Increased mesothelioma incidence in New Zealand: the asbestos-cancer epidemic has started

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Abstract

Aims. To examine the incidence and mortality patterns for malignant mesothelioma and pleural cancer in New Zealand between 1962-1996, and relate these to past use of asbestos.

Methods. Data concerning cases of mesothelioma 1962-1996, deaths from pleural and lung cancers 1974-1996, and data on imports of raw asbestos and asbestos products were obtained from government registers and publications. Time trends were analysed using different models.

Results. Mesothelioma incidence rates have increased progressively in New Zealand since the 1960s, and reached 25 per million for men in 1995. The increase follows an exponential model departing from a crude 'background rate' of 1-2 per million in 1984, and is particularly steep in males 50 to 60 years of age. The incidence is expected to double by 2010.

Conclusion. New Zealand has entered an unrivalled period of occupational cancer deaths resulting from past workplace exposure to airborne asbestos fibres. The steep rise in mesothelioma incidence is likely to be accompanied by increases in other asbestos related diseases such as lung cancer. The unique causal association between mesothelioma and asbestos may be used to monitor changes in the public health impact of these exposures. The notification by medical practitioners of all potential asbestos related conditions/exposures to the Occupational Safety and Health (OSH) service is of great importance.

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Malignant mesothelioma (MM) is a relatively rare tumour. Crude 'background' incidence rates are commonly quoted at ≤1-2 per million.[1,2] In the last 20-30 years, incidence rates among men have increased considerably in many industrialised countries.[3] Once diagnosed, it is rapidly fatal: the median survival time is eight to seventeen months and less

than 5% live more than five years.[3,4] Pleural and peritoneal MM has been strongly linked to exposure to airborne asbestos fibres.[1,3,5] Even minimal exposures to some forms of asbestos can lead to MM decades later.[6] Pleural MM is reported to be the most common form of the disease,[3,7] however, in some studies peritoneal MM predominates.[8-10] Other rarely reported sites of MM are the pericardium, the tunica vaginalis testis, fallopian tube, ovary and uterus.[11] The overall risk for MM is a function of the time since first asbestos exposure, the type of asbestos inhaled and the dose received.[12] The median age of onset of symptomatic MM is 50-60 years,[11] with latency period between exposure and symptomatic disease of 13-70 years (median 32 years).[13,14] Patients with pleural MM usually present with dyspnoea, chest pain, weight loss, cough and fever, and in the case of peritoneal MM, bowel obstruction.[15]

A relationship between asbestos and lung cancer has also been clearly established.[16,17] The number of asbestos-related lung cancers in an exposed population may be larger than the number of MMs.[12,18-20] The risk of lung cancer in asbestos workers is increased in an approximately multiplicative manner by tobacco smoking.[21] Gastrointestinal and laryngeal cancer have also been reported in exposed workers.[22,23] Thus, in order to estimate the total extent of the asbestos related cancer epidemic, other asbestos related cancers, particularly asbestos related lung cancer, need to be considered.

In New Zealand, concern about the health impact of asbestos exposure was first raised in the 1970s by trade unions and families of MM cases. The Department of Health[24] published information for medical practitioners in 1983, concluding that "the recorded mortality rate in New Zealand from asbestos-related disease is very low". Cooke[25] calculated that the annual rate of MM in the whole New Zealand population for 1975-1980 was two per million. This figure is similar to 'background rates' reported from other countries. Kjellstrom[26] made rough estimates of the total asbestos-related mortality (including lung cancer and asbestosis), suggesting that it could be 36 per year in 1984, rising to about 100 per year in the 1990s. Glass[27] reported 32 cases of MM between 1963-1974 and 93 cases between 1975-1986. The yearly number of cases fluctuated (3-16 cases per year in the 1980s) to the extent that a beginning of the 'epidemic' was not clearly seen. Glass et al[28] carried out a case-control study of selected cancers in men, classified into occupation groups with different likely asbestos exposure levels. For lung, pleural and peritoneal cancer, the odds ratios for being from the occupational group with the likely highest asbestos exposure were 1.3, 5.3 and 4.4 respectively, confirming, in New Zealand workers, an increased risk of these cancers after asbestos exposure.

