

Chronic Bronchitis: Prevalence, Smoking Habits, Impact, and Antismoking Advice¹

BETSY FOXMAN, PH.D.,*† ELIZABETH M. SLOSS, PH.D.,*²
KATHLEEN N. LOHR, PH.D.,‡ AND ROBERT H. BROOK, M.D., SC.D.*§

**The Health Sciences Program, The Rand Corporation, 1700 Main Street, Santa Monica, California 90406, †Department of Epidemiology, The University of Michigan, 109 Observatory, Ann Arbor, Michigan 48109, ‡The Health Sciences Program, The Rand Corporation, 2100 M Street, N.W., Washington, D.C. 20037; and §Departments of Medicine and Public Health, University of California Center for the Health Sciences, Los Angeles, California 90024*

Although the prevalence of chronic bronchitis has been measured in several populations, its impact on quality of life has not been assessed. We report the prevalence and impact of chronic bronchitis (defined as having phlegm on most days for at least 3 months during the previous year) among 4,708 adults ages 20 to 69 representative of the nonaged U.S. population. Men reported chronic bronchitis more frequently than women (12 vs 8%); smokers, regardless of age and sex, reported chronic bronchitis more frequently than former or never smokers. Among both men and women 35 years of age or older, current smokers—as opposed to ex- or never smokers—with chronic bronchitis had the poorest forced expiratory volume in 1 sec (FEV₁). The most commonly reported impact of chronic bronchitis was worry, followed by pain and restricted activity days, regardless of age, sex, or smoking habits. Of those current and ex-smokers who had seen a physician about their chronic bronchitis, 65% of men and 44% of women had decreased or stopped smoking. Among those current and ex-smokers with chronic bronchitis who did not consult a physician, the proportion of those who had decreased or stopped smoking was 29% for men and 37% for women. Finally, only 43% of male current smokers and 55% of female current smokers who had chronic bronchitis reported that a physician had advised them to decrease or stop smoking. © 1986 Academic Press, Inc.

INTRODUCTION

Although the prevalence of chronic bronchitis has been measured in several populations throughout the world over the past three decades (2, 3, 9, 13), how this condition affects the quality of daily life has not been examined. Here we assess, paying special attention to smoking status, the impact of chronic bronchitis as measured by pain, worry, and restricted activity days. Further, we examine the response of individuals with and without chronic bronchitis to physician advice to avoid or decrease smoking.

METHODS

This study uses data gathered during the enrollment phase of the Rand Health Insurance Experiment (HIE). The HIE sample represents the general nonaged

¹ The work reported herein was done pursuant to the Health Insurance Experiment funded by Grant 016B80 from the U.S. Department of Health and Human Services. The views expressed are those of the authors and do not necessarily reflect those of The Rand Corporation or of the Department of Health and Human Services.

² To whom reprint requests should be addressed at The Rand Corporation.

population of the United States; the elderly and disabled eligible for Medicare, persons in the military or in various institutions, and high-income families (those with incomes exceeding \$54,000 in 1982 dollars) were excluded. Families were sampled from six sites around the United States: Dayton, Ohio; Seattle, Washington; Fitchburg/Leominster, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown County, South Carolina. Details of the experimental design are described elsewhere (10).

During enrollment, all participants completed a self-administered medical history questionnaire that included a series of questions about emphysema, chronic bronchitis, and phlegm production. Those individuals not reporting a physician diagnosis of emphysema or chronic bronchitis or a history of phlegm production skipped over the remaining questions related to these conditions. The phlegm production questions originated from the World Health Organization/International Collaborative Study of Medical Care Utilization (15). Those who did report presence of any of these conditions went on to complete questions about the impact of their conditions on daily life (described below) and about physician visits for their condition. A series of questions regarding smoking history and physician advice to avoid or decrease smoking was included in a separate questionnaire section. All current and former smokers completed the questions on smoking. The validity and reliability of the questionnaire are described elsewhere (4, 14).

