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SHORT COMMUNICATION

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Three decades of pleural cancer and mesothelioma registration in Austria where asbestos cement was invented

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Abstract Recently, a new mesothelioma epidemic was predicted from observations made in Western Europe. From early observations in Austria the lower increase in cases of mesothelioma compared with neighbor countries had been related to different uses of asbestos. In order to test this hypothesis, incidence and mortality of pleural cancer [International Classification of Diseases (ICD)-8/9 163] were analyzed for three decades and supplemented by data from a cohort study in the factory that had been the largest consumer of asbestos imported to Austria and from all Austrian occupational diseases registered between 1990 and 2001. In men, mortality rates (based on 15 to 45 deaths/year) were lowest in 1980-1989, but similar in 1970-1979 and 1990-2001. No increase in younger-birth cohorts was detected. Incidence rates (based on 13 to 44 cases/year) increased (36%) non-significantly (P = 0.14). In women, a significant decrease in mortality and incidence rates (P<0.01) was observed from 1970. Rates from work-related mesothelioma (based on only 0-7 men and 0-4 women/year) must be interpreted with caution. In the cohort of 2,816 asbestos cement workers 26 pleural mesotheliomas were registered from 1990 through mid-1999. Six of these cases (three male and three female) had not been registered as an occupational disease, but all of these cases had been encoded under ICD 163 in mortality statistics. One female cohort member registered as having asbestosis according to the death certificate had died from mesothelioma according to the statistics of occupational diseases. We conclude that no epidemic of mesothelioma due to past asbestos exposure is to be expected in Austria.

Keywords Mesothelioma • Incidence • Mortality • Occupational disease • Asbestos

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Introduction

From occupational use of asbestos a sleep increase in asbestosis, mesothelioma and occupational lung cancer was found in North America [37]. From similar observations made in European countries a new mesothelioma epidemic was predicted for Europe in the next decades [5]. At least part of these trends, however, could be artificial, as suggested by the observation that trends were discontinuous in several countries, with major rises often being concomitant with changes in classification [16]. From early observations in Austria a much lower increase in cases of mesothelioma was predicted than for neighboring countries and related to different uses of asbestos [26], mainly for asbestos cement in Austria, which had been invented in Austria at the turn of the century. Therefore, we updated the analysis of pleural cancer incidence, mortality, occupational diseases and the cohort study performed in the oldest asbestos cement factory in the world (Voecklabruck, Upper Austria).

Methods

All data on incidence and mortality of malignant neoplasms of the pleura were obtained from Statistics Austria, which operates the nationwide cancer registry.

Pleural cancer was coded 163.0 under the 8th and 163 under the 9th revision of the International Classification of Diseases (ICD). Mortality of pleural cancer, mainly due to mesothelioma, was analyzed for the period 1970-2001. Death certification is performed in Austria by medical doctors. Two-thirds of all sufferers had died in a hospital and one-third had undergone autopsy [8, 15]. Nevertheless, the diagnosis of primary cancer (mesothelioma) of the pleura is less reliable from death certificates than from the cancer register, due to contamination from cases of secondary carcinosis of the pleura [26]. Therefore, we also analyzed the incidence that was available up to 1999 (for Upper Austria preliminary data for the year 2000). In the last decade average reporting frequency of mesolhelioma to the cancer register was 96% (J Klimont-Langgassner, (Austrian Central Statistical Office, Vienna; personal communication, 2002). In addition, data from the Austrian Worker's Compensation Board were analyzed for cases of pleural and peritoneal mesothelioma accepted as work-related (computerized data available from 1990 through 2001). For quality control a cohort study [28] was also updated till mid-1999. Mortality rates for men were analyzed by birth cohort and age at death by 5-year intervals during 1971-2001. All rates are standardized to the Austrian census population 1991 or to world standard population for international comparison.