Asbestos associated lung cancer is thought to be severely under reported in New Zealand,[29] as a result of the focus on smoking as the major cause of lung cancer. One approach to estimating the number of asbestos related lung cancers is to analyse the lung to mesothelioma case ratios. This ratio varies considerably between different countries, but is generally between one and ten.[30] The ratio at any given time will depend on the historical pattern of smoking, the time since first exposure to asbestos, the type and amount of asbestos fibre inhaled, the stage of the mesothelioma epidemic, the population studied and differences in the latency period between the two diseases.

This study is the first to establish that a 'mesothelioma epidemic' has begun in New Zealand and that the pattern of increase closely mirrors that of imports of crude asbestos approximately 30 years earlier.

Methods

Individual Cancer Registry incidence records (without identifying information) for mesothelioma (ICD-O morphology codes M9050-M9053), lung cancer (ICD-9-CM code 162) and pleural cancer (ICD-9-CM code 163) were obtained from the New Zealand Health Information Service (NZHIS) for 1980-1996. Published data[31] enabled an extension of the mesothelioma data back to 1962. Individual information was not available for these extended data and the incidence pattern for mesothelioma between 1962-1979 could not be examined by gender or age. Annual incidence figures for lung cancer and pleural cancer between 1974-1996 were obtained from the New Zealand Cancer Registry reports.[32] Individual mortality data (without identifying information) for cancer of the lung and pleura were obtained from the National Mortality Database (NZHIS) for the years 1974-1996. In order to calculate age and gender specific rates, estimated population data were obtained from NZHIS publications for the period 1962-1996.[33] The cancer morphology codes are not included in the National Mortality Database. Therefore, mesothelioma deaths cannot be identified directly from these records. Deaths from pleural cancer (ICD 163) were used to approximate mesothelioma mortality. The number of asbestos related lung cancer deaths in 1995 was estimated by relating this number to the number of mesotheliomas. A ratio of lung cancer to mesothelioma cases of 2:1 was used as a 'conservative' estimate and 10:1 as a 'maximum' estimate.[19,30]

Data on annual crude asbestos and asbestos product imports into New Zealand between 1949-1998 were obtained from annual statistical reports on the External Trade of New Zealand prepared by the Customs Department (1949-1980)[34] and the Department of Statistics (1981-1987).[35] Import data for the period 1988-1998 were obtained from the INFOS database.[36] In order to assess time trends, simple linear and exponential models were fitted to the annual MM rates. The 95% prediction interval for the annual rates of the best fitting model was used to ascertain when the MM epidemic began. Standard errors of the rates estimates were calculated assuming Poisson distributions.

Results

Between 1962 and 1971, eighteen new cases of MM were registered in New Zealand (1.8 cases per year). 25 years later, 1987-1996, 330 new cases were registered (33 cases per year), an eighteen-fold increase (Table 1). Pleural cancer case numbers from 1974-1996 closely maps that of mesothelioma, with a marked increase over the period and a predominance of male cases. Individual case data for pleural cancer between 1980-1996 revealed that 71% were recorded as mesothelioma, 10% adenocarcinoma, 6% papillary, squamous or epithelial carcinoma, and 2% various types of sarcoma. The remaining 11% were of unknown or unspecified morphology: some may have been undiagnosed MM.

