

Farmer's lung in Devon

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Smyth, J. T., Adkins, G. E., Lloyd, Margaret, Moore, B., and McWhite, Elizabeth (1975). *Thorax*, 30, 197–203. **Farmer's lung in Devon.** Farmer's lung is a cause of disability to agricultural workers in Devon and there is no evidence that the incidence is falling. A survey of known cases was made to assess the degree of disability in relation to the clinical history, the presence of farmer's lung precipitins, tests of lung function, and radiographic changes. Information was obtained about 200 patients diagnosed between 1939 and 1971. A survey of 148 of these patients showed that the disease was most commonly diagnosed in men aged 40 to 50 years and the most important symptom at diagnosis was dyspnoea related to occupational exposure to hay or grain. The onset was often insidious and only 67 patients (45%) were diagnosed during the first year of the disorder.

Disability was severe in about one-third of the cases. The degree of disability did not seem to be related to the serological changes recorded either at diagnosis or at the time of our survey. Disability was commonly associated with restriction and reduced gas transfer factor and with airways obstruction in more severe cases. Many individuals reporting significant disability had only slightly abnormal ventilatory function tests at rest. Radiographic changes were found at survey in about one-third of the subjects reporting disability.

Many farmers had not used an efficient mask. Treatment is unsatisfactory but steroid therapy is effective in acute episodes.

For many years, Devon farmers have known of a disabling breathlessness associated with handling mouldy hay or grain. Fuller (1953) described the clinical features of farmer's lung as seen in the Exeter area from 1936 onwards. He recognized three phases of the disorder. The relationship between the acute and chronic stages of the disease was studied in detail by Hapke, Seal, and Thomas (1968). The association of farmer's lung with a specific antibody response to thermophilic actinomycetes, and particularly to *Micropolyspora faeni*, was reported by Pepys *et al.* (1963) and Pepys and Jenkins (1965).

Fuller believed that the incidence of farmer's lung among Devon farm workers was not high, since exposure to the causal dust was only seasonal. In 1969, however, we saw 24 new cases of farmer's lung in the Exeter clinical area and some of these patients were severely disabled. It seemed possible that changes in farming methods, particularly baling of hay, widely adopted in

Devon during the 1950s, might have increased the danger to farmers. The present study was planned, therefore, to assess the magnitude of the problem among farmers in Devon and to learn how they themselves tried to avoid further disability. The clinical features of farmer's lung were also studied.

MATERIALS AND METHODS

The investigation was done in the Exeter and Mid-Devon clinical area, which has a population of 570,000, of whom about 25,000 are employed in agriculture, particularly in dairy farming. The average annual rainfall is 36 inches (0.9 m). An attempt was made to identify all known cases of farmer's lung within this area by writing to family doctors and consultant physicians and by a survey of hospital and laboratory records. The patients studied were those in whom a diagnosis of farmer's lung had been made from a history of dyspnoea or cough related to occupational exposure to hay or grain and for which there

TABLE I
YEAR OF DIAGNOSIS OF CASES OF FARMER'S LUNG IN DEVON

	1955	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	Total
No. of cases	5	3	4	3	20	4	6	1	5	12	7	10	10	11	26	18	18	163 ¹

¹37 cases diagnosed before 1955.

was no other obvious cause such as chronic bronchitis or asthma.

In most cases there was supporting evidence of positive precipitins or radiographic changes or a restrictive ventilatory defect, but in a small proportion diagnosed before precipitin tests were generally available patients were included on the basis of a firm clinical diagnosis alone. History and clinical findings were recorded on a questionnaire adapted from that used by Hapke *et al.* (1968). The disability reported by the farmer was graded as follows:

1. *No disability* Able to keep up with others of similar age and build
2. *Mild disability* Noticeably more breathless than usual during heavy work or when hurrying
3. *Moderate to severe disability* Noticeably more breathless during normal work and unable to hurry or do heavy work.

