The Chilliwack Respiratory Survey, 1963:

Part III. The Prevalence of Respiratory Disease in a Rural Canadian Town

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ABSTRACT

The prevalence of chronic respiratory symptoms and of abnormalities in pulmonary function was determined by a survey of persons, aged 25 to 74, residing during May and June 1963 in a rural town, Chilliwack, B.C. Morning phlegm was reported by 26% of men and 13% of women. Chronic bronchitis was considered present in 21.5% of men and 11.3% of women. More serious obstructive lung disease, not related to heart disease, was found in 12.6% of men and 8.7% of women. These prevalences were higher than those found by the authors at Berlin, New Hampshire, U.S.A., in 1961. Demographic factors, such as birthplace, occupational class and measures of social stability, were not related to the prevalence of respiratory disease at Chilliwack. Some observer variation was found after analysis to be the result of non-randomization of respondents among the observers. An incidental observation was a high prevalence at Chilliwack of heart disease and hypertension under treatment.

SOMMAIRE

La fréquence des symptômes respiratoires chroniques et des anomalies de la fonction pulmonaire ont été observées chez un groupe de personnes âgées de 25 à 74 ans et résidant dans une agglomération rurale (Chilliwack, C.B.) en mai et juin 1963. On a constaté un flegme matinal chez 26% des hommes et 13% des femmes. La présence de bronchite chronique a été observée chez 21.5% des hommes et 11.3% des femmes. Des pneumopathies occlusives plus graves, n'ayant pas de lien avec des cardiopathies, ont été notées chez 12.6% des hommes et 8.7% des femmes. Ces statistiques étaient plus élevées que celles notées par l'auteur à Berlin (New Hampshire, E.U.) en 1961. Les éléments purement démographiques par ex. lieu de naissance, emploi et stabilité sur le plan social ne jouaient aucun rôle sur la prédominance des affections respiratoires à Chilliwack. Certaines variantes des observateurs ont été rattachées, après analyse, au fait qu'on n'avait pas choisi au hasard les répondants parmi les observateurs. Une observation fortuite a été la découverte d'une forte prédominance à Chilliwack des cas de cardiopathie et d'hypertension en traitement.

IN MAY and June, 1963, a random sample of adult residents of the rural town of Chilliwack, British Columbia, was surveyed for the presence of chronic respiratory disease. The questionnaire used, the physiological tests administered, and the air pollution survey conducted, were all chosen to conform to methods used elsewhere, and particularly in 1961 by the authors at Berlin, New Hampshire.[1, 2]

To the best of our knowledge, this respiratory survey is the first, conducted in this now standard manner, which has been reported for a random sample of a total Canadian community. The questionnaire has, however, been used in a prospective "natural history" study of chronic bronchitis in pensioned veterans[3] and in a study of the miners and ex-miners at St. Lawrence, Newfoundland.[4] To some extent, therefore, the Chilliwack survey adds to the growing understanding of the geographic distribution of the prevalence of respiratory disease.

Unfortunately, such data are of only limited value for international comparisons, since the effect of personal air pollution by cigarette smoking greatly outweighs the effect on the respiratory system of community air pollution.[2, 5] There are, further, geographic differences in the *manner* of cigarette smoking which may also be related to the prevalence of respiratory disease.[6, 7]

The purpose of this communication is to present data on the prevalence of chronic respiratory disease in 558 persons who were residing at Chilliwack during the early summer of 1963. The air quality of this town has been previously documented.[8] The method of presentation of these data is similar to that of the Berlin, N.H., survey,[1, 2] and certain limited comparisons of the two studies will be made.

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METHODS

Descriptions of the city of Chilliwack and of the conduct of the survey have been previously published.[9] The present report reviews respiratory symptoms and physiological abnormalities in 246 males and 312 females, aged 25 to 74 years inclusive, who co-operated in the survey. This represents more than 95% of a random sample chosen, at a sampling ratio of one-in-seven, from a recent commercial census conducted by a city directory company. The representativeness of this sample has been judged to be satisfactory after comparison with data obtained during the 1961 Canadian Census.[9] Although volunteers and persons 18 to 24 years of age and 75 years and older were also interviewed, these respondents have not been included in this analysis.

The survey was conducted by three physicians at the office of the Upper Fraser Valley Health Unit in Chilliwack during May and June, 1963. Approximately 20% of the respondents had to be interviewed at home.

All respondents answered the precoded Harvard Questionnaire of respiratory symptoms,* following which they performed five forced expiratory spirograms on a Collins 6-litre recording vitalometer. The means of the last three forced vital capacities (FVC), and forced expiratory volumes expelled in one second ($FEV_{1.0}$), were determined by the recommended methods of Kory *et al.*[10] and have been corrected to 37° C., saturated with water vapour at the ambient pressure (BTPS). In addition, each respondent made five rapid expirations after maximal inspiration into the Wright peak-flow meter, and the mean of the last three peak expiratory flow rates (PEFR) was calculated.

Not everyone performed all the pulmonary function tests, which will explain certain deficiencies in Tables VII and VIII.

DEFINITIONS

To assist in data processing and in summarizing the data, three pathologic states were defined by criteria which corresponded as much as possible with clinical experience and with the recommendations of the Ciba Foundation Guest Symposium.[11] Similar definitions had been developed at Berlin, N.H., and these have been discussed in detail elsewhere.[1] The "diagnosis" was made by the coding clerk; this was based upon certain rigid criteria which were dependent either upon answers to certain questions or a low $FEV_{1.0}$. Since these states could coexist, a respondent might be placed in more than one category. The categories were as follows: *chronic bronchitis,* if a respondent produced phlegm on at least four days a week for three months of a year for three years; *asthma,* if a respondent had a history of bronchial asthma that had been diagnosed by a physician and was still present during the current year; *obstructive lung disease,*† if a respondent had a history of wheezing or whistling in the chest most days or nights, dyspnea not due to neuromuscular disability that caused the respondent to stop for breath when walking at his own pace on the level, or a mean $FEV_{1.0}$ less than 60% of the mean FVC; and *all chronic respiratory disease* if a respondent was included in at least one of the above chronic respiratory groups. The exact questions used for the "diagnosis" of these disease states are given in the appendix.

There is evidence from one Anglo-American study that geographic comparisons can be facilitated by the combination of symptoms into "standard syndromes".[12] The definition of chronic bronchitis used here corresponds with the clinical state which Fletcher has termed "simple bronchitis".[13]

The prevalence of known cardiovascular disease, and hypertension which had been treated during the 10 years, was also obtained by direct enquiry.

