

Respiratory disorders in Manitoba cattle farmers

C.P.W. WARREN, MB, FRCP[C]

A group of 76 cattle farmers from southern Manitoba answered the National Heart, Lung, and Blood Institute questionnaire on respiratory symptoms and supplementary questions on farming and farming-related symptoms. Lung function was tested, serum was examined for precipitating antibodies, and skin testing with common allergens was performed. Analysis of the men's answers revealed a high prevalence of chronic respiratory symptoms among the farmers in all categories of smoking history, and the presence of these symptoms was significantly associated with a history of symptoms related to handling mouldy hay or grain; 51% of the men had chronic symptoms and 55% had symptoms related to crop handling. In seven farmers (9%) the symptoms related to crop handling suggested an attack of farmer's lung. One other farmer, with a history of illness after handling mouldy hay, had a reduced total lung capacity, and in 18 the ratio of the forced expiratory volume in the first second to the forced vital capacity was lower than predicted. Precipitating antibodies against *Thermoactinomyces* were absent in all farmers, but two farmers had antibodies against *Aspergillus ruber*. Immediate hypersensitivity was found in 16 (21%) of the farmers; sensitivity to *Dermatophagoides farinae* was commonest.

Un groupe de 76 éleveurs de troupeaux du sud du Manitoba ont complété le questionnaire sur les symptômes respiratoires du National Heart, Lung, and Blood Institute et ont répondu à des questions supplémentaires sur l'élevage et les symptômes associés à cette profession. On a testé la fonction pulmonaire, fait la recherche des anticorps précipitants sériques et pratiqué une cutiréaction aux allergènes habituels. L'analyse des réponses aux questionnaire a révélé, chez ces éleveurs, une fréquence élevée des symptômes respiratoires chroniques, quelles que soient leurs habitudes de fumer; de plus, la présence de ces symptômes était significativement reliée à des antécédents de symptômes apparaissant lors de la manipulation de foin ou de céréales moisies; 51% de ces hommes souffraient de symptômes chroniques et 55% avaient des symptômes lors de la manipulation des récoltes. Chez sept (9%) des fermiers les symptômes apparaissant lors de la récolte faisaient penser à un accès d'asthme du fermier. Un autre éleveur ayant des antécédents de maladie après la manipulation de foin moisi présentait une capacité pulmonaire totale réduite, et chez 18 le rapport entre le volume expiratoire maximum à la première seconde et la capacité vitale maximum était plus bas que la valeur prévue. Les anticorps précipitants anti-*Thermoactinomyces* étaient absents chez tous les éleveurs, mais deux d'entre-eux avaient des anticorps anti-*Aspergillus ruber*. Une hypersensibilité immédiate a été retrouvée chez 16 (21%) des fermiers; la sensibilité à *Dermatophagoides farinae* était la plus fréquente.

From the department of medicine, University of Manitoba, Winnipeg

Reprint requests to: Dr. C.P.W. Warren, D.A. Stewart
Respiratory Centre, 668 Bannatyne Ave., Winnipeg, Man.
R3E 0V8

Farmer's lung, an allergic alveolitis that develops from exposure to wet, mouldy hay, is well recognized in cattle farmers who use hay as a feedstuff. The prevalence of the disease is directly related to the rainfall of the area under study, because it is wet crops that readily become mouldy. The disease has rarely been attributed to mouldy grain, probably because grain is usually a dry crop and does not mould severely. The prevalence of the disease in farmers has been reported as ranging from 2% to 9% in Scotland,¹ 12% in England and Wales,² and 9% in Wyoming.³ No prevalence studies of the disease have been published in Canada, but cases have been reported from several provinces.⁴⁻⁶

In May 1976, 1200 farmers in two southern Manitoba crop districts were randomly selected from the 1971 farm census list and sent a questionnaire adapted from the British Medical Research Council (MRC) questionnaire on respiratory symptoms supplemented by questions on farming; 833 farmers returned completed questionnaires. As reported last year in this journal,⁷ 113 of the 833 farmers produced only cattle; of these 113 farmers 27% reported chronic cough or phlegm production, or both, 8% reported wheezing on most days and 13% reported exertional dyspnea. Some of the 113 cattle farmers also reported having had dyspnea from handling their crops; this problem was related to fresh grain or hay, or both, in 10%, old grain alone in 10% and old grain and old hay in 17%; 7% had experienced dyspnea with fever after handling an old crop.

