



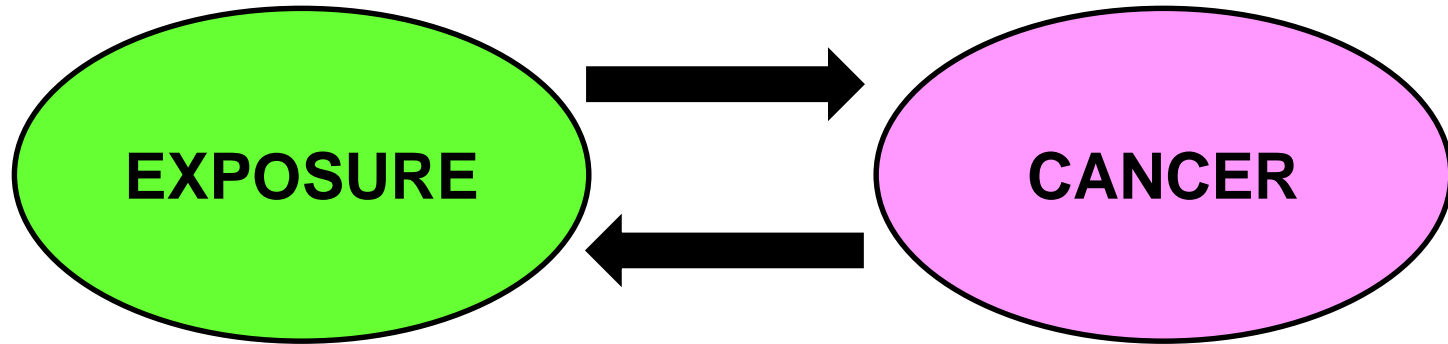
WORKSHOP ON CARCINOGENS AND WORK-RELATED CANCER
Berlin, 3 September 2012

**Social inequalities and their impact on
exposures to carcinogens and
occupational cancer**

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Occupational cancer Traditional study approaches



- Exposure to cancer approach: Estimation of cancer incidence from exposures to known work-place carcinogens
- Cancer to "exposure" approach: Observed cancer incidence of occupational groups controlled for social class / life-style carcinogens

Exposure to cancer approach – the famous debate

- **Bridbord et al. (OSHA-report), 1978:** Estimates of the fraction of cancer in the United States related to occupational factors
- Asbestos: number exposed, percent who died from various cancers
- Arsenic, benzene, chromium, nickel, and petroleum products: Exposed (N), Relative risk RR), Incidence (I)
- Conclusion: "In our view there is nothing in the gross cancer statistics for the U. S. population which is inconsistent with the hypothesis that up to **20-40%** of all cancers are ... attributable to occupational factors"

Exposure to cancer approach – the famous debate

- **Doll and Peto, 1981:** Estimates of the fraction of cancer in the United States related to occupational factors
- Cancers: 1) not known to be produced by occupational hazards; 2) that possible may be produced by occupational hazards; 3) that definitely can be produced by occupational hazards
- Conclusion: "The proportion of cancer deaths that we have tentatively attributed to occupational causes is ... about **4%** of all US cancer deaths"



Exposure to cancer approach – recent estimate

- **Rushton et al., 2012:** Occupational cancer burden in Great Britain
- Attributable fraction, AF: proportion of cancer cases that would not have occurred in the absence of exposure
- Exposures: IARC Group 1 or 2A carcinogens
- Risk estimates: Key studies, meta-analysis, pool studies
- Number exposed: CARcinogen EXposure (CAREX), UK Labour Force Survey, Census of Employment
- Cancer incidence: 2004

Table 2 Cancer registrations in 2004 attributable to occupation by exposure and cancer sites with at least 14 total attributable registrations

