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Royal Naval Dockyards Asbestosis Research Project — Survey of Registered Asbestos Workers

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ABSTRACT

A Register of Asbestos Workers was set up in each Royal Naval Dockyard in 1969 to ensure that the health of those who worked with asbestos was medically supervised at regular intervals.

The examination of this group of workers showed that radiographic, clinical, and lung function abnormalities associated with exposure to asbestos only occurred in the older men who had been exposed before the introduction of strict protective measures.

The results obtained will form a valuable base line for the future assessment of these workers.

Introduction

The major programme to examine the effects of asbestos exposure on the health of Naval Dockyard workers is described by Harries, Rossiter and Coles (1976), and the results of the detailed examination of a random sample of these workers, stratified by age and occupation, are described by Rossiter and Harries (*in preparation*).

When it was discovered in 1965 that cases of asbestosis were occurring among the asbestos workers at Devonport Dockyard, the Ministry of Defence (Navy) brought about great improvements in working conditions and protective clothing, and substituted safer materials for asbestos wherever possible (Harries 1968, 1970). In addition, because some asbestos still had to be used and asbestos still had to be removed from Naval Ships, each Dockyard was required to compile a register of all the people who had worked directly with asbestos, whether full or part-time, to ensure that their health was medically supervised at regular intervals whilst they remained in Ministry of Defence (Navy) employment, even if they subsequently stopped working with asbestos.

These employees were called 'Registered Asbestos Workers' (RAWs). It was considered particularly important to try to obtain a high response rate from these workers as a basis for assessment in the future, and this report is concerned with the detailed radiological, clinical and lung functional results obtained from the examination of these people.

Methods

Selection of the Population

The number and occupations of Registered Asbestos Workers in each Dockyard varied according to each Dockyard's need for employees in various occupations to work with asbestos. Shortly after the enumeration of the population in each Dockyard, that is 1 March, 1972 for Devonport, 4 September, 1972 for Chatham, 5 February, 1973 for Portsmouth and 1 August, 1973 for Rosyth, the Personnel Department in each Dockyard was asked to provide a list of all the Registered Asbestos Workers. Those who were aged 50-59 years on the enumeration dates also formed Group 1 of the age and occupation stratified sample (Rossiter and Harries — *in preparation*). There were two females and two male Registered Asbestos Workers who worked in places outside the main Dockyard areas. Omitting these, there were 990 male RAWs of all ages currently employed within the Dockyards (Male in Yard Registered Asbestos Workers) who form the population for this study.

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Additional Data

At the beginning of the Morbidity Survey in each Dockyard, each Registered Asbestos Worker was asked to attend for a full size chest radiograph, interview and clinical examination, and lung function assessment. As part of the general response to the study of the total Dockyard population, a number of these workers had also completed a self administered questionnaire on respiratory symptoms and occupational histories, but they were deliberately asked not to attend for a 100 mm chest radiograph because they were all required to have a large chest radiograph as part of their regular annual medical examination, which, on this occasion, was carried out by the Survey team. In the event 99 men did have a 100 mm chest radiograph taken, of whom 30 had only this small film.

Full Size Chest Radiographs

Full size (40 cm × 40 cm) chest radiographs were taken by the Medical Research Council's Mobile Radiographic Unit. Two views, posterior-anterior and right anterior oblique, were taken. Fuller details of the procedure are given elsewhere — Rossiter and Harries (*in preparation*) and Sheers, Rossiter, Gilson and McKenzie (*in preparation*).

The interview was conducted shortly after the full size chest radiographs were taken. It was based on the Medical Research Council's Respiratory Questionnaire 1966, modified to include all the questions required by the Employment Medical Advisory Service National Survey of Asbestos Workers (EMAS, 1975) because all of these workers were to be included in that Survey. Questions were also asked on chest pain and to establish a full occupational history.

The Clinical Examination was usually confined to the respiratory and cardiovascular systems. In all subjects the presence or absence of cyanosis, rales, rhonchi, pleural rub, finger clubbing, and asbestos corns was noted. Blood pressure was recorded with the subject seated. Height and weight was recorded in indoor clothing without shoes and jacket.

Lung Function was assessed by measurements of Forced Expiratory Volume in one second (FEV_1), Forced Vital Capacity (FVC), and Transfer Factor (TF), using the single breath carbon monoxide method. Values for Residual Volume (RV) and Total Lung Capacity (TLC) were obtained during the TF measurements. Full details of the methods used are given by Rossiter and Harries (*in preparation*).

FEV_1, FVC, RV and TLC are reported in Litres at body temperature and pressure saturated with water vapour (BTPS). TF is reported in millimoles per minute per kilo Pascal (mmol min^{-1} kPa^{-1}) at standard temperature and pressure dry (STPD).

Results

Response Rates

The number of men included in the study together with the numbers of responders by age and dockyard are given in Table 1. Altogether 92.4 per cent had a large chest radiograph taken, 93.5 per cent had a controlled questionnaire and 92.8 per cent underwent lung function examination.

Classification of Chest Radiographs

The prevalence rates of radiographic abnormalities are given in Tables 2-8, and the reading of the large films has been used except for those 30 men who only had a 100 mm film taken. The prevalence rates are based on the independent reading of the radiographs by two of a panel of four readers*, using the simplified classification described by Harries et al. (1976). Each x-ray reading was allocated to one of the following groups:

*Surgeon Captain F. A. F. McKenzie, Dr G. Sheers, Surgeon Commanders P. G. Harries and K. P. S. Lumley.

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1. Normal films.
2. Pleural thickening.
3. Pleural calcification.
4. Pulmonary fibrosis (approximately equivalent to ILO/UC 1971 category of small irregular opacities of 1/1 or more).
5. Pulmonary tuberculosis excluding primary complex.
6. All other abnormalities.

To avoid bias, by having to choose between discrepant readings, each reading was counted as a ½ in the calculation of prevalence rates.

Radiographic Abnormalities

Table 2 gives the overall prevalence for each of the categories of radiographic appearance by dockyard, age and smoking habits, but without taking into account any index of exposure. For pleural thickening and pulmonary fibrosis, non-smokers have lower prevalence than smokers, whereas for pleural calcification the prevalence rate is highest in ex-smokers.

