RESPIRATORY SYMPTOMS, BRONCHITIS, AND VENTILATORY CAPACITY IN RANDOM SAMPLE OF AN AGRICULTURAL POPULATION

BY

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Measurement of disease in industry necessitates suitable controls. A comparison of miners and ex-miners with non-miners of similar age living in the same neighbourhood has been made (Higgins *et al.*, 1956). In that comparison it is possible that our controls may have been affected by the industrial environment of the mining community to some extent, and accordingly any deleterious effect of mining on health may have been underestimated. We have tried to assess the importance of the environment by studying an agricultural community. This paper gives an account of a survey of respiratory symptoms in a random sample of the inhabitants of the Vale of Glamorgan.

The Vale of Glamorgan is an undulating plain, about 200 feet (60 metres) above sea level, of unspoilt agricultural land lying 15 miles (24 km.) west of Cardiff, between the South Wales coalfield in the north and the Bristol Channel in the south. The rainfall is about 40 inches (1 metre) per annum and the average temperatures for January and June are 41 and 58° F. (5 and 14.4° C.) respectively. The area is exceptionally free from atmospheric pollution, and only the strip bordering the coast is subject to winter mists.

During the summer of 1955 Cochrane conducted a survey of the population living in a geographically defined area of the Vale (Cochrane *et al.*, 1956). This area was approximately 55 square miles (142 square km.), with a density of 0.5 person per acre (0.2 person per hectare) (General Register Office, 1954). A private census was taken, social and occupational details were recorded, and chest radiography of 95% of the defined population was achieved. The information obtained was transferred to punch cards. Random samples by sex and age can therefore be readily drawn from this community.

Sample, Procedure, and Methods

The present sample is shown in Table I. The original intention was to study 50 men and 50 women in each 10-year age group from 25 to 74 except in the 55-64 groups, in whom we are particularly interested, where we intended seeing 100 of each sex. It was, however, found that of the 100 men drawn in this group 31 had worked at some time in mining or other dusty occupation, and as we were anxious to exclude such men the sample was therefore increased by a further 31 who had never worked in dusty jobs.

A number of investigations had been planned for the men aged 55-64. They were therefore seen at a centre during the second half of April, 1956. Each man was visited at his house by a member of the field survey team, the purpose of the investigations explained to him, his co-operation sought, and an appointment given. Transport was offered and usually accepted. Any man who failed to attend was promptly revisited, the reason ascertained, and a new appointment given. The rest of the men and all the women were visited in their homes, the majority during

January and February, 1956. Appointments were not made before these home visits, since it was considered possible that any reluctant participant might arrange to be out at the appointed time. Instead visits were continued until a person sampled was either seen or found to have moved from the area. In this way, with the help of a driver who knew the area well, 20-25 people could be interviewed daily and the main part of the visiting was completed in six weeks. Each person interviewed was asked to co-operate in a piece of research. It was emphasized that we were not looking for a disease but trying to find out more about respiratory symptoms in normal people living in healthy surroundings.

1. Respiratory symptoms were recorded, using a questionnaire similar to that used in previous studies (Higgins *et al.*, 1956). Chest illness during the past three years, persistent cough and sputum, wheeze and tightness, and a number of possible aetiological factors such as smoking habits, previous chest illnesses, and head colds "going down on the chest" were

TABLE I.—Random Sample

Age Group at Time of Survey (April 1, 1956)	Living in Vale at Time of Census (July 1, 1955)	Sampled	Left Area since Census	Died	Refused	Interviewed	Excluded	Analysed
Men:								
25- ..	453	50	0	0	4	46	0	46
35- ..	437	50	0	0	1	49	1	48
45- ..	414	50	1	0	3	46	1	45
55- ..	316	131	5	1	7	118	1	117
65- ..	213	50	1	2	1	46	1	45
Total	1,833	331 (100%)	7	3	16	305	4	301 (90.9%)
Women:								
25- ..	454	50	1	0	2	47	0	47
35- ..	407	50	1	0	2	47	0	47
45- ..	434	50	2	0	0	48	0	48
55- ..	351	100	1	0	5	94	2	92
65- ..	232	50	2	0	1	47	1	46
Total	1,878	300 (100%)	7	0	10	283	3	280 (93.3%)

Reasons for exclusion of men: One man had pulmonary tuberculosis, one man was bedridden following a stroke, and in two the sitting height and weight were omitted.

