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Malignant pleural mesothelioma among Swiss furniture workers

A new high-risk group

by Christoph E Minder, PhD, John-Paul Vader, MD¹

MINDER CE, VADER J-P. Malignant pleural mesothelioma among Swiss furniture workers: A new high-risk group. *Scand J Work Environ Health* 14 (1988) 252–256. Within the framework of a research project concerning occupational mortality, attention was drawn to a highly significant standardized mortality ratio for mesothelioma among furniture workers. From information drawn from the mortality records for the years 1979–1985 and from the 1980 national census, the number of pleural mesotheliomas among this occupational group was examined. The expected number of deaths from pleural mesothelioma among Swiss furniture workers for this period was 4.4; the observed number was 12. This finding indicates a 2.7-fold relative risk ($P=0.004$) for death due to these cancers among Swiss furniture workers.

Key terms: asbestos, furniture workers, mesothelioma, methodology of mortality studies, numerator-denominator bias, wood dust, wood working.

Our group has analyzed Swiss mortality data in order to produce occupation-specific standardized mortality ratios and proportional mortality ratios for a statistical report on cancer mortality by occupation in Switzerland. In this as yet unpublished screening exercise, there was a highly significant standardized mortality ratio (SMR) of 366 ($P=0.00001$) and proportional mortality ratio (PMR) of 344 ($P=0.00002$) for deaths due to respiratory cancers, excluding those of the lung and bronchus, among furniture workers between 1979 and 1982. Further examination of this association by site indicated a possible excess of pleural cancer. The present article focuses on the association between furniture making and pleural mesothelioma.

Malignant pleural mesotheliomas are rare, and reliable figures for incidence are frequently lacking, or those available are based on gross estimates and extrapolations. In Switzerland, the annual incidence is estimated to be 1.5 cases per 100 000 persons (15). Among persons not exposed to asbestos, the incidence has been estimated to be about one case per million of the population (14).

The relative risk for these fatal neoplasms is greatly increased among occupations in contact with asbestos dust, for which it may be as high as 1 000 (14). Among the occupations shown to present an increased risk are asbestos mining, work in asbestos mills and factories, insulation manufacturing and installation, gas mask manufacturing, and shipbuilding (6).

Material and methods

The data for our study were drawn from the death register of Swiss men aged 30–74 years in 1979–1985. Deaths due to pleural mesothelioma were defined as those for which the death certificate mentioned code 163.0 of the International Classification of Diseases, eighth revision (ICD-8) (3) as the primary cause. Deaths due to this cause were identified by computer enumeration for the general male working population and for furniture workers.

In Swiss mortality statistics occupation is coded according to a three-digit system (4), which is a reduced version of the census classification (2). Persons whose death certificate mentioned the code 306 (Schreiner, Tischler) for the item “occupation of the deceased” are called “furniture workers” in the present article. (See the Results section.) The reference population was defined as all Swiss men 30–74 years of age who indicated a clearly defined occupation on the 1980 census. Occupation can be coded in three different places on the census form. Our reference population included those who were professionally active in a particular occupation. If no clear-cut occupation was indicated but the person specified that he had retired from a certain occupation, then that profession was used. Only in the small percentage of cases where no well-defined occupation was available in either of these two coded areas did we check the person’s training for a particular occupation. If so, then that was used. The risk population of furniture workers consisted of those whose occupational code was 306–312 on the census file (Schreiner, Bauschreiner, Fensterschreiner, Möbelschreiner, Modellschreiner, Anschläger und sonstige Spezialschreiner) which, by the rules of coding, should correspond exactly to the code 306 used on the death certificates. All enumerations were done by computer

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from the official death register tapes of 1979 to 1985 and the official census tape of the 1980 census.

