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RESEARCH ARTICLE

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Work-related asthma prevalence among US employed adults

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Abstract

Background: Work-related asthma (WRA), a preventable occupational disease, can result in adverse health outcomes and employment disability, including decreased productivity, lost workdays, and job loss. Early identification of WRA cases and avoidance of further exposures is crucial for optimal management.

Objective: We estimate WRA prevalence among US workers by selected socio-demographic characteristics, industry, and occupation groups and assess the differences in adverse health outcomes, preventive care, and lost workdays between persons with WRA and those with non-WRA.

Methods: The 2020 National Health Interview Survey (NHIS) data for working adults aged ≥18 years employed in the 12 months before the survey were analyzed. Prevalence, and adjusted prevalence ratios with 95% confidence intervals were estimated using multivariate logistic regression.

Results: Of the estimated 170 million US adults working in the past year, 13.0 million (7.6%) had asthma. Among workers with asthma, an estimated 896,000 (6.9%) had WRA. WRA prevalence was highest among males, workers aged ≥55 years, those with no health insurance, those living in the Midwest, and those employed in the accommodation, food, and other services industry, and in production, installation, transportation, and material moving occupations. Workers with WRA were significantly more likely to use preventive medication and rescue inhalers, and to experience adverse health outcomes and lost workdays than workers with non-WRA.

Conclusion: Early identification of WRA cases, assessment of workplace exposures, and implementation of targeted interventions that consider the hierarchy of controls are critical to preventing future WRA cases and associated adverse health consequences.

KEYWORDS
employment, industry and occupation, prevention, work-lost days, work-related asthma

1 | INTRODUCTION

Work-related asthma (WRA), a preventable, common but under-recognized respiratory condition, is a major public health concern affecting 16% of adults with current asthma in the United States.[1,2]

WRA includes occupational asthma (new-onset asthma caused by workplace exposures) and work-exacerbated asthma (preexisting asthma that is made worse by workplace exposures).[1,2] Certain industries and occupations have been previously associated with a high asthma prevalence and exposure to potential asthmagens.[1–5] Both WRA and non-WRA share common symptoms such as shortness of breath, wheezing chest tightness, and cough. However, their underlying causes and triggers distinguish them apart. WRA is directly associated with workplace exposures, whereas nonwork-related asthma may be

associated with genetic factors, allergies, or other nonwork-related exposures or triggers.[1] WRA can have serious consequences on workers' health, quality of life, and productivity[1,4,6] and can impose a substantial economic burden on employers, healthcare systems, and society at large.[1,6–8] In addition, WRA suggests the presence of exposures in the workplace and indicates the need for medical surveillance of workers and to identify and reduce or eliminate relevant exposures to prevent additional cases from occurring.[1] Periodic assessment of WRA prevalence enables early identification of workers with asthma or WRA, which can lead to timely implementation of targeted interventions, prevent complications, and improve overall worker health.[9] This report provides national estimates of WRA prevalence among workers and examines health-related characteristics of workers with WRA and non-WRA.

2 | METHODS

Data from the 2020 National Health Interview Survey (NHIS), a cross-sectional survey collected annually from a nationally representative sample of the civilian noninstitutionalized US population, were analyzed.[9] The NHIS adult questionnaire is administered to one adult aged ≥18 years randomly selected from each family within the sampled household. The NHIS samples are selected through a complex, multistage, probability design, and the data are collected through personal interviews.[9] In 2020, due to the COVID-19 pandemic, the data collection procedures were disrupted, shifting from in-person interviewing to all-telephone interviewing during late March through June.[9] To reduce concerns of loss of coverage and low response rates associated with telephone interviews, approximately half of the original sample allocated for the last 5 months of 2020 was replaced with 2019 sample adults; adults who completed the survey in 2019 were reinterviewed using the 2020 questionnaire.[9] The final annual 2020 NHIS sample adult file included 31,568 persons.[9] Additional details on survey methodology are available in the 2020 survey description document.[9]

