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October 2, 1990

Honorable Jack B. Weinstein
U.S. District Court
Eastern District of New York
225 Cadman Plaza, East
Brooklyn, NY 11201

Dear Judge Weinstein:

When we met, I promised to collect data for you bearing on several aspects of the asbestos problem. I've been able to do this for three questions and am working on two or three more. I hope to complete work on these in the next months.

Attached is a manuscript concerned with two of the questions.

1. Among exposed individuals, how significant is minimal x-ray parenchymal change (fibrosis)?

   For our current purpose this may be defined as the lowest "positive" category in the ILO Classification [i.e., category 1, or even category 1/0].

   In 1963, we examined 1,117 insulators in New York-New Jersey (90% of the Union membership). All have been observed since. Their 1963 x-rays were categorized and their mortality experience during the 27 subsequent years analyzed in relation to the 1963 status.

   It was found that minimal x-ray change carried a significantly greater risk of death of lung cancer, mesothelioma and asbestosis than that suffered by those with no lung scarring on x-ray, although even those with "normal" x-rays had important risk [as a result of their exposure]. Minimal lung scarring carries an important risk of death of asbestos-associated disease in subsequent years.

2. What is the significance of pleural fibrosis (in the absence of parenchymal change on x-ray)?

Pleural fibrosis was a bad omen. Those whose x-rays showed (circumscribed) plaques subsequently died significantly more often of asbestos diseases than those whose x-rays did not show such change.

3. A third question was: how little exposure might cause disease?

During two weekends recently (September 15-16, 23-23) we examined 283 family contacts of asbestos factory workers.* [This was the plant which made the insulation materials used in the Brooklyn Navy Yard.] These men had worked for shorter or longer spans (1 week-13 years) during the time the plant was in operation, 1941-1954.

Forty percent (40%) had abnormal x-rays (parenchymal and/or pleural fibrosis).

Thus, the levels in contaminated houses can cause disease. This disease, incidentally, has also been found to be associated with excess lung cancer, as well as mesothelioma.

With all good wishes.

Sincerely yours,

Irving J. Selikoff, M.D.
Professor Emeritus

IJS:jm
Enc.
cc: Judge Helen Freedman
Mark Peterson, Esq.

* 54 wives, 106 daughters, 62 sons, 22 sisters, 15 brothers, 3 mothers, 21 other. See attached sheet.

Predictive significance of parenchymal and/or pleural fibrosis for subsequent death of asbestos-associated diseases.

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Abstract

In 1963, 1,117 asbestos insulation workers in the New York-New Jersey metropolitan area were examined with demographic information recorded and chest x-rays made. Results were reported. When the current ILO Classification of Radiographs of Pneumoconioses (1971) became available, the retained roentgenograms were reevaluated and categorized in that Classification.

The 1,117 men were observed prospectively to December 31, 1989. Four hundred and eighty-four (484) died. Each death was investigated, with all available clinical and histopathological material studied. Causes of death were classified in two ways - by death certificate category and as ascertained by best evidence. Mortality experience was then studied in relation to the 1963 x-ray appearances, in equivalent duration-from-onset groups. Analyses focused on death rates from lung cancer, mesothelioma and asbestosis. Lowest death rates - but still significantly elevated - were found among those with no parenchymal opacities (category 0) in 1963. Category 1 was associated with higher rates and these were in turn exceeded by the group with category 2 or 3 films. It was of interest that this gradation of asbestos-associated deaths was also seen when the x-rays were categorized in "intermediate" ILO categories. 0/1 gave higher death rates than 0/0, and those in categories 1/1 and 1/2, higher still. Liddell's scheme for intermediate readings, originally introduced for coal workers' pneumoconiosis, was thus validated (at least for mortality) for asbestos exposure of insulation workers.

It was also found that the presence of radiographic evidence of pleural fibrosis (even in the absence of concurrent parenchymal small opacities) was a bad omen. The group with such abnormality had significantly higher death rates from lung cancer, mesothelioma and asbestosis than the group without pleural fibrosis on x-ray.

Introduction

From January 1, 1943 to December 31, 1962, 1,522 men were members of the Insulation Workers' Union in the New York metropolitan area* (632 were members in 1943, 890 joined during the next two decades).

Two hundred and seventy-three (273) died during the 20 years; 1,249 remained alive on January 1, 1963. 90.6% were employed at the time. All were invited to come for clinical and x-ray examinations. Eleven hundred and seventeen (1,117) presented themselves, 132 did not. Both groups were then followed. Five hundred and forty-two (542) subsequently died; 484 of the 1,117 examined men and 58 of those who did not participate. All deaths were investigated.

The 1963 x-rays (findings originally reported in 1964) had been retained and when the current ILO Classification of Radiographs of Pneumoconioses (1971) became available, the films were evaluated once more and placed in ILO Classification categories.

It has been of interest to study how the various ILO category groups fared during the 27-year period of prospective observation to December 31, 1989, and to ascertain whether their initial (1963) x-ray status (in equivalent duration-from-onset categories) was associated with subsequent differences in mortality rates from lung cancer, mesothelioma and asbestosis. Analyses focused on the 1963 grading of parenchymal fibrosis (profusion of small opacities), and pleural fibrosis.

Materials and methods

On January 1, 1963, there were 1,249 members of the New York-New Jersey metropolitan area locals of the International Association of Heat and Frost Insulators and Asbestos Workers, AFL-CIO (Locals 12 and 32). They were the survivors of the 1,522 men who were in these locals on January 1, 1943

* Locals 12 and 32 of the International Association of Heat and Frost Insulators and Asbestos Workers, AFL-CIO.

