The prevalence of chronic respiratory disease in the male physicians of London, Ontario

Summary: a survey of respiratory disease among male physicians of London, Ontario, resulted in a 96.3% response.

The age-standardized rates of chronic bronchitis were not very different from others reported in the recent medical literature, taking into account smoking habits, but the overall prevalence of bronchial asthma was high (7.4%), with a low prevalence in the category "obstructive lung disease". The possibility of overlap or interchange in these diagnoses is raised, although the diagnosis of bronchial asthma in this particular group is believed to be well established in every case.

A history of seasonal hay fever was given by 19.4%.

One of 88 (1%) non-smokers had bronchitis, whereas six of them (7%) had asthma.

Rhonchi heard in the chest, on a single examination, appeared to be most closely related to current smoking habits, ventilatory function tests and also to a clinical diagnosis of chronic bronchitis or obstructive lung disease, but not to bronchial asthma.

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Surveys of the effects of occupation on the morbidity and mortality of chronic non-specific pulmonary disease have been confounded by variables not prominent in those surveys dealing with community-wide population samples. Community studies in England and Wales have shown important urban-rural differences and there is evidence that other differences may be associated with smoking habits, age, sex and social class, as well as atmospheric pollution.[1-4]

In North America, several excellent community surveys have failed to demonstrate conclusively a relationship between the level of air pollution and the prevalence of chronic bronchitis,[5-7] although morbidity and mortality patterns arising with acute changes in pollutants in large urban complexes have been suggested by a few American studies.[3,8] Occupational surveys, however, apart from selected, well-defined over-exposures, have suffered from the problems presented by such factors as place of residence, intermittent exposure, personnel selection policies in certain industries and, in North America particularly, by job and population mobility.[9,10]

It was felt that a group of physicians, at least in the middle-age groups, represent a fairly stable population in occupational Class I,[11] and can be considered to be less affected by the previously mentioned occupational variables. They are also unlikely to be exposed chronically to occupational gaseous or particulate inhalation hazards. The problem of extra exposure to viral respiratory disease represents an uncontrolled hazard. The survey was constructed with the following primary objectives in mind:

(a) To determine the prevalence of hay fever, asthma, chronic bronchitis and obstructive lung disease (as defined below) in the male physicians of London, Ontario, considering their age and smoking habits, as well as climatic features and air quality.

(b) To assess the prevalence of rhonchi as related to smoking habits, symptoms and ventilatory function.

(c) To assess simple ventilatory function with regard to smoking habits, symptoms and signs.

Location

London is a city with a population of 200,000, situated in the relatively flat farm country of Western Ontario, with an elevation of 900 feet. It is 125 miles west and slightly south of Toronto, and about the same distance east and slightly north of Detroit.

The weather is moderated by the surrounding Great Lakes: Lake Huron is 50 miles north and west; Lake Erie is 40 miles to the south. Relative humidity is high all year (Fig. 1), and pollination during spring, summer and fall is profuse.

The available index of community air pollution is the soiling index, monitored in several sites. The average soiling index at two stations in town for each month is shown in Fig. 2.

Population

Population at risk was defined as those male physicians, ages 25 to 74, who (1) were listed under "Physicians and Surgeons" in the yellow pages of the London telephone directory; (2) were listed in the Announcement of the Faculty of Medicine, University of

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Western Ontario, and (3) were on a separate list, compiled before the survey, of full-time physicians in industry, school and city health offices, chronic care hospital staff, as well as inactive physicians living in town. A total of 322 doctors appeared at risk. Of these, 310 completed the survey.

Location of survey

The survey was set up at three locations at different times during June, July and August: (1) Laboratory; (2) Victoria Hospital, London, doctors' lounge; (3) St. Joseph's Hospital, London, doctors' lounge. In addition, 23 physicians were interviewed and tested with the same equipment in their own offices.

Survey personnel

The group consisted of a medical student, a physician and a technician. The questionnaire was administered by the medical student or physician, after an initial period of training and practice in the administration of the questionnaire and after standardization of technique for auscultation and ventilatory tests (see Methods).

