



Original Contribution

Is Childhood Asthma Associated With Educational Level and Longest-Held Occupation?

Jacek M. Mazurek*, Patricia L. Schleiff, and Paul K. Henneberger

* Correspondence to Dr. Jacek M. Mazurek, Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Surveillance Branch, Mailstop HG 900.2, 1095 Willowdale Road, Morgantown, WV 26505 (e-mail: jmazurek1@cdc.gov).

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Children with asthma can experience chronic morbidity that may interfere with education and career progression. The authors investigated retrospectively whether a history of childhood asthma is associated with educational level and longest-held occupation, by gender. Cross-sectional analysis included a nationally representative sample of 10,452 adults aged ≥ 20 years who participated in the US National Health and Nutrition Examination Survey (2001–2004). Logistic regression was used to assess associations between a childhood-asthma history and educational level, employment, and longest-held occupation. An estimated 6.9% of men and 5.8% of women had a childhood-asthma history. Persons with a childhood-asthma history tended to have a higher educational level than those with no asthma history. Among those who ever worked, and after adjustment for age and race/ethnicity, men with a childhood-asthma history were more likely to work in health-diagnosing occupations, other professional occupations, and as cooks; women with a childhood-asthma history were more likely to work in management-related, entertainment-related, and health service occupations. Compared with those with no asthma history, persons with a childhood-asthma history tended to achieve a higher educational level and, if they worked, were more likely to work in particular occupations.

counseling; healthy worker effect; occupational health; vocational guidance

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio.

Adverse effects of asthma remain major clinical and public health problems in the United States. In 2008, 13.9% of US children aged <18 years had ever been diagnosed with asthma (i.e., lifetime asthma), with higher rates among males (16.5%) than females (11.2%) (1). There is evidence that the consequences of chronic illness in childhood could lead to poorer academic achievement, unemployment, and decreased earning power (2–4). A report from the Centers for Disease Control and Prevention found that, in 2003, asthma was associated with nearly 13 million school absence days annually for children aged 5–17 years in the United States (5). Also, prospective employers might illegally discriminate in the hiring process against applicants with asthma, fearing that they would be absent more often and consequently less productive (6, 7). Symptoms of concurrent asthma can worsen as a result of exposure to respiratory irritants or allergens in the

workplace, or previously quiescent asthma can recur because of new immunologic sensitization to workplace agents or exposure to an inhaled irritant at work that may result in medical management alterations or the need to change occupations or workplace conditions (8, 9). Reports indicate that, among all working adults with asthma, work-exacerbated asthma prevalence ranges from 14% to 58% (median: 21%) (10). Development of work-related asthma has been associated with long-term disability, mortality, and adverse socioeconomic outcomes (8, 11). However, a review of 29 studies found inconsistency in the evidence relating to socioeconomic consequences of childhood asthma (12). There was no difference in academic performance between children with asthma and those without it, but there was some indication that children with asthma may experience a disadvantage in subsequent employment as adults (12).

Little is known about the association of childhood asthma with subsequent occupational choices and employment (12). Persons with an asthma history may tend to choose a career where exposures do not aggravate their disease or where there is a low probability for exposure to airway irritants (13, 14). The aim of this study was to examine retrospectively whether a childhood-asthma history assessed in adulthood is associated with longest-held occupation and educational level by using 2001–2004 data from the National Health and Nutrition Examination Survey (NHANES).

MATERIALS AND METHODS

We analyzed data for US adults aged ≥ 20 years. We used the 2001–2004 NHANES data because in 2001 the question on age at asthma onset was administered to every participant who had ever been told by a physician or other health professional that he/she had asthma. This allowed for identification of individuals with a childhood-asthma history. The year 2004 was the last year for which coded information on employment was available.

We defined childhood asthma cases as persons with a history of health-professional–diagnosed asthma at age < 18 years. We examined employment status and, for those who were ever employed, longest-held occupations. We collapsed 42 occupational groups into 31 groups (4 major groups) because of small sample sizes, following a previously used algorithm (15). The NHANES Institutional Review Board study protocol (protocol 98-12) approval for the NHANES and related questionnaires is available (<http://www.cdc.gov/nchs/nhanes/irba98.htm>). Additional details are provided in the Web Appendix, including 6 Web tables, posted on the *Journal's* Web site (<http://aje.oupjournals.org/>).

With regard to statistical analyses, we estimated appropriate sampling errors using the Taylor series method with the stratum and cluster variables from NHANES to account for survey design. Survey weights were used to estimate national percentages (16). We excluded observations with “missing,” “unknown,” or “refused” answers. We performed bivariate tests of association between predictor variables and childhood asthma using the Rao-Scott χ^2 test.

We created separate logistic regression models to assess the associations between a childhood-asthma history and employment status, each occupational group, educational level, and socioeconomic status. Because of gender differences in asthma prevalence and severity, separate regression models were fit by gender (17). For these analyses, we compared persons with a childhood-asthma history with those with no asthma history. The estimated prevalence odds ratios (PORs) were adjusted for age (5 categories: 20–29, 30–39, 40–49, 50–59, ≥ 60 years) and race/ethnicity (4 categories: non-Hispanic white, non-Hispanic black, Mexican American and other Hispanic, other race including multiracial) because of reported disparities in adverse childhood-asthma outcomes (i.e., emergency department visits, hospitalizations, and death) associated with these factors (18). For demographics, groups with the greatest estimated populations were used as references to enhance precision of the calculated PORs. To examine the association of a childhood-asthma history with longest-held occupation

and socioeconomic status (categorized in quartiles), we further restricted the analysis to those who were ever employed. The reference category with which each specific occupational group was compared included all other individuals who were ever employed but not in the occupational group of interest. The reference category with which each specific socioeconomic status quartile was compared included all other individuals who were ever employed but not in the socioeconomic status quartile of interest.

All tests were 2 sided, and $P < 0.05$ was considered significant. All statistical analyses were done by using survey procedures in SAS, version 9.2, software (SAS Institute, Inc., Cary, North Carolina).

RESULTS

During 2001–2004, a total of 25,917 persons were selected for the NHANES sample, and 21,161 (81.6%) were available for interview. Of these, 10,452 participants (4,954 men and 5,498 women), representing an estimated 202 million persons, were aged ≥ 20 years and were included in the study. Demographic characteristics, educational level, and employment status, by gender, are shown in Table 1.

An estimated 45.1% of persons had completed no more than high school, and 54.9% had more than a high school education. The most common occupational group varied by educational level among those who were ever employed. The largest occupational groups were precision production, craft, and repair/operators, fabricators, and laborers with an estimated 40.3% of persons with a high school diploma or less and managerial and professional specialty/technical, sales, and administrative support with an estimated 71.6% of persons with more than a high school education (data not shown).

Overall, an estimated prevalence of a childhood-asthma history was 6.3% and varied significantly by age ($P < 0.001$), race/ethnicity ($P = 0.04$), and educational level ($P = 0.01$) (data not shown). Childhood-asthma history was more frequent among men than women (6.9% vs. 5.8%) and among ever-employed men than among ever-employed women (7.0% vs. 5.9%), but these differences were not statistically significant. Because such small percentages of the male (i.e., 0.7%) and female (i.e., 3.8%) populations had never been employed, it was not possible to test the association between a childhood-asthma history and employment status (Table 1).