(632) or had joined from 1943 to December 31, 1962 (890). Two hundred and seventy-three (273) had died in that period (262 of the 1943 members and 11 of those who joined in the next 20 years).

All 1,249 were invited to come for examination. One thousand one hundred seventeen (1,117) came - 132 did not (89.9% participation).

Clinical evaluation included physical examination, chest x-rays (PA, both obliques), ventilatory pulmonary function tests, complete blood counts, blood chemistry, urine analysis, as well as the recording of much demographic data, including date of birth, date of first employment, lifetime occupational history, military service, details of insulation work including duration, shipyard work, respirator use, etc. Work status was noted. Symptoms such as cough, chest pain, sputum, exertional dyspnoea were listed as were signs such as finger clubbing, rales, rhonchi, cyanosis. Lifetime history of tobacco use was detailed (cigarette, pipe/cigar; age at onset, amount smoked, current smoking, when discontinued, if ceased). Other information was also sought and recorded, such as dust counts observed, number of employers, special exposure circumstances. The results were reported.[1]

The entire group of 1,249 remained under observation (both examined and not examined). Demographic and employment data were obtained for the latter from union records. The majority of the examinees were restudied from time to time.

Mortality experience.

The members of both unions were observed continuously (and continue to be), with the valuable assistance of the local unions. Whenever a worker became ill, if the unions were aware of this, we were informed, so that we could offer such advice as we might. If a death occurred, we were notified and a death certificate was submitted (the latter were received by the Unions as part of their death benefit programs).

The circumstances of each death were investigated, whatever the stated cause. Information was sought with equal vigor in each case, from treating

physicians, hospitals, pathology departments. Data sought included x-rays, clinical findings and histopathological material. The x-rays and clinical data were studied by one of us (IJS) and the latter by our Pathology Unit* and, where consultation was deemed desirable, by the Medical Center's Pathology Department. The results of these studies yielded an ascertained diagnosis, that was derived from "Best Evidence" ("BE"), which could be compared with the Death Certificate categorization ("DC"). Results of the mortality studies have been reported.[2]

In the large majority of deaths, death certificate categories were accurate. In some cases, they were not.** Such discrepancies pose a problem. It has long been known that a proportion of death certificate diagnoses are wrong[3,4] including those with asbesotos-associated disease.[5] Still, there are advantages in utilizing expected death rates based upon death certificate records; they are extensive, stable, permit a wide selection of comparisons.

It may be hoped that whatever inaccuracies there are in death certificate diagnoses, they would be proportionally the same in the group being studied, so that comparisons would be valid. Nevertheless, when the study group is subject to significant additional influences - not seen in the general

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* Dr. Jacob Churg, Dr. Milton Kannerstein and, since 1975, Dr. Yasunosuke Suzuki. We are also grateful to Dr. Mamoru Kaneko of our Department of Pathology for his valuable advice in special cases.

** The fact that death was due to cancer of one of another variety was accurately noted on death certificates in 213/237 cases (89.9%). Accuracy of designation of a specific primary site varied, however, from 87.6% for lung cancer (99/113), to 56.9% for mesothelioma (30/59). The specific designation of asbestosis as the form of chronic non-infectious respiratory disease that caused death was present in 43.6% (24/55). For lung cancer, diagnosis was based upon autopsy and/or surgery in 94 of 113 cases. Slides were reviewed at Mount Sinai in 71. All diagnoses of mesotheliomas were based upon histopathological material, reviewed in each case at Mount Sinai. Histopathological ascertainment was considerably less for asbestosis, 34 of 55, with slides reviewed in 20 of the 34.

population - then comparisons may not be appropriate. A case in point is asbestos exposure: mesothelioma and asbestosis have been extremely rare in the general population but can be fairly common in asbestos-exposed groups, in which the incidence of lung cancer can also be significantly elevate.

We have elected to report our mortality findings in both ways, as categorized on death certificates and as ascertained after review of all material - "best evidence". Our rationale for this has been published.[2]

The only deviation has been mesothelioma, where "best evidence" categorization has required Mount Sinai review of histopathological material. If material was not available, or not made available to us, an alternate diagnosis was ascertained, frequently "disseminated neoplasm [often, abdominal], primary site not established." This may have resulted in some underestimation of mesothelioma.

1963 Chest X-rays.

There was no suitable ILO Classification for radiographs of asbestos-exposed workers in 1963. Therefore, results were reported[1,6] using the Saupe Classification.[7] It was considered the best approach at the time.

However, the original films were retained and were reread in 1983 (RL) employing the 1971 ILO Classification of Radiographs of Pneumoconioses, including the utilization of the standard films which accompanied the Classification[8,9]. The interpretations were made without knowledge of the status of the individual. Only findings on the standard postero-anterior films were evaluated.

Results

Mortality

Four hundred and eighty-four (484) deaths occurred among the 1,117 men examined in 1963, from January 1, 1963 to December 31, 1989. There were 23,352.2 person-years of observation during this span of 27 years. Table 1 provides details of the age distribution of the cohort, in duration-from-onset

categories, during the 27 year period. The large majority of the men in 1963 had yet to reach 20 years from onset of their work, 833/879 (94.8%).

Table 2 gives the overall mortality results for both "death certificate" and "best evidence" analyses, for major asbestos diseases, as well as for total deaths and total cancer. Experience was very much like that previously reported.[2,10] 24.73 deaths of lung cancer were expected; 113 occurred. There were 59 deaths of mesothelioma (15 pleural, 43 peritoneal and one with site undetermined) and 55 of asbestosis. Table 3 provides analyses of the deaths for lung cancer, mesothelioma and asbestosis in duration-from-onset categories; it can be seen that virtually no such cases were observed in the first 20 years from onset of work exposure. Indeed, most asbestos-associated deaths occurred 30 or more years after onset (e.g., 102/114, or 89.5%, of mesothelioma and asbestosis deaths).

