

Work-related respiratory disease in employees leaving an electronics factory

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ABSTRACT Examination of the records of employees leaving an electronics factory over three-and-a-half years showed that a significantly greater proportion left the shop floor (where soldering took place) because of ill health than left the stores and office areas. This difference was largely due to work-related respiratory disease in those whose job was soldering. Shop floor workers leaving for health reasons also had increased sickness certification due to respiratory illness compared to stores and office workers. These findings suggest that work-related respiratory illness is a significant cause of morbidity and loss of employment in solderers working at the factory and that this has been a longstanding problem with its onset before the first recorded cases of occupational asthma caused by solder flux containing colophony.

A prevalence study of an electronics factory has shown work-related respiratory symptoms in 22% of those exposed to solder flux fumes (Burge *et al.*, 1979). To ascertain if this represented a survivor population and to see if it had a recent onset the records of employees leaving the factory over the previous three-and-a-half years was studied retrospectively.

Methods

The factory, set in a modern industrial estate, currently employs 914 people in the manufacture of domestic audio equipment by mass production techniques. Some hand-soldered daily and so were exposed to high levels of solder flux fumes. Those doing jobs other than hand soldering were also exposed as solder fumes were liberated into the atmosphere, there being no individual air extraction at the soldering positions. The rest of the employees worked either in offices or the stores, which were adjacent to but separate from the shop floor. These employees were only intermittently exposed to a low level of solder flux fumes. For analysis the workers were divided into those on the shop floor, subdivided into solderers (high exposure) and workers with jobs other than soldering (moderate exposure), and office workers, including workers in the stores (low exposure).

The records of all employees leaving the factory from 1 January 1974 (the earliest available com-

plete records) to 30 June 1977 were examined. Information was obtained from two sources.

Leaving cards—Recorded work area (shop floor, stores, or office), length of employment, and reason for leaving.

Work records—Recorded sex, age, date of leaving, application form on starting employment (with details of previous illness and previous employment), work area, job, detailed reason for leaving, number of days off work a year from illness and “no reason for absence,” and certificated medical illness.

The leaving cards of all employees leaving the factory were analysed. The work records were examined of those who stated that ill health was the reason for leaving (health leavers), and for comparison a 10% random sample (obtained from a table of random numbers) of the remainder leaving for reasons other than health were likewise examined. The health leavers were further classified on information obtained from the work records. If the work records stated that the employee had left because of respiratory illness caused by or worsened by work the employee was classified as suffering from “work-related respiratory illness.” Medical certificates of sickness were classified into respiratory (if the diagnosis referred to any illness in the respiratory tract) and non-respiratory (Taylor and Pocock, 1977). If there was any doubt the certificate was classified as non-respiratory. Because the distribution of the data was not

Gaussian, non-parametric statistics were used for analysis.

Results

A total of 1339 employees left the factory between January 1974 and June 1977, of whom 123 left for health reasons. The random selection of a 10% sample of the 1216 who left for other than health reasons gave 123 employees six of whose work records were not found. The proportion of shop floor workers in the 10% random sample was identical to that in the total group (table 1). As the job of employees on the shop floor was not stated on the leaving cards, the proportion of solderers to non-solderers leaving the factory was estimated from the 10% random sample, in which 29% of those leaving were solderers. The reasons for leaving the factory, obtained from the leaving cards, were classified into four groups: socio-economic (including dismissal and pregnancy); redundancy; health; and, if no reason was stated on the leaving cards, not known. There was no significant difference in the numbers leaving the shop floor and offices for socioeconomic reasons, redundancy, and "not known" (table 2). There were, however, significantly more employees leaving the shop floor because of health reasons.

Table 1 *Work area derived from leaving cards (all leavers) compared to the 10% random sample in whom the work records were examined. Observed (%total)*

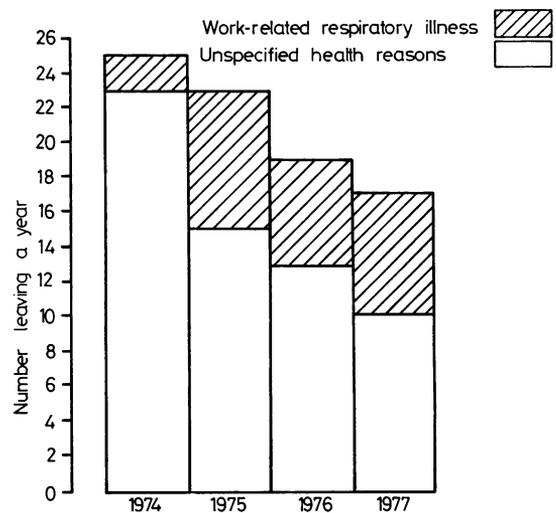
	All leavers	10% Random sample
Total	1339	117 (6 work records not found)
Office	235 (18%)	21 (18%)
Total shop floor	1104 (82%)	96 (82%)

Table 2 *Reasons for leaving factory. Number (%total)*

	Shop floor	Office
Total	1104	235
Socioeconomic	643 (58%)	140 (60%)
Redundancy	258 (23%)	59 (25%)
Not known	88 (8%)	28 (12%)
Health	A 115 (11%)	B 8 (3%)

A-B $P < 0.01$ (Chi-squared test)

Analysis of the work records showed that 4% of the solderers, 1% of other shop floor workers, and no office workers left with work-related respiratory illness ($P < 0.001$). Workers leaving for unspecified health reasons were similarly distributed (solderers 7%, other shop floor workers 4%, office workers 2%, $P < 0.001$). The proportion of workers leaving with work-related respiratory illness is increasing (see figure), though the total number leaving for health reasons are decreasing. In addition the work records on the 10% random sample of those leaving for reasons other than health confirmed that there was no significant difference between the shop floor and office in the numbers leaving for socioeconomic reasons, redundancy, and "not known." Four employees, however, chose voluntary redundancy because of work-related respiratory illness. This information was not apparent on the leaving cards.



