REPUBLIKA SLOVENIJA
MINISTRSTVO ZA DELO, DRUŽINO,
SOCIALNE ZADEVE IN ENAKE MOŽNOSTI

Zdravo delovno okolje

Gender differences in occupational exposure to carcinogens and cancer incidence among Italian workers.

Alessandro Marinaccio

Ljubljiana, October, 14th, 2019

Kongresni center, Brdo

MEDNARODNA KONFERENCA

ŽENSKE IN MOŠKI NA DELOVNEM MESTU: VARNOST IN ZDRAVJE PRI DELU V KONTEKSTU ENAKIH MOŽNOSTI

Ponedeljek, 14. oktober 2019
Kongresni center Brdo
Dvorana Grandis

Keypoints

- ✓ Occupational cancers epidemiology and gender differences in exposures and health effects dimension;
- ✓ The Italian experiences of epidemiological surveillance of occupational exposure and cancer cases;
- ✓ Asbestos exposure, mesothelioma incidence and gender differences in Italy;
- ✓ Conclusive remarks for public health.

Gender differences in occupational exposure to carcinogens and cancer incidence

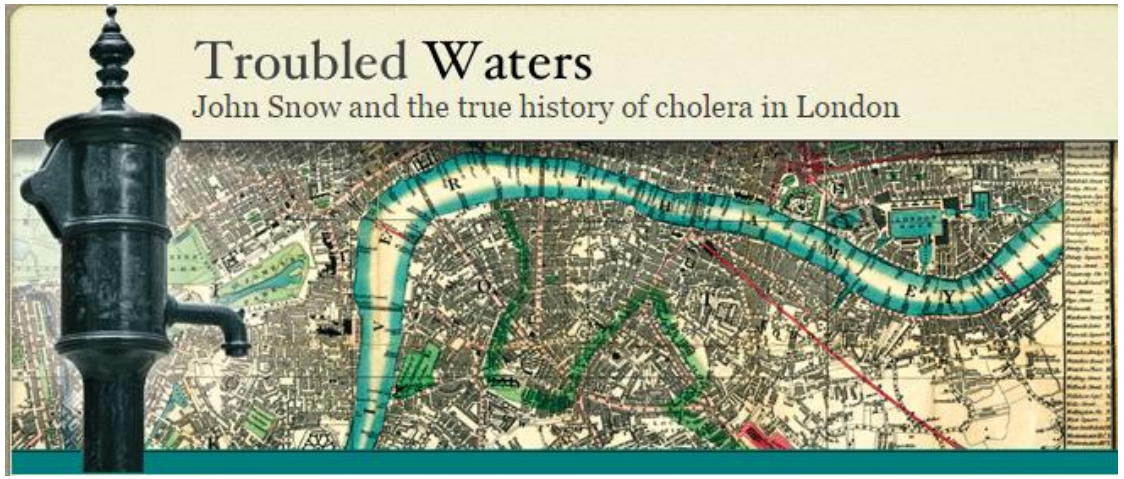
Bernardino Ramazzini in 1713 noticed the virtual absence of cervical cancer among nuns, and the high incidence of breast cancer within the same population.
This observation lead the way to discovering the importance of hormonal factors in cancer. His work is a very early example of an epidemiological study of gender differences in occupational cancer research field.

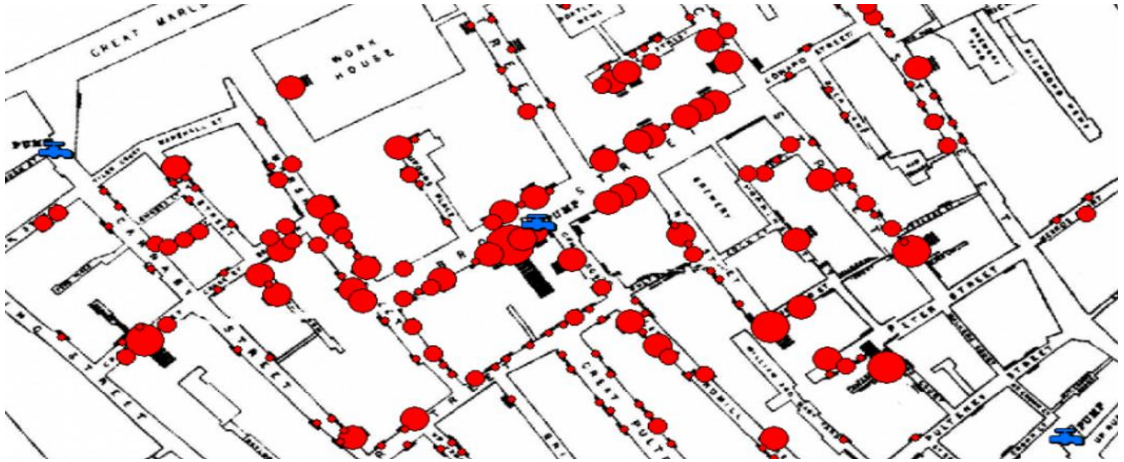
Source: Bernardino Ramazzini, Padua, 1713

Epidemiological surveillance of health effects for etiological research.

Epidemiological surveillance of health effect is a precious tool for etiologic research and risk prevention.

John Snow in 1848, by mapping cholera cases on a London map, lead the way to discovering cholera etiology.





Source: John Snow, London, 1848

Epidemiology of occupational cancers extent. Global burden of diseases 2016

Global Health Metrics

Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016

GBD 2016 Risk Factors Collaborators*

Summary

Background The Global Burden of Diseases, Injuries, and Risk Factors Study 2016 (GBD 2016) provides a comprehensive assessment of risk factor exposure and attributable burden of disease. By providing estimates over a long time series, this study can monitor risk exposure trends critical to health surveillance and inform policy debates on the importance of addressing risks in context.

Lancet 2017; 390: 1345–422

*Collaborators listed at the end of the Article

This online publication has been corrected. The corrected version

Global all age attributable deaths and DALYs, both genders combined (2016).

Occupational carcinogens.
Attibutable deaths: 746,540 cases
DALYs: 20,682,730 years

Change in number of DALYs 2006-2016:
Men +18.7%
Women +17.7%

Source: GDB 2016 Risk Factors Collaborators. Lancet 2017;390:1345-422

Epidemiology of occupational cancers extent. Occupational cancers burden in Great Britain

BJC OPEN

British Journal of Cancer (2012) 107, S3–S7

www.bjcancer.com

Introduction

Occupational cancer burden in Great Britain

Lesley Rushton*[,1], Sally J Hutchings[1], Lea Fortunato[1], Charlotte Young[2], Gareth S Evans[2], Terry Brown[3], Ruth Bevan[3], Rebecca Slack[5], Phillip Holmes[3], Sanjeev Bagga[3], John W Cherrie[4] and Martie Van Tongeren[4]

[1]Department of Epidemiology and Biostatistics, School of Public Health and MRC-HPA Centre for Environment and Health, Imperial College London, St Mary's Campus, Norfolk Place, London W2 3PG, UK; [2]Health and Safety Laboratory, Harpur Hill, Buxton, Derbyshire SK17 9JN, UK; [3]Institute of Environment and Health, Cranfield Health, Cranfield University, Cranfield MK43 0AL, UK; [5]School of Geography, University of Leeds, Leeds LS2 9JT, UK; [4]Institute of Occupational Medicine, Research Avenue North, Riccarton, Edinburgh EH14 4AP, UK

«Overall, 8,010 (5.3%) total cancer deaths in Britain (1,655 in women) and 13,598 (4.0%) cancer registration (3,611 in women) were attributable to occupation».

Estimated attributable fraction (%) by anatomical site.

	Men	Women
Bladder	7.1	1.9
Breast		4.6
Lung	21.1	5.3
Mesothelioma	97.0	82.5
Nasopharynx	10.8	2.4
Sinonasal	43.3	19.8
…		
Total		
Based on deaths	8.2	2.3
Based on incidence	5.7	2.1

Source: Rushton L et al. Occupational cancer burden in Great Britain. Br J Cancer 2012;107:S3-S7

Epidemiology of occupational cancers in women. Jobs and economic sectors majorly involved.

Jobs in the services industries are not usually thought of as hazardous, but many involve exposures to potential carcinogens.

Hairdressers (increased bladder cancer) (exposure to formaldehyde, solvents and other chemicals).

A meta-analysis found an increased risk of multiple myeloma, bladder, lung and larynx cancer.