The purpose of the study reported here was to examine the 113 cattle farmers more fully and so learn whether their respiratory symptoms were associated with abnormal lung function and whether farmer's lung could be responsible for their symptoms. Evidence of sensitivity to organic dusts to which the farmer might have been exposed was sought.

Materials and methods

The subjects were the 113 farmers who had reported that cattle was their main produce in answer to the MRC questionnaire on respiratory symptoms mailed to 1200 randomly selected farmers, of whom 833 replied. Evidence that the responders and nonresponders to the questionnaire did not differ in age, smoking history, farming characteristics or symptoms was presented in the earlier paper.⁷ The 113 cattle farmers were therefore representative of the cattle farmers of southern Manitoba.

The follow-up study was performed in the spring of 1977, by which time 14 of the cattle farmers had

retired, moved away or died, and so were unavailable. As well, 23 declined to take part in the second study; their replies to the MRC questionnaire and their mean age did not differ significantly from those of the 76 participants in the follow-up study (67% of the original sample of cattle farmers).

The farmers were interviewed by a trained questioner who completed the National Heart, Lung, and Blood Institute questionnaire on standard respiratory symptoms and asked supplementary questions on farming and farming-related symptoms regardless of the answers to the standard questions. All the men had lung function tests. The helium dilution method was used to estimate functional residual capacity, and spirometry was used to estimate total lung capacity and residual volume. Three measurements of forced vital capacity (FVC), forced expiratory volume in the first second (FEV₁) and maximum expiratory flow at 50% of the FVC were obtained with a Stead-Wells spirometer attached to an X-Y recorder. Three single-breath nitrogen washout curves were recorded, and the slope of phase III (the alveolar plateau) was measured.⁸ The best results in the farmers were compared with predicted values for lung volumes⁹ and forced expiratory measurements.¹⁰

All the farmers were tested for immediate hypersensitivity by prick testing on the forearm with extracts of danders from domestic and farm animals, house dust, *Dermatophagoides farinae* (the house dust mite), grain dust, grass mix, weed mix, tree mix (Prairie Flora), common mould spores and a control (all supplied by Hollister Stier Laboratories [HS], Mississauga, Ont.). The maximum size of any wheal was measured at 10 to 15 minutes. A wheal more than 2 mm wider than that produced by the control was deemed positive.

Blood was drawn from all the farmers. The serum was tested by double immunodiffusion¹¹ for the presence of precipitating antibodies against suspensions of *Micropolyspora faeni* (HS, MMF18 and MMF2), *Sacharomonospora viridis* (HS and MMF7), *Thermoactinomyces vulgaris* (HS and MMF11), *T. candidus* (MMF31), *Aspergillus ruber*, *A. amstelodami* and *A. fumigatus* (Brompton Hospital, London, England) and *Aspergillus* mix (HS). Antigens for the immunodiffusion tests were obtained from Hollister Stier and also extracted from cultures kindly provided by Drs. J. Lacey, J. Pepys, F.B. Greatorex and M.W. Treuhaft. The actinomycetes were cultured and antigens prepared by the method of Edwards.¹² The *Aspergillus* species were cultured on Sabouraud glucose broth and extracted by the method of Schaffer and colleagues.¹³ The *A. ruber* and *A. amstelodami* were isolated from the hay of a patient with farmer's lung, and the species were identified by Dr. J. Lacey. The activity of the three *M. faeni* types was tested against farmer's lung serum provided by Dr. J.H. Edwards; all three produced precipitin lines.

All the serum samples were examined for antibodies by counter immunoelectrophoresis. Glass slides were coated with 1% agarose in Veronal (barbital sodium) acetate buffer, then parallel rows of wells 11 mm apart were cut in the agarose. The serum was placed in wells

on the anode side, and antigens (*M. faeni* MMF18, *S. viridis* MMF7, *T. vulgaris* MMF11, *A. ruber*, *A. fumigatus* and *A. amstelodami*) were placed in those on the cathode site. Countercurrent immunoelectrophoresis was carried out at room temperature at 4 V/cm for 45 minutes.