Blood was sent to the Public Health Laboratory, Exeter for examination for precipitins to *M. faeni*, *Thermoactinomyces vulgaris*, and *Aspergillus fumigatus*. Where a recent radiograph was not available arrangements were made for one to be taken. Forced vital capacity and forced expiratory volume in one second were measured with a Vitalograph spirometer. Measurements of lung volume by helium dilution and transfer factor by the single-breath method were made on some patients using a Resparameter Mark 3 (Meade *et al.*, 1965). Normal values for each individual were predicted from the data of Cotes (1968). Skin testing by the prick method was performed with Dohme house dust mite antigen and with the following Bencard antigens: control, grass pollen, *A. fumigatus*, dog hair, *Cladosporium*, chicken feathers, and cow dander. *M. faeni* antigen suitable for skin testing was not available.

RESULTS

Data were collected on 200 patients diagnosed as having farmer's lung. We were unable to interview 52 patients but some information about them was obtained from clinical notes. Thirteen had died, seven from causes unrelated to farmer's lung, two from unknown causes, and four from farmer's lung, the youngest aged 27 and the eldest 52. Eighteen of the 52 patients could not be visited, five were unwilling to co-operate, and the remaining 16 could not be traced. One hundred and forty-eight patients were seen and information about these is the basis of our analysis. Supporting evidence of the diagnosis was available in all but

five of these patients who were included on the basis of a firm clinical diagnosis made before serological tests were generally available.

INCIDENCE OF NEW CASES The number of new cases of farmer's lung diagnosed each year between 1955 and 1971 is shown in Table I. Thirty-seven of the cases included in the present series were diagnosed before 1955, the earliest in 1939.

The month of diagnosis of the 148 patients included in the survey is shown in Figure 1. Most were diagnosed between January and May when stored hay is used for feeding cattle. There were 132 males and 16 females and the age at diagnosis shows a peak between ages 30 and 60 years (Fig. 2).

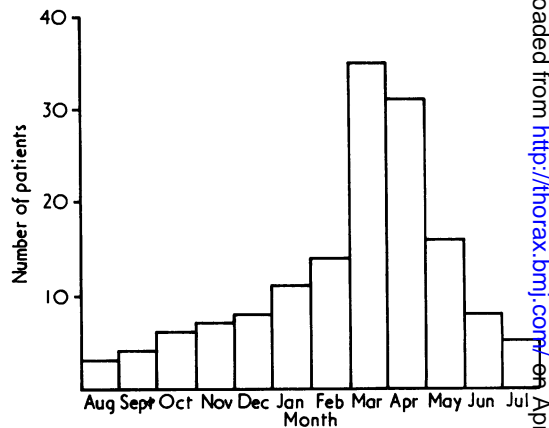


FIG. 1. Month of diagnosis in 148 cases of farmer's lung in Devon.

SYMPTOMS Dyspnoea was the commonest symptom at diagnosis for 132 of the 148 patients seen. In the acute episode it was of sudden onset, often nocturnal and associated with fever and shivering. Many cases had a more insidious onset with recurrent minor episodes of dyspnoea and influenza-like febrile episodes with progressive disability. Sixty-seven patients were diagnosed during the acute attack or in a series of attacks during the first year, of whom nine complained more

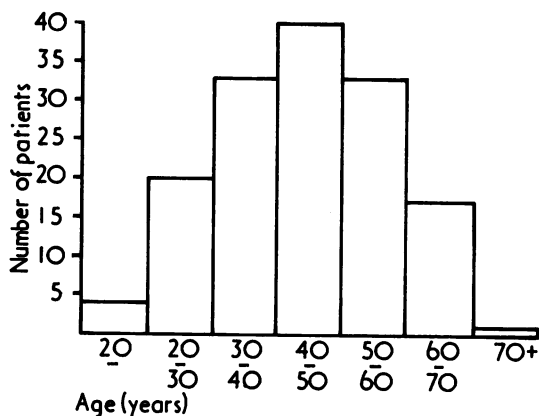


FIG. 2. Age at diagnosis of 148 cases of farmer's lung.

cough than of dyspnoea. Persistent illness, lassitude, and weight loss were the presenting symptoms in seven patients.