As part of the HIE design, a 60% random sample of participants underwent a physical examination during enrollment. The examination included lung function tests consisting of three tries at a Gould M-10 spirometer to measure forced expiratory volume in 1 sec (FEV_1) and forced vital capacity (FVC). All measures were corrected for barometric temperature and pressure. The best of the three tries was used for analysis. We predicted each individual's FEV_1 using Knudson's equations (6), which take into account age, height, and sex, and then calculated the percentage of predicted FEV_1 . Knudson's prediction equations are based on a sample of white individuals between 8 and 90 years of age who were "totally free of symptoms or history of cardiorespiratory disease and who had never smoked" (6).

Definition of Chronic Bronchitis and Disease Burden

We considered an individual to have chronic bronchitis if he or she answered yes to the following two questions: "During the past 12 months have you brought up any phlegm from your chest the first thing in the morning?" and "During the past year, were there at least three months when you brought up phlegm on most days?" This definition is similar to that recommended by the British Medical Research Council (1). The burden of chronic bronchitis on the individual was assessed by four "disease impact" questions. All persons who reported chronic phlegm production were asked if they had any pain, worry, restricted activity, or bed days related to the presence of emphysema, chronic bronchitis, or phlegm production. Precoded responses to the disease impact questions ranged from "none" to "a great deal" (worry and pain) or to "all the time" (activity restriction); these three items referred to the past 3 months. The question about days in

bed due to chronic bronchitis required that the respondent write either zero or the specific number of days spent in bed within the past 30 days.

Data were examined using multilevel contingency tables. All reported rates, unless otherwise stated, were age-adjusted using the direct method, with the age distribution of the entire sample as a standard.

RESULTS

We studied 4,708 adults ages 20 to 69 years representative of the adult, nonelderly U.S. population. Of those studied, 54% were women, 14% were nonwhite, and 38% had at least some college education.

Prevalence of Chronic Bronchitis by Age, Sex, and Smoking Habits

Of the study population, 10% reported the presence of phlegm on most days during at least 3 months during the previous year (chronic bronchitis by our definition). Men reported chronic bronchitis more frequently than did women (12 vs 8%); this difference was consistent across age groups (Table 1). In each age and sex group, current smokers reported chronic bronchitis more frequently than never or ex-smokers. Prevalence of chronic bronchitis rose with age among male current smokers, but there were no consistent age trends among other sex- and smoking-specific strata.

Lung Function and Chronic Bronchitis

The analyses in this section include the 60% random sample of participants from the experiment, 2,721 adults, who completed both a physical examination,

TABLE 1
PREVALENCE RATES (PER 100) OF CHRONIC BRONCHITIS^a BY SEX, AGE, AND SMOKING STATUS

Sex	Age (years)	Never smoked		Ex-smoker		Current smoker		Total	
		N ^b	%	N ^b	%	N ^b	%	N ^b	%
Male	20-24	134	8.2	30	13.3	150	14.0	314	11.5
	25-34	283	3.5	166	6.6	366	18.3	815	10.8
	35-44	124	10.5	133	3.8	216	18.5	473	12.3
	45-54	84	4.8	110	12.7	144	20.1	338	13.9
	55-69 ^c	49	6.1	69	8.7	69	31.9	187	16.6
	20-69 ^c	674	6.1	508	7.9	945	18.9	2,127	12.2
Female	20-24	222	5.0	58	3.5	156	11.5	436	7.1
	25-34	428	4.0	126	6.4	367	14.7	921	8.6
	35-44	265	5.7	59	6.8	173	12.1	497	8.1
	45-54	206	5.3	75	6.7	165	13.9	446	8.7
	55-69 ^c	111	4.5	49	8.2	70	17.1	230	9.1
	20-69 ^c	1,232	4.8	367	6.3	931	13.8	2,530	8.3

^a Phlegm on most days for at least 3 months during the previous year.