Results

The participants were aged 27 to 67 years (mean age 48.6 years). All were male. Of the 76 farmers 43% had only dairy cattle, 39% had only beef cattle and 17% had both; 37% wintered all their cattle outside, 35% wintered their cattle in a barn, and 28% had some cattle outside and some in. The cattle were fed hay, grain and sometimes silage. Most (92%) of the farmers had been raised on farms, and 82% had been exposed at some time to mouldy crops — 58% to mouldy hay alone, 4% to mouldy grain alone and 38% to both. Currently 9% smoked fewer than 25 cigarettes a day and 16% smoked 25 or more a day (the categories for current smokers used in the previous analysis⁷); 42% had never smoked and 33% had stopped smoking.

Table I shows the respiratory symptoms reported by 51% of the farmers. Chronic cough, chronic phlegm production, wheezing apart from colds, and cough related to handling mouldy crops were found to be positively related to smoking by the test of linear trend;¹⁴ a lack of standard respiratory symptoms was inversely related to smoking. Asthma was reported by 5% of the farmers, all of whom attended physicians for this disease, and was not related to smoking.

The timing of the onset of symptoms after exposure to mouldy crops is summarized in Table II. At some time 42 (55%) of the farmers had experienced symptoms, cough and dyspnea most frequently, after handling mouldy crops. In most of the men these symptoms had appeared soon after exposure to the crops, but in seven farmers dyspnea and fever had begun more than 1 hour after exposure. That these crop-related symptoms are important is suggested by the fact that 7 of the 12 who had begun wheezing after exposure had to stop working, and 4 of them consulted their doctor. Moreover, four of the nine who had had a fever after crop handling also consulted their doctor. There was a significant association ($P < 0.05$, by the chi-square test) between the presence of standard respiratory symptoms and the occurrence of respiratory symptoms after handling mouldy crops: 25 of the 42 who had experienced crop-related symptoms had standard respiratory symptoms, while only 14 of the 34 who had not been affected by crops had standard respiratory symptoms.

To learn whether the presence of standard respiratory symptoms in the farmers was reflected in the results of their lung function tests the results for asymptomatic farmers and those with one or more standard symptoms were compared according to the various smoking categories. The mean values for each test were compared with the *t*-test. The only groups consistently showing significant differences were the symptomatic

and asymptomatic nonsmokers (Table III). Because of the lack of significant differences between the symptomatic and asymptomatic farmers in the other smoking categories, which reflects to some extent the small size of the groups (there were 10 asymptomatic ex-smokers and 3 asymptomatic smokers), the lung function results for the farmers in these smoking categories are presented in Table III without regard to symptom status. Comparison of the means for these groups of farmers with those for the asymptomatic nonsmokers (by means of the *t*-test) showed that lung function deteriorated significantly with increasing amounts of smoking.

One man had a total lung capacity more than two standard deviations below the predicted mean value for his group, indicating restrictive lung disease. This 29-year-old nonsmoker had reported no chronic respiratory symptoms in the earlier survey, although he had experienced shortness of breath and fever soon after handling old grain and old hay. By the time of the follow-up study a cough, phlegm production and dyspnea on exertion had been present for 5 months; in the first episode, 4 months after the first survey, cough, dyspnea, wheezing, fever, muscle aches and headaches appeared 1 hour after he had handled mouldy hay. The illness had lasted 7 days and he had been under the care of his doctor. His chest roentgenogram had been normal during this illness.

In 18 farmers (24%) the FEV₁/FVC ratio was more than two standard deviations below the mean for local men in other occupations.¹⁵ Of the 18, 4 were nonsmokers, 6 were ex-smokers and 8 were current smokers. Three of the four nonsmokers had experienced a late reaction to mouldy crops, and two of the four had attended physicians for asthma.

