

LEUKEMIA AND APLASTIC ANAEMIA IN A SHOEWORKER COHORT EXPOSED TO BENZENE

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INTRODUCTION

A retrospective cohort study of shoe workers was carried out in the largest shoe manufacturing plant in Florence (1). Benzene was used as a solvent in glues during the 1950s and 1960s in shoe production and cases of leukemia and aplastic anaemia occurred in this plant. A national regulation limited the use of benzene in 1963 and since 1965 benzene has not been used in this industry in quantities greater than 2% by weight.

MATERIALS AND METHODS

Members of the cohort study are workers recorded in the plant registry as having been employed on or after 01.01.1950. The analysis presented here is restricted to the subjects at work between 1953-1964; the period in which benzene was used.

The follow-up ended on 31.12.1984 and national Italian population mortality rates obtained by the WHO were used for standardization by age, sex and calendar period.

Additional evidence of the cause of death was collected for the cases of leukemia and aplastic anaemia using several sources of information (clinical records, legal proceedings, documentation, published reports).

The data analysis was carried out using the Person Year Program (2).

THE EXPOSURE ASSESSMENT

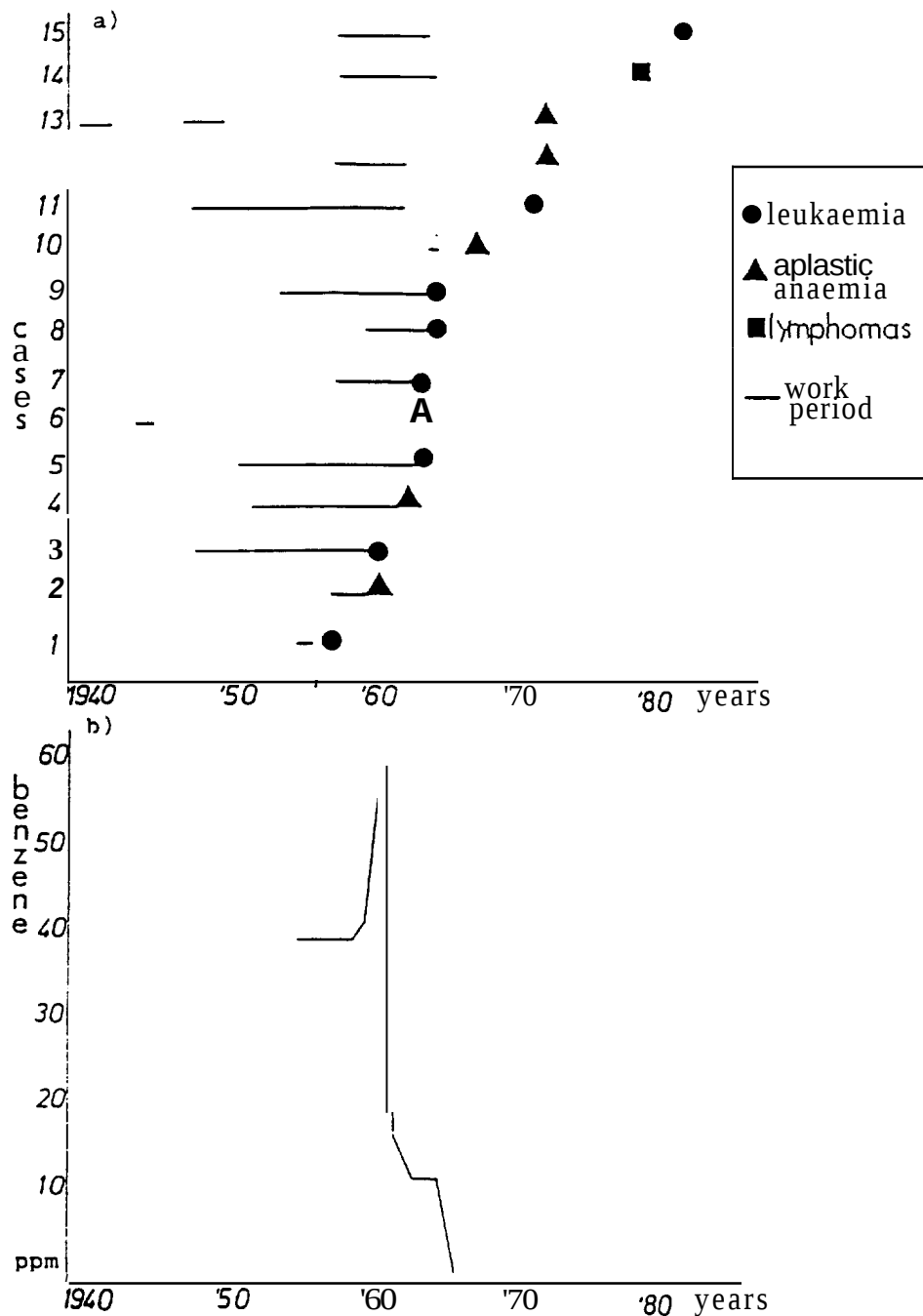
A preliminary assessment of the average concentration of benzene in the general room air of the plant was made over the time period when benzene was used.