Males

A childhood-asthma history prevalence varied significantly by age ($P < 0.001$) and was highest among those aged 20–29 years (12.7%) (Table 1). By race/ethnicity, Mexican Americans and other Hispanics had the lowest prevalence (6.2%) and non-Hispanic blacks had the highest (9.5%). Childhood asthma was positively associated with education, and the prevalence was higher for those with a high school diploma (7.8%) or more than high school (7.2%). These findings by education were corroborated when we used logistic regression to model education and adjust for age and race/ethnicity. With the men who had less than a high school education as the reference group, childhood-

Table 1. History of Childhood Asthma in Persons Aged ≥ 20 Years, by Gender, National Health and Nutrition Examination Survey, 2001–2004

Characteristics	No. in Sample		Estimated ^a Population (Thousands)		History of Childhood Asthma ^b					
	Males	Females	Males	Females	Males			Females		
					No. in Sample	Prevalence, % ^a	95% CI	No. in Sample	Prevalence, % ^a	95% CI
Total	4,954	5,498	96,905	105,535	278	6.9	6.1, 7.7	291	5.8	4.8, 6.8
Age group, years										
20–29	851	1,077	19,241	20,399	97	12.7	9.6, 15.8	131	12.1	9.1, 15.1
30–39	777	962	20,015	21,255	62	7.9	6.0, 9.8	50	6.2	3.8, 8.6
40–49	860	852	22,204	22,349	37	4.8	3.0, 6.6	42	5.1	3.3, 7.0
50–59	653	647	16,543	16,821	45	6.9	4.4, 9.4	26	3.7	1.8, 5.6
≥ 60	1,813	1,960	18,902	24,711	37	2.6	1.5, 3.6	42	2.3	1.4, 3.3
Race/ethnicity										
Non-Hispanic white	2,618	2,929	69,954	74,866	141	6.6	5.5, 7.8	148	5.3	4.3, 6.3
Non-Hispanic black	953	1,053	9,838	12,578	82	9.5	7.5, 11.6	76	8.0	6.3, 9.6
Mexican American and other Hispanic	1,200	1,287	12,409	12,463	41	6.2	3.9, 8.5	51	6.1	3.3, 8.9
Other race including multiracial	183	229	4,704	5,628	14	7.3	3.0, 11.6	16	6.7	3.3, 10.0
Educational level ^c										
Less than high school	1,541	1,613	18,240	20,077	53	4.8	3.6, 6.1	63	4.6	3.1, 6.1
High school diploma	1,195	1,339	25,888	26,916	76	7.8	6.0, 9.6	62	4.7	3.3, 6.0
More than high school	2,204	2,525	52,598	58,241	149	7.2	6.0, 8.5	166	6.8	5.4, 8.2
Employment status ^c										
Never worked	38	309	660	3,971	3	— ^d		9	3.1 ^e	0.7, 5.4
Ever worked	4,899	5,175	95,987	101,378	275	7.0	6.1, 7.8	282	5.9	4.9, 6.9

Abbreviation: CI, confidence interval.

^a Weighted on the basis of population estimates of the US Census Bureau to produce unbiased national estimates.^b Information on a history of childhood asthma was missing for 25 participants.^c Differences between the total number of subjects and the 10,452 participants in the survey resulted from missing data (35 for education and 31 for longest-held job).^d —, relative standard error for the estimated number of persons with childhood asthma $> 50\%$; estimates suppressed.^e Estimated prevalence not reliable because the standard error for the estimated number of individuals with childhood asthma is 30%–50%.

asthma history was associated with completing a high school education (POR = 1.54, 95% confidence interval (CI): 1.12, 2.12) ($P = 0.008$) and more than a high school education (POR = 1.49, 95% CI: 1.01, 2.20) ($P = 0.046$).

The ever-employed men had worked predominantly in 2 of 4 major occupational groups—1) managerial and professional specialty/technical, sales, and administrative support (42.0%) and 2) precision production, craft, and repair/operators, fabricators, and laborers (41.8%) (Table 2). Reliable prevalence estimates (i.e., standard error of the estimate: $< 30\%$) of a childhood-asthma history were available for 3 major occupational groups (Table 2). From regression models that adjusted for age and race/ethnicity, ever-employed men with a childhood-asthma history had greater odds of working in managerial and professional specialty/technical, sales, and administrative support and service occupations and lower odds of working in precision production, craft, and repair/operators, fabricators, and laborers (Table 2).

Small sample sizes provided problems in several occupational groups. In particular, 2 occupational groups had no men, and another 12 had too few reports of a childhood-asthma history to calculate estimates (i.e., standard error of the estimate: $> 50\%$) (Table 2). Among the other occupational groups, the crude prevalence was highest among men working in health-diagnosing, -assessing, and -treating occupations (19.1%). When both health-related occupational groups (i.e., health-diagnosing, -assessing, and -treating occupations and health service occupations) were combined, the prevalence of a childhood-asthma history was 16.2% (95% CI: 9.1, 23.3).

Ever-employed men with a childhood-asthma history had greater odds of working in 3 of the 31 occupational groups—health-diagnosing, -assessing, and -treating occupations, other professional occupations, and cooks. Also, the combination of the 2 health-related occupational groups had a POR of 2.77 ($P < 0.001$) (Table 2). Examples of occupations in these occupational groups are shown in Table 3.

Table 2. History of Childhood Asthma in Ever-Employed Men Aged ≥ 20 Years, by Occupation, National Health and Nutrition Examination Survey, 2001–2004

Occupational Group	No. in Sample	Estimated ^a Population (Thousands)	History of Childhood Asthma							
			No. in Sample	% ^a	95% CI	Prevalence, % ^a	95% CI	POR ^b	95% CI	P Value
Total ^c	4,899	95,987	275	100.0		7.0	6.1, 7.8			
Managerial and professional specialty/technical, sales, and administrative support	1,783	40,360	127	49.7	41.2, 58.2	8.2	6.7, 9.7	1.53	1.11, 2.11	0.01
Management related	467	11,143	26	10.5	6.2, 14.7	6.3	3.4, 9.1	1.03	0.63, 1.68	0.91
Engineers and scientists	228	5,568	16	6.5 ^d	2.5, 10.5	7.7 ^d	3.1, 12.4	1.20 ^d	0.61, 2.36	0.59
Health-diagnosing, -assessing, and -treating occupations ^e	58	1,349	8	3.9	1.9, 5.9	19.1	7.9, 30.4	3.82	1.90, 7.68	<0.001
Teachers	103	2,165	9	3.8 ^d	0.5, 7.0	11.7 ^d	3.2, 20.1	1.97 ^d	0.84, 4.63	0.12
Entertainment-related occupations	86	2,113	7	2.3 ^d	0.2, 4.3	7.2 ^d	1.2, 13.2	1.00 ^d	0.40, 2.46	1.00
Other professional occupations	93	2,260	10	4.6	1.9, 7.3	13.5	6.0, 21.1	2.95	1.47, 5.91	0.002
Technicians	110	2,544	1	— ^f		—		—		
Supervisors and proprietors	244	5,395	20	8.3	3.6, 12.9	10.2	5.2, 15.2	1.59	0.89, 2.85	0.12
Sales workers	138	2,974	9	3.2 ^d	0.9, 5.5	7.2 ^d	2.1, 12.2	0.80 ^d	0.38, 1.67	0.55
Secretaries and clerical occupations	256	4,850	21	6.8	3.6, 10.0	9.4	6.0, 12.7	1.32	0.83, 2.09	0.24
Service	493	9,063	43	14.5	10.2, 18.7	10.7	7.6, 13.7	1.38	1.00, 1.91	0.05
Private household occupations	4	—	0							
Protective service occupations	111	2,377	10	2.9 ^d	1.1, 4.7	8.0 ^d	3.1, 13.0	1.11 ^d	0.56, 2.21	0.76
Waiters and waitresses	23	563	2	—		—		—		
Cooks	187	3,347	23	7.8	4.0, 11.5	15.5	8.4, 22.6	1.97	1.11, 3.50	0.02
Health service occupations ^e	31	653	3	—		—		—		
Cleaning	98	1,414	4	—		—		—		
Personal service occupations	39	663	1	—	—	—		—		

Table continues

Of ever-employed men with a childhood-asthma history, an estimated 34.9% were in the highest socioeconomic status quartile, and 25.0% were in the lowest socioeconomic status quartile (Web Table 1). From regression models that adjusted for age and race/ethnicity, ever-employed men with a childhood-asthma history were more likely to be in the highest socioeconomic status quartile and less likely to be in the second highest socioeconomic status quartile (Web Table 1).