Carcinogen or occupation	Cancer site ^a															Total attributable cancer registrations ^b		
	Bladder	Brain	Breast	Cervix	Larynx	Leukemia	Lung	Mesothelioma	Nasopharynx	NMSC	NHL	Oesophagus	Ovary	Sinonasal	STS		Stomach ^c	Other sites
Asbestos					8		2223	1937								47		4216
Shift work (including flight personnel)			1957															1957
Mineral oils	296						470			902				55 ^d				1730
Solar radiation										1541								1541
Silica							907											907
Diesel engine exhaust	106						695											801
PAHs: coal tars and pitches										475 ^e								475
Painters	71						282									83		359
TCDD (dioxins)							215				74				27			316
Environmental tobacco smoke (non-smokers)							284											284
Radon							209											209
Welders							175											175
Tetrachloroethylene				18							17	130						164
Aranic							129											129
Strong inorganic-acid mists containing sulphuric acid					46		76											122
Chromium VI							67							22				89
Non-organical insecticides		11				19					33							MM (10)
Cobalt							73											73
Inorganic lead ^f		2					42									23		67

Etc.

Rushton et al, 2012

Exposure to cancer approach – recent estimate

- **Rushton et al., 2012:** Occupational cancer burden in Great Britain
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- Exposures: IARC Group 1 or 2A carcinogens
- Risk estimates: Key studies, meta-analysis, pool studies
- Number exposed: CARcinogen EXposure (CAREX), UK Labour Force Survey, Census of Employment
- Cancer incidence: 2004
- AF: men **5.7%**; women **2.1%**; all **4.0%**
- AF: men lung cancer **21.1%**

Cancer to "exposure" approach - controlled for social class

- **Fox & Adelstein, 1978:** Occupational mortality: work or way of life?

Occupation	Class	SMR	Adj SMR
Stevedores/dock lab.	V	140	106
Bun conductors	IV	118	104
Painters	IIIM	112	105
Clerks	IIIN	104	105
Teachers	II	66	82
Doctors	I	81	105

- Variation in cancer mortality between occupational orders associated with work: **12%**

Cancer to "exposure" approach - controlled for life-style carcinogens

- **Haldorsen et al., 2005:** Smoking-adjusted incidence of lung cancer by occupation among Norwegian men

Occupation	SIR	Adj SIR	95% CI
Farmer	0.42	0.93	0.9-1.0
Physician	0.49	0.37	0.3-0.5
Glass/chemamics	1.30	1.73	1.5-1.9
Waiter	1.66	1.08	0.9-1.4

- Across 42 occupational groups: observed cases 12,250, expected cases taking smoking into account 8893, excess for all **21%**, excess for econ. active **17%**

So, what can we conclude from the traditional approaches

- From exposure to cancer: **4%** of cancers
- From cancer to "exposure": **12%** of cancers
- Point to existence of unidentified work-place carcinogens

- Men: Exposure to lung cancer: **21%** of cancers
- Men: Lung cancer to "exposure": **21%** of cancers
- Strength of Exposure to lung cancer approach is direct use for prevention, e.g. for British HSE: asbestos, respiratory crystalline silica, diesel engine exhaust, [shift work and breast cancer], construction industry, **Chen & Osman, 2012**

What is an occupational cancer?

”We have to decide how to classify cancers such as the:

- lip and skin cancers produced by exposure to UV light associated with work in the open air,
- cancers of the upper respiratory and digestive tract due to the consumption of alcohol associated with work in bars, restaurants, and ... manufacture of alcoholic drinks,
- cancer of the cervix uteri in prostitutes due to intercourse with many men, and
- cancer of the breast in nuns due to the avoidance of pregnancy.

As these are not the sort of cancers that are commonly termed ”occupational”, **we should perhaps omit them, although we do so reluctantly.** **Doll & Peto, 1981**



What is an occupational risk factor?

- During the tobacco smoking epidemic, smoking was predominantly considered a personal life-style habit, a confounder not caused by occupation
- Obesity new epidemic causally associated with cancer of the colon, breast, endometrium, oesophagus, and kidney, **IARC, 2002**
- During the obesity epidemic, the personal life-style habit concept is increasingly questioned
- Obesogenic environment, geographical concentrations of fast-food outlets, **Poston & Foreyt, 1999**
- Obesity as response to stress invoked by economic insecurity, **Offer et al, 2010**

A work-related approach to occupational cancer

- NOCCA

Nordic Occupational Cancer Study

- NOCCA I, **Andersen et al., 1999**

Cohort study of 1970-census population

10 million people

1 million cancers

- NOCCA II, **Pukkala et al., 2009**

Cohort study of 1960, 1970, 1980 and 1990-census populations

15 million people

2.8 million cancers



Table 30. Farmers, men (N = 436,387). Observed number (Obs) of cancers and standardised incidence ratio (SIR), 1971-91, by country and cancer site.

