

Mortality of two groups of women who manufactured gas masks from chrysotile and crocidolite asbestos: a 40-year follow-up

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ABSTRACT Two groups of women were exposed to asbestos while manufacturing gas masks in Lancashire before and during the second world war. One group (in Blackburn) is believed to have been concerned almost exclusively with the manufacture of civilian respirators (containing chrysotile) while the other (in Leyland) made respirators for the armed Forces (containing crocidolite) and a much smaller number of civilian respirators. Excess mortality ascribed to lung cancer and ovarian cancer were found at the second factory (statistically significant at the 1% level) but not at the first. Mesothelioma was mentioned on the death certificates of five women who had worked in Leyland and one woman in Blackburn.

The starting point of this study was an attempt to define two populations similar in other ways, exposed respectively to crocidolite and chrysotile asbestos in the manufacture of gas masks. It was known that the standard respirators issued to the armed Forces of the British Commonwealth before and during the second world war contained filters consisting of activated charcoal, merino wool, and West Australian crocidolite.¹ Studies of the mortality of factory workers employed in manufacturing Service respirators in Nottingham, England, and Ottawa, Canada, have been published.¹⁻³ Both groups of workers have suffered from excess mortality due to mesothelioma of the pleura and peritoneum. A study of women who worked in the Nottingham factory has also shown excesses of cancer of the lung and ovary.⁴

In Britain respirators were also manufactured to protect the civilian population. A contract was placed with a factory in Blackburn, Lancashire, in 1936 to manufacture more than 70 million civilian gas masks and work continued in this factory until the end of the war. From contemporary data (Ministry

of Supply, Home Office, and War Office papers 1927-45) and analysis of the contents of surviving masks, civilian gas masks are known to have contained chrysotile, charcoal, and merino wool but not crocidolite.

At Leyland, Lancashire, the same firm operated a factory that from 1927 held a monopoly for the manufacture of gas masks for the armed Forces. At an unknown date in the 1930s these respirators were modified to contain crocidolite, and gas masks of the improved type continued to be manufactured there throughout the war and thereafter. Industrial gas masks containing crocidolite were made there until 1969. From the testimony of workers it is known that some civilian gas masks containing chrysotile were also made during the war at the Leyland factory. Some workers travelled from Preston to work in the Leyland factory.

We describe the mortality during 1951-80 of the two groups of female gas mask makers. The 570 women resident in Blackburn were working in 1939 at the factory that manufactured civilian respirators containing chrysotile. The 757 women resident in Leyland (435) and Preston (322) were engaged in 1939 principally in manufacturing Service respirators and had been exposed to crocidolite but also to some chrysotile. They are referred to hereafter, for convenience, as the Leyland group.

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Method

Using the National Health Service Central Register, staff of the Office of Population Censuses and Surveys searched the records of everyone resident in September 1939 at Leyland, Preston, and Blackburn. They identified those whose occupations at that time indicated that they were manufacturing gas masks. The vital status of these workers on 30 June 1980 was ascertained, and in the case of those who had died the date and cause of death was abstracted.

The main analysis was restricted to women, thus excluding the 95 men employed at Leyland and the 58 employed at Blackburn. The number of deaths expected in these women was calculated using the person-years method,⁵ and compared with the number observed. Deaths from 1 January 1951 to 30 June 1980 were included, and five-year age group cause-specific death-rates for five-year calendar periods were used to calculate the expected numbers.^{6,7} The rates used were for England and Wales as a whole, and an area correction was then incorporated into the analysis to adjust for local mortality during the years 1968–78. Although these years do not span the whole period of 1951–80 they

are the only ones for which rates for Leyland, Preston, and Blackburn are available. Tests of the statistical significance of the observed number of deaths compared with the numbers expected are based on the Poisson distribution.

The average age of each group of women in 1939 was 28.3 years, although the spread of ages was slightly greater in Leyland than in Blackburn (the standard deviations are 8.7 and 7.2 years respectively).

Results

Table 1 shows the basic follow-up information of the women in each area. A few left England and Wales during the period, and their vital status subsequent to embarkation is unknown. Also, the small number of deaths occurring before 1951 has been omitted from the main analysis as having only short elapse time since exposure in 1939. Overall about a third of each group have died, and most of those still alive were over 60 in 1980.

In table 2 the general mortality experience of the two groups of women during 1951–80 is set out. Both groups showed a statistically significant excess of deaths from all causes combined compared with the numbers expected on the basis of rates for England and Wales. In Leyland, after adjustment for local area mortality, this excess is principally due to deaths from cancer. On the other hand, for Blackburn there is only a slight excess of deaths from cancer, but there is a large increase in deaths from other causes. On breaking the latter down into individual causes the excess can be shown to be due to deaths from acute myocardial infarction (ICD No 410, 8th revision).⁸

Mortality from malignant neoplasms is given by site in table 3 for the leading causes of death from cancer in women. Only sites with more than five

1. not all workers in final study
2. Some deaths (12 yr. out and less) omitted
3. 1/3 of total group had died (2/3 still to die) and most over 60 (longer latency effects?)

Table 1 Female gas mask makers by status, person-years of follow-up, and area

	Leyland		Blackburn	
	No	%	No	%
Size of group	757	100	570	100
Status at 30 June 1980:				
Alive	493	65	367	64
Died (before 1951)	27	4	21	4
Died (after 1950)	219	29	177	31
Embarked	18	2	5	1
Person-years of follow-up from 1 January 1951–30 June 1980	18 781		14 324	

Table 2 Mortality of female gas mask makers in Leyland and Blackburn between 1 January 1951 and 30 June 1980, and relation to local area mortality

Cause of death	Area	Gas mask makers					Area standardised mortality ratio (SMR) 1968-78	Ratio gas mask makers SMR to area SMR
		No of deaths		Standardised mortality ratio				
		Obs	Exp	SMR	L	U		
All causes	Leyland Blackburn	219	185	118*	103	135	110	1.07
		177	128	138**	119	160	116	1.19*
All malignant neoplasms	Leyland Blackburn	66	54	123	95	156	95	1.29*
		44	41	109	79	146	103	1.06
Other causes	Leyland Blackburn	153	131	117	99	137	114	1.03
		133	88	152**	127	180	119	1.28*

*p < 0.05. **p < 0.01.

L = Lower 95% confidence limit. U = Upper 95% confidence limit.

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- ¹ International Steering Committee of Medical Editors. Uniform requirements for manuscripts submitted to biomedical journals. *Br Med J* 1979;1:532-5.
- ² Soter NA, Wasserman SI, Austen KF. Cold urticaria: release into the circulation of histamine and eosinophil chemotactic factor of anaphylaxis during cold challenge. *N Engl J Med* 1976;294:687-90.
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