MORTALITY UNDER AGE 25 AROUND SIX FRENCH NUCLEAR SITES

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ABSTRACT

Mortality under age 25 between 1968 and 1987 has been studied in the population residing around the six major nuclear sites (two reprocessing plants and four power plants), in operation before 1976 in France. The population under study represents 3 million person-years. A total of 58 leukaemia deaths were observed, similar to the 67 leukaemia deaths expected from national death rates, and to the 62 leukaemia deaths observed in control communes. The risk of leukaemia did not depend on distance to the installation.

INTRODUCTION

In 1983, a British television programme reported an increased incidence of leukaemia in children in the village of Seascale, near the Sellafield nuclear reprocessing plant. Following this report, a working group, commissioned by the British government, concluded that there was an increased incidence of lymphoid leukaemia in children around Sellafield (1), and this result has been confirmed by numerous studies (2-5). Other excesses of leukaemias have been observed around the Dounreay facility, a reprocessing plant located in the North of Scotland (6), in the vicinity of the two nuclear military facilities of Aldermaston and Burghfield (7), and in the vicinity of the Hinkley point nuclear power plant (8).

France derived 75% of its electricity from nuclear energy in 1989, and the first nuclear unit producing electricy started operating industrially in 1962 (9). We have studied the main sites in operation during 1975 or before in order to have a minimum follow-up of 10 years for mortality. Before the study presented here, two studies of mortality around La Hague, French nuclear reprocessing plant had been reported (10,11); their results are summarised elsewhere in the present volume (12).

MATERIALS AND METHODS

Four geographical zones were defined around each installation according to the distance from the installation: <5 km, 5-10 km, 10-13 km, and 13-16 km. For La Hague, the farthest zone bordered the densely populated suburbs of the city of Cherbourg: an extra zone corresponding to a distance of 16-21 km has been considered for this site. France is divided into 36,500 administrative units called 'communes'. The average population of a commune is 1,500, and the average area 15 km^2. For each site and each zone, the 'exposed'

communes were identified, and for each exposed commune, a 'control' commune was selected as the commune in the same 'Département' having the closest total population figure. This defines, for each site, four (five for La Hague) exposed zones according to the distance to the installation, and the same number of control zones. The average distance between control communes and installation is 53 km (range 16-133 km, s.d. 24 km).

From the Institut National de la Santé et de la Recherche Médicale, we obtained the cause of each death that occurred in the population aged 0-24 between 1968 and 1987, by zone. The underlying cause of each death was coded according to the International Classification of Diseases. Census data by commune were obtained from Institut National de la Statistique et des Etudes Economiques (INSEE), for the three censuses of 1968, 1975, and 1982. The population at risk were estimated from these data.

To test the possible existence of an increase in leukaemia mortality between age 0 and 24 around French nuclear sites, we made two comparisons. First, the observed mortality was compared to the mortality expected from national rates. Second, in an attempt to control for possible systematic differences between death certification procedures in rural, sparsely populated areas and in the country as a whole, the mortality around nuclear sites was compared with the mortality in control communes, matched for total population and large geographical unit (Département).

RESULTS

The table gives the number of leukaemia deaths by type of installation (reprocessing plants versus others) and by distance from installation. The number of leukaemia deaths was 58, which is slightly less than the 66.9 deaths expected from national mortality statistics. Among the other causes considered, two significant differences (both with $p=0.02$, two-sided test) were observed between nuclear sites and national mortality: an excess of Hodgkin's disease, and a deficit of malignant brain tumors. After correction for the multiple tests due to the consideration of several causes of death, these results are no longer significant. No significant differences were observed when comparing the standardised mortality ratios in the exposed and control areas, but these comparisons are less powerful than the comparison of the exposed population to the nation as a whole. There was no effect of sex and age, no difference between reprocessing plants and reactors, and no trend with increasing distance from installation.

Table

Number of person-years, observed and expected number of leukaemia deaths, and standardised mortality ratios (SMR) by type of installation and distance from nuclear installations

Characteristics	Person-years in thousands	Observed	Expected	SMR(%)
Installation				
Reprocessing	1,576	30	36.7	82
Other	1,316	28	30.2	93
Distance in km				
< 5	260	5	6.1	82
5-9.9	982	21	22.7	93
10-12.9	373	4	8.5	47
13-15.9	748	17	17.3	92
16-21	530	11	12.3	90
Total	2,892	58	66.9	87

CONCLUSION AND DISCUSSION

Our study shows no excess leukaemia mortality in the population aged 0-24 residing near French nuclear sites. The power of this study is reasonable: when the reference is the general population, and with an expected number of leukaemias around installations equal to 60, the probability of detecting an increase of 50% is 95% (with a type I error of 5%), and the probability of detecting an increase of 23% is 50% (13). When the reference is a control group of similar size, the probability of detecting an increase of 50% is 80% (13).

Our results confirm Viel and Richardson's study of leukaemia mortality around La Hague (11), which used geographical units with populations seven times larger than in our study.

The excess leukaemia observed around nuclear sites in the United Kingdom was not observed around French nuclear sites. The amount of radioactive effluent discharged might have been higher around Sellafield and Dounreay than around French installations (11). The excess leukaemia observed in the United Kingdom could also be attributed to some characteristic common to Sellafield and Dounreay, but not shared by French installations, for instance a rapid increase of population leading to viral infections (14), or some unknown factor shared by existing and potential nuclear sites in the United Kingdom (15).

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