^b Total number of persons in the specific age, sex, and smoking status categories.

^c Only two persons in the sample were over 62 years of age.

including lung function testing, and the medical history questionnaire upon enrollment in the HIE. Measures of lung function were approximately normally distributed in each age and sex group. Both FEV_1 and FEV_1/FVC values were higher than those found by the National Center for Health Statistics (NCHS) Health and Nutrition Examination Survey of 1971–1975 (7), but in most instances the HIE values fell within the 95% confidence limits for the best trial in the NCHS survey (4).

Percentage of predicted FEV_1 decreased with age regardless of bronchitis, smoking habits, or sex (Figs. 1 and 2). This decrease is seen for all strata, but is particularly marked for current smokers with and without chronic bronchitis. (Note that the prediction equations were based on a sample of healthy persons who had never smoked.) For both men and women (Figs. 1 and 2), ex-smokers without chronic bronchitis had the highest values for percentage of predicted FEV_1 , followed by never smokers without chronic bronchitis and current smokers without chronic bronchitis. Current smokers reporting chronic bronchitis had the lowest measured values for percentage of predicted FEV_1 among both men and women 35 years of age or older. Ex- and never smokers with chronic bronchitis were excluded because of their small numbers.

Impact Associated with Chronic Bronchitis

As described earlier, only adults who reported emphysema, chronic bronchitis, or phlegm production answered a series of questions regarding the impact of these conditions. These analyses are limited to those individuals with chronic bronchitis by our definition. The presence of impact among people with chronic bronchitis differed greatly by sex and smoking habits (Table 2). Women with

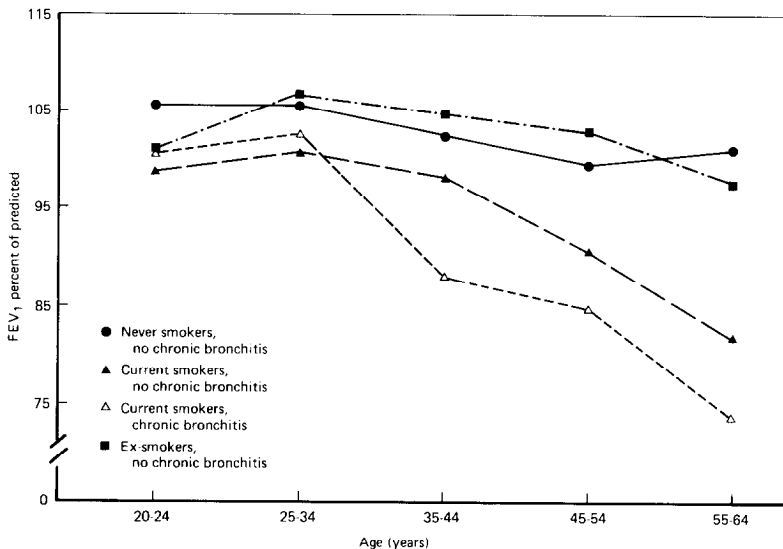


FIG. 1. Mean percentages of predicted FEV_1 among men by age, cigarette smoking status, and presence of chronic bronchitis.

