

Chronic Obstructive Pulmonary Disease in Lifelong Nonsmokers: Results from NHANES

ABSTRACT

The prevalence of chronic obstructive pulmonary disease was evaluated in 12 980 lifelong nonsmoking adults who participated in one of three National US Health and Nutrition Examination Surveys. Also evaluated were the relationships between chronic obstructive pulmonary disease and age, sex, ethnicity, education, income, and certain environmental and occupational factors. Overall, 4% of men and 5% of women reported physician-diagnosed chronic obstructive pulmonary disease. Prevalence increased with age and with decreasing household income, was higher in Whites than in non-Whites, and was particularly high in Hispanic women. Further research is needed to explain the excess risk for chronic obstructive pulmonary disease in economically disadvantaged nonsmokers, and to assess the role of environmental tobacco smoke in nonsmokers' risk for the disease. (*Am J Public Health*. 1995;85:702-706)

Alice S. Whittemore, PhD, Susan A. Perlin, ScD, and Yasamin DiCiccio

Introduction

Chronic obstructive pulmonary disease is a process characterized by the presence of chronic bronchitis or emphysema that may lead to the development of airways obstruction.¹ Chronic obstructive pulmonary disease is a major cause of morbidity and mortality throughout the world; 82 384 such deaths occurred in the United States in 1988, making the disease the fifth leading cause of death.² Apart from its role as a direct cause of death, chronic obstructive pulmonary disease also contributes to deaths from cardiovascular disease.³ Approximately 85% of chronic obstructive pulmonary disease mortality in men and 69% of its mortality in women can be attributed to cigarette smoking.⁴⁻⁶ In the United States, this higher share of mortality among men⁷ may reflect a higher proportion of male cigarette smokers than of female cigarette smokers in the past.

Little is known about the epidemiology of chronic obstructive pulmonary disease in lifelong nonsmokers. Here we present age-, sex-, and race-specific chronic obstructive pulmonary disease prevalence rates among 12 980 never-smoking adults (3904 men and 9076 women) who participated in one of three US National Health and Nutrition Examination Surveys (NHANES). We use these data to examine associations between chronic obstructive pulmonary disease prevalence and certain demographic characteristics and occupational factors.

Methods

Study subjects were participants in either NHANES I (April 1971 to September 1975), NHANES II (February 1976 to February 1980), or the Hispanic Health and Nutrition Examination Survey

(HHANES) (July 1982 to December 1984). These surveys provide a probability sample of the civilian, noninstitutionalized population of the continental United States, aged 6 months to 74 years. This analysis includes all participants aged 18 to 74 years (25 to 74 years for NHANES I) who provided information on their race and chronic obstructive pulmonary disease status and who replied negatively to the question "Have you smoked at least 100 cigarettes during your entire life?"

A history of chronic obstructive pulmonary disease was defined as an affirmative response to either "Has a doctor ever told you that you had chronic bronchitis?" or "Has a doctor ever told you that you had emphysema?" Characteristics examined in relation to chronic obstructive pulmonary disease risk include sex, age, race (White, non-White), income, educational level, body size, industry of principal job or business and job title, home heating equipment and air conditioning information, and residential characteristics (e.g., urban vs rural area, population size of area). Industries and job titles were coded using national indexes of industries and occupations (1970 edition⁸ for NHANES I and II; 1980 edition⁹ for

Alice S. Whittemore and Yasamin DiCiccio are with the Department of Health Research and Policy, Stanford University School of Medicine, Stanford, Calif. Susan A. Perlin is with the Office of Health Research, US Environmental Protection Agency, Washington, DC.

Requests for reprints should be sent to Alice S. Whittemore, PhD, Department of Health Research and Policy, Stanford University School of Medicine, Redwood Bldg, Room T204, Stanford, CA 94305-5092.

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Note. This research, while supported by the US Environmental Protection Agency, has not been subjected to agency review; thus, it does not necessarily reflect the views of the agency, and no official endorsement should be inferred.