PROVOKING CAUSES The cause of the symptoms as judged by the farmers was hay in 106 cases, threshing in 16, corn meal in 4, thatching straw in 4, deep litter in 1, and in 16 the cause was not known. There was no apparent relationship between disability and smoking history (Table II). Thirty-five subjects had been smokers and 29 ex-smokers at the time of diagnosis.

IMMUNOLOGY (a) Precipitins Many of the patients included in the present series were diagnosed before serological tests first became generally

available. The relationship between disability at the time of our survey and serological results at diagnosis is shown in Table III. The frequency of positive precipitin tests at diagnosis was similar for all three grades of disability. The proportion of patients with precipitins at the time of our survey (Table IV) was similar in those with no disability (65%) and those with most disability (65%) but higher (88%) in those reporting mild disability. Four had precipitins against both *M. faeni* and *T. vulgaris* and four had precipitins against *M. faeni* and *A. fumigatus*. Two persons had precipitins against all three antigens. Since 1967, 13 people have been diagnosed as having farmer's lung despite a negative precipitin test to *M. faeni*. Three of these gave positive results on repeat testing within six months, two were positive for precipitins against *T. vulgaris* only, and two showed precipitins against *A. fumigatus* only. Precipitin reactions in those who had been retired less than six years were positive in two-thirds, approximately the same proportion as those who were still farming at the time of the survey. Two (of 11) were still positive more than ten years after leaving farming.

(b) Skin tests Skin testing with eight antigens showed only 17 individuals with two or more positive reactions and 13 with only one positive reaction. Positive reactions were most commonly found to house dust mite (17 individuals) and to *A. fumigatus* (14 individuals). None of our survey population gave a history of asthma. There was no obvious increase in obstructive ventilatory disability in those individuals who showed positive skin tests.

TABLE II
DISABILITY IN RELATION TO SMOKING HISTORY AT TIME OF SURVEY

Disability	Total	Smoker	Ex-Smoker	Non-Smoker	Not Known
None	47	5	12	30	Nil
Mild	41	6	10	25	Nil
Moderate to severe	60	4	28	27	1
Total	148	15	50	82	1

TABLE III
PRECIPITINS TO *M. FAENI* OR FARMER'S LUNG HAY AT DIAGNOSIS RELATED TO DISABILITY AT SURVEY

Precipitins	Degree of Disability			
	Total	None	Mild	Moderate to Severe
Positive	78	24	25	29
Negative	14	3	4	7
Not done	56	20	12	24
Total	148	47	41	60

TABLE IV
PRECIPITINS TO *M. FAENI* AT SURVEY RELATED TO DISABILITY AT SURVEY

Precipitins	Degree of Disability			
	Total	None	Mild	Moderate to Severe
Positive	105	30	36	39
Negative	41	17	5	19
Not done	2	—	—	2
Total	148	47	41	60

TABLE V
DISABILITY RELATED TO SPIROMETRY IN 148 PATIENTS

Degree of Disability	Spirometry				
	Total	Normal	Restriction	Obstruction	Combined Restriction and Obstruction
None	47	29	15	2	1
Mild	41	22	13	4	2
Moderate to severe	60	8	28	2	22
Total	148	59	56	8	25

PHYSIOLOGY Disability due to dyspnoea was present in 101 of the 148 patients seen. Spirometry showed a restrictive ventilatory defect, with forced vital capacity less than 90% of the predicted value in about one-third of the groups reporting no disability or moderate disability and in almost half of the severely disabled (Table V). A combination of restriction and reduced FEV/FVC ratio was found in just over one-third of the patients with severe disability.

Lung volume and transfer factor were measured in 81 patients. The patients seen during the first acute attack showed a reduction in transfer factor greater in proportion than the reduction in vital capacity or total lung volume and there was a return to normal values after leaving farming or after treatment with prednisone. Patients first seen after several episodes of farmer's lung showed a defect in transfer factor roughly in proportion to the restriction, and serial tests showed little variation. Many patients who reported moderate to severe disability on exertion showed only slightly abnormal function at rest. None of these subjects was tested during exercise.