These results for pleural thickening and pulmonary fibrosis agree completely with those from the study of the sample population (Rossiter and Harries — *in preparation*) and again confirm trends seen in the study of the total population where response rates are not so high (Harries *et al*, 1976). The patterns for pleural calcification and pulmonary tuberculosis differ in that for all RAWs the ex-smokers have the highest prevalences. As described by Harries *et al* (1976), the smokers and ex-smokers develop pleural calcification earlier than non-smokers.

There are close relationships between prevalence of radiographic abnormalities and age. Pleural thickening is more prevalent at Portsmouth, and pleural calcification at Portsmouth and Chatham. Pulmonary fibrosis was not seen at Rosyth and the rates at Devonport are a little lower than at Chatham and Portsmouth.

Pleural Thickening

Tables 3-6 give the prevalences of pleural thickening by age and smoking habits for the four indices of employment and asbestos exposure. There is not very much variation in the rates for any of these indices for the younger men so that evidence of dose response relations is largely restricted for those aged 40-59. The relations with the employment indices are less clear cut than with the exposure indices, and duration of exposure to asbestos is again the better correlator.

Pleural Calcification

Pleural calcification occurs only very rarely in those RAWs under the age of 50. (Table 7). The only evidence of a dose-response relation is the increased prevalence in those over 60 years who have been exposed to asbestos for more than 20 years.

Pulmonary Fibrosis

Table 7 also shows the patterns for pulmonary fibrosis and it is seen that the smokers develop pulmonary fibrosis more frequently than non-smokers. There is a definite relation to age, as reported by Harries *et al* (1976), but little evidence of dose related response in RAWs.

Pulmonary Tuberculosis

Table 8 shows that there is some relation to age but no pattern by duration of exposure.

Normal Radiographs

At all ages, except the very young, ex-smokers have fewer normal radiographs than either current or non-smokers (Table 8). The older men do show evidence of dose response relation with duration of exposure to asbestos.

Respiratory Symptoms

History of Past Chest Illnesses

Table 9 shows the prevalences of past history of chest illness by smoking habits.

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TABLE 1 NUMBER OF REGISTERED ASBESTOS WORKERS AND RESPONDERS BY AGE AND DOCKYARD

Age (Years)	Number of men	Men with large films	Additional men with small film only	Men with 'controlled' questionnaire	Additional men with 'free' questionnaire	Men with Lung function
≤ 29	284	265	8	269	12	268
30-39	257	234	9	239	12	237
40-49	183	173	3	174	4	173
50-59	195	179	6	180	8	177
60+	71	64	4	64	4	64
All Ages	990	915 (92.4)	30 (=95.5)	926 (93.5)	40 (=97.6)	919 (92.8)
Devonport	500	459	13	465	23	462
Chatham	212	185	17	188	17	187
Portsmouth	228	222	-	223	-	221
Rosyth	50	49	-	50	-	49

The numbers in brackets are the percentage response rates for all ages.

TABLE 2 PREVALENCE (%) OF RADIOGRAPHIC ABNORMALITIES BY SMOKING HABITS, DOCKYARD AND AGE

	Smoking Habits	DOCKYARD				AGE GROUP (YEARS)					
		DEVONPORT	CHATHAM	PORTSMOUTH	ROSYTH	ALL AGES	≤29	30-39	40-49	50-59	60+
Pleural Thickening	non-smokers	4.0	0.0	7.1	12.5	4.1	0.0	7.3	4.6	7.5	3.6
	ex-smokers	8.6	9.7	16.3	0.0	10.5	0.0	7.1	16.1	12.8	15.0
	smokers	3.8	7.1	6.1	8.6	5.3	0.3	3.1	7.9	9.3	18.0
Pleural Calcification	non-smokers	0.0	2.6	2.9	0.0	1.3	0.0	0.0	0.0	5.0	11.1
	ex-smokers	2.0	6.5	6.3	8.3	4.3	0.0	0.0	3.6	8.5	7.5
	smokers	0.2	4.1	1.7	2.9	1.5	0.0	0.3	2.0	3.0	7.7
Pulmonary Fibrosis	non-smokers	2.6	1.3	1.4	0.0	1.9	0.0	1.0	4.6	5.0	5.6
	ex-smokers	4.6	9.7	7.5	0.0	6.2	0.0	0.0	5.4	5.3	27.5
	smokers	2.8	6.8	8.2	0.0	4.7	0.0	1.9	5.2	15.6	11.5
Pulmonary * Tuberculosis	non-smokers	0.7	6.6	0.0	0.0	1.9	0.0	1.0	6.8	0.0	11.1
	ex-smokers	0.7	3.2	5.0	8.3	2.6	0.0	0.0	0.0	6.4	5.0
	smokers	0.8	0.0	0.7	0.0	0.6	0.0	0.9	1.6	0.0	0.0
Normal Radiographs	non-smokers	92.1	86.8	84.3	87.5	88.9	98.3	88.5	84.1	77.5	66.7
	ex-smokers	79.6	56.5	58.8	66.7	69.0	100.0	84.3	64.3	58.5	57.5
	smokers	87.6	74.8	72.8	84.3	81.3	98.4	87.2	73.4	63.1	53.9
Numbers of men	non-smokers	76	38	35	8	157	58	48	22	20	9
	ex-smokers	76	31	40	6	153	23	35	28	47	20
	smokers	320	133	147	35	635	192	160	126	118	39

* Includes active and clinically significant inactive tuberculosis, but not primary complex

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TABLE 3 PREVALENCE OF PLEURAL THICKENING RELATED TO AGE, SMOKING HABITS AND DURATION OF DOCKYARD EMPLOYMENT