TABLE 1—The Prevalence of Self-Reported Physician-Diagnosed Chronic Obstructive Pulmonary Disease among Lifelong Nonsmokers in NHANES, by Age, Sex, Race, and Survey

	NHANES I, 1971–1975			NHANES II, 1976–1980			HHANES, 1982–1984			Total		
	No.	Observed No. with COPD	%	No.	Observed No. with COPD	%	No.	Observed No. with COPD	%	No.	Observed No. with COPD	%
Men												
Whites	688	31	4.5	1842	68	3.7	941	36	3.8	3471	135	3.9
Non-Whites	121	0	0	295	7	2.4	17	3	17.6	433	10	2.3
Age, y												
< 50	423	13	3.1	1291	31	2.4	719	26	3.6	2433	70	2.9
50–69	317	13	4.1	656	35	5.3	212	12	5.7	1185	60	5.1
70+	69	5	7.2	190	9	4.7	27	1	3.7	286	15	5.2
Subtotal	809	31	3.8	2137	75	3.5	958	39	4.1	3904	145	3.7
Women												
Whites	1736	92	5.3	4028	233	5.8	2257	141	6.2	8021	466	5.8
Non-Whites	275	10	3.6	721	34	4.7	59	2	3.4	1055	46	4.4
Age, y												
< 50	921	43	4.7	2107	70	3.3	1535	90	5.9	4563	203	4.4
50–69	885	48	5.4	1953	142	7.3	692	48	6.9	3530	238	6.7
70+	205	11	5.4	689	55	8.0	89	5	5.6	983	71	7.2
Subtotal	2011	102	5.1	4749	267	5.6	2316	143	6.2	9076	512	5.6
Total	2820	133	4.7	6886	342	5.0	3274	182	5.6	12 980	657	5.1

Note. NHANES = National Health and Nutrition Examination Survey; HHANES = Hispanic Health and Nutrition Examination Survey; COPD = chronic obstructive pulmonary disease.

HHANES). None of the surveys provided information on exposures to dusts, fumes, or chemicals potentially associated with chronic obstructive pulmonary disease risk. Therefore, reported job titles were used to classify individuals into high, medium, or low categories based on potential for exposure to airborne contaminants that may cause or exacerbate the disease.

Multiple logistic regression implemented on EGRET software¹⁰ was used to estimate regression coefficients relating chronic obstructive pulmonary disease prevalence to personal characteristics and to adjust for potential confounding factors. All *P* values are two tailed. The surveys were based on a weighted sampling design, with oversampling of non-Whites, individuals of lower income, and the elderly. Chronic obstructive pulmonary disease prevalence in demographic subgroups was computed both with and without the sampling weights, and similar prevalence estimates were found. Since incorporation of the weights in logistic regression is not straightforward, only the unweighted prevalence estimates are presented.