Sixteen (21%) of the farmers had immediate hypersensitivity skin reactions to prick testing with various allergens. The findings are summarized in Table IV. Reactions to the house dust mite *D. farinae* were commonest, followed by reactions to house dust, grasses and weeds. Sensitivity to cattle danders was found in 5%. Mould sensitivity was detected in only two farmers (3%). Six men reacted to two allergens, and two men reacted to one, three, four, five and six allergens. The farmers with positive skin reactions could not be distinguished from those without by the presence of standard respiratory symptoms or symptoms related to crop handling, or by the results of lung function tests.

No precipitating antibodies against the various moulds were found by the immunodiffusion tests in the farmers' serum. The serum of nine farmers contained C-reactive protein, which produces calcium-dependent precipitation with *Aspergillus*.¹⁶ Nothing in the study distinguished these nine from the other farmers. Counter immunoelectrophoresis showed that two farmers had antibodies against *A. ruber*; again, nothing distinguished them from the other farmers.

Table II—Timing of onset of symptoms after exposure to mouldy hay or grain or both

Time (min) after exposure before symptoms appeared	No. (and %) of farmers				
	Cough	Dyspnea	Wheeze	Fever	Dyspnea and fever
5-15	26 (34)	18 (24)	8 (10)	0	0
15-60	7 (9)	7 (9)	3 (4)	2 (3)	1 (1)
> 60	6 (8)	7 (9)	1 (1)	7 (9)	7 (9)
Total	39 (51)	32 (42)	12 (16)	9 (12)	8 (10)

Table I—Respiratory symptoms in cattle farmers in relation to smoking history

Symptoms	% of farmers				
	Smokers; no. of cigarettes per day				Total (n = 76)
	Nonsmokers (n = 32)	1-24 (n = 7)	25+ (n = 12)	Ex-smokers (n = 25)	
Standard*					
Cough on most days at least 3 mo/yr	16	43	67†	20	26
Phlegm production on most days at least 3 mo/yr	19	57	67†	24	31
Wheezing apart from colds	22	42	58†	16	28
Attacks of dyspnea and wheezing	19	14	33	12	18
Dyspnea compared with persons of same sex and age	6	0	25	8	9
Asthma	9	0	0	4	5
None	59	29	8†	60	49
Related to handling mouldy hay or grain or both					
Cough	47	57	75†	44	51
Dyspnea	41	43	58	36	42
Wheeze	19	0	17	16	16
Fever	19	14	8	4	12
Dyspnea and fever	10	0	8	4	10
None	50	43	25	36	45

*Reported in answer to National Heart, Lung, and Blood Institute questionnaire.

†Significantly different (*P* < 0.05) from values for nonsmokers and light smokers by test of linear trend of values from nonsmokers to heavy smokers.

The farmers' replies to the questionnaire used in this study were compared with their replies to the questionnaire used in the previous study.⁷ The birth dates agreed in all instances, and the farm size differed only once. For comparable questions on respiratory symptoms, 5% of the answers did not agree. The reported smoking histories agreed, although the stated age of starting and stopping smoking often varied by a few years.

Discussion

The replies to the questionnaire used in this study concurred with those obtained in the earlier study,⁷ so the validity of the conclusions drawn from the latter has been confirmed. Once again nonsmokers predominated and the presence of standard respiratory symptoms was positively related to the amount of cigarette smoking. But the nonsmokers were not free of such symptoms: their prevalence was high in this group, compared with local nonsmoking men in other occupations.¹⁵ In a study of respiratory abnormalities in people aged 20 to 55 years in the rural Manitoba city of Portage la Prairie and in suburban Winnipeg the National Heart, Lung, and Blood Institute questionnaire was used,¹⁵ but the methods of selection of subjects precluded the use of that population as a control group for our study. Nevertheless, among the male nonsmokers under 55 years of age in that study and in the present one, respectively, the following symptoms were reported: chronic cough, by 6% and 20%; chronic phlegm production, by 2% and 20%; wheezing apart from colds, by 6% and 20%; attacks of dyspnea and wheezing, by 6% and 15%; dyspnea on exertion, by 6% and 10%; and asthma, by 2% and 9%.