Results

Age-adjusted rates are shown in Table 1 for both genders. In men the lowest mortality rates were in 1980-1889, but rates (based on 15 to 45 deaths per year) were similar in 1970-1979 and 1990-2001, and the overall trend was not significant. Incidence rates (based on 13 to 44 cases per year) slightly increased (non-significant). In women rates of mortality (based on 16 to 43 deaths per year) and incidence (based on 6 to 26 cases per year) have steadily decreased since 1970 ($P<0.01$). Rates from work-related mesothelioma are based on small absolute numbers of cases (men: 0 to 7 cases, women: 0 to 4 cases per year) and, therefore, trends must be interpreted with caution.

Rates for Upper Austria are shown in Table 2, because of small numbers for men only. As in Austria the mortality trend was not significant ($P = 0.48$). Rates for men, by year of birth and age group, are given in Table 3. No deaths had occurred in some of the younger-birth cohorts, and random variation is to be considered, because the age-specific rates are based on small absolute numbers; however, no distinct increase can be observed in younger-birth cohorts.

In the cohort of 2,816 asbestos cement workers 26 pleural mesotheliomas were registered from 1990 through mid-1999. Six of these cases (three male and three female) had not been registered as an occupational disease, but all of these cases had been encoded under ICD 163 in mortality statistics. One female cohort member registered as having asbestosis on the death certificate had died from mesothelioma according to the statistics of occupational diseases. Data protection laws prohibited us from verifying if this case had been encoded as mesothelioma in the cancer register.

Table 1 Trends in age-standardized rates per 100,000 men/women for pleural cancer mortality, pleural cancer incidence and mesothelioma registered as occupational disease, Austria 1970-2001

Parameter	Period							Percent change	P
	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001		
Men									
Mortality									
World standard population	0.83	0.72	0.54	0.50	0.74	0.74	0.83	0	0.76
Austrian population, 1991	1.02	0.88	0.69	0.63	0.94	0.96	1.06	+4	0.58
Incidence									
World standard population	0.45	0.33	0.4	0.35	0.54	0.61		+36	0.14
Austrian population, 1991	0.56	0.40	0.5	0.45	0.67	0.70		+25	0.16
Work-related mesothelioma									
World standard population					0.18	0.29	0.19	+6	
Austrian population, 1991					0.21	0.36	0.26	+24	
Women									
Mortality									
World standard population	0.72	0.56	0.49	0.43	0.44	0.31	0.32	-56	0.001
Austrian population, 1991	0.98	0.84	0.66	0.70	0.72	0.55	0.54	-45	0.005
Incidence									
World standard population	0.37	0.21	0.23	0.23	0.25	0.27		-27	0.49
Austrian population, 1991	0.51	0.32	0.29	0.28	0.36	0.42		-18	0.69
Work-related mesothelioma									
World standard population					0.03	0.02	0.06	+ 100	

Austrian population, 1991	0.04	0.03	0.06	+ 50	

Table 2 Trends in age-standardized (Austrian population, 1991) rates per 100,000 men for pleural cancer mortality, pleural cancer incidence and mesothelioma registered as occupational disease, Upper Austria 1970-2001

Parameter	Period							Percent
	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	change
Mortality	1.1	0.47	0.66	0.90	1.26	1.14	0.84	-24
Incidence				0.77	0.76	1.01	[0.72][a]	+ 31(-6)[a]
Work-related mesothelioma					0.29	0.47	0.51	+ 76

[a]Incidence 2000, preliminary data

Table 3 Pleural cancer mortality rates per 100,000 men by year of birth and age group, Austria 1971-2001

Age group	Year of birth														
	1887-1891	1892-1896	1897-1901	1901-1906	1907-1911	1912-1916	1917-1921	1922-1926	1927-1931	1932-1936	1937-1941	1942-1946	1947-1951	1952-1956	1957-1961
40-44	-	-	-	-	-	-	-	-	0.4	1.5	0	0	0.4	0	0.3
45-49	-	-	-	-	-	-	-	1.0	0	0	0	0.4	0.4	0	
50-54	-	-	-	-	-	-	2.1	0	1.4	1.0	1.2	0.4	1.5		
55-59	-	-	-	-	-	1.2	2.2	1.1	0.5	2.2	1.3	2.7			
60-64	-	-	-	-	4.2	1.9	1.6	0.6	2.2	2.9	2.3				
56-69	-	-	-	3.0	4.3	3.7	1.8	0.7	5.4	2.6					
70-74	-	-	6.8	3.1	3.1	3.7	5.5	7.8	7.1						
75-79	-	10.6	3.9	6.8	2.3	3.7	1.4	7.1							
80-84	9.0	2.8	7.2	2.0	13.0	13.5	4.4								