Reasons for exclusion of women: One woman was incapable, and in two the sitting height and weight were omitted.

noted. All questionnaires were completed by the observer who had completed them in the previous surveys.

2. Sitting height was recorded in inches to the nearest half-inch, a special stool fitted with a measuring-rod being used for this purpose. Weight was recorded in pounds to the nearest pound, an appropriate deduction being made for clothing.

3. An attempt was made to assess lung function, using a respiratory flow-meter designed to measure peak air flows during a maximal forced expiration (B. M. Wright, to be published). The instrument is simple and portable, and appears to give useful information about the ventilatory capacity. It was hoped that this survey would indicate its value as a rough sorting instrument for those with ventilatory insufficiency and also provide normal values for men and women living in an agricultural area.

4. In the men aged 55-64 who had never worked in dusty occupations the ventilatory capacity was also assessed from the volume of air expelled in 0.75 second during a forced expiration, using the method described previously (Carpenter *et al.*, 1956). The result is expressed as the maximum voluntary ventilation (M.V.V.) (indirect) in litres/minute by multiplying the volume by 40. In both physiological tests the mean of three results after a preliminary practice blow was taken.

5. Occupational histories and chest radiographs were available from the previous survey (Cochrane *et al.*, 1956).

Results

Table I shows what was achieved; co-operation was very good. Over 95% of those still living in the area, or 91%

of those originally drawn in the sample, were interviewed. Even in those who refused to co-operate fully it was remarkable how easily information about respiratory symptoms could be elicited. Only those who consented to the physiological test and to the measurement of their heights and weights have, however, been included in the analysis. Their mean ages and anthropometric measurements are given in Table II. In both men and women there was a progressive

TABLE II.—Mean Age and Measurements of the Men and Women Seen in the Sample

Age Group	No.	Age (Years)	Sitting Height		Weight		Peak Expiratory Flow Rate (Litres/Minute)
			in.	cm.	lb.	kg.	
25—	M	46	29.5	35.8	90.9	156.5	71.0
	F	47	30.3	33.7	85.6	131.0	59.4
35—	M	48	39.6	35.7	90.7	160.1	72.6
	F	47	39.8	33.6	85.3	143.0	64.9
45—	M	45	49.0	35.1	89.2	154.5	70.1
	F	48	49.9	33.2	84.3	143.0	64.9
55—	M	117	59.3	34.5	87.6	149.0	67.6
	F	92	59.2	32.6	82.8	141.1	64.0
65—	M	45	68.9	34.3*	87.1	149.6	67.9
	F	46	69.3	32.1	81.5	139.5	63.3

* Omitting one man with severe kyphosis.

reduction in sitting height with age. Weight, on the other hand, reached a maximum in the 35–44 age group and was followed by a moderate decline in the men but only a slight fall in the women.

Prevalence of Respiratory Symptoms and Bronchitis

Table III shows the prevalence of respiratory symptoms and "chronic bronchitis" in the men and women examined in the sample. Respiratory symptoms were common in both sexes. Less than half the sample had no symptoms at all. In the men there was a fairly steady increase in the prevalence of all symptoms with age, which is best seen in the

TABLE III.—Prevalence of Respiratory Symptoms and "Chronic Bronchitis" (% in Parentheses)