Females

History of childhood-asthma prevalence varied significantly by age ($P < 0.001$) and was most common among those aged 20–29 years (12.1%) (Table 1). By race/ethnicity, the prevalence of a childhood-asthma history was lowest for non-Hispanic whites (5.3%) and highest for non-Hispanic blacks (8.0%). Childhood asthma was positively associated with education and was highest for those who had more than a high school diploma (6.8%) (Table 1). From logistic regression models of education that adjusted for age and

race/ethnicity, a childhood-asthma history was not associated with having a high school diploma (POR = 1.00, 95% CI: 0.61, 1.63) ($P = 0.99$) or more than a high school education (POR = 1.39, 95% CI: 0.91, 2.14) ($P = 0.13$).

Of all women aged ≥ 20 years, an estimated 96.2% had ever been employed, predominantly in 2 of 4 major occupational groups—managerial and professional specialty/technical, sales, and administrative support (65.9%) and service (21.3%) (Table 4). Reliable estimates of the prevalence of a childhood-asthma history among ever-employed women were available for 3 major occupational groups (Table 4). Regression models that adjusted for age and race/ethnicity yielded a statistically significant finding for 1 major occupational group, with lower odds of working in precision production, craft, and repair/operators, fabricators, and laborers (Table 4).

It was not possible to estimate the prevalence of childhood-asthma history for all occupational groups because of small sample sizes. Specifically, 5 occupational groups had no women, and another 12 had so few women that prevalence estimates could not be calculated (Table 4). Among

Table 2. Continued

Occupational Group	No. in Sample	Estimated ^a Population (Thousands)	History of Childhood Asthma							
			No. in Sample	% ^a	95% CI	Prevalence, % ^a	95% CI	POR ^b	95% CI	P Value
Farming, forestry, and fishing	324	4,284	9	2.4 ^d	0.3, 4.5	3.8 ^d	0.7, 7.0	0.54 ^d	0.23, 1.30	0.17
Farm-related occupations	203	2,460	4	—		—		—		
Related agricultural, forestry, and fishing	121	1,824	5	—		—		—		
Precision production, craft, and repair/operators, fabricators, and laborers	2,182	40,077	89	31.3	23.0, 39.6	5.2	3.8, 6.6	0.62	0.44, 0.88	0.007
Mechanics and repairers	325	6,700	15	5.9	2.3, 9.4	5.8	3.0, 8.6	0.94	0.55, 1.60	0.81
Construction	626	11,338	30	11.1	7.2, 15.0	6.5	4.2, 8.9	0.91	0.61, 1.35	0.63
Extractive and precision production	303	5,527	8	2.9 ^d	1.1, 4.8	3.6 ^d	1.5, 5.6	0.55 ^d	0.32, 0.94	0.03
Textile	21	297	0							
Machine operators	163	2,669	5	1.9 ^d	0.0, 3.7	4.7 ^d	0.0, 9.6	0.65 ^d	0.22, 1.94	0.44
Fabricators and assemblers	140	2,522	4	—		—		—		
Motor vehicle operators	271	5,029	15	5.3	2.4, 8.2	7.0	3.4, 10.6	1.01	0.56, 1.83	0.97
Other transportation	138	2,589	4	—		—		—		
Laborers	45	738 ^e	1	—		—		—		
Freight and stock movers	98	1,843	6	1.4 ^d	0.1, 2.7	5.2 ^d	0.6, 9.7	0.52 ^d	0.22, 1.27	0.15
Equipment cleaners	52	825	1	—		—		—		
Military	91	1,779	5	—		—		—		
Not disclosed	26	424	2	—		—		—		

Abbreviations: CI, confidence interval; POR, prevalence odds ratio.

^a Weighted on the basis of population estimates of the US Census Bureau to produce unbiased national estimates.

^b POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model, the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined, and the predictor variables were asthma history (childhood asthma vs. no asthma), age, and race/ethnicity.

^c Data on longest-held job were missing for 17 participants.

^d Estimates not reliable because the standard error for the estimated number of males with a history of childhood asthma was 30%–50%.

^e When both occupational groups were combined (i.e., as health-related occupations), prevalence of childhood asthma was 16.2% (95% CI: 9.1, 23.3), and POR was 2.77 (95% CI: 1.69, 4.51) ($P < 0.001$).

^f —, standard error for the estimate > 50%; estimates suppressed.

Table 3. Examples of Occupations in Occupational Groups Associated With a History of Childhood Asthma, National Health and Nutrition Examination Survey, 2001–2004

Occupational Group	Occupation
Management-related occupations	Legislators, chief executives and general administrators, administrators and officials, managers, administrators, postmasters and mail superintendents, funeral directors, accountants and auditors, underwriters, other financial officers, and management analysts; personnel, training, and labor specialists; purchasing agents and buyers, business and promotion agents, construction inspectors, and inspectors and compliance officers
Health-diagnosing, -assessing, and -treating occupations	Health-diagnosing occupations (e.g., physicians, dentists, veterinarians, optometrists, podiatrists); health-assessment and -treating occupations (e.g., registered nurses, pharmacists, dietitians, respiratory therapists, occupational therapists, physical therapists, speech therapists, and physicians' assistants)
Entertainment-related occupations	Authors, technical writers, designers, musicians and composers, actors and directors, painters, sculptors, craft artists and artist printmakers, photographers, dancers, artists, performers, editors and reporters, public relations specialists, announcers, and athletes
Other professional occupations	Educational and vocational counselors, librarians, archivists, curators, social scientists, and urban planners (e.g., economists, psychologists, sociologists, social scientists); social, recreation, and religious workers (e.g., social workers, recreation workers, clergy, religious workers); and lawyers and judges
Cooks	Bartenders, cooks, food counter, fountain and related occupations, kitchen workers, waiters/waitresses' assistants, and miscellaneous food preparation occupations
Health service occupations	Dental assistants, health and nursing aides, orderlies, and attendants

Table 4. History of Childhood Asthma in Ever-Employed Women Aged ≥ 20 Years, by Occupation, National Health and Nutrition Examination Survey, 2001–2004