CHEST RADIOGRAPH The radiographic changes were of nodular miliary appearances which either resolved or progressed to reticular fibrotic changes, as described by Hapke *et al.* (1968) and Mindell (1970). At some time radiographic changes consistent with farmer's lung were reported in 101 patients and precipitins were found in 89 of these.

The relationship of disability at survey to radiographic findings and the presence of precipitins at survey are shown in Table VI. Positive radiographs were those considered to show nodular or reticular shadows at survey. The proportion of positive to negative radiographs was about 1 : 2 for both precipitin positive and precipitin negative patients. A higher proportion with radiographic changes reported severe disability.

A series of at least three films with an average duration of eight years was available for 31

patients. Some had reticular appearances at diagnosis. Six showed recurrent episodes of nodulation and clearing, one having two episodes 15 and 22 years later.

CONTROL AND TREATMENT The majority of individuals in this survey had used a face mask at some time (Table VII) but most of these chose an inefficient mask, often a metal frame with a simple 'gauze filter', or merely a scarf across the mouth. Some had tried more than one type of mask. Roughly equal proportions of farmers reported benefit from efficient or inefficient masks. Efficient masks with a large disposable filter, well-fitting face piece, and usually an expiratory valve were tolerated equally well as inefficient masks. In some cases, farmers already disabled by dyspnoea were unable to tolerate any sort of mask.

One hundred and eleven subjects continued farming but 37 had left the industry, of whom

TABLE VI
DISABILITY RELATED TO PRECIPITINS TO *M. FAENI* AND RADIOGRAPHIC CHANGES AT SURVEY

Precipitins	Radiograph	Degree of Disability			
		Total	None	Mild	Moderate to Severe
Positive	Positive	36	9	11	16
Positive	Negative	67	21	23	23
Negative	Positive	10	2	1	7
Negative	Negative	24	11	2	11
Not done at survey		2	—	—	2
	Not done at survey	9	4	4	1
Total		148	47	41	60

TABLE VII
USE OF MASK BY FARMERS INCLUDED IN SURVEY

Type of Mask	Well Tolerated	Poorly Tolerated	Total
Efficient	22	14	36
Inefficient	37	38	75
None	—	—	46
Total	59	52	157

Some farmers used more than one type of mask.

three were slightly disabled and 22 were more severely disabled.

Steroid therapy had been given to 13 (27%) of those reporting no disability, 17 (40%) of those with mild disability, and only 26 (42%) of those most severely disabled (Table VIII). About half the patients had never received this therapy but some were diagnosed before it was available.

TABLE VIII
DISABILITY AT SURVEY RELATED TO STEROID
THERAPY SINCE DIAGNOSIS

Degree of Disability	Total	Steroid Therapy		
		Yes	No	Not Known
None	47	13	33	1
Mild	41	17	23	1
Moderate to severe	60	26	33	1
Total	148	56	89	3

DISCUSSION

In this area of Devon there appear to be 15 to 20 new cases of farmer's lung each year in a farm working population of 20,000 to 25,000. The peak of 20 cases diagnosed in 1959 may simply reflect interest generated by a survey conducted by two west country general practitioners about that time (Staines and Forman, 1961). The greater number of cases diagnosed since 1969 may be attributable to the present survey. The prevalence calculated from the 148 cases seen in this survey is of the order of 6 per 1,000 of farming population and this is almost certainly an under-estimate. Since our survey closed, we have learned of proven cases of farmer's lung overlooked by their family doctors when completing our questionnaire. Staines and Forman (1961), from a postal census, recorded a prevalence of 0.73 cases per 1,000 in southwest England and they thought this likely to be an under-estimate. Many cases of farmer's lung are probably not formally diagnosed, and in the present survey only 67 patients (45%) were diagnosed after a single episode or during the first year of the disorder. Grant *et al.* (1972) have reported prevalences of 86 per 1,000 and 23 per 1,000 from surveys of farming populations in different areas of Scotland, and direct surveys of the kind they report are likely to give the most accurate estimates of prevalence of farmer's lung, which appears to be considerably higher than had previously been reported.