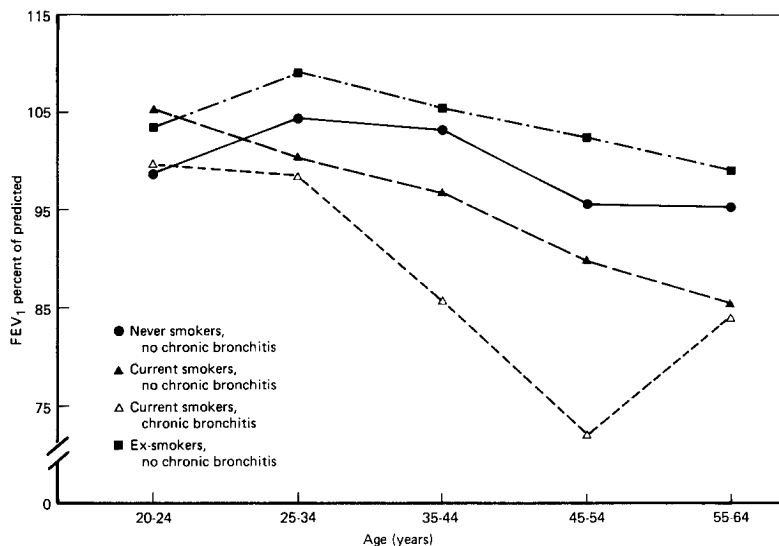


FIG. 2. Mean percentages of predicted FEV₁ among women by age, cigarette smoking status, and presence of chronic bronchitis.

chronic bronchitis reported more impact than did men with chronic bronchitis. Never smokers with chronic bronchitis reported more impact than did either current or ex-smokers with chronic bronchitis; most notably, never smokers reported more restricted activity days and bed days. The most frequently reported impact was worry; about half of those with chronic bronchitis reported worrying about it.

Effect of Physician Intervention

Although more than half of those with chronic bronchitis reported some negative impact from the condition during the past 3 months, less than one-third had

TABLE 2
AGE-ADJUSTED^a PREVALENCE RATES (PER 100) OF SELF-REPORTED IMPACT OF CHRONIC BRONCHITIS ON DAILY LIFE AMONG THOSE WITH CHRONIC BRONCHITIS BY SMOKING STATUS AND SEX

Type of impact	Never smoked		Ex-smoker		Current smoker		Total	
	Male (N = 41)	Female (N = 59)	Male (N = 40)	Female (N = 23)	Male (N = 179)	Female (N = 127)	Male (N = 260)	Female (N = 209)
Any pain during the past 3 months	33.3	34.5	35.7	18.8	25.3	35.5	28.1	34.1
Any worry during the past 3 months	55.7	56.9	46.7	33.8	54.5	56.2	52.6	53.5
Any restricted activity during the past 3 months	14.4	26.3	19.4	10.3	10.1	14.9	12.0	18.4
Bed-days during the past 30 days (% with 1 or more)	8.3	5.7	5.2	4.7	1.7	4.3	3.0	4.7

^a Adjusted for age using the direct method, all persons in the sample (both sexes) as standard.

TABLE 3
 PERCENTAGE OF PERSONS WITH CHRONIC BRONCHITIS EVER VISITING A PHYSICIAN ABOUT THEIR
 CHRONIC BRONCHITIS ACCORDING TO SMOKING STATUS AND SEX

Smoking status	Male		Female	
	<i>N</i> ^a	% ^b	<i>N</i> ^a	% ^b
Never smoked	41	32.1	59	37.8
Ex-smoker	38	30.6	22	23.6
Current smoker	175	15.7	123	25.7
Total	254	21.3	204	29.7

^a Total number of persons in smoking status and sex-specific category.

^b Adjusted for age using the direct method, all persons in the sample (both sexes) as standard.

ever visited a doctor about their chronic bronchitis (Table 3). Current smokers with chronic bronchitis received physician advice to avoid or decrease smoking almost twice as often as did current smokers without chronic bronchitis; nevertheless, only 48% of current smokers with chronic bronchitis reported that their physician had advised them to stop smoking (Table 4).

We expected that many smokers with chronic bronchitis would reduce their smoking with or without physician advice. Overall, among current and ex-smokers with chronic bronchitis, 35% of men and 38% of women had decreased or stopped smoking. Men with chronic bronchitis who had seen a physician about it were more than twice as likely to have decreased or stopped smoking as those with chronic bronchitis who had not seen a physician (Table 5). The association between a physician visit and a decline in smoking among women was less pronounced: Women who had seen a physician about their chronic bronchitis were 20% more likely to have decreased or stopped smoking than those who had not.