Age Groups (Years)	Smoking Habits	DURATION OF EMPLOYMENT (YEARS)									
		Prevalence Rates (%)					Number of Men				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
<29	non-smokers	0.0	0.0	-	-	0.0	41	17	-	-	58
	ex-smokers	0.0	0.0	-	-	0.0	17	6	-	-	23
	smokers	0.3	0.0	-	-	0.3	161	31	-	-	192
30-39	non-smokers	10.0	7.8	0.0	-	7.3	10	32	6	-	48
	ex-smokers	0.0	12.5	12.5	-	7.1	15	16	4	-	35
	smokers	2.9	2.7	6.3	-	3.1	70	74	16	-	160
40-49	non-smokers	20.0	0.0	0.0	0.0	4.6	5	7	8	2	22
	ex-smokers	25.0	14.3	18.2	0.0	16.1	6	7	11	4	28
	smokers	6.1	4.8	14.3	4.6	7.9	49	31	35	11	126
50-59	non-smokers	0.0	0.0	8.3	14.3	7.5	4	3	6	7	20
	ex-smokers	12.5	12.5	13.2	12.5	12.8	8	12	19	8	47
	smokers	3.2	6.5	18.2	8.1	9.3	31	23	33	31	118
60+	non-smokers	0.0	0.0	50.0	0.0	5.6	3	1	1	4	9
	ex-smokers	100.0	0.0	14.3	10.0	15.0	1	2	7	10	20
	smokers	12.5	20.0	7.1	23.7	18.0	8	5	7	19	39
All Ages	non-smokers	3.2	4.2	4.8	7.7	4.1	63	60	21	13	157
	ex-smokers	7.5	10.5	14.6	9.1	10.5	47	43	41	22	153
	smokers	2.4	3.7	13.7	12.3	5.3	319	164	91	61	635

TABLE 4 PREVALENCE OF PLEURAL THICKENING RELATED TO AGE, SMOKING HABITS AND YEARS SINCE FIRST DOCKYARD EMPLOYMENT

Age Groups (Years)	Smoking Habits	YEARS SINCE FIRST EMPLOYED (YEARS)									
		Prevalence Rates (%)					Number of Men				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
<29	non-smokers	0.0	0.0	-	-	0.0	40	18	-	-	58
	ex-smokers	0.0	0.0	-	-	0.0	14	9	-	-	23
	smokers	0.3	0.0	-	-	0.3	153	39	-	-	192
30-39	non-smokers	11.1	6.0	7.1	-	7.3	9	25	14	-	48
	ex-smokers	0.0	3.9	18.2	-	7.1	11	13	11	-	35
	smokers	3.3	2.9	3.5	-	3.1	61	70	29	-	160
40-49	non-smokers	0.0	0.0	10.0	0.0	4.6	4	6	10	2	22
	ex-smokers	30.0	20.0	16.7	5.6	16.1	5	5	9	9	28
	smokers	7.1	5.4	12.5	6.3	7.9	42	28	32	24	126
50-59	non-smokers	0.0	0.0	10.0	11.1	7.5	4	2	5	9	20
	ex-smokers	14.3	13.6	3.6	20.0	12.8	7	11	14	15	47
	smokers	3.9	4.6	19.2	9.1	9.3	26	22	26	44	118
60+	non-smokers	0.0	0.0	50.0	0.0	5.6	3	1	1	4	9
	ex-smokers	100.0	0.0	10.0	12.5	15.0	1	2	5	12	20
	smokers	12.5	0.0	0.0	26.1	18.0	8	3	5	23	39
All Ages	non-smokers	1.7	2.9	10.0	6.7	4.1	60	52	30	15	157
	ex-smokers	9.2	7.5	11.5	13.9	10.5	38	40	39	36	153
	smokers	2.6	2.8	10.9	12.6	5.3	290	162	92	91	635

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TABLE 5 PREVALENCE OF PLEURAL THICKENING RELATED TO AGE, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		Prevalence Rates (%)					Number of Men				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	0.0	0.0	-	-	0.0	52	5	-	-	57
	ex-smokers	0.0	0.0	-	-	0.0	22	1	-	-	23
	smokers	0.3	0.0	-	-	0.3	170	15	-	-	185
30-39	non-smokers	0.0	11.7	0.0	-	7.5	15	30	2	-	47
	ex-smokers	0.0	13.9	0.0	-	7.2	16	18	1	-	35
	smokers	0.7	4.0	37.5	-	3.3	73	73	4	-	152
40-49	non-smokers	11.1	0.0	0.0	-	4.8	9	7	5	-	21
	ex-smokers	16.7	16.7	16.7	0.0	16.1	9	6	12	1	28
	smokers	5.7	5.5	10.7	8.3	8.1	53	37	28	6	124
50-59	non-smokers	0.0	0.0	7.1	25.0	7.5	6	3	7	4	20
	ex-smokers	0.0	12.5	13.3	28.6	12.5	9	16	15	7	47
	smokers	6.4	5.2	23.9	2.4	8.9	39	29	23	21	112
60+	non-smokers	0.0	-	50.0	0.0	6.3	3	-	1	4	8
	ex-smokers	66.7	0.0	16.7	0.0	15.0	3	3	6	8	20
	smokers	7.7	16.7	28.6	28.6	18.1	13	9	7	7	36
All Ages	non-smokers	1.2	7.8	6.7	12.5	4.3	85	49	15	8	153
	ex-smokers	5.9	12.5	14.7	12.5	10.5	59	44	34	16	153
	smokers	2.2	5.8	19.4	8.8	5.3	348	165	62	34	609

TABLE 6 PREVALENCE OF PLEURAL THICKENING RELATED TO AGE, SMOKING HABITS AND YEARS SINCE FIRST EXPOSURE TO ASBESTOS

Age Groups (Years)	Smoking Habits	YEARS SINCE FIRST EXPOSURE TO ASBESTOS (YEARS)									
		Prevalence Rates (%)					Number of Men				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	0.0	0.0	-	-	0.0	52	5	-	-	57
	ex-smokers	0.0	0.0	-	-	0.0	18	5	-	-	23
	smokers	0.3	0.0	-	-	0.3	164	21	-	-	185
30-39	non-smokers	0.0	10.9	0.0	-	7.5	10	32	5	-	47
	ex-smokers	0.0	10.5	12.5	-	7.1	12	19	4	-	35
	smokers	0.7	4.1	15.0	-	3.3	68	74	10	-	152
40-49	non-smokers	0.0	0.0	12.5	0.0	4.8	4	8	8	1	21
	ex-smokers	25.0	11.1	18.2	0.0	16.1	6	9	11	2	28
	smokers	6.3	8.3	11.3	4.2	8.1	48	24	40	12	124
50-59	non-smokers	0.0	0.0	7.2	20.0	7.5	5	3	7	5	20
	ex-smokers	0.0	3.9	17.9	21.4	12.8	6	13	14	14	47
	smokers	6.9	4.4	24.0	2.9	8.9	29	23	25	35	112
60+	non-smokers	0.0	-	50.0	0.0	6.3	3	-	1	4	8
	ex-smokers	100.0	0.0	10.0	13.6	15.0	1	3	5	11	20
	smokers	10.0	14.3	12.5	26.7	18.1	10	7	4	15	36
All Ages	non-smokers	0.0	7.3	9.5	10.0	4.3	74	48	21	10	153
	ex-smokers	5.8	7.1	16.2	16.7	10.5	43	49	34	27	153
	smokers	2.2	4.7	15.8	8.9	5.3	319	149	79	62	609

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TABLE 7 PREVALENCE RATES (%) OF PLEURAL CALCIFICATION AND PULMONARY FIBROSIS RELATED TO AGE GROUP, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS.