The coding quality for occupation was checked from a random sample of 3 058 deaths among men in 1981; these deaths were linked to the respective 1980 census document. We checked the quality of the diagnosis of cases by tracing the cancer register and hospital records of all seven cases of death-certificate mesothelioma found for furniture workers in the age bracket 45 to 79 years between 1979 and 1982, as well as by using a set of records culled from 12 478 linked death and hospital records mentioning mesothelioma from 1979.

Results

General

In the seven years of the study, 1979–1985, 402 deaths (307 men and 95 women) were attributed in Switzerland to malignant pleural mesothelioma, listed as the *primary cause*. Of these, 203 were among Swiss working men 30–74 years of age. This figure represents 0.1 % of all deaths among men during this four-year period.

In the 1980 census, 1 265 677 Swiss men between the ages of 30 and 74 years indicated a clearly defined occupation, of which 23 549 were furniture workers; 4.0 % of this age bracket could not be classified by occupation (total 1 318 428 Swiss men aged 30–74 years). A total of 58 298 deaths of Swiss men aged 30 to 74 years was registered in 1979–1982, of which 54 366 could be classified according to occupation, while 6.7 % could not.

Relative risk

An expected rate of mortality from pleural mesothelioma in the Swiss male population as defined could thus be 203/1 265 677 or 16.0/100 000. The observed number for furniture workers was 12 deaths for a population of 23 549 or a rate of 51.0/100 000. This figure gives an estimated relative risk of 51.0/16.0 or 3.2. The odds ratio would be 3.2 [95 % confidence interval (95 % CI) 1.71–5.71, $P = 0.00004$], and the SMR 271

(95 % CI 240–473, $P = 0.004$) (7). Table 1 shows the age distribution of cases and the corresponding at-risk numbers of the reference population and the furniture workers. These figures were used as the basis for computing the SMR.

Quality of diagnosis

Although overreporting of mesothelioma has at times been observed (6), the most serious problem is underreporting, with detection rates often on the order of 50 % (13). A Swiss study by Forster (5) shows that overreporting by 20 to 30 % is probable. There is, however, no reason to believe that these phenomena operate to favor furniture workers among mesothelioma deaths selectively. Under the assumption of no occupational selectivity, such misclassification results in little bias to the estimates of relative risk, so that a significant result continues to indicate a true difference.

In addition, the specific diagnosis of mesothelioma (ICD 163.0) on the death certificate was investigated with the use of a linked sample of Swiss death certificates and hospital records. A comparison of diagnoses showed that the primary cause ICD-8 163.0 was among the reliable diagnoses on the death certificate, with 78 % (14 of 18) also found in corresponding hospital records (unpublished results). Mesotheliomas have a high rate of operative and/or histopathological confirmation on Swiss death certificates. In the present study the diagnosis was confirmed by either operation or autopsy in 73 % of all cases among the 203 Swiss men and in 8 out of 12 (67 %) of the cases among furniture workers.

A preliminary, more careful investigation of all seven cases designated as occurring in furniture workers in the first four years 1979 to 1982 (including ages up to 79 years) revealed the following information. For five of the seven cases a medical record which provided additional details could be traced. One of the non-autopsied furniture workers of this group had undergone a biopsy for pleural effusion showing tumor cells, so that one can consider six out of the seven cases, or 86 %, as confirmed mesotheliomas. It is likely that the cases from 1983 to 1985 are, if anything, better

Table 1. Five-year age distribution of pleural mesothelioma deaths among the furniture workers and the reference population.

Age group	Furniture workers		Reference population	
	Size of group (N)	Cases (N)	Size of population (N)	Cases (N)
30–34	3 360	0	194 759	0
35–39	2 682	0	184 410	4
40–44	2 300	0	146 009	7
45–49	2 654	2	148 577	20
50–54	2 802	2	143 315	20
55–59	2 076	1	136 384	27
60–64	2 062	1	103 669	38
65–69	2 841	4	113 654	45
70–74	2 772	2	94 900	42
Total	23 549	12	1 265 677	203

documented and more valid, although at the moment, this assumption cannot be confirmed.