STATISTICAL METHODS

The statistical significance of the variables under study was assessed by a variety of appropriate statistical techniques. Because the number of respondents with a disease in many multi-variate groupings was small, contingency chi-square tests were used. This technique enables a comparison to be made between the numbers of cases and non-cases observed and the numbers expected if the test variable was unrelated to the disease. The effects of two variables could therefore be determined by calculating the expected number of cases at each level of one variable after it had been adjusted to the other, and *vice versa.* The chi-square test was applied to compare observed and expected number of persons with disease and no disease under the null hypothesis that the expected number, after adjustment for the variable under study, would be no different from that actually observed in each category of the other variable. To summarize quantitative physiological data, multiple regression equations with the standard error of the estimates, correlation matrices and multiple correlation coefficients were calculated on a computer according to standard methods.

The levels of significance assigned *a priori* were: $P < .05$ significant, $P < .01$ highly significant.

RESULTS

1. *Prevalence of All Respiratory Symptoms*

The prevalence of various respiratory symptoms reported by the respondents is given in Table I. This complex table has been prepared in a fashion comparable to those published elsewhere.[1, 14, 15]

By far the commonest symptom was that of dyspnea; breathlessness, at least on hurrying on the level or walking up a slight hill, was reported by 35.8% of the men and 47.6% of the women. More severe breathlessness, sufficient to cause the respondent to stop for breath when walking at his own pace on the level, was present in only 5.7% of the men and 11.7% of the women. About one-quarter of the population reported that they had nasal catarrh or that colds usually settled in the chest. Despite the tendency to "chestiness", only 5.7% of the men reported that they had had at least one incapacitating chest illness in the past three years, i.e., an illness associated with phlegm which had lasted at least a week and which had kept them off work, indoors at home, or in bed. More women (18.0%) reported such chest illnesses.

*This questionnaire and detailed instructions for its use are available from the authors.

†This grouping was termed "irreversible obstructive lung disease" in the Berlin study.1, 2 Because reversibility was not actually tested by bronchodilators or steroids, it seems better to use the general term "obstructive lung disease".

TABLE I.—PERCENTAGE OF RESPONDENTS WITH RESPIRATORY SYMPTOMS, CHILLIWACK, B.C., 1963

Question*	Males						Females					
Age group:	25 - 34	35 - 44	45 - 54	55 - 64	65 - 74	Total	25 - 34	35 - 44	45 - 54	55 - 64	65 - 74	Total
No. in group:	(51)	(61)	(59)	(41)	(34)	(246)	(48)	(65)	(82)	(57)	(60)	(312)
21. *Cough* usually on rising—winter	19.6	16.4	18.6	29.3	26.5	21.1	12.5	7.7	14.6	17.5	8.3	12.2
22. *Cough* usually on rising—summer	21.6	9.8	11.9	21.9	23.5	16.7	14.6	3.1	13.4	12.3	8.3	10.3
23. *Cough* during day—winter	19.6	14.8	10.2	17.1	14.7	15.0	10.4	9.2	11.0	8.8	11.7	10.3
24. *Cough* during day—summer	17.6	14.8	11.9	9.8	11.8	13.4	10.4	4.6	7.3	8.8	8.3	7.7
26. *Phlegm* on rising—winter	19.6	29.5	18.6	31.7	35.3	26.0	14.6	10.8	13.4	19.3	8.3	13.1
27. *Phlegm* on rising—summer	19.6	16.4	15.3	24.4	29.4	19.9	12.5	7.7	8.5	15.8	8.3	10.3
28. *Phlegm* during day—winter	15.7	16.4	5.1	14.6	26.5	14.6	8.3	9.2	8.5	14.0	11.7	10.3
29. *Phlegm* during day—summer	17.6	14.8	5.1	12.2	17.6	13.0	10.4	6.2	6.1	12.3	6.7	8.0
34. *Dyspnea*‡ Grade 1	78.4	67.2	72.9	51.2	38.2	64.2	68.8	53.9	56.1	44.5	38.6	52.4
Grade 2	21.6	31.1	22.0	39.0	44.1	30.1	25.0	35.4	37.8	42.6	36.8	36.0
Grade 3	0.0	1.6	5.1	4.9	11.8	4.1	6.3	10.8	3.7	9.3	17.6	9.1
Grades 4 and 5	0.0	0.0	0.0	4.9	5.8	1.6	0.0	0.0	2.4	3.7†	7.0†	2.6
38. *Wheezing* most days or nights	2.0	4.9	5.1	2.4	5.9	4.1	6.3	1.5	2.4	3.5	3.3	3.2
40. *Weather* affects chest	3.9	3.3	5.1	12.2	14.7	6.9	8.3	13.8	18.3	8.8	11.7	12.8
42. *Weather* effect is breathlessness	0.0	3.3	1.7	12.2	0.0	3.3	2.1	12.3	13.4	8.8	10.0	9.9
43. *Nasal catarrh*—winter	27.5	32.8	35.6	24.4	26.5	30.1	12.5	16.9	22.0	28.1	20.0	20.2
44. *Nasal catarrh*—summer	33.3	24.6	28.8	14.6	23.5	25.6	12.5	16.9	17.1	17.5	18.3	16.7
46. *Colds* usually in chest	31.4	19.7	27.1	17.1	26.5	24.4	35.4	24.6	26.8	33.3	23.3	28.2
47. *Chest illness;* past three years only one	3.9	3.3	1.7	2.4	8.8	3.7	16.7	7.7	13.4	26.3	13.3	15.1
Two plus	0.0	1.6	0.0	4.9	5.9	2.0	0.0	1.5	3.6	7.0	1.7	2.9

*Numbers refer to item in questionnaire used.
†Excluding three persons in each age group who suffered from a neuromuscular disability which prevented an assessment of the symptom of dyspnea.
‡Proportions in this category may not add exactly to 100% owing to rounding.

The other important and prevalent respiratory symptom was morning phlegm, present in 26.0% of the men and 13.1% of the women.

It is customary to consider that respiratory symptoms increase with age. No clear progression was observed across age groups for the symptoms listed in Table I except for dyspnea of Grade 3 severity or more, and the presence of an effect upon the chest caused by weather; both these progressions were observed in males only.

2. *Prevalence of Chronic Non-specific Respiratory Disease*

The prevalence of the three disease states, here called chronic bronchitis, asthma and obstructive lung disease, has been recorded in Table II for males and in Table III for females. Since these three states could coexist (and indeed all are "obstructive" lung diseases), some respondents have been listed in more than one column. Several observations can be made.

