Epidemiology

# Assessing historical exposure is like solving a mystery

**H Kromhout**

Commentary on the paper by Johansen *et al* (see page 434)

Historical exposure assessment for epidemiological studies has always been a great challenge for occupational hygienists and exposure assessors. In the paper by Johansen and colleagues[1] published in this issue of the journal, the authors describe what they call ''history science methods'' for exposure assessment for occupational health studies. The paper reads likes a detective story, with this exception that not only the culprits (exposed) have to be identified but also the innocents (non-exposed). Their approach is unconventional, given that they start from very unlikely sources for exposure assessment such as census data, telephone books, and biographies. The census was even the sampling frame, because identifying a cohort of small shop owners and employees through regular means (approaching companies, employer's organisations, pension funds) was impossible. Instead the authors started with the computerised 1970 Danish census data. Of course these files contained a personal identification number (so typical for the Scandinavian countries and almost non-existent in most other countries) with which data linkage became an option. Unfortunately (or luckily) the researchers had to go beyond the electronic files, because the available job codes in the files were not detailed enough to separate dry cleaners from laundry workers and dyers. The personal identification number enabled linkage to the Danish Cancer Register and so case-control studies nested within a general population sample could be consequently designed.

After cases and controls were identified, it was however still unclear who was exposed and who was not (the plot still had to be solved). The researchers were lucky to learn that in the dungeons of the Danish National Archives the actual filled-in census forms containing free text on employment were still available. This enabled the researchers to partly assess the exposure status of cases and controls by separating dry cleaners from laundry workers.

For the dry cleaners, intensity and duration of exposure was estimated through length of employment and number of people employed at their workplaces. This information was partly obtained from pension funds (employees) and a biographical registration of self-employed dry cleaning and laundry workers unearthed in the Royal Library. The length of employment for self-employed not present in the biography, was estimated from the number of years their name was listed as an owner in the telephone books (also available in the Royal Library of Denmark). The occupational codes together with size of the company were used to distinguish between (a) dry cleaners and other workers in small shops (less than 10 employees), (b) other workers in dry cleaning shops with more than 10 individuals, and (c) unexposed laundry workers.

The decision to combine dry cleaners with workers from small shops with other jobs was a very sensible one, since, as was noted in the IARC monograph on dry cleaning, ''differences in personal exposure to tetrachloroethylene between dry cleaning plants and shops are often many times larger than the differences between machine operators and other staff within dry cleaning premises''.[2] This was based on statistical analyses of measurement data from three dry cleaning shops in the Netherlands[3–5] and 12 dry cleaning shops in the USA[6] for which repeated personal measurement data was available in the WAUNC database.[7] In figs 1 and 2 the measurement results of these 12 shops are broken down by, respectively, job and shop. What is obvious from the graphs was confirmed in the analyses of variance that hardly showed between-job variability in average exposure within a shop, but a large difference in average exposure between shops. This led to the conclusion that applying fixed multipliers for job titles in the calculation of cumulative exposure to tetrachloroethylene will introduce severe misclassification in this industry when factors that modify exposures in specific plants and shops are not taken into account.[2]

Johansen *et al* moved from the Royal Archives to the archives of the Labour Inspection Agency, the Danish Medical Association, and the National Institute of Occupational Health for reports on poisoning cases and measurements of tetrachloroethylene. The returns of this exercise were relatively meagre given that most of the measurements were short term measurements and not stemming from representative sampling strategies or the period of interest (1964–76). Measurements made by the Danish Technological Institute in 1979–80 appeared to be most valuable, and additional measurement results were obtained from a Scandinavian database.