Discussion

Compared with other European countries mortality from pleural cancer in men is low in Austria, and the trend is different. For 1970-1974 and 1990-1994, age-standardized mortality rates per 100,000 men (world standard population) increased in Britain by 264% (0.33 to 1.20), in France by 109% (0.68 to 1.42), in Germany by 129% (0.52 to 1.14), in Italy by 68% (0.74 to 1.24), in the Netherlands by 184% (0.84 to 2.39), in Switzerland by 114% (0.63 to 1.35), and in Hungary by 118% (0.32 to 0.70) [17], whereas in Austria mortality declined during this period by 11%. But, from Table 1, a more recent and only slight increase can be seen in Austria. The same pattern of trends is observed in Upper Austria (Table 2), where the largest asbestos-processing industry was situated. No major change in risk is seen in men born after 1950 (Table 3). In women all rates are steadily decreasing, except from work-related mesothelioma (Table 1); however, the latter rates are based on small absolute numbers (1990-1994: seven cases, 1995-1999: six cases, 2000-2001: six cases) and, therefore, the power of even a national study to detect a possible trend is limited.

Results of an earlier study on mesothelioma in Austria [26], based on a revision of 192,172 autopsy records, had shown that false positive diagnoses of pleural cancer are more frequent on death certificates (in part issued by general practitioners) than on reports to the cancer registry (issued by hospitals and usually the pathologist). Because diagnoses in 1969-1974 were not encoded by physicians, even the cancer register showed a considerable proportion of secondary pleural cancer miscoded as primary pleural cancer [26]. From this earlier population-based case control study on 120 cases of mesothelioma with histological

confirmation, and from a cohort study on asbestos cement workers [29], the conclusions were drawn that the predominant use of chrysotile and lower exposures in production and use of asbestos cement led to fewer occupational diseases than in neighbor countries such as Germany (asbestos textile and shipyard industries), Switzerland (asbestos insulation industry) or Italy (asbestos mining and shipyard industry). These conclusions had to be questioned, because the follow-up of the asbestos-cement workers cohort [30] had shown an increase in mesotheliomas, and in the population-based study the lack of mesotheliomas in workers from the largest importer of asbestos was found to be due to the fact that in 1939-1948 fiber cement had been produced without asbestos.

This study, however, confirms the earlier hypothesis that type and use of asbestos are at least as important for the epidemiology of mesothelioma as asbestos import is, and it gives hope that we do not have to wait for asbestos disease to disappear up to 50 years after 1990 when the use of asbestos was banned in Austria [7]. Most occupational cases in Upper Austria are from the largest importer, and relate to the use of amphiboles in asbestos cement production since 1948 for about 20 years [28, 30]; however, the low overall rate of mesothelioma is still explained by the fact that in Austria only a very small proportion of the workforce was employed in occupations that have been defined as high-risk groups [21]. High steel-framed buildings were rare until recently, when artificial fibers were used instead of sprayed asbestos. The only Austrian shipyards left in 1918 are two small ones on the Danube. Steam power stations (which in other countries used to be insulated with asbestos) are less common due to the water power available. In general, insulating with materials of high asbestos content and low binding of asbestos, such as limpet spraying, was never performed on a large scale before it was banned in 1978 [28]. Therefore, the use of asbestos in secondary industry was also less dangerous, because from high density (and mainly chrysotile-based) products fine dust was only produced by high-speed tools and caused occupational diseases mainly when used indoors. There was only one small asbestos textile industry, which closed down (for economic reasons) in 1971. In 1973 three-quarters of asbestos imports went into asbestos cement production [26], and also, other productions such as gaskets and brake linings had reduced the occupational exposures by that time. All uses of asbestos were banned in Austria in 1990 [7].