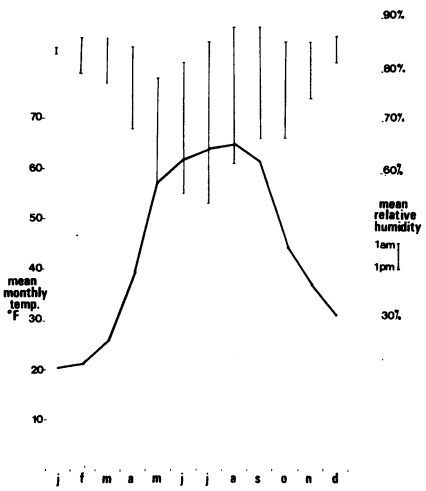

FIG. 1—London, Ontario. Temperature and relative humidity, 1966.

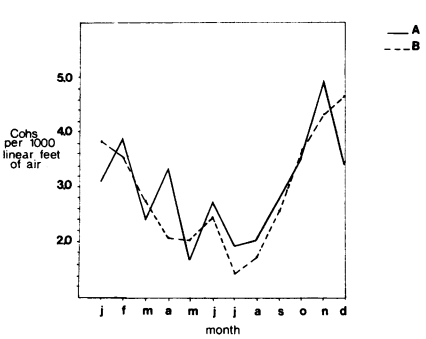

FIG. 2—London, Ontario. Mean monthly soiling index at two stations in town, A and B.

Definitions

Disease—The major classes of respiratory disease were defined as outlined by others doing survey work. These definitions conformed as closely as possible to those laid down in Ciba Foundation Guest Symposium.[12]

(1) Chronic bronchitis was diagnosed on a history of sputum production most days of the week, at least three months per year, for three years.

(2) Bronchial asthma—episodic wheezing, not due to other lung or heart disease, present in the year before the survey and labelled as asthma by the respondent.

(3) Obstructive lung disease—wheezing and/or shortness of breath, constantly present or very nearly so, without a history of bronchial asthma or chronic bronchitis, and/or a forced expiratory ratio (FER) of less than 60%.

(4) Hay fever—itchy eyes, with lacrimation, and rhinorrhea, occurring seasonally in the spring, summer or fall months.

Smoking Categories—These were defined as follows:

"Never smoked"—respondent who had never smoked cigarettes, pipe or cigars regularly; specifically, had smoked fewer than 365 cigarettes in any one year.

"Cigarette smoker"—respondent who was smoking at least 10 cigarettes per week. (There were no respondents in this category who smoked fewer than 10 cigarettes per week.)

"Ex-cigarette smoker"—former cigarette smoker who had not smoked for one month before the survey.

"Ex-cigarette smoker, now smoking pipe or cigars"—respondents now smoking pipe and/or cigars, having given up cigarettes at least one month before the survey.

"Pipe and/or cigar smoker"—a regular smoker of at least one cigar and/or one pipeful per day, but not including cigarettes.

A respondent who smoked a pipe and/or cigar plus cigarettes was classified as a current cigarette smoker. It was considered that this coalescence of two groups was justified on the grounds of: (1) a paucity of respondents in this category, and (2) failure of others to demonstrate differences in a cigar and/or pipe plus cigarette category from those smoking cigarettes only.[5]

Methods

1. Questionnaire—The standard questionnaire of respiratory symptoms, as used in the United Kingdom,[13] with a few additional questions, was employed.
2. Auscultation — The respondents were asked to hyperventilate moderately. The stethoscope was placed on the bare skin over upper lobes anteriorly and over lower lobes posteriorly. The respondents were classified as "rhonchi present" if rhonchi persisted in any location. Two observers participated in the survey. As a random check, in 50 consecutive cases results of one observer were checked with those of the other and no disagreement was found. If no rhonchi were heard, this was recorded. There were no categories other than "rhonchi present" or "rhonchi absent".
3. Using a light-weight spirometer of the Stead-Wells type, the best of three comparable forced vital capacity maneuvers corrected to BTPS was used. This method has been used in our laboratory in preference to averaging the three best of five efforts.