TABLE II.—PREVALENCE OF CHRONIC NON-SPECIFIC RESPIRATORY DISEASES AT CHILLIWACK, B.C., 1963

Age group	Males								
	No disease (1)	Chronic bronchitis (2)	Asthma (3)	Obstructive lung disease (4)	Combination (2 + 3)	Combination (2 + 4)	Combination (3 + 4)	Combination (2 + 3 + 4)	Total*
25 - 34	37	10	1	3	0	0	0	0	51
Per cent	72.5	19.6	2.0	5.9	0.0	0.0	0.0	0.0	100.0
35 - 44	44	15	1	6	0	3	0	1	61
Per cent	72.1	24.6	1.6	9.8	0.0	4.9	0.0	1.6	100.0
45 - 54	49	7	0	6	0	3	0	0	59
Per cent	83.1	11.9	0.0	10.2	0.0	5.1	0.0	0.0	100.0
55 - 64	27	9	0	8	0	3	0	0	41
Per cent	65.9	21.9	0.0	19.5	0.0	7.3	0.0	0.0	100.0
65 - 74	17	12	0	8	0	3	0	0	34
Per cent	50.0	35.3	0.0	23.5	0.0	8.8	0.0	0.0	100.0
Totals	174	53	2	31	0	12	0	1	24.6
Per cent	70.7	21.5	0.8	12.6	0.0	4.9	0.0	0.4	100.0
Totals without heart disease	155	50	2	26	0	10	0	1	221
Per cent	70.1	22.6	0.9	11.8	0.0	4.5	0.0	0.5	100.0

*Unduplicated total. Percentages do not add across because of duplication of subjects in different columns.

TABLE III.—PREVALENCE OF CHRONIC NON-SPECIFIC RESPIRATORY DISEASES AT CHILLIWACK, B.C., 1963

Age group	Females*								
	No disease (1)	Chronic bronchitis (2)	Asthma (3)	Obstructive lung disease (4)	Combination (2 + 3)	Combination (2 + 4)	Combination (3 + 4)	Combination (2 + 3 + 4)	Total†
25 - 34	38	7	0	4	0	1	0	0	48
Per cent	79.2	14.6	0.0	8.3	0.0	2.1	0.0	0.0	100.0
35 - 44	55	7	1	3	0	1	0	0	65
Per cent	84.6	10.8	1.5	4.6	0.0	1.5	0.0	0.0	100.0
45 - 54	66	9	2	7	0	1	1	0	82
Per cent	80.5	11.0	2.4	8.5	0.0	1.2	1.2	0.0	100.0
55 - 64	47	8	1	5	0	2	0	1	57
Per cent	82.5	14.0	1.8	8.8	0.0	3.5	0.0	1.8	100.0
65 - 74	49	4	0	8	0	2	0	0	59
Per cent	83.0	6.8	0.0	13.6	0.0	3.4	0.0	0.0	100.0
Totals	255	35	4	27	0	7	1	1	311
Per cent	82.0	11.3	1.3	8.7	0.0	2.3	0.3	0.3	100.0
Totals without heart disease	255	29	3	18	0	6	1	0	268
Per cent	84.0	10.8	1.1	6.7	0.0	2.2	0.4	0.0	100.0

*Excluding one female aged 65 - 74 with whom necessary portions of the interview were omitted.
†Unduplicated total. Percentages do not add across because of duplication of subjects in different columns.

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First, asthma presently under treatment was rare in this community; only 0.8% of males and 1.3% of females reported its occurrence. This crude prevalence was not unlike that reported in the Canadian Sickness Survey of 1950-51[16] where it was estimated to be found in 1.1% of the Canadian population.

Second, most respiratory disease states existed in pure form, though 4.9% of males and 2.3% of females suffered from both chronic bronchitis and obstructive symptoms.

Third, the over-all prevalence of chronic respiratory disease, as defined, was 29.3% of males and 18.0% of females 25 to 74 years of age. Standardization for age did not reduce the excess prevalence seen for males.

Fourth, obstructive lung disease in males showed a gradation of increased prevalence with ageing; chronic bronchitis did not. Bronchitis with obstructive lung disease, however, also showed an age gradient. This is as expected if obstructive lung disease largely reflects severe bronchitis and pulmonary emphysema. One-half of all males 65 to 74 years of age suffered from either chronic bronchitis or obstructive lung disease in the ratio of 3:2. In the case of females, however, there was a striking absence of any regular age gradient; females 65 to 74 years of age had virtually no higher prevalence of chronic respiratory disease than females 25 to 34 years of age.

TABLE IV.—RELATIVE PROPORTION OF DIAGNOSTIC CRITERIA IN OBSTRUCTIVE LUNG DISEASE,* CHILLIWACK, B.C., 1963

Diagnostic criteria	*Males* (%)	*Females* (%)
A. Sole criteria		
$FEV_{1.0}$ <60% FVC	58.1	40.7
Wheezing most days and nights	16.1	22.2
Breathlessness (Grade 4 or 5)	12.9	25.9
B. Combination of criteria	12.9	11.2
Total	100.0	100.0
Number	31.0	27.0

*As defined in Appendix.

It should be noted that obstructive lung disease is a composite diagnosis: wheezing, breathlessness, or a reduced $FEV_{1.0}$ (expressed as percentage of FVC) can result in such a diagnosis. In Table IV the relative frequencies of the diagnostic criteria for this disease category are presented. Most obstructive lung disease was diagnosed on the basis of a single criterion, most commonly a low relative $FEV_{1.0}$. Breathlessness and wheezing were, however, used more commonly as criteria in females than in males.

Heart disease may produce symptoms of dyspnea, winter bronchitis and wheezing, that may be confused with the symptoms of chronic non-specific respiratory disease; for this reason respondents who reported heart disease could be removed from these prevalence estimates. The result would be a minimum estimate of the prevalence of respiratory disease in the community, though there would be, of course, no certainty that the symptoms so removed were actually due to heart disease and not to coexisting primary respiratory disease. For example, Moriyama, Dawber and Kannel[17] have found, from a follow-back inquiry of certifying physicians, that of all cardiovascular-renal deaths 18% had emphysema and 8% had chronic bronchitis also.

At Chilliwack, 25 males (10.2% of the male respondents) and 43 females (13.8% of the female respondents) said they had heart disease or hypertension that had been treated in the past 10 years. Removal of these persons from the analysis did not appreciably change the total prevalence of respiratory disease, as shown at the bottom of Tables II and III.

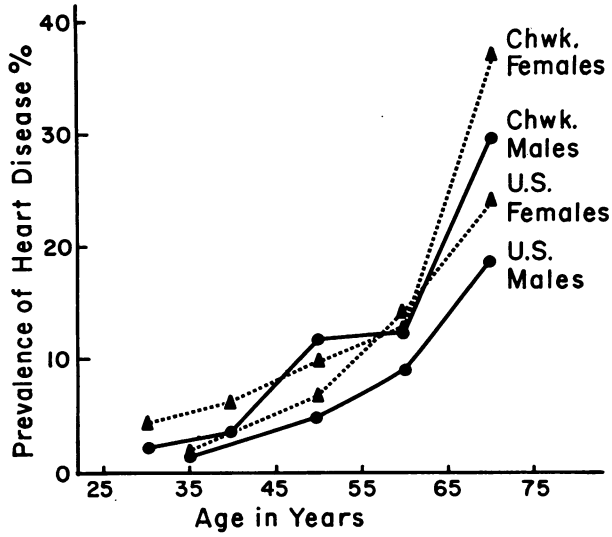

Fig. 1.—The prevalence of heart disease and hypertension under treatment by sex and age for Chilliwack (Chwk.), 1963, and for the civilian non-institutional population of the United States, 1957-58.[28]

3. *Relationship Between Heart Disease and Chronic Non-specific Respiratory Disease*

It is demonstrated by Fig. 1 that the prevalence of heart disease at Chilliwack increased with age in persons of either sex. Removal of respondents with heart disease from the analysis of Table II does not change the age gradient which was observed for chronic bronchitis and bronchitis with obstructive lung disease in males; the age trend for those two disease categories in males was not, therefore, accounted for by the fact that cardiac symptoms increased with age.

