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Occupational Contributions to Respiratory Health Disparities

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INTRODUCTION

Social determinants of health are conditions in the environment that affect a wide range of health and quality-of-life outcomes. A large body of scientific research has documented that many respiratory diseases [e.g., asthma, chronic obstructive pulmonary disease (COPD), lung cancer, and pneumoconiosis] are not evenly distributed throughout society and disproportionately affect some populations, particularly people of color and lower-income communities.[1-3] The roots of these inequities are complex and include structural factors such as systemic racism and discriminatory policies, as well as individual factors such as employment, socioeconomic status, housing, neighborhood, education, social support networks, and access to health care.

Work is a significant contributor to health disparities, affecting financial status, health care access, and exposure to hazardous substances. Yet, while occupation and associated exposures are included in the socioecological models, work exposures remain persistently absent from research on health inequities and their contribution to health.[4,5] Though a large proportion of our adult lives is spent at work, and many occupational exposures can contribute to pulmonary diseases, few studies in the field of pulmonology have sought to examine the contribution of these occupational exposures to respiratory health inequities.[6,7]

The respiratory system is particularly vulnerable to insults by occupational exposures, given the opportunities for contact with airborne contaminants. Therefore, differences in occupational exposure can amplify respiratory disease disparities. Because occupational

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exposures are largely considered to be preventable through proper workplace safety controls, recognition of occupational etiologies of disease can provide an opportunity for interventions that can bring about health equity.

Since the beginning of the COVID-19 pandemic in 2020, societal awareness of the occupational risks faced by “essential workers” has increased interest in the complex interaction between work and health. Health care workers were recognized early on to be at increased risk of SARS-CoV-2 transmission, especially without access to adequate personal protective equipment and vaccination.[8,9] More generally, an increased risk of infection was identified for workers who were required to work in person, travel on crowded public transportation, work in crowded spaces, or who lacked proper personal protective equipment.[7,10] The COVID-19 pandemic has highlighted how such occupational risk factors co-exist with and magnify the impact of non-occupational factors associated with health disparities, including age, race/ethnicity, education, and income.[10] These concepts can be applied not only to COVID-19 but also to other respiratory diseases, as Brigham et al. have previously suggested (Figure 1).[7]

In this review, we present an overview of ways in which occupational exposures contribute to disparities across a spectrum of respiratory diseases (Table 1). While our list is not comprehensive, we have selected specific respiratory diseases to highlight as examples based upon their demonstrable disparity and their overall disease burden and effects on populations at increased risk.. While we predominantly present topics related to health disparities within the upper-income regions of the world due to available data, we recognize that this is not reflective of all literature and health determinants worldwide.

DISEASE EXAMPLES

Airway Disease

Asthma—Asthma is a common chronic disease that causes reversible airway obstruction, leading to wheezing, shortness of breath, coughing, and dyspnea and affecting over 25 million Americans in 2020, including 21 million adults.[11] It is a serious illness that can profoundly affect quality of life, ability to work, and economic well-being. In addition to high individual costs, it also has a significant societal economic burden. A recent United States study estimated that in 2013, the cost of treating asthma was $81.9 billion annually, including medical treatment, absenteeism, and mortality.[12] But a large body of scientific research has documented that asthma is not evenly distributed throughout society and disproportionately affects some populations, particularly people of color and lower-income communities.[3,13]

Studies have shown that between 15%-54% of all adult asthma is attributable to exposures at work, affecting an estimated 3-11 million adults.[14,15] Work-related asthma (WRA) is a preventable condition that includes asthma caused or worsened by workplace exposure. Nearly three-quarters of adults with asthma are employed and at risk of asthma exacerbations from conditions at work.[16] In addition, over 300 workplace substances have been identified as capable of inducing new-onset asthma.[17,18] Despite being one of the most common occupational lung conditions, WRA is well-recognized as being underdiagnosed and underreported.[19-22]