Almost half (48.1%) of all deaths occurred before the age of 65; 51.3% of the lung cancer deaths. Comparison with ages at death for the U.S. general population for total deaths and lung cancer indicates that not only were there more deaths than expected, but the men "died young" (Table 4). For the U.S. general population in 1987, the comparable percentages were 28.9% of all deaths and 37.1% of those dying of lung cancer.

Chest X-rays

Table 5 provides the statistical background for evaluation of mortality 1963-1989 in relation to the x-ray status in 1963, by describing the number of person-years of observation for parenchymal and pleural fibrosis categories over the study period, including combinations of parenchymal and pleural changes.

Parenchymal fibrosis.

The x-rays of 695 men showed no parenchymal fibrosis in 1963 (category 0) while 385 had x-rays in category 1 and 36 were in categories 2 or 3. As expected, deaths generally followed this ascending distribution, although there were differences in causes of death - asbestosis becoming more important than cancer as grade of parenchymal fibrosis increased (Table 6). Those whose x-rays in 1963 had been interpreted as not showing small opacities

nevertheless had increased mortality from lung cancer, mesothelioma and asbestosis, even in the subgroup with x-rays showing no reticular small opacities 20 or 30 years after onset of employment.

Thus, ILO category 0 x-rays did not indicate that death of asbestos-associated disease (lung cancer, mesothelioma), in workers with such films, was not going to occur although there were proportionately fewer such deaths than among those with films of categories, 1, 2 or higher in equivalent duration-from-onset categories. In men with category 0 films, over the next 27 years, 17.2% of 198 deaths were due to lung cancer, 12.6% of mesothelioma and 5.6% of asbestosis. For men with category 1 films, it was 26.7%, 13.2% and 11.2% and for categories 2 and 3, 34.3%, 2.9% and 45.7%

It is known, of course, that standard x-rays may not show histologically present (but radiologically inapparent) diffuse interstitial fibrosis.[11] We have no knowledge of what high resolution computed tomography would have shown among these asbestos-exposed men.

The 12-point ILO scale.

Liddell and Lindars, in our opinion, made a very useful contribution in their introduction of intermediate recording categories for the prevalence of small opacities.[12] Offered originally for the small rounded opacities seen in x-rays of coal workers' pneumoconiosis, it has been successfully applied to parenchymal small opacities in asbestos miners and millers, as well.[13] While the ultimate categorizations remain the same (the major categories 0, 1, 2, 3) as, essentially, they indeed have in the various revisions of pneumoconiosis classifications since the 1930 ILO Johannesburg Conference,[14] the formulation allows the recording of other tentative scores that may have been considered when the films were analyzed. Grade 1 may be the final decision, but an analysis may have considered grade 0 (0/1) or grade 2 (1/2). Or there may have been no doubt (1/1).

There have been limited data to allow judgment as to the overall quantitative validity of the several subcategories, in the scoring of small opacities.

We have sought to evaluate whether different subcategories were associated with different subsequent mortality experience among insulation workers,

taking duration-from-onset of exposure into account, and using age and year--specific expected death rates where applicable, and rates/10,000 person-years for evaluation of the incidence of fatal mesothelioma and asbestosis.

Table 7 details the mortality experience 1963-1989 of 364 insulators whose films in 1963 were category 0/0 and of 331 in category 0/1. The latter group bore a greater risk. Mortality from asbestos-associated disease increased further for categories 1/0, 1/1 and 1/2. Table 8 indicates that lung cancer was responsible for 11 of 84 deaths in men with category 0/0 films (13.1%) and for 23 of 114 deaths in men with 0/1 films (20.2%). For mesothelioma it was 8.3% vs. 15.8% and for asbestosis, 6.0% vs. 5.3%. For men with category 1 x-rays, lung cancer claimed 20 of 102 deaths (19.6%) of men with films categorized as 1/0, 38 of 130 (29.2%) with films 1/1 and 21 of 54 (38.9%) with films 1/2+. For mesothelioma, it was 13.7%, 12.3% and 7.4% and for asbestosis, 8.8%, 13.9% and 33.3%. Categories 2 and 3, particularly, were associated with even heavier subsequent risk, particularly of fatal asbestosis. Of 35 deaths, there were 12 due to lung cancer (34.3%), 1 of mesothelioma (2.9%) and 16 of asbestosis (45.7%).

These data suggest a discriminatory potential of the subcategories of profusion scores, with regard to subsequent mortality experience. The data indicate that the subtle judgments of a reviewer may reflect different levels of profusion, as might be expected in a disease with a continuum of abnormality.

Pleural fibrosis.

It has long been appreciated that pleural fibrosis, either circumscribed or diffuse (or combinations thereof), is frequently seen on x-rays following asbestos exposure.[15-20]

However, there has been some hesitation in ascribing serious potential for asbestos-associated disease in individuals whose sole radiological abnormality has been pleural fibrosis, especially if circumscribed. Such insecurity has perhaps been lessened recently by descriptions of pulmonary function decrements in asbestos workers without evidence of identifiable parenchymal fibrosis[21-24] and by the growing awareness that only a portion of the pleural fibrosis actually present may be seen on standard films.[25,26] Further,

the potential importance of fibrosis of the visceral pleura is increasingly being brought to attention.[27-29] Finally, the fatal potential of diffuse pleural fibrosis has been noteworthy.[30]

These considerations coexist with observations that many patients have radiologically evident pleural fibrosis without appreciable clinical difficulty (dyspnoea). They represent one end of a spectrum of the effects of pleural fibrosis - fibrosis present but no observed disability, through functional decrement with or without clinical disability of varying degree, to extensive disability or even death. Where each case fits in such a spectrum has to be separately evaluated by appropriate studies.