Impact from the condition may also influence an individual's decision to stop or restrict smoking. A decrease in smoking among current and ex-smokers with chronic bronchitis was more common among those who reported at least some pain (46%), worry (42%), or activity restriction (55%) than among those without

TABLE 4
 PERCENTAGE OF CURRENT AND EX-SMOKERS EVER RECEIVING PHYSICIAN ADVICE TO STOP OR
 DECREASE SMOKING ACCORDING TO PRESENCE OF CHRONIC BRONCHITIS AND SEX

Category	Male		Female	
	<i>N</i> ^a	% ^b	<i>N</i> ^a	% ^b
No chronic bronchitis				
Ex-smoker	466	14.3	343	14.3
Current smoker	764	21.1	802	25.6
Chronic bronchitis				
Ex-smoker	40	19.3	23	24.2
Current smoker	179	42.6	128	54.6

^a Total number of persons in smoking status, bronchitis status, and sex-specific category.

^b Adjusted for age using the direct method, all persons in the sample (both sexes) as standard.

TABLE 5
 PERCENTAGE OF CURRENT AND EX-SMOKERS WITH CHRONIC BRONCHITIS WHO DECREASED OR STOPPED SMOKING ACCORDING TO PHYSICIAN CONTACT, SMOKING ADVICE, AND SEX

Physician contact about chronic bronchitis	Antismoking advice from any physician	Male		Female	
		<i>N</i> ^a	% ^b	<i>N</i> ^a	% ^b
Ever contacted	Advice	25	84.7	24	48.2
	No advice	15	37.2	13	33.7
	Total	40	65.1	37	43.5
Never contacted	Advice	60	25.6	50	44.6
	No advice	113	31.3	58	30.1
	Total	173	28.6	108	36.6

^a Total number of persons in contact, advice, and sex-specific categories.

^b Adjusted for age using the direct method, all persons in the sample (both sexes) as standard.

any negative impact (28%). The decrease in smoking among those with no impact from chronic bronchitis was about two-thirds that of those with some impact.

DISCUSSION

We measured the prevalence and impact of chronic bronchitis in a sample representative of the general, nonaged U.S. population. Because the study was cross-sectional, data regarding phlegm production, impact, physician advice, and change in smoking habits were gathered retrospectively. The validity of such information depends on the respondent's ability to recall accurately the desired event; this ability may vary with the event. Although an individual may easily recall a chronic condition, a doctor visit occurring as recently as 1 month earlier may be less accurately remembered. Finally, a person who suffered pain, worry, or activity restriction associated with chronic bronchitis 2 months ago may be less likely to report these effects than someone currently suffering from these impacts. Even so, more than half of those with chronic bronchitis reported some form of negative impact from that condition on their health.

We found men more likely than women to comply with physician advice to avoid or decrease smoking, a fact consistent with the literature (11). However, women were more likely than men to receive, or to recall receiving, such advice. This may be explained by the higher rate of physician contact among women 17 years of age or older (8). Among those with chronic bronchitis, if men usually wait until their condition is more severe before consulting a physician, they may be more likely to comply with physician advice than women, who may see a physician when their condition is less severe.

Current smokers had the worst lung function and the highest rate of chronic bronchitis. Poor lung function and phlegm production are strong predictors of mortality (5, 12). Compliance with physician advice to stop smoking among patients with pulmonary disease has been reported to be as high as 51% (11). Considering all of these facts together, physicians should increase their efforts to offer antismoking advice to their patients with pulmonary symptoms.

ACKNOWLEDGMENTS

We thank our Rand colleagues Emmett Keeler and Joseph Newhouse for their thoughtful comments, criticism, and suggestions. We are grateful to Nancy Lees for her meticulous secretarial assistance.