Quality of occupational coding

Our definition of "furniture worker" may not correspond exactly to the definition of "furniture worker" used in other studies. This problem is similar to that recognized for the occupational category "carpenter" (8, p 154). It is, we feel, the most appropriate term in English for the German "Schreiner". Other woodworkers involved not only in furniture making, but also in the finer working of wood for windows, frames, models, etc., are included. Our definition does, however, exclude "carpenters" (code 304) and "other wood and corkworking occupations" (code 313) (4).

In a preliminary study (11) of a random sample of 3 058 deaths among men in 1981 and their 1980 census records, we were able to determine the concordance of occupational coding on death certificates and census records by a computer comparison of occupational codes on both records. For "furniture worker," the concordance was good in that 72 % of 43 men with death certificates listing furniture worker were described as such on their census forms and 73 % of men reporting furniture worker as an occupation in the census, also had that occupation listed on their death certificate. Thus only a slight bias towards 1 is to be expected for the relative risk from occupational misclassification (1).

An analysis of other cancers as causes of death for furniture makers revealed no other significant excesses apart from the well-known sinonasal cancers (20). The all-cause SMR for furniture workers was equal to 105, which was significant even though the value did not differ much from 100 (table 2). This finding supports the analysis indicating congruence between the occupation of "furniture worker" on death certificates and census forms and the excess death risks due to mesothelioma.

Time trend

In 1979–1982, the SMR for mesothelioma among Swiss furniture workers aged 30 to 74 years was 213 (95 % CI 68–439), while for 1983–1985 it amounted to 321 (95 % CI 128–596).

Table 2. All-cause and cancer mortality for male Swiss furniture workers. (SMR = standardized mortality ratio, PMR = proportional mortality ratio)

Cause of death ^a	N	SMR ^b	PMR ^b
All causes (ICD 000–999)	2 347	105 (101–109)	100
All cancers (ICD 140–209)	690	110 (102–119)	105 (97–113)

^a Code of the International Classification of Diseases, eighth revision, in parentheses.

^b 95 % confidence interval in parentheses.

Discussion

Our results indicate a 2.7-fold increased relative risk of mortality from pleural mesothelioma among Swiss furniture workers. This is the first study in which furniture workers as a separate group have been found to have a statistically significant increased risk for this fatal neoplasm. In the face of such a finding, the question must be asked of whether the increased risk is real or a study artifact.

Multiple testing

The initial hint regarding excess mortality for respiratory cancers other than of the lung and bronchus in furniture workers came from a broad screening of 126 occupational categories with regard to 22 groups of cancers. When the possibility of the excess mortality being due to chance was considered, two findings spoke against it. First, the expected number of chance findings with a P-value smaller than the observed $P=0.00001$ among the $126 \times 22 = 2\,772$ tests performed was 0.03 under the hypothesis of no effects anywhere. Second, the screening exercise comprised the years 1979–1982 and ages of 30 years and up and showed significance. However, the years 1983–1985 again showed a significant excess mortality risk for mesothelioma among furniture workers. (See the Results section, Time Trend.) Except for possible biases inherent in the data, the result is well established.

Biases

There are some well-known possibilities for biases with studies such as the present one (18): (i) occupational information is usually incomplete and may be not specific enough, (ii) there may be a registration bias of certain occupations between death certificate and census form, and (iii) diagnostic information is limited to three diagnoses and may be inaccurate.

Our checks of the congruence of the occupational description between the death certificates and the census data, as well as the screening of all cancer and total mortality risks, indicate that a grave bias due to occupational misclassification is not likely. Random misclassification leads to diminished observed risk (1).

Reliability of the diagnosis "mesothelioma" on Swiss death certificates seems to be fairly high according to our own and other studies (5), though some over-reporting may occur. Diagnostic misclassification, however, can only bias the risk for furniture workers upwards if mesothelioma is falsely diagnosed more frequently in the death certificates of furniture workers than in those of other men, an unlikely situation. In all other cases, misclassification tends to diminish the observed risk (1).

