

smoking habits, but also regarding the occurrence of parenchymal small lesions according to ILO. As seen from the tables, the relative risk for lung cancer for patients with changes compatible with asbestosis (1/0 or more) was 2.03, and for those without asbestosis it was 1.56.

All the studies cited here and seen in the table agree fairly well. One must therefore conclude that lung cancer risk is increased also in patients without asbestosis.

Mechanism of asbestos-related lung cancer

It has been claimed that fibrosis in the lung parenchyma is unlikely to cause cancer in the large bronchi, where a large part of asbestos-related cancers are seen (58, 152, 153). In tracheal organ cultures, necrosis and desquamation of surface cells accompanied by basal cell hyperplasia can be seen after 1 week (154), and this occurrence is presumably independent of any accompanying parenchymal changes. These changes presumably cause an increase in the susceptibility of epithelial cells of the bronchi to be transformed by environmental carcinogens (31). Fibrosis of the lungs and cancer of the bronchi can thus be seen as end points of 2 unknown mechanisms that may work independently (153).

Concluding remarks

There is an increasing body of evidence which indicates that asbestos at low exposure levels produces a slight increase in the relative risk of lung cancer. The relative risk of cancer in asbestosis patients is higher, but it is unclear whether this higher risk is attributable entirely to higher fiber burden within lung tissue (a dose-response effect) or whether there is also an adjuvant effect of fibrosis by way of cytokine production, over and above the dose effect.

This conclusion is not a purely academic question but has important practical consequences in 2 different areas. One is in the legal world and the other is in the world of industrial hygienists. The legal consequences have an important bearing for many persons. Accepting a no-threshold hypothesis for lung cancer would open the field for a large number of patients with low-grade exposure to claim compensation for lung cancers caused by asbestos exposure, even when the principal cause of the tumor is smoking. However, science should try to find the facts independent of how the law might be affected by these findings. In other words, law should follow science, not the other way around. The legal world has to come to terms with whether — and if so, how much — a

small increased risk, such as an increased risk of 10% or 20%, should be compensated. Proposals have been made (33).

The more important fact is that even if an increased risk of 10% or 20% is not very important for a person, it will result in a large number of bronchial carcinomas in the general population where smoking, unfortunately, is far from eliminated. Given this fact, society cannot conclude from the present data that lung cancer risk is increased only when exposure is heavy enough to cause asbestosis. Anyone claiming such an unproved hypothesis shoulders a heavy responsibility. All exposure to asbestos must be minimized, and if asbestos is to be used, stringent precautions must be taken.

References

1. Gloyne SR. Two cases of squamous carcinoma of the lung occurring in asbestosis. *Tubercle* 1935;17:5—10.
2. Nordmann M. Der Berufskrebs der Asbestarbeiter. *Z Krebsforsch* 1938;47:288—302.
3. Lynch KM, Cannon WM. Asbestosis: analysis of forty necropsied cases. *Dis Chest* 1948;14:874—89.
4. Doll R. Mortality from lung cancer in asbestos workers. *Br J Ind Med* 1955;12:81—6.
5. Enterline PE. Changing attitudes and opinions regarding asbestos and cancer 1934—1965. *Am J Ind Med* 1991;20:685—700.
6. Knox JF, Holmes S, Doll R, Hill ID. Mortality from lung cancer and other causes among workers in an asbestos textile factory. *Br J Ind Med* 1968;25:293—303.
7. Enterline PE, Henderson V. Type of asbestos and respiratory cancer in the asbestos industry. *Arch Environ Health* 1973;27:312—7.
8. Parkes WR. Review article: asbestos-related disorders. *Br J Dis Chest* 1973;67:261—300.
9. Enterline PE. Estimating health risks in studies of the health effects of asbestos. *Am Rev Respir Dis* 1976;113:175—80.
10. Sluis-Cremer GK. The relationship between asbestosis and bronchial cancer. *Chest* 1980;78 suppl:380—1.
11. Browne K. Is asbestos or asbestosis the cause of increased risk of lung cancer in asbestos workers? *Br J Ind Med* 1986;43:145—9.
12. Hughes JM, Weill H. Asbestos as a precursor of asbestos related lung cancer: results of a prospective mortality study. *Br J Ind Med* 1991;48:229—33.
13. Morgan WKC. The pneumoconioses. *Curr Opin Pulm Med* 1995;1:82—8.
14. Wright GW. Asbestos and health in 1969. *Am Rev Respir Dis* 1969;100:467—78.
15. Hammond EC, Selikoff IJ. *The effects of air pollution: epidemiological evidence*. In: Shapiro HA, editor. *Pneumoconiosis: Proceedings of the International Conference; 1969; Johannesburg*. Cape Town: Oxford University Press, 1970: 368—73.
16. Wagner JC, Gilson JC, Berry G and Timbrell V. Epidemiology of asbestos cancers. *Br Med Bull* 1971;27:71—6.
17. Newhouse ML, Berry G, Wagner JC, Turok ME. A study of the mortality of female asbestos workers. *Br J Ind Med* 1972;