Age Group	No.	No Symptoms	Chest Illness	Cough and Sputum*	Wheeze and Tightness	Breathlessness†	"Chronic Bronchitis"
Men:							
25—	46	22 (47.8)	3 (6.5)	6 (13.0)	6 (13.0)	1 (2.2)	1 (2.2)
35—	48	20 (41.7)	2 (4.2)	5 (10.4)	7 (14.6)	5 (10.4)	2 (4.2)
45—	45	11 (24.4)	6 (13.3)	8 (17.8)	11 (24.4)	10 (22.2)	4 (8.9)
55—	117	28 (23.9)	25 (21.4)	29 (24.8)	34 (29.1)	27 (23.1)	12 (10.3)
65—	45	9 (20.0)	12 (26.7)	17 (37.8)	23 (51.1)	16 (35.6)	7 (15.6)
Women:							
25—	47	20 (42.6)	5 (10.6)	6 (12.8)	12 (25.5)	4 (8.5)	3 (6.4)
35—	47	20 (42.6)	8 (17.0)	3 (6.4)	10 (21.3)	4 (8.5)	2 (4.3)
45—	48	27 (56.3)	2 (4.2)	3 (6.3)	7 (14.6)	11 (22.9)	1 (2.1)
55—	92	31 (33.7)	11 (12.0)	7 (7.6)	25 (27.2)	17 (18.9)	4 (4.3)
65—	46	16 (34.8)	11 (23.9)	6 (13.0)	13 (28.3)	11 (23.9)	4 (8.7)

* Tables showing the prevalence of the individual symptoms are available from the Pneumoconiosis Research Unit.

† Grade 2 (those who are unable to keep up with people of their own age at work, on hurrying, on hills, or on stairs) and over (Fletcher, 1952).

FIG. 1.—Prevalence of "chronic bronchitis" in a random sample of the population of the Vale of Glamorgan (persistent sputum and at least one chest illness during the past three years).

case of persistent cough and sputum, wheezing, and breathlessness. In the women, on the other hand, an increase in prevalence with age is less striking. There was an upward trend from age 45; but the prevalence of cough and sputum at age 65–74 was little different from that at age 25–34.

In our previous paper we defined "chronic bronchitis" arbitrarily as the persistent production of phlegm (for at least three consecutive months in the year) and at least one chest illness with increased cough and sputum during the past three years. The prevalence of chronic bronchitis in the two sexes according to this definition is shown in Fig. 1. There was a steady rise in prevalence in the men but not in the women, leading to a well-marked sex difference in the older age groups; but under 45 the prevalence was slightly higher in the women.

Ventilatory Capacity

The scatter diagram (Fig. 2) compares the peak flow and M.V.V. (indirect) results obtained in the men aged 55–64 who had never worked in dusty occupations. There was a high correlation ($r = 0.86$) between the two sets of data. In the lower range of values, in which we are most interested, sorting of subjects would have been equally effective

FIG. 2.—Relationship between peak flow and maximum voluntary ventilation (indirect) in a random sample of males aged 55–64 who had never worked in dusty jobs.

with either instrument. It seems justifiable, therefore, to use the respiratory flow meter as a rough measure of the ventilatory capacity.

Figs. 3 and 4 show the frequency distributions of the peak flow measurements* in each 10-year age group for all the men and women studied. There was a linear fall of 6.34 ± 0.579 litres/minute in men and of 3.83 ± 0.445 litres/minute in the women for each year of life.

*The instrument used was an early model and was later found to underestimate the true peak flow, defined as one lasting 1/100 of a second or more, measured with a pneumotachograph, by about 17%. This underestimate was very consistent, and the figures given can be converted to true peak flow by multiplying them by 1.17.

Effect of Occupation

Fifty-five men in the sample, mainly over the age of 45, had worked at some period of their lives in mining or quarrying. The division of the sample by occupational dust exposure into two groups and the mean ages and measurements in each are given in Table IV. Table V shows that the prevalence of respiratory symptoms and "chronic bronchitis" was higher in those men who had worked in dust. In the 55-64 group in particular a considerably higher prevalence of chest illness and wheeze and tightness was recorded. The average peak flow in this group was significantly lower (70 litres/minute) than that of the men who had worked only in dust-free occupations ($0.02 > P > 0.01$). The differences in height and weight between the two occupational groups do not account for this finding, which is clearly associated with the higher symptom prevalence in the men exposed to dust. The difference of 37 litres/minute

in peak flow in the 65-74 group, while suggesting a similar trend, is, however, insignificant ($0.50 > P > 0.40$).