Published by Oxford University Press on behalf of the International Epidemiological Association
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International Journal of Epidemiology 2009;**38**:1512–1531
doi:10.1093/ije/dyp283

Risk of cancer among hairdressers and related workers: a meta-analysis

Bahi Takkouche,[1,2]* Carlos Regueira-Méndez[1,2] and Agustín Montes-Martínez[1,2]

Source: Takkouche B. et al. Int J Epidemiol. 2009 Dec;38(6):1512-31.

Epidemiology of occupational cancers in women. Jobs and economic sectors majorly involved.

Dry cleaners may be exposed to tetrachloroethylene and trichloroethylene which are considered probable human carcinogens.

Cohort of **dry cleaners** (two-thirds women) exhibited excess mortality from cancers of the bladder, cervix, esophagus, lung and pancreas.

All *EHP* content is accessible to individuals with disabilities. A fully accessible (Section 508–compliant) HTML version of this article is available at http://dx.doi.org/10.1289/ehp.1307055.

Review

Tetrachloroethylene Exposure and Bladder Cancer Risk: A Meta-Analysis of Dry-Cleaning-Worker Studies

Jelle Vlaanderen,[1] Kurt Straif,[2] Avima Ruder,[3] Aaron Blair,[4] Johnni Hansen,[5] Elsebeth Lynge,[6] Barbara Charbotel,[7] Dana Loomis,[2] Timo Kauppinen,[8] Pentti Kyyronen,[9] Eero Pukkala,[9,10] Elisabete Weiderpass,[11,12,13,14] and Neela Guha[2]

Source: Vlaanderen J. et al. Environ Health Perspect. 2014 Jul;122(7):661-6

Epidemiology of occupational cancers in women. Jobs and economic sectors majorly involved.

Female **flight attendants** have found increased risks of breast cancer and malignant melanoma.

Breast cancer risk could be related to the disruption of circadian rhythms or from exposure to cosmic radiation.

But it's difficult to control the study design for other well known breast cancer risk factor (null parity, age at first birth).

Original article

Scand J Work Environ Health. 2016;42(6):538–546. doi:10.5271/sjweh.3586

Breast cancer incidence among female flight attendants: exposure–response analyses

By Lynne E Pinkerton, MD, MPH,[1] Misty J Hein, PhD,[2] Jeri L Anderson, PhD, [1] Mark P Little, DPhil,[3] Alice J Sigurdson, PhD,[3] Mary K Schubauer-Berigan, PhD [1]

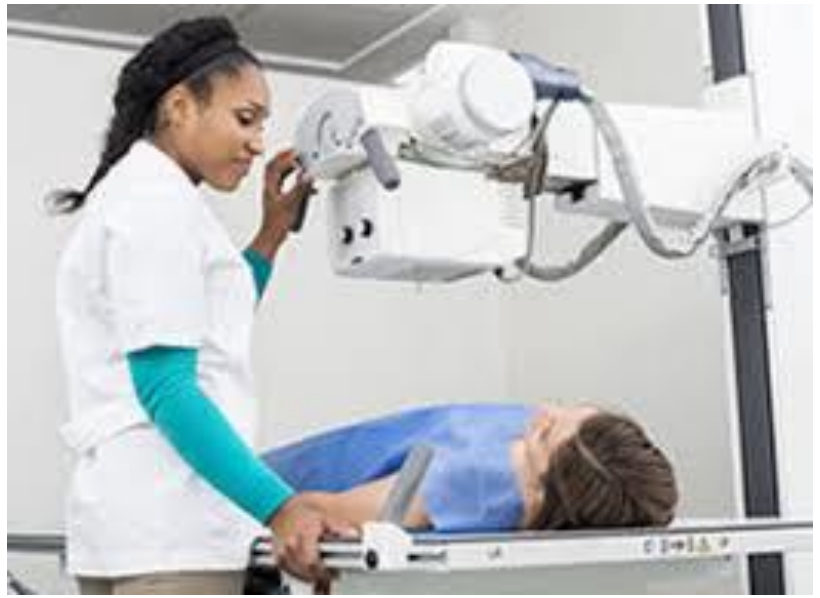
Source: Pinkerton LE. et al. SJWEH. 2016;42(6):538-46

Epidemiology of occupational cancers in women. Jobs and economic sectors majorly involved.

Women as **health care workers** are potentially exposed to antineoplastic drugs, anesthetic gases, ethylene, ionizing radiation and electromagnetic fields.

Excess cancer cases have been observed for leukemia, lymphomas, bladder, lung, breast, brain, ovaries, skin and thyroid cancer.

Radiologic technologists (75% women in US cohorts) have been showed an increased risk for several cancer sites (lung, breast, leukemia) due to exposure to ionizing radiation assisting patients during x-rays.



Article

August 2, 1995

Breast Cancer Among Radiologic Technologists

John D. Boice Jr, ScD; Jack S. Mandel, PhD; Michele Morin Doody, MS

» Author Affiliations

JAMA. 1995;274(5):394-401. doi:10.1001/jama.1995.03530050042030

Source: Boice JR. et al. JAMA. 1995;274(5):394-401.

Focus: Occupational exposure to carcinogens in women. Italy. Context

Most of epidemiological study on carcinogens in workplace are conducted in the male workforce;

Women's employment in Italy has increased by almost 50% over the last 35 years;

Italian law establishes that employers collect data on workers exposure to carcinogens (1A and 1B, ascertained or presumed) and report them to INAIL.

Scarselli et al. BMC Public Health (2018) 18:413
https://doi.org/10.1186/s12889-018-5332-x

BMC Public Health

RESEARCH ARTICLE Open Access

Gender differences in occupational exposure to carcinogens among Italian workers

Alberto Scarselli*, Marisa Corfiati, Davide Di Marzio, Alessandro Marinaccio and Sergio Iavicoli

Abstract

Background: Many carcinogenic chemicals are still used or produced in several economic sectors. The aim of this study is to investigate differences in occupational exposure patterns to carcinogens by gender in Italy.

Methods: Information about the most common carcinogens recorded in the Italian occupational exposures database (SIREP) for the period 1996–2015 was retrieved. Descriptive statistics were calculated for exposure-related variables (carcinogenic agent, occupational group, economic activity sector, and workforce size). The chi-square(χ^2) test was used to verify differences between genders, and logistic regression analysis was performed to evaluate the association between gender and risk of having higher exposure levels, after adjusting for age. Concurrent exposures to multiple carcinogens were investigated using the two-step cluster analysis.

Results: A total of 166,617 exposure measurements were selected for 40 different carcinogens. Exposed workers were only in a small proportion women (9%), and mostly aged 20–44 years (70%) in both genders. Women were more likely to be exposed than men to higher levels for several carcinogens even after correction for age at exposure, and the exposure level was significantly ($p < 0.01$) associated with occupation, economic sector and workforce size. The five main clusters of co-exposures identified in the entire dataset showed a differential distribution across economic sectors between genders.

Conclusions: The exposures to occupational carcinogens have distinguishing characteristics in women, that are explained in part by work and job segregation. Because of the presence of high-exposed groups of female workers in many industrial sectors, further research and prevention efforts are recommended.

Keywords: Gender disparities, Exposure assessment, Occupational health, Surveillance system, Prevention database, Carcinogenic agents

Source: Scarselli A. et al. BMC Public Health 2018;18:413

Focus: Occupational exposure to carcinogens in women. Italy. Methods

Data extract from SIREP (Italian national system on occupational exposure to carcinogens) for the period 1996-2015;

Economic sectors of activity and occupations classified by NACE Rev. 1 and ISCO-88;

Logistic regression model to study the association between gender and exposure (adjusted for age);

Co-exposure assessment by cluster analysis.