- 29:134—41.
18. Becklake MR. Asbestos-related diseases of the lung and other organs: their epidemiology and implications for clinical practice. *Am Rev Respir Dis* 1976;114:187—227.
 19. Turiaf J, Battesti JP. Le pouvoir cancérogène de l'amiante sur les voies aériennes. *Rev Fr Mal Respir* 1976;suppl 2 au Tome 4:39—50.
 20. Nicholson WJ. Case study I: asbestos — the TLV approach. *Ann NY Acad Sci* 1976;271:152—69.
 21. Saracci R. Asbestos and lung cancer: an analysis of the epidemiological evidence on the asbestos-smoking interaction. *Int J Cancer* 1977;20:323—31.
 22. Whitwell F, Scott J, Grimshaw M. Relationship between occupations and asbestos-fibre content of the lungs in patients with pleural mesothelioma, lung cancer, and other diseases. *Thorax* 1977;32:377—86.
 23. Peto J. The hygiene standard for chrysotile asbestos. *Lancet* 1978;1:484—9.
 24. Preger L. Lung cancer. In: Preger L, editor. *Asbestos-related disease*. New York (NY): Grune and Stratton, 1978:174—204.
 25. Henderson VL, Enterline PE. Asbestos exposure: factors associated with excess cancer and respiratory disease mortality. *Ann NY Acad Sci* 1979;330:117—26.
 26. Lemen RA, Dement JM, Wagoner JK. Epidemiology of asbestos-related diseases. *Environ Health Perspect* 1980;34:1—11.
 27. McDonald JC. Asbestos and lung cancer: has the case been proven? *Chest* 1980;78 suppl:374S—6S.
 28. Newhouse M. Epidemiology of asbestos-related tumors. *Semin Oncol* 1981;8:250—7.
 29. Casey KR, Rom WN, Moatamed F. Asbestos-related diseases. *Clin Chest Med* 1981;2:179—202.
 30. Becklake MR. Asbestos-related diseases of the lungs and pleura: current clinical issues. *Am Rev Respir Dis* 1982;126:187—94.
 31. Craighead JE, Mossman BT. The pathogenesis of asbestos-associated diseases. *N Engl J Med* 1982;306:1446—55.
 32. Walker AM, Loughlin JE, Friedlander ER, Rothman KJ, Dreyer NA. Projections of asbestos-related disease 1980—2009. *J Occup med* 1983;25:409—25.
 33. Chase GR, Kotin P, Crump K, Mitchell RS. Evaluation for compensation of asbestos-exposed individuals, II: apportionment of risk for lung cancer and mesothelioma. *J Occup Med* 1985;27:189—98.
 34. Doll R, Petó J. *Effects on health of exposure to asbestos*. London: Her Majesty's Stationery Office, 1985.
 35. Liddell FDK, Hanley JA. Relations between asbestos exposure and lung cancer SMRs in occupational cohort studies. *Br J Ind Med* 1985;42:389—96.
 36. Seidman H, Selikoff IJ, Gelb SK. Mortality experience of amosite asbestos factory workers: dose-response relationships 5 and 40 years after onset of short-term exposure. *Am J Ind Med* 1986;10:479—514.
 37. World Health Organization (WHO). *Asbestos and other natural mineral fibers*. Geneva: WHO, 1986. Environment health criteria.
 38. Enterline PE. Asbestos and cancer: a cohort followed up to death. *Br J Ind Med* 1987;44:396—401.
 39. Dunn MM. Asbestos and the lung. *Chest* 1989;95:1304—8.
 40. Dement JM, Brown DP, Okun A. Follow-up study of chrysotile asbestos textile workers: cohort mortality and case-control analyses. *Am J Ind Med* 1994;26:431—47.
 41. Nicholson WJ. Cancer following occupational exposure to asbestos and to vinyl chloride. *Cancer* 1977;39:1792—1801.
