

MINERAL FIBERS AND DUSTS IN THE LUNGS OF SUBJECTS LIVING IN AN URBAN ENVIRONMENT

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INTRODUCTION

It is well-known that toxic and carcinogenic substances can be present in the breathable airborne particulate of urban areas and the higher incidence of tumors and chronic obstructive lung diseases, documented in these areas as compared with rural ones, is generally considered to be a consequence of the environmental conditions.³ Recently, the need to better define the carcinogenetic role of atmospheric pollution in comparison with that played by other factors, such as cigarette smoking, has been emphasized.⁴

Here, we have studied mineral particulate from autoptical lungs in a sample of population having lived in Rome area and not occupationally exposed to dusts. Their life-style, in particular their smoke habits, and the quantity and quality of fibers and mineral dusts found in their lungs were correlated.

MATERIALS AND METHODS

Sixty subjects, who had lived in Rome, aging from 15 to 65 years, were selected for this study. Subjects with a history of occupational exposition to mineral dusts or with serious pathologic conditions and drug addicts were excluded. During post-mortem examination, fragments of lung tissue were taken from the upper lobe of right lung.^{1,2} They were mineralized in atomic oxygen plasma. Dry weight was also estimated. Inorganic component was resuspended in deionized water and filtered on 0.45 μ m cellulose membrane filters. Mineral particles were then transferred on copper grids, which had been coated with carbon films. They were observed under a 430 Philips transmission electron microscope, equipped with an energy-dispersive spectrometer for X-ray. Adjacent fragments of lung tissue were fixed in formalin and embedded in paraffin for light microscope observation.

RESULTS

Concentration and Type of Mineral Particulate in the Lungs

Mineral particle concentrations in the lung parenchyma ranged from 0.7×10^5 to 1.7×10^5 particle/mg of dry tissue (Figure 1). Two principal components were found—Silicates and crystalline silica (52%)—Heavy metal oxides and sulfates (48%). The relative percentage of components, however, showed significative differences, since in nearly 12% of sub-

jects the ratio between silicates and metal compounds differed for more than 50% of the average value. Fibrous particles were detected in 16% of subjects. They were generally represented by asbestos fibers (chrysotile and amphiboles), but small amounts of talc, rutile (titanium oxide) and calcium sulfate fibers were also found. Asbestos fiber concentration ranged from 200 to 300 ff/mg of dry tissue and represented 0.5–1% of total particulate.

Seven groups of silicates were detected: micas, clays, talc, chlorites, serpentine and amphiboles. The majority of particles had a diameter ranging from 1 to 5 μ m. No particles more than 30 μ m in diameter were observed.

Asbestos fibers were represented for more than two thirds by chrysotile and ranged in length from 1 to 8 μ m, with a length/width ratio higher than 10 (Figure 2).

Up to sixteen different metallic elements, in the form of oxides and sulfates, were found (Figure 3). Nearly 80% of particles ranged in size from 0.1 to 1 μ m and no particles larger than 2 μ m were found. Six elements (Al, Ca, Ti, Cr, Fe, Ni) could be identified in more than two thirds of subjects.

Dependence between Mineral Particulate, Age and Life-style of Subjects

The dependence between particle concentrations and the age of subjects is shown in Figure 4. In general, concentration appeared to increase with age. Moreover, observation in light microscopy showed that anthracosis, which was scored from 0 (absent) to 3 (severe) also tended to increase with age (Figure 5). Smoking habit seemed to influence the quantity of mineral particulate deposited in the lungs, since in the same age-groups, a greater amount of particulate was found in the lung parenchyma of smokers than in non-smokers (Figure 6).

CONCLUSIONS

Our results confirm the high degree of dependence between the concentration of mineral particulate in the lung parenchyma and the environmental situation. Particularly, it appears that subjects living in an urban area are exposed to toxic and carcinogenic substances released by motor vehicles (heavy metals, asbestos fibers). Finally, our results confirm the effect of smoking on the quality and quantity of the particulate in the lungs.