The correlation of asbestos import with lagged mesothelioma mortality [2, 35,41] is an oversimplification as it disregards different uses of different types of asbestos. Therefore any figures obtained by such methods cannot be applied to another country with different uses of asbestos in the past. The same is true for a certain percentage of mesotheliomas due to occupational asbestos exposure. The mass media tend to apply the highest percentages reported [9, 10, 14, 40] or attribute "almost all" cases to past asbestos exposure. They disregard that in a country without occupational use of asbestos this rate has to be 0%. Even in a country with extensive use of asbestos the rate cannot reach 100% because of the so-called spontaneous cases [9, 22]. In most countries the rates will be in between these two extremes. Even in Australia which has the world's highest incidence rate [41] a rate of 90% has be given for males and 61% for females [18]. From asbestos contents of lungs unrecognized exposures were suspected, but also unrecognized occupational, para-occupational or environmental exposures have to be expected more frequently in areas like Western Australia with many and common uses of amphibole asbestos in the past.

Uncritical extrapolation of results from countries with a high incidence of asbestos-induced mesothelioma to countries with a low incidence could be harmful, because in countries with a low incidence other risk factors of mesothelioma [6, 11, 12, 19, 20, 23, 33, 34] of possible higher future importance could be investigated only if self-fulfilling prophecies do not disturb the investigations. Also, countries with a high incidence of asbestos-induced mesothelioma could profit by such investigations and contribute by studying combined effects, in particular of asbestos and artificial fibers, which have been used as mixtures in insulating, etc. [38]. Animal experiments suggest that artificial fibers with

high durability could be a carcinogenic risk similar to or higher than asbestos [1]. If, on the one hand, any hint of past asbestos exposure is accepted as sufficient causal proof and if, on the other hand, the diagnosis of mesothelioma is influenced by the knowledge of asbestos exposure, then mesothelioma from asbestos becomes a fashionable diagnosis, decreasing the chance of discovering any additional risk factor [27].

Of course, we also have to consider alternative explanations for the low incidence of asbestos-induced diseases in Austria, for example, that these diseases were less known among Austrian physicians. To clarify this question we have to look at the history of diagnosing asbestos-related diseases in Austria. The first description of asbestosis was reported to have been given in 1907 after an autopsy performed by Murray in 1900 in England [25], however, the disease must have been known to Austrian pathologists 20 years before Murray reported his first case [3], because documents of 1888, on the occasion of the visit of the new "Burgtheater" in Vienna by the German Emperor, Wilhelm 2nd, invited by the Austrian Emperor, Franz Josef, is proof that asbestos was not used any more "because of its dust generation harmful to the lung", and that, as a substitute, impregnated fabrics were used on stage, which is all the more amazing, because in 1881 about 500 persons had died when the old theatre burned down. As a hangover from a law dating back to Emperor Joseph 2nd autopsy rates in Austria were the highest worldwide, and in the 1970s still exceeded 40% [8]. With the improvement of intra vitam diagnoses, post-mortems gradually decreased, but still exceeded 30% in the 1980s, and in 1991 Austria still had the highest autopsy rates, together with the North European countries, while the rates in the West European countries, the US and Japan had always been much lower. Most countries from which data were used for the reviews on mesothelioma mortality [5, 13, 18, 36] had autopsy rates < 10%. Nevertheless, Austrian general practitioners at the beginning of the observation period might still have had to learn about the importance of mesothelioma as a marker tumor for diseases from asbestos. In the 1970s and 1980s, however, reports from the US [39] had wide media coverage in Austria. During the population-based study [26], when every third death certificate in a 6-year period was controlled by an autopsy diagnosis, all heads of pathology institutes and many clinicians (all major thoracic surgeons) were involved, and results were presented repeatedly in the Austrian Lung Society and in meetings for general practitioners. Unfortunately, cancer registration was not complete in the beginning, but improved after 1969. During the past decade the cancer register reached 97% completion, which is exceeded only by Finland. In Austria nearly all cancer patients visit a hospital because of the health insurance system, and all hospitals are obliged to notify the cancer registry of all cancer cases that come to their attention. The diagnosis of mesothelioma is more reliable from the cancer register because of the histological confirmation in most cases. In countries where only death certificates are used for mesothelioma registration [35], the miscoding of the more common secondary cancers of the pleura as "primary" has to be considered, and trends from such statistics are more likely to be influenced by so-called fashionable diagnoses. Mesothelioma panels cannot improve this situation if applied selectively.