RESEARCH ARTICLE Open Access

Gender differences in occupational exposure to carcinogens among Italian workers

Table 2 Gender differences in the risk of having higher occupational exposure levels by exposure-related variables *(Continued)*

Variable	Description	Total	Males (ref.)	Females	M/F Ratio	OR (95% CI) for medium level[a]	OR (95% CI) for high level[a]
29	Manufacture of machinery and equipment nec	5093	4567	526	8.7	0.15 (0.08 to 0.28)†	0.12 (0.05 to 0.30)†
34	Manufacture of motor vehicles	1425	1303	122	10.7	0.95 (0.49 to 1.82)	0.27 (0.10 to 0.74)†
35	Manufacture of other transport equipment	8536	8198	338	24.3	0.32 (0.23 to 0.44)†	0.17 (0.08 to 0.34)†
36	Manufacture of furniture; manufacturing nec	38,097	34,069	4028	8.5	0.61 (0.56 to 0.67)†	0.83 (0.75 to 0.92)†
45	Construction	13,720	13,685	35	391.0	2.68 (1.18 to 6.13)†	2.95 (1.02 to 8.57)†
50	Repair of motor vehicles; retail sale of fuel	2828	2608	220	11.9	1.01 (0.48 to 2.10)	0.45 (0.24 to 0.85)†
51	Wholesale trade and commission trade	1673	1591	82	19.4	0.10 (0.01 to 0.72)†	0.86 (0.42 to 1.76)
52	Retail trade, repair of household goods	2435	2325	110	21.1	0.86 (0.49 to 1.54))	5.03 (2.70 to 9.35)†
74	Other business activities	1620	1534	86	17.8	0.27 (0.11 to 0.68)†	0.24 (0.06 to 0.98)†
90	Sewage and refuse disposal, sanitation	4707	4609	98	47.0	0.08 (0.01 to 0.57)†	–
	Overall	*166,617*	*151,524*	*15,093*	*10.0*	*0.96 (0.92 to 1.01)*	*1.20 (1.13 to 1.27)†*

[a]Low level is the reference group; †Significant at $p = 0.05$ level; OR: Odds ratios; 95% CI: 95% confidence interval; [b]only main sectors are showed; nec: not elsewhere classified; Elementary occupations consist of simple and routine tasks which mainly require the use of hand-held tools

Source: Scarselli A. et al. BMC Public Health 2018;18:413

Focus: Occupational exposure to carcinogens in women. Italy. Findings

A relevant number of exposure measurements were recorded in women (15,093, 10%);

A clear gender segregation by occupation is present (as reported for EU in 2007);

Women present an higher risk to be exposed (OR=1.20; IC95%=1.13-1.27), considering all carcinogens as a whole.

RESEARCH ARTICLE Open Access

Gender differences in occupational exposure to carcinogens among Italian workers

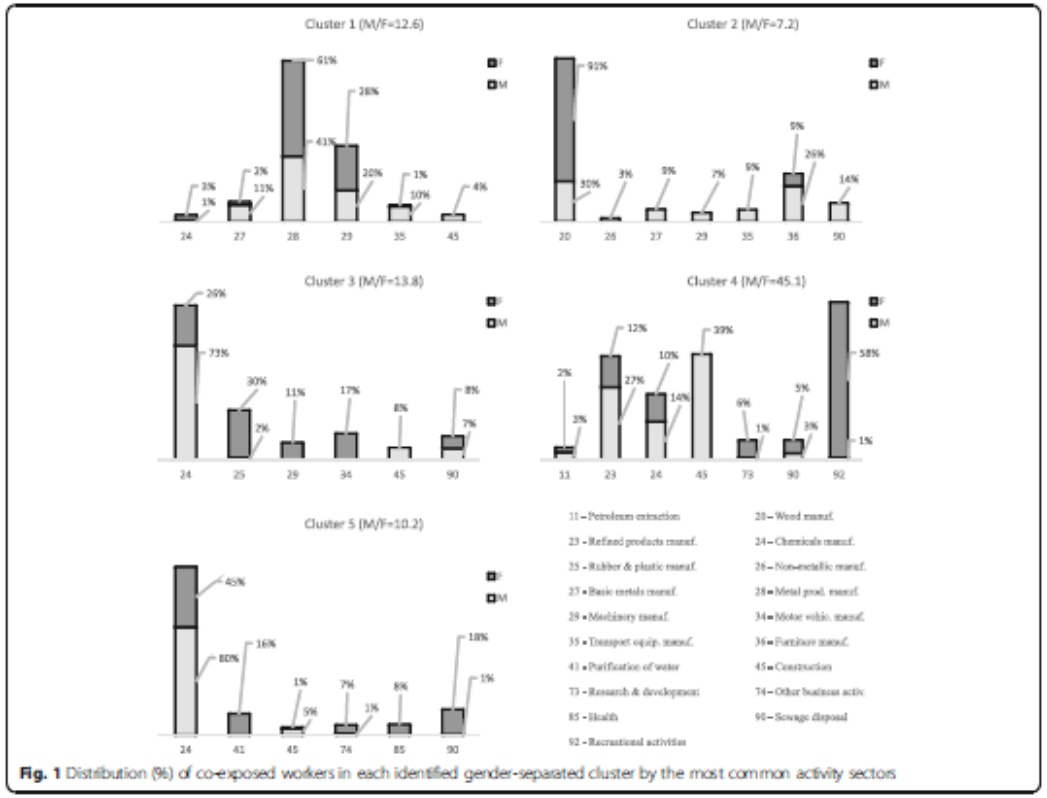


Fig. 1 Distribution (%) of co-exposed workers in each identified gender-separated cluster by the most common activity sectors

Source: Scarselli A. et al. BMC Public Health 2018;18:413

Focus: Occupational exposure to carcinogens in women. Italy. Remarks

Occupational co-exposure to formaldehyde and wood dust in female workers is a critical issue (small size enterprises);

Co-exposure to chromium VI and nickel in manufacturing of metal products and in metallurgy and transport equipment production;

Environmental tobacco smoking (ETS) exposure in women has been found in gambling and betting sectors.

Scarselli et al. BMC Public Health (2018) 18:413
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Keywords: Gender disparities, Exposure assessment, Occupational health, Surveillance system, Prevention database, Carcinogenic agents

Source: Scarselli A. et al. BMC Public Health 2018;18:413

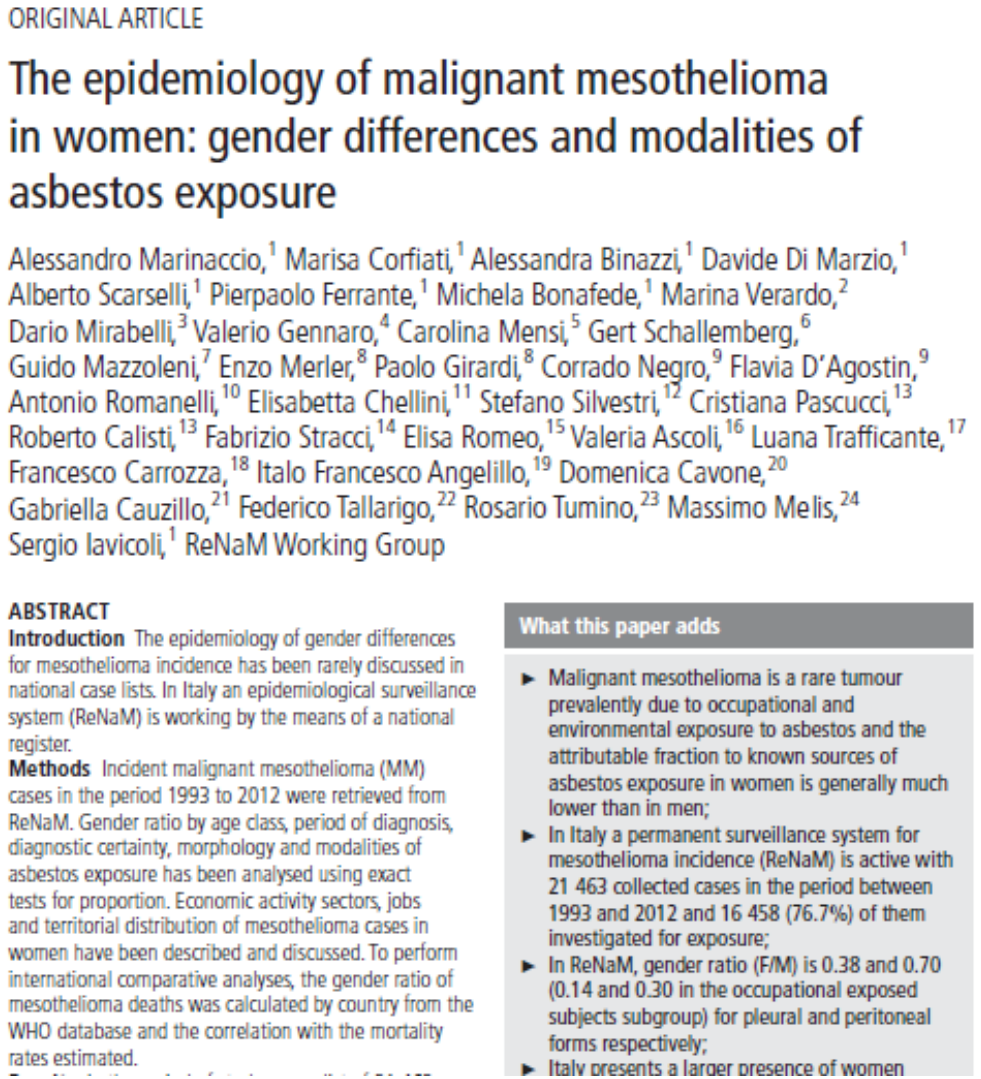
Focus 2: Gender differences in asbestos exposure and mesothelioma cases in Italy.