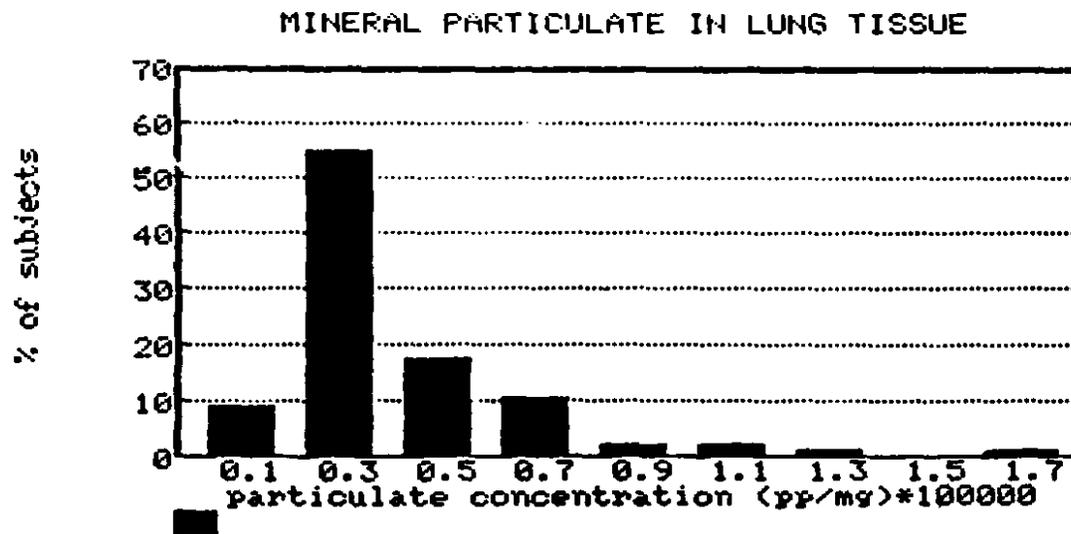


Figure 1. Particulate concentration in the lung parenchyma of sixty subjects.

% OF ASBESTOS QUALITIES
detected in 16% of subjects

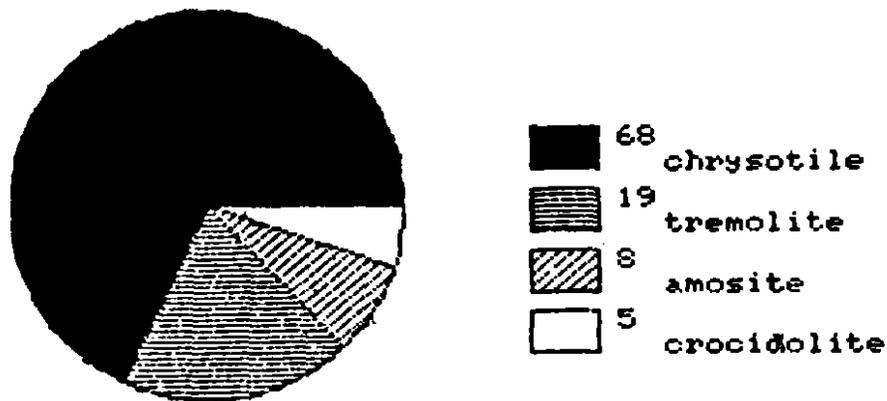


Figure 2. Percentage of asbestos types detected in the lung tissue.