This inconceivable wealth of information obtained by the authors was consequently used to sketch a very detailed picture of the state of affairs in dry cleaning in Denmark around 1970 (using the information obtained for the controls). The numbers of workers in dry cleaning shops, the number of dry

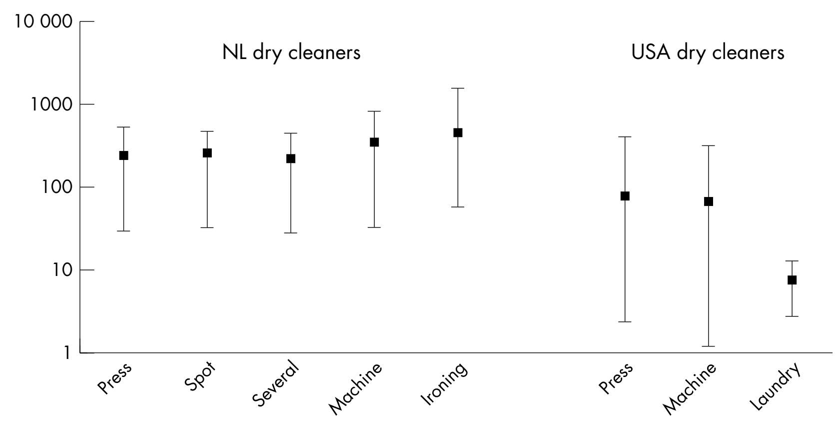


**Figure 1** Range and average (AM) exposure of dry cleaners in the Netherlands and in the USA by job (NL: 5 job codes, 23 workers, 113 measurements; USA: 3 job codes, 13 workers, 58 measurements).

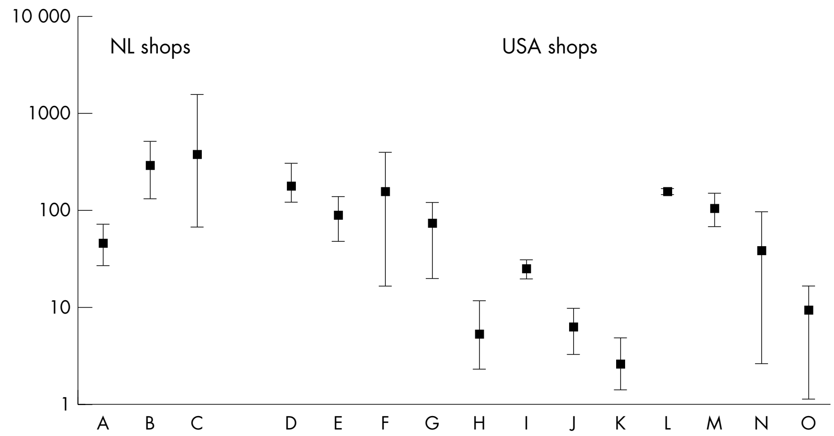


**Figure 2** Range and average (AM) exposure of dry cleaners in the Netherlands and in the USA by dry cleaning shop (NL: 3 shops, 23 workers, 113 measurements; USA: 12 shops, 13 workers, 58 measurements).

cleaners, the average number of dry cleaning machines per shop, the number of tons of tetrachloroethylene used by these shops, and the average exposure in a shop are just part of this very detailed picture. The authors were able to validate some of their estimates satisfactorily through additional sources of information. They also convincingly claim that the exposure in dry cleaning shops Denmark was considerably lower than in the USA in this time period.

The critique on the lack of valid exposure data in studies addressing the carcinogenicity of tetrachloroethylene[8] will be irrelevant for the Danish case-control study. One might only hope that the authors' decision to assume the exposure level to be constant from 1964 to 1979 was only part of the exposure assessment strategy for the case-control study, since differences between shops such as lay-out, ventilation, and dimensions of the shop, to name a few, will have resulted in shops with distinctly different exposure levels (see fig 2).

Contrary to what the authors claim, I think that we in occupational health epidemiology do usually search for literature outside the "Medline world".[9] Unfortunately the wealth of data available to the authors in Denmark is something exposure assessors in other countries can only dream of. Nevertheless, the authors have set the standard for the use of history science in exposure assessment that others should strive for. Ironically this paper comes from the same country where recently the national occupational hygiene society ceased to exist. More disadvantaged exposure assessors (such as, for instance, from my country, where the Ministry of Social Affairs and Employment does not even keep copies of their yearly updated Occupational Exposure Limits lists) might consider a move to Denmark.