This study sample included only working adults (n = 19,552). Working adults were identified as persons aged ≥18 years who reported "working for pay at a job or business," or "with a job or business but not at work," or "working, but not for pay, at a family-owned job or business" any time during the 12 months before the interview.[9] The NHIS public use data file included information on participants' current industry (21 groups) and occupation (23 groups) information. Due to small sample sizes in certain groups, information on survey participants' current industry and occupation was categorized into 10 industry groups and 7 occupation groups (Supporting Information Table).[10] Information on asthma management (inhaler use and preventive medication use) and WRA were collected in 2020.[9] Participants were considered to have WRA if they were told by a doctor or other health professional that their asthma was caused by, or symptoms were made worse by, any job they ever had.[9] The WRA question was asked to adults with asthma (i.e., adults who were told by a doctor or other health professional that they ever had asthma and still have asthma or had an asthma attack/episode anytime during the 12 months before the survey interview).[9] Responses to asthma-related hospitalizations, emergency room visits, and lost workdays (days unable to work because of asthma) during the past 12 months were examined. Asthma preventive medication use was assessed based on responses to the question: "Are you now taking a preventive asthma medication every day, most days, some days, or never?" Rescue inhaler use was assessed based on responses to the question: "During the past 3 months, have you used the kind of prescription asthma inhaler that gives quick relief from asthma symptoms during an attack?"

Data were weighted to produce estimates representative of the US working adult population using sample weights provided in the 2020 NHIS data.[9] Variance estimates were calculated to account for the clustered and stratified complex survey design. WRA prevalence with 95% confidence intervals by selected characteristics, industry, and occupation were estimated using SAS survey procedures.

Adjusted prevalence ratios (PRs) with 95% confidence intervals were estimated using multivariate logistic regression to examine differences in WRA prevalence within selected demographic characteristics. Additionally, PRs were calculated to assess the differences in adverse health outcomes, preventive care, and lost workdays between persons with WRA and those with non-WRA (workers with asthma who reported that their asthma was not work-related). PRs were adjusted for age and sex. Analyses were done using SAS software version 9.4 (SAS Institute Inc.) and SUDAAN release 11.0.3 software (Research Triangle Institute). Survey procedures were used to account for complex survey design. The NHIS data collection was approved by the Research Ethics Review Board of the National Center for Health Statistics and the US Office of Management and Budget. For this study, a secondary data analysis, publicly available NHIS data were used, and National Institute for Occupational Safety and Health Internal Review Board approval was not required.

3 | RESULTS

In 2020, of the estimated 170 million US adults working at any time in the previous 12 months, 13.0 million (7.6%) had asthma. Among those with asthma, an estimated 896,000 (6.9%) had WRA. WRA prevalence was elevated among males (8.9%), those aged ≥55 years (8.2%), workers with income <100%–199% of the federal poverty level (9.1%), those with no health insurance (8.7%), and workers in the Midwest (10.0%) region (Table 1). Workers in the accommodation, food, and other services industry (8.5%) and workers in production installation, transportation, and material moving occupation (9.0%) had the highest WRA prevalence (Table 1).

Workers with WRA had significantly (p < 0.05) higher prevalence of preventive asthma medication use (PR = 1.30), rescue inhaler use (PR = 1.30); ≥8 days lost workdays (PR = 4.25), poor/fair physical health (PR = 2.32), depression (PR = 1.29), COPD (PR = 2.48), and hypertension (PR = 1.62) than those with non-WRA (Table 2).

TABLE 1 Number of working[a] adults with asthma[b] who have been told by their health professional that their asthma was work-related,[c] by selected characteristics, industry, and occupation. National Health Interview Survey, United States 2020.