No records were judged to be unsatisfactory. Fifteen telephone calls were necessary after the survey was completed, to clarify details, largely related to poor handwriting. Because of the methods employed, it was not possible to form any opinion regarding the 12 physicians (3.7%) who did not take part in the study. We have no knowledge of whether they were likely to have more or less disease than the 96.3% of those at risk who were actually surveyed.

Statistical methods

Since almost the whole population of London doctors was studied, classical statistical inference from a sample to a population may seem irrelevant. However, for some purposes it is useful to think of the London doctors as a random sample from a conceptual infinite population of doctors living in a similar environment, with similar climate, similar pollution, etc., to London. Therefore, in this paper, confidence intervals have been constructed for the conceptual population parameters. The authors have chosen to express their statistical inferences in terms of 95% confidence intervals, rather than statistical tests such as chi-square, for two reasons: (1) Statistical tests of hypothesis merely tell whether an effect is present in the population as well as the sample. For

many medical problems, including smoking and bronchitis, the presence of an effect is hardly an issue. The real issue is the magnitude of the effect, and this is best expressed with a confidence interval. (2) From a 95% confidence interval, it is easy to make automatically a 5% significance test of a null hypothesis H by simply noting whether H lies within the confidence interval.

Confidence intervals, however, present some difficulties. They are harder to compute and often have to be approximated. Furthermore, it is often difficult to calculate a set of intervals that will simultaneously be true (at the 95% level of confidence) for a whole set of tables (Tables IV-VI); hence we did not attempt "multiple comparisons".

The actual formulas[18] used for large sample 95% confidence intervals for proportions are shown below:

For small samples (Table IV and following), the confidence interval for a single population was more accurately obtained from Table 41 of Biometrika Tables for Statisticians.[19] The confidence interval for two populations given above is also too rough, especially when either p_1 is extremely small; in these cases, the formula was modified conservatively by substituting under the $\sqrt{\ }$ symbol. The value of p_1 was replaced by the upper 95% confidence limit obtained from p_1.

Results

Smoking habits—Many samples of community populations have shown the strongest association of cigarette smoking with chronic bronchitis and obstructive lung disease. Hence any appraisal of the prevalence of these diseases without reference to current tobacco habits or lifetime cigarette smoking exposure was not considered to be meaningful. Since many others have explored the relationship of disease to current tobacco habits and to lifetime exposure, we have reported only the current tobacco categories.

There were 32.6% of the physicians who were current cigarette smokers (Table I); 19.7% were ex-cigarette smokers, and an additional 8.7% were ex-cigarette smokers now on pipe and/or cigars. Pipe and cigar only smokers accounted for 10.6% and the remaining 28.4% were non-smokers. The mean age of each smoking group was within 2.2 years of the mean age of the population (45.7 years). The rates are comparable to those of Canadian physicians who responded to a mailed survey of smoking habits, where 35.4% smoked cigarettes regularly and 27% were non-smokers.[16]

Prevalence of respiratory disease—Table I presents the age-standardized rates of chronic bronchitis, obstructive lung disease and asthma by current tobacco habits. Table II shows the age-specific prevalence of hay fever, as well as of the chronic respiratory diseases. The prevalence of bronchial asthma as defined is quite high in this population. A history of hay fever was also high—close to one physician in five in all age groups except the small group over 65 years of age. The relationship between chronic bronchitis and current tobacco habits is depicted in Fig. 3. There is nothing in this relationship that has not been shown in many reported surveys of pulmonary disease. Statistically significant differences (at the 99% confidence level) exist between current cigarette smokers and ex-cigarette smokers as well as those who have never smoked. The confidence co-efficient of the difference between those who have never smoked and ex-smokers now smoking pipe and/or cigar is between 95 and 99%. There remains in this Occupation Class I group (physicians) a residual of 1% prevalence of chronic bron-