Asbestos consumption worldwide and specific Italian context;

Italian mesothelioma surveillance system: the national registry (ReNaM);

Occupational and environmental exposure to asbestos in women;

Epidemiological evidence and risk prevention and insurance system connections.



ORIGINAL ARTICLE

The epidemiology of malignant mesothelioma in women: gender differences and modalities of asbestos exposure

Alessandro Marinaccio,[1] Marisa Corfiati,[1] Alessandra Binazzi,[1] Davide Di Marzio,[1] Alberto Scarselli,[1] Pierpaolo Ferrante,[1] Michela Bonafede,[1] Marina Verardo,[2] Dario Mirabelli,[3] Valerio Gennaro,[4] Carolina Mensi,[5] Gert Schallemberg,[6] Guido Mazzoleni,[7] Enzo Merler,[8] Paolo Girardi,[8] Corrado Negro,[9] Flavia D'Agostin,[9] Antonio Romanelli,[10] Elisabetta Chellini,[11] Stefano Silvestri,[12] Cristiana Pascucci,[13] Roberto Calisti,[13] Fabrizio Stracci,[14] Elisa Romeo,[15] Valeria Ascoli,[16] Luana Trafficante,[17] Francesco Carrozza,[18] Italo Francesco Angelillo,[19] Domenica Cavone,[20] Gabriella Cauzillo,[21] Federico Tallarigo,[22] Rosario Tumino,[23] Massimo Melis,[24] Sergio Iavicoli,[1] ReNaM Working Group

ABSTRACT

Introduction The epidemiology of gender differences for mesothelioma incidence has been rarely discussed in national case lists. In Italy an epidemiological surveillance system (ReNaM) is working by the means of a national register.

Methods Incident malignant mesothelioma (MM) cases in the period 1993 to 2012 were retrieved from ReNaM. Gender ratio by age class, period of diagnosis, diagnostic certainty, morphology and modalities of asbestos exposure has been analysed using exact tests for proportion. Economic activity sectors, jobs and territorial distribution of mesothelioma cases in women have been described and discussed. To perform international comparative analyses, the gender ratio of mesothelioma deaths was calculated by country from the WHO database and the correlation with the mortality rates estimated.

What this paper adds

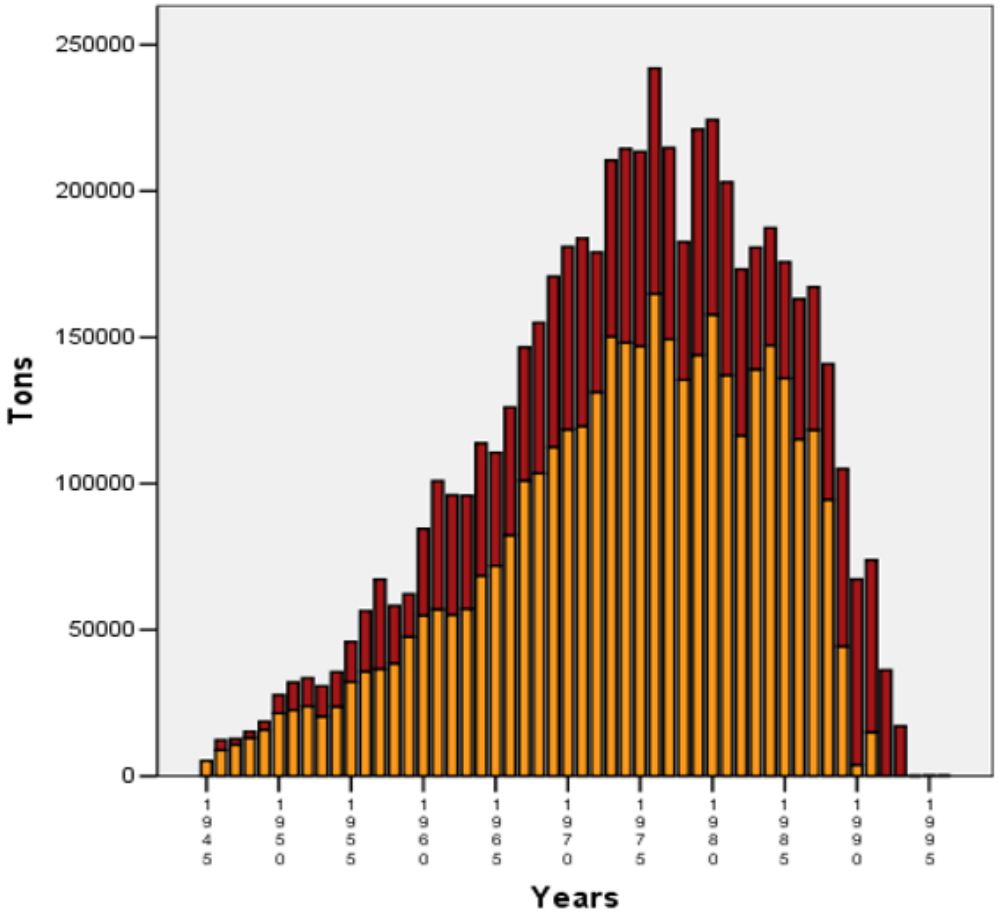
- Malignant mesothelioma is a rare tumour prevalently due to occupational and environmental exposure to asbestos and the attributable fraction to known sources of asbestos exposure in women is generally much lower than in men;
- In Italy a permanent surveillance system for mesothelioma incidence (ReNaM) is active with 21 463 collected cases in the period between 1993 and 2012 and 16 458 (76.7%) of them investigated for exposure;
- In ReNaM, gender ratio (F/M) is 0.38 and 0.70 (0.14 and 0.30 in the occupational exposed subjects subgroup) for pleural and peritoneal forms respectively;
- Italy presents a larger presence of women

Source: Marinaccio A. et al. Occup Environ Med 2018;75:254-62

Cumulative asbestos consumption and Italian context

In Italy the greatest asbestos cave of western Europe (Balangero, TO) has been active until 1990.
Casale Monferrato asbestos cement plant until 1986.

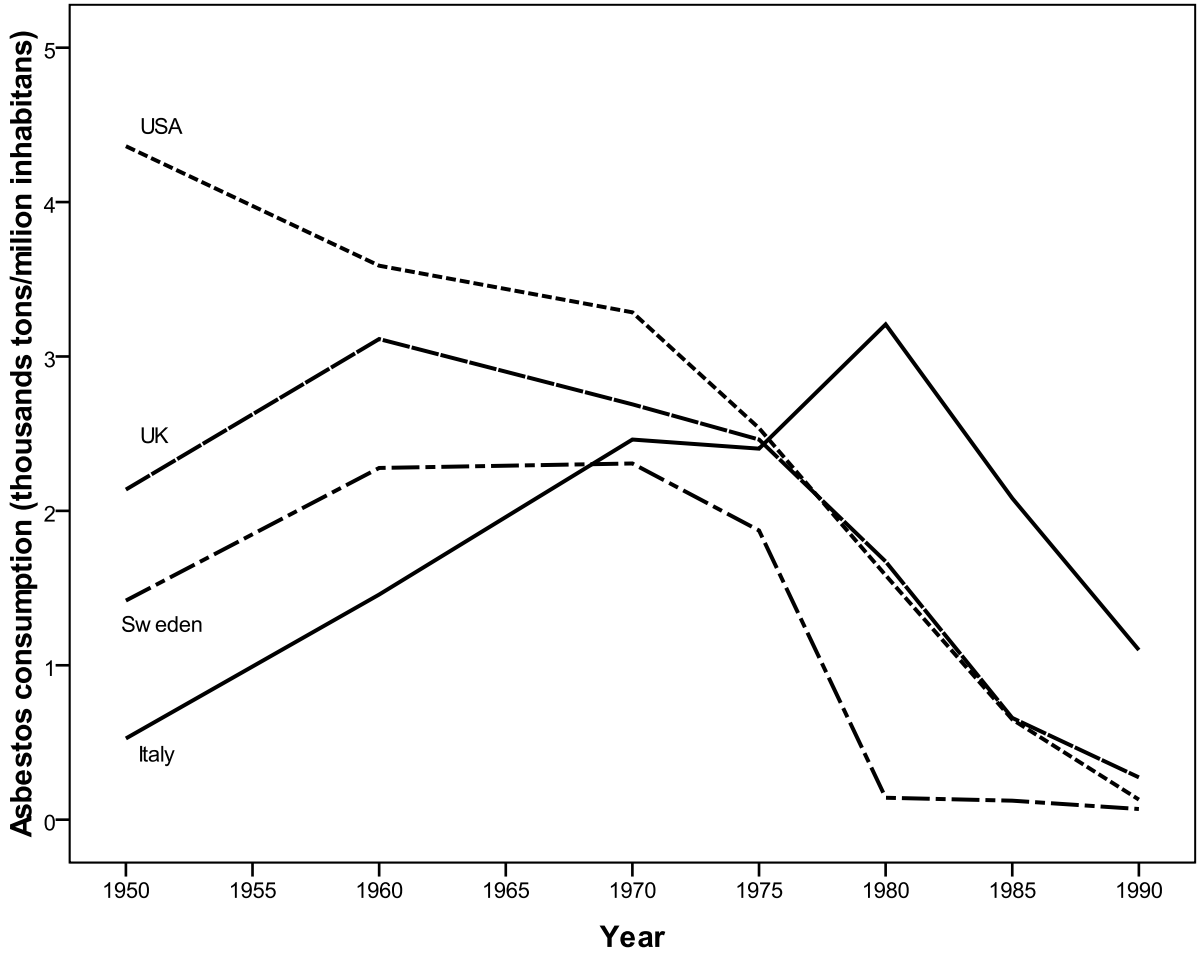
Since 1945 to 1992 (year of the ban) 3,748,550 tons of raw asbestos have been produced (in yellow in figure) and 1,900,885 tons imported (red).