 42. Liddell FDK, McDonald JC. Radiological findings as predictors of mortality in Quebec asbestos workers. *Br J Ind Med* 1980;37:257—67.
 43. Selikoff IJ, Seidman H, Hammond EC. Mortality effects of cigarette smoking among amosite asbestos factory workers. *JNCI* 1980;65:507—13.
 44. Seidman H, Selikoff IJ, Hammond EC. Short-term asbestos exposure and long-term observation. *Ann NY Acad Sci* 1979;330:61—89.
 45. Hughes JM, Weill H, Hammad YY. Mortality of workers employed in two asbestos cement manufacturing plants. *Br J Ind Med* 1987;44:161—74.
 46. Stayner LT, Dankovic DA, Lemen RA. Occupational exposure to chrysotile asbestos and cancer risk: a review of the amphibole hypothesis. *Am J Public Health* 1996;86:179—86.
 47. Martischniig KM, Newell DJ, Barnsley WC, Cowan WK, Feinmann EL, Oliver E. Unsuspected exposure to asbestos and bronchogenic carcinoma. *Br Med J* 1977;1:746—9.
 48. Warnock ML, Chung AM. Association of asbestos and bronchogenic carcinoma in a population with low asbestos exposure. *Cancer* 1975;35:1236—42.
 49. Finkelstein MM. Mortality among employees of an Ontario asbestos-cement factory. *Am Rev Respir Dis* 1984;129:754—61.
 50. Anttila S, Karjalainen A, Tiakina-Aho O, Kyrönen P, Vainio H. Lung cancer in the lower lobe is associated with pulmonary asbestos fiber count and fiber size. *Environ Health Perspect* 1993;101:166—170.
 51. Karjalainen A, Karhunen P, Lalu K, Penttilä A, Vanhala E, Kyyrönen P, et al. Pleural plaques and exposure to mineral fibers in a male and the risk of lung cancer in a male urban necropsy population. *Occup Environ Med* 1994;51:456—60.
 52. Gardner MJ, Winter PD, Pannett B, Powell CA. Follow up study of workers manufacturing chrysotile asbestos cement products. *Br J Ind Med* 1986;43:726—32.
 53. Ohlson CG, Hogstedt C. Lung cancer among asbestos cement workers: a Swedish cohort study and a review. *Br J Ind Med* 1985;42:397—402.
 54. Thomas HF, Benjamin IT, Elwood PC, Sweetnam PM. Further follow-up study of workers from an asbestos cement factory. *Br J Ind Med* 1982;39:273—6.
 55. Weiss W. Mortality of a cohort exposed to chrysotile asbestos. *J Occup Med* 1977;19:737—40.
 56. Dement JM. Carcinogenicity of chrysotile asbestos: evidence from cohort studies. *Ann NY Acad Sci* 1991;643:15—23.
 57. Tubiana M. The carcinogenic effect of exposure to low doses of carcinogens [editorial]. *Br J Ind Med* 1992;49:601—5.
 58. Roggli VL, Hammar SP, Pratt PC, Maddox JC, Legier J, Mark EJ, et al. Does asbestos or asbestosis cause carcinoma of the lung? [commentary]. *Am J Ind Med* 1994;26:835—8.
 59. Meurman LO, Kiviluoto R, Hakama M. Combined effect of asbestos exposure and tobacco smoking on Finnish anthophyllite miners and millers. *Ann NY Acad Sci* 1979;330:491—5.
 60. Vainio H, Boffetta P. Mechanisms of the combined effect of asbestos and smoking in the etiology of lung cancer [review]. *Scand J Work Environ Health* 1994;20:235—42.
 61. Siemiatycki J, Wacholder S, Dewar R, Cardis E, Greenwood C, Richardson L. Degree of confounding bias related to smoking, ethnic group, and socioeconomic status in estimates of the associations between occupation and cancer. *J Occup Med* 1988;30:617—25.