Selected characteristics	Working adults Weighted[d] *N* in 1000 s	Asthma Weighted *N* in 1000 s (%)	Work-related asthma *N* (in 1000s)	Work-related asthma Prevalence among workers with asthma (95% CI)	Work-related asthma PR[e] (95% CI)
Total	170,360	12,970 (7.6)	896	6.9 (5.3–8.6)	
Age group					
18–34	62,511	5356 (8.6)	349	6.5 (3.4–9.6)	ref
35–54	66,592	4877 (7.3)	325	6.7 (4.5–8.8)	1.03 (0.58–1.82)
≥55	41,257	2737 (6.6)	223	8.2 (5.1–11.3)	1.26 (0.68–2.33)
Sex					
Males	88,590	4716 (5.3)	421	8.9 (6.2–11.7)	1.55 (0.95–2.51)
Females	81,735	8254 (10.1)	475	5.8 (3.7–7.8)	ref
Race/ethnicity					
Hispanic	30,740	2239 (7.3)	–	–	–
NH White	105,408	7973 (7.6)	526	6.6 (4.8–8.4)	0.66 (0.31–1.40)
NH Black	19,236	1787 (9.3)	–	–	–
Other	14,960	971 (6.5)	–	–	ref
Education					
<High school, GED	36,042	2590 (7.2)	198	7.7 (4.4–11.0)	1.13 (0.68–1.88)
≥High school	133,913	10,359 (7.7)	698	6.7 (4.8–8.6	ref
Family income-to-poverty level ratios[f]					
<100% and up to 200%	37,491	3562 (9.5)	320	9.1 (4.9–13.2)	1.59 (0.94–2.69)
At least 200%	121,320	8548 (7.5)	524	6.1 (4.4–7.9)	ref
Health insurance					
Not insured	21,648	1381 (6.4)	121	8.7 (3.0–14.5)	1.34 (0.65–2.77)
Insured	148,302	11,558 (7.8)	775	6.7 (5.0–8.4)	ref
US Census region					
Northeast	30,065	2313 (7.7)	145	6.3 (3.1–9.5)	1.04 (0.51–2.14)
Midwest	37,207	2812 (7.6)	281	10.0 (6.2–13.7)	1.66 (0.86–3.22)
South	61,715	4503 (7.4)	264	5.9 (2.7–9.0)	ref
West	41,373	3342 (8.1)	207	6.2 (3.4–8.9)	1.02 (0.51–2.03)
Industry groups[g]					
Natural resources and construction	15,746	465 (3.0)	–	–	
Utilities and transportation	10,091	631 (6.3)	–	–	
Manufacturing	15,617	898 (5.8)	–	–	
Retail and wholesale	20,562	1773 (8.6)	–	–	
Information, finance, real estate rental	13,864	896 (6.5)	–	–	
Professional, scientific, and technical services, education, training, and library	31,451	2729 (8.7)	133	4.9 (2.4–7.4)	

TABLE 1 (Continued)

Selected characteristics	Working adults Weighted[d] *N* in 1000 s	Asthma Weighted *N* in 1000 s (%)	Work-related asthma *N* (in 1000s)	Work-related asthma Prevalence among workers with asthma (95% CI)	Work-related asthma PR[e] (95% CI)
Management and administrative & support and waste management	7508	703 (9.4)	–	–	
Healthcare and social assistance	22,734	2323 (10.2)	140	6.0 (3.0–9.1)	
Accommodation, food, and other services	21,610	1733 (8.0)	147	8.5 (3.6–13.3)	
Public administration	7747	512 (6.6)	–	–	
Occupation groups					
Management, business, and financial	26,766	1773 (6.6)	109	6.2 (2.5–9.8)	
Professional and related	19,417	1417 (7.3)	90	6.3 (2.4–10.3)	
Education, training, and library	9809	931 (9.5)	–	–	
Healthcare practitioners and technical	9236	1532 (10.5)	–	–	
Services	30,908	2504 (8.1)	148	7.7 (3.5–12.0)	
Sales and office administrative support	32,376	2877 (8.9)	212	7.4 (2.5–12.2)	
Natural resources and construction	10,577	397 (3.8)	–	–	
Production, installation, transportation, material moving	27,890	1808 (6.5)	162	9.0 (4.3–13.7)	

Abbreviations: CI, confidence interval; PR, prevalence ratio; WRA, work-related asthma.

"–" Estimate is not shown because it does not meet National Center for Health Statistics standards of reliability.