TABLE I
Age-standardized rates of chronic non-specific respiratory disease by current tobacco habits

	Number %	*Chronic respiratory disease* %	*Chronic bronchitis* %	*Obstructive lung disease* %	*Asthma* %
Never smoked	88 (28.4%)	9	1	1	7
Ex-cigarette smoker	61 (19.7%)	25	5	5	15
Pipe and/or cigar smoker	33 (10.6%)	18	12	3	3
Ex-cigarette smoker, now smoking pipe and/or cigars	27 (8.7%)	23	19	0	4
Cigarette smoker	101 (32.6%)	44	34	4	6
Total	310 (100%)				
Weighted means		25	15	2	7

Standardized to age 45 years and rounded to the nearest per cent.

TABLE II
Age-specific prevalence of chronic respiratory disease uncorrected for smoking habits

Age Group (years)	*No.*	*Hay fever* (%)	*Asthma* (%)	*Chronic bronchitis* (%)	*Obstructive lung disease* (%)	*All chronic respiratory disease** (%)
25-34	46	21.7	4.3	2.7	0	10.9
35-44	130	19.2	8.5	12.3	0	20.8
45-54	78	21.8	8.9	18.0	2.5	29.4
55-64	44	18.2	6.8	36.3	6.8	50.0
65-74	12	0	0	8.3	33.3	41.7

**Does not include hay fever.*

(1) *Single population*

$$\theta \doteq p \pm 1.96 \sqrt{\frac{p(1-p)}{n}}$$

(2) *Comparison of two populations*

$$(\theta_1 - \theta_2) \doteq (p_1 - p_2) \pm 1.96 \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

Where θ = population proportion
p = sample proportion
n = sample size

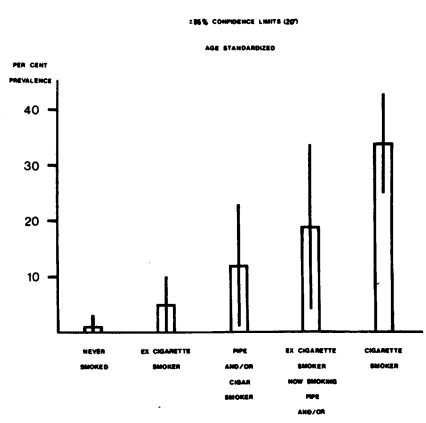

FIG. 3—Chronic bronchitis and current tobacco habits.

chitis in those who have never smoked cigarettes, cigars or pipes.

History of other lung disease excluding pneumonia—None of the patients had active disease, except possibly the one with bronchiectasis (Table III).

Rhonchi—None of the 88 individuals who had never smoked showed rhonchi upon physical examination while the highest proportion of those (8.9%) with rhonchi was found in the current cigarette smokers (Table IV). Table V shows the frequency of rhonchi in each disease category. The differences in forced expiratory volume, first second ($FEV_{1.0}$) and maximum expiratory flow rate (MMFR), between those with and those without rhonchi, standardized for age and height, were statistically significant (Table VI).

TABLE VI
Rhonchi and flow rates standardized to age and height*

	No.	*$FEV_{1.0}$ litres/sec.*	*FER per cent*	*MMFR litres/sec.*
Rhonchi absent	297	3.55 ± .07	78.8 ± .8	4.01 ± .07
Rhonchi present	13	3.08 ± .56	73.3 ± 6.2	2.89 ± .77
95% confidence interval for difference		.47 ± .39**	5.5 ± 6.0	1.12 ± .73**

**Standadized to age 45 years and to height 170 cm. ±95% confidence intervals.*
***Difference in flow rates significant at the 95% level of confidence.*

Ventilatory function—The flow rates expressed as $FEV_{1.0}$ and MMFR, standardized for age and height, (Table VII) are entirely comparable to those found in community surveys elsewhere. The highest $FEV_{1.0}$ was shown by non-smokers, the lowest by cigarette smokers and ex-cigarette smokers now on pipe and/or cigars.