Disability at the time of our survey was moderate or severe in 60 individuals (31%). In this group the age at diagnosis was generally higher,

40 to 50 years, and less than half had been treated with steroids. Subjects who reported either no disability or only mild disability showed similar proportions of smokers, ex-smokers, and non-smokers but there were relatively more smokers and ex-smokers in those with most severe disability. At our survey only 15 individuals were smoking regularly and it seems unlikely that current smoking contributes much to disability in this group. The present survey records smoking habits over a number of years and close comparison of smoking habits is probably not helpful. The proportion of smokers (24%), ex-smokers (19%), and non-smokers (55%) in the survey population at diagnosis was similar to that found in a recent survey of 184 farmworkers in the Honiton area of Devon where corresponding percentages were 29%, 24%, and 47% (Morgan *et al.*, 1973). In the latter survey, the proportion of individuals with precipitins to farmer's lung antigens was higher in non-smokers and ex-smokers.

Although the majority of our cases had precipitins at either diagnosis or follow-up, we agree with Grant *et al.* (1972) that positive serology is not essential for diagnosis. Pepys and Jenkins (1965) found 89% of their group of 205 cases of farmer's lung had positive serology, and 87% of their positive cases had precipitins to *Thermopolyspora (M. faeni)*. A small number of our cases were positive only for precipitins to other organisms, suggesting that routine examination for precipitins to those other moulds is desirable but not essential.

The level of precipitins showed no correlation with the degree of disability. In one area of East Devon, 23% of farmworkers were found to have precipitins and most of these had no evidence of farmer's lung (Morgan *et al.*, 1973). Pepys and Jenkins (1965) found that 18% of a selected group of farmers not suffering from farmer's lung had precipitins. We feel that the presence of precipitins is evidence of exposure to moulds and is not related to disability.

Restriction is the most frequent abnormality on spirometry but a combination of restriction and obstruction was found in over one-third of patients, including many non-smokers, reporting severe disability. We agree with Hapke *et al.* (1968) that airways obstruction is a feature of farmer's lung. In the acute disorder, restriction is associated with decreased transfer factor (Bishop, Melnick, and Raine, 1963). Rankin *et al.* (1967) have noted the value of serial tests, and our experience agrees with theirs that after a single acute attack there is an improvement towards

normal values in three to 12 months. We have found our tests of lung function helpful in acute cases but less adequate in chronic cases. Many farmers are able to continue farming but we lack an accurate guide to whether their disability is progressing. Hapke *et al.* (1968) noted the value of assessment of response to exercise, and the method described by Cotes (1972) seems well suited. A study of this method of assessment in farmer's lung patients is planned.

Radiographic changes did not correlate with disability in the majority of cases. Campbell (1932) and Fuller (1953) both described the changes in the acute phase and also noted that some cases progressed to a chronic fibroid condition. Hapke *et al.* (1968) found a good correlation between disability and x-ray appearances in their group of acute cases but not in chronic cases. Fine nodulation appears to be of diagnostic value only in the acute stage, and we found no correlation between the extent of this nodulation and any subsequent changes or permanent disability.

There has been uncertainty about the value of masks in farmer's lung (Davies, 1968; Crofton and Douglas, 1969). Evidence of the value of an efficient mask in controlled conditions has been reported by Gourley and Braidwood (1971). Nearly one-third of our patients had never used a mask and most of the others had chosen an inefficient one. More than one-third of those who had chosen an efficient respirator had found it difficult to tolerate, and a slightly higher proportion reported intolerance of an inefficient respirator. In 1969 we were advised of the value of the Baxter Pneu Seal respirator, of the type tested by Gourley and Braidwood, and we have recommended this to some farmers. Most have found it comfortable but the practical problem appears to be that the more disabled farmers were those least able to tolerate a mask while working.