[a]Workers were defined as those who were "working for pay at a job or business," or "with a job or business but not at work," or "working, but not for pay, at a family-owned job or business" any time during the 12 months before the interview.

[b]Asthma was defined as a "yes" response to the questions "Have you ever been told by a doctor or other health professional that you had asthma?" and "Do you still have asthma? Or had an asthma attack/episode in the past 12 months."

[c]Work-related asthma was defined as a "yes" response to the question, "Have you ever been told by a doctor or other health professional that your asthma was caused by, or your symptoms were made worse by, any job you ever had?" (Question was asked to persons who still have asthma or had an asthma attack/episode in the past 12 months).

[d]Weighted to provide national estimates.

[e]Differences in WRA prevalence within specific characteristics, adjusted for age and sex.

[f]Poverty index is based on family income and family size using the US Census Bureau's poverty thresholds for the previous calendar year. In the NHIS, poor was defined as having incomes below the poverty threshold; poor or near poor was defined as having incomes of 100%–199% of the poverty threshold; and not poor was defined as having incomes that are 200% or more of the poverty threshold. Imputed income files were not used for this analysis.

[g]Industry and occupation groupings were based on 2018 Standard Occupational Classification and Coding Structure. https://www.bls.gov/soc/2018/soc_2018_class_and_coding_structure.pdf and https://www.bls.gov/news.release/ecec.t10.htm

4 | DISCUSSION

In 2020, among the 13 million US adults with asthma who were working during the 12 months before the interview, an estimated 6.9% had WRA. The current WRA estimate is lower than the previously reported 16%.[2] This difference in the WRA prevalence can be attributed to several factors, including differences in how "workers" were defined, variation in the sample population, and study methodologies. The 16% estimate was based on a literature review and data pooled from nine longitudinal studies for occupational contribution to incident asthma.[2] A population-based cross-sectional study using the Behavioral Risk Factor Surveillance System Asthma Call-Back Survey data found that the proportion of incident asthma among adults that is work-related was 4.7% for health professional-diagnosed new-onset asthma. This proportion, however, was 18.2% when both health professional-diagnosed new-onset WRA and potential new-onset WRA (i.e., asthma that was self-described as caused by chemicals, smoke, fumes, or dust in a current

TABLE 2 Adverse asthma-related health outcomes, work lost days, rescue inhaler use and preventive care use among workers[a] with asthma[b] by work-related asthma status. National Health Interview Survey, United States, 2020.

	WRA[c]		Non-WRA[d]		
Characteristics	***N* x 1000**	**Proportion% (95% CI)**	***N* x 1000**	**Proportion% (95% CI)**	**WRA versus non-WRA PR[e]**
ER visits due to asthma	127	14.2 (6.6–21.8)	1121	9.3 (7.2–11.5)	1.58 (0.88–2.84)
Hospitalization due to asthma	–	–	185	1.5 (0.8–2.3)	-
Cigarette smoke status					
Current	141	15.8 (7.7–23.9)	1270	10.5 (8.5–12.5)	1.50 (0.87–2.57)
Former	177	19.8 (11.0–28.6)	2482	20.6 (17.8–23.3)	0.91 (0.58–1.43)
Never	577	64.4 (53.4–75.5)	8265	68.5 (65.4–71.8)	0.95 (0.81–1.12)
Physical health[f]					
Excellent/very good/good	603	67.4 (56.5–78.2)	10,344	85.8 (83.6–88.1)	0.78 (0.67–0.91)
Poor/fair	292	32.6 (21.8–43.5)	1705	14.2 (11.9–16.4)	2.32 (1.64–3.28)
Comorbidity					
Feeling depressed[g]	646	72.2 (61.6–82.8)	6875	57.1 (53.7–60.4)	1.29 (1.12–1.49)
Hypertension[h]	259	29.0 (18.4–39.5)	2014	16.7 (14.3–19.1)	1.62 (1.13–2.31)
Chronic obstructive pulmonary disease (COPD)[i]	207	23.1 (10.9–35.3)	1133	9.4 (7.5–11.3)	2.48 (1.35–4.53)
Missed workdays due to asthma[j]					
Zero days	562	63.8 (52.8–74.8)	8497	71.0 (67.9–74.1)	0.88 (0.73–1.06)
1–7 days	199	22.6 (13.8–31.3)	3073	25.7 (22.6–28.7)	0.91 (0.60–1.38)
≥8 days	120	13.6 (5.8–21.4)	399	3.3 (2.2–4.5)	4.25 (2.19–8.24)
Rescue inhaler use[k]	959	73.5 (62.2–84.7)	6834	56.7 (53.5–60.0)	1.30 (1.10–1.53)
Preventive care medications[l]					
Everyday/some days/most	539	60.2 (48.4–71.9)	3017	46.6 (43.2–49.9)	1.30 (1.05–1.60)