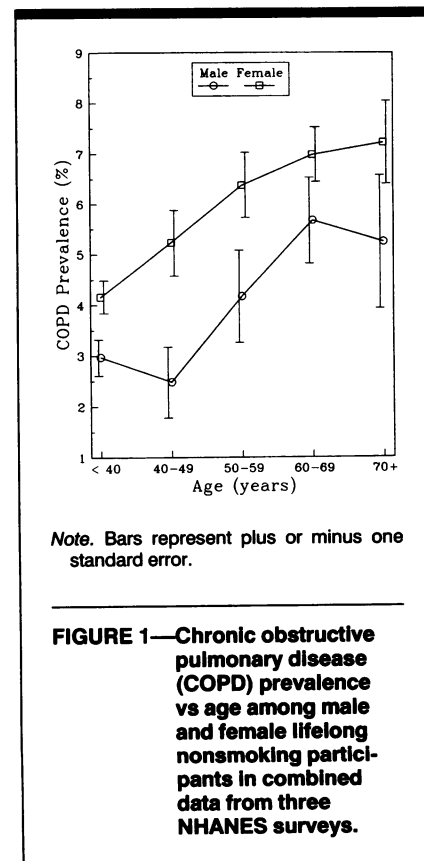
Results

In NHANES I, 2820 participants (809 men, 2011 women) stated that they

were lifelong nonsmokers. This represents 41% of all 6905 participants (3166 men, 3739 women) who provided definitive information about their lifelong smoking habits. In NHANES II, 6886 participants (2137 men, 4749 women) declared themselves lifelong nonsmokers, which was 38% of all 18 337 participants (8589 men, 9748 women) who provided smoking information. Comparable numbers for HHANES were 3274 lifelong nonsmokers (958 men, 2316 women), or 36% of all 9148 subjects (4111 men, 5037 women) who provided smoking data.

Table 1 shows chronic obstructive pulmonary disease prevalence rates by sex, race, and age group for each of the surveys. Prevalence increased with age (see also Figure 1), was higher in women (5.6%) than in men (3.7%), and, within each sex, was higher in Whites than in non-Whites. After adjustment for age and race, prevalence in men did not differ among the three surveys (*P* = .45). However, age- and race-adjusted prevalence in female HHANES participants was higher than that of women from the other two surveys (*P* = .02).

Table 2 presents odds ratios (ORs) relating chronic obstructive pulmonary disease prevalence to sex and race, by survey. After adjustment for age, race, and survey, prevalence was significantly higher in women than in men. The overall



Note. Bars represent plus or minus one standard error.

FIGURE 1—Chronic obstructive pulmonary disease (COPD) prevalence vs age among male and female lifelong nonsmoking participants in combined data from three NHANES surveys.

odds ratio was 1.4, with 95% confidence interval (CI) of 1.1, 1.7. Age-adjusted prevalence of the disease was higher for

TABLE 2—Risk for Chronic Obstructive Pulmonary Disease among Lifelong Nonsmokers according to Sex, Race, and Socioeconomic Status, by Survey