About one-third of the men in the sample were farmers, agricultural labourers, foresters, and gardeners. Mortality statistics suggest that those engaged in these occupations are less liable to bronchitis than other members of the community (Registrar-General, 1938). Although the numbers in

FIG. 3

FIG. 4

FIG. 3.—Peak-flow measurements in a random sample of males aged 25-74 in the Vale of Glamorgan. Black area="chronic bronchitis." FIG. 4.—Peak-flow measurements in a random sample of females aged 25-74 in the Vale of Glamorgan. Black area="chronic bronchitis."

TABLE IV.—Mean Age and Measurements According to Occupational Dust Exposure

Age Group	No.			Age in Years			Sitting Height (in.)			Weight (lb.)			Peak Flow (l./min.)		
	D	ND	T	D	ND	T	D	ND	T	D	ND	T	D	ND	T
25-	3	43	46	31.7	29.3	29.5	35.8	35.8	35.8	150.7	156.9	156.5	601	584	585
35-	3	45	48	41.0	39.5	39.6	35.7	35.7	35.7	145.3	161.1	160.1	493	502	501
45-	8	37	45	50.0	48.8	49.0	35.3	35.0	35.1	156.3	154.2	154.5	497	447	456
55-	29	86	115*	59.3	59.3	59.3	34.1	34.7	34.5	139.2	152.6	148.9	352	422	404
65-	12	33	45	69.7	68.6	68.9	33.8	34.5	34.3	147.3	150.4	149.6	277	314	304

D=Dusty—i.e., those who had worked in mining or quarrying. ND=Non-dusty—i.e., those who had never worked in mining or quarrying. T=Total.
* In two men the M.V.V. (indirect) was not measured. They have been omitted from the non-dusty group in this table and in the subsequent analysis.

the individual age groups are small, Table VI suggests that in the present sample this group had rather less cough and sputum and "chronic bronchitis" than the rest of the sample (Table VII).

TABLE V.—Prevalence of Respiratory Symptoms and "Chronic Bronchitis"

Age Group	No.	No Symptoms	Chest Illness	Cough and Sputum	Wheeze and Tightness	Breathlessness	"Chronic Bronchitis"
<i>Men who had worked in dusty occupations</i>							
25-34	3	3 (100.0)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
35-44	3	1 (33.3)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
45-54	8	1 (12.5)	1 (12.5)	3 (37.5)	3 (37.5)	3 (37.5)	1 (12.5)
55-64	29	5 (17.3)	11 (37.9)	7 (24.1)	13 (44.8)	6 (20.7)	7 (24.1)
65+	12	2 (16.7)	2 (16.7)	7 (58.3)	8 (66.7)	5 (41.7)	2 (16.7)
<i>Men who had never worked in dusty occupations</i>							
25-34	43	19 (44.2)	3 (7.0)	6 (14.0)	6 (14.0)	1 (2.3)	1 (2.3)
35-44	45	19 (42.2)	2 (4.4)	5 (11.1)	7 (15.6)	5 (11.1)	2 (4.4)
45-54	37	10 (27.0)	5 (13.5)	5 (13.5)	8 (21.6)	7 (18.9)	3 (8.1)
55-64	86	23 (26.7)	14 (16.3)	22 (25.6)	21 (24.4)	11 (12.8)	5 (5.8)
65+	33	7 (21.2)	10 (30.3)	10 (30.3)	15 (45.5)	11 (33.3)	5 (15.2)

TABLE VI.—Prevalence of Respiratory Symptoms and "Chronic Bronchitis" in Farmers, Agricultural Workers, Foresters, Gardeners (Males)