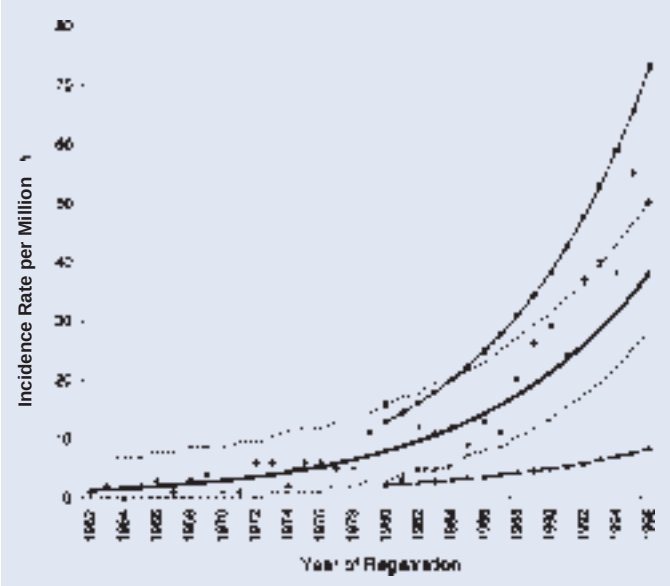
Of the 357 male MM cases registered in New Zealand between 1980-1996, 310 were verified by 'histology of the primary tumour' or 'autopsy with concurrent or previous histology', 30 by 'cytology or haematology' and 10 by 'histology of metastases' (New Zealand Cancer Registry). In seven cases, the basis of the diagnosis was 'unknown'. An analysis of the cases by primary site revealed that 297 (83%) were located in the pleura, 31(9%) in the lung, 14(4%) in the peritoneum, 3(1%) in the pericardium and 3(1%) in the testis and other male genitalia. The number of cases of female MM registered in the same period (n=49) was small, but it is noteworthy that female mesotheliomas tended to present less frequently in the pleura (51%) and more frequently in the peritoneum (22%) than for males. The annual incidence rates of mesothelioma (age 40+yrs) increased between 1980 and 1996 much more for men than for women (Figure 1).

Time and gender trends for mesothelioma and pleural cancers were quite different to those for lung cancer (Table 1). A comparison of the incidence figures for 1980-1984 and 1992-1996 for lung cancer revealed an increase (both genders) from an average of 1345 per year to 1547 per year. Most of this was caused by an increase of lung cancer in females, from an average of 340 per year to 549 per year. For men there is a decrease from an average of 1004 to 998 per year. Male MM cases in the period increased from an average of 9 per year to 39 per year. Part of these time trends may be associated with population increase, particularly in the older age groups (40+ years).

Table 1. Incident cases of lung cancer, pleural cancer and malignant mesothelioma in New Zealand between 1962-1996.

Reg	Lung Cancer			Pleural Cancer			Mesothelioma		
Year	Male	Female	Total	Male	Female	Total	Male	Female	Total
1962									1
1963									2
1964									0
1965									2
1966									3
1967									1
1968									3
1969									4
1970									1
1971									1
1972									6
1973									6
1974	**849**	**226**	**1075**	**3**	**3**	**6**			2
1975	**918**	**237**	**1155**	**4**	**1**	**5**			6
1976	**912**	**245**	**1157**	**13**	**2**	**15**			6
1977	**895**	**272**	**1167**	**6**	**2**	**8**			5
1978	**972**	**293**	**1265**	**8**	**4**	**12**			5
1979	**968**	**296**	**1264**	**13**	**1**	**14**			11
1980	**968**	**315**	**1283**	**13**	**1**	**14**	*15*	*1*	*16*
1981	**918**	**323**	**1241**	**4**	**2**	**6**	*2*	*1*	*3*
1982	**1008**	**340**	**1348**	**7**	**2**	**9**	*9*	*3*	*12*
1983	**1084**	**331**	**1415**	**10**		**10**	*10*	*1*	*11*
1984	**1044**	**392**	**1436**	**11**	**2**	**13**	*11*	*1*	*12*
1985	**985**	**366**	**1351**	**5**		**5**	*7*	*2*	*9*
1986	**998**	**387**	**1385**	**13**	**3**	**16**	*11*	*2*	*13*
1987	**993**	**437**	**1430**	**12**	**3**	**15**	*8*	*3*	*11*
1988	**1046**	**478**	**1524**	**12**	**1**	**13**	*18*	*2*	*20*
1989	**1053**	**486**	**1539**	**14**	**1**	**15**	*23*	*3*	*26*
1990	**980**	**475**	**1455**	**26**	**6**	**32**	*28*	*1*	*29*
1991	**955**	**482**	**1437**	**23**	**8**	**31**	*20*	*4*	*24*
1992	**990**	**516**	**1506**	**43**	**9**	**52**	*33*	*4*	*37*
1993	**991**	**526**	**1517**	**42**	**1**	**43**	*35*	*5*	*40*
1994	**1072**	**586**	**1658**	**40**	**5**	**45**	*34*	*4*	*38*
1995	**967**	**535**	**1502**	**47**	**6**	**53**	*48*	*7*	*55*
1996	**970**	**580**	**1550**	**49**	**4**	**53**	*45*	*5*	*50*

Data sources: bold typeface=published data from "Cancer Registrations & Deaths" 1974-1996, NZHIS[32] for lung and pleural cancer and the "Report of the Asbestos Advisory Committee" 1991, OSH,[31] for mesothelioma data. Italicised type=electronic data files for 1980-1996 obtained from NZHIS.