DETECTION FREQUENCY OF METALLIC ELEMENTS

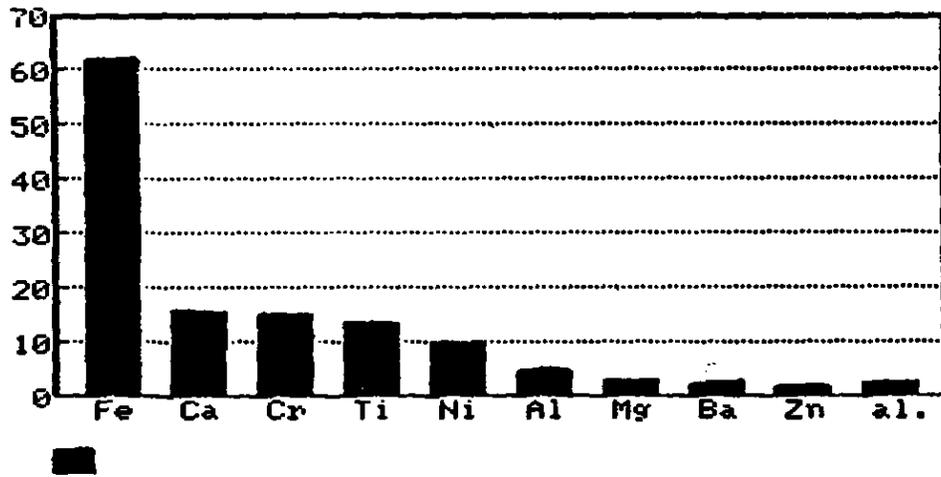


Figure 3. Frequency of the metal elements observed.

