A French silica job-exposure matrix : uses in occupational health surveillance and research

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Background : the Matgéné program

- Created in 2004 and directed by the Occupational Health Department of the French Institute for Public Health Surveillance

- To elaborate JEM adapted to the French general population

- Each JEM assesses occupational exposure for a specific agent, following a standardized method :
    1) Documentary research on the agent
    2) Selection of [occupation x activity] combinations potentially exposed
    3) Exposure assessment

- Main strengths :
    - JEMs are exhaustive
    - Cover the exposure periods from 1950 to nowadays,
    - Provide accurate assessment : at least 2 exposure indices (probability and level of exposure)

The silica job-exposure matrix (CS-JEM) : definition

- **Respirable dust of free crystalline silica** SiO_2
  - IARC: group 1, carcinogenic to humans (1997); EU (CMR): unclassified
  - **Respirable dust :** diameter < 4 µm
  - Exclude silicates (SiO_4 with diverse metallic oxides inserted) and free amorphous silica (SiO_4 without regular structure)

    ⇒ Mainly **quartz** (N° CAS : 14808-60-7) and cristobalite (N° CAS : 14464-46-1)
- **Different versions of JEMs available** with national and international occupation and industry classifications :
  - PCS2003*NAF2003
  - PCS1994*NAF2000
  - ISCO1968*NAF2000
  - ISCO1968*ISIC1975

The CS-JEM : exposure indices

- **Probability** : % of workers, in a given job, exposed to respirable free crystalline silica dust. If <1%, job not exposed.
- **Frequency** *:* % total work time that the operator spends at tasks causing exposure. If <1%, job not exposed.
- **Intensity of exposure during tasks**: based on exposure measurements

Class	mg/m^3	ppm
1	0.02* - 0.1	0.008 – 0.04
2	0.1** - 0.5	0.04 - 0.2
3	0.5 - 1	0.2 – 0.4
4	> 0.1	> 0.4

**below 0.02 mg/m^3, workers are considered as not occupationally exposed to silica (corresponding to the level found in the general environment)*