	NHANES I												NHANES II												HHANES												Total		
	Men				Women				Total				Men				Women				Total				Men			Women			Total								
	No.	COPD ^a	%	OR ^b	CI	No.	COPD ^a	%	OR ^b	CI	No.	COPD ^a	%	OR ^b	CI	No.	COPD ^a	%	OR ^b	CI	No.	COPD ^a	%	OR ^b	CI	No.	COPD ^a	%	OR ^c	CI									
Sex	688 ^d	31	4.5	1.0	...	2137	75	3.5	1.0	...	958	39	4.1	1.0	...	3783	145	3.8	1.0	...	3783	145	3.8	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Men	2011	102	5.1	1.1	0.75, 1.7	4749	267	5.6	1.4**	1.1, 1.9	2316	143	6.2	1.5*	1.0, 2.2	9076	512	5.6	1.4**	1.1, 1.7	...	...	...	...	...	...	...	...	...	...
Women	688	31	4.5	...	...	1842	68	3.7	1.0	...	941	36	3.8	1.0	...	3471	135	3.9	1.0	...	3471	135	3.9	1.0	...	9076	512	5.6	1.4**	1.1, 1.7							
Race	121	0	0	0	...	295	7	2.4	0.62	0.28, 1.4	17	3	17.6	5.4*	1.5, 19.7	312	10	3.2	0.87	0.45, 1.7	...	...	...	...	...	...	...	...	...	...
Men	1736	92	5.3	1.0	...	4028	233	5.8	1.0	...	2257	141	6.2	1.0	...	8021	446	5.8	1.0	...	8021	446	5.8	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Women	275	10	3.6	0.67	0.34, 1.3	721	34	4.7	0.84	0.58, 1.2	59	2	3.4	0.51	0.12, 2.1	1055	46	4.4	0.77	0.56, 1.1	...	...	...	...	...	...	...	...	...	...
Income	53	4	7.5	1.0	...	362	4	1.1	1.0	...	286	11	3.8	1.0	...	701	19	2.7	1.0	...	701	19	2.7	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Men	153	4	2.6	0.41	0.10, 1.8	563	17	3.0	2.9	0.95, 8.6	250	7	2.8	0.68	0.25, 1.9	966	28	2.9	1.1	0.62, 2.1								
Women	294	15	5.1	0.90	0.26, 3.1	699	29	4.1	3.7*	1.3, 10.9	252	11	4.4	1.0	0.40, 2.5	1245	55	4.4	1.7	0.98, 3.0	...	...	...	...	...	...	...	...	...	...
Overall trend	165	8	4.8	0.66	0.16, 2.7	393	20	5.1	4.4**	1.4, 13.5	98	9	9.2	2.0	0.71, 5.5	656	37	5.6	2.0*	1.1, 3.6	...	...	...	...	...	...	...	...	...	...
Education	86	4	4.7	1.0	...	453	12	2.7	1.0	...	477	23	4.8	1.0	...	1016	39	3.8	1.0	...	1016	39	3.8	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Men	313	22	7.0	1.7	0.55, 5.0	939	38	4.0	1.5	0.77, 2.9	516	27	5.2	1.2	0.65, 2.1	1768	87	4.9	1.3	0.90, 2.0								
Women	745	31	4.2	0.93	0.31, 2.7	1659	98	5.9	1.9*	1.0, 3.4	620	39	6.3	1.4	0.83, 2.5	3024	168	5.6	1.4*	1.0, 2.1								
Overall trend	775	40	5.2	0.99	0.33, 3.0	1385	102	7.4	1.9*	1.0, 3.7	492	41	8.3	1.9*	1.1, 3.4	2652	183	6.9	1.6*	1.1, 2.4								
Education	269	14	5.2	1.0	...	871	24	2.8	1.0	...	260	10	3.8	1.0	...	1400	48	3.4	1.0	...	1400	48	3.4	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Men	261	10	3.8	0.63	0.26, 1.5	785	25	3.2	0.88	0.49, 1.6	374	11	2.9	0.68	0.27, 1.7	1420	46	3.2	0.76	0.49, 1.2								
Women	135	7	5.2	0.60	0.20, 1.8	361	21	5.8	1.0	0.51, 2.1	252	17	6.7	1.4	0.53, 3.5	748	45	6.0	0.97	0.59, 1.6								
Overall trend	440	23	5.2	1.0	...	1191	46	3.9	1.0	...	376	25	6.6	1.0	...	2007	94	4.7	1.0	...	2007	94	4.7	1.0	...	9076	512	5.6	1.4**	1.1, 1.7									
Education	989	42	4.2	0.84	0.49, 1.4	2166	99	4.6	1.0	0.70, 1.5	849	50	5.9	0.77	0.46, 1.3	4004	191	4.8	0.91	0.70, 1.2								
Overall trend	490	32	6.5	1.4	0.75, 2.7	1079	105	9.7	1.8*	1.2, 2.7	880	55	6.3	0.66	0.38, 1.1	2449	192	7.8	1.3	0.96, 1.7								

Note. NHANES = National Health and Nutrition Examination Survey; HHANES = Hispanic Health and Nutrition Examination Survey; COPD = chronic obstructive pulmonary disease; OR = odds ratio; CI = confidence interval.
^aObserved number with COPD.
^bOdds ratios for race are adjusted for age; odds ratios for sex are adjusted for age and race; odds ratios for income (education) are adjusted for age, race, education (income). For NHANES I men, odds ratios are adjusted for age only since no non-White men in NHANES I reported COPD. Subtotals for income and education are smaller than totals because of missing data.
^cOdds ratios for race are adjusted for age and survey; odds ratios for sex, income, and education are also adjusted for race.
^dExcluding non-White men from all analyses.
 *P < .05; **P < .01.