Our calculated SMR was not based on observed person-years, but on the assumption that the numbers in occupational classes remained stable at the 1980

census level over the study period. For a clear-cut occupation such as "furniture worker," this assumption is not unreasonable, especially in Switzerland, where occupational changes are still fairly rare.

Exposure

Death certificates obviously do not provide information on exposure to carcinogenic substances. That furniture workers may be exposed to asbestos dust has been documented in a review published by the International Agency for Research on Cancer (8). That they are likely exposed in Switzerland was demonstrated by the study of Rüttner et al on workers in a railway car construction and repair plant (15), as well as by the dissertation of Forster (5), in which four of five furniture workers with mesothelioma were exposed to asbestos.

Our data, on the other hand, do not support the hypothesis of asbestos exposure. There were no cases with confirmed asbestos exposure. For five of the seven cases investigated more closely, a medical record could be found giving further details. Three cases with possible asbestos exposure were investigated for asbestos in lung and pleural tissue, and in no case could asbestos exposure be confirmed. In one other case, the clinical record mentioned explicitly "no asbestos," and in three other cases no information was given.

Thus other hypotheses are consistent with our data. On the basis of experimental and epidemiologic evidence, other airborne mineral fibers have been postulated as possible factors in the etiology of mesothelioma (12, 17, 21). Wood components are able to produce tunica albuginea mesothelioma in rats in the absence of asbestos exposure (16). McDonald et al, however, found no increased risk for mesothelioma among persons exposed to wood dust as compared to referents collected from decedents with secondary lung cancer (10).

Confounders

We have obviously not been able to control for or investigate the possible confounding influence of such factors as nonoccupational asbestos exposure. This is a weakness shared by most other studies. There is however little possibility of a confounding influence of any other risk variables on mesothelioma mortality.

Similar findings

A suspicion of such an increased risk for furniture workers can be gleaned from a few other publications. Malmer et al, in their study of mesotheliomas in Sweden, found a relative risk of 1.4 for furniture workers (9). Their finding, though nonsignificant, indicates a trend towards increased risk. In that study, other related woodworking occupations also showed a similar nonsignificant tendency towards increased risk, ie, carpenters and joiners 1.4, cabinet makers 1.4, and not

otherwise classified woodworkers 2.5. The incidence study by Teta et al (19) shows a significantly elevated relative risk of 2.25 for carpenters and cabinet makers combined. Though the study by Rüttner et al (15) was not designed to permit a calculation of relative risk, the fact that 2 of the 14 cases in that series would satisfy our definition of "furniture workers" also raises suspicion as to increased risk among this occupation. Then, too, related wood workers (carpenters: Zimmerleute) represented an additional 4 of the 14 cases.

Concluding remarks

The results presented were first suggested by the findings of a broad mortality surveillance effort and subsequently refined with the use of part of the same data. Hence, the results have the status of a still largely unconfirmed hypothesis, which gains interest through the fact that, for none of the deceased furniture workers, was asbestos confirmed as the cause of mesothelioma (although it remains a possible cause for some). These facts, as well as hints of an increasing trend, call for further investigations in other countries and for follow-up of the present effort as new data become available.