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		Pleural Calcification					Pulmonary Fibrosis				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0
	ex-smokers	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0
	smokers	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0
30-39	non-smokers	0.0	0.0	0.0	-	0.0	3.3	0.0	0.0	-	1.1
	ex-smokers	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0
	smokers	0.0	0.0	12.5	-	0.3	2.7	1.3	0.0	-	2.0
40-49	non-smokers	0.0	0.0	0.0	-	0.0	5.6	0.0	10.0	-	4.8
	ex-smokers	0.0	0.0	8.3	0.0	3.6	0.0	0.0	12.5	0.0	5.4
	smokers	0.0	4.1	0.0	0.0	2.0	0.9	6.8	12.5	0.0	5.2
50-59	non-smokers	0.0	0.0	14.3	0.0	5.0	0.0	0.0	14.3	0.0	5.0
	ex-smokers	11.1	6.5	6.7	14.3	8.5	0.0	6.3	10.0	0.0	5.3
	smokers	6.4	0.0	4.4	0.0	3.1	1.3	13.8	15.2	33.3	13.4
60+	non-smokers	0.0	-	0.0	25.0	12.5	0.0	-	50.0	0.0	6.3
	ex-smokers	0.0	0.0	8.3	12.5	7.5	0.0	0.0	33.3	43.8	27.5
	smokers	0.0	0.0	14.3	21.4	6.9	15.4	22.2	0.0	7.1	12.5
All Ages	non-smokers	0.0	0.0	6.7	12.5	1.3	1.2	0.0	13.3	0.0	2.0
	ex-smokers	1.7	2.3	7.4	12.5	4.3	0.0	2.3	14.7	21.9	6.2
	smokers	0.7	0.9	4.0	7.4	1.5	1.4	5.8	11.3	22.1	4.8

(For numbers in each sub-group see table 5)

TABLE 8 PREVALENCE RATES (%) OF PULMONARY TUBERCULOSIS AND NORMAL RADIOGRAPHS RELATED TO AGE, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS.

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		Pulmonary Tuberculosis *					Normal Radiographs				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	0.0	0.0	-	-	0.0	98	100	-	-	98
	ex-smokers	0.0	0.0	-	-	0.0	100	100	-	-	100
	smokers	0.0	0.0	-	-	0.0	99	93	-	-	98
30-39	non-smokers	0.0	1.7	0.0	-	1.1	90	87	100	-	88
	ex-smokers	0.0	0.0	0.0	-	0.0	88	81	100	-	84
	smokers	0.7	1.3	0.0	-	1.0	86	89	50	-	87
40-49	non-smokers	0.0	7.1	20.0	-	7.1	83	93	70	-	83
	ex-smokers	0.0	0.0	0.0	0.0	0.0	61	83	54	100	64
	smokers	0.9	1.4	3.6	0.0	1.6	84	68	61	75	73
50-59	non-smokers	0.0	0.0	0.0	0.0	0.0	100	100	50	75	78
	ex-smokers	0.0	12.5	6.7	0.0	6.4	78	59	47	57	59
	smokers	0.0	0.0	0.0	0.0	0.0	79	76	43	45	65
60+	non-smokers	0.0	-	0.0	25.0	12.5	100	-	0	50	63
	ex-smokers	0.0	33.3	0.0	0.0	5.0	77	67	42	31	38
	smokers	0.0	0.0	0.0	0.0	0.0	65	61	37	29	56
All Ages	non-smokers	0.0	2.2	6.7	12.5	2.0	95.3	90.0	60.0	62.5	88.6
	ex-smokers	0.0	6.8	2.9	0.0	2.6	83.1	72.7	50.0	46.9	69.0
	smokers	0.3	0.9	1.6	0.0	0.6	90.5	80.6	33.2	47.1	81.6

(For numbers in each sub-group see Table 5) * Not including primary complex

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TABLE 9 PREVALENCE (%) OF PAST RESPIRATORY SYMPTOMS BY SMOKING HABITS, DOCKYARD AND AGE.

	Smoking Habits	DOCKYARD				AGE GROUP (YEARS)					
		DEVONPORT	CHATHAM	PORTSMOUTH	ROSYTH	ALL AGES	15-29	30-39	40-49	50-59	60+
Injury or Operation to Chest	non-smokers	0.0	2.9	0.0	0.0	0.7	0.0	0.0	4.8	0.0	0.0
	ex-smokers	5.2	6.5	5.0	16.7	5.8	0.0	8.3	3.6	8.5	5.0
	smokers	1.6	6.6	5.4	8.3	3.9	2.7	3.2	5.6	4.4	5.6
Pulmonary Tuberculosis	non-smokers	1.3	2.9	2.8	0.0	2.0	1.8	2.1	4.8	0.0	0.0
	ex-smokers	2.6	3.2	5.0	0.0	3.3	0.0	0.0	3.6	2.1	15.[illegible]
	smokers	0.6	0.0	1.4	0.0	0.9	0.0	1.3	1.6	0.0	0.0
Bronchitis	non-smokers	16.0	14.3	16.7	0.0	14.9	14.0	12.5	23.8	15.0	12.5
	ex-smokers	29.9	22.6	22.5	0.0	25.5	21.7	27.8	25.0	25.4	30.0
	smokers	24.0	25.0	20.4	2.8	21.7	17.5	15.5	24.8	30.1	33.3
Any past Chest Illness	non-smokers	36.0	20.0	30.6	12.5	29.9	24.6	33.3	33.3	30.0	37.5
	ex-smokers	40.3	41.9	37.5	16.7	39.0	30.4	36.1	50.0	38.3	40.0
	smokers	37.4	34.4	40.8	16.7	36.4	31.8	32.3	38.4	46.0	41.7
Number of Respondents	non-smokers	78	35	36	8	154	57	48	21	20	8
	ex-smokers	77	31	40	6	154	23	36	28	47	20
	smokers	313	122	147	36	618	189	155	125	113	36

TABLE 10 PREVALENCE (%) OF CURRENT RESPIRATORY SYMPTOMS BY SMOKING HABITS, DOCKYARD AND AGE.