The presence of pleural fibrosis signals that exposure has taken place and that the individual has, in that respect, been altered - he or she is "at risk" of subsequent serious asbestos-associated disease.

We have been interested in whether radiologically evident pleural fibrosis, as recorded in the ILO Classification, has or does not have predictive significance insofar as mortality experience is concerned.

In 1963, 488 insulators of the 1,117 examined had pleural fibrosis on their films. In 195, this was the sole radiological abnormality; in 293, there was parenchymal fibrosis as well. 310 of these men died by the end of 1989. Table 9 lists the causes of death in categories of greatest interest. The presence of radiologically evident pleural fibrosis, in the absence of parenchymal fibrosis, significantly increased the risk of death of lung cancer, mesothelioma, and asbestosis. If there was concurrent radiologically evident parenchymal fibrosis, the risk was greater. But pleural fibrosis by itself gave excess deaths of lung cancer as well as deaths of mesothelioma and asbestosis. Men whose x-rays in 1963 showed pleural fibrosis [the types of pleural changes are listed in Table 10], but no parenchymal small opacities had, in the next 27 years, 20 deaths from lung cancer of 90 deaths in all (22.2%), 16 from mesothelioma (17.8%) and 6 (6.7%) from asbestosis. Among those whose x-rays had both pleural and parenchymal fibrosis, it was 61/220 (27.7%) from lung cancer, 25/220 (11.4%) from mesothelioma and 42/220 (19.1%) from asbestosis (Table 11)

In contrast, where there had been no pleural fibrosis, the percentages dying

of these asbestos-associated diseases were lower, albeit again influenced by the presence or absence of radiologically evident parenchymal fibrosis (Table 11) when comparing the subgroup without parenchymal and pleural changes, with the subgroup in which pleural changes only were detected. Mortality from lung cancer was 13.0% vs. 22.2%, from mesothelioma 8.3 vs. 17.8%, and from asbestosis 4.6% vs. 6.7%. The predictive significance of radiologically evident pleural fibrosis was particularly seen in longer duration-from-onset categories (Table 12).

Pleural fibrosis on chest x-rays, as a result of asbestos exposure, is by no means a benign condition, in terms of risk of death of asbestos-associated disease.

Selective bias.

One hundred and thirty-two (132) (10.1%) of the Unions' membership on January 1, 1963 did not participate in the clinical examinations. We have been interested whether this might have introduced elements of selective bias in the results of the analyses.

We maintained observation of the 132 non-participants in exactly the same manner as the 1,117 who were examined. Their mortality experiences were very much the same. Table 13 provides the age and duration from onset distributions over the 27-year period and Table 14 gives the distribution of the 58 deaths among them, which can be compared with those among the examined men in Table 2. There was no evidence of significant selective bias, at least of the sort reflected in mortality data.

Discussion

The results described here represent the effects of one kind of asbestos exposure - that resulting from the use of asbestos products in insulation work. This was surely markedly excessive during the 1930's, 1940's, 1950's and probably through most of the 1960's - although how excessive cannot be documented since very few dust counts were made. Exposures are believed to have decreased in the 1970's and further in the 1980's because of increasing awareness of the hazardous nature of asbestos insulation work,

and the elimination of asbestos in insulation products newly manufactured after 1972-1973.

While there has been a paucity of dust counts to document this belief, analysis of death rates of insulation workers in three periods of time (1967-1972, 1973-1978 and 1979-1986) has found that, in equivalent duration-from-onset groups, rates declined somewhat (± 15%) for lung cancer, asbestosis and peritoneal mesothelioma, (for those less than 40 years from onset of exposure) but not for pleural mesothelioma nor for those more than 40 years from onset.[32] This secular change may have had some influence on rates found in this study.

The clear trends in the death rates for asbestos-associated diseases as a function of categories of small opacities provide evidence that validates the pertinence of the 12-point ILO scale, at least insofar as predictive value for mortality risks is concerned. They do not help us very much in evaluation of an individual case at any one time, with regard to function decrement or disability. But, then, the ILO Classification was not designed nor destined for such clinical use - an admonition repeatedly offered, but as frequently disregarded. Workers with x-rays that are interpreted as 1/1 or even greater profusion may be fit, while others categorized as 0/1 or 1/0 can have troubling disability. Individual evaluation and judgment are needed.[32-34]

The same is true for pleural fibrosis. In epidemiological terms, groups with pleural fibrosis, even without radiologically evident parenchymal fibrosis, have significantly less favorable prognosis than workers without such radiological change. This is to a considerable extent due to effects of the exposure that had occurred and not necessarily to consequences of the fibrosis that is seen.

For the individual, disability is again variable. Some with pleural fibrosis may have functional decrement and/or disability. Others may not, whatever is seen on the x-ray. Judgments will have to be made with regard to findings in individuals, insofar as current status is concerned. Prognosis is a separate question.

From a public health control point of view the data in this study indicate that every effort should be made to avoid asbestos exposures which can result in radiologically detectable fibrosis, parenchymal or pleural.

Conclusions

1. Asbestos insulation workers without radiologically evident parenchymal fibrosis had significant risk of death of asbestos-associated disease, including lung cancer, mesothelioma and asbestosis, when observed over a period of 27 years (1963-1989).

2. When initial x-rays showed fibrosis, the risk was greater. This was well demonstrated by ascending levels of risk of asbestos-associated deaths with increasing ILO major categories of parenchymal fibrosis (0--->1--->2/3).

   It was also true for increasing levels of intermittent categories (0/0, 0/1, 1/0, 1/1, 1/2 or greater).