AGE - RELATED DISTRIBUTION OF PARTICULATE CONCENTRATIONS

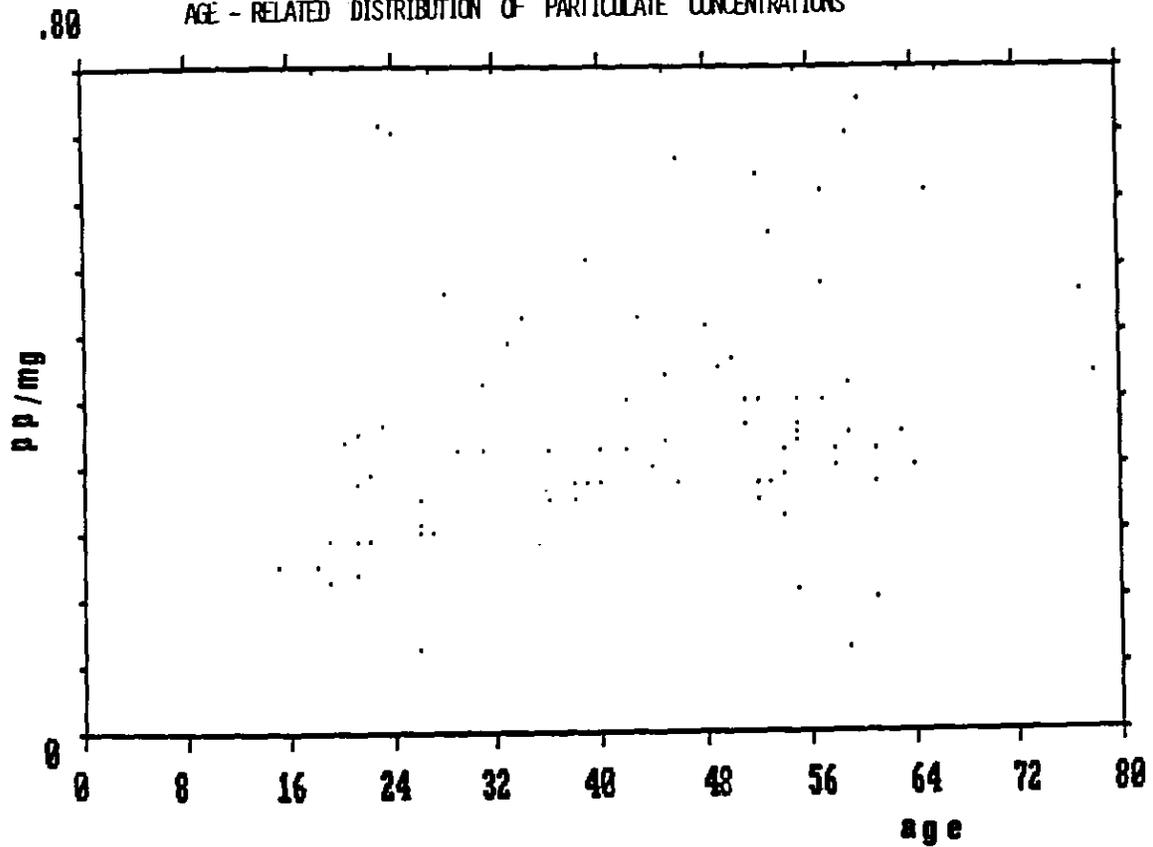


Figure 4. Particulate concentration in relation to the age-groups.

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SUBJECTS FREQUENCY

65			5	5
55			6	7
45		1	6	2
35	1	3	5	
25	1	5	3	1
	0	1	2	3
	ANTHRACOSIS DEGREE			

Figure 5. Distribution of anthracosis (scored from 0-absent to 3-severe) in relation to age-groups in sixty subjects.

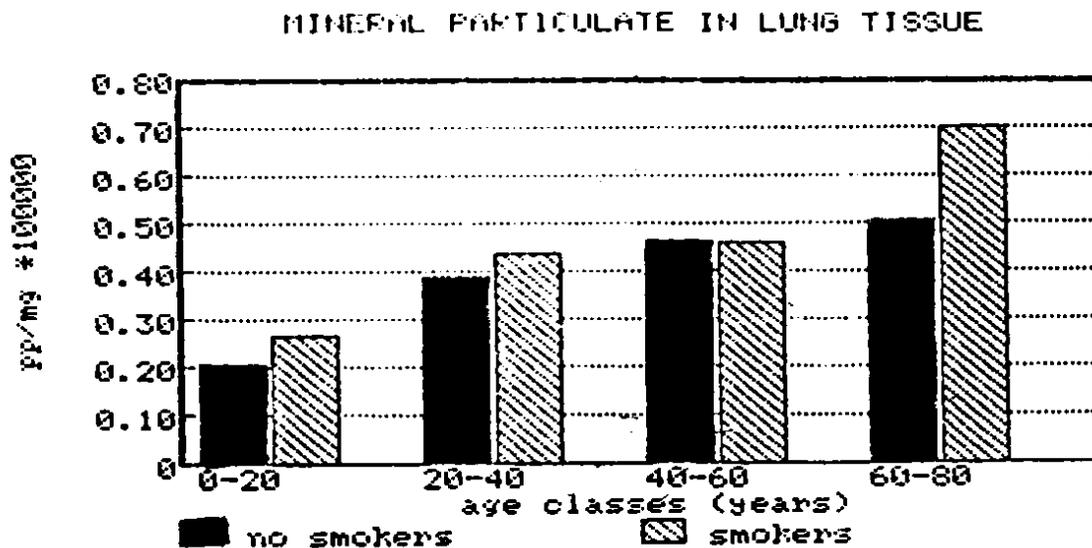
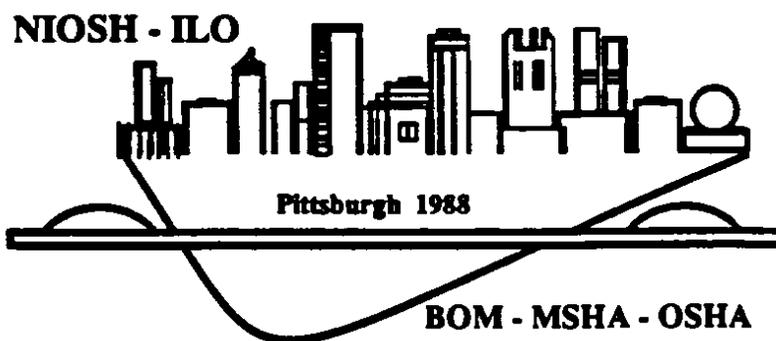


Figure 6. Influence of smoking in particulate concentration in the lung tissue.

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