In their analysis on "the European mesothelioma epidemic" [36] the authors did not comply with their own selection criteria but omitted to mention results available from countries such as Austria or the Czech and Slovak Republic [16, 32] in order to justify the extrapolation of calculations for the UK and six other countries, to all of Europe. They attempted to mitigate the exaggeration of their projection of future mortality based on past trends due to increasing diagnostic awareness of mesothelioma over the past 20 years by excluding their most recent (1990-1994) data, but still arrived at the conclusion that the number of men who will die from mesothelioma in Western Europe each year will almost double over the next 20 years, and that one in 150 men born between 1945 and 1950 will die of mesothelioma. The calculations made use of some questionable indicators for under- and overdiagnosis and of ratios such as excess lung cancer to mesothelioma in historical cohort studies which, in fact, differed largely between countries and periods due to different cumulative exposures and different uses of amphibole asbestos. Another analysis of

mesothelioma in the UK, which made use of systematic reports from chest and occupational physicians, found the highest incidence in the birth cohort of 1925-1940 [24]. If we assume that 15 years of age was the beginning of occupational exposure for these individuals, then these cohorts had their first asbestos exposure at work between 1940 and 1955. As the beginning of first exposure is more important for the risk of mesothelioma than cumulative dose, we may conclude from this study in the UK that the most decisive exposures occurred during the 2nd World War and in the 1950s (and 1960s if we assume first occupational exposure up to age 30). If the mean latency of mesothelioma is 35 years, the decline in mesothelioma rates should begin in the UK in 2005, which is only 5 years later than was predicted for the US. [37].

For countries with low mesothelioma rates, such as Japan [41] or Spain [5], it has been argued that they only lag behind the development in North America and Western Europe. From our observations in Austria we have no reason to assume any dramatic increase in mesothelioma rates in the future and regard all these predictions as being useless for countries like Austria, where the use of asbestos has obviously been better controlled than in the countries from which projections were made. In Austria in the 1990s, the annual incidence of pleural neoplasms averaged 6.8 in men and 3.9 in women per million Austrians (Table 1). This corresponds to 7.5 men and 2.6 women per million world standard population. In Upper Austria, where most asbestos was used, the rate is slightly higher in men (8.9 per million Austrian). Also, the rates of pleural mesothelioma registered as being occupational were higher in Upper Austria (3.8 per million men) than in total Austria (2.9 per million men). Of course, statistics of occupational diseases bear the risk of underestimation, but we do not think that the number of unrecorded cases is higher than in other countries, because reporting of all suspected occupational diseases is compulsory for every Austrian physician. In Upper Austria, also, retired asbestos-cement workers have been invited since 1989 to participate every 2 years in free medical checkups at the office of an independent pulmologist. Not all pleural neoplasms reported to the cancer registry are mesotheliomas, not all of them are asbestos induced, and not all of these exposures occurred in an occupation covered by insurance. Nevertheless, we think that the rate of mesothelioma reported as occupational disease is too low, which will prompt us to carry out another in formation campaign with the help of the Worker's Compensation Board. From the synopsis of all diagnoses, however, we are confident that under-diagnosis and under-reporting of mesothelioma in Austria has been lower than in other countries, because autopsy (at a rate which was on average (the highest in Europe) is supplemented by cancer registration, and physicians are informed on the relationships between asbestos and mesothelioma at an early stage.