ICD-7	Site	Denmark		Finland		Norway		Sweden		Total		
		Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	95% CI
140	Lip	358	176	617	150	237	151	270	181	1482	161	153 - 169
141	Tongue	16	39	57	82	13	25	16	29	102	47	39 - 57
143-144	Mouth	39	45	42	62	35	48	32	38	148	47	40 - 56
145-148	Pharynx	39	36	83	62	33	38	47	40	202	45	39 - 51
150	Oesophagus	101	53	234	84	69	46	90	50	494	62	57 - 68
151	Stomach	700	98	1899	103	801	87	757	97	4157	98	95 - 101
153	Colon	757	70	664	75	780	75	861	82	3062	76	73 - 78
154	Rectum	743	84	732	86	565	79	646	86	2686	84	81 - 87
155.0	Liver	62	35	174	53	44	45	84	38	364	44	40 - 49
155.1	Gallbladder	77	69	149	86	47	76	49	57	322	75	67 - 83
157	Pancreas	375	72	684	82	350	75	378	70	1787	76	72 - 79
160	Nose	33	74	46	83	25	68	37	110	141	83	70 - 98
161	Larynx	108	36	292	68	59	34	58	31	517	47	43 - 52
162	Lung	1501	43	4757	75	755	42	673	40	7686	58	56 - 59
162.2	Pleura	18	24	36	51	9	18	7	14	70	29	22 - 36
170	Breast	19	76	13	61	15	94	20	84	67	78	60 - 99
177	Prostate	1277	89	2782	97	2474	99	3084	95	9617	96	94 - 98
178	Testis	130	90	53	99	76	119	45	98	304	99	88 - 111
180.0	Kidney	243	62	543	74	289	74	429	78	1504	73	69 - 76
181	Bladder	744	54	916	79	700	70	652	60	3012	65	63 - 68
190	Melanoma	179	69	392	100	244	70	298	79	1113	81	76 - 86
191	Other skin*	1303	68	480	102	405	101	510	97	2698	81	78 - 85
193	Brain	394	98	427	89	268	93	406	97	1495	94	90 - 99
194	Thyroid	34	81	99	94	68	113	74	102	275	98	87 - 110
197	Connective tissue	52	108	106	89	46	85	94	95	298	93	83 - 104
201	Hodgkin's disease	61	78	134	115	62	112	85	104	342	103	93 - 115
200,202	NHL	318	103	363	92	314	96	436	98	1431	97	92 - 102
203	Multiple myeloma	170	98	292	103	215	94	285	120	962	104	98 - 111
204.3	Acute leukaemia	175	121	173	99	107	97	135	95	590	103	95 - 112
204.0-2,4	Other leukaemia	240	92	357	102	164	105	245	99	1006	99	93 - 106
199	Unknown	93	81	378	97	341	71	293	71	1105	79	74 - 84
140-204	All sites**	9276	70	17983	86	9397	77	11290	79	47946	79	78 - 79

* Basal cell carcinomas are included for Denmark and excluded for Finland, Norway and Sweden

** Excludes non-melanoma skin cancer

Table 84. Waiters, men (N = 8,974). Observed number (Obs) of cancers and standardised incidence ratio (SIR), 1971-91, by country and cancer site.