3. The stepwise increase in risk, if radiographic profusion of small opacities is accepted as a surrogate for levels of exposure, constitute evidence for a dose/disease response relationship, for fatal asbestos-associated disease. Alternatively, it may relate to biological phenomena of which parenchymal fibrosis is one evidence, or to a combination of exposure and biological response influences.

4. The fact that 0/1 profusion readings were associated with greater mortality risk than 0/0 has both prospective clinical and epidemiological importance. It also tends to validate the usefulness of the 12-point scale of readings of profusion of small opacities originally introduced for coal workers pneumoconiosis and frequently used nowadays for asbestosis.

   0/0 categorization in an individual who has had significant exposure (as determined by the experiences of a group) does not "protect" against subsequent increased risk of death of asbestosis, lung cancer or mesothelioma. But 0/1 carries greater risk.

5. The presence of pleural fibrosis in initial films also was associated with important subsequent increased risk of death of asbestos-associated disease. 195 insulators had films in 1963 with pleural fibrosis, without parenchymal disease. 500 had no pleural fibrosis, again in the absence of small opacities. Those with pleural change had greater risk of asbestos disease death when both groups were followed prospectively, January 1, 1963-December 31, 1989. If there was parenchymal fibrosis in addition to the pleural change, the results were, as expected, even worse, particularly for death of asbestosis.

Whatever the exposure/biological response complex may be that is associated with the radiological appearance of pleural fibrosis after asbestos exposure, it is also associated with increased mortality risk. However, this is not to say that the fibrosis seen on the x-rays (in the very large majority of cases, circumscribed) directly resulted in death. The plaques did not become pleural mesothelioma and lung cancer did not occur preferentially in the regions of pleural fibrosis.

6. Two other observations were of interest. In this prospective investigation, we were able to explore the potential for selective bias. There were 1,249 members of the Union in 1963. One thousand one hundred and seventeen (1,117) came for examination, 132 did not. Observation was maintained of both groups. Over the next 27 years, their mortality experience was very much the same.

Second, approximately half of the deaths were under the age of 65. Asbestos insulation workers not only died in excess, but the deaths were frequently premature.

Table 1

Prospective observation of 1117 New York - New Jersey
asbestos insulation workers, January 1, 1963 - December 31, 1989

Person years of observation

Duration from onset (years)

Age	Total	<10	10-19	20-29	30-39	40-49	50+
15-19	11.5	11.5	0.0	0.0	0.0	0.0	0.0
20-24	283.8	283.8	0.0	0.0	0.0	0.0	0.0
25-29	925.3	789.8	135.4	0.0	0.0	0.0	0.0
30-34	1851.7	654.0	1195.7	1.9	0.0	0.0	0.0
35-39	2728.8	257.0	2157.8	314.0	0.0	0.0	0.0
40-44	3247.9	12.8	1501.5	1730.4	3.1	0.0	0.0
45-49	3494.3	0.0	527.9	2658.8	655.4	0.0	0.0
50-54	3310.5	0.0	59.6	1694.2	1549.7	6.6	0.0
55-59	2822.0	0.0	25.8	521.4	1979.1	295.2	0.0
60-69	1227.8	0.0	13.1	81.9	90.6	888.1	2.9
65-69	1227.8	0.0	6.4	31.2	233.3	799.6	156.9
70-74	812.0	0.0	0.0	8.5	47.1	294.2	461.9
75-79	475.9	0.0	0.0	3.3	22.6	48.1	401.6
80-84	213.8	0.0	0.0	0.0	5.6	18.7	189.3
85+	59.2	0.0	0.0	0.0	0.0	3.1	56.1
Total	23,352.2	2008.9	5623.2	7045.6	5049.5	2353.6	1268.7

Table 2

Observed and expected deaths among 1117 New York - New Jersey asbestos insulation workers observed prospectively January 1, 1963 - December 31, 1989

	Death Certificate			Best Evidence[2]			
Cause of death	Obs.	Exp.[1]	Ratio	Obs.[2]	Exp.[1]	Ratio[3]	10^4p.y.
All causes	484	317.14	1.53	484	317.14	1.53	207.3
All cancer	213	70.92	3.00	237	70.92	3.34	101.5
Lung	99	24.73	4.00	113	24.73	4.57	48.4
Mesothelioma[4]	30	0.00	-	59	0.00	-	25.3
Pleural[4]	7	0.00	-	15	0.00	-	6.4
Peritoneal[4]	11	0.00	-	43	0.00	-	18.4
G.I. Cancer[5]	32	18.28	1.75	30	18.28	1.64	12.8
Non-infectious Resp. Disease	49	13.85	3.54	60	13.85	4.33	25.7
Asbestosis[4]	24	0.00	-	55	0.00	-	23.6
Cardiovascular	154	161.32	9.5	128	161.32	0.79	54.8

Person - years = 23,352.5

1.Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2.Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3.Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

4.Rates are not available since these have been rare causes of death in the general population.

5.Includes cancer of stomach, esophagus, colon-rectum, liver, gall-bladder and bile ducts.