The attribution of all mesotheliomas that cannot be explained by occupation to environmental asbestos exposure [4] seems to be only a continuation of a onesided research on etiology. Environmental asbestos exposure in Austria caused endemic pleural plaques [31], but no malignant neoplasms [27]. We conclude that no epidemic of mesothelioma due to past asbestos exposure is to be expected in Austria. However, workers exposed to asbestos in the 1950s and 1960s without appropriate ventilation systems being in place seem to be at highest risk and should be given computer tomographic screening. Because of their lung cancer risk they should also be offered smoking cessation therapy.

References

1. Adachi S, Kawamura K, Takemoto K (2001) A trial on the quantitative risk assessment of man-made mineral fibers by the rat intraperitoneal administration assay. Ind Health 39:168-174
2. Banaei A, Auvert B, Goldberg M (2000) Computer modeling of population exposure to a carcinogen: the example of asbestos and mesothelioma mortality in France. Comput Biomed Res 33:97-109
3. Bergmann L (1998) The construction of the Neues Burgtheater in Vienna and the problem of asbestos in rooms - a historical look back. Zbl Arbeitsmed 39:9-11
4. Berry M (1997) Mesothelioma incidence and

community asbestos exposure. Environ Res 75:34-40
5. Bianchi C, Brollo A, Ramani L, Bianchi T (2000) Malignant mesothelioma in Europe. Int J Med Biol Environ 28:103-107
6. Carbone M, Rizzo P, Pass H (2000) Simian Virus 40: the link with human malignant mesothelioma is well established. Anticancer Res 20:875-877
7. Federal Law (1990) Asbestverordnung. Bundesgesetzblatt für die Republik Österreich 139/324/1990
8. Feigl W, Friedl HP (1979) Daten aus der österreichischen Gesundheitsstatistik und ihre Verwendbarkeit für epidemiologische Untersuchungen. Österreichische Ärztezeitung 34:1313-1316
9. Gun RT (1995): Mesothelioma: is asbestos exposure the only cause? Med J Aust 162:429-431
10. Hansen J, de-Klerk NH, Musk AW, Hobbs MS (1998) Environmental exposure to crocidolite and mesothelioma: exposure-response relationships. Am J Respir Crit Care Med 157:69-75
11. Hillerdal G, Berg J (1985) Malignant mesothelioma secondary to chronic inflammation and old scars. Cancer 55:1968-1972
12. Huncharek M (2002) Non-asbestos related diffuse malignant mesothelioma. Tumori 88:1-9
13. Jemal A. Grauman D, Devesa S (2000) Recent geographic patterns of lung cancer and mesothelioma mortality rates in 49 shipyard counties in the United States, 1970-94. Am J Ind Med 37:512-21
14. Karjalainen A, Pukkala E, Malison K, Tammilehto L, Vainio H (1997) Trends in mesothelioma incidence and occupational mesotheliomas in Finland in 1960-1995 Stand J Work Environ Health 23:266-270
15. Langgassner J, Kytir J, Vutuc C, Dohlhammer-Reiter G (1998) Atlas of mortality in Austria by causes of death 1984/94. Austrian Central Statistical Office, Vienna (ISBN 3-7046-1351-7)
16. LaVecchia C, Lucchini F, Negri E, Boyle P, Maisonneuve P, Levi F (1992) Trends of cancer mortality in Europe, 1955-1989, II, Eur J Cancer 28:514-599
17. LaVecchia C, Decarli A, Peto J, Levi F, Tomei F, Negri E (2000) An age, period and cohort analysis of pleural cancer mortality in Europe. Eur J Cancer Prev 9:179-184
18. Leigh J, Davidson P, Hendrie L, Berry D (2002) Malignant mesothelioma in Australia, 1945-2000. Am J Ind Med 41:188-201
19. Leithner A, Weinhaeusel A, Windhager R, et al. (2002) Absence of SV40 in Austrian tumors correlates with low incidence of mesotheliomas. Cancer Biol Ther 1:379
20. McDonald AD, McDonald JC (1980) Malignant mesothelioma in North America. Cancer 46:1650-1656
21. McDonald JC, McDonald AD (1977) Epidemiology of mesothelioma from estimated incidence. Prev Med 6:426-446
22. McDonald JC, McDonald AD (1996) The epidemiology of mesothelioma in historical context. Eur Respir J 9:1932-1942
23. Mehnert WH, Bender E, Gram A, Schramm T, Wildner GP (1974) Mesotheliome beim Goldhamster IV. Arch Geschwulstforsch 43:22-35
24. Meyer JD, Holt DL, Chen Y, Cherry NM, McDonald JC (2001) Surveillance of work-related and occupational respiratory disease in the UK. Occup Med 51:204-208
25. Murray MH (1907) Report of Departmental Committee on Compensation for Industrial Diseases, minutes of evidence. Cd. 3946: 127-128, HMSO, London
26. Neuberger M (1979) Neue Wege zur Risikobewertung von Luftschadstoffen. Facultas, Wien 1979 (ISBN 3-85076-079-0). English translation: Asbestos: epidemiological contributions to risk evaluation, Facultas, Vienna 1981 (ISBN 3-85076-104-5)
27. Neuberger M (1989) Pleural plaques from low levels of asbestos. In: Peters GA, Peters BJ (eds) Sourcebook on asbestos diseases, vol 4 (medical research). Garland, New York; Butterworth, Salem, pp 231-275
28. Neuberger M, Kundi M (1990) Individual asbestos exposure, smoking and mortality - a cohort study in the asbestos cement industry. Br J Ind Med 47:615-620
29. Neuberger M, Kundi M (1991) Zum Berufskrebsrisiko durch Asbest in Österreich. In: Fischer M (ed) Materialien zur umwelthygienischen Beurteilung mineralischer Fasern, Band 1: Beurteilung