TABLE III
Other lung disease excluding pneumonia

	No. of cases	*% of population*
Tuberculosis	11	4
Spontaneous pneumothorax	1	<1
Bronchogenic carcinoma	1	<1
Bronchiectasis	1	<1
Empyema	1	<1
Histoplasmosis	1	<1

TABLE IV
Current tobacco habits and rhonchi

No.		*Rhonchi %*	*95% confidence interval*
88	Never smoked	0	0-6%
61	Ex-cigarette smoker	1.6	1-7%
33	Pipe and/or cigar smoker	3.0	0-13%
27	Ex-cigarette smoker now smoking pipe and/or cigars	7.4	2-22%
101	Cigarette smoker	8.9	3-17%

The only statistically significant difference at the 95% confidence level is between "never smoked" and "cigarette smoker".

TABLE V
The occurrence of rhonchi in the clinical disease categories

	No.	*% with rhonchi*	*95% confidence level*
Chronic bronchitis	48	15.8	7-28%
Obstructive lung disease	9	22.2	3-60%
Asthma	23	4.4	0-22%
No chronic respiratory disease	230	1.3	0-3%

The only statistically significant differences, at the 95% confidence level, are between "no chronic respiratory disease" and "bronchitis," and between "no chronic respiratory disease" and "obstructive lung disease".

TABLE VII
Mean flow rates by smoking category standardized to age and height*

	Mean $FEV_{1.0}$ litres	*MMFR litres/sec.*
Never smoked	3.39 ± .13	4.09 ± .24
Ex-cigarette smoker	3.38 ± .16	3.99 ± .27
Pipe and/or cigar smoker	3.17 ± .33	4.17 ± .38
Ex-cigarette smoker now smoking pipe and/or cigars	3.09 ± .36	3.68 ± .45
Cigarette smoker	3.11 ± .12	3.64 ± .24

**Standardized to age 45 years and to height 170 cm. ±95% confidence intervals.*

Discussion

The prevalence of chronic bronchitis shows the usual increase with age, largely explained on the basis of increased lifetime consumption of cigarettes.[15] Others have shown some residual age effect in males after standardization for smoking habits.[5] What is required is an age-specific comparison of the non-smokers. Since there was only one case of chronic bronchitis in the 88 non-smokers, the data are insufficient. The prevalence of bronchial asthma, high in all smoking groups, as it is in all age groups up to age 65, shows a maximum value in ex-cigarette smokers. One might assume this to be the result of asthmatics finding that smoking exacerbated their symptoms. The confidence intervals, however, do not allow further interpretation of the figures. The high proportion of asthmatics in this population without an age trend, compared with other studies[4,5] prompted a review of the cases of asthma. Episodic wheezing was the distinguishing feature of the disease, not associated with chronic cough and sputum. Of the 23 who gave a history of bronchial asthma, recently active, 21 had clearly defined hay fever; the other two had summer and autumnal wheezing. Of the five asthmatics who also had chronic bronchitis, four were childhood asthmatics and all had hay fever. The number considered to be asthmatic (7.4%), by their own definitions and on the basis of our criteria, deserves further comment. It was also evident that the diagnosis of "obstructive lung disease" was made less frequently here than in the community-wide samples reported by Anderson and Ferris.[4,5] Some exchange of diagnosis may well be suspected, with the physicians reporting the symptoms for "asthma" more frequently. To test the hypothe-