The prevalence of abnormal lung function in the nonfarming population of Manitoba is unknown. But the study of local nonfarmers showed that among smokers the slope of phase III of the single-breath nitrogen washout curve was abnormal in 40% and the FEV₁/FVC ratio was abnormal in 16%;¹⁵ the proportions of cattle farmers with these abnormalities who smoked were 37% and 31% respectively when the same regression equations were used.

The first objective of the follow-up study was to determine whether respiratory symptoms were asso-

ciated with abnormal lung function. In the nonsmokers this was clearly so for most tests of lung function. In the smokers so few were asymptomatic that the lung function did not significantly differ between the symptomatic and asymptomatic. In the ex-smokers there was no difference in lung function between the symptomatic and asymptomatic, which reflects that symptoms related to smoking are more reversible than lung function abnormalities. Increasing smoking was associated significantly with deteriorating lung function.

The second objective of the study was to ascertain whether the disorders found in the cattle farmers could be attributed to farmer's lung. This disease is the result of a hypersensitivity reaction, either a type III (antigen-antibody-mediated) or a type IV (lymphocyte-mediated) reaction to inhaled organic matter, usually the spores of *Thermoactinomyces* growing in mouldy crops.¹⁷ Sensitivity to these spores is detected by the presence of precipitating antibodies against the offending antigen in the serum, but this finding is not diagnostic, for such antibodies are found in up to one fifth of healthy farmers.¹⁸ The symptoms of farmer's lung, usually cough, dyspnea, fever and "flu-like" symptoms, develop some hours after inhalation of the spores. In the acute and usually the chronic illness lung function tests reveal a restrictive disorder, but in the chronic form airflow obstruction and emphysema can also be found.^{19,20}

The diagnosis of farmer's lung is difficult to make in epidemiologic surveys, for no feature clinches it. In prevalence studies of farmer's lung the presence of dyspnea and fever after crop handling is the usual

Table IV—Numbers and percentages with immediate skin reactions to prick testing with various allergens

Allergen	No. (and %) of farmers
<i>Dermatophagoides farinae</i>	11 (14)
House dust	7 (9)
Grasses	6 (8)
Weeds	6 (8)
Trees	5 (6)
Cattle dander	4 (5)
Grain dust	3 (4)
Moulds	2 (3)
Cat dander	2 (3)

Table III—Results of lung function* tests according to symptom status and smoking history

Category of farmers	No. of farmers	Mean† ± one standard deviation					
		% of predicted value					
		TLC	VC	$\dot{V}_{50}$	Slope III	FEV ₁ /FVC	
Asymptomatic nonsmokers	19	110.6 ± 11.7	114.7 ± 11.9	97.8 ± 19.7	0.76 ± 0.49	76.8 ± 5.8	
Nonsmokers with standard symptoms	13	99.3‡ ± 13.8	103.7‡ ± 10.4	72.3‡ ± 33.7	1.15‡ ± 0.50	69.9‡ ± 11.4	
Ex-smokers	25	104.1 ± 12.4	105.8‡ ± 10.5	77.1‡ ± 21.0	0.91 ± 0.79	74.1 ± 8.4	
Smokers; no. of cigarettes per day							
1-24	7	103.3 ± 10.1	104.6 ± 12.5	76.8‡ ± 25.0	1.37§ ± 0.45	76.4 ± 5.8	
25+	12	108.6 ± 9.4	100.5‡ ± 12.4	65.5§ ± 30.4	1.70§ ± 0.94	67.9‡ ± 11.6	

*TLC = total lung capacity; VC = vital capacity; $\dot{V}_{50}$ = maximum expiratory flow at 50% of the vital capacity; slope III = slope of alveolar plateau of single-breath nitrogen washout curve; FEV₁/FVC = ratio of forced expiratory volume in the first second to forced vital capacity.
 †Significant differences (‡P < 0.05, §P < 0.01) from values for asymptomatic nonsmokers were determined by the t-test.

criterion, and with this criterion farmer's lung has been reported to occur in 2% to 9% of farmers in Scotland,¹ 12% of farmers in England² and 9% of farmers in Wyoming.³ The same criterion suggests that 9% of Manitoba cattle farmers have farmer's lung; of the farmers in this study meeting this criterion, one nonsmoker had restrictive lung disease and a clear history of a pneumonia-like illness after exposure to mouldy hay, and the others, two of whom had a reduced FEV₁/FVC ratio, had standard respiratory symptoms.