Source: INAIL, ReNaM national reports, different years

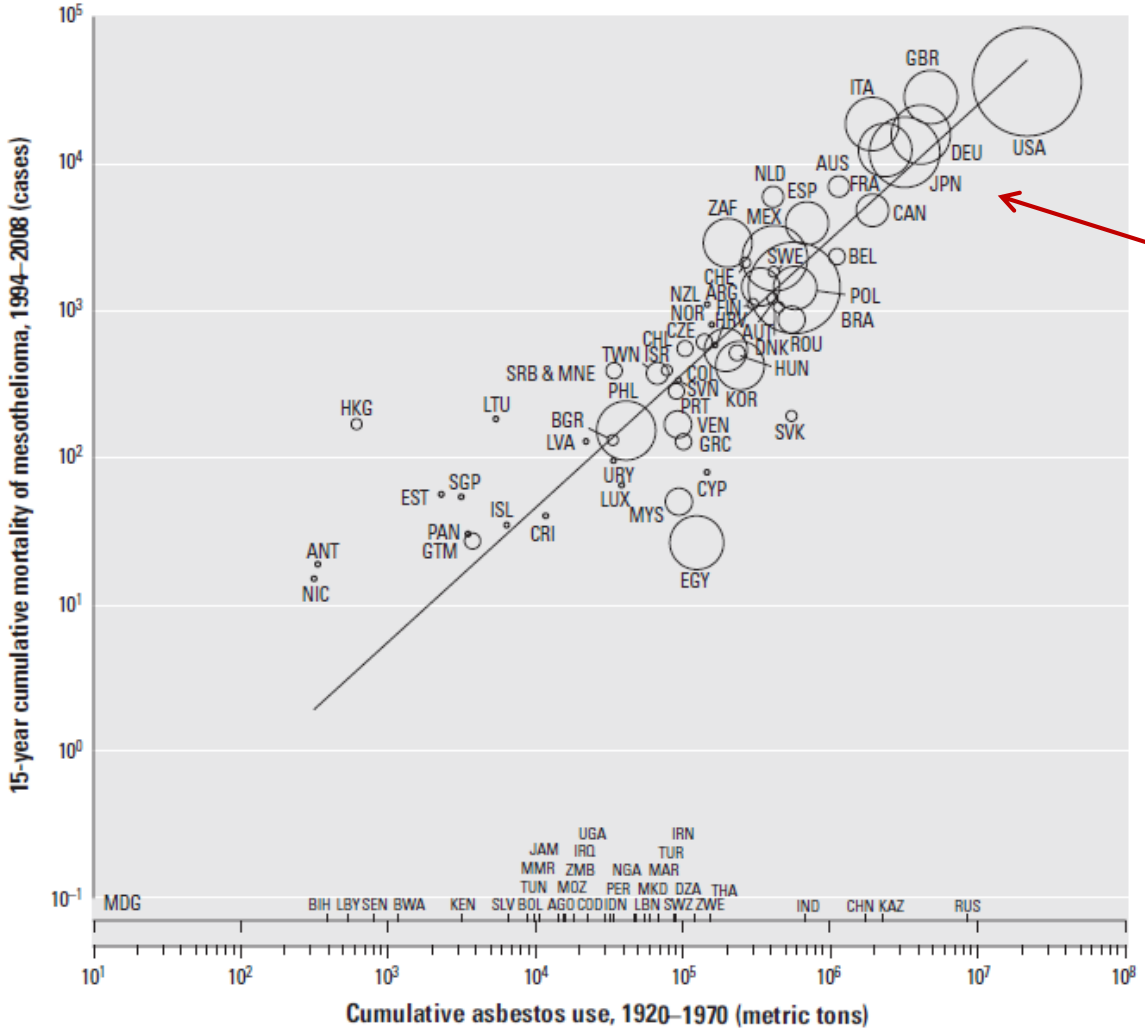
Cumulative asbestos consumption and Italian context

The beginning of decreasing of asbestos consumption took place in Italy mainly ten years after many other industrialized countries.



Source: Marinaccio A, et al. IJC, 2012;130(9):2146-54

Asbestos consumption and ARDs epidemiology



Park EK, et al.
Global magnitude of reported and unreported mesothelioma.
EHP 2011, 119(4):514-8

Environmental Health Perspectives • VOLUME 119 | NUMBER 4 | April 2011

ITALY

This impressive graph shows the linear correlation between asbestos consumption and MM mortality (i), the role of surveillance systems (ii) and specific Italian context (iii).

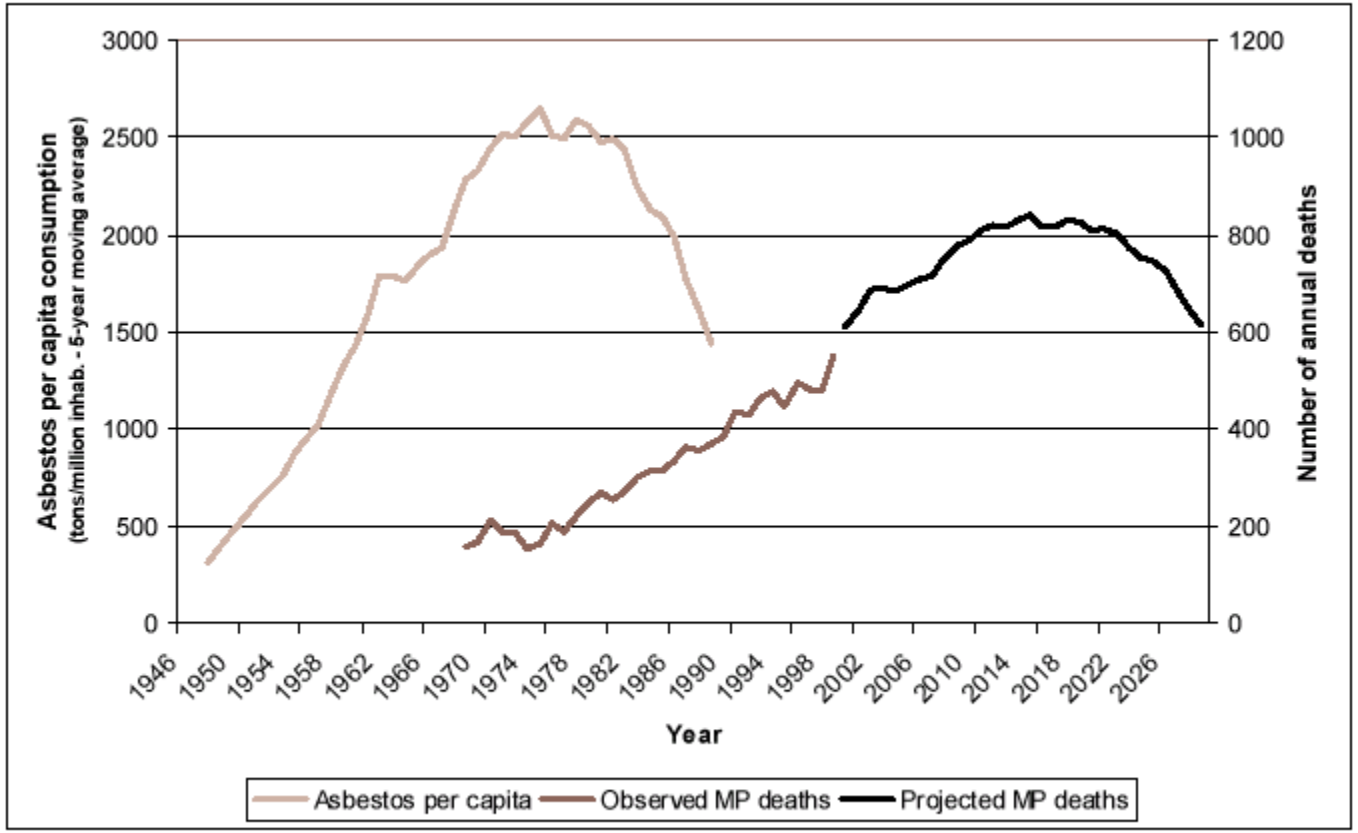
Source: Park EK, et al. EHP, 2011;119(4):514-8. Marinaccio A, et al. IJC, 2012;130(9):2146-54