	Smoking Habits	DOCKYARD				AGE GROUP (YEARS)					
		DEVONPORT	CHATHAM	PORTSMOUTH	ROSYTH	ALL AGES	15-29	30-39	40-49	50-59	60+
Cough	non-smokers	6.7	2.9	11.1	0.0	6.5	8.8	2.1	9.5	10.0	0.0
	ex-smokers	15.6	12.9	25.0	16.7	17.5	4.4	11.1	21.4	23.4	25.0
	smokers	37.1	34.4	33.1	36.1	40.3	36.5	37.4	44.8	47.8	33.3
Phlegm	non-smokers	9.3	11.4	8.3	0.0	9.1	7.0	8.3	4.8	25.0	0.0
	ex-smokers	13.0	12.9	15.0	16.9	13.6	4.4	8.3	10.7	25.5	10.0
	smokers	37.7	27.9	39.5	22.2	35.3	29.1	31.6	37.6	44.3	47.2
Breathlessness (MRC Grade 3 or more)	non-smokers	6.7	2.9	2.8	0.0	4.6	7.0	2.1	4.8	0.0	12.5
	ex-smokers	13.0	6.5	17.5	0.0	12.3	4.4	5.6	14.3	19.2	15.0
	smokers	5.1	4.9	10.2	0.0	6.0	1.1	3.2	6.4	14.2	16.7
Chest Illness in last 3 years	non-smokers	8.0	11.4	5.6	12.5	8.4	7.0	10.4	9.5	10.0	0.0
	ex-smokers	20.8	19.4	20.0	16.7	20.1	8.7	13.9	21.4	25.5	30.0
	smokers	16.6	16.4	13.6	5.6	15.2	13.2	11.6	16.8	19.5	22.2
"Bronchitis"*	non-smokers	1.3	2.9	5.6	0.0	2.6	1.8	2.1	4.8	5.0	0.0
	ex-smokers	6.5	9.7	12.5	16.7	9.1	4.4	2.8	9.1	17.0	10.0
	smokers	24.3	21.3	34.9	22.2	26.1	20.6	22.6	27.2	38.1	27.[illegible]

* 'Bronchitis' defined as positive response to cough and phlegm
(see table 9 for numbers in sub-group)

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TABLE 11 PREVALENCE RATES (%) OF 'COUGH' AND 'PHLEGM' RELATED TO AGE, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		Cough					Phlegm				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	9.6	0.0	-	-	8.8	7.7	0.0	-	-	7.1
	ex-smokers	4.6	0.0	-	-	4.4	4.6	0.0	-	-	4.4
	smokers	36.8	33.3	-	-	36.5	30.5	13.3	-	-	29.1
30-39	non-smokers	0.0	3.3	0.0	-	2.1	0.0	13.3	0.0	-	8.3
	ex-smokers	5.9	16.7	0.0	-	11.1	5.9	11.1	0.0	-	8.3
	smokers	31.6	42.7	50.0	-	37.4	23.7	40.0	25.0	-	31.6
40-49	non-smokers	0.0	0.0	40.0	-	9.5	0.0	0.0	20.0	-	4.8
	ex-smokers	0.0	33.3	33.3	0.0	21.4	0.0	0.0	25.0	0.0	10.7
	smokers	43.4	43.2	53.6	28.6	44.8	41.5	29.7	39.3	42.9	37.6
50-59	non-smokers	0.0	0.0	14.3	25.0	10.0	33.3	0.0	14.3	50.0	25.0
	ex-smokers	0.0	37.5	26.7	14.3	23.4	0.0	25.0	40.0	28.6	25.5
	smokers	55.0	37.9	43.5	52.4	47.8	47.5	34.5	39.1	57.1	44.3
60+	non-smokers	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0
	ex-smokers	0.0	0.0	33.3	37.5	25.0	0.0	0.0	0.0	25.0	10.0
	smokers	46.2	33.3	42.9	0.0	33.3	53.9	77.8	28.6	14.3	47.2
All Ages	non-smokers	5.8	2.2	20.0	12.5	6.5	7.0	8.9	13.3	25.0	9.1
	ex-smokers	3.3	25.0	29.4	25.0	17.5	3.3	13.6	26.5	25.0	13.6
	smokers	39.0	40.6	48.4	37.1	40.3	33.4	36.4	37.1	45.7	35.3

(For numbers in each sub-group see table 12)

TABLE 12 PREVALENCE RATES (%) FOR 'CURRENT BRONCHITIS'* RELATED TO AGE, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS.

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		'Bronchitis'					Number of Men				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	1.9	0.0	-	-	1.8	52	5	-	-	57
	ex-smokers	4.6	0.0	-	-	4.4	22	1	-	-	23
	smokers	21.3	13.3	-	-	20.6	174	15	-	-	189
30-39	non-smokers	0.0	3.3	0.0	-	2.1	46	30	2	-	48
	ex-smokers	0.0	5.6	0.0	-	2.8	17	18	1	-	36
	smokers	17.1	28.0	25.0	-	22.6	76	75	4	-	155
40-49	non-smokers	0.0	0.0	20.0	-	4.8	9	7	5	-	21
	ex-smokers	0.0	0.0	16.7	0.0	7.1	9	6	12	1	28
	smokers	28.3	21.6	35.7	14.3	27.2	53	37	28	7	125
50-59	non-smokers	0.0	0.0	0.0	25.0	5.0	6	3	7	4	20
	ex-smokers	0.0	25.0	20.0	14.3	17.0	9	16	15	7	47
	smokers	42.5	27.6	34.8	47.6	38.1	40	29	23	21	113
60+	non-smokers	0.0	-	0.0	0.0	0.0	3	-	1	4	8
	ex-smokers	0.0	0.0	0.0	25.0	10.0	3	3	6	8	20
	smokers	38.5	33.3	28.6	0.0	27.8	13	9	7	7	36
All Ages	non-smokers	1.2	2.2	6.7	12.5	2.6	86	45	15	8	154
	ex-smokers	1.7	11.4	14.7	18.8	9.1	60	44	34	16	154
	smokers	24.4	25.5	33.9	31.4	26.1	356	165	62	35	618

* 'Bronchitis' defined as positive response to cough and phlegm

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TABLE 13 PREVALENCE RATES (%) OF 'BREATHLESSNESS' (MRC GRADE 3 OR MORE) AND CHEST ILLNESS IN LAST 5 YEARS RELATED TO AGE, SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS.