The only drug therapy which appears to have been used successfully in farmer's lung is steroid treatment but we can find little guidance on the dosage or duration of treatment. In this area, for the past ten years, we have recommended its use over a minimum period of two months in acute cases, starting with prednisone, 15 mg daily for two weeks, and reducing the dose according to clinical findings (Adkins and Smyth, 1969). Hapke *et al.* (1968) used larger doses in their acute group, 40 mg of prednisolone daily for ten days, and a minimum total course of two months. From our survey we could not assess the effect on later disability of this treatment as the timing and duration of therapy was so variable but we have

no doubt of its value. Some patients had been treated with prednisone, 5 mg daily, during the winter months to enable them to continue at work.

Our studies suggest that farmer's lung is a significant hazard to the farming industry in Devon. Although only a relatively small number of farmers are affected, personal contact with the victims emphasizes the disruption to health and livelihood which this condition causes. The use of a mask does not appear to give adequate protection, and this health hazard is likely to persist until a method preventing the moulding of hay is in general use.

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REFERENCES

- Adkins, G. E. and Smyth, J. T. (1969). Farmer's lung. *British Medical Journal*, **1**, 643.
- Bishop, J. M., Melnick, S. C., and Raine, June (1965). Farmer's lung; studies of pulmonary function and aetiology. *Quarterly Journal of Medicine*, **32**, 257.
- Campbell, J. M. (1932). Acute symptoms following work with hay. *British Medical Journal*, **2**, 1143.
- Cotes, J. E. (1968). *Lung Function; Assessment and Application in Medicine*, 2nd edition. Blackwell Scientific Publications, Oxford.
- (1972). Response to progressive exercise. A three index test. *British Journal of Diseases of the Chest*, **66**, 169.
- Crofton, J. W. and Douglas, A. C. (1969). *Respiratory Diseases*, pp. 506 and 508. Blackwell Scientific Publications, Oxford.
- Davies, C. N. (1968). Farmer's lung. Report on a Joint Meeting of the Medical Research Council and the Ministry of Agriculture, Fisheries and Food, 23 January 1968. *Annals of Occupational Hygiene*, **11**, 377.
- Fuller, C. J. (1953). Farmer's lung; a review of present knowledge. *Thorax*, **8**, 59.
- Gourley, C. A. and Braidwood, G. D. (1971). The use of dust respirators in the prevention of the occurrence of farmer's lung. *Transactions of the Society of Occupational Medicine*, **21**, 93.

- Grant, I. W. B., Blyth, W., Wardrop, Violet E., Gordon, R. M., Pearson, J. C. G., and Mair, A. (1972). Prevalence of farmer's lung in Scotland; a pilot survey. *British Medical Journal*, **1**, 530.
- Hapke, E. J., Seal, R. M. E., and Thomas, G. O. (1968). Farmer's lung. A clinical, radiographic, functional, and serological correlation of acute and chronic stages. *Thorax*, **23**, 451.
- Meade, F., Saunders, M. J., Hyett, F., Reynolds, J. A., Pearl, N., and Cotes, J. E. (1965). Automatic measurement of lung function. *Lancet*, **2**, 573.
- Mindell, H. J. (1970). Roentgen findings in farmer's lung. *Radiology*, **97**, 341.
- Morgan, D. C., Smyth, J. T., Lister, R. W., and Pethybridge, R. J. (1973). Chest symptoms and farmer's lung; a community survey. *British Journal of Industrial Medicine*, **30**, 259.
- Pepys, J. and Jenkins, P. A. (1965). Precipitin (F.L.H.) test in farmer's lung. *Thorax*, **20**, 21.
- , —, Festenstein, G. N., Gregory, P. H., Lacey, M. E., and Skinner, F. A. (1963). Farmer's lung. Thermophilic actinomycetes as a source of "farmer's lung hay" antigen. *Lancet*, **2**, 607.
- Rankin, J., Kobayashi, M., Barbee, R. A., and Dickie, Helen A. (1967). Pulmonary granulomatoses due to inhaled organic antigens. *Medical Clinics of North America*, **51**, 459.
- Staines, F. H. and Forman, J. A. S. (1961). A survey of farmer's lung. *Journal of the Royal College of General Practitioners*, **4**, 351.

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