Numbers leaving each year with work-related respiratory disease and unspecified health reasons. 1977 figures are for six months only.

Table 3 shows the mean length of employment of shop floor workers leaving for various reasons. Employees leaving for redundancy and ill health (including work-related respiratory illness) were employed significantly longer than employees leaving for other reasons.

Table 4 shows details from the work records of the health leavers and the 10% random sample of non-health leavers. The mean leaving age and mean length of employment was less in solderers ($P < 0.01$) than non-solderers leaving for health

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Table 3 Length of employment (years) by work area (mean ± standard deviation)

Reason for leaving	Shop floor workers	Office workers
Socioeconomic	1.3 ±2.2	1.4 ±2.3
Redundancy	4.0 ±3.3	5.1 ±3.6
Not known	1.0 ±1.7	1.6 ±2.5
Health other than work-related respiratory illness	3.1 ±3.4	4.0 ±3.6
Work-related respiratory illness	4.0 ±2.8	Nil

reasons (but greater in both than the random sample). There were also more respiratory sick notes in solderers compared to other shop floor workers and office workers in both groups, but the difference did not achieve statistical significance. The shop floor health leavers, however, had a greater percentage of respiratory sick notes ($P < 0.05$) than the office health leavers.

Discussion

Of 122 employees who left the electronics factory because of ill health, 19 had documented evidence of work-related respiratory disease. This is probably an underestimate as 61 employment records citing ill health as the cause of leaving gave no details of the illness. In addition, examination of the employment records of a 10% random sample of leavers whose leaving cards did not give ill health as the reason for leaving showed that four

employees chose voluntary redundancy because of work-related respiratory illness. On this basis it could be estimated that 59 or more of the 1104 shop floor workers left the factory because of work-related respiratory illness. This still underestimates the size of the problem in the factory as many employees continue to work despite symptoms (Burge *et al*, 1977; Burge *et al*, 1979). Furthermore, many employees may have given reasons for leaving other than ill health, yet suffered work-related respiratory illness. The factory management suggested that the problem was of recent onset. The records, however, show that employees were leaving because of work-related respiratory illness as early as 1974, two years before the first report of colophony-induced asthma (Fawcett *et al*, 1976). Two of these leavers have previously been seen at this hospital, and both were confirmed as having colophony sensitivity.

The mean length of employment of workers leaving because of work-related respiratory illness was four years, and this accords well with the documented length of exposure before the development of the symptoms of solder flux asthma (Burge *et al*, 1978). Possibly the high turnover of employees in this factory (mean length of employment of workers leaving for socioeconomic reasons and "not known" being 1.3 and 1 year respectively) protects most workers from developing work-related respiratory illness.

There appears to be a relationship between the degree of exposure to solder flux fumes and the numbers leaving the factory because of work-related respiratory illness, the percentage of respiratory sick notes per employee a year (although

Table 4 Details from work records by job category (health leavers and 10% random sample of non-health leavers). (Mean ± standard deviation or percentage of total)

	Health leavers			10% Random sample		
	Solderers	Other shop floor workers	Office workers	Solderers	Other shop floor workers	Office workers
Total	55	59	7	28	68	21
Leaving age (years)	A 37.7 ± 10.4	B 43.6 ± 13.7	51.1 ± 18.1	29.4 ± 9.5	33.2 ± 13.9	32.8 ± 16.5
Length of employment (months)	C 35.3 ± 35.6	D 57.9 ± 52.1	67.3 ± 59.7	21.9 ± 21.0	35.0 ± 44.7	27.7 ± 37.6
Non-respiratory sick notes/employee/year	3.4 ± 4.5	3.1 ± 3.1	4.1 ± 5.4	0.9 ± 1.2	1.0 ± 2.0	1.5 ± 5.2
Respiratory sick notes/employee/year	1.7 ± 1.9	1.4 ± 1.8	0.6 ± 0.7	1.2 ± 2.3	0.4 ± 0.9	0.3 ± 0.7
Days absent/employee/year	59.5 ± 43.7	45.1 ± 37.9	51.6 ± 49.6	20.5 ± 16.4	24.1 ± 24.1	17.1 ± 25.5
Respiratory sick notes as percentage of total	E 36%	F 37%	G 24%	44%	40%	45%

A-B, C-D $P < 0.01$ (Mann-Whitney U test)
E-G, F-G $P < 0.05$ (Chi-squared test)

in the latter the results do not achieve statistical significance). There was no statistical difference between other shop floor workers and office workers in the number of days off work per employee a year both in the health leavers and 10% random sample. Other studies, however, have shown that time off work does not correlate well with morbidity within an industry (Taylor, 1976).

In view of the documented number of employees leaving the factory because of work-related respiratory illness (and there is evidence that this is an underestimate) we believe that this is an important cause of morbidity and eventual loss of employment at this factory. The fact that solder flux asthma was for long unrecognised at this factory suggests that other factories producing electronics equipment may be similarly affected.

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