Note: Overall totals may not add up owing to rounding.

Abbreviations: CI, confidence interval; PR, prevalence ratio; WRA, work-related asthma.

"–" Estimate is not shown because it does not meet National Center for Health Statistics standards of reliability.

[a]Workers were defined as those who were "working for pay at a job or business," or "with a job or business but not at work," or "working, but not for pay, at a family-owned job or business" any time during the 12 months before the interview.

[b]Asthma was defined as a "yes" response to the questions "Have you ever been told by a doctor or other health professional that you had asthma?" and "Do you still have asthma? Or had an asthma attack/episode in the past 12 months."

[c]Workers with WRA were those with asthma who answered "Yes" to the question, "Have you ever been told by a doctor or other health professional that your asthma was caused by, or your symptoms were made worse by, any job you ever had?"

[d]Workers with non-WRA were those with asthma who answered "No" to the questions "Have you ever been told by a doctor or other health professional that your asthma was caused by, or your symptoms were made worse by, any job you ever had?"

[e]Differences in selected characteristics by WRA status, adjusted for age and sex.

[f]Physical health was assessed based on responses to the question: "Would you say your health in general is excellent, very good, good, fair, or poor?" and grouped into two categories (1) excellent/good and (2) poor/fair health.

[g]Workers were considered feeling depressed based on "daily," "weekly," "monthly," "a few times a year" responses to questions: "How often do you feel depressed? Would you say daily, weekly, monthly, a few times a year, or never?"

[h]Hypertension was defined as a "yes" response to both questions: (1) Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure? and (2) Were you told on two or more different visits that you had hypertension or high blood pressure?

[i]COPD was defined as a "yes" response to the question, "Have you ever been told by a doctor or other health professional that you had…Chronic Obstructive Pulmonary Disease, COPD, emphysema, or chronic bronchitis?"

[j]Missed workdays due to asthma were categorized based on responses to the question: "During the past 12 months, how many days were you unable to work because of your asthma?"

[k]Rescue inhaler use was identified based on a "yes" response to the question: "During the past 3 months, have you used the kind of prescription asthma inhaler that gives quick relief from asthma symptoms during an attack"?

[l]Preventive asthma medication use was identified based on "every day," "most days," or "some days" responses to the question: "Are you now taking a preventive asthma medication every day, most days, some days, or never?"

or previous job) were considered.[11] Using data from 31 US states and the District of Columbia, Dodd et al. reported 13.9% of ever-employed adults with current asthma had WRA during 2012–2014.[12] However, the current report provides WRA prevalence estimates among US adults with asthma who were employed at any time during the past 12 months. Some of the workers with WRA might have left employment due to their asthma and were not included in our analyses, thus lowering the estimates.