62. Talbott JH, Barrocas M. Carcinoma of the lung in systemic sclerosis: a tabular review of the literature and a detailed report of the roentgenographic changes in two cases. *Semin Arthritis Rheum* 1980;9:191—217.
63. Turner-Warwick M, Lebowitz M, Burrows B, Johnson A. Cryptogenic fibrosing alveolitis and lung cancer. *Thorax* 1980;35:496—9.
64. Nagai A, Chiyotani A, Nakadate T, Konno K. Lung cancer in patients with idiopathic pulmonary fibrosis. *Tohoku J Exp Med* 1992;167:231—7.
65. Goldsmith DF. Silica exposure and pulmonary cancer. In: Samet JM, editor. *Epidemiology of lung cancer*. New York (NY): Marcel Dekker, 1994:245—98.
66. Goldsmith DF, Wagner GR, Saffiotti U, Rabovsky J, Leigh J. Special issue: second international symposium on silica, silicosis, and cancer. *Scand J Work Environ Health* 1995;21 suppl 2.
67. Weill H, McDonald JC. Exposure to crystalline silica and risk of lung cancer: the epidemiological evidence. *Thorax* 1996;51:97—102.
68. Mizushima Y, Kobayashi M. Clinical characteristics of synchronous multiple lung cancer associated with idiopathic pulmonary fibrosis: a review of Japanese cases. *Chest* 1995;108:1272—77.
69. Iwai K, Mori T, Yamada N, Yamaguchi M, Hosoda Y. Idiopathic pulmonary fibrosis: epidemiologic approaches to occupational exposure. *Am J Respir Crit Care Med* 1994;150:670—5.
70. Meyer EC, Liebow AA. Relationship of interstitial pneumonia, honeycombing, and atypical epithelial proliferation to cancer of the lung. *Cancer* 1965;18:322—51.
71. Brody AR. Asbestos-induced lung disease. *Environ Health Perspect* 1993;100:21—30.
72. Rom WR, Travis WD, Brody AR. Cellular and molecular basis of the asbestos-related diseases. *Am Rev Respir Dis* 1991;143:408—22.
73. Coutts II, Gilson JC, Kerr IH, Parkes WR, Turner-Warwick M. Mortality in cases of asbestosis diagnosed by a pneumoconiosis medical panel. *Thorax* 1987;42:111—6.
74. Berry G. Mortality of workers certified by pneumoconiosis medical panels as having asbestosis. *Br J Ind Med* 1981;38:130—7.
75. Huuskonen MS. Clinical features, mortality and survival of patients with asbestosis. *Scand J Work Environ Health* 1978;4:265—74.
76. McMillan GHG, Sheers G, Pethybridge R. A radiological follow-up study of the effect of asbestos in dockyard workers at Devonport. *J R Nav Med Serv* 1978;64:88—104.
77. Buchanan WD. Asbestosis and primary intrathoracic neoplasms. *Ann NY Acad Sci* 1965;132:507—18.
78. Sluis-Cremer GK. Asbestos disease at low exposures after long time residence. *Ann NY Acad Sci* 1991;643:182—93.
79. Wilkinson P, Hansell DM, Janssens J, Rubens M, Rudd RM, Newman-Taylor A, et al. Is lung cancer associated with asbestos exposure when there are no small opacities on the chest radiographs? *Lancet* 1995;345:1074—8.
80. Hillerdal G. Pleural plaques and risk for bronchial carcinoma and mesothelioma: a prospective study. *Chest* 1994;105:144—50.
81. Jacob G, Anspach M. Pulmonary neoplasia among Dresden asbestos workers. *Ann NY Acad Sci* 1965;132:536—48.
82. Edge JR. Asbestos-related disease in Barrow-in-Furness. *Environ Res* 1976;11:244—7.
83. Fletcher DE. A mortality study of ship yard workers with pleural plaques. *Br J Ind Med* 1972;29:142—5.
84. Loomis DP, Collman GW, Rogan WJ. Relationship of mortality, occupation, and pulmonary diffusing capacity to pleural thickening in the first national health and nutrition examination survey. *Am J Ind Med* 1989;16:477—84.
85. Sandén Å, Järholm B. Cancer morbidity in Swedish shipyard workers 1978—1983. *Int Arch Occup Environ Health* 1987;59:455—62.
86. Navratil M, Moravkova K, Gafronova M, Hruska F. The fate of people with pleural hyalinosis (plaques): relationship to direct and indirect asbestos exposure. *Czech Med* 1988;11:146—56.
87. Kipen HM, Lilis R, Suzuki Y, Valciukas JA, Selikoff IJ. Pulmonary fibrosis in asbestos insulation workers with lung cancer: a radiological and histopathological evaluation. *Br J Ind Med* 1987;44:96—100.
88. Giesen T. The validity of radiological and histological findings in former asbestos workers with lung cancer. In: *Proceedings of the VII International Pneumoconiosis Conference: part I*. Pittsburg (PA): United States Department of Health and Human Services, 1988:520—4.
89. Sluis-Cremer GK, Hessel PA, Hnizdo E. Factors influencing the reading of small irregular opacities in a radiological survey of asbestos miners in South Africa. *Arch Environ Health* 1989;44:237—43.
90. Weiss W. State of the art: cigarette smoke, asbestos, and small irregular opacities. *Am Rev Respir Dis* 1984;130:293—301.
91. Lilis R, Selikoff IJ, Lerman Y, Seidman H, Gelb K. Asbestosis: interstitial pulmonary fibrosis and pleural fibrosis in a cohort of asbestos insulation workers: influence of cigarette smoking. *Am J Ind Med* 1986;10:459—70.
92. Henderson DW, Roggli VL, Shilkin KB, Hammar S, Leigh J. Is asbestosis an obligate precursor for asbestos-induced lung cancer? Fibre burden and the changing balance of evidence: a preliminary discussion document. In: Peters GA, Peters BJ, editors. *Sourcebook on asbestos diseases; vol II*. Charlottesville (NC): Michie Company, 1995:97—170.
93. Sluis-Cremer GK, Bezuidenhout BN. Relation between asbestosis and bronchial cancer in amphibole miners. *Br J Ind Med* 1989;46:537—40.
94. Hughes JM, Weill H, Hammad YY. Mortality of workers employed in two asbestos cement manufacturing plants. *Br J Ind Med* 1987;44:161—74.
95. Hourihane DOB, McCaughey WTE. Pathological aspects of asbestosis. *Postgrad Med J* 1966;42:613—22.
96. Newhouse ML, Berry G, Wagner JC. Mortality of factory workers in east London 1933—80. *Br J Ind Med* 1985;42:4—11.
97. Wagner JC, Pooley FD, Berry G, Seal RME, Munday DE, Morgan J, et al. A pathological and mineralogical study of asbestos-related deaths in the United Kingdom in 1977. *Ann Occup Hyg* 1982;26:423—31.
98. Karjalainen A, Anttila S, Heikkilä L, Karhunen P, Vainio H. Asbestos exposure among Finnish lung cancer patients: occupational history and fiber concentration in tissue. *Am J Ind Med* 1993;23:461—71.
99. Smith PG. Pulmonary asbestos bodies, pleural hyaline plaques and neoplasia in man. In: *Proceedings of the conference on biological effects of asbestos; 1968; Dresden*. Berlin: Deutsche Zentralinstitut für Arbeitsmedizin, 1968:277—9.
100. Kishimoto T. Cancer due to asbestos. *Chest* 1992;101:58—63.
101. Hiraoka K, Horie A, Kido M. Study of asbestos bodies in