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		Breathlessness					Chest Illness in last 5 years				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
≤29	non-smokers	7.7	0.0	-	-	7.0	5.8	20.0	-	-	7.0
	ex-smokers	4.6	0.0	-	-	4.4	9.1	0.0	-	-	8.7
	smokers	1.2	0.0	-	-	1.1	14.4	0.0	-	-	13.2
30-39	non-smokers	0.0	3.3	0.0	-	2.1	6.3	13.3	0.0	-	10.4
	ex-smokers	0.0	11.1	0.0	-	9.6	17.7	11.1	0.0	-	13.9
	smokers	1.3	4.0	25.0	-	3.2	13.2	10.7	0.0	-	11.6
40-49	non-smokers	11.1	0.0	0.0	-	4.8	11.1	0.0	20.0	-	9.5
	ex-smokers	0.0	0.0	33.3	0.0	14.3	11.1	16.7	33.3	0.0	21.4
	smokers	3.8	8.1	10.7	0.0	6.4	22.6	8.1	21.4	0.0	16.8
50-59	non-smokers	0.0	0.0	0.0	0.0	0.0	0.0	33.3	14.3	0.0	10.0
	ex-smokers	0.0	18.8	33.3	14.3	19.2	22.2	25.0	33.3	14.3	25.5
	smokers	13.0	6.9	13.0	23.8	14.2	17.5	17.2	21.7	23.8	19.5
60+	non-smokers	0.0	-	0.0	25.0	12.5	0.0	-	0.0	0.0	0.0
	ex-smokers	0.0	33.3	0.0	25.0	15.0	0.0	0.0	50.0	37.5	30.0
	smokers	15.4	33.3	14.3	0.0	16.7	23.1	33.3	14.3	14.3	22.2
All Ages	non-smokers	5.8	2.2	0.0	12.5	4.6	5.8	13.3	13.3	0.0	8.4
	ex-smokers	1.7	13.6	26.5	18.8	12.3	13.3	15.9	35.3	25.0	20.1
	smokers	3.7	6.7	12.9	14.3	6.0	16.0	11.5	19.4	17.1	15.2

(For numbers in each sub-group see table 12)

TABLE 14 PREVALENCE RATES (%) FOR PHYSICAL SIGNS RELATED TO SMOKING HABITS, DOCKYARD AND AGE.

	SMOKING HABITS	DOCKYARD				AGE GROUP (YEARS)					
		DEVONPORT	CHATHAM	PORTSMOUTH	ROSYTH	ALL AGES	≤29	30-39	40-49	50-59	60+
Persistent Rales	non-smokers	2.7	5.7	0.0	0.0	2.6	0.0	0.0	4.8	5.0	25.0
	ex-smokers	9.1	19.4	12.5	0.0	11.7	0.0	2.8	14.3	10.6	40.0
	smokers	4.5	6.6	10.2	2.8	6.2	0.0	2.6	6.4	17.7	16.7
Rhonchi	non-smokers	5.3	0.0	2.8	12.5	3.9	0.0	6.3	0.0	15.0	0.0
	ex-smokers	2.6	0.0	2.5	0.0	2.0	4.4	0.0	0.0	4.5	0.0
	smokers	10.5	1.6	6.1	13.9	7.9	5.8	8.4	8.8	10.6	5.6
Systolic BP >150mmHg	non-smokers	6.7	8.6	11.1	0.0	7.8	1.8	10.4	0.0	20.0	5.8
	ex-smokers	11.7	12.9	15.0	0.0	12.3	0.0	2.8	7.1	17.0	16.9
	smokers	7.0	9.0	8.8	8.3	7.9	1.1	3.2	6.8	20.8	7.3
Diastolic BP >90mmHg	non-smokers	4.0	5.7	11.1	0.0	5.8	0.0	6.3	4.8	15.0	25.0
	ex-smokers	10.4	19.4	30.0	0.0	16.9	0.0	2.8	21.4	27.7	30.0
	smokers	7.0	6.6	8.8	5.6	7.3	1.1	3.2	7.2	20.4	16.7
Numbers of men	non-smokers	75	35	36	8	154	57	48	21	20	8
	ex-smokers	77	31	40	6	154	23	36	28	40	20
	smokers	313	122	147	36	618	189	155	125	113	36

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TABLE 15 NUMBERS OF MEN WHO PERFORMED TESTS OF LUNG FUNCTION BY AGE SMOKING HABITS AND DURATION OF EXPOSURE TO ASBESTOS

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)									
		FEV, FVC					FV, TLC, TF				
		<10	10-19	20-29	30+	All Years	<10	10-19	20-29	30+	All Years
<29	non-smokers	52	5	-	-	57	52	5	-	-	57
	ex-smokers	22	1	-	-	23	21	1	-	-	22
	smokers	173	15	-	-	188	171	15	-	-	186
30-39	non-smokers	16	30	1	-	47	16	30	1	-	47
	ex-smokers	17	18	1	-	36	17	18	1	-	36
	smokers	75	75	4	-	154	74	75	4	-	153
40-49	non-smokers	9	7	5	-	21	9	7	5	-	21
	ex-smokers	9	6	12	1	28	9	6	12	1	28
	smokers	52	37	28	7	124	52	37	27	7	123
50-59	non-smokers	6	3	7	4	20	6	3	7	4	20
	ex-smokers	9	16	15	7	47	9	16	15	7	47
	smokers	38	29	22	21	110	36	29	22	21	108
60+	non-smokers	3	-	1	4	8	3	-	1	4	8
	ex-smokers	3	3	6	8	20	3	2	6	8	19
	smokers	13	9	7	7	36	12	9	7	7	35
All Ages	non-smokers	86	45	14	8	153	86	45	14	8	153
	ex-smokers	60	44	34	16	154	59	43	34	16	152
	smokers	351	165	61	35	612	345	165	60	35	605