Of the 25 males with heart disease, six had also at least one of the chronic non-specific respiratory diseases; of the 43 females with heart disease, 13 had a chronic non-specific respiratory disease. The concordance between heart disease and respiratory disease was examined in the manner shown by Table V using the so-called marginal chi-square test.[18] No significant discordance was found in the case of females. There was, however, a highly significant discordance in the case of males because of an excess of men with respiratory disease who did not have coexisting heart disease.

TABLE V.—CONCORDANCE BETWEEN HEART DISEASE AND CHRONIC NON-SPECIFIC RESPIRATORY DISEASE, CHILLIWACK, B.C., 1963

	Males			*Females*		
	Heart disease present	*Heart disease absent*	*Total*	*Heart disease present*	*Heart disease absent*	*Total*
Respiratory disease present	6	66	72	13	43	56
Respiratory disease absent	19	155	174	30	225	255
Total	25	221	246	43	268	311*
χ_c^2		24.89			1.97	
P		P < .001			.2 < P < .1	

χ_c^2 Marginal chi-square test, corrected for continuity.[18]
*Excluding one female with whom necessary portions of the interview were omitted.

4. *Effect of Demographic Characteristics on the Prevalence of Disease*

It had been previously observed that the prevalence of chronic non-specific respiratory disease was profoundly affected by the practice of cigarette smoking.[2, 19] It was therefore thought necessary to standardize each sex for current cigarette-smoking habits before examining for any significant association between certain demographic variables and respiratory disease.*

Four demographic variables were examined in this fashion: birthplace, occupational class, number of job changes in the previous 10 years, and number of residence changes (i.e. change of town) in the previous 10 years. These variables were presumed to describe certain features of social class and stability, and have been peviously defined.[9] After standardization as described above, no association was found between any of these variables, in either sex, and the presence of all respiratory disease, chronic bronchitis or obstructive lung disease.

There were insufficient single persons in the sample to check for the effect of the variable of marital status. The effect of the variable of smoking will be described in a separate communication.[20]

5. *Observer Variation in Reporting of Respiratory Disease*

In a survey of this nature in which more than one interviewer takes part, it is essential to the subsequent statistical analysis that it be demonstrated there is no significant observer variation in eliciting responses. The magnitude and direction of this variation can best be determined by a randomized program of re-interviewing by different persons as carried out, for example, by Fairbairn, Wood and Fletcher.[21] Another less satisfactory approach is to ensure that the respondents are randomly distributed to the interviewers; in this case the prevalence of respiratory disease reported by each interviewer should be similar and within the range of sampling variability because the situation is, in effect, N number of samples of the same population, where N represents the number of interviewers.

Only two of the three interviewers, D.A. and B.F., had previously collaborated in the Berlin, N.H., survey.[1] In that survey only insignificant differences in disease prevalence had been obtained by the two workers; this was attributed to careful standardization of the technique and frequent interview conferences. These same practices were adhered to at Chilliwack,[9] and T.D. was trained to follow the same procedure as the more experienced interviewers. Respondents were not, however, selected randomly by the interviewers: B.F. was present only during the initial two weeks of the survey and conducted no interviews at home, while T.D. spent several weeks alone at the end of the survey to interview the stragglers. As a consequence, 31.5% of the respondents interviewed by T.D., 23.0% of the respondents interviewed by D.A., and none of the respondents interviewed by B.F. were seen at home. From evidence collected at Berlin,[22] subjects interviewed at home could be expected to have more respiratory disease than those interviewed at the clinic.

The prevalence of chronic bronchitis and obstructive lung disease by observer is presented in Table VI. Observer T.D., who interviewed the largest proportion of males, reported a higher prevalence of obstructive lung disease in that sex than the other two observers. The prevalence of chronic bronchitis was remarkably similar for all observers. The effect of observer on the prevalence of obstructive lung disease in males was found to be significant when the prevalence was standardized for age ($\chi^2 = 6.66$, $.05 > P > .01$) but not significant when the prevalence was standardized for current cigarette-smoking category ($\chi^2 = 4.78$, $.10 > P > .05$). The effect of observer on the prevalence of chronic bronchitis in either sex or on the prevalence of obstructive lung disease in females was not significant following standardization for either age or current cigarette-smoking category.

We have carefully examined the data for males to see if some systematic bias caused T.D. to report symptoms and signs of obstructive lung disease more often than the other two observers. One possibility was that T.D. was less skilled at administering the spirogram test. It should be

*Standardization for a specific variable, such as smoking, removes the effect of the standardized parameter and permits a more precise examination of the effect of other variables.

TABLE VI.—PREVALENCE OF CERTAIN CHRONIC NON-SPECIFIC RESPIRATORY DISEASES BY OBSERVER, CHILLIWACK, B.C., 1963

Observer	Males: Interviewed (No.)	Males: Interviewed (%)	Males: Chronic bronchitis (%)	Males: Obstructive lung disease (%)	Females: Interviewed (No.)	Females: Interviewed (%)	Females: Chronic bronchitis (%)	Females: Obstructive lung disease (%)
D.A.	80	32.5	21.3	8.8	126	40.5	10.3	5.6
T.D.	96	39.0	21.9	18.8	102	32.8	11.8	11.8
B.F.	70	28.5	21.4	8.6	83	26.7	12.1	9.6
Total	246	100.0	21.5	12.6	311*	100.0	11.3	8.7

*Excluding one female with whom necessary portions of the interview were omitted.

recalled that an $FEV_{1.0} < 60\%$ of the FVC will result in a diagnosis of obstructive lung disease (see Appendix). T.D. did not, however, have a larger proportion of respondents with this disease who were diagnosed exclusively on the basis of the spirometric reading. Further, the number of low values of the $FEV_{1.0}$ calculated from the spirograms he obtained was not significantly greater than that of those calculated from spirograms recorded by the other observers. We have further reviewed the distribution of values by observer for all measures of $FEV_{1.0}$, expressed as a percentage of FVC, and have been unable to detect any obvious difference between the three distribution curves. Analysis of the data shows, however, that T.D. saw not only more respondents at home, but also more heavy smokers. We are therefore inclined to believe that the higher prevalence of obstructive lung disease reported by T.D. was due not to a systematic *bias* on the part of the observer but rather to *non-randomization* of the respondents among the observers.