- Japanese urban patients. *Am J Ind Med* 1990;18:547—54.
102. Hillerdal G, Lindgren A. Pleural plaques: correlation of autopsy findings to radiographic findings and occupational history. *Eur J Respir Dis* 1980;61:315—9.
 103. Wain SL, Roggli VL, Foster WJ. Parietal pleural plaques, asbestos bodies, and neoplasia: a clinical, pathologic, and roentgenographic correlation of 25 consecutive cases. *Chest* 1984;86:707—13.
 104. Svenes KB, Borgersen A, Haaversen O, Holten K. Parietal pleural plaques: a comparison between autopsy and X-ray findings. *Eur J Respir Dis* 1986;69:10—5.
 105. Frumkin H, Pransky G, Cosmatos I. Radiologic detection of pleural thickening. *Am Rev Respir Dis* 1990;142:1325—30.
 106. Greene R, Boggis C, Jantsch H. Asbestos-related pleural thickening: effect of threshold criteria on interpretation. *Radiology* 1984;152:569—73.
 107. Macpherson P, Davidson JK. Correlation between lung asbestos count at necropsy and radiological appearances. *Br Med J* 1969;1:355—7.
 108. Pratt PC, Brody AR. Asbestos content of lung tissue in asbestos associated disease: a study of 110 cases. *Br J Ind Med* 1986;43:18—28.
 109. Gylseth B, Mowé G, Skaug V, Wannag A. Inorganic fibers in lung tissue from patients with pleural plaques or malignant mesothelioma. *Scand J Work Environ Health* 1981;7:109—13.
 110. Warnock ML, Prescott BT, Kuwahara TJ. Numbers and types of asbestos fibers in subjects with pleural plaques. *Am J Pathol* 1982;109:37—46.
 111. Roggli VL, Pratt PC, Brody AR. Asbestos content of lung tissue in asbestos associated diseases: a study of 110 cases. *Br J Ind Med* 1986;43:18—28.
 112. Mollo F, Andron A, Bertasso L, Colombo A. Placche pleuriche ialine ed esposizione all'asbesto [Pleural plaques and asbestos exposure]. *Pathologica* 1980;72:55—65.
 113. Kishimoto T, Ono T, Okada K, Ito H. Relationship between number of asbestos bodies in autopsy lung and pleural plaques on chest X-ray film. *Chest* 1989;95:549—52.
 114. Ren H, Lee DR, Hruban RH, Kuhlman JE, Fishman EK, Wheeler PS, et al. Pleural plaques do not predict asbestosis: high-resolution computed tomography and pathology study. *Mod Pathol* 1991;4:201—9.
 115. Karjalainen A, Anttila S, Vanhala E, Vainio H. Asbestos exposure and the risk of lung cancer in a general urban population. *Scand J Work Environ Health* 1994;20:243—50.
 116. McLarthy JW, Greenberg DS, Hurst GA, Spivey CG, Seitzman LH, Rieger RL, et al. The clinical significance of ferruginous bodies in sputa. *J Occup Med* 1980;22:92—6.
 117. Mollo F, Andron A, Bellis D, Bertoldo E, Colombo E. Screening of autopsy populations for previous occupational exposure to asbestos. *Arch Environ Health* 1987;42:44—50.
 118. Sheers G, Templeton AR. Effects of asbestos in dock yard workers. *Br Med J* 1968;574—9.
 119. Sarto F, Rossi A, Toffanin R, Mafessanti M, Camposanpiero A. Indagine Clinico-Radiografica in 119 soggetti esposti all'asbesto: significato della ricerca delle placche pleuriche fibrose [Clinical and radiological survey of 119 asbestos workers: importance of detecting fibrous pleural plaques]. *Med Lav* 1982;1:45—57.
 120. Jones RN, Diem JE, Hughes J, Hammad YY, Glindmeyer HW, Weill H. Progression of asbestos effects: a prospective longitudinal study of chest radiographs and lung function. *Br J Ind Med* 1989;46:97—105.
