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MORTALITY AND MORBIDITY AMONG TALC MINERS AND MILLERS IN ITALY

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The mortality experience of workers engaged in mining and milling the Italian non-asbestiform talc of Val Chisone was previously described (Rubino *et al.*, 1976). In that paper we expressed some doubt as to whether we could be fully confident in the comparison with the agricultural neighbouring population we had chosen as a control. For this report, therefore, expected deaths were recalulated by using as a standard the deaths rates of the Italian Male Population. These rates are available since 1951. We have examined mortality patterns for the observation period from 1946 through 1974 using for the first quinquennium the rates relevant to the year 1951. The "man-years" method according to Case and Lea was used (Case and Lea, 1955).

The results of this further analysis are reported in Table 1. There is in both miners and millers a significant excess of overall mortality, which in miners is mainly accounted for by respiratory diseases and within this category by pneumoconiosis. In millers there were 4 deaths from simple pneumoconiosis or with superimposed tuberculosis. In both groups a very low incidence of respiratory cancer was observed.

TABLE 1. Miners and Millers - Observed and Expected Deaths During 1946 - 1974.

	Miners			Millers		
Number in study	1260			418		
Cause of Death	O	E	SMR	O	E	SMR
All causes	560	446.9	125[1]	193	164.4	117[1]
Lung cancer	8	17 2	47	4	6.1	66
Non-malignant respiratory diseases	109	33.1	329[2]	18	12.4	145
Pneumoconiosis	58	–	–	3	–	–
Tb associated with Pneumoconiosis	13	–	–	1	–	–
Tb	23	11.6	198[2]	8	4.1	195

[1] $P < .05$
[2] $P < .01$
Treating observed number of death as a Poisson variable.
No expectation was assumed for pneumoconiosis

The mortality among miners according to cumulative dust exposure is shown in Table 2. Environmental information regarding the mines and mills, the composition of the talc, and the methods for allocating individuals to exposure categories, were reported in the previous paper (Rubino *et al.*, 1976). It should be stated, however, that all mention of dust counts in this paper represent respirable particles of 0.5 to 5.0 micrometers. From Table 2 it is evident that an increasing trend of pneumoconiosis and tuberculosis is associated with increasing exposure. At the highest level of exposure, which was estimated to be more than 5,665 mppef/years, about 20% of total deaths were due to pneumoconiosis, complicated or not by tuberculosis.

The relationship of mortality to the intensity of exposure is not consistent in millers (Table 3). The four observed cases of pneumoconiosis are quite uniformly distributed in the three exposure levels.

Further investigations were carried out for these deaths among millers in order to confirm the certified diagnosis, and to assess any possible exposure to other dust not previously recognized. Additional data were provided by the National Institute for Insurance. The description of these cases is reported in Table 4.

For cases no. 1 and no. 3, exposure to free silica in addition to talc was found. Case no. 1 had also worked as a graphite miner for 9 years. Case no. 3 was qualified for pay rolls as a miller, but he had, at irregular intervals, also worked as talc miner helper. For case no. 4, no additional data were available, as no claim compensation was set up.

Case no. 2, whose death was certified as due to silico-tuberculosis, was only exposed to talc milling. Chest-X-Ray film showed rounded opacities, which were classified, according to ILO-UICC Classification (1970), as r ½, in lower pulmonary zones in addition to tuberculous sclerosis and calcifications. Histological examination of necropsy specimens showed the presence of nodules partly fibro-hyaline with central necrosis, similar to caseous necrosis (Figure 1). These nodules may hardly be considered as classical silicotic nodules. However, the origin not simply tuberculous is supported by the presence of several birefringent particles which were found the as well as within the fibrous thickening of the septa (Figure 2). Infrared analysis and X-ray-diffractograms of dust from digested lung demonstrated 85-90% of talc particles mixed with 10-15% quartz.

In conclusion, the results of our study show a marked difference between miners' and millers' mortality, as regards the incidence of pneumoconiosis. The high frequency among miners is attributable to the high content of free silica in the air dust in the mines, which was measured to be as high as 18% in drilling operations (Rubino *et al.*, 1976).

Through our further investigations, evidence was provided on one case of pneumoconiosis with tuberculous association, following exposure to talc in a workroom where free silica content in the air dust was less than 2%. This death occurred 29 years after first exposure, in a worker exposed to an estimated average dust concentration of 24 mppcf for 23 years. The role of the small amount of free silica, in addition to talc, in inducing such pulmonary fibrosis is still an open question. Moreover, superimposed tuberculosis may be implicated in the development of the fibrosis as it happens in Pulmonary Massive Fibrosis (James, 1954).

However, on the basis of results of investigations by Kleinfeld *et al.* (1964) and Leophonte *et al.* (1976) the experimental study of rats by Wagner *et al.* (1977), and our present findings, the biological possibility of a pneumoconiosis produced by non-asbestiform talc with low silica content emerges, although clinical and histological aspects may differ in the various studies.