Italian national mesothelioma registry (ReNaM). Forecast scenario.

On the basis of an age-period-cohort model and including asbestos consumption trend in the past (as esplicative variable), ReNaM have predicted a peak in MM epidemic curve in Italy around 2015-2020.

Recent mortality and incidence data confirm these scenarios.

Figure 2. Italian raw asbestos per capita consumption (five-year moving average - tons per 1,000,000 inhabitants), observed (1969-1999) and predicted (2000-2029) pleural mesothelioma deaths[1] (MP) among men aged 25-89 years old in Italy.



[1] Pleural mesothelioma deaths = pleural cancer deaths * 0.73.

Source: Marinaccio A, et al. IJC, 2005;115(1):142-7

Italian national mesothelioma registry (ReNaM). Structure, aims, procedures.

ReNaM keywords.

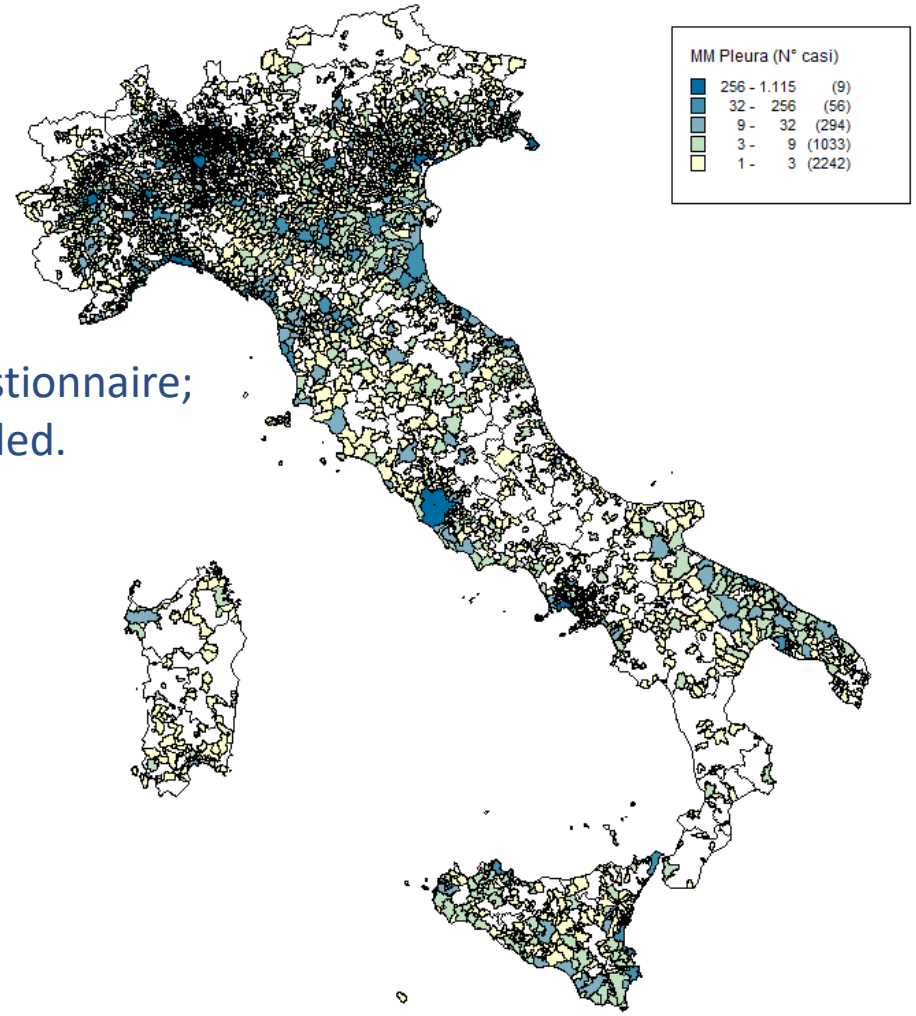
- ✓ National network with regional structure;
- ✓ Active search of MM incident cases (all anatomical sites);
- ✓ Diagnosis specific system of coding;
- ✓ Individual anamnestic analysis on the basis of structured questionnaire;
- ✓ Environmental, familial and leisure activities anamnesis included.

Regional operative centers (COR) in each Italian regions:

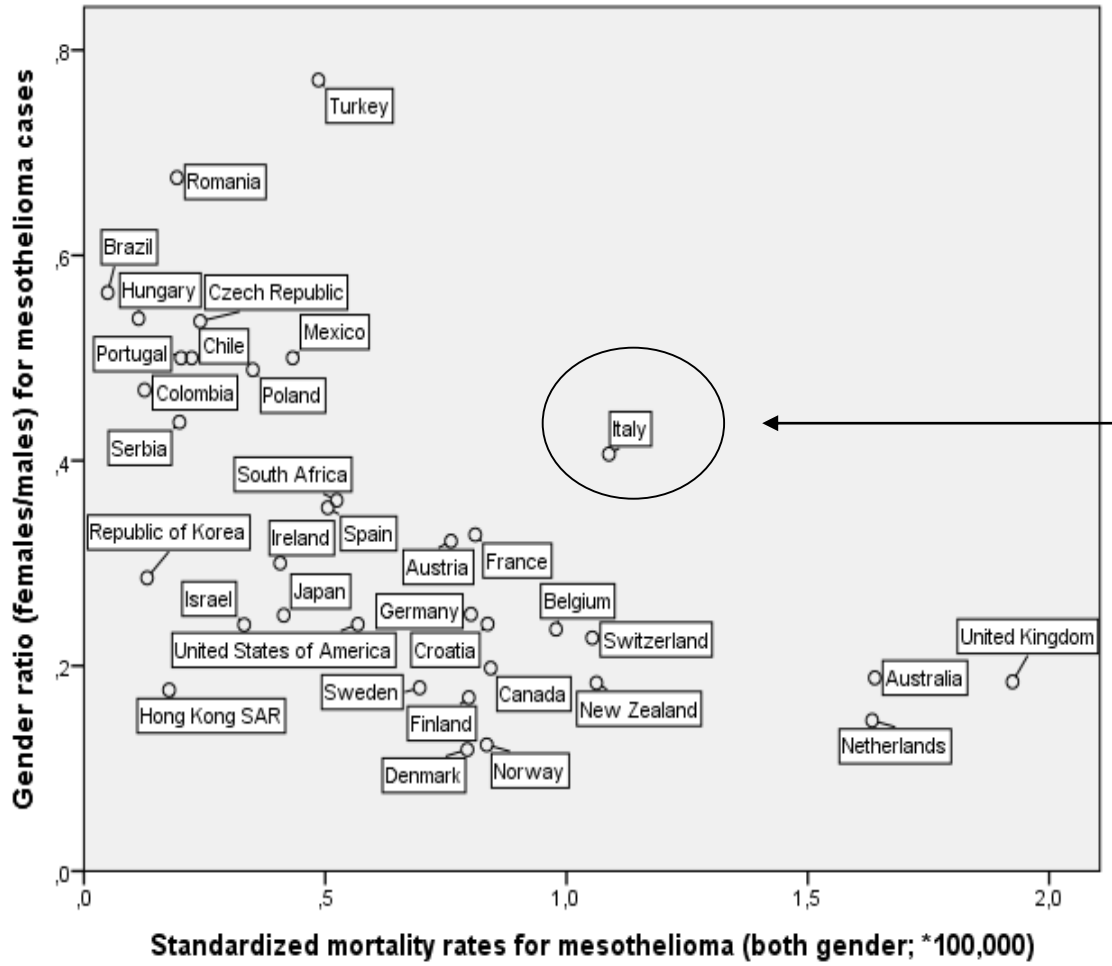
- ✓ Actively searching MM cases;
- ✓ Verifying and coding diagnosis;
- ✓ Interviewing affected people (or care givers);
- ✓ Defining asbestos exposure.