Whites than for non-Whites in each survey and sex, but these differences were not statistically significant. The overall odds ratios for non-Whites relative to Whites were 0.87 (95% CI = 0.45, 1.7) for men and 0.77 (95% CI = 0.56, 1.1) for women.

Table 2 also shows chronic obstructive pulmonary disease prevalence in relation to household income, by sex and survey. Odds ratios are adjusted for age, ethnicity, and education. In NHANES II and HHANES but not in NHANES I, strong and statistically significant trends are seen with decreasing household income for both men and women. These trends also are evident when all three surveys are combined. By contrast, only weak and inconsistent trends are seen with educational level after adjusting for age, ethnicity, and income. As an exception, prevalence was elevated among women in NHANES II who did not complete high school compared with prevalence among those with a college degree (OR = 1.8; 95% CI = 1.2, 2.7).

After adjustment for age, race, and income, chronic obstructive pulmonary disease prevalence was unrelated in either sex to body size (height, weight, weight-for-height), type of home heating equipment, and presence of home air conditioning. Information on type of fuel used for cooking (available only for HHANES) revealed no association with chronic obstructive pulmonary disease risk. Similarly, we found no consistent or statistically significant associations between chronic obstructive pulmonary disease and area (urban vs rural) or population size of city or town of residence. Other characteristics examined and found unrelated to prevalence were employment in jobs with high potential for exposures to dusts and fumes, and nativity (US vs foreign born).

There were few individuals who never smoked cigarettes but who used pipes or cigars, and the chronic obstructive pulmonary disease prevalence rates were unchanged when they were excluded.

Discussion

We have examined the prevalence of chronic obstructive pulmonary disease in never-smoking participants of three US national surveys. Chronic obstructive pulmonary disease prevalence increased with age and was higher in women than in men, higher in Whites than in non-Whites, and higher in low-income than in affluent

individuals. No clear or consistent associations were seen with body size, area of residence (urban vs rural), type of home heating equipment, home air conditioning, or type of occupation.

The study has several limitations. First, the findings are based on self-reported history of physician-diagnosed chronic obstructive pulmonary disease rather than on lung function measurements. Use of the latter to define the disease would have reduced the sample size since spirometry data were not available for all participants. Apart from loss of power, the use of spirometry data could introduce bias by excluding those individuals unable to provide reproducible lung function measurements.¹¹ Nevertheless some individuals with asthma, idiopathic interstitial fibrosis, or acute bronchitis may misclassify themselves as having chronic obstructive pulmonary disease, leading to an overestimation of prevalence. Moreover, differential errors by race or socioeconomic status could introduce bias.

Second, the surveys lack information on exposures to environmental tobacco smoke. Such exposures have been associated with decreased pulmonary function in nonsmoking women¹² and chronic obstructive pulmonary disease in nonsmoking adults.^{13,14} They could account for the higher prevalence observed in women compared with men (since nonsmoking women are more likely than nonsmoking men to have a smoking spouse¹⁵) and for the trend of increasing risk with decreasing income (since household income and household smoking prevalence are inversely related). Finally, sparse numbers of chronic obstructive pulmonary disease outcomes among nonsmokers and possible misclassification of occupational potential for exposure to airborne contaminants limit the study's sensitivity to detect occupational risk factors.

Despite these limitations, some conclusions seem warranted. In particular, the disease is not vanishingly rare in lifelong nonsmokers. The overall prevalence in adults aged 18 to 74 is about 4% to 6%. The observed chronic obstructive pulmonary disease prevalence of 3.7% in men is similar to the prevalences of 3.7% and 3.4%, respectively, noted in Finnish nonsmoking farmers (although these data included ex-smokers, and sex-specific rates were not provided) and a nonsmoking comparison group.¹⁶ The present prevalence rates also are similar to those noted for self-reported prevalence of chronic

cough, phlegm, or wheezing (symptoms consistent with chronic obstructive pulmonary disease) in lifelong nonsmoking men and women in Finland.¹⁷ Unlike the present study, however, the Finnish study did not find an excess of symptoms in women.