The WRA prevalence was elevated among certain worker groups. Similar to previous reports, workers with WRA more frequently reported poorer physical health, depression, COPD, and work lost days than those with non-WRA.[1,2,7,11] Moreover, workers with WRA were more likely to take preventive asthma medications and use a rescue inhaler than workers with non-WRA, suggesting greater asthma severity. Primary prevention, early diagnosis of WRA, identification of workplace exposures, and implementation of targeted interventions are essential to improve worker health.[1,2,4,13] Also, asthma education and preventive training play an important role in increasing worker awareness of potential exposures and their avoidance, leading to improved worker health and well-being, potentially reducing absenteeism, and increasing productivity.[1,4,12]

WRA prevalence varied by industry and occupation groups. Similar to previous reports,[4,5,8] workers in the accommodation and food services industry and production, installation, maintenance, transportation, and material moving occupations were found to have high WRA prevalence. Work in the food services industry has been associated with exposure to a variety of asthmagens including food derived allergens, (e.g., cereals, flours, seafood, spice dust), irritants (cleaning agents, cooking fumes, and byproducts of combustion), and other factors (second-hand smoke, temperature, and physical exertion).[4,5,8] Workers in the production, transportation, installation, maintenance, and material moving occupations are at risk of exposure to engine exhaust fumes, preservatives, aromatic amines, paints, fragrances, silica dust, mineral fibers, biofuels, epoxy, and other resins, all of which have been linked to WRA.[1,3,5,8,14] Additionally, higher risk for WRA was previously reported among workers in the healthcare and social assistance industry (associated with exposure to latex or cleaning chemicals), construction workers (associated with exposure to engine exhaust fumes), and beauty industry workers (associated with exposure to formaldehyde, acrylic monomers).[4,14]

5 | LIMITATIONS

The findings in this report are subject to some limitations. First, WRA data are self-reported, and diagnoses were not validated by medical records review or follow-up with healthcare providers. However, previous studies have found self-report of adult asthma to be reliable when compared with reviews of medical records.[15] Second, this study included only adults who were employed at any time in the past 12 months, therefore, results underestimate the prevalence of WRA among all workers. Moreover, because adults with severe asthma might have left employment, results likely underestimate the prevalence of adverse asthma-related outcomes (e.g., hospitalizations and ER visits for WRA). Third, due to the cross-sectional design of the survey, causality could not be assessed. Finally, despite combining data, small sample sizes in certain industry and occupation groups resulted in unreliable estimates. Combining additional years of data are needed to estimate detailed industry- and occupation-specific WRA estimates.

These findings can assist clinicians in identifying workers in occupational groups with greater asthma or WRA prevalence who should be evaluated for the disease. Occupational exposure to asthmagens has been associated with uncontrolled adult-onset asthma[16,17] therefore, considering occupational contributions is essential for effective management and prevention of exacerbations.[9,16–18] Although pharmacologic treatment of WRA is similar to that of non-WRA,[1] WRA management requires avoidance or reduction of workplace exposures.[17] Workers with asthma should inform their healthcare providers about their asthma-related concerns, and providers should consider WRA in all workers with new-onset or worsening asthma.[1,2,9,18] Employers and employees should work together to assure a safe work environment, which can be achieved by eliminating, when possible, or reducing exposure to asthma triggers in the workplace,[18] or substituting triggers, using engineering controls (e.g., isolating, enclosing processes or improving ventilation), implementing administrative controls (e.g., smoke free policies), work practices, worker training and personal protective equipment use, and medical monitoring for early identification of asthma cases.[18–20]

AUTHOR CONTRIBUTIONS

Girija Syamlal: Conceptualization, methodology, data analyses, interpretation, and writing—original draft preparation. **Katelynn Dodd**: Conceptualization, writing, reviewing, and editing of the manuscript. **Jacek Mazurek**: Supervision, writing—reviewing and editing of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS APPROVAL AND INFORMED CONSENT

The National Health Interview Survey (NHIS) data was approved by the Research Ethics Review Board of the National Center for Health Statistics. For this study, a secondary data analysis, publicly-available NHIS data were used, and National Institute for Occupational Safety and Health Internal Review Board approval was not required.

DISCLAIMER

The findings and conclusions of this report are those of the authors and do not necessarily represent the view of the National Institute for Occupational Safety and Health. This manuscript was prepared and written by NIOSH employees as part of their employment. Mention of a specific product or company does not constitute an endorsement by the Centers for Disease Control and Prevention.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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