Age Group	No.	No Symptoms	Chest Illness	Cough and Sputum	Wheeze and Tightness	Breathlessness	"Chronic Bronchitis"
25-34	7	3 (42.9)	0 (—)	1 (14.3)	2 (28.6)	1 (14.3)	0 (—)
35-44	14	6 (42.9)	0 (—)	2 (14.3)	3 (21.4)	2 (14.3)	0 (—)
45-54	20	7 (35.0)	2 (10.0)	2 (10.0)	2 (10.0)	3 (15.0)	1 (5.0)
55-64	38	15 (39.5)	8 (21.1)	6 (15.8)	10 (26.3)	9 (23.7)	2 (5.3)
65+	15	3 (20.0)	6 (40.0)	3 (20.0)	10 (60.0)	5 (33.3)	1 (6.7)

TABLE VII.—Comparison of Prevalence of Symptoms and "Chronic Bronchitis" in the Men by Occupation (Percentages)

Age Group	Chest Illness				Cough and Sputum				Wheeze and Tightness				Breathlessness				"Chronic Bronchitis"			
	A	D	ND	F	A	D	ND	F	A	D	ND	F	A	D	ND	F	A	D	ND	F
25-34	6.5	0	7.0	0	13.0	0	14.0	14.3	13.0	0	14.0	28.6	2.2	0	2.3	14.3	2.2	0	2.3	0
35-44	4.2	0	4.4	0	10.4	0	11.1	14.3	14.6	0	15.6	21.4	10.4	0	11.1	14.3	4.2	0	4.4	0
45-54	13.3	12.5	13.5	10.0	17.8	37.5	13.5	10.0	24.4	37.5	21.6	10.0	22.2	37.5	18.9	15.0	8.9	12.5	8.1	5.0
55-64	21.4	37.9	16.3	21.1	24.8	24.1	25.6	15.8	29.1	44.8	24.4	26.3	23.1	20.7	23.7	10.3	24.1	5.8	5.3	5.3
65+	26.7	16.7	30.3	40.0	37.8	58.3	30.3	20.0	51.1	66.7	45.5	60.0	35.6	41.7	33.3	33.3	15.6	16.7	15.2	6.7

A = All men in the sample. D = Dusty—i.e., those who had worked in mining or quarrying. ND = Non-dusty—i.e., those who had never worked in mining or quarrying. F = Farmers, agricultural labourers, gardeners, and foresters.

TABLE VIII.—Effect of Smoking Habits on Respiratory Symptoms (Men Aged 25-74)

Symptom Group	Non-smokers	Ex-smokers	Smokers Cigarettes/day		Total
			1-14	15+	
Whole group	28	51	100	122	301
Those with:					
Persistent cough and sputum	2	10	13	40	65
Chest illness	1	9	18	20	48
Breathlessness	2	13	21	23	59
"Chronic bronchitis"	1	3	7	15	26

TABLE IX.—Effect of Smoking Habits on Respiratory Symptoms (Women)

Age Group	Symptom Group	Non-smokers	Ex-smokers	Smokers Cigarettes/day		Total
				1-14	15+	
25-44	Whole group	41	4	42	7	94
	Those with:					
	Persistent cough and sputum	0	0	7	2	9
	Chest illness	6	0	6	1	13
	Breathlessness	4	2	2	0	8
	"Chronic bronchitis"	1	0	3	1	5
45-74	Whole group	135	7	35	9	186
	Those with:					
	Persistent cough and sputum	8	1	4	3	16
	Chest illness	17	0	4	3	24
	Breathlessness	31	1	6	1	39
	"Chronic bronchitis"	5	0	1	3	9

Effect of Smoking

Smoking habits were recorded as in our previous studies. Tables VIII and IX show the effect of smoking on respiratory symptoms in the men and women. In the men there was relatively little change in smoking habits with age, and it is therefore justifiable to consider all age groups together. In the women, however, this cannot be done because those under 45 differed strikingly in their smoking habits from those over 45. The women are therefore considered in two age groups, 25-44 and 45-74.