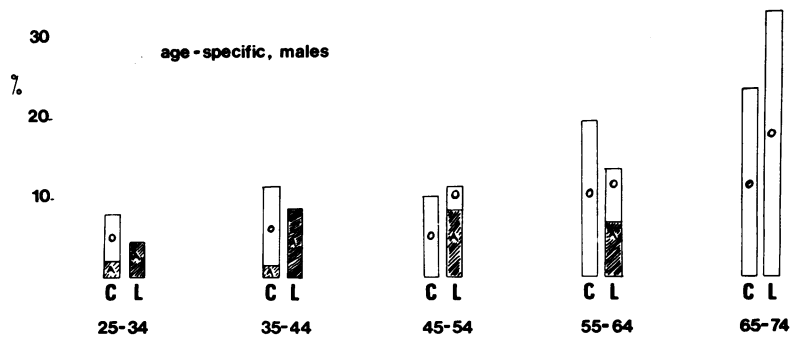

FIG. 4—Asthma plus obstructive lung disease — London, Ontario, and Chilliwack, British Columbia. Comparing London and Chilliwack: 95% confidence intervals for the difference:
(a) In asthma rates —6.6% ± 3.2%;
(b) In obstructive lung disease rates —9.1% ±4.5%;
(c) In (asthma and obstructive lung disease rates) —3.1% ±5.2%.
The differences between London(L) and Chilliwack(C), in asthma and obstructive lung disease rates separately, are statistically significant, but in the combined rates they are not.

sis of interchange in diagnosis between "asthma" and "obstructive lung disease," London, Ontario, versus Chilliwack, British Columbia, Fig. 4 attempts to add "asthma" and "obstructive lung disease" in each age group. The result shows a much closer agreement in prevalence than by using either diagnosis alone.

Broder, Barlow and Horton,[17] in a community survey in Tecumseh, Michigan, reported a 4.0 to 10.6% prevalence of "a history of asthma" in male residents, without an age trend. The lower figure is based upon "a certain diagnosis of asthma," whereas the higher one includes respondents with a "less certain" diagnosis. These figures are closer to the prevalence rates obtained in the present survey.

We are left with the possibility that asthma is much more prevalent in the Great Lakes area than in most other areas from which prevalence rates have been reported. Once again, diagnostic standards appear to influence the result. How many attacks of wheezing dyspnea and under what circumstances constitute a history of asthma? The length of time since the last episode varies somewhat in different surveys; some, as in this survey, insist that symptoms should have been present in the last year before making the diagnosis.

The correlation between rhonchi and ventilatory tests was of interest, and perhaps encouraging to those who like to think of rhonchi as meaning a degree of obstruction in the bronchial tree. The infrequent finding of rhonchi in the asthmatics was also of interest, but this was in active persons, who had ready access to and knowledge of bronchodilators and other means of controlling the disease.

Both chronic bronchitis and obstructive lung disease were significantly associated with rhonchi. At least in the former this correlation reflects the demonstrated relationships between cigarette smoking and both chronic bronchitis and rhonchi.

Résumé

La fréquence des pneumopathies chroniques chez les médecins de sexe masculin à London, Ontario

Une enquête sur les pneumopathies dont souffraient les médecins de sexe masculin de London, Ontario, a reçu un accueil favorable de la part de 96.3% des intéressés.

L'âge de la bronchite chronique ne différait pas sensiblement de celui qui a été noté dans des travaux publiés dans la littérature médicale récente, compte tenu de l'habitude de fumer, mais le pourcentage global de l'asthme bronchique était élevé (7.4%) et faible dans la catégorie des "pneumopathies occlusives". On a soulevé la possibilité qu'il y ait eu chevauchement ou échange entre ces divers diagnostics, mais il faut remarquer que le diagnostic d'asthme bronchique dans ce groupe particulier avait été clairement établi dans chaque cas.

Dans une proportion de 19.4%, les médecins ont déclaré avoir souffert de rhume des foins saisonnier.

Parmi les 88 médecins non fumeurs, on comptait un cas de bronchite (1%) et six cas d'asthme (7%).

Les râles thoraciques, entendus au cours d'un seul examen, étaient fort probablement attribuables à l'habitude de fumer, aux épreuves de la fonction respiratoire et, enfin, à un diagnostic clinique de bronchite chronique ou de pneumopathie occlusive, mais ne relevaient pas de l'asthme bronchique.

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