The elevated chronic obstructive pulmonary disease prevalence in Hispanic women and in economically disadvantaged adults of both sexes suggests that environmental factors associated with poverty may increase risk for the disease in nonsmokers. Because most chronic obstructive pulmonary disease is due to cigarette smoking, relatively little is known about such factors. Acute respiratory infections in childhood may increase risk for disabling lung disease in adulthood.¹⁸ Increased exposure to environmental tobacco smoke, particularly in childhood, may be involved. Occupational exposures to inorganic dusts and fumes,^{19,20} residence in urban areas,²¹ and use of gas for cooking²² have also been implicated in elevated rates of chronic obstructive pulmonary disease. Additionally, chronic obstructive pulmonary disease has been linked to decreased levels of serum retinol.²³ A small fraction of the disease in nonsmokers is due to inherited deficiency of an α_1 -proteinase inhibitor (formerly called α_1 -antitrypsin), although not all individuals who inherit this deficiency develop chronic obstructive pulmonary disease.²⁴ Further research is needed to determine any environmental factors that increase risk of both the inherited and noninherited forms of the disease. □

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ABSTRACT

The relative contribution of walking to overall leisure-time physical activity participation rates was studied among respondents from the 45 states that participated in the 1990 Behavioral Risk Factor Surveillance System (n = 81 557). The percentages of low income, unemployed, and obese persons who engaged in leisure-time physical activity (range = 51.1% to 57.7%) were substantially lower than the percentage among the total adult population (70.3%). In contrast, the prevalence of walking for exercise among these sedentary groups (range = 32.5% to 35.9%) was similar to that among the total population (35.6%). Walking appears to be an acceptable, accessible exercise activity, especially among population subgroups with a low prevalence of leisure-time physical activity. (*Am J Public Health.* 1995;85: 706-710)

The Epidemiology of Walking for Exercise: Implications for Promoting Activity among Sedentary Groups

Paul Z. Siegel, MD, MPH, Robert M. Brackbill, PhD, MPH, and Gregory W. Heath, DHSc, MPH

Introduction

Evidence for the health benefits of regular physical activity has mounted in recent years,¹⁻⁶ and an increasing number of health-related organizations have advocated increased physical activity as a critical step toward a healthier population.⁷⁻¹⁰ For several reasons, walking is of special interest in this regard. It is becoming increasingly apparent that light-to moderate-intensity activities such as walking may provide some of the same health benefits as do more vigorous types of physical activity,¹⁰⁻¹³ along with a lower risk of injury and sudden death.¹⁴

Walking also has unique epidemiological features. First, walking is widely reported as the most popular form of physical activity.¹⁵⁻¹⁸ Second, unlike most other leisure-time activities, particularly the more vigorous ones, walking for exercise has been shown to be preva-

lent among people with low family incomes as it is among people with higher incomes.^{16,19} The apparent preference for walking among persons of low socioeconomic status (SES) is of particular interest because low SES has been associated with decreased physical activity participation.¹⁹⁻²² Based on this association, national health objectives for the year 2000

Paul Z. Siegel is with the Office of Surveillance and Analysis, National Center for Chronic Disease Prevention and Health Promotion; Robert M. Brackbill is with the National Center for Prevention Services; and Gregory W. Heath is with the Epidemiology Program Office, all at the Centers for Disease Control and Prevention, Atlanta, Ga.

Requests for reprints should be sent to Paul Z. Siegel, MD, MPH, National Center for Chronic Disease Prevention and Health Promotion, Office of Surveillance and Analysis, Mailstop K30, Centers for Disease Control and Prevention, Atlanta, GA 30341-3724.

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