In each case the habits of the whole group are given first and then the relation of smoking to symptoms. In the men the prevalence of persistent cough and sputum was significantly higher in smokers than in non-smokers ($P < 0.001$) and proportionally higher in heavy than in light smokers. Smokers appeared more liable than non-smokers to chest illness, breathlessness, and "chronic bronchitis," but for none of these symptoms did the differences reach the conventional level of statistical significance.

The ventilatory capacity according to smoking habits for the men aged 55-64 is shown in Fig. 5. The mean M.V.V. (indirect) of those smoking 15 g. or more of tobacco a day was lower than that of non-smokers and smokers of less than 15 g. a day. It should be noted that the exclusion of ex-smokers tends to raise the mean values for smokers. The peak-flow measurements indicate a similar trend, but show in addition a slight reduction in the group of light smokers. In each 10-year age group over 45 the peak flow was lower in smokers and ex-smokers than in the non-smokers; but the numbers in these groups were very small. These differences could not be explained by differences in age, social class, or occupation between the groups.

FIG. 5.—Effect of smoking on ventilatory capacity as assessed by maximum voluntary ventilation (indirect) and peak flow in a random sample of males aged 55-64 who had never worked in dusty occupations.

A significantly higher prevalence of cough and sputum in smokers than in non-smokers was found in the women under 45 ($P<0.01$); but over this age the difference was insignificant ($0.10>P>0.05$). The high prevalence of cough and sputum and wheeze in the young women was largely explicable on the basis of their smoking habits. There were, however, no striking differences in the prevalence of the other symptoms or in the peak-flow measurements between smokers and non-smokers.

Occurrence of Chest Illnesses in the Past

The prevalence of past attacks of pneumonia, pleurisy, and bronchitis (those occurring more than three years ago) is shown in Table X. In both sexes those with "chronic

TABLE X.—Influence of Previous Chest Illnesses on "Chronic Bronchitis"

		No.	Previous History of		
			Pneumonia	Pleurisy	Bronchitis
Men	All in the sample ..	301	46 (15.3)	31 (10.3)	63 (20.9)
	Those with cough and sputum ..	65	13 (20.0)	7 (10.8)	25 (38.5)
	Those with "chronic bronchitis" ..	26	6 (23.1)	1 (3.8)	18 (69.2)
Women	All in the sample ..	280	45 (16.1)	35 (12.5)	60 (21.4)
	Those with cough and sputum ..	25	5 (20.0)	2 (8.0)	7 (28.0)
	Those with "chronic bronchitis" ..	14	6 (42.9)	2 (14.3)	8 (57.1)

bronchitis" recorded significantly more attacks of bronchitis in the past than the average for the sample (men: $P<0.001$; women: $0.01>P>0.001$). The women with "chronic bronchitis" also recorded significantly more pneumonia ($0.05>P>0.02$); but in the men the difference was insignificant ($0.5>P>0.3$). No excess of pleurisy in the past was found in either sex.

The number of head colds each year and whether or not head colds usually "went down on the chest" were recorded. The overall mean number of colds was 2.0 each year for both men and women, and 31.9% of these went down on the chest in the men and 34.6% in the women. Those with "chronic bronchitis" reported more colds than the others, averaging 3.0 each year in the men and 2.7 in the women, and in this group 61.5% of the men and 87.6% of the women said that colds went to the chest. Further questions suggested that the phrase "going to the chest" usually implied a cold with cough and sputum but not necessarily frank chest illness.

These findings may be compared with those of Oswald *et al.* (1953), who found that the annual mean number of colds was higher in patients with bronchitis than in controls, and that whereas colds "went down to the chest" in only 27% of the controls, they did so in 90% of the patients.