Assumed maximum background level for age ≥40 years
Upper and lower 95% prediction intervals for annual rates
Fitted exponential trendline (M+F)*
Fitted exponential (M)
Fitted exponential (F)
\+ Meosothelioma Incidence Rate (M+F)

*Regression slope =10.3% per year (95% CI=9.0-11.7)

Figure 1. The best fit exponential model together with 95% prediction intervals of a single years mesothelioma incidence rate (per million) for male and females combined, ≥40 years, between 1962 and 1996 and male and female separately from 1980.

Age specific rates for MM increased significantly from 1980-89 to 1990-96 (Table 2). The male age-specific rates in the 1990s peaked at age 70-79 years at over ten times the female rates. Only thirteen cases (3%) occurred before age 40, within an overall age range of 20-91 years. The greatest relative increase of the rate from the 1980s to the 1990s occurred in the male 50-59 year age group (incidence rate ratio 5.9/1.6 =3.7 times increase between the decades). Another view of age-specific time trends for males is given in Figure 2, which is based on pleural cancer mortality over the last three decades. The dramatic increase in the number of cases in both the older (60-89) and younger adult age groups (40-59) is clear, as is the decade-by-decade increase in deaths for these age groups (Figure 2).

Another aspect of the epidemic is the ethnic group distribution of MM. Of 357 male cases registered 1980-1996, only ten (3%) were Maori and six (2%) from Pacific ethnic groups. Five of these sixteen cases were registered in 1980-1989 and eleven in 1990-1996. The numbers are too small to analyse by age group. Maori appear to be under-represented, particularly as they are likely to have been over represented in manual occupations with potential asbestos exposure. Further research is required in this area to establish the numbers of Maori that may have been exposed, the timing of exposure, and any cultural or other barriers to diagnosis. In order to assess when the MM epidemic in New Zealand started, annual rates for men and women combined ≥40 years (and assuming all cases were in this range) for 1962-1996 were calculated, and different mathematical models fitted to the trends. The best fit was with an exponential model (10.3% increase per year). The 95% prediction interval for each annual rate shows that the lower boundary exceeds a 'background rate' of 5 per million in the age group ≥40 years in 1984 (Figure 1). This 'background

Table 2. Number of incident cases and age specific average annual rates per 100 000 of malignant mesothelioma in New Zealand for males and females according to age-group.

Age Group (years)	1980-1989 MALE			1980-1989 FEMALE		1990-1996 MALE			1990-1996 FEMALE	
	Cases	Rate	95% CI	Cases	Rate	Cases	Rate	95% CI	Cases	Rate
20-29	1	0.0	NC	0	0.0	0	0.0	NC	1	0.1
30-39	3	0.1	NC	3	0.1	3	0.2	NC	2	0.1
40-49	6	0.3	NC	2	0.1	10	0.6	NC	6	0.4
50-59	22	1.6	0.9-2.2	4	0.3	65	5.9	4.4-7.3	6	0.5
60-69	38	3.2	2.2-4.3	6	0.5	77	8.4	6.5-10	6	0.6
70-79	29	4.3	2.7-5.9	2	0.2	67	11.6	8.8-14	7	1.0
80+	15	8.0	NC	2	0.5	21	10.6	NC	2	0.5
Total	114			19		243			30	
	Total Number of Cases 1980-1989=133					Total Number of Cases 1990-1996=273				

Differences between the males rates for all age groups between 1980s vs 1990s have been assessed using 95% confidence intervals for each period. NC=not calculated due to small numbers.

rate' was estimated in two ways: 1) based on the highest commonly quoted rate in the general population of 2 per million and adjusting for the New Zealand population distribution, and 2) based on the age-distribution of MM cases in the 1970s (Figure 1) giving an age specific rate in the ≥40 years age group of 4.5 per million. Another model fitting two joined straight regression lines to the data, using the time of the joining of the lines as a parameter marking the initiation of the epidemic, showed that the year of shift from a slow growth in incidence line to a more rapid growth line was 1986 (95% CI, 1984-1988).