*Occup Environ Med* 2005;**62**:429–430.
doi: 10.1136/oem.2004.019158

Correspondence to: Dr H Kromhout, Environmental and Occupational Health Division, Institute for Risk Assessment Sciences, Utrecht University, PO Box 80176, 3508 TD Utrecht, Netherlands; H.Kromhout@iras.uu.nl

Competing interests: none declared

## REFERENCES

1. **Johansen K**, Tinnerberg H, Lynge E. Use of history science methods in exposure assessment for occupational health studies. *Occup Environ Med* 2005;**62**:434–41.
2. **International Agency for Research on Cancer (IARC)**. *Dry cleaning, some chlorinated solvents and other industrial chemicals*, Vol 63. Lyon: IARC, 1995.
3. **van der Tuin J**, Hoevers W. *Perchloroethylene in dry cleaning services* (TNO Report F1560). Rijswijk, TNO, 1977a (in Dutch).
4. **van der Tuin J**, Hoevers W. *Perchloroethylene in dry cleaning services* (TNO Report F1590). Rijswijk, TNO, 1977b (in Dutch).
5. **van der Tuin J**, Hoevers W. *Perchloroethylene in dry cleaning services* (TNO Report F1560). Rijswijk, TNO, 1979 (in Dutch).
6. **Petreas MX**, Rappaport SM, Materna BL, *et al*. Mixed exhaled air measurements to assess exposure to tetrachloroethylene in dry cleaners. *J Exp Anal Environ Epidemiol* 1992;(suppl 1):25–39.
7. **Kromhout H**, Symanski E, Rappaport SM. A comprehensive evaluation of within-and between-worker components of occupational exposure to chemical agents. *Ann Occup Hyg* 1993;**37**:253–70.
8. **Mundt KA**, Birk T, Burch MT. Critical review of the epidemiological literature on occupational exposure to perchloroethylene and cancer. *Int Arch Occup Environ Health* 2003;**76**:473–91.
9. **Burstyn I**, Kromhout H, Cruise PJ, *et al*. Designing an international industrial hygiene database of exposures among workers in the asphalt industry. *Ann Occup Hyg* 2000;**44**:57–66.

Epidemiology

# Silica: déjà vu all over again?

**K Steenland**

## Commentary on the paper by Brown and Rushton (see page 446)

Brown and Rushton[1] have conducted a retrospective cohort mortality study of 2700 workers in the industrial sand industry. Work in the industrial sand industry results in exposure to crystalline silica, and the focus of the study was whether exposure to silica causes lung cancer. Retrospective exposure assessment, based on air measurements since 1978, and some assumptions about exposure before then, was used to estimate exposure levels for different jobs in the industry over time. The resulting job-exposure matrix was used to assign estimated exposure levels to each worker and to estimate cumulative silica exposure, which is commonly the exposure measure of interest for chronic diseases such as lung cancer.

Brown and Rushton did not find an excess of lung cancer in this cohort compared to the general population (lung cancer SMR 0.99, 77 deaths), nor did they find any excess silicosis (only two silicosis deaths were observed). Furthermore, they did not find a positive exposure-response trend for lung cancer by cumulative exposure category (rate ratios of 1.0, 1.24, 1.42, and 0.88 by increasing exposure).

Should this negative result be considered surprising? After all, the International Agency for Research on Cancer (IARC) declared in 1997 that crystalline silica was a group I (definite) human carcinogen, based on lung cancer findings across a large number of existing occupational studies and positive animal studies.[2] The National Toxicology Program (NTP) (www.ntp.niehs.nih.gov/ntp/roc/toc11.html) in the USA followed this by declaring silica a known human carcinogen in 2000. Our own subsequent pooled analysis of 10 large silica exposed cohorts (65 000 workers, 1000 lung cancer deaths) found a significant positive exposure-response