Discussion

The results found in this survey in the men aged 55-64 who had never worked in mining or quarrying may be compared with those found for non-miners in Leigh (Lancs) (Higgins *et al.*, 1956). The comparison is shown in Table XI. There was little difference in the prevalence of wheeze and tightness and of breathlessness recorded in the two areas, and persistent cough and sputum was actually slightly commoner in the Vale. Bronchitic chest illness was only slightly more prevalent in Leigh; but if single attacks of illness are excluded it will be seen that recurrent attacks were more

than twice as common in Leigh—13% compared with 5% in the Vale. This was the most striking symptom difference between the two places, but the numbers are too small for the difference to be statistically significant ($0.10>P>0.05$). "Chronic bronchitis" as defined was also insignificantly commoner in Leigh—11% compared with 6%.

The similarity in the prevalence of respiratory symptoms recorded in the two places is surprising in view of the great differences in atmospheric pollution between them. The Vale is completely free from such pollution; Leigh is situated in the centre of the polluted S.E. Lancashire conurbation. There is a considerable difference in mortality rates in the 45-64 age group between the two areas (Goodman *et al.*, 1953) and a difference in respiratory symptomatology would certainly have been expected. One possibility is that there are regional differences in the way people answer questions about respiratory symptoms. A cough and sputum that might be ignored in the industrial north may be recorded as being present in South Wales. Every effort in questioning was made to avoid introducing a bias of this kind, and the physiological measurements do not suggest that it was likely. Fig. 6 compares the ventilation capacity measurements in the two areas. The mean M.V.V. (indirect) in the men who had never worked in dusty jobs in the Vale was 89 litres/minute compared with 85 litres/minute in the non-miners in Leigh. The difference of 4 litres/minute is quite insignificant.

FIG. 6.—Frequency distributions of maximum voluntary ventilation (indirect) in random samples of non-mining males aged 55-64 in the Vale of Glamorgan and Leigh (Lancs). Black area = bronchitics.

TABLE XI.—Comparison of Prevalence of Respiratory Symptoms and "Chronic Bronchitis" in the Vale of Glamorgan and Leigh (Lancs). Non-miners aged 55-64

Random Sample	No.	Cough and Sputum	Wheeze and Tightness	Breathlessness		Bronchitic Chest Illness		"Chronic Bronchitis"
				Grade 2 and Over	Grade 3* and Over	Once Only	More than Once	
Vale of Glamorgan	86	22 (25.6)	21 (24.4)	21 (24.4)	7 (7.9)	10 (11.6)	4 (4.7)	5 (5.8)
Leigh (Lancs)	84	15 (17.9)	19 (22.6)	19 (22.6)	6 (7.2)	4 (4.8)	11 (13.1)	9 (10.7)

* Grade 3 are those unable to keep up with other people of their own age walking on the level, but able to walk a mile or so at their own speed (Fletcher, 1952).

A more probable explanation is that smoking is a more important cause of respiratory symptoms and reduction in ventilatory capacity than atmospheric pollution. The importance of smoking as a cause of bronchitis has often been stressed (Oswald *et al.*, 1953; Waldbott, 1953; Joules, 1954; Palmer, 1954; Oswald and Medvei, 1955; Phillips *et al.*, 1956; Clifton, 1956; Leese, 1956; Edwards, 1957; Ogilvie and Newell, 1957). In the present comparison the smoking habits of the non-miners in the two areas were similar, and this may account for similar prevalence of symptoms and ventilatory capacity. It seems probable that the effect of smoking may overshadow any effect attributable to atmospheric pollution, so that one would have to study non-smokers to demonstrate it.

The importance of standardizing for smoking habits in considering chronic cough has recently been stressed by Phillips *et al.* (1956). The greater frequency of recurrent chest illness in Leigh suggests, however, that once the respiratory tract has been damaged those subjected to an industrial environment, including polluted atmospheres, may be more likely to become ill, and to become ill more frequently. The results point to the importance of obtaining information about exacerbations of chest illness in evaluating the effect of atmospheric pollution. Despite the apparently increased liability to illness of those living in the polluted town there was less evidence of the deleterious effect of the atmosphere than might have been anticipated. One might expect that increased exacerbations would lead to greater breathlessness, but in fact this was not so. Nor do the ventilatory capacity measurements support the belief that respiratory symptoms were more severe in Leigh than in the Vale.