The final objective of the study was to detect evidence of sensitivity to organic dusts in the farmers. Since the historical evidence suggested that 9% of the farmers studied had had farmer's lung at some time, the complete absence of precipitating antibodies against *Thermoactinomyces* in all the farmers was disappointing. Madsen and colleagues³ found these antibodies in 3% of a sample of Wyoming farmers. Their absence in the Manitoba farmers probably reflects the relatively small size of the study and the fact that it was conducted during the driest summer in 30 years, when mouldy crops were rare. Two farmers had antibodies against *A. ruber*; antibodies against *Aspergillus* spp. but not *Thermoactinomyces* spp. are common in persons with farmer's lung in Finland,²¹ a country with a climate similar to that of Manitoba. Thus, in cold northern areas the etiologic agent of farmer's lung may not be the *Thermoactinomyces* spp. found in the more temperate climates of Wisconsin¹¹ and Britain.² On the other hand, antibodies against *Thermoactinomyces* were found in a study of farmer's serum in Manitoba in 1969.²² C-reactive protein is associated with farmer's lung, but its significance is unknown.²³

Skin testing showed that 14 of the cattle farmers in this study were sensitive to two or more of the allergens used; this suggests that they were atopic. There is no information in the literature on the prevalence of atopy in Manitoba. The reactions were commonest to the house dust mite *D. farinae*. A Manitoba study of persons with asthma has shown an association between sensitivity to *D. farinae*, house dust and the crop mite *Lepidoglyphus destructor*.²⁴ *L. destructor*, which is found in stored hay and grain, is now recognized as an important allergen in the respiratory disorders of farmers in Scotland,^{25,26} which have been called barn lung. Among the Manitoba cattle farmers sensitivity to *D. farinae* did not correlate with the presence of respiratory disorders, although two of the nonsmokers with asthma were sensitive to this mite. Thus, immediate hypersensitivity reactions, as well as farmer's lung, may contribute to the high prevalence of respiratory disorders in Manitoba cattle farmers.

Other studies have suggested an excess of respiratory disorders in farmers. Stuart-Harris and Hanley²⁷ in England compared the respiratory symptoms of men in a petrochemical works with those of men in a rural medical practice; the petrochemical workers and farmers had a comparable, increased frequency of chronic cough, chronic phlegm production and dyspnea, and one third of the farmers had experienced symptoms handling hay. In Switzerland Bartschi and Rogli²⁸

found that of 500 asthma clinic patients, farmers had the highest mortality and the worst lung function. In Ontario Lefcoe and Wonnacott²⁹ examined the respiratory health of four occupational groups: doctors, fire-fighters, farmers and petrochemical workers. They found that farmers had the lowest FEV₁, the highest frequency of asthma and the second-highest frequency of bronchitis.

Thus, a fuller study of Manitoba cattle farmers has confirmed the high prevalence of respiratory symptoms, and in the nonsmokers these symptoms were associated with abnormal lung function. Although there was little evidence of sensitivity to the etiologic agents of farmer's lung, the answers to the questionnaire suggested that farmer's lung was contributing to some of these farmers' symptoms. The asthma found in the farmers may reflect immediate hypersensitivity reactions to organic dusts found on farms.

The working environment of Manitoba cattle farmers warrants study to determine the quantity and composition of the respirable dust present, for it seems likely that sensitivity to organic dusts is contributing to disorders in these farmers. Good husbandry to control moulding of crops and to reduce mite infestation should be encouraged. In barns, either proper ventilation or the use of appropriate masks by the farmers should also reduce crop dust inhalation.

I thank the farmers of Manitoba for their continued support, Mrs. J. DeVries for her technical help, Mrs. J. Young for preparing the questionnaires and Dr. N. Nelson for statistical help. The advice and supply of cultures and serum by Drs. J.H. Edwards (MRC Pneumoconiosis Unit, Penarth, Wales), J. Lacey (Rothamsted Experimental Station, Harpenden, England), J. Pepys (Institute of Diseases of the Chest, London, England), F.B. Greatorex (Public Health Laboratory, Taunton, England) and M.W. Treuhaft (Marshfield Medical Foundation, Marshfield, Wisconsin) are gratefully acknowledged.