Occupational Group	No. in Sample	Estimated ^a Population (Thousands)	History of Childhood Asthma							
			No. in Sample	% ^a	95% CI	Prevalence, % ^a	95% CI	POR ^b	95% CI	P Value
Total ^c	5,175	101,378	282	100.0		5.9	4.9, 6.9			
Managerial and professional specialty/technical, sales, and administrative support	3,046	66,823	180	67.8	61.7, 73.9	6.1	4.8, 7.4	1.16	0.87, 1.55	0.30
Management related	412	9,692	28	11.9	7.8, 16.1	7.4	4.7, 10.2	1.41	0.95, 2.10	0.09
Engineers and scientists	65	1,410	4	— ^d		—		—		
Health-diagnosing, -assessing, and -treating occupations ^f	205	4,874	11	3.8 ^e	0.9, 6.7	4.7 ^e	0.9, 8.5	0.96	0.44, 2.10	0.91
Teachers	323	6,804	12	4.6 ^e	1.5, 7.8	4.1 ^e	1.5, 6.8	0.71 ^e	0.37, 1.39	0.32
Entertainment-related occupations	81	2,025	9	3.6 ^e	0.8, 6.3	10.6 ^e	3.0, 18.2	2.41 ^e	1.08, 5.41	0.03
Other professional occupations	113	2,749	8	—		—		—		
Technicians	164	3,826	11	4.8 ^e	0.9, 8.8	7.6 ^e	1.9, 13.3	1.22 ^e	0.52, 2.87	0.64
Supervisors and proprietors	173	3,912	13	4.7 ^e	1.7, 7.8	7.3 ^e	2.5, 12.1	1.29 ^e	0.63, 2.63	0.49
Sales workers	373	7,365	29	11.3	6.3, 16.2	9.2	5.2, 13.1	1.25	0.76, 2.07	0.38
Secretaries and clerical occupations	1,137	24,164	55	18.8	14.4, 23.3	4.7	3.2, 6.2	0.80	0.59, 1.09	0.16
Service	1,275	21,600	74	24.9	18.2, 31.6	6.9	5.2, 8.6	1.09	0.78, 1.51	0.62
Private household occupations	162	2,017	3	0.6	0.4, 0.7	1.7	1.1, 2.2	0.27	0.16, 0.44	<0.001
Protective service occupations	29	490	7	—		—		—		
Waiters and waitresses	145	3,085	13	5.0	2.0, 7.9	9.6	4.8, 14.4	1.30	0.71, 2.38	0.40
Cooks	283	4,817	15	4.0 ^e	1.3, 6.7	5.0 ^e	1.8, 8.2	0.80 ^e	0.41, 1.55	0.50
Health service occupations ^f	287	4,933	22	9.5 ^e	4.4, 14.6	11.5 ^e	5.2, 17.8	1.89 ^e	1.02, 3.49	0.04
Cleaning	168	2,224	4	—		—		—		
Personal service occupations	201	4,035	10	3.2 ^e	1.2, 5.2	4.8 ^e	1.8, 7.7	0.74 ^e	0.35, 1.58	0.44

Table continues

the occupational groups with reliable estimates, the prevalence was highest among waiters and waitresses (9.6%). When both health-related occupational groups (i.e., health-diagnosing, -assessing, and -treating occupations and health service occupations) were combined, the prevalence of a childhood-asthma history was 8.1% (95% CI: 4.4, 11.9).

For ever-employed women, 2 occupational groups were significantly associated with a childhood-asthma history, entertainment-related and health service occupations; however, the estimates may be unreliable (Table 4). Women with a childhood-asthma history had elevated odds of working in management-related occupations, although this finding was borderline statistically significant. When both health-related occupational groups were combined, the POR was 1.47 ($P = 0.09$) (Table 4). Examples of occupations in these occupational groups are shown in Table 3.

Of ever-employed women with a childhood-asthma history, an estimated 26.7% were in the highest socioeconomic status quartile, and 16.1% were in the lowest socioeconomic status

quartile (Web Table 2). From regression models that adjusted for age and race/ethnicity, ever-employed women with a childhood-asthma history had lower odds to be in the lowest socioeconomic status quartile (Web Table 2).

Analyses by age, educational level, age at asthma onset, and smoking status

For both men and women, to account for the fact that some individuals may have not finished their education, we explored whether education was operating as an intermediate variable or a confounder in the relation between a childhood-asthma history and occupational group. In addition, we examined the associations after stratification by age group (20–34 and ≥ 35 years) and gender, by educational level, and by gender. Results were similar to those already reported (refer to the Web Appendix results). Further analyses by age at asthma onset (asthma diagnosed at age ≤ 11 years and diagnosed at age 12–17 years) and gender, as well as by

Table 4. Continued

Occupational Group	No. in Sample	Estimated ^a Population (Thousands)	History of Childhood Asthma							
			No. in Sample	% ^a	95% CI	Prevalence, % ^a	95% CI	POR ^b	95% CI	P Value
Farming, forestry, and fishing	110	1,325	1	—		—		—		
Farm-related occupations	81	823	0							
Related agricultural, forestry, and fishing	29	501	1	—		—		—		
Precision production, craft, and repair/operators, fabricators, and laborers	700	10,925	24	5.9	2.8, 8.9	3.2	1.7, 4.8	0.59	0.35, 0.98	0.04
Mechanics and repairers	5	—	0							
Construction	19	495 ^e	4	—		—		—		
Extractive and precision production	153	2,325	7	1.4 ^e	0.1, 2.7	3.6 ^e	0.4, 6.8	0.77 ^e	0.31, 1.91	0.57
Textile	144	1,995	4	—		—		—		
Machine operators	80	1,239	3	—		—		—		
Fabricators and assemblers	124	1,992	2	—		—		—		
Motor vehicle operators	33	705	2	—		—		—		
Other transportation	4	—	0							
Laborers	35	495	0							
Freight and stock movers	37	621 ^e	0							
Equipment cleaners	66	856	2	—		—		—		
Military	12	227 ^e	1	—		—		—		
Not disclosed	32	478 ^e	2	—		—		—		

Abbreviations: CI, confidence interval; POR, prevalence odds ratio.

^a Weighted on the basis of population estimates of the US Census Bureau to produce unbiased national estimates.

^b POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model, the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined, and the predictor variables were asthma history (childhood asthma vs. no asthma), age, and race/ethnicity.

^c Data on longest-held job were missing for 14 participants.

^d —, standard error for the estimate > 50%; estimates suppressed.

^e Estimates not reliable because the standard error for the estimated number of females with a history of childhood asthma was 30%–50%.

^f When both health-specific occupational groups were combined (i.e., as health-related occupations), prevalence of childhood asthma was 8.1% (95% CI: 4.4, 11.9), and POR was 1.47 (95% CI: 0.94, 2.31) ($P = 0.09$).

smoking status (smoking cigarette at age <18 years and non-smoking) and gender, were done and similar results were observed (data not shown).

DISCUSSION

Our exploratory study analyzed data from the 2001–2004 NHANES to assess the association of a childhood-asthma history with educational level and occupation in the adult US population. We estimated that the overall prevalence of a childhood-asthma history among adults aged ≥20 years was 6.3% and was higher among men (6.9%) than women (5.8%). The prevalence was highest among those aged 20–29 years, likely reflecting the increase in asthma prevalence among children reported from 1980 to 1996 (18, 19).

This study identified significant differences between adults with a childhood-asthma history and those with no asthma with regard to their educational level and occupation, and it

confirms some previous results. In a cohort of French adult men, those with childhood asthma were more often high school graduates than those with no asthma (20). Other authors, however, reported no such differences (21, 22). For example, a community-based follow-up study found no difference in educational achievement assessed by academic qualification or in employment between individuals with childhood asthma and those with no asthma (21). It is possible that gender differences in childhood-asthma severity could explain, in part, the observed differences in educational achievements (17). More research is needed to better understand the current findings that men, but not women, with a childhood-asthma history achieve higher education.

The significantly low and high prevalences of childhood asthma among some occupational groups may be due to the healthy worker effect (23). Persons with childhood asthma may be less likely to be hired into jobs associated with potential exposure to irritants. In addition, persons with a childhood-asthma history who are hired into such jobs may experience

recurrence or worsening of their asthma symptoms over time, potentially leading to quitting work or transferring to a less-exposed job (23–26). NHANES collects information on a participant's longest and current occupation. For this study, we examined information on longest-held occupation. It is possible that workers with asthma changed their jobs early in their career or, especially for younger adults, their longest-held job was their short-term job (e.g., while enrolled in college) and not their initial career choice selection. No data were available on lifetime course of asthma or occupational history to assess the impact of these possible healthy worker effects.