6. *Physiological Measurements*

The respiratory health of a population can be described not only by the prevalence of certain symptoms or diseases in the community but also by the distribution of certain physiological measurements such as FVC, $FEV_{1.0}$ and PEFR, all of which indicate airway obstruction. In simplest form the measurements can be presented as a series of means and standard deviations for each age group and sex as in Table VII.

It is clear from Table VII that there was a gradual decrease in $FEV_{1.0}$ and PEFR with age. There was also, however, a relationship with standing height which is not shown by this static type of presentation. Table VIII is a matrix of first-order correlations calculated for males and females who did not have any respiratory disease as defined in this survey. The FVC, $FEV_{1.0}$ and PEFR were correlated with standing height; these correlations, while not as large as the correlations with age, were greater than the correlation between age and standing height, and must therefore be taken into account.* The extra refinement of calculating sitting height or the cube of height (thereby expressing volume) does not appreciably increase the correlation.[23]

TABLE VII.—MEAN VALUES FOR $FEV_{1.0}$ AND PEFR BY AGE AND SEX, CHILLIWACK, B.C., 1963 (BTPS)

Age group	Males: N	Males: $FEV_{1.0}$ (litres)	Males: PEFR (l./min.)	Females: N	Females: $FEV_{1.0}$ (litres)	Females: PEFR (l./min.)
25 - 34	51	3.93 ± .62	566 ± 72	48	2.92 ± .48	419 ± 58
35 - 44	61	3.47 ± .67	530 ± 73	64	2.65 ± .41	405 ± 56
45 - 54	59	3.25 ± .66	534 ± 110	81	2.37 ± .52	369 ± 85
55 - 64	41	2.83 ± .55	487 ± 88	55	2.11 ± .46	353 ± 88
65 - 74	32	2.39 ± .62	400 ± 121	56	1.63 ± .33	313 ± 76
Total	244			304		

Values recorded for $FEV_{1.0}$ and PEFR are the mean (μ) and standard deviation corrected for small sample size (σ). Only respondents with both tests are included in this table.

*Partial correlation coefficients of FVC, $FEV_{1.0}$ and PEFR against height, with age held constant, were all significantly greater than zero.

TABLE VIII.—CORRELATION MATRIX BETWEEN CERTAIN QUANTITATIVE PARAMETERS FOR HEALTHY RESPONDENTS* CHILLIWACK, B.C., 1963

	Males (n = 174): Age	Standing height	FVC	$FEV_{1.0}$	PEFR	Females (n = 249): Age	Standing height	FVC	$FEV_{1.0}$	PEFR
Age	1.00	−.33	−.61	−.63	−.38	1.00	−.20	−.68	−.73	−.49
Standing height		1.00	+.56	+.52	+.29		1.00	+.47	+.43	+.32
FVC			1.00	+.89	+.50			1.00	+.94	+.67
$FEV_{1.0}$				1.00	+.67				1.00	+.72
PEFR					1.00					1.00

*Persons who have no respiratory disease according to the criteria of the Appendix.

Because of these intercorrelations, it has become our practice to calculate the best-fit linear multiple regression equation for each parameter under study; these equations express simultaneously the relationship between age, height, and the physiological parameter in the form: $z = a + bx + cy$. It is our experience that such equations provide a useful means of expressing this complex interrelationship in a simple fashion, and permit ready comparison of data with those collected elsewhere.

More detailed study of the relationship between the results of pulmonary function tests and chronic respiratory disease at Chilliwack is in progress, using the statistical techniques of discriminant analysis. Because we are still uncertain of the magnitude of this relationship, it seems reasonable to confine the discussion here to that group of 174 males and 249 females who had no respiratory disease and who performed both the spirogram and flow-meter tests. The regression equations for these individuals were as follows:

Males:

$$FVC = -1.987 - 0.031\ \text{Age} + 0.045\ \text{Ht.} \quad (\text{S.E.E.} = 0.564)$$

$$FEV_{1.0} = -1.091 - 0.029\ \text{Age} + 0.034\ \text{Ht.} \quad (\text{S.E.E.} = 0.502)$$

$$PEFR = 260.8 - 2.11\ \text{Age} + 2.18\ \text{Ht.} \quad (\text{S.E.E.} = 75.9)$$

Females:

$$FVC = -1.877 - 0.031\ \text{Age} + 0.040\ \text{Ht.} \quad (\text{S.E.E.} = 0.455)$$

$$FEV_{1.0} = -0.806 - 0.030\ \text{Age} + 0.029\ \text{Ht.} \quad (\text{S.E.E.} = 0.377)$$

$$PEFR = 27.9 - 2.52\ \text{Age} + 2.97\ \text{Ht.} \quad (\text{S.E.E.} = 65.3)$$

where the units are Height (Ht.) in cm., Age in years, FVC in litres, $FEV_{1.0}$ in litres and PEFR in litres per minute. S.E.E. is the standard error of the estimate around the line.

The multiple correlation coefficients, R, for these functions were of a good order: FVC = 0.72, males and 0.76, females; $FEV_{1.0}$ = 0.71, males and 0.78, females; PEFR = 0.42, males and 0.54, females.

The regression coefficient (or slope) with age was remarkably constant in both sexes and for the FVC and $FEV_{1.0}$.

DISCUSSION

The prevalence of respiratory symptoms, chronic non-specific respiratory disease, and respiratory physiological abnormality found at Chilliwack, B.C., should be considered to reflect that which would be found in a small rural town which has low levels of air pollution.[8] Because birthplace, occupational class, number of job and residence changes, and years of residence were not found to affect significantly the prevalence of chronic non-specific respiratory disease at either Chilliwack or Berlin,[2] one might be tempted to assume that the higher prevalence of disease in a polluted area would be causally related to the air pollution. Previous experience at Berlin, N.H., however, has indicated this would be an unwarranted conclusion *unless the prevalence of cigarette smoking* (in amount per day) *was the same also.*[2] It is unfortunate that the lack of knowledge concerning geographic differences in smoking prevents meaningful comparisons of morbidity data between different areas.

Similar questionnaires have been used in a number of studies on this side of the Atlantic,[3, 4, 24-26] and a number of Anglo-American analyses have been made.[12, 13, 27] Because of our reservations about the similarity of survey techniques and the difficulty in controlling for smoking habits and demographic factors, we shall confine our analysis to the Chilliwack-Berlin comparison. Even here, differences between the two communities in a known factor such as ethnic composition reduce any confidence one might have regarding the validity of this comparison.