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TABLE 2. Miners - Observed and Expected Deaths by Cumulative Dust Exposure.

Exposure (as mppcf-years)	< 1700			1700-5665			> 5665		
Number in Study	303			425			532		
Cause of Death	O	E	SMR	O	E	SMR	O	E	SMR
All causes	126	107.7	117	183	130.7	140[2]	251	208.5	120[2]
Lung cancer	2	3.9	51	1	4.8	21	5	8.5	59
Non-malignant respiratory diseases	15	8.3	181[1]	30	9.5	316[2]	64	15.3	418[2]
Pneumoconiosis	3	–	–	15	–	–	40	–	–
Tb associated with Pneumoconiosis	0	–	–	3	–	–	10	–	–
Tb	4	2.6	154	7	3.5	200	12	5 5	218[1]

[1] $P < .05$
[2] $P < .01$

TABLE 3. Millers - Observed and Expected Deaths by Cumulative Dust Exposure

Exposure (as mppcf-years)	< 142			142-424			> 424		
Number in Study	129			137			152		
Cause of Death	O	E	SMR	O	E	SMR	O	E	SMR
All causes	72	47 4	152[2]	59	49.5	119	62	67 5	92
Lung cancer	3	1 5	200	1	1.5	67	0	3.1	–
Non-malignant Respiratory Diseases	8	2.7	296[1]	6	4.3	140	4	5.4	74
Pneumoconiosis	1	–	–	2	–	–	0	–	–
Tb associated with Pneumoconiosis	0	–	–	0	–	–	1	–	–
Tb	3	1 1	273	4	1 1	364[1]	1	1.9	53

[1]P < 05
[2]P < .01

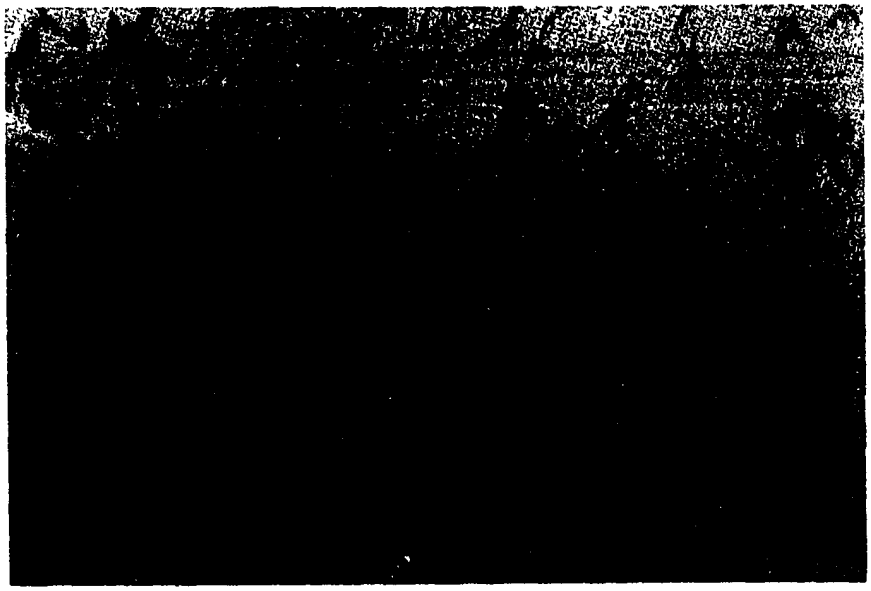


FIGURE 1. A module partly fibrohyaline with central necrotic area (Hematoxylin and Eosin. x 17 5)

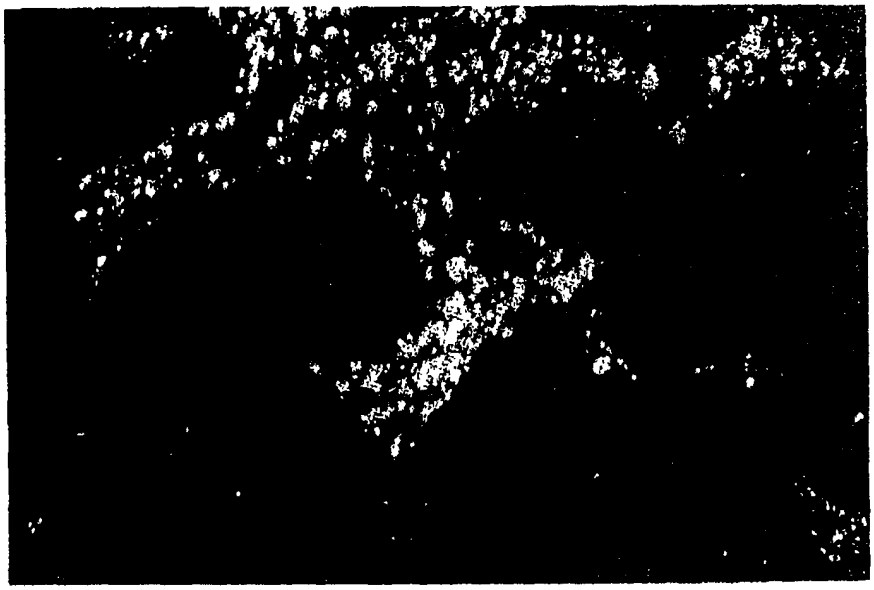


FIGURE 2. Fibrous thickening of alveolar septa with several birefringent particles. (Hematoxylin and Eosin. Polarized light. X40.