Nevertheless, we found evidence suggesting that adults with a childhood-asthma history may preferentially remain in certain occupations. Limited information is available on the risk of asthma exacerbation associated with these occupations. Using case-based data from 4 US states, Pechter et al. (27) reported that 23% of 305 work-related asthma cases among health-care workers had asthma aggravated by workplace exposure.

Compared with persons with no asthma history, those with a childhood-asthma history were less likely to work in the following occupations: precision production, craft, and repair/operators, fabricators, and laborers. This could be explained partially by gender-specific preferences in selecting an occupation, resulting in an overall small number of individuals working in a particular occupation. However, it is possible that individuals with childhood asthma may avoid occupations known or suspected to be associated with increased risk of developing or exacerbating respiratory symptoms. A cross-sectional study of coal miners showed that workers with hyperresponsive airways tended to develop more respiratory symptoms related to dust exposure than their coworkers, and they selected jobs on that basis (28). In this study, a small number of persons with a childhood-asthma history were associated with cleaning occupations known to be associated with a higher risk of new-onset and exacerbated asthma (29).

The results of other studies also suggest that persons with childhood asthma may have selected into certain occupations (13, 14, 30–33). A Swedish study found that men with asthma diagnosed in adolescence appeared to avoid jobs with a high probability for airway-irritating exposure (14). A French study found that adult men with childhood asthma were less likely to be blue-collar workers (20). Two other European studies reported that preexisting asthma may influence whether one becomes employed in a job involving asthma-related exposures (31, 32). On the contrary, a German study examining predictors of preferred job choice among vocational trainees did not find significant association between having asthma, allergic rhinitis, or atopic dermatitis and selecting jobs with asthma risk (33). The authors found that only 4% of vocational trainees and 2% of high school students reported that their preferred job choice was influenced by allergies or respiratory symptoms. However, in a Canadian study of 101 high school, college, and university students with physician-diagnosed asthma who were aged 16–22 years, 35% of the participants indicated that asthma was an important factor affecting their career plans (30).

Results of analysis by socioeconomic status quartile indicated that ever-employed men with a childhood-asthma

history had greater odds of having very high socioeconomic status and that ever-employed women with a childhood-asthma history had lower odds of having very low socioeconomic status. These results corroborate results of the analysis by occupational group for men and women. Ever-employed men with a childhood-asthma history had greater odds of working in managerial and professional specialty/technical, sales, and administrative support (mean Nam-Powers score: 71.84) and in service occupations (mean Nam-Powers score: 33.60) and lower odds of working in precision production, craft, and repair/operators, fabricators, and laborers occupations (mean Nam-Powers score: 41.23). Ever-employed women with a childhood-asthma history had lower odds of working in precision production, craft, and repair/operators, fabricators, and laborers occupations (mean Nam-Powers score: 41.23).

Study results suggesting that an asthma diagnosis is only marginally associated with future job choice may be partly a consequence of the lack of professional advice in selecting an occupational career (14, 33). A report from the Centers for Disease Control and Prevention indicated that only 53% of persons aged ≤ 17 years had ever been advised to change aspects of home, school, or work to improve their asthma (34). Bhinder et al. (30) reported that most of the Canadian students with asthma discussed their career plans with family and friends (73%), and only a minority had this type of discussion with their family physician (14%) or guidance counselor (5%). Because of potential severe consequences of asthma exacerbation associated with work, the development of educational materials on the interaction of asthma and work for adolescents with asthma, their parents, and health-care providers would facilitate informed decisions regarding job choices (30, 31, 34).

The childhood-asthma estimates presented here relied on self-reported survey data that required respondent recall of the physician's diagnosis. Either the physician's diagnosis or the patient's recall of that diagnosis might be inaccurate. Although no data were available to validate asthma diagnosis, we increased reliability of this information by using age at asthma onset (35, 36). We may have overestimated the prevalence of a childhood-asthma history among adults. For this analysis, 120 of 10,452 (or an estimated 1.2%) respondents reported age at asthma onset of < 3 years. It is possible that, in some of these cases, asthma did not persist through childhood (37).

The Nam-Powers scores used to measure socioeconomic status in this study are based on 1980 and 1990 US Census data on income and educational level and were not updated with the most current information. Although the score may not be applicable to our data, results of the analysis by occupational group were corroborated by the results of the socioeconomic status analysis for both men and women.

There is some evidence that childhood asthma and persistence of asthma symptoms are associated with being born in a particular region, experiencing a higher number of respiratory infections in the first year of life, having elevated serum immunoglobulin E levels measured at age 6 months, having parents who experience parenting difficulties, having parents who smoke at home, and having parents of low socioeconomic status (24, 38–40). However, no such information was available from NHANES to control for their effects. Finally, some

occupational groups had small sample sizes in our analyses. The use of broad occupational groups may hide information on specific occupational choices. Industry-specific studies could address this limitation.

This is the first large-scale, nationally representative, general US adult population analysis of the associations of childhood asthma with education and longest-held job. The results suggest that persons with a childhood-asthma history generally achieve a higher educational level and socioeconomic status and that they tend to preferentially work in certain occupations. Further research should explore asthma outcomes and their association with workplace exposure among adults with a childhood-asthma history.

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Author affiliations: Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia (Jacek M. Mazurek, Patricia L. Schleiff, Paul K. Henneberger).

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Web Appendix

Is Childhood Asthma Associated With Educational Level and Longest-Held Occupation?

Jacek M. Mazurek, Patricia L. Schleiff, Paul K. Henneberger

METHODS

Data source

The U.S. National Health and Nutrition Examination Survey (NHANES) is designed to provide national estimates of health and nutritional status of the civilian non-institutionalized population of the United States aged 2 months and older. The survey includes questions on asthma and work history. We limited the analysis to adults aged ≥ 20 years. We used the NHANES 2001–2004 data because the year 2001 was the first year in which the question on the age at asthma onset was administered to every participant who has ever been told by a doctor or other health professional that he/she has asthma, allowing for identification of individuals with childhood asthma, and the year 2004 was the last year for which coded information on employment was available. The study protocol for NHANES (Protocol #98-12) was approved by the National Center for Health Statistics Institutional Review Board (1). There were no personally identifiable data in the databases we accessed.

Definitions

Childhood asthma. History of asthma diagnosis was determined using the Medical Conditions database from NHANES 2001–2004. Participants were determined to have ever been diagnosed with asthma (lifetime asthma) on the basis of a positive response to the question “Has a doctor or other health professional ever told you that you have asthma?” Participants with lifetime asthma were further asked about age at asthma diagnosis (“How old were you when you were first told

you had asthma?”). We defined childhood asthma cases as persons with a history of health-professional diagnosed asthma at age <18 years.

Employment status and longest occupation. The NHANES 2001–2004 Occupation Questionnaire database contains employment history of the survey participants. The question “Thinking of all the paid jobs or businesses you ever had, what kind of work were you doing the longest?” was used to identify those who have ever/never worked and assess the longest occupation. Self-reported longest occupations were coded by trained NCHS coders using the U.S. Census Bureau’s Census 2000 Indexes of Industry and Occupation and grouped closely following the previously established pattern for reporting industry and occupation groupings (2–4). Because of the small number of observations in some of the 42 occupational groups in NHANES 2001–2004, we collapsed them into 31 groups (grouped in four major groups) following a previously used algorithm (5). Although NHANES is intended to cover only the civilian, non-institutionalized population, civilian employees of the armed forces and military occupations were valid entries for a participant’s longest occupation data and were included in the analysis. We did not analyze industry information because the NHANES 2001–2004 was not designed to collect industry information for all participants’ designated longest job.