Table 3

Deaths of lung cancer, mesothelioma and asbestosis among 1,117
New York - New Jersey asbestos insulation workers .
January 1, 1963 - December 31, 1989

Duration from onset categories

Duration from onset (years)	Person years	Total deaths Obs.[2]	Total deaths Exp.[1]	Total deaths Ratio[3]	Lung Cancer Obs.[2]	Lung Cancer Exp.[1]	Lung Cancer Ratio[3]	Mesothelioma Obs.[2]	Mesothelioma 10^4py	Asbestosis Obs.[2]	Asbestosis 10^4py
<10	2008.9	8	3.73	2.14	0	0.04	0.00	0	-	0	-
10-19	5623.2	16	18.41	0.87	2	0.81	2.48	0	-	0	-
20-29	7045.6	64	48.77	1.31	12	4.12	2.91	3	4.3	9	12.8
30-39	5049.5	110	75.52	1.46	36	8.00	4.50	17	33.7	6	11.9
40-49	2353.6	145	76.88	1.89	34	6.57	5.17	22	93.5	21	89.2
50+	1268.7	141	93.74	1.50	29	5.18	5.60	17	134.0	19	149.8
TOTAL	23,352.2	484	317.14	1.53	113	24.73	4.57	59	25.3	55	23.6

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 4

Age at death of 484 New York - New Jersey
asbestos insulation workers
January 1, 1963 - December 31, 1989

		Age at death (years)			
		Under 65		65 or older	
Cause of death	Total	No.	%	No.	%
All causes	484	233	48.1	251	51.9
All cancer	237	121	51.1	116	48.9
Lung cancer	113	58	51.3	55	48.7
Mesothelioma	59	32	54.2	27	45.8
Asbestosis	55	20	36.4	35	63.6

Table 5

I.L.O. classification of x-rays of 1,117 New York - New Jersey asbestos insulation workers observed prospectively January 1, 1963 - December 31, 1989, in duration from onset categories.

Person years of observation

1. X-ray status 1963 small opacities (ILO)

Small irregular* opacities	Number of workers	Total	Years from onset ≤10	10-19	20-29	30-39	40-49	50+
0/0	364	8869.8	1222.0	2689.5	2953.7	1519.6	375.7	106.8
0/1	331	7392.4	555.0	1742.8	2280.8	1688.6	711.8	410.5
1/0	199	3989.7	194.3	834.0	1193.4	1057.6	473.4	234.5
1/1	166	2536.6	36.9	350.7	573.4	643.4	568.1	362.2
1/2 +	57	558.5	0.0	4.0	41.7	137.7	221.1	152.2
	1117	23,352.2	2008.9	5623.2	7045.6	5049.5	2353.6	1268.7

*Totals vary slightly associated with compression of results to one decimal place.

2. Parenchymal/pleural fibrosis 1963 (ILO)

Parenchymal fibrosis	Pleural fibrosis	Number of workers	Total	Years from onset ≤10	10-19	20-29	30-39	40-49	50+
0	0	500	12176.8	1679.0	3657.6	4070.1	2084.3	524.2	161.6
0	+	195	4080.4	98.3	775.0	1164.7	1123.7	563.3	355.4
+	0	129	2716.9	175.2	648.5	876.7	669.7	236.8	110.0
+	+	293	4363.1	55.7	540.0	931.6	1169.5	1026.9	639.4
		1117	23,337.2	2008.2	5621.1	7043.1	5047.2	2351.2	1266.4

Table 6

Deaths of lung cancer, mesothelioma and asbestosis among 1,117 New York - New Jersey asbestos insulation workers . January 1, 1963 - December 31, 1989

1963 Chest X-rays
Profusion = 0
(0/0, 364; 0/1, 331)

Duration from onset (years)	Person years	Total deaths Obs.[2]	Exp.[1]	Ratio[3]	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	1777.4	8	3.27	2.45	0	0.03	0.00	0	-	0	-
10-19	4433.1	12	13.90	0.86	2	0.59	0.00	0	-	0	
20-29	5235.7	42	34.20	1.23	5	2.91	1.72	2	3.8	5	8.0
30-39	3208.6	51	45.31	1.13	7	5.00	1.40	5	15.6	3	9.3
40-49	1088.2	47	32.40	1.45	7	3.08	2.27	13	19.5	1	9.2
50+	517.8	38	38.99	0.97	5	2.21	2.26	5	96.6	2	38.6
TOTAL	16,264.2	198	168.18	1.18	34	13.83	2.46	25	15.4	11	6.8

Profusion = 1
(1/0 = 199; 1/1 = 166; 1/2 = 20))

Duration from onset (years)	Person years	Total deaths Obs.[2]	Exp.[1]	Ratio[3]	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	231.3	0	0.46	0.00	0	0.01	0.00	0	-	0	-
10-19	1,188.7	4	4.50	0.89	2	0.22	9.24	0	-	0	
20-29	1,791.5	19	14.27	1.33	6	1.19	5.06	1	5.6	2	11.2
30-39	1,753.6	56	28.60	1.96	18	2.87	6.27	12	68.4	3	17.1
40-49	1,121.1	79	39.30	2.01	22	3.11	7.08	8	71.4	8	71.4
50+	660.3	93	47.85	1.94	19	2.61	7.29	12	181.7	15	227.2
TOTAL	6,749.0	251	135.1	1.86	67	10.00	6.70	33	48.9	28	41.5

Profusion = 2,3
(2/1 = 23; 2/2 = 5; 2/3 = 3; 3/2 = 1; 3/3 = 5))

Duration from onset (years)	Person years	Total deaths Obs.[2]	Exp.[1]	Ratio[3]	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	0.0	0	0.0	-	0	0.0	-	0	-	0	-
10-19	0.5	0	0.0	-	0	0.0	-	0	-	0	-
20-29	17.6	3	0.30	10.0	1	0.02	56.0	0	-	2	1136.4
30-39	85.8	3	1.56	1.9	1	0.13	7.7	0	-	0	-
40-49	142.9	19	5.12	3.7	5	0.38	13.2	1	70.0	12	839.7
50+	89.0	10	6.74	1.6	5	0.36	13.9	0	-	2	224.7
TOTAL	336.7	35	13.75	2.5	12	0.88	13.6	1	29.7	16	475.2