REFERENCES

1. British Medical Research Council. Definition and classification of chronic bronchitis for clinical and epidemiological purposes. *Lancet* 1, 775-779 (1965).
2. Ferris, B. G., Higgins, I. T. T., Higgins, M. W., Peters, J. M., VanGanse, W. F., and Goldman, M. D. Chronic nonspecific respiratory disease, Berlin, New Hampshire, 1961-1967: A cross-sectional study. *Amer. Rev. Respir. Dis.* 104, 232-244 (1971).
3. Fletcher, C. M., Elmes, P. C., Fairbairn, A. S., and Wood, C. H. The significance of respiratory symptoms and the diagnosis of chronic bronchitis in working population. *Brit. Med. J.* 2, 257-266 (1959).
4. Foxman, B., Lohr, K. N., Brook, R. H., Goldberg, G. A., Rosenthal, M., and Sloss, E. "Conceptualization and Measurement of Physiologic Health for Adults," Vol. 8, "Chronic Obstructive Airway Disease." Report No. R-2262/8-1-HHS. The Rand Corporation, Santa Monica, Calif., Sept. 1982.
5. Foxman, B., Higgins, I. T. T., and Oh, M. S. The effects of occupation and smoking on respiratory disease mortality. *Amer. Rev. Respir. Dis.* 134, (1986).
6. Knudson, R. J., Slatin, R. C., Lebowitz, M. D., and Burrows, B. The maximal expiratory flow-volume curve: Normal standards, variability, and effects of age. *Amer. Rev. Respir. Dis.* 113, 587-600 (1976).
7. National Center for Health Statistics. Basic data on spirometry in adults 25-74 years of age: United States, 1971-75, in "Vital and Health Statistics," Series 11, No. 222, DHHS Publication No. (PHS) 81-1672. U.S. Govt. Printing Office, Washington D.C., March 1981.
8. National Center for Health Statistics. Current estimates from the National Health Interview Survey: United States, 1981, in "Vital and Health Statistics," Series 10, No. 141, DHHS Publication No. (PHS) 82-1569. U.S. Govt. Printing Office, Washington, D.C., Oct. 1982.
9. Neri, L. C., Mandel, J. S., Hewitt, D., and Jurkowski, D. Chronic obstructive pulmonary disease in two cities of contrasting air quality. *Canad. Med. Assoc. J.* 113, 1043-1046 (1975).
10. Newhouse, J. P., Manning, W. G., Morris, C. N., Orr, L. L., Duan, N., Keeler, E. B., Leibowitz, A., Marquis, K. H., Marquis, M. S., Phelps, C. E., and Brook, R. H. Some interim results from a controlled trial of cost sharing in health insurance. *New Engl. J. Med.* 305, 1501-1507 (1981).
11. Pederson, L. L. Compliance with physician advice to quit smoking. A review of the literature. *Prev. Med.* 11, 71-84 (1982).
12. Peto, R., Speizer, F. E., Cochrane, A. L., Moore, F., Fletcher, C. M., Tinker, C. M., Higgins, I. T. T., Gray, R. G., Richards, S. M., Gilliland, J., and Norman-Smith, B. The relevance in adults of air-flow obstruction, but not of mucus hypersecretion, to mortality from chronic lung disease. *Amer. Rev. Respir. Dis.* 128, 491-500 (1983).
13. Rokaw, S. N., Detels, R., Coulson, A. H., Sayre, J. W., Tashkin, D. P., Allwright, S. S., and Massey, F. J. The UCLA population studies of chronic obstructive respiratory disease. 3. Comparison of pulmonary function in three communities exposed to photochemical oxidants, multiple primary pollutants, or minimal pollutants. *Chest* 78, 252-262 (1980).
14. Stewart, A. L., Brook, R. H., and Kane, R. L. "Conceptualization and Measurement of Health Habits for Adults in the Health Insurance Study," Vol. 1, "Smoking." Report No. R-2374/1-HEW, The Rand Corporation, Santa Monica, Calif., June 1979.
15. World Health Organization. "International Collaborative Study of Medical Care Utilization: 2. Questionnaire." Coordinating Committee for the International Collaborative Study of Medical Care Utilization, Maryland, 1970.