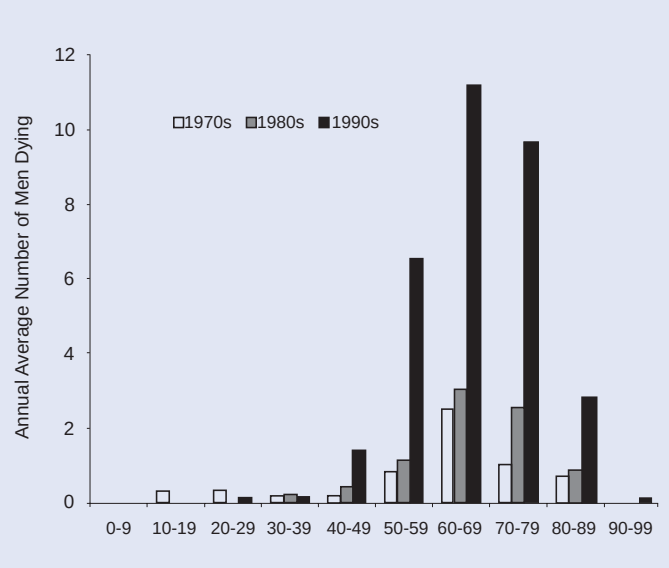


Figure 2. Pleural cancer mortality in New Zealand men during the 1970s, 1980s and 1990s. Values plotted as the annual average number of male deaths in each period.

The MM incidence and mortality rates for New Zealand males in 1995 are similar to estimates for other countries (Table 3). The highest crude annual rates for male MM were recorded for Australia (58 per million) and the UK (44 per million). These comparisons suffer from variation in the age groups included and the timing of development of the national MM epidemics.

Import of crude asbestos into New Zealand peaked in 1974 at 12 500 tonnes (4 kg per capita), with a steep decline thereafter (Figure 3). No crude asbestos was imported into New Zealand after 1991. The total use of, and exposure to, asbestos in New Zealand over the last 50 years is difficult to ascertain. However, adding up the published import figures as an estimate of asbestos products in the country, gives at least 200 000 tonnes of crude asbestos, 7 million m^2 of asbestos fabric and 8 million m^2 of asbestos cement sheets. For the latter, coding and industry practice changes from 1988 make it impossible to distinguish between cement sheets containing asbestos and those containing other materials or asbestos substitutes (personal communication, New Zealand Imports coder, May 2000). The estimated range of asbestos-related lung cancer deaths in New Zealand males in 1995 is 74-370 (Table 4), and assuming that the combined numbers of MM and lung cancers reflect the total asbestos cancer burden, a 'conservative' estimate of 111 and a 'maximum' estimate of 407 cases can be calculated. These estimates still exclude any other cancers that may be associated with asbestos exposure.

The actual and estimated incidence/mortality for asbestos associated malignancies is within the same range as the mortality for several other major public health concerns in New Zealand males (Table 4). The 1995 crude mortality rate for mesothelioma alone was approaching that of HIV or workplace injury, the 'conservative' estimate for all asbestos

Table 3. Published annual incidence or mortality rates (per million) for mesothelioma in males and females between 1986 and 1995 in different countries.

Country	Source	Measure	Population Age (years)	Time Period	Rates Male	Female
Western Europe	Takahashi et al (1999)50	Incidence	15+	1991-1995	10-25*	
Japan	Takahashi et al (1999)50	Incidence	15+	1995	5*	
USA	Spirtas et al (1986)51	Incidence	35+	1986‡	13	3
France	Boutin et al (1998)3	Incidence	all	to 1993	16‡	1.5‡
New Zealand	this study	Incidence	all	1995†	25	3
UK	Peto et al (1995)39	Mortality	25+	1987-1991	44	6
Australia	Leigh et al (1998)38	Notification	20+	1994	58	6

related cancer was approaching that of malignant melanoma and the 'maximum' estimate exceeds that of traffic accident deaths.