Plant records, testimonies submitted for legal proceedings, interviews with plant managers and older workers, and site visits were used to make the benzene exposure estimates.

The quantity of benzene that was used was estimated using information including the annual production of shoes, the amount of glue used for each pair of shoes, the percentage of benzene contained in the glues and the distribution of glue use throughout the plant.

Blue prints and engineering records were used to estimate the air changes per hour on each floor from natural and mechanical ventilation. A range of concentrations of benzene was then estimated using a dynamic model considering continuous ventila-

Fig.1 a) Cases and work period
b) Average concentration of benzene in
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The benzene air concentrations presented in Figure 1 are weighted averages of this range assuming a 3.5 month cool period when windows would be shut and a 8.5 month period of open Windows.

RESULTS

In the whole cohort 1 case of lymphatic and hem atopoietic neoplasm and 1 aplastic anaemia occurred among females: six leukemias, 1 "other lymphatic and hematopoietic neoplasm" and 6 aplastic anaemias among males. The SMRs for males were 1566 for the aplastic anaemia (95% CI: 547-3264) and 400 for leukemia (95% CI: 146-870).

Figure 1 shows the pattern of occurrence of the case series in the cohort over time compared with the annual estimates of the benzene air concentration the plant.

Table 1 and 2 show the leukemia and aplastic anemia mortality in the subcohort exposed to benzene in the period 1953-1964 by duration of exposure and risk interval since first exposure (1953 if they were at work before this date).

DISCUSSION

The pattern of the occurrence of cases of leukemia and aplastic anaemia over time is consistent with the results obtained in the cohort mortality study showing a strong temporal relationship between benzene exposure and deaths.

A relevant finding is that no cases occurred in people at work after the elimination of the benzene exposure. However, the analysis did not show an increasing risk with either latency or duration of exposure. A possible explanation for this is that there was misclassification of the exposure within the study population.

We are conducting a more precise exposure assessment to calculate an index of exposure for individuals in the cohort based on the exposure to benzene in each job over time.

The exposure for each job will include an estimate of the air benzene concentration in work areas and an estimate of the breathing zone air concentration and skin exposure for the jobs that involved the direct application of benzene-based glues.

TABLE 1
LEUKEMIA MORTALITY IN COHORT STUDY POPULATION

Observed (O), expected (E), and Standardised Mortality Ratios (SMR) for leukemia by duration exposure and risk interval since first exposure in the exposed sub-cohort (Males).

Risk interval since first exposure (years)				Duration of employ. in the period 1953-1964 (years)			
	O.	E.	SMR		Obs.	Exp.	SMR
years				years			
0-4	1	0.13	753	<1	1	0.13	719
5-9	1	0.16	611	1-5	2	0.36	555
10-19	3	0.44	679	>5	3	0.72	416
20-29	1	0.46	215				
Total	6	1.21	477		6	1.21	477

TABLE 2
APLASTIC ANAEMIA MORTALITY IN COHORT STUDY POPULATION

Observed (O), expected (E) and Standardized Mortality Ratios (SMR) by duration of exposure and risk interval since first exposure in the exposed sub-cohort (Males).

Risk interval since first exposure (years)				Duration of employ. (years-)			
	Obs.	Exp.	SMR		Obs.	Exp.	SMR
years				years			
0-4	2	0.06	3333	<1	1	0.05	2000
5-9	2	0.06	3333	1-5	2	0.11	1818
10-19	2	0.10	2000	>5	3	0.19	1578
20-29	0	0.09					
Totale	6	0.31	1935		6	0.31	1935

REFERENCES

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- 2) M.Coleman, A.Douglas et al Cohort study analysis with a for-tan computer program (1986) Int.J.Epid.15,134-137

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PROGRESS IN OCCUPATIONAL EPIDEMIOLOGY

Proceedings of the Sixth International Symposium on
Epidemiology in Occupational Health, Stockholm, Sweden,
16–19 August 1988

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1988

EXCERPTA MEDICA, Amsterdam – New York – Oxford