***Quartz TLV-TWA*

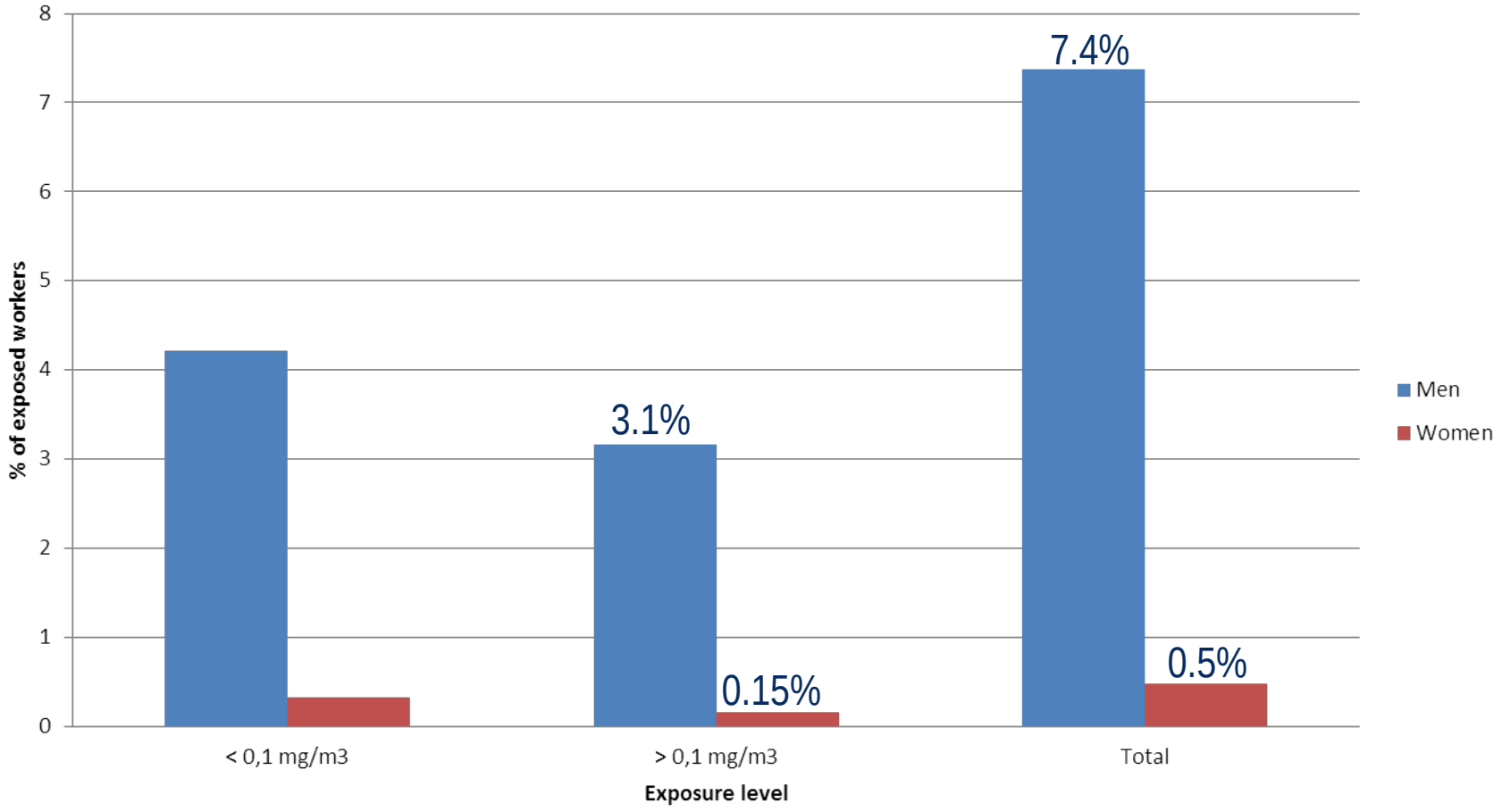
The CS-JEM : Periods from 1947 to 2007

Industry	Periods	Reason
Mines	1947-1960	Average date of implementation of the 30/11/1956 instruction that recommended effective preventive techniques for extraction
	1961-1980	Average date of implementation of the 15/12/1975 circular on prevention of pneumoconioses
	1981-2007	
Quarries	1947-1960	Average date of implementation of the 30/11/1956 instruction that recommended effective preventive techniques for extraction
	1961-1995	Average date of implementation of the 02/09/1994 decree that defined a reference dust level and then classes of dust levels
	1996-2007	
Industrial and construction settings	1947-1970	Global improvement in working conditions in France in industrial settings
	1971-1985	Average date of implementation of the 21/03/1983 circular that sets forth indicative TLV-TWA
	1986-1998	Average date of implementation of the 10/04/1997 decree that made mandatory the TLV-TWA recommended in the 21/03/1983 circular
	1999-2007	

Uses of the CS-JEM (1)

- Estimate prevalence
  - For a given year
  - Lifetime prevalence
  - By industry, socio-occupational category, region, age classes etc…

Estimation of prevalence by exposure level in 2006 (French population Census)



Prevalence of lifetime exposure in 2007 by maximum level of exposure during their working life calculated with a large sample of occupational calendars (N≈28500)

Exposure level*	Men	Women
	% exposed [95% CI]	% exposed [95% CI]
<0.02 mg/m^3	**4.84** [4.29-5.39]	**0.40** [0.25-0.54]
0.02-0.1 mg/m^3	**4.96** [4.36-5.57]	**0.16** [0.06-0.25]
0.1-0.5 mg/m^3	**5.50** [4.86-6.15]	**0.18** [0.07-0.29]
0.5-1 mg/m^3	**0.25** [0.11-0.38]	**0.02** [0-0.06]
> 1 mg/m^3	**0.02** [0-0.06]	-
All level	**15,6** [14.66-16.54]	**0,75** [0.54-0.96]

Prevalence of silica exposure in 2006 among men by industry (ISIC 2003)

Uses of the CS-JEM (2)

- Assess silica exposure in epidemiological studies
  - Espri study : estimation of lifetime prevalence of exposure among craftsmen retired between 2004 and 2008 for research on an adapted medical survey (Homere J, et al. InVS 2014)
  - Icare study : risk estimation in epidemiological study on head and neck cancer (Paget-Bailly S, et al. Occup Environ Med. 2014)
- Estimate the fraction of lung cancer attributable to silica exposure (Levin's formula with prevalence estimated with the CS-JEM and relative risk identified in the French and international scientific literature)
- Help occupational medical team to identify past exposure (http://www.exppro.fr)

Conclusion and perspectives

- Multiple applications to describe and quantify occupational exposure to free crystalline silica
- It can be updated to 2015 (new relevant regulation especially in quarry) and adapted in more recent national or international classifications (ex : NAF2008/ISIC 2008; ISCO 2008)
- Available with the JEM :
  - Technical guide
  - Booklet (in French and in English)
  - The JEM in the different versions

Freely accessible on http://www.exppro.fr or on request at dst-matgene@invs.sante.fr

- Other JEMs available via Matgéné program (http://www.exppro.fr) :
  - Dust : cement, leather, flour
  - Fibers :asbestos, mineral wool (wool glass,slag wool and rock wool), refractory ceramic fiber
  - Solvents : chlorinated, petroleum based, oxygenated
  - In progress : formaldehyde, night work

THANK YOU FOR YOUR ATTENTION

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