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 7

Deaths of lung cancer, mesothelioma and asbestosis among 1,117
New York - New Jersey asbestos insulation workers .
January 1, 1963 - December 31, 1989

1963 Chest x-rays

Profusion 0/0 (364 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	1222.0	6	0	0.02	-	-	0	-	0	-
10-19	2689.5	8	0	0.34	-	-	0	-	0	-
20-29	2953.7	23	1	1.57	0.64	3.4	0	-	3	10.2
30-39	1519.6	19	8	2.33	3.43	52.6	0	-	0	-
40-49	375.7	17	1	1.07	0.93	26.6	5	133.1	1	26.6
50+	106.8	11	1	0.47	2.12	93.6	2	187.3	1	93.6
TOTAL	8869.8	84	11	5.82	1.89	12.4	7	7.9	5	5.6

Profusion 0/1 (331 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	555.0	2	0	0.01	-	-	0	-	-	0
10-19	1742.8	4	0	0.24	-	-	0	-	-	0
20-29	2280.8	19	4	1.34	2.98	17.5	2	8.8	2	8.8
30-39	1688.6	32	9	2.67	3.37	53.3	5	29.6	3	17.8
40-49	711.8	30	6	2.01	2.99	84.3	8	112.4	0	-
50+	410.5	27	4	1.73	2.31	97.4	3	73.1	1	24.4
TOTAL	7392.4	114	23	8.01	2.87	243.0	18	24.3	6	8.1

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 8

Deaths of lung cancer, mesothelioma and asbestosis among 1,117 New York - New Jersey asbestos insulation workers . January 1, 1963 - December 31, 1989

1963 Chest x-rays

Profusion 1/0 (199 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	194.3	0	0	0.00	-	-	0	-	0	-
10-19	834.0	2	0	0.13	-	-	0	-	0	-
20-29	1193.4	7	2	0.73	2.73	16.8	0	-	0	-
30-39	1057.6	27	5	1.71	2.92	47.3	6	56.7	1	9.5
40-49	473.4	36	6	1.34	4.49	126.7	5	105.6	2	42.2
50+	234.5	30	1	0.95	7.35	298.5	3	127.9	6	255.9
TOTAL	3989.7	102	20	4.87	4.11	50.1	14	35.1	9	22.6

Profusion 1/1 (166 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	36.9	0	0	0	-	-	0	-	0	-
10-19	350.7	2	2	0.09	22.73	57.0	0	-	0	-
20-29	573.4	12	4	0.44	9.10	69.8	1	17.4	2	34.9
30-39	643.4	24	10	1.09	9.20	155.4	4	62.2	2	31.1
40-49	568.1	37	13	1.57	8.27	228.8	3	52.8	5	88.0
50+	362.2	55	9	1.40	6.41	248.5	8	220.9	8	220.9
TOTAL	2536.6	130	38	4.60	8.26	149.8	16	63.1	17	67.0

Profusion 1/2 + (57 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	0.0	0	0	-	-	-	0	-	0	-
10-19	4.0	0	0	-	-	-	0	-	0	-
20-29	41.7	3	1	0.04	28.37	239.8	0	-	2	479.6
30-39	137.7	8	4	0.19	20.91	290.5	2	145.2	0	-
40-49	221.1	25	8	0.58	13.89	361.8	1	45.2	13	588.0
50+	152.2	18	8	0.61	13.10	525.6	1	65.7	3	197.1
TOTAL	558.5	54	21	1.42	14.83	376.0	4	71.6	18	304.4

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 9

Deaths of lung cancer, mesothelioma and asbestosis among 1,117 New York - New Jersey asbestos insulation workers . January 1, 1963 - December 31, 1989

1963 Chest x-rays
Small opacities - 0
Pleural fibrosis +
(195 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	98.3	1	0	0.00	-	-	0	-	0	-
10-19	775.0	1	0	0.14	-	-	0	-	0	-
20-29	1164.7	13	3	0.74	4.08	25.8	1	8.6	1	8.6
30-39	1123.7	24	10	1.81	5.52	89.0	3	26.7	2	17.8
40-49	563.3	21	4	1.58	2.53	71.0	7	124.3	1	17.8
50+	355.4	30	3	1.50	2.00	84.4	5	140.7	2	56.3
TOTAL	4083.0	90	20	5.78	3.46	49.0	16	39.2	6	14.7

Small opacities - +
Pleural fibrosis +
(293 workers)

Duration from onset (years)	Person years	Total deaths	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
<10	55.7	0	0	0.00	-	-	0	-	0	-
10-19	540.0	2	1	0.11	9.05	18.5	0	-	0	-
20-29	931.6	15	5	0.65	7.71	53.7	0	-	4	-
30-39	1169.5	35	11	1.89	5.81	94.1	6	51.3	3	25.7
40-49	1026.9	80	24	2.82	8.51	233.7	8	77.9	18	175.3
50+	639.4	88	20	2.55	7.55	312.8	11	143.0	17	265.9
TOTAL	4364.9	220	61	8.03	7.60	139.8	25	57.3	42	96.2

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 10

Pleural fibrosis in chest x-rays of 1,117 insulation workers examined in 1963.

	Pleural fibrosis	
Extent	Number	Percent
1	184	
2	68	
Total	252	22.56
Width		
A	153	
B	83	
C	16	
Total	252	22.56
Diaphragmatic plaques		
R	63	
L	150	
Bilateral	129	
Total	342	30.62
Calcification		
Extent 1	42	
Extent 2	65	
Extent 3	57	
Total	170	15.22
Costophrenic angle obliteration		
R	44	
L	54	
Bilateral	44	
Total	142	12.71

Table 11

Deaths of lung cancer, mesothelioma and asbestosis among 1,117
New York - New Jersey asbestos insulation workers .
January 1, 1963 - December 31, 1989.