ReNaM:

- ✓ National data analyses;
- ✓ Research projects;
- ✓ Supporting COR and contributing to uniform procedures (Guide Lines).



Focus 2: Gender differences in asbestos exposure and mesothelioma cases in Italy.



ORIGINAL ARTICLE

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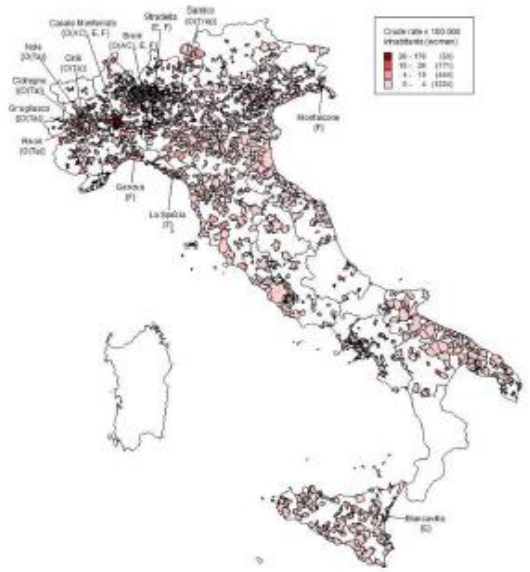


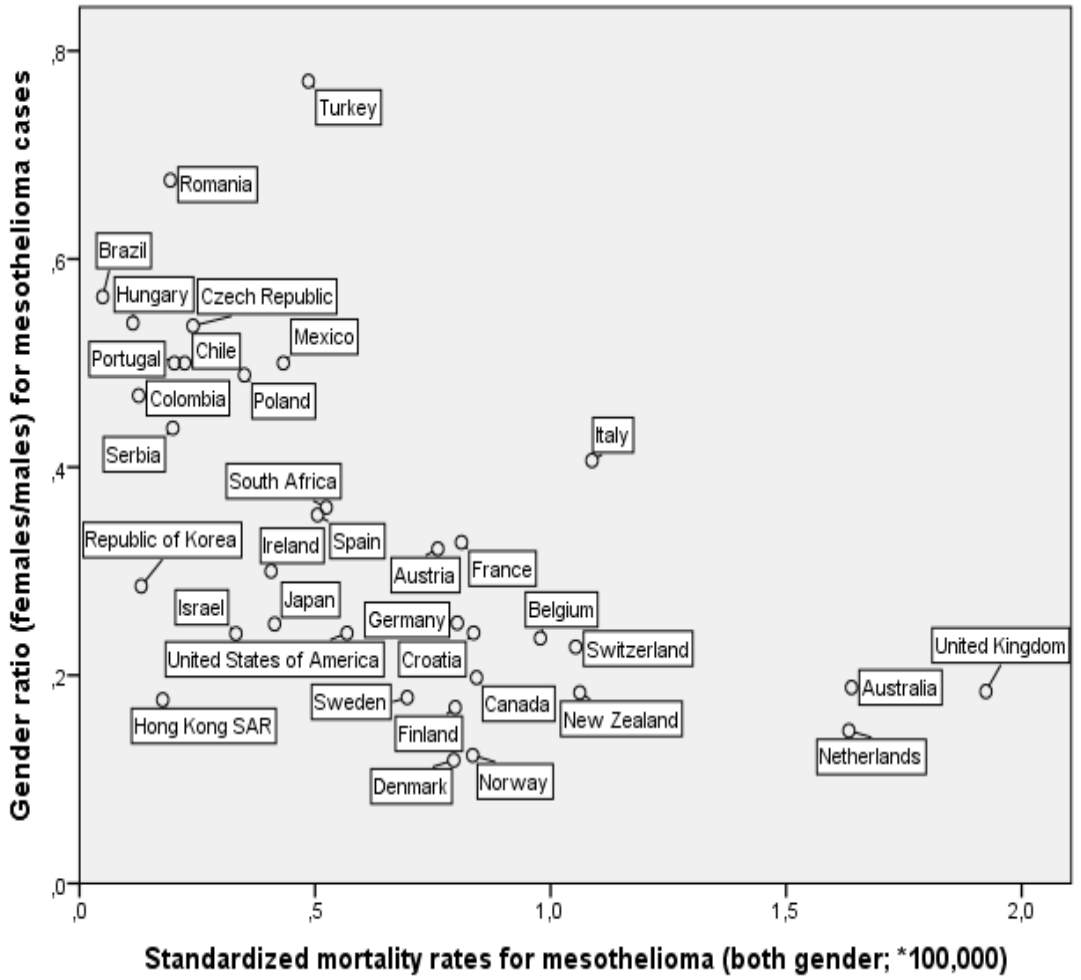
Source: Marinaccio A. et al. Occup Environ Med 2018;75:254-62

Focus 2: Gender differences in asbestos exposure and mesothelioma cases in Italy.

In Italy the presence of female mesothelioma cases is relevant (F/M=0.38 in pleural and 0.70 in peritoneal cases);

The causes of the high incidence of mesothelioma in women are:

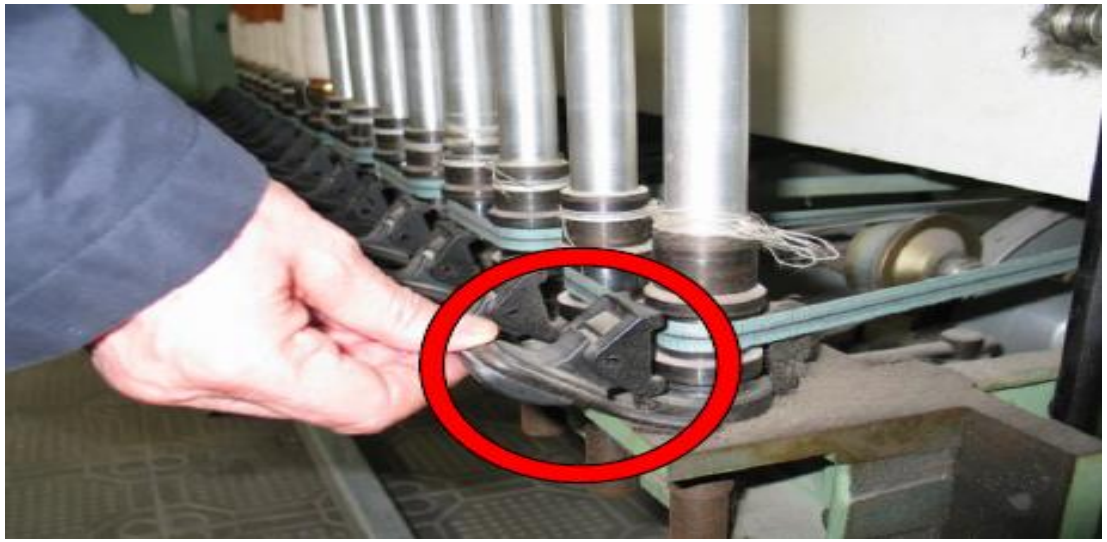
i) the historically high female workforce in textile sector;
ii) the weight of familial and environmental exposure to asbestos;



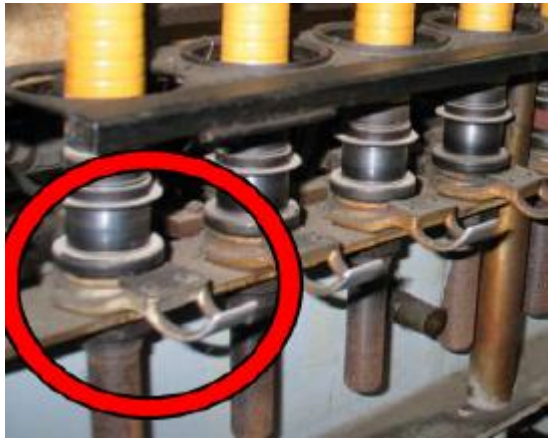
Source: Marinaccio A. et al. Occup Environ Med 2018;75:254-62

Focus 2: Gender differences in asbestos exposure and mesothelioma cases in Italy.