TABLE 4. Description of the Certified Cases of Pneumoconiosis Among Talc Millers

Case Number	1	2	3	4
Duration of exposure (yrs)	3	23	12	11
Latent period (yrs)	33	29	38	41
Cumulative dust exposure as talc worker (mppcf-years)	99 1	552.5	365.8	351.0
Other Exposures to Dust	Free silica	None	Free silica	No information available
Death certification	Silicosis	Silico-Tb	Silicosis	Silicosis
Necropsy findings	Fibrohyaline nodules. Tb-sclerosis	Fibrohyaline nodules. Tb-sclerosis	Interstitial fibrosis	Not available
Chest-X-Rays : ILO (UICC) category	q 2/2 A - tb	r 1/2-pl -tb	0/0	Not available

In order to assess the exposure level at which pneumoconiosis may occur, we have undertaken a morbidity study on talc millers. This is a preliminary report based on radiographic changes. The persons under study were the 43 millers still working in the years 1975 - 1976, and qualified by not having other exposures to inorganic or organic dust.

Frequency of radiological opacities was assessed according to the estimated cumulative dust exposure. Table 5 shows that radiographic changes of 1/0 ILO-UICC category, or above, appear after a cumulative exposure of more than 160 mppcf-years, with the observation of 2 cases, classified as 1/1 and 1/2, confined to the cumulative exposure of more than 320 mppcf-years.

TABLE 5. Radiographic Changes Among Talc Millers According to Cumulative Dust Exposure.

Cumulative Dust Exposure (as mppcf-years)	- 80	81-160	161-320	320 +
Mean value of mppcf-years within each category	45.8	131 6	246 8	418 0
Mean duration of exposure (years)	7.5	15.5	21.8	28 7
Number in Study	8	11	13	11
Irregular or rounded opacities ·				
0/0	8	8	4	2
0/1	0	3	5	4
1/0	0	0	4	3
1/1	0	0	0	1[1]
1/2	0	0	0	1[2]
More than 1/2	0	0	0	0

[1]p type
[2]s type

Results of this radiological examination indicate that rounded and irregular opacities consistent with pneumoconiosis can be found among these talc millers after an average duration of exposure of about 22 years, at an average dust concentration of about 11 mppcf. During the period these workers were exposed, the content of free silica in air dust was approximately 1% or less.

In conclusion, our findings show that no relationship has been found between Italian talc exposure and cancer, whereas pneumoconiosis may be observed.

Based on the radiographic changes we have classified, signs definitely consistent with pneumoconiosis (1/1 or more of rounded or irregular opacities) may be found after an exposure of more than 320 mppcf-years, which means a lifetime exposure to more than 8 mppcf (assuming a 40 year working life). Initial signs may appear after 160 mppcf-years, which means a lifetime expsure to more than 4 mppcf. It is suggested from this data that the current Threshold Limit Value does not prevent radiological signs of pneumoconiosis.

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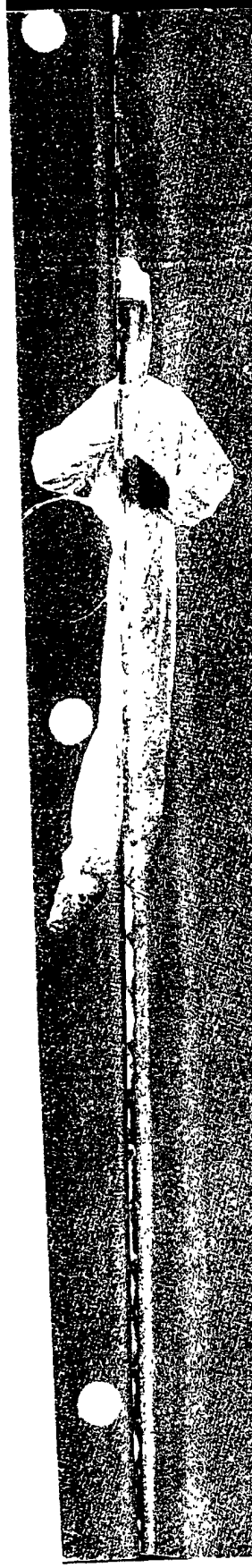
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