Educational level. Educational level of the study participants was found in the NHANES 2001–2004 Demographics database. The question “What is the highest grade or level of school you have completed or the highest degree you have received?” was used to ascertain educational level. Three possible answers were analyzed: less than high school; high school diploma (including General Educational Development); and more than high school.

Smoking status. Smoking status of the study participants was found in the NHANES 2001–2004 Smoking and Tobacco Use database. Participants who smoked at least 100 cigarettes in their life

were asked the question “How old were you when you first started to smoke cigarettes fairly regularly?” to ascertain age when they started smoking cigarettes regularly. We examined data for persons who started smoking cigarettes at age <18 years and those who did not smoke at age <18 years.

Socioeconomic status

Socioeconomic status (SES) is commonly measured using Nam-Powers scores (6–8). A list of occupations (three digit codes) and their corresponding scores was made available to us by K. Steenland (written communication, 2011). These scores are rankings (1 through 99 [the highest possible score]) based on 1980 and 1990 census data on income and educational level by occupation and are assigned for each occupation that has a U.S. Census code. Some example occupations and their corresponding Nam-Powers scores were physicians (99), airplane pilots (93), financial managers (91), elementary-school teachers (84), insurance adjuster (67), motor vehicles and boats sales workers (58), secretaries (51), plumbers, pipefitters, and steamfitters (50), truck drivers (40), bartender (34), waiters and waitresses (23), cashiers (15), and cooks (8). In NHANES, occupation text data were coded by trained coders using the U.S. Census Bureau’s Census 2000 Indexes of Industry and Occupations. Public release data include two-digit recodes for 41 occupational groups. We identified occupations within each group and computed mean Nam-Powers score for each of the 41 occupational groups. Some example occupational groups and their corresponding mean Nam-Powers scores were *engineers, architects and scientists* (93.40), *secretaries, stenographers, and typists* (53.67); *construction trades* (41.27); and *cooks* (8.00). We grouped persons into sex-specific quartiles of SES based on the sex-specific overall mean Nam-Powers scores distribution. The four sex-specific quartiles have mean Nam-Powers

scores of < 37.33 37.33–47.00, 47.00–75.10, and ≥ 75.10 for men and < 34.07, 34.07–50.77, 50.77–75.25, and ≥ 75.25 for women.

Statistical analysis

A complex, stratified, multistage probability cluster sampling design was used in the NHANES. Analyses were conducted using SAS® software version 9.2 (SAS Institute Inc., Cary, NC). Survey weights were used to estimate national percentages (9). To account for survey design, we estimated appropriate sampling errors using the Taylor series method with the stratum and the cluster variables from NHANES (9). We calculated prevalence of a history of childhood asthma by age, gender, race/ethnicity, educational level, and occupational group. We excluded observations with “missing”, “unknown”, and “refused” answers. We performed bivariate tests of association between the predictor variable and childhood asthma by using the Rao-Scott X^2 test.

We created separate logistic regression models to assess the association between a history of childhood asthma and variables of interest (i.e., employment status, each occupational group, and educational level). Because of gender differences in asthma prevalence and severity, discrete regression models were for males and females (10). For these analyses we compared persons with a history of childhood asthma to those with no asthma history. The estimated prevalence odds ratios (PORs) were adjusted for age and race/ethnicity because of reported disparities in adverse childhood-asthma outcomes (i.e., emergency department visits, hospitalizations, and death) associated with these factors (11). For demographics, groups with the greatest estimated populations were used as references to enhance precision of the calculated PORs. To examine whether those with a history of childhood asthma are associated with a specific occupational group and SES, we further restricted the analysis to those who were ever employed. The

reference category to which each specific occupational group was compared in separate logistic regression included all other individuals who were ever employed not in the occupational group of interest. The reference category to which each specific SES quartile was compared included all other individuals who were ever employed but not in the SES quartile of interest. All tests were 2-sided, and P values of <0.05 were considered to be significant.

RESULTS

Results of analysis by SES quartile mean Nam-Powers scores indicated that ever-employed men with a childhood-asthma history had greater odds of having very high SES and that ever-employed women with a childhood-asthma history had lower odds of having very low SES (Web Tables 1 and 2).

To account for the fact that some individuals may have not finished their education we explored if education was operating as an intermediate variable or confounder in the relationship between a childhood-asthma history and occupational group, by gender. The introduction of education into the regression models had little impact on the effect estimates of interest for both men and women (results not shown). When we stratified by age group (20–34 and ≥ 35 years) and gender, the major trend not earlier observed in Table 2 was for men aged 20–34 years with a history of childhood asthma to work in *service occupations* (POR 1.74, 95% CI: 1.12, 2.70, $P=0.01$) (Web Table 3). Among men aged ≥ 35 years, childhood-asthma history was associated with employment as *supervisors and proprietors* (POR 2.01, 95% CI: 1.01, 3.98, $P=0.047$) (Web Table 4). The major trend not earlier observed in Table 4 was for women aged ≥ 35 years with a history of childhood asthma to work in *management-related occupations* (POR 1.73, 95% CI: 1.12, 2.69, $P=0.01$) (Web Table 4).

When we stratified by education level and gender, no new trends for men were observed (Web Tables 5 and 6). The major trend not earlier observed in Table 4 was for women with a history of childhood asthma and a high school diploma or less to work as *sales workers* (POR 2.70, 95% CI: 1.56, 4.66, $P<0.001$) (Web Table 5).

After stratifying by age at childhood asthma diagnosis (diagnosed at age ≤ 11 years and diagnosed at age 12–17 years) and gender, and cigarette smoking status at age <18 years (smoker and nonsmoker) and gender the data analysis did not reveal new trends not earlier observed in Tables 2 and 4 (data not shown).

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Web Table 1. Multivariate Associations of Childhood Asthma With Socioeconomic Status Among Ever-Employed Men Aged ≥ 16 years — National Health and Nutrition Examination Survey (NHANES), United States, 2001–2004

SES quartile ^a	Sample	Estimated ^b Population (Thousands)	History of Childhood Asthma							
			Sample	% ^a	95% CI	Prevalence ^b (%)	95% CI	POR ^c	95% CI	<i>P</i> value
Total ^c	4,873	95,563	273	100.0		7.1	6.3, 8.0			
SES 1 (highest)	1,062	25,154	80	34.9	27.3, 42.4	9.5	7.2, 11.9	2.09	1.45, 3.03	<.0001
SES 2	1,174	24,370	68	21.4	15.8, 27.0	6.0	4.8, 7.2	0.69	0.49, 0.98	0.04
SES 3	1,250	23,026	51	18.7	13.3, 24.1	5.6	4.0, 7.1	0.72	0.49, 1.04	0.08
SES 4 (lowest)	1,387	23,013	74	25.0	19.3, 30.6	7.3	5.2, 9.5	0.86	0.59, 1.25	0.42

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio; SES, socioeconomic status.

^a SES quartile is defined by occupation and corresponding mean Nam-Powers scores (based on income and education for each occupational group); the 4 gender-specific quartiles have Nam-Powers scores of < 37.33, 37.33–47.00, 47.00–75.10, and ≥ 75.10 . Men with occupation not disclosed were excluded from analysis (n=2).