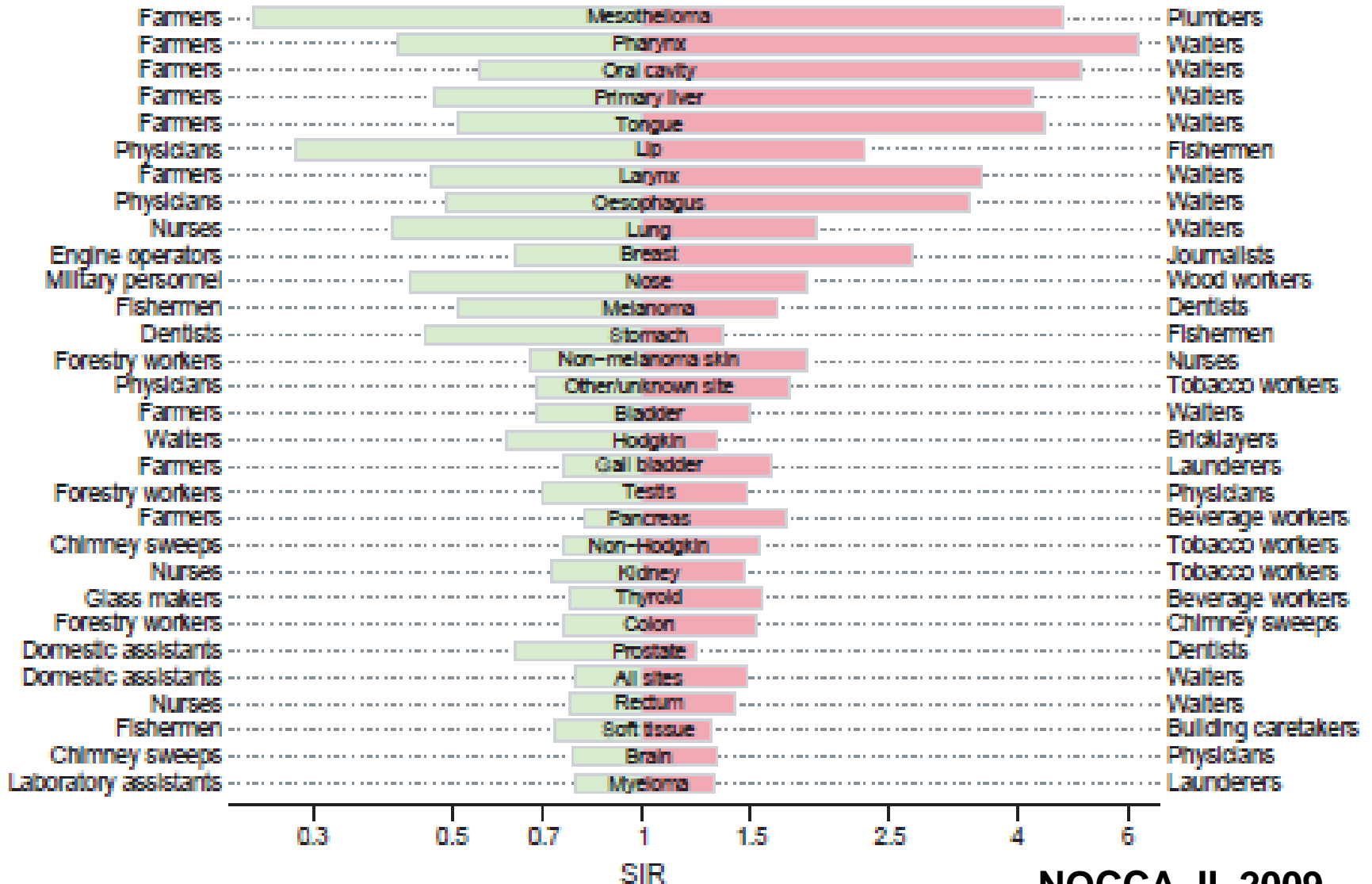
ICD-7	Site	Denmark		Finland		Norway		Sweden		Total		
		Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	Obs	SIR	95% CI
140	Lip	[4.3]	0	[1.2]	0	4	167	1	55	5	51	17 - 120
141	Tongue	5	541	2	743	5	537	9	1112	21	716	443 - 1094
143-144	Mouth	15	824	[0.3]	0	5	392	5	412	25	547	354 - 808
145-148	Pharynx	20	840	1	214	11	723	8	463	40	656	469 - 894
150	Oesophagus	24	639	4	492	11	490	6	285	45	505	368 - 675
151	Stomach	17	122	3	54	12	94	10	113	42	102	74 - 138
153	Colon	24	117	4	143	24	157	17	137	69	135	105 - 171
154	Rectum	28	163	[2.5]	0	12	113	9	101	49	125	92 - 165
155.0	Liver	21	612	4	426	5	364	11	441	41	498	357 - 676
155.1	Gallbladder	5	234	1	196	3	351	[1.0]	0	9	201	92 - 382
157	Pancreas	17	169	3	119	9	137	11	171	40	156	112 - 213
160	Nose	2	214	1	519	[0.6]	0	1	208	4	181	49 - 464
161	Larynx	36	582	2	147	5	181	4	158	47	366	269 - 487
162	Lung	135	202	17	93	45	166	49	235	246	185	163 - 210
162.2	Pleura	1	67	[0.3]	0	[0.8]	0	2	292	3	93	19 - 272
170	Breast	[0.5]	0	[0.1]	0	1	376	[0.3]	0	1	87	2 - 484
177	Prostate	33	133	15	215	37	123	38	122	123	132	111 - 158
178	Testis	7	130	[0.4]	0	3	115	3	178	13	129	69 - 221
180.0	Kidney	13	162	3	120	11	177	6	79	33	135	93 - 190
181	Bladder	46	174	4	120	16	111	26	196	92	160	129 - 197
190	Melanoma	5	77	[1.9]	0	9	109	9	128	23	97	62 - 146
191	Other skin*	30	77	[1.3]	0	6	111	5	90	41	80	58 - 109
193	Brain	10	107	4	181	5	84	9	126	28	113	75 - 164
194	Thyroid	1	103	[0.5]	0	1	82	1	81	3	77	16 - 225
197	Connective tissue	2	179	[0.5]	0	[1.0]	0	1	66	3	73	15 - 213
201	Hodgkin's disease	1	46	[0.6]	0	3	238	[1.5]	0	4	72	20 - 185
200,202	NHL	2	30	1	68	3	53	7	111	13	65	35 - 111
203	Multiple myeloma	4	119	1	115	3	92	1	34	9	87	40 - 164
204.3	Acute leukaemia	2	65	1	151	3	167	1	50	7	93	37 - 191
204.0-2,4	Other leukaemia	5	97	2	182	3	132	5	160	15	129	72 - 212
199	Unknown	3	137	2	169	7	103	10	192	22	143	90 - 217
140-204	All sites**	481	181	76	119	264	145	271	153	1092	159	149 - 168