This study was supported by a grant from the Manitoba Medical Service Foundation.

References

1. GRANT IWB, BLYTH W, WARDROP VE, GORDON RM, PEARSON JCG, MAIR A: Prevalence of farmer's lung in Scotland: a pilot survey. *Br Med J* 1972; 1: 530-534
2. MORGAN DC, SMYTH JT, LISTER RW, PETHYBRIDGE RJ, GILSON JC, CALLAGHAN P, THOMAS GO: Chest symptoms in farming communities with special reference to farmer's lung. *Br J Ind Med* 1975; 32: 228-234
3. MADSEN D, KLOCK LE, WENZEL FJ, ROBBINS JL, SCHMIDT CD: The prevalence of farmer's lung in an agricultural population. *Am Rev Respir Dis* 1976; 113: 171-174
4. WARREN WP, MANDEL MAJ, ROSE B: Farmer's lung. *Can Med Assoc J* 1969; 100: 699-704
5. CHARBONNEAU R, SIEGFRIED C, BERNIER J: Trois observations cliniques récentes de la maladie du poumon du fermier. *Union Med Can* 1970; 99: 1828-1836
6. GHOSE T, LANDRIGAN P, KILLEEN R, DILL J: Immunopathological studies in patients with farmer's lung. *Clin Allergy* 1974; 4: 119-129
7. WARREN CPW, MANFREDA J: Respiratory symptoms in Manitoba farmers: an association with hay and grain handling. *Can Med Assoc J* 1980; 122: 1259-1264
8. ANTHONISEN NR, DANSON J, ROBERTSON PC, ROSS WRD: Airway closure as a function of age. *Respir Physiol* 1970; 8: 58-65

9. BATES DV, WOOLF CR, PAUL GI: Chronic bronchitis. A report on the first two stages of the coordinated study of chronic bronchitis. *Med Serv J Can* 1962; 18: 211-306
10. CHERNIACK RM, RABER MB: Normal standards for ventilatory function utilizing an automated wedge spirometer. *Am Rev Respir Dis* 1972; 106: 38-46
11. WENZEL FJ, GRAY RL, ROBERTS RC, EMANUEL DA: Serologic studies in farmer's lung. Precipitins to the thermophilic actinomycetes. *Am Rev Respir Dis* 1974; 109: 464-468
12. EDWARDS JH: The double dialysis method of producing farmer's lung antigens. *J Lab Clin Med* 1972; 79: 683-688
13. SCHAFFER N, MOLOMUT N, CENTER JG: Studies on allergenic extracts. I. A new method for the preparation of mold extracts using a synthetic medium. *Ann Allergy* 1959; 17: 380-384
14. ARMITAGE P: *Statistical Methods in Medical Research*. Wiley, New York, 1971: 147-156, 388-391
15. MANFREDI J, NELSON N, CHERNIACK RM: Prevalence of respiratory abnormalities in a rural and an urban community. *Am Rev Respir Dis* 1978; 117: 215-226
16. LONGBOTTOM JL, PEPYS J: Pulmonary aspergillosis: diagnostic and immunological significance of antigens and C-substance in *Aspergillus fumigatus*. *J Pathol Bacteriol* 1964; 88: 141-151
17. PEPYS J: *Hypersensitivity Diseases of the Lungs due to Fungi and Organic Dusts (Monographs in Allergy, vol 4)*. Karger, Basel, 1969
18. ROBERTS RC, WENZEL FJ, EMANUEL DA: Precipitating antibodies in a midwest dairy farming population toward the antigens associated with farmer's lung disease. *J Allergy Clin Immunol* 1976; 57: 518-524
19. WARREN CP, TSE KS, CHERNIACK RM: Mechanical properties of the lung in extrinsic allergic alveolitis. *Thorax* 1978; 33: 315-321
20. BARBEE RA, CALLIES Q, DICKIE HA, RANKIN J: The long-term prognosis in farmer's lung. *Am Rev Respir Dis* 1968; 97: 223-231
21. TEIKO EO, LACEY J: Microbiological and serological studies of farmer's lung in Finland. *Clin Allergy* 1979; 9: 43-52
22. WENZEL FJ, GRAY RL, EMANUEL DA: Farmer's lung, its geographic distribution. *J Occup Med* 1970; 12: 493-496
23. BERENS L, DE RIDDER G, DE BOER F: Longitudinal studies of immunological parameters in farmer's lung. *Scand J Respir Dis* 1977; 58: 205-214
24. WARREN CPW, SINHA RN, STREVEN V: Allergic reactions to the grain mite, *Lepidoglyphus destructor* (abstr). *J Allergy Clin Immunol* 1979; 63: 149
25. CUTHBERT OD, BROSTOFF J, WRATH DG, BRIGHTON WD: Barn allergy: asthma and rhinitis due to storage mites. *Clin Allergy* 1979; 9: 229-236
26. INGRAM CG, JEFFREY IG, SYMINGTON IS, CUTHBERT OD: Bronchial provocation studies in farmers allergic to storage mites. *Lancet* 1979; 2: 1330-1332
27. STUART-HARRIS CH, HANLEY T: *Chronic Bronchitis, Emphysema, and Cor Pulmonale*, John Wright, Bristol, Engl, 1957: 214-228
28. BARTSCHI R, ROGLI J: Chronic bronchitis in a rural area and its prognosis. *Respiration* 1969; 26: 231-238
29. LEFCOE NM, WONNACOTT TH: Chronic respiratory disease in four occupational groups. *Arch Environ Health* 1974; 29: 143-146