A further factor that must be considered is mortality. Death rates from bronchitis are higher in towns than in the country, and consequently our rural sample may contain a higher proportion of survivors with respiratory symptoms than did our sample at Leigh. Prevalence and mortality rates are, however, of such different orders of magnitude that it is unlikely that the factor of survival could be large.

This comparison between the unpolluted Vale and the grossly polluted Lancashire town has been restricted to men who have never worked in mining. Miners and ex-miners have been shown to have significantly more respiratory symptoms and chronic bronchitis than other industrial workers (Pemberton, 1956; Higgins *et al.*, 1956), and they also have a significantly lower ventilatory capacity than non-miners of comparable age living in the same area (Carpenter *et al.*, 1956). The proportion of miners and ex-miners in the Vale and Leigh is very different. Thus in Leigh over half the men aged 55-64 worked or had worked for some time in mining, whereas in the Vale ex-miners comprised slightly less than one-third. A comparison between the two areas which ignored occupation would therefore have shown a higher prevalence of bronchitis in the town. This excess would, however, have been explicable on the basis of occupation rather than urban environment and atmospheric pollution.

There is a great need for a simple test of lung function that could be used in the home. The peak respiratory flow meter used in the present investigation is a useful instrument that might perhaps fulfil this need. Its main disadvantage is that compared with the M.V.V. (indirect) it requires more co-operation from the subject to obtain a repeatable result. The practical advantage of adding objective measurement to the subjective information obtained in this type of survey, however, outweighs this objection.

Summary and Conclusions

A survey of respiratory symptoms and ventilatory capacity in over 90% of a random sample of 331 men and 300 women aged 25-74 living in the Vale of Glamorgan has been carried out.

The prevalence of "chronic bronchitis," defined as persistent sputum and at least one chest illness during the past three years, rose in the men from 2.2% in the 25-34

age group to 15.6% in the 65-74 group. In the women, on the other hand, the prevalence fell from 6.4% in the 25-34 group to a minimum of 2.1% at age 45-54 and then rose to 8.7% in the 65-74 group.

In both sexes smokers recorded a significantly higher prevalence of persistent cough and sputum than non-smokers, and in the men smokers also appeared more liable to chest illnesses and breathlessness. The influence of occupation, head colds, and previous chest illnesses is also considered.

The results obtained in the men aged 55-64 who had never worked in mining or quarrying are compared with those found previously in a comparable group of non-miners living in an industrial town. The town dwellers appeared more liable to recurrent chest illnesses and they also had slightly more "chronic bronchitis." The overall prevalence of respiratory symptoms and of ventilatory capacity, measured by the M.V.V. (indirect), was, however, surprisingly similar in the two groups. This is discussed in the light of their smoking habits; and stress is laid on the necessity for standardizing for smoking habits in studies designed to evaluate the importance of atmospheric pollution as a cause of respiratory disease.

While confirmation of these findings in different areas and over a wider age range is needed, the similarity in the pattern of respiratory symptoms and disability in non-miners in Leigh and in the Vale suggests that the industrial environment exerted a smaller effect on the general population than might have been anticipated. In assessing the importance of occupational factors as a cause of respiratory disease in a particular industry, therefore, a control group, such as we have used previously, of men of comparable age who have never worked in the industry but who live in the same neighbourhood may justifiably be employed provided there are no great differences in the smoking habits of the two groups.

A respiratory flow meter, designed to record peak expiratory flow, was used. Although still in a developmental stage the correlation ($r=0.86$) with the M.V.V. (indirect) in the men aged 55-64 appeared to justify the use of this instrument to measure the ventilatory capacity, and normal values for the men and women in the sample are given for each 10-year age group.

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