Some of the respiratory symptoms from Table I have been listed again in Table IX in company with the prevalence of the same symptoms found at Berlin, N.H. These disease rates are directly comparable because of an age adjustment. In general, most respiratory symptoms were more common in Berlin, although Chilliwack women claimed more chest illnesses in the previous three years, and both men and women at Chilliwack had more breathlessness of the order of Grade 2. The greater prevalence of breathlessness was almost certainly an artefact; the Berlin questionnaire was prepared from an earlier version of the Medical Research Council Questionnaire (Great Britain) which, while it resulted in the same grading, probably produced a subtle bias towards a negative answer to the question, "Are you troubled by shortness of breath? (*If no: check*: Not even on hurrying on the level or walking up a slight hill?)" At Chilliwack the question was stated more boldly: "Are you ever troubled by shortness of breath when hurrying on the level or walking up a slight hill?" It is of interest, however, that dyspnea of higher grades (Grade 3 or more) was still greater at Chilliwack.

TABLE IX.—STANDARDIZED PREVALENCE OF CERTAIN RESPIRATORY SYMPTOMS AT CHILLIWACK AND BERLIN, BOTH SEXES, AGE 25 - 74 YEARS

	Males		*Females*	
Question	*Chilliwack* (%)	*Berlin** (%)	*Chilliwack* (%)	*Berlin** (%)
21. *Cough* on rising—winter.	21.1†	34.4†	12.2	14.3
26. *Phlegm* on rising—winter	26.0	32.6	13.1	13.9
34. *Dyspnea*				
Grade 1.....	64.2†	92.6†	52.4†	82.7†
Grade 2.....	30.1†	4.2†	36.0†	11.0†
Grade 3 or more...	5.7	3.1	11.7†	6.3†
38. *Wheezing* most days or nights....	4.1	6.9	3.2	3.7
42. *Weather* affects chest....	6.9†	13.4†	12.8†	19.2†
43. *Nasal* catarrh—winter..	30.1	33.3	20.2	20.6
46. *Colds* usually in chest...	24.4†	43.9†	28.2†	37.8†
47. *Chest illness*, past 3 years	5.7	7.1	18.0†	11.5†

*Prevalence adjusted to the age distribution of the Chilliwack sample.
†Berlin and Chilliwack comparisons so marked are highly significant ($P < .01$).

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Figs. 2 and 3 have been prepared from the data of Tables II and III and from the Berlin survey. Chilliwack had a lower total prevalence of all chronic respiratory disease, chronic bronchitis, and obstructive lung disease. One explanation might be a dissimilarity of the age distribution of the two populations; in these figures, however, has been plotted the expected prevalence of respiratory disease if the age-specific disease rates found at Berlin applied at Chilliwack. If the dissimilarity by age was the explanation, the observed and expected disease prevalence at Chilliwack should be the same; in fact, they are not. It is also apparent from these figures that the prevalence of respiratory disease is rather similar for females in the two areas. It will be shown in a subsequent publication[20] that the difference between the prevalence of chronic non-specific respiratory disease found at Berlin and Chilliwack can be explained by rather marked differences in the current cigarette smoking habits of the populations.

It had been observed at Berlin[2] that males had a higher proportion of obstructive lung disease which was associated with bronchitis (53.1%) than females (30.0%). This significant difference was interpreted to mean either that obstructive lung disease was "dry" in females or that females denied the existence of sputum. The comparable proportions at Chilliwack failed to show a significant sex difference, being 38.7% for males and 25.9% for females. It had also been noted at Berlin[2] that only 24.3% of females with obstructive lung disease had a low $FEV_{1.0}$. The data in Table IV indicate that at Chilliwack a much higher proportion with this disease had physiological abnormalities.

Heart disease was found to be more common in both males and females at Chilliwack (10.2% of males and 13.8% of females) than at Berlin (8.8% of males and 9.6% of females). This observation is of importance in view of the higher prevalence of chronic non-specific respiratory disease at Berlin: it may reflect the effect of cigarette smoking, which has a greater relative effect upon respiratory disease than upon heart disease. It may also, however, reflect the level of health awareness or medical attention. The comparable prevalence of heart disease at Berlin might be lower than reported, since at Chilliwack the definition was restricted to hypertension and heart disease under medical treatment during the preceding 10 years (Appendix). The age distribution of heart disease is shown in Fig. 1 in conjunction with the prevalence of "persons with heart conditions or high blood pressure under care of a physician" reported in interviews conducted by the U.S. National Health Survey, July 1957 to June 1958.[28] The apparently higher prevalence of heart disease in the rural town of Chilliwack should be further examined to determine if it is the result of artefact, differential migration, or some other factor.

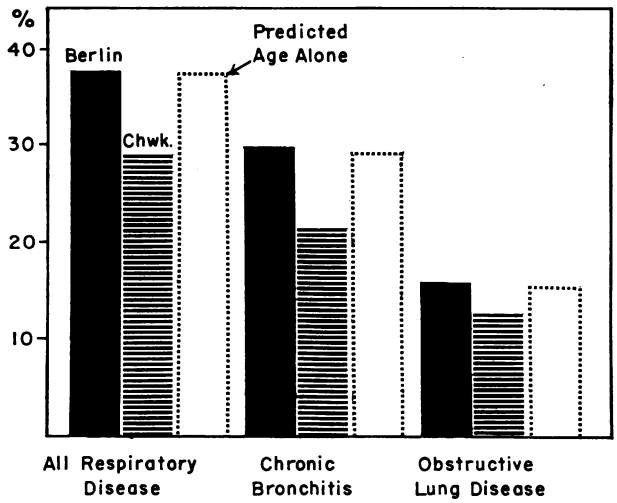

Fig. 2.—Prevalence of chronic respiratory disease in males, 25 to 74 years, at Berlin and Chilliwack (Chwk.). The dotted bar indicates the expected prevalence at Chilliwack after age adjustment to the age-specific rates of disease at Berlin.

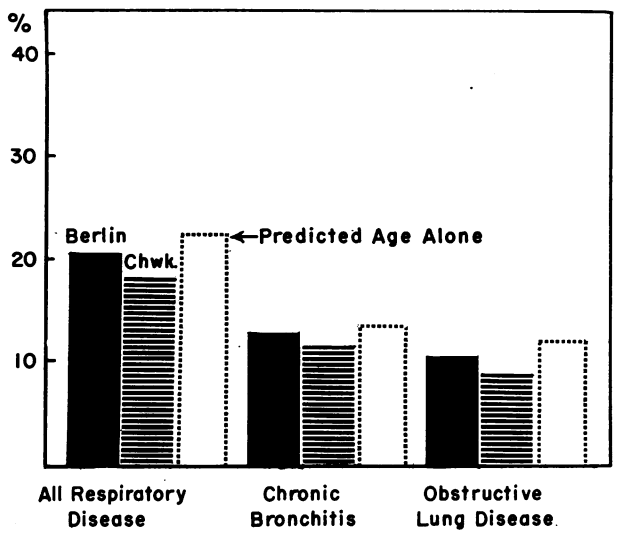

Fig. 3.—Prevalence of chronic respiratory disease in females, 25 to 74 years, at Berlin and Chilliwack (Chwk.). The dotted bar indicates the expected prevalence at Chilliwack after age adjustment to the age-specific rates of disease at Berlin.

