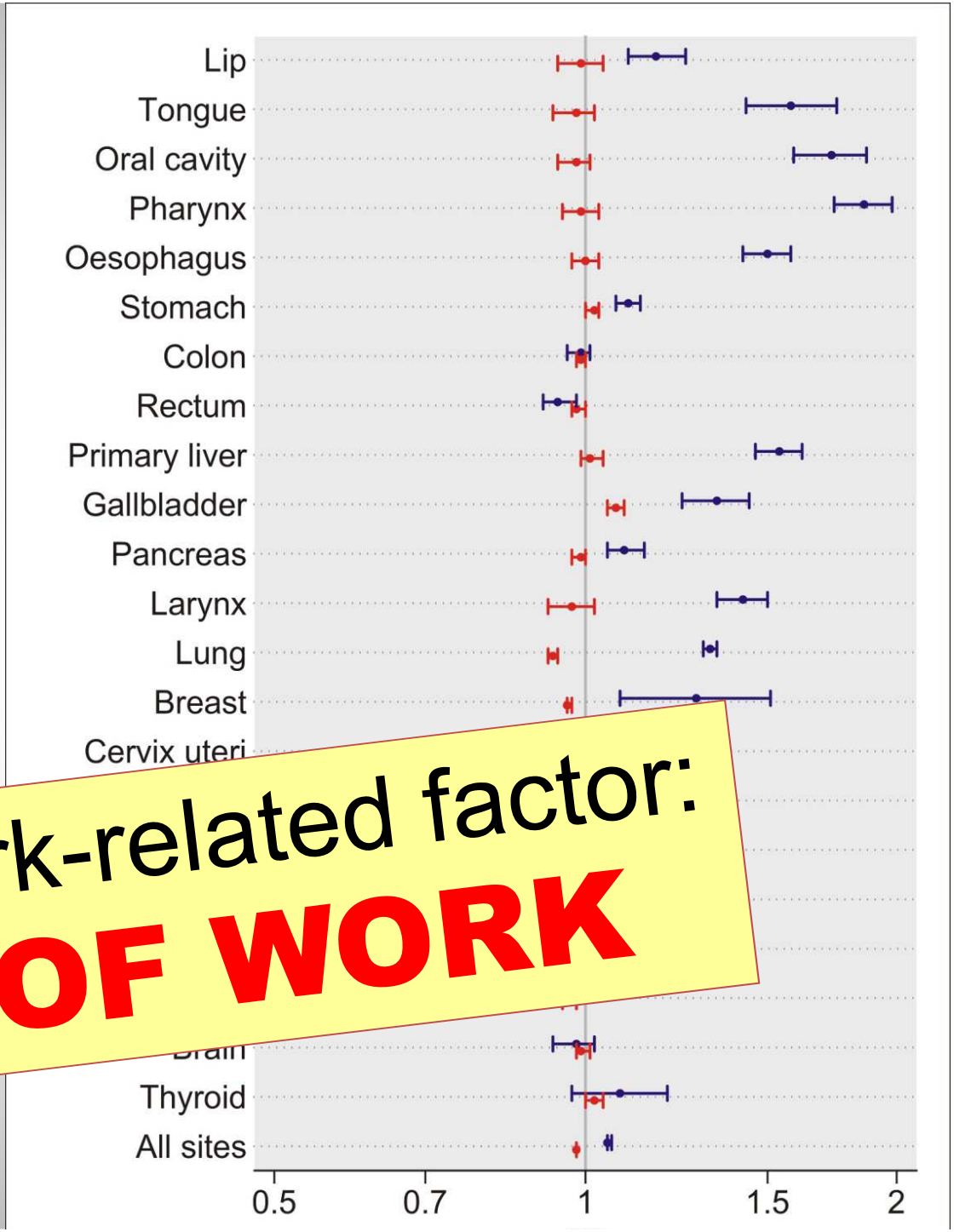
Skin, non-melanoma
Incidence: ASR (World), Female age 0-85+




"Paradise of epidemiology"

NOCCA**new** Study

Cancer among ECONOMICALLY INACTINE **men** and **women**



Worst work-related factor:

LACK OF WORK


Kiitos
(Thank you)