der Krebsgefahr durch Asbest und andere faserige Feinstäube. WaBoLu - Schriftenreihe des Bundesgesundheitsamtes Berlin. 7:74-96

30. Neuberger M, Kundi M (1993) Cancer in asbestos cement production and implications for risk management (abstract). 24. Congress of the International Commission on Occupational Health, Nice, p 197
31. Neuberger M, Kundi M, Friedl HP (1984) Environmental asbestos exposure and cancer mortality. Arch Environ Health 39:261-265
32. Parkin DM, Muir CS, Whelan SL, Gao YT, Ferlay J, Powell J (1992) Cancer incidence in 5 continents, vol. 6. IARC Scientific Publication 120, IARC, Lyon
33. Pelnar PV (1985) Non-asbestos related malignant mesothelioma. A review of the scientific and medical literature. Canadian Asbestos Information Centre
34. Peterson JT, Greenberg SD, Burner PA (1984) Non-asbestos-related malignant mesothelioma: a review. Cancer 54:951-960
35. Peto J, Hodgson JT, Matthews FE Jones JR (1995) Continuing increase in mesothelioma mortality in Britain. Lancet 345:535-539
36. Peto J, Decarli A, La Vecchia C, Levi F, Negri E (1999) The European mesothelioma epidemic. Br J Cancer 79:666-672
37. Price B (1997) Analysis of current trends in United States mesothelioma incidence. Am J Epidemiol 145:211-218
38. Rodelsperger K, Jockel KH, Pohlabeln H, Romer W, Woitowitz HJ (2001) Asbestos and man-made vitreous fibers as risk factors for diffuse malignant mesothelioma: results from a German hospital-based case-control study. Am J Ind Med 39:262-275
39. Selikoff IJ, Lee DH (1978) Asbestos and disease. Academic Press, New York
40. Spirtas R, Heineman EF, Bernstein L, Beebe GW, Keehn RJ, Stark A, Harlow BL, Benichou J (1994) Malignant mesothelioma: attributable risk of asbestos exposure. Occup Environ Med 51:804-811
41. Takahashi K, Huuskonen MS, Tossavainen A, Higashi T, Okubo T, Rantanen J (1999) Ecological relationship between mesothelioma incidence/mortality and asbestos consumption in ten Western countries and Japan. J Occup Health 41:8-11