 121. McMillan CHG, Rossiter CE. Development of radiological and clinical evidence of parenchymal fibrosis in men with non-malignant asbestos-related pleural lesions. *Br J Ind Med* 1982;39:54—9.
 122. Schwartz DA. New developments in asbestos-induced pleural disease. *Chest* 1991;99:191—8.
 123. Schwartz DA, Fuoprtes LJ, Galvin JR, Burmeister LF, Schmidt LE, Lesitkow BN, et al. Asbestos-induced pleural fibrosis and impaired lung function. *Am Rev Respir Dis* 1990;141:321—6.
 124. Sison R, Hruban R, Moore W, Kuhlman J, Wheeler P, Hutchins G. Pulmonary disease associated with pleural "asbestos" plaques. *Chest* 1989;95:831—5.
 125. Smith DD. Plaques, cancer, and confusion. *Chest* 1994;105:8—9.
 126. Weiss W. Asbestos-related plaques and lung cancer. *Chest* 1993;103:1854—9.
 127. Edelman DE. Asbestos exposure, pleural plaques and the risk of lung cancer. *Int Arch Occup Environ Health* 1988;60:389—93.
 128. Hillerdal G, Nöu E. Occupation and bronchial carcinoma. *Scand J Respir Dis* 1979;60:76—82.
 129. Hillerdal G. Lung cancer: is the etiology changing? *Cancer Detect Prev* 1981;4:319—25.
 130. Hillerdal G, Karlén E, Åberg T. Tobacco consumption and asbestos exposure in patients with lung cancer: a three-year prospective study. *Br J Ind Med* 1983;40:380—3.
 131. Hertzog P, Toty L, Personne C, Roujeau J. Plaques pleurales, parietales, fibrohyalines. *J Fr Med Chir Thor* 1972;26:59—70.
 132. Toty L, Hertzog P, Personne C, Bakdach H. Thoracotomies et plaques pleurales fibro-hyalines. *Rev Fr Mal Respir* 1976; suppl 2 au Tome 4:93—6.
 133. Harber P, Mohensifar Z, Oren A, Lew M. Pleural plaques and asbestos-associated malignancy. *J Occup Med* 1987;29:641—4.
 134. Kiviluoto R, Meurman LO, Hakama M. Pleural plaques and neoplasia in Finland. *Ann NY Acad Sci* 1979;330:31—3.
 135. Partanen T, Nurminen H, Zitting A, Koskinen H, Wilkeri M, Ahlman K. Localized pleural plaques and lung cancer. *Am J Ind Med* 1992;22:185—92.
 136. Nurminen M, Tossavainen A. Is there an association between pleural plaques and lung cancer without asbestosis?. *Scand J Work Environ Health* 1994;20:62—4.
 137. Kannerstein M, Churg J. Pathology of carcinoma of the lung associated with asbestos exposure. *Cancer* 1972;30:14—21.
 138. Karjalainen A, Anttila S, Heikkilä L, Kyyrönen P, Vainio H. Lobe of origin in lung cancer among asbestos-exposed patients with or without diffuse interstitial fibrosis. *Scand J Work Environ Health* 1993;19:102—7.
 139. Whitwell F, Newhouse ML, Bennett DR. A study of the histological cell types of lung cancer in workers suffering from asbestosis in the United Kingdom. *Br J Ind Med* 1974;31:298—303.
 140. Mollo F, Pira E, Piolatto G, Bellis D, Burlo P, Andreozzi A, et al. Lung adenocarcinoma and indicators of asbestos exposure. *Int J Cancer* 1995;60:289—93.
 141. Johansson L, Albin M, Jakobsson K, Mkozky Z. Histological type of lung carcinoma in asbestos cement workers and matched controls. *Br J Ind Med* 1992;49:626—30.
 142. Vena JE, Byers TE, Cookfair D, Swanson M. Occupation and lung cancer risk: an analysis by histologic subtypes. *Cancer* 1985;56:910—7.
 143. Kjuus H, Langård S, Skjærven R. A case-referent study of lung cancer, occupational exposures and smoking: III. etio-