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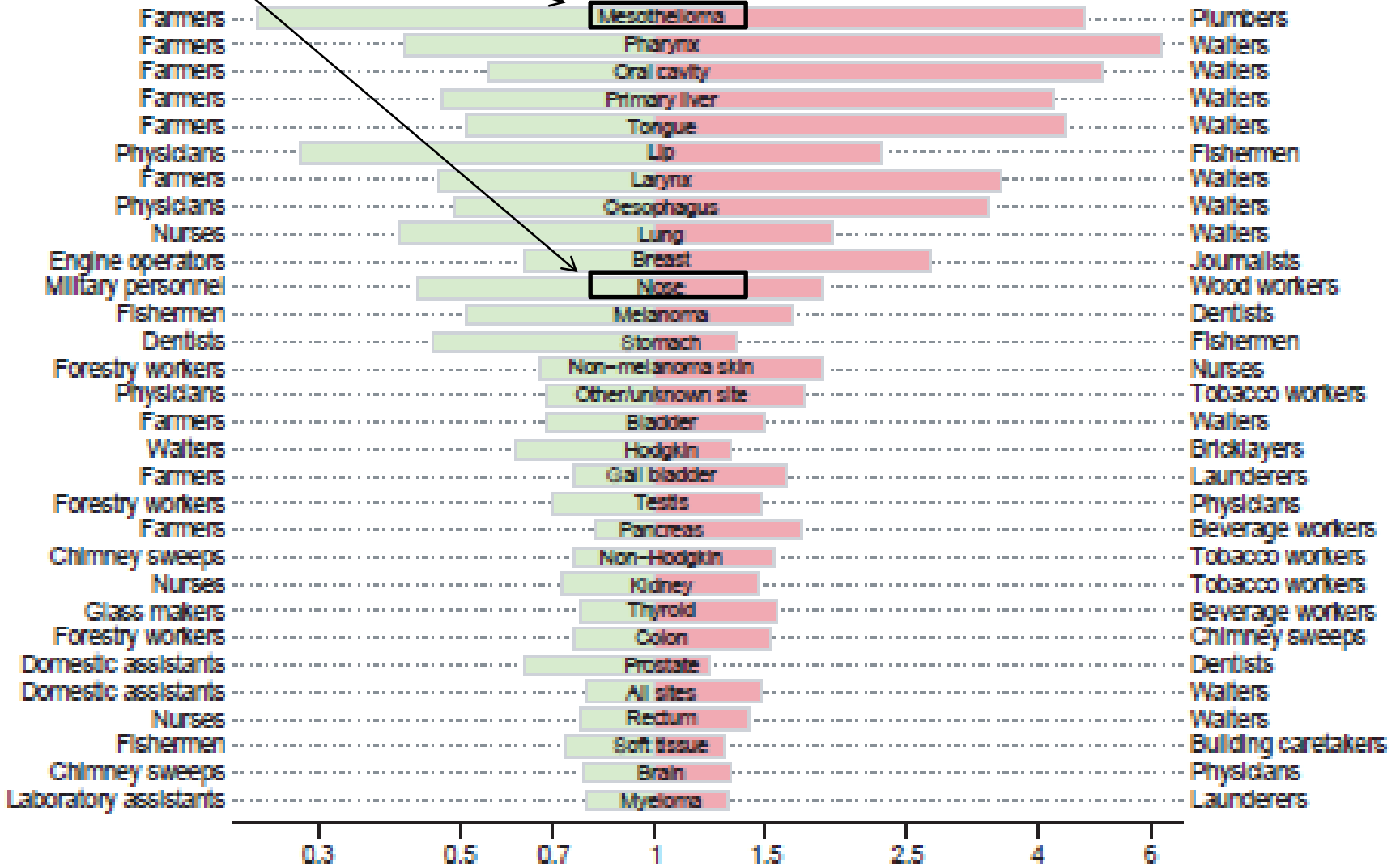
Socially discriminating cancers