TABLE 16 AVERAGE VALUES OF ONE SECOND FORCED EXPIRATORY VOLUME (LITRES) STANDARDIZED TO HEIGHT 1.7 m AND AGE 25, 35, 45, 55 or 65

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)				
		<10	10-19	20-29	30+	All Years
<29	non-smokers	2.94	3.31	-	-	2.97
	ex-smokers	3.16	2.56	-	-	3.13
	smokers	2.96	3.11	-	-	2.97
30-39	non-smokers	2.98	3.15	3.11	-	3.09
	ex-smokers	3.11	3.08	3.07	-	3.09
	smokers	2.87	2.98	2.78	-	2.92
40-49	non-smokers	2.84	3.00	2.76	-	2.88
	ex-smokers	2.92	2.81	2.76	2.57	2.82
	smokers	2.76	2.70	2.52	2.78	2.69
50-59	non-smokers	3.31	3.20	2.84	2.70	3.01
	ex-smokers	2.92	2.79	2.44	2.91	2.72
	smokers	2.75	2.65	2.38	2.63	2.63
60+	non-smokers	2.42	-	2.62	2.87	2.67
	ex-smokers	2.77	2.67	2.77	2.77	2.75
	smokers	2.45	2.68	2.75	2.79	2.63
All Ages	non-smokers	2.94	3.15	2.82	2.78	2.98
	ex-smokers	3.05	2.90	2.63	2.82	2.89
	smokers	2.87	2.85	2.52	2.69	2.82

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TABLE 17 AVERAGE VALUES OF FORCED VITAL CAPACITY (LITRES) STANDARDIZED TO HEIGHT 1.7m AND AGE 25, 35, 45, 55 or 65

Age Groups (years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)				
		<10	10–19	20–29	30+	All Years
≤ 29	non-smokers	4.13	4.72	-	-	4.18
	ex-smokers	4.41	4.76	-	-	4.43
	smokers	4.21	4.22	-	-	4.21
30–39	non-smokers	3.98	4.33	4.23	-	4.21
	ex-smokers	4.29	4.15	4.06	-	4.21
	smokers	4.19	4.22	4.25	-	4.20
40–49	non-smokers	4.21	4.25	3.77	-	4.12
	ex-smokers	4.14	4.21	3.89	3.26	4.01
	smokers	4.08	3.91	3.74	4.00	3.95
50–59	non-smokers	4.33	4.16	4.12	4.00	4.17
	ex-smokers	4.16	3.80	3.56	3.81	3.80
	smokers	4.01	3.79	3.62	3.88	3.85
60+	non-smokers	3.50	-	4.11	3.96	3.81
	ex-smokers	3.74	3.28	3.70	3.65	3.63
	smokers	3.85	3.90	3.72	3.79	3.82
All Ages	non-smokers	4.10	4.35	4.00	3.98	4.16
	ex-smokers	4.27	3.99	3.72	3.70	4.01
	smokers	4.15	4.06	3.73	3.89	4.07

dockyard and age. As the ex-smokers are older they show the biggest prevalences overall, and detailed examination of the rates by age shows that this is largely an age effect. Apart from a history of injury or operation to the chest the rates for other past chest illnesses are lowest at Rosyth, with the other three yards having similar rates to each other.

Current Respiratory Symptoms

The overwhelming effect of smoking on current respiratory symptoms is seen in Table 10, and this is true of all ages. The smoking effect is much greater than that of age for both cough and phlegm. The differences between the yards are less consistent, but Rosyth tends to show the lowest prevalences.

Cough and Phlegm and 'Bronchitis'

Tabels 11 and 12 confirm the symptoms even when duration of exposure to asbestos is taken into account, and there is little evidence in this population of dose response relationships unlike those described by Harries *et al* (1976) and Rossiter and Harries *(in preparation)*.

Breathlessness (MRC Grade 3 or more) (Table 13)

There is little evidence of any relation with duration of exposure and the pattern of lower rates for the least exposed men is not as clearly seen as for the sample population (Rossiter and Harries — *in preparation*).

Recent Chest Illness

The prevalence of chest illness occurring within the last three years appear to be least in non-smokers, but there is little evidence of any exposure effect (Table 13).

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TABLE 18 AVERAGE VALUES OF TOTAL LUNG CAPACITY (LITRES) STANDARDIZED TO HEIGHT 1.7m

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)				
		<10	10–19	20–29	30+	All Years
≤29	non-smokers	5.88	6.40	-	-	5.93
	ex-smokers	6.00	6.07	-	-	6.00
	smokers	5.90	5.79	-	-	5.89
30–39	non-smokers	5.72	5.90	6.15	-	5.85
	ex-smokers	6.08	5.86	6.04	-	5.96
	smokers	6.01	5.85	6.18	-	5.94
40–49	non-smokers	6.01	6.57	5.18	-	6.00
	ex-smokers	5.94	6.40	5.46	4.84	5.79
	smokers	5.96	5.87	5.65	5.76	5.85
50–59	non-smokers	6.31	5.62	5.78	5.70	5.90
	ex-smokers	5.67	5.84	5.42	5.62	5.64
	smokers	5.81	5.72	5.57	6.07	5.79
60+	non-smokers	5.57	-	5.33	5.99	5.75
	ex-smokers	5.89	5.38	5.36	5.39	5.46
	smokers	6.00	5.23	5.61	5.48	5.62
All Ages	non-smokers	5.89	6.04	5.56	5.84	5.90
	ex-smokers	5.95	5.91	5.44	5.45	5.77
	smokers	5.93	5.79	5.65	5.89	5.86

Physical Signs

Rales

Rales which persisted after coughing were present in 60 men (6.5%) and a further 10 men had rales which did clear after coughing. Table 14 shows that persistent rales occurred most frequently in ex-smokers even after making allowance for age differences. As for the sample population, there is some evidence of a dose-response relationship in age groups 40-49 years and 50-59 years, but the numbers involved are small.

Rhonchi

Rhonchi occurred in 58 men and most frequently in smokers (Table 14).