- logic fraction of occupational exposures. *Scand J Work Environ Health* 1986;12:210—5.
144. Raffn E, Lyng E, Korsgard B. Incidence of lung cancer by histological type among asbestos cement workers in Denmark. *Br J Ind Med* 1993;50:85—9.
 145. Imbernon E, Goldberg M, Bonenfant S, Chevalier A, Guénel P, Vatré R, Dehayé J. Occupational respiratory cancer and exposure to asbestos: a case-control study in a cohort of workers in the electricity and gas industry. *Am J Ind Med* 1995;28:339—52.
 146. De Vos Irvine H, Lamont DW, Hole DJ, Gillis CR. Asbestos and lung cancer in Glasgow and the west of Scotland. *Br Med J* 1993;306:1503—6.
 147. Blot WI, Harrington JM, Toledo A, Hoover R, Heath CW, Fraumeni JF. Lung cancer after employment in shipyards during World War II. *N Engl J Med* 1978;299:620—4.
 148. Järholm B, Larsson S, Hagberg S, Olling S, Ryd W, Torén K. Quantitative importance of asbestos as a cause of lung cancer in a Swedish industrial city: a case-referent study. *Eur Respir J* 1993;6:1271—5.
 149. Bovenzi M, Stanta G, Antiga GL, Peruzzo P, Cavallieri F. Occupation and lung cancer risk in Trieste, Italy. *Med Lav* 1992;83:338—48.
 150. Vilkmán S, Lahdensuo A, Mattila J, Tossavainen A, Tuomi T. Asbestos exposure according to different exposure indices among Finnish lung cancer patients. *Int Arch Occup Environ Health* 1993;65:269—74.
 151. Abraham JL. Asbestos inhalation, not asbestosis, causes lung cancer. *Am J Ind Med* 1994;26:839—42.
 152. Pott F. Neoplastic findings in experimental studies and conclusions for fiber carcinogenesis in humans. *Ann NY Acad Sci* 1991;643:205—18.
 153. Mossman BT, Kessler JB, Ley BW, Craighead JE. Interaction of crocidolite asbestos with hamster respiratory mucosa in organ culture. *Lab Invest* 1977;36:131—9.

Received for publication: 28 October 1996