Men



Traditional occupational cancers, all the rest traditional life-style cancers

Men



So, what can we conclude from the work-related approach

- Variation across occupational groups in cancer incidence is much wider than the variation traditionally termed "occupational cancers"
- Obesity, tobacco smoking, alcohol use, etc. are not solely personal life-style habits
- These exposures are also determined by the living environment and the experience of subordination and economic insecurity which may come with the occupation

Conclusion

Social inequalities and their impact on exposures to carcinogens and occupational cancer

- In the social inequality perspective a two-tier strategy is needed for prevention of occupational cancer
- First, the British HSE- approach: asbestos, respiratory crystalline silica, diesel engine exhaust, shift work and breast cancer, construction industry, **Chen & Osman, 2012**
- Second, the broader political approach: liberal market economies (e.g. USA, Britain) versus coordinated market economies (e.g. Germany, Nordic), **Offer et al, 2010**

Conclusion

Social inequalities and their impact on exposures to carcinogens and occupational cancer

- In the social inequality perspective a two-tier strategy is needed for prevention of occupational cancer
- First, the British HSE- approach: asbestos, respiratory crystalline silica, diesel engine exhaust, shift work and breast cancer, construction industry, **Chen & Osman, 2012**
- Second, the broader political approach: liberal market economies (e.g. USA, Britain) versus coordinated market economies (e.g. Germany, Nordic), **Offer et al, 2010**



**Useful tools,
but only part of the solution**

Thank you for your attention



Copenhagen Old Municipality Hospital, now part of University of Copenhagen