The epidemiological surveillance of mesothelioma cases in Italy has demonstrated the presence of asbestos in the textile (non-asbestos) sector, with an great amount of female workforce.



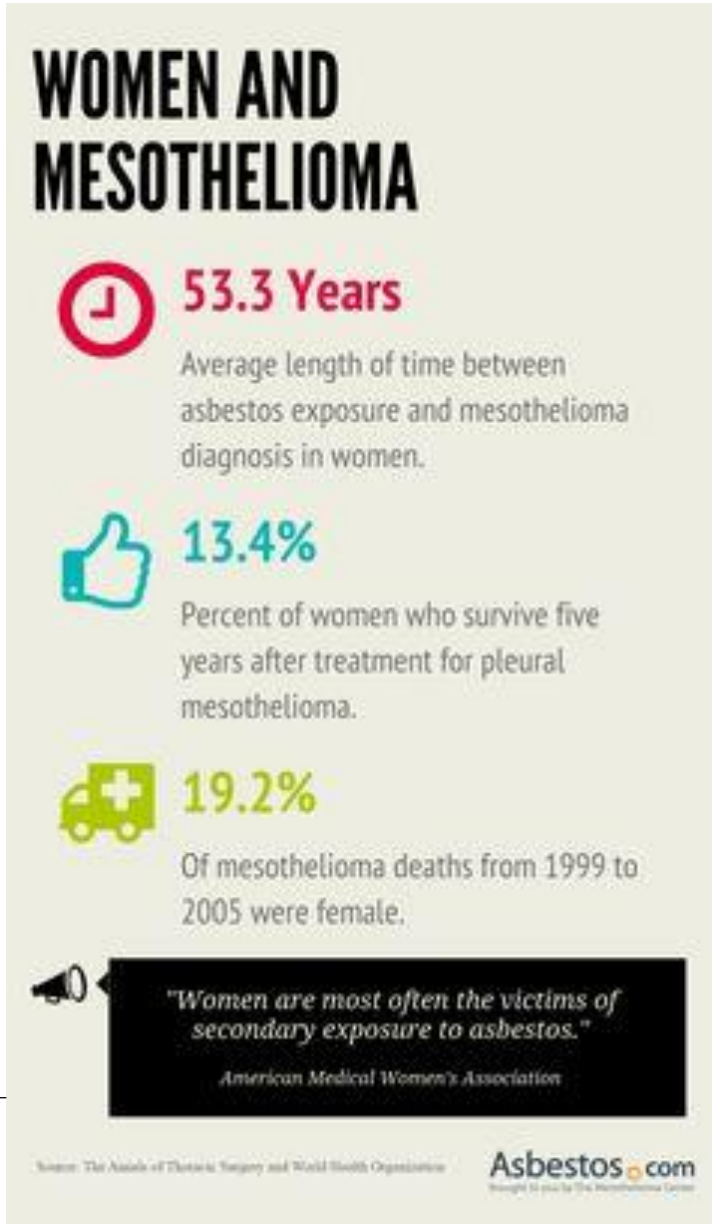
Textile (non-asbestos) workers
for asbestos presence in brake systems



Source: Chiappino Med Lav 2003; 2005. Thank to Carolina Mensi for pictures

Focus 2: Gender differences in asbestos exposure and mesothelioma cases in Italy.

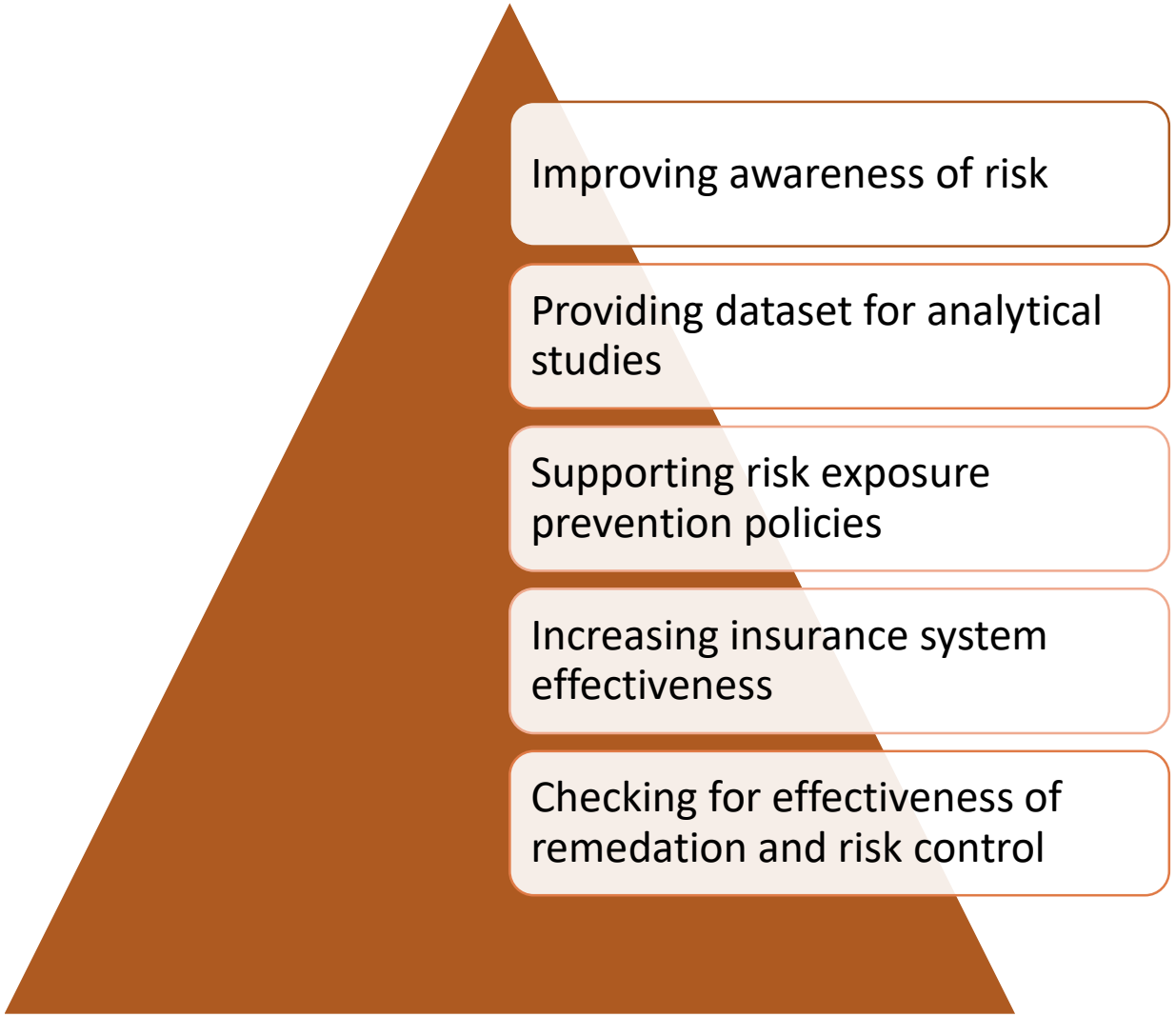
The epidemiological surveillance of mesothelioma cases in Italy (and elsewhere) has demonstrated the risk of mesothelioma in women due to the cohabitation with exposed people (generally, the husbands).



Epidemiological surveillance of occupational cancer. Remarks

Occupational cancer incident cases (and exposure) surveillance is precious for promoting research studies, for planning risk prevention measures, for supporting insurance system effectiveness.

Michael Marmot
“No data, no problem.
No problem, no action.”



Epidemiological surveillance of occupational cancer in women. Remarks

Studies of occupational cancer among women have identified increased risk associated with employment in several job context (agriculture, health care, manufacturing).

Occupational exposure to carcinogens and cancer risk in women remain a real concern in the actual working society.

Occupational cancers among women are largely preventable and deserve attention for our kids' future.

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«Nihil volitum, quin cognitum»

Summa theologica scholastica

Thanks for attention

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