Finger Clubbing

Finger clubbing occurred in 21 men, mainly in current smokers.

Pleural Rubs

Pleural rubs occurred in only eight men, one non-smoker, three ex-smokers and four current smokers.

Cyanosis

Cyanosis was recorded for only nine men, seven of whom were smokers.

Asbestos Corns

No asbestos corns were recorded.

Blood Pressure

The prevalence of systolic blood pressure over 150 mm Hg is seen to increase markedly in those aged 50 or more. (Table 14). Diastolic blood pressure also shows increased prevalence in older RAW's, mainly in ex-smokers.

Lung Function

Average values of lung function indices

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TABLE 19 AVERAGE VALUES OF RESIDUAL VOLUME (LITRES) STANDARDIZED TO HEIGHT 1.7m AND AGE 25, 35, 45, 55 or 65

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)				
		<10	10-19	20-29	30+	All Years
≤29	non-smokers	1.65	1.63	-	-	1.65
	ex-smokers	1.70	1.91	-	-	1.71
	smokers	1.63	1.58	-	-	1.63
30-39	non-smokers	1.61	1.72	2.25	-	1.70
	ex-smokers	1.66	1.57	1.76	-	1.62
	smokers	1.78	1.72	2.38	-	1.76
40-49	non-smokers	1.77	2.03	1.62	-	1.77
	ex-smokers	1.81	2.06	1.59	1.38	1.75
	smokers	2.00	1.91	1.85	1.68	1.92
50-59	non-smokers	1.66	1.40	1.89	1.83	1.74
	ex-smokers	1.94	1.92	1.78	1.80	1.78
	smokers	1.80	1.91	1.93	2.15	1.92
60+	non-smokers	2.23	-	1.51	1.85	1.95
	ex-smokers	2.05	1.59	1.57	1.66	1.68
	smokers	2.02	1.53	1.92	1.49	1.77
All Ages	non-smokers	1.68	1.74	1.72	1.84	1.71
	ex-smokers	1.70	1.78	1.68	1.70	1.72
	smokers	1.75	1.77	1.92	1.92	1.78

standardised to height 1.7 m and ages 25, 35, 45, 55 and 65 for the five age groups using the regression equations of Cotes (1968) are shown in Tables 16-20. Table 15 gives the numbers of men who completed the various tests of lung function.

One Second Forced Expiratory Volume (FEV)

There is a slight relation to age (Table 16) but rather less than would have been predicted from the regression coefficient on age (Cotes, 1968). There is a tendency for smokers to have lower values of FEV_1 and the difference between smokers and non-smokers increases with age agreeing with the findings of Rossiter and Weill (1974) in asbestos cement workers. For those aged 50-59 there is a relation to duration of exposure, but not at other ages.

Forced Vital Capacity (FVC)

In accordance with the findings of Rossiter and Harries (*in preparation*) the differences in values of FVC are smaller than those for FEV between smoking groups. As for FEV_1 there is a dose response relation for those aged 50-59 but not for other ages, although an expected decline with age has occurred. (Table 17).

Total Lung Capacity (TLC) and Residual Volume (RV)

Tables 18 and 19 show the values for TLC and RV. Total lung capacity is not related to age, as expected, and there is no relation to smoking or duration of asbestos exposure. Residual volume increases, with age, as expected, but it only shows a relation with smoking in those aged 40-59 years. Again there is no consistent dose-response except in those aged 50-59 years.

Transfer Factor (TF)

A marked smoking effect is seen in Table 20 but there is surprisingly no relation with

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TABLE 20 AVERAGE VALUES OF TRANSFER FACTOR (mmol min^{-1} kPa^{-1}) STANDARDIZED TO HEIGHT 1.7m AND AGE 25, 35, 45, 55 or 65

Age Groups (Years)	Smoking Habits	DURATION OF EXPOSURE TO ASBESTOS (YEARS)				
		<10	10–19	20–29	30+	All Years
≤29	non-smokers	9.7	9.3	-	-	9.6
	ex-smokers	10.0	11.1	-	-	10.1
	smokers	8.5	8.6	-	-	8.5
30–39	non-smokers	9.1	9.6	9.0	-	9.4
	ex-smokers	9.3	9.3	8.1	-	9.3
	smokers	8.4	8.5	9.9	-	8.5
40–49	non-smokers	9.3	10.9	9.0	-	9.8
	ex-smokers	9.3	9.0	9.2	8.2	9.1
	smokers	8.5	7.8	7.8	8.5	8.2
50–59	non-smokers	10.3	10.0	9.1	9.4	9.7
	ex-smokers	9.2	9.8	9.0	9.8	9.4
	smokers	7.9	8.6	8.1	8.8	8.3
60+	non-smokers	10.9	-	6.7	11.2	10.5
	ex-smokers	9.3	9.8	8.6	8.9	9.0
	smokers	8.3	8.1	9.7	8.6	8.6
All Ages	non-smokers	9.6	9.8	8.9	10.3	9.6
	ex-smokers	9.5	9.5	9.0	9.2	9.4
	smokers	8.4	8.4	8.3	8.7	8.4

age or duration of exposure to asbestos in the RAWs even though Harries, Heath and Rossiter (*in preparation*) suggest that this index is one of the most useful in diagnosing asbestosis.

Discussion

The different types of work undertaken at the four yards and the different approaches to problems associated with insulating materials have resulted in different criteria being applied for inclusion of workers into the Register of Asbestos Workers and the comparison to be drawn between the four yards are of dubious value.

The data obtained however are of value in establishing a base line for those men considered to be exposed to asbestos and other insulating dusts, albeit many of them to low concentrations and for intermittent periods of time. They will be used in the prospective study being undertaken by the Employment Medical Advisory Service.

In terms of assessment of the effects of asbestos exposure the results of this particular report fall between those obtained from the Main Survey (Harries *et al*, 1976) and from the study of men more heavily exposed to asbestos Harries *et al*, (*in preparation*). The 'dilution effect' of introducing men only intermittently exposed to asbestos into the Register of Asbestos Workers and the medical selection of these since 1969 account for these differences.

The results of the survey show that the selection of these workers has meant that radiographic, clinical and lung function abnormalities associated with exposure to asbestos have only occurred in the older men who were exposed before the new protective measures were introduced into the dockyards by the Ministry of Defence (Navy) in 1969.

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