^b Weighted based on population estimates of the U.S. Census Bureau to produce unbiased national estimates.

^c POR represents the odds that a person with a history of childhood asthma belongs to a specific SES quartile relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model the outcome variable was SES categorized in quartiles and referent group that included all other SES quartiles combined and the predictor variables were asthma history (childhood asthma versus no asthma), age, and race/ethnicity.

Web Table 2. Multivariate Associations of Childhood Asthma With Socioeconomic Status Among Ever-Employed Women Aged ≥ 16 years — National Health and Nutrition Examination Survey (NHANES), United States, 2001–2004

SES quartile ^c	Sample	Estimated ^b Population (Thousands)	History of Childhood Asthma							
			Sample	% ^a	95% CI	Prevalence ^b (%)	95% CI	POR ^c	95% CI	<i>P</i> value
Total ^c	5,143	100,900	280	100.0		6.4	5.4, 7.5			
SES 1 (highest)	1,192	27,290	68	26.7	20.8, 32.6	6.4	4.6, 8.2	1.16	0.78, 1.73	0.47
SES 2	1,135	23,998	73	26.1	20.9, 31.2	7.0	5.5, 8.5	1.24	0.89, 1.72	0.20
SES 3	1,354	26,322	84	31.1	25.1, 37.2	7.6	5.5, 9.7	1.21	0.86, 1.70	0.27
SES 4 (lowest)	1,462	23,291	55	16.1	11.5, 20.6	4.5	3.3, 5.7	0.47	0.31, 0.72	<0.001

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio; SES, socioeconomic status.

^a SES quartile is defined by occupation and corresponding mean Nam-Powers scores (based on income and education for each occupational group); the 4 gender-specific quartiles have Nam-Powers scores of < 34.07, 34.07–50.77, 50.77–75.25, and ≥ 75.25 . Women with occupation not disclosed were excluded from analysis (n=2).

^b Weighted based on population estimates of the U.S. Census Bureau to produce unbiased national estimates.

^c POR represents the odds that a person with a history of childhood asthma belongs to a specific SES quartile relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model the outcome variable was SES categorized in quartiles and referent group that included all other SES quartiles combined and the predictor variables were asthma history (childhood asthma versus no asthma), age, and race/ethnicity.

Web Table 3. Multivariate Associations of Childhood Asthma With Longest-Held Occupation Among Ever-Employed Adults Aged 20–34 Years, by Gender — NHANES, 2001–2004

Occupational group	Male			Female		
	Adjusted POR ^a	95% CI	P value ^a	Adjusted POR ^a	95% CI	P value ^a
Managerial and professional specialty/ Technical, sales, and administrative support	1.09	0.63, 1.90	0.76	0.88	0.56, 1.38	0.57
Management-related occupations	0.71 ^b	0.23, 2.17	0.54	1.18	0.53, 2.64	0.69
Teachers	—	—	—	0.66	0.25, 1.72	0.39
Sales workers	0.81 ^b	0.33, 2.01	0.65	1.13	0.63, 2.06	0.68
Secretaries and clerical occupations	1.03	0.55, 1.92	0.92	0.93	0.62, 1.40	0.74
Service	1.74	1.12, 2.70	0.01	1.42	0.86, 2.34	0.17
Protective service occupations	1.42 ^b	0.49, 4.16	0.52	—	—	—
Waiters and waitresses	—	—	—	1.91	0.98, 3.69	0.06
Cooks	2.34 ^b	1.14, 4.79	0.02	0.91	0.39, 2.12	0.83
Health service occupations ^c	—	—	—	2.07	0.90, 4.76	0.09
Personal service occupations	0 cases	—	—	0.68	0.26, 1.78	0.43
Farming, forestry, and fishing	—	—	—	—	—	—
Precision production, craft, and repair/Operators, fabricators, and laborers	0.72	0.41, 1.26	0.24	0.44^b	0.18, 1.04	0.12
Mechanics and repairers	1.52 ^b	0.67, 3.44	0.32	—	—	—
Construction	0.95 ^b	0.46, 1.93	0.88	—	—	—

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio.

^a POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for race/ethnicity. In the model the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined and the predictor variables were asthma history (childhood asthma versus no asthma) and race/ethnicity.

^b Estimated number of persons with childhood asthma and related odds ratios not reliable because the standard error for the estimated number of persons with childhood asthma was 30%–50%.

^c When *health diagnosing, assessing and treating* and *health service occupations* were combined (i.e., as health-related occupations), POR for men was 2.46 (95% CI 0.72–8.46, $P=0.15$) and for women was 1.62 (95% CI 0.83–3.16, $P=0.16$).

“—” indicates the standard error for the estimated number of persons with a history of childhood asthma >50%; PORs suppressed.

Note: PORs not calculated for *engineers and scientists; health diagnosing, assessing and treating; entertainment-related; other professional; technicians; supervisors and proprietors; private household; cleaning; farm-related; related agricultural, forestry, and fishing; extractive and precision production; textile; machine operators; fabricators and assemblers; motor vehicle operators; other transportation; laborers; freight and stock movers; equipment cleaners; and military occupations* because either no persons with childhood asthma were identified or the standard error for the estimated number of men/women with a history of childhood asthma >50%.

Web Table 4. Multivariate Associations of a History of Childhood Asthma With Longest-Held Occupation Among Ever-Employed Adults Aged ≥ 35 Years, by Gender — NHANES, 2001–2004

Occupational group	Male			Female		
	Adjusted POR ^a	95% CI	P value ^a	Adjusted POR ^a	95% CI	P value ^a
Managerial and professional specialty/ Technical, sales, and administrative support	1.92	1.34, 2.74	<0.001	1.53	1.01, 2.31	0.048
Management-related occupations	1.18	0.77, 1.81	0.45	1.73	1.12, 2.69	0.01
Engineers and scientists	1.53	0.78, 3.03	0.22	0 cases		
Health diagnosing, assessing and treating occupations ^c	3.37	1.78, 6.39	<0.001	1.06 ^b	0.42, 2.68	0.90
Teachers	—			0.72 ^b	0.34, 1.52	0.39
Entertainment-related occupations	—			3.43 ^b	1.45, 8.12	0.01
Other professional occupations	2.73 ^b	1.27, 5.91	0.01	—		
Supervisors and proprietors	2.01	1.01, 3.98	0.047	2.37 ^b	1.06, 5.32	0.04
Sales workers	—			1.65 ^b	0.68, 4.01	0.27
Secretaries and clerical occupations	1.58	0.82, 3.03	0.17	0.64	0.36, 1.12	0.12
Service	0.77	0.37, 1.61	0.49	0.71	0.44, 1.13	0.15
Cooks	—			0.68 ^b	0.30, 1.53	0.35
Health service occupations ^c	—			1.35 ^b	0.65, 2.81	0.42
Farming, forestry, and fishing	—			—		
Precision production, craft, and repair/Operators, fabricators, and laborers	0.58	0.39, 0.86	0.01	0.69^b	0.35, 1.36	0.28
Mechanics and repairers	0.77 ^b	0.32, 1.86	0.57	—		
Construction	0.91 ^b	0.46, 1.82	0.79	—		

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio.

^a POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for race/ethnicity. In the model the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined and the predictor variables were asthma history (childhood asthma versus no asthma) and race/ethnicity.

^b Estimated number of persons with a history of childhood asthma and related odds ratios not reliable because the standard error for the estimated number of persons with a history of childhood asthma was 30%–50%.

^c When *health diagnosing, assessing and treating* and *health service occupations* were combined (i.e., as health-related occupations), POR for men was 2.97 (95% CI 1.71–5.16, $P<0.001$) and for women 1.21 (95% CI 0.67–2.19, $P=0.54$).