1963 Chest x-ray					Percent of deaths					
					Lung cancer		Mesothelioma		Asbestosis	
Parenchymal fibrosis	Pleural fibrosis	Number of men	Total deaths	Person-years	No.	%	No.	%	No.	%
0	0	500	108	12,179.9	14	13.0	9	8.3	5	4.6
0	+	195	90	4,083.0	20	22.2	16	17.8	6	6.7
+	0	129	66	2,719.7	18	27.3	9	13.6	2	3.0
+	+	293	220	4,364.9	61	27.7	25	11.4	42	19.1
		1,117	484		113	23.4	59	12.2	55	11.4

Table 12

Predictive significance of radiological abnormalities among 1,117 New York - New Jersey asbestos insulation workers observed prospectively January 1, 1963 - December 31, 1989

Results in equivalent duration from onset categories

Parenchyma fibrosis	Pleural fibrosis	Person years	Lung Cancer Obs.[2]	Exp.[1]	Ratio[3]	10^4py	Mesothelioma Obs.[2]	10^4py	Asbestosis Obs.[2]	10^4py
			20-29 years from onset							
0	0	4070.1	2	2.18	0.92	4.9	1	2.5	4	9.8
0	+	1164.7	3	0.74	4.08	25.8	1	8.6	1	8.6
+	0	876.7	2	0.56	3.58	22.8	1	11.4	1	-
+	+	931.6	5	0.65	7.71	53.7	0	-	4	42.9
			30-39 years from onset							
0	0	2084.3	7	3.19	2.19	33.6	2	9.6	1	4.8
0	+	1123.7	10	1.81	5.52	89.0	3	26.7	2	17.8
+	0	669.7	8	1.10	7.28	119.5	6	89.6	0	-
+	+	1169.5	11	1.89	5.81	94.1	6	51.3	3	25.7
			40-49 years from onset							
0	0	524.2	3	1.50	2.01	57.2	2	38.2	0	-
0	+	563.3	4	1.58	2.53	71.0	7	124.3	1	17.8
+	0	236.8	3	0.67	4.51	126.7	1	42.2	2	84.5
+	+	1026.9	24	2.82	8.51	233.7	8	77.9	18	175.3
			50+ years from onset							
0	0	161.6	2	0.70	2.85	123.8	0	-	0	-
0	+	355.4	3	1.50	2.00	84.4	5	140.7	2	56.3
+	0	110.0	4	0.42	9.53	363.6	1	90.9	0	-
+	+	639.4	20	2.55	7.55	312.8	11	142.0	17	265.9

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BE"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai, were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

Table 13

Deaths of 132 Local 12 and 32 asbestos insulation workers who failed to appear for examination in 1963 but who were nevertheless observed prospectively January 1, 1963 - December 31, 1989

Person years of observation

Years from onset

Age	Total	≤10	10-19	20-29	30-39	40-49	50+
15-19	6.4	6.4	0	0	0	0	0
20-24	81.9	81.9	0	0	0	0	0
25-29	193.0	162.9	30.0	0	0	0	0
30-34	299.5	97.0	202.4	0	0	0	0
35-39	387.1	23.5	325.3	38.2	0	0	0
40-44	427.3	3.9	192.1	226.6	4.6	0	0
45-49	382.8	0.5	47.6	309.8	23.7	1.1	0
50-54	310.7	2.7	20.2	176.3	106.2	4.9	0
55-59	226.3	0.7	14.0	35.2	155.4	19.4	1.1
60-64	128.7	0	4.9	15.7	62.5	40.1	4.9
65-69	58.4	0	0.7	10.2	10.7	31.9	4.5
70-74	51.6	0	0	4.9	7.4	25.7	13.4
75-79	40.4	0	0	0.7	5.9	19.4	14.2
80-84	23.9	0	0	0	0	1.4	22.5
85+	4.1	0	0	0	0	0	4.1
Total	2622.1	379.5	837.2	817.6	376.4	143.9	64.7

Table 14

Observed and expected deaths among 132 New York - New Jersey asbestos insulation workers, not examined in 1963 but observed prospectively from January 1, 1963 - December 31, 1989.

	Deaths 1963 - 1989 (2622 person-years)			
Cause of death	Observed[2]	Expected[1]	Ratio[3]	10^4
All causes	58	26.38	2.20	2212.0
All cancer	24	5.51	4.35	91.5
Lung cancer	12	1.84	6.53	45.8
Mesothelioma[4]	5	0.00	0.00	19.1
Pleural[4]	1	0.00	0.00	3.8
Peritoneal[4]	4	0.00	0.00	15.3
G.I. + Cancer[5]	5	1.44	3.48	19.1
Non-inf. resp. disease	5	0.99	5.07	19.1
Asbestosis4	5	0.00	0.00	19.1

1. Expected deaths ("DC") are based upon age and year specific death rates of the U.S. National Center for Health Statistics for white males, for 1963 - 1987, extrapolated for 1988 and 1989.

2. Best Evidence ("BC"). Ascertained after review of all available autopsy, surgical and clinical material. For mesothelioma, only cases in which histopathological material was confirmed as mesothelioma at Mount Sinai were so categorized. Cases not so verified, even if considered by others as mesothelioma, are not categorized as mesothelioma in this investigation.

3. Calculated for information only, since it utilized "Best Evidence" vs. "Death Certificate" diagnoses, not strictly comparable due to different quality of ascertainment and verification.

4. Rates are not available since these have been rare causes of death in the general population.

5. Includes cancer of stomach, esophagus, colon-rectum, liver, gall-bladder and bile ducts.