The physiological measurements of FVC, $FEV_{1.0}$ and PEFR permit a quantitative comparison between communities. The multiple regression equations permit standardization of populations in terms of height, age, and sex. It has been our practice, following British methodology,[14, 15, 21] to use the mean of the last three of five physiological trials. These equations, therefore, will not be perfectly comparable to those developed by other workers who chose a single maximum value for each physiological parameter. The similarity of the Chilliwack results to those of other surveys can be demonstrated, however, by calculating from the multiple regression equations the pulmonary function for a standard* male and standard female who do not have respiratory dis-

*Selected to be at or near the median of the age and height distribution.

TABLE X.—COMPARISON OF PREDICTED VALUES FOR FVC, $FEV_{1.0}$ AND PEFR FROM LITERATURE, STANDARDIZED FOR AGE AND HEIGHT, FOR PERSONS WITHOUT RESPIRATORY DISEASE

	40-year-old male 170 cm. tall			*40-year-old female 150 cm. tall*		
	FVC (*litres*)	*$FEV_{1.0}$* (*litres*)	*PEFR* (*l./min.*)	*FVC* (*litres*)	*$FEV_{1.0}$* (*litres*)	*PEFR* (*l./min.*)
Chilliwack, B.C.	4.42	3.49	547	2.85	2.37	373
Berlin, N.H.[23]	4.12	3.39	505	2.63	2.25	336
Kory *et al.*[29]	4.42	3.55		2.76	2.50	
Leiner *et al.*[31]			569			396

ease. This has been done in Table X. The standardized values for FVC and $FEV_{1.0}$ at Chilliwack corresponded very closely to those calculated from the prediction formulas of Kory *et al.*,[29] and were higher than those at Berlin. It has been noted elsewhere[30] that the lower values at Berlin cannot be explained by differences in cigarette smoking, and therefore reflect the effects of such variables as air pollution, ethnic composition, or social class. The values for PEFR reported by Leiner *et al.*[31] were still higher than those observed at Chilliwack, but Leiner used the average of the three largest values obtained from 10 trials.

The respiratory survey remains a convenient way of assessing the prevalence of respiratory disease in a standardized fashion which can be repeated by other investigators. The prevalence of chronic non-specific respiratory disease at Chilliwack might be considered the minimum prevalence which would be found in a population not exposed to pollution of the community ambient air or to irritating dust or gas at work. These data, however, cannot be fully interpreted without an appreciation of the effect of tobacco smoking, discussed in a subsequent report.[20]

A significant observer variation in reporting the symptoms of obstructive lung disease was assumed, after study, to be the result of non-randomization of the respondents among the interviewers. Fletcher and Tinker[15] encountered the same difficulty in their survey at the London Transport Executive Works. It is clear that every effort should be made to randomize respondents among observers or else confine the observations to a single observer as was done in a heroic series of surveys by Higgins.[5] When a team of physicians has to be maintained in the field, the first refinement may be hard to achieve.

SUMMARY

The prevalence of chronic respiratory symptoms and of chronic non-specific respiratory disease at Chilliwack, British Columbia, was determined by a survey of a random sample of persons 25 to 74 years of age, conducted by three physicians during May and June 1963. Over 26% of males and 13% of females reported morning phlegm in the winter. In 21.5% of males and 11.3% of females, this symptom had been present for three years or more and could therefore be called chronic bronchitis. In 12.6% of males and 8.7% of females, symptoms and physiologic evidence suggested that more serious obstructive lung disease was present. Obstructive lung disease increased with age while chronic bronchitis did not. This age gradient was not due to confusion with symptoms of heart disease under treatment.

The prevalence of respiratory disease, as defined in this study, was not significantly related to birthplace, occupational class and measures of social stability. Although some observer variation was noted, careful analysis failed to show a systematic bias operating, and it was assumed that this was the result of non-randomization of respondents to interviewers.

A method was described of summarizing physiologic measurements by multiple regression equations incorporating age and height. For respondents without respiratory disease, values for FVC, $FEV_{1.0}$ and PEFR were found to be not appreciably different at Chilliwack from those purported to be "normal".

In general, respiratory symptoms and disease, and physiological abnormalities were more common in a comparison community, Berlin, New Hampshire. Some reasons for this observation have been suggested.

An incidental observation was a high prevalence at Chilliwack of heart disease and hypertension under treatment. A statistical deficiency of heart disease in males with respiratory disease was also noted.

Data processing was conducted on the IBM 1620 computer at the University of British Columbia Computing Centre.