“—” indicates the standard error for the estimated number of persons with childhood asthma $>50\%$; PORs suppressed.

Note: PORs not calculated for *technicians; private household occupations; protective service occupations; waiters and waitresses; cleaning; personal service; farm-related; related agricultural, forestry, and fishing; extractive and precision production occupations; textile; machine operators; fabricators and assemblers; other transportation; laborers; freight and stock movers; equipment cleaners; and military occupations* because either no persons with a history of childhood asthma were identified or the standard error for the estimated number of men/women with a history of childhood asthma $>50\%$.

Web Table 5. Multivariate Associations of a History of Childhood Asthma With Longest-Held Occupation Among Ever-Employed Adults Aged ≥20 Years With a High School Diploma or Less, by Gender — NHANES, 2001–2004

Occupational group	Male			Female		
	Adjusted POR ^a	95% CI	P value ^a	Adjusted POR ^a	95% CI	P value ^a
Managerial and professional specialty/ Technical, sales, and administrative support	1.36	0.78, 2.39	0.28	1.60	0.97, 2.62	0.06
Management-related occupations	—			1.61 ^b	0.57, 4.55	0.37
Supervisors and proprietors	1.51 ^b	0.55, 4.12	0.43	—		
Sales workers	—			2.70	1.56, 4.66	<0.001
Secretaries and clerical occupations	2.00 ^b	0.88, 4.57	0.10	0.59 ^b	0.29, 1.22	0.16
Service	1.98	1.31, 3.01	0.001	0.84	0.51, 1.38	0.49
Protective service occupations	2.66 ^b	0.87, 8.13	0.09	—		
Cooks	2.34	1.18, 4.65	0.02	0.90 ^b	0.39, 2.11	0.81
Health service occupations ^c	—			1.40 ^b	0.48, 4.08	0.54
Farming, forestry, and fishing	—			—		
Precision production, craft, and repair/Operators, fabricators, and laborers	0.53	0.36, 0.79	0.002	0.61^b	0.30, 1.24	0.17
Mechanics and repairers	1.26 ^b	0.65, 2.43	0.50	—		
Construction	0.98	0.67, 1.42	0.91	—		
Extractive and precision production occupations	0.58 ^b	0.32, 1.03	0.06	—		
Motor vehicle operators	0.77 ^b	0.32, 1.86	0.56	—		
Freight and stock movers	0.84 ^b	0.33, 2.19	0.73	0 cases		

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio.

^a POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined and the predictor variables were asthma history (childhood asthma versus no asthma), age, and race/ethnicity.

^b Estimated number of persons with childhood asthma and related odds ratios not reliable because the standard error for the estimated number of persons with childhood asthma was 30%–50%.

^c When *health diagnosing, assessing and treating* and *health service occupations* were combined (i.e., as health-related occupations), POR for women with a high school diploma or less was 1.42 (95% CI: 0.51, 3.93, $P=0.51$) but the standard error for the estimated number of women with a history of childhood asthma 30%–50%; the standard error for the estimated number of men with a history of childhood asthma >50% and POR for men with a high school diploma or less was not calculated.

“—” indicates the standard error for the estimated number of persons with a history of childhood asthma >50%; PORs suppressed.

Note: PORs not calculated for *engineers and scientists; health diagnosing, assessing and treating; teachers entertainment-related; other professional; technicians; private household; waiters and waitresses; cleaning; personal service; farm-related; related agricultural, forestry, and fishing; textile; machine operators fabricators and assemblers; other transportation; laborers; equipment cleaners; and military occupations* because either no persons with a history of childhood asthma were identified in the sample or the standard error for the estimated number of men/women with a history of childhood asthma >50%.

Web Table 6. Multivariate Associations of Childhood Asthma With Longest-Held Occupation Among Ever-Employed Adults Aged ≥ 20 Years With More Than a High School Diploma, by Gender — NHANES, 2001–2004

Occupational group	Male			Female		
	Adjusted POR ^a	95% CI	P value ^a	Adjusted POR ^a	95% CI	P value ^a
Managerial and professional specialty/ Technical, sales, and administrative support	1.62	1.08, 2.44	0.02	0.75	0.49, 1.16	0.20
Management-related occupations	0.90	0.54, 1.49	0.68	1.30	0.80, 2.11	0.30
Engineers and scientists	1.13 ^b	0.56, 2.30	0.73	—		
Health diagnosing, assessing and treating occupations ^c	3.71	1.79, 7.69	<0.001	0.84 ^b	0.38, 1.84	0.66
Teachers	1.91 ^b	0.80, 4.58	0.15	0.68 ^b	0.35, 1.31	0.25
Entertainment-related occupations	1.12 ^b	0.44, 2.80	0.82	2.21 ^b	0.89, 5.47	0.09
Other professional occupations	2.50 ^b	1.21, 5.15	0.01	—		
Technicians	—			0.97 ^b	0.37, 2.50	0.94
Supervisors and proprietors	1.62 ^b	0.81, 3.27	0.17	0.92	0.34, 2.50	0.87
Sales workers	1.06 ^b	0.44, 2.54	0.90	0.53 ^b	0.20, 1.40	0.20
Secretaries and clerical occupations	0.90 ^b	0.42, 1.93	0.79	0.91	0.59, 1.38	0.65
Service	0.83^b	0.47, 1.45	0.51	1.42	0.86, 2.35	0.17
Protective service occupations	0.47 ^b	0.17, 1.29	0.14	—		
Waiters and waitresses	—			2.12 ^b	0.93, 4.81	0.07
Cooks	1.74 ^b	0.66, 4.56	0.26	—		
Health service occupations ^c	—			2.03 ^b	0.95, 4.31	0.07
Personal service occupations	0 cases			0.94	0.37, 2.38	0.90
Farming, forestry, and fishing	—			—		
Precision production, craft, and repair/Operators, fabricators, and laborers	0.71	0.42, 1.19	0.19	0.85^b	0.32, 2.28	0.74
Mechanics and repairers	0.56 ^b	0.22, 1.43	0.23	0 cases		
Construction	0.95	0.45, 2.00	0.89	0 cases		
Motor vehicle operators	1.65 ^b	0.69, 3.97	0.26	0 cases		

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; POR, prevalence odds ratio.

^a POR represents the odds that a person with a history of childhood asthma belongs to a specific occupational group based on longest-held job relative to those same odds for a person with no history of asthma, adjusted for age and race/ethnicity. In the model the outcome variable was occupational group categorized as occupational group of interest and referent group that included all other occupational groups combined and the predictor variables were asthma history (childhood asthma versus no asthma), age, and race/ethnicity.

^b Estimated number of persons with a history of childhood asthma and related odds ratios not reliable because the standard error for the estimated number of persons with a history of childhood asthma was 30%–50%.

^c When *health diagnosing, assessing and treating* and *health service occupations* were combined (i.e., as health-related occupations), POR for men was 2.96 (95% CI: 1.72, 5.09, $P < 0.001$) and for women was 1.34 (95% CI: 0.79, 2.26, $P = 0.28$).

“—” indicates the standard error for the estimated number of persons with a history of childhood asthma >50%; PORs suppressed.

Note: PORs not calculated for *private household; cleaning; farm-related; related agricultural, forestry, and fishing; extractive and precision production; textile; machine operators; fabricators and assemblers; other transportation; laborers; freight and stock movers; equipment cleaners; and military occupations* because either no persons with a history of childhood asthma were identified in the sample or the standard error for the estimated number of men/women with a history of childhood asthma >50%.