Respiratory profiles of grain handlers and sedentary workers

FRANK A. HERBERT, MD, FRCP
VICKI WOYTOWICH, RN
ELAINE SCHRAM, B SC N
DOUGLAS BALDWIN

During 1978, grain handlers employed at three large inland grain terminals were studied along with an equal number of office workers matched for sex, age and smoking history. Respiratory symptoms and spirometric abnormalities were no more frequent in 16 grain handlers who were non-smokers than in their controls. However, 20 grain handlers who were smokers complained significantly more ($P < 0.01$) of grade 1 dyspnea and had significantly lower ratios of forced expiratory volume in the first second to forced vital capacity ($P < 0.05$) than their controls. Only 3% of the grain handlers were sensitive to grain dust, and 18% were found to be atopic but to have good lung function. A family history of asthma or allergic rhinitis was no more frequent in the grain handlers than in the control subjects. We conclude that the combination of cigarette smoking and exposure to grain dust causes a deterioration in lung function.

From the division of pulmonary diseases, department of medicine, University of Alberta, Edmonton
Reprint requests to: Dr. Frank A. Herbert, 6-107 Clinical Sciences Building, University of Alberta, Edmonton, Alta. T6G 2G3

En 1978 les manipulateurs de grains à l'emploi de trois grands entrepôts de grains ont fait l'objet d'une étude où un nombre égal d'employés de bureau appariés pour le sexe, l'âge et les habitudes de fumer ont été utilisés comme témoins. Les symptômes respiratoires et les anomalies spirométriques n'ont pas été plus fréquentes chez les 16 manipulateurs de grains non fumeurs que chez leurs témoins. Toutefois, 20 manipulateurs de grains fumeurs ont signalé significativement plus ($P < 0.01$) de dyspnée de type 1 et ont présenté un rapport du volume expiratoire maximum par première seconde sur la capacité vitale maximum significativement plus faible ($P < 0.05$) que leurs témoins. Seulement 3% des manipulateurs de grains se sont avérés sensibles à la poussière de grains, et 18% ont montré une atopie tout en ayant une bonne fonction pulmonaire. Les antécédents familiaux d'asthme ou de rhinite allergique n'étaient pas plus fréquents chez les manipulateurs de grains que chez les témoins. Nous concluons que l'association du tabagisme et de l'exposition à la poussière de grains peut causer une détérioration de la fonction pulmonaire.