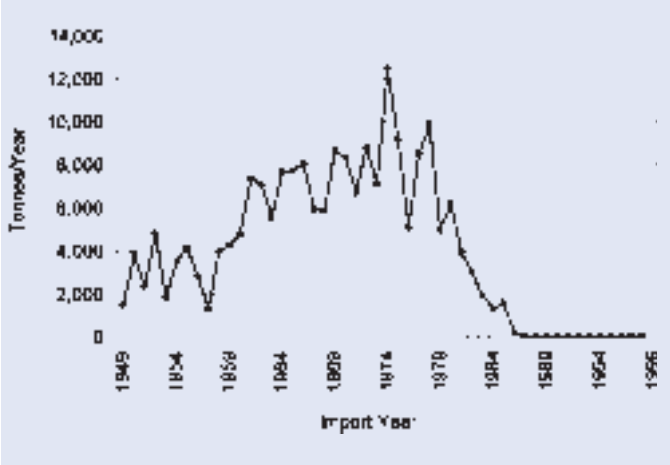


Figure 3. Imports of crude asbestos (including asbestos powder) between 1949-1998.

Table 4. A comparison of asbestos related cancer mortality and mortality for selected other causes in New Zealand men, 1995.

Disease	ICD Code	Number of Male Deaths
Mesothelioma (ICD-O)	M9050-9053	37
Pleural Cancer (ICD-9)	163	45
Asbestos Induced Lung Cancer (2:1)*	-	74
Asbestos Induced Lung Cancer (10:1)†	-	370
Estimated range for all asbestos induced cancers	-	111-407
HIV (ICD-9)	42	53
Workplace Injury Fatalities‡	-	59
Skin Melanoma (ICD-9)	172**	121
Traffic Accidents (ICD-9)	E810-E819	402
All Lung Cancers (ICD-9)	162	894

*Based on 2:1 or 'conservative estimate' for lung cancer to mesothelioma cases, †based on a 10:1 or 'maximum estimate' for lung cancer to mesothelioma cases, ‡1994 figure, excluding traffic accidents at work, **excludes some sites eg skin of genital organs and anal canal. Data Sources: Mortality and Cancer Registration Data - individual records obtained from NZHIS. Workplace Injury Fatalities obtained from the IPRU/NEOH report "Work-related Fatal Injuries in New Zealand 1985-1994".[52]

Discussion

The dramatic increase in the incidence and mortality of malignant mesothelioma in New Zealand in the last 20 years is consistent with studies elsewhere.[2,18,37-39] Comments on this issue in 1984 by Kjellstrom[26] suggested that such an increase would happen, but the detailed retrospective data needed to ascertain that the 'epidemic' had started was not available at that time.

Interpretation of these trends may be influenced by a number of factors, including the extent to which MM has been under-reported or misdiagnosed in the past. There have undoubtedly been improvements in the diagnosis of MM since the 1960s, however, the possibility that this could explain a large proportion of the recent increases in MM in other countries has been examined and rejected.[39,40] Pleural cancer has been used as a surrogate for MM in several national studies.[18] A close relationship between MM and pleural cancer incidence (most pleural cancers are classified as MM and most MM are located in the pleura) has also been found in the present study. Diagnostic uncertainty for pleural cancer is likely to be much less than that for MM. More importantly, the large difference in the trends for males and females MM strongly supports the notion that MM in New Zealand is primarily an occupational cancer associated with the increase of asbestos use about 30 years earlier.

Major reviews have concluded[1,18] that the cause of the recent increase of MM in a number of countries is occupational exposure to asbestos. However, not all reported cases of mesothelioma have a clear association with asbestos exposure,[1,2,41,42] and other possible causes have been examined. In vitro studies have suggested that simian virus 40 (SV40) could contribute to the development of human mesothelioma, by rendering cells more susceptible to neoplastic transformation by asbestos.[43] Peto[39] and Carbone et al[44] discussed the possibility that the risk of mesothelioma could be increased through SV40 contaminated polio vaccine administered between 1955-1963. The difference in the trends for males and females (Figure 1) does not support SV40 exposure itself being the cause of the MM epidemic in males, as this would affect men and women equally. This cohort of vaccinated people is still relatively young so it is too early to tell if mesothelioma increases have been heightened by SV40 infection. It should be noted that there are reported incidences of environmentally induced mesothelioma, resulting from daily exposure to local asbestos containing rocks.[45,46] Unlike occupational exposures, environmental exposures are characterised by high rates of MM in both sexes and/or particularly high rates for females (domestic exposure), early age of disease onset (childhood exposure) and limitation to specific rural populations (local rock outcrops).