REFERENCES

1. FERRIS, B. G., JR. AND ANDERSON, D. O.: *Amer. Rev. Resp. Dis.*, **86**: 165, 1962.
2. ANDERSON, D. O. AND FERRIS, B. G., JR.: *New Eng. J. Med.*, **267**: 787, 1962.
3. BATES, D. V., WOOLF, C. R. AND PAUL, G. I.: *Med. Serv. J. Canada*, **18**: 211, 1962.
4. PARSONS, W. D. *et al.*: *Brit. J. Industr. Med.*, 21: 110, 1964.
5. HIGGINS, I. T. T.: *Brit. Med. J.*, **1**: 325, 1959.
6. HILDING, A. C.: *New Eng. J. Med.*, **254**: 775, 1956.
7. DOLL, R. *et al.*: *Brit. Med. J.*, **1**: 322, 1959.
8. ANDERSON, D. O., WILLIAMS, I. H. AND FERRIS, B. G., JR.: *Canad. Med. Ass. J.*, 92: 954, 1965.
9. ANDERSON, D. O., FERRIS, B. G., JR. AND DAVIS, T. W.: *Ibid.*, **92**: 899, 1965.
10. KORY, R. C. *et al.*: *Dis. Chest*, **43**: 214, 1963.
11. Ciba Foundation Guest Symposium: *Thorax*, **14**: 286, 1959.
12. REID, D. D. *et al.*: *Brit. Med. J.*, **2**: 1487, 1964.
13. FLETCHER, C. M.: *Dis. Chest*, **44**: 1, 1963.
14. FLETCHER, C. M. *et al.*: *Brit. Med. J.*, **2**: 257, 1959.
15. FLETCHER, C. M. AND TINKER, C. M.: *Ibid.*, **1**: 1491, 1961.
16. Canada. Department of National Health and Welfare and the Dominion Bureau of Statistics: Illness and health care in Canada; Canadian sickness survey, 1950-51, Queen's Printer, Ottawa, 1960, p. 126.
17. MORIYAMA, I. M., DAWBER, T. R. AND KANNEL, W. B.: Evaluation of diagnostic information supporting medical certification of cardiovascular disease deaths, paper presented to the 91st meeting of the American Public Health Association, Kansas City, Missouri, November 13, 1963.
18. FISHER, S.: *J. New Drugs*, **2**: 84, 1962.
19. FERRIS, B. G., JR., ANDERSON, D. O. AND BURGESS, W. A.: *Brit. J. Industr. Med.*, **19**: 180, 1962.
20. ANDERSON, D. O., FERRIS, B. G., JR. AND ZICKMANTEL, R.: *Canad. Med. Ass. J.*, In press.
21. FAIRBAIRN, A. S., WOOD, C. H. AND FLETCHER, C. M.: *Brit. J. Prev. Soc. Med.*, **13**: 175, 1959.
22. ANDERSON, D. O., ZICKMANTEL, R. AND FERRIS, B. G., JR.: *Canad. Med. Ass. J.*, **88**: 596, 1963.
23. FERRIS, B. G., JR., ANDERSON, D. O. AND ZICKMANTEL, R.: *Amer. Rev. Resp. Dis.*, **91**: 252, 1965.
24. GOCKE, T. M. AND DUFFY, B. J.: *Arch. Intern. Med. (Chicago)*, **110**: 606, 1962.
25. PRINDLE, R. A. *et al.*: *Amer. J. Public Health*, **53**: 200, 1963.
26. PAYNE, M. AND KJELSBERG, M.: *Ibid.*, **54**: 261, 1964.
27. HOLLAND, W. W., REID, D. D., SELTSER, R. AND STONE, R. W.: Studies of comparative prevalence of respiratory disease in England and the United States, paper presented to the Seventh Annual Air Pollution Medical Research Conference, Los Angeles, February 11, 1964.
28. United States. National Health Survey: Heart conditions and high blood pressure reported in interviews, United States, July 1957—June 1958, U.S. Department of Health, Education and Welfare, Public Health Service, Publication No. 584-B13, Superintendent of Documents, Government Printing Office, Washington, D.C., 1960, p. 18.
29. KORY, R. C. *et al.*: *Amer. J. Med.*, **30**: 243, 1961.
30. ANDERSON, D. O. AND FERRIS, B. G., JR.: *Arch. Environ. Health (Chicago)*, **10**: 307, 1965.
31. LEINER, G. C. *et al.*: *Amer. Rev. Resp. Dis.*, **88**: 644, 1963.

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APPENDIX

The "survey" definitions of the three disease states used in the present study are given by the following questions or physiological tests, which have been abstracted from the full questionnaire. Certain details from the instructions for the use of the questionnaire have also been included.

1. *Chronic Bronchitis*

Positive answer to:

26. Do you usually raise up any phlegm from your chest first thing in the morning (on getting up) in the winter? (Count phlegm with the first smoke or on "first going out of doors". Exclude phlegm from the nose. Count swallowed phlegm.)

Do you do this four mornings out of a week?

and/or

27. Do you do this in summer?

and/or

28. Do you bring up any phlegm from your chest during the day, or at night, in the winter? (Accept twice or more.)

and/or

29. Do you do this in the summer?

plus

30. Do you bring up any phlegm like this on most days for as much as three months a year?

and

31. How long have you had this cough and/or phlegm: three years or more?

2. *Asthma*

Positive answer to:

53. Has a doctor ever said you had bronchial asthma?

and

54. If yes, still present? (To be considered still present if the respondent has visited a physician for it during the preceding *12 months*.)

3. *Obstructive Lung Disease*

Positive answer to:

either

36. Does your chest ever sound wheezy or whistling? (If "no", ask "Not even when you have a cold?")

and

38. Do you get this most days or nights?

or: dyspnea of level 4 or 5 (Fletcher) as in question 34.

34. Are you ever troubled by shortness of breath when hurrying on the level or walking up a slight hill? (If no—Grade 1; if yes, proceed.)

Do you have to walk slower than persons your own age on the level because of breathlessness? (If no—Grade 2; if yes, proceed.)

Do you have to stop for breath when walking at your own pace on the level? (If no—Grade 3; if yes, proceed.)

Are you short of breath on washing or undressing? (If no—Grade 4; if yes, Grade 5.)

or: $FEV_{1.0} < 60\%$ FVC.

4. *Heart Disease*

Positive answer to:

55. Has a doctor ever told you that you had heart trouble or treated you for high blood pressure? (If yes, specify.) ("Nervous heart", palpitations untreated, and hypertension untreated are to be recorded as "no". Treatment for heart disease or hypertension discontinued *more than 10 years* before the date of present interview is to be recorded as "no". Murmurs and rheumatic fever are recorded as "no" unless the respondent has received treatment during the past 10 years. Treated hypertension with pregnancy during the past 10 years is to be recorded as "yes".)

PAGES OUT OF THE PAST: FROM THE JOURNAL OF FIFTY YEARS AGO

AFTER ALL, BUT ANIMALS

Schistosoma japonicum provides additional proof of a truth which physicians are coming to realize more and more—that men are, after all, but animals, and are subject to very much the same diseases as those which affect the lower creation. It is for that reason that much light has been, and will continue to be thrown upon obscure human diseases by an investigation of diseases affecting animals.

Most medical students learn, during a course in systematic biology, that a disease of sheep, called among other names liver fluke, is due to the presence in the liver of a flat worm —a fluke. The life history of that worm is extremely interesting and is mentioned by every lecturer on medical zoology. It furnishes one of the first instances in which two hosts were known to be necessary for the complete development of a parasitic animal. The eggs of the liver fluke reach the outside world with the fæces of an infected sheep. In the presence of moisture the eggs hatch out a developmental form which becomes parasitic in a water snail. The development of the worm proceeds in the snail and a new form results which attaches itself to blades of grass and becomes encysted there. The encysted form is ingested by browsing sheep. It develops in the body of the sheep into an adult worm, and so the cycle of development of the parasite is completed. The flukes, one division of the flat-worms, are the cause of several interesting diseases in man. The one with which Canadian practitioners are most familiar is that which is commonly called bilharziasis. There are a good many men in Canada who saw service in the South African War and still suffer from cystitis depending upon their infection with *Schistosoma hematobium*, or, as it is usually called, *Bilharzia hematobium*. The precise method by which infection with *Schistosoma hematobium* is contracted is uncertain. Many persons have thought that the eggs, or the free-living embryos, were ingested with drinking water. Looss, of Cairo, emphatically maintains that infection is certainly incurred by the penetration of the active, free-living miracidia through the skin of those who come in contact with water contaminated by urine or fæces containing the eggs of the *Schistosoma hematobium*. Neither of these suggestions, however, is entirely acceptable to biologists, who remember the life cycle of the sheep fluke and the way in which it is transmitted from infected to healthy animals. They always have felt that an intermediate host also probably plays a part in the development of the flukes infecting man. An intermediate host, a water snail, does in fact play a part in the development of a fluke parasitic in man.—J. L. Todd, *Canad. Med. Ass. J.*, 5: 557, 1915.