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References

1. Bross I. Misclassification in 2×2 tables. *Biometrics* 10 (1954) 478—486.
2. Bundesamt für Statistik. Verzeichnis der persönlichen Berufe. Bern 1981. (Arbeitsdokumente für die schweizerische Statistik/Heft 7d).
3. Eidgenössisches Statistisches Amt. Internationale Klassifikation der Krankheiten und Todesursachen, ergänzt für den schweizerischen Gebrauch ab 1969. Bern 1970.
4. Eidgenössisches Statistisches Amt. Klassifikation der Berufe, der Stellung im Beruf, der Erwerbsklassen für die Schlüsselung der Statistikarten der Bevölkerungsbewegung. Bern 1979.
5. Forster T. Epidemiologie des Pleuramesothelioms im Kanton Zürich 1980—1983. Medizinische Fakultät, Zürich 1987. (Inaugural-Dissertation).
6. Fraumeni JF, Blot WJ. Lung and Pleura. In: Schottenfeld D, Fraumeni JF Jr, ed. *Cancer epidemiology and prevention*. WB Saunders Co, Philadelphia, PA 1982, pp 564—582.
7. Harrington JM. Occupational mortality. *Scand J Work Environ Health* 10 (1984) 347—352.
8. International Agency for Research on Cancer. Wood, leather and some associated industries. Lyon 1981, p 315. (IARC monographs on the evaluation of carcinogenic risk of chemicals to humans, volume 25).
9. Malmer HSR, McLaughlin JK, Malmer BK, Stone BJ, Weiner JA, Erickson JLE, Blot WJ. Occupational risk

- for pleural mesothelioma in Sweden, 1961—1979. *J Natl Cancer Inst* 74 (1985) 61—66.
10. McDonald AD, Harper A, El Attar OA, McDonald JC. Epidemiology of primary malignant mesothelial tumors in Canada. *Cancer* 26 (1970) 914—919.
 11. Minder CE. Qualitätsanalyse der schweizerischen Sterblichkeits-Statistik als Vorarbeit zur Sterblichkeitsanalyse nach Beruf. Institut für Sozial- und Präventivmedizin, Bern 1985. (Report to the National Science Fund).
 12. Newman RH. Fine biogenic silica fibres in sugar cane: A possible hazard. *Ann Occup Hyg* 30 (1986) 365—370.
 13. Percy C, Stanek E III, Gloeckler L. Accuracy of cancer death certificates and its effect on cancer mortality statistics. *Am J Publ Health* 71 (1981) 242—250.
 14. Peto J, Henderson BE, Pike MC. Trends in mesothelioma incidence on the United States and the forecast epidemic due to asbestos exposure during World War II. In: Peto R, Schneiderman P, ed. Quantification of occupational cancer. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY 1981, pp 51—72. (Banbury report 9).
 15. Rüttner JR, Reber P, Schüller G, Spycher MA, Stolklin I, Wälchli P. Endemie von Pleuramesotheliomen in Eisenbahnwaggonbau- und -reparaturbetrieben. *Arbeitsmed Sozialmed Präventivmed* 20 (1985) 128—130.
 16. Schoental R, Gibbard S. Nasal and other tumours in rats given 3,4,5-trimethoxycinnamaldehyde, a derivate of sinapaldehyde and of other a,b-unsaturated aldehydic wood lignin constituents. *Br J Cancer* 26 (1972) 504—505.
 17. Sebastien P, Bignon J, Barris YI, Awad L, Petit G. Ferruginous bodies in sputum as an indication of exposure to airborne mineral fibers in the mesothelioma villages of Cappadocia. *Arch Environ Health* 39 (1984): 11, 18—23.
 18. Siemiatycki J, Day NE, Fabry J, Cooper JA. Discovering carcinogens in the occupational environment: A novel epidemiologic approach. *J Natl Cancer Inst* 66 (1981) 217—225.
 19. Teta MJ, Lewinson HC, Meigs JW, Vidme RA, Mowad LZ, Flannery JT. Mesothelioma in Connecticut 1955—1977, occupational and geographic associations. *J Occup Med* 25 (1983) 749—756.
 20. Vader JP, Minder ChE. Nasen- und Nasennebenhöhlenkrebs bei Schreibern in der Schweiz. *Schweiz med Wochenschr* 117 (1987) 481—486.
 21. Wagner JC, Elmes PC. The mineral fiber problem. In: McDonald JC, ed. Recent advances in occupational health. Churchill Livingstone, New York, NY 1981, pp 1—13.

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