The trend for MM incidence rate in New Zealand and its predictor interval show that a significant increase (over the maximum reported background rate) occurred in 1984 and continues to rise thereafter. In the 20 years up to 1996, there was an approximately seven-fold increase above the 'background rate', which is similar to the increase of annual asbestos imports into New Zealand from 1949 to 1970. There is a delayed exposure-response relationship between asbestos and MM with time lag of 13-70 years.[13,14] The likely trend beyond 1996 based on this relationship is at least a doubling of the New Zealand MM rate by 2010. On a global scale, the 1995 MM incidence rate in all New Zealand men (25 per million) is in the higher region of the 10-30 per million quoted for industrialised countries.[3]

Based on the number of MM cases, the estimated number of asbestos-related male lung cancer deaths in New Zealand in 1995 would be at least 74, making the total number of asbestos cancer deaths (MM plus lung cancer) comparable to the number of deaths for some other major public health concerns (Table 4). Further study of the causal role of asbestos for lung cancer in New Zealand is needed to make more accurate assessment of the total burden of disease due to asbestos. However, taking potential under-reporting of MM into account, and using a higher estimate of the ratio of lung cancer to MM (the highest reported in the literature is 10:1[30]), the asbestos cancer burden would be much bigger.

Clearly, asbestos is an occupational hazard which merits further attention in New Zealand. The victims and their families would benefit from active screening and surveillance (including notification to the OSH National Asbestos Registers)[29,31] and assistance with workers compensation issues. Medical practitioners have a key role to play[27] in establishing the true extent of the current epidemic, by identifying and notifying all lung cancer and MM cases with past asbestos exposure, regardless of smoking habits, and recording a full occupational history for each case. All suspected cases should be reported to the OSH National Asbestos Register and the ACC. Laboratories are required by law to report all diagnosed cancer cases to the Cancer Registry. One could argue that medical practitioners should notify cases of asbestos cancer to the Medical Officer of Health as 'poisoning arising from chemical contamination of

the environment.' It is unfortunate that the different tracks for reporting and notification are not linked.

In spite of the large increase of MM in the New Zealand male population, this is still a rare disease. On average, a GP may see only one case of MM every 20 years (based on more than 2000 GPs and 50-100 cases of MM per year), and one case of lung cancer each year. The possibility of an asbestos connection should be considered in each case of MM and lung cancer.

The occupations with the highest risk of MM in Australia and New Zealand have been construction (including repair and maintenance) and manufacturing: eg builders, carpenters, renovators, asbestos removal workers, shipbuilding and repair workers, boiler men, laggers, railway and power station workers, watersiders, asbestos product manufacturers and friction product workers.[29,47-49]

There are still many asbestos products in New Zealand buildings, including schools, homes and commercial workplaces. These products will continue to pose a health threat for the foreseeable future, particularly to workers engaged in asbestos removal, building renovation and repair, and local populations exposed to airborne asbestos fibres as a result of fire and other forms of destruction and deterioration. Continued vigilance is essential to identify and control exposure sources, and ensure strict adherence to occupational and environmental health guidelines, to limit the extent and duration of the current asbestos cancer epidemic.

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A votre santé?

Reported rates of morbidity and mortality from coronary heart disease (CHD) are significantly lower in France than other Western populations, despite a cholesterol-rich diet. If this "French Paradox" were due to the high consumption of wine, especially red wine, there would be an ideal therapy for CHD: patients can readily be persuaded to pay for their own supply and compliance will rarely be a problem, although intentional overdosage may be common.

A double-blind placebo-controlled trial, treating red wine like any other candidate therapy, would be an ideal way to test the French Paradox. Without such direct evidence, people should be cautioned against increased wine consumption, since the harmful effects of excess alcohol consumption (in whatever form it is taken) are well established. In the interim, the view must be that more pleasure than medical benefit is likely to be gained from drinking red wine.

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