As with overall adult asthma, WRA is distributed inequitably across subsectors of workers. Factors that contribute to disparate rates of asthma in communities, such as historical discrimination and other social determinants of health, also lead to disproportionate employment in jobs with a high risk of asthma-associated exposures. Workers in these jobs are inherently at increased risk, often afraid of retribution for questioning safety practices or reporting asthma-related symptoms at work.[23-26] Research has shown that jobs considered high risk for asthma increase asthma risk significantly more for Black and Hispanic workers than non-Hispanic White workers.[27] Similarly, the rate of WRA in Michigan for Black workers is more than twice that of White workers.[28] Mazurek et al. examined survey data of people with current asthma and found that people of color, low-income people, and those with less education were more likely to have WRA than White people or those with more education and income.[19,19] Similarly, workers with less education or low income had significantly elevated odds of frequent workplace exposure to vapors, gas, dust, or fumes compared to workers with more education or income.[29]

While WRA can occur in any industry or occupation, people in high-risk occupations have been more than four times more likely to report asthma diagnoses than those in low-risk occupations.[27] Population-based surveys and state-based surveillance have shown that the types of work most at risk for WRA are often low-paying jobs with high exposure potential. Michigan workers identified through a WRA surveillance system were most commonly employed in manufacturing, health care and social assistance, and mining.[28,30] California and Washington workers with high rates of WRA were employed in transit, health care support, utilities, manufacturing, social services, protective services, public administration, and agriculture.[31,32]

Black and Hispanic workers are overrepresented in lower wage, higher manual labor and high-risk occupations.[33] White workers are disproportionately employed in management and professional occupations, the highest paying occupation category with low asthma risk. In contrast, Black and Hispanic workers are overrepresented in occupations with low pay and high asthma risk, including transportation and material moving, manufacturing, health care support, utilities, and maintenance.[34]

The economic impacts of WRA can be severe, amplified for workers in low-wage jobs with little safety net or power to demand change in workplace exposures. Unplanned emergency room visits, hospital stays, and missed work may have unevenly significant impacts on people in lower-paying jobs that may offer fewer benefits and less job security. Contingency and contract workers may have even less cushion. People with WRA have more severe disease and worse outcomes than non-WRA, including more asthma attacks, poorer control of asthma, more medical care utilization, impaired mental health, poor self-rated health, impaired physical health, and limited activity.[35-37] WRA patients are also more likely to have financial barriers to care, need more medications, and are more likely to become unemployed than individuals with non-work-related asthma.[35,38] WRA impacts can also include job loss, lost work days, altered job duties due to asthma symptoms, or inability to be effective at work.[39] Workers with WRA may not report asthma symptoms or exposures in the workplace due to a belief that nothing can be done, fear of job loss, concern about confirming a diagnosis, lack of awareness of asthma-causing agents or associations between symptoms with work, or a lack of access to health care.[19,22] The asthma disparities that are well-described in the community are compounded by the conditions and outcomes associated with WRA.

Despite these challenges, work-related asthma is preventable and offers opportunities to lessen overall asthma disparities. Reducing asthma exposures in the workplace is often more immediately achievable than addressing other social determinants of health that contribute to asthma inequities. Preventive actions in the workplace also protect all workers in that environment, including future workers. Clinicians need to include an assessment of workplace exposure history as part of their evaluation of any adult patient seen for asthma, whether pre-existing or new onset, in order to assess the critical contributing factor of work.

Chronic Obstructive Pulmonary Disease—Chronic Obstructive Pulmonary Disease (COPD) is a respiratory disease defined by airflow obstruction that is not fully reversible and is associated with chronic exposure to inhaled particles or gases. COPD affects 4% of the global population, causing at least 3 million deaths yearly.[40] Tobacco smoke is the most common risk factor, but occupational exposure to inhaled toxins is an often underrecognized contributor. In a recent meta-analysis, occupational exposure to vapors, gases, dusts, and fumes accounted for 14% of cases of COPD.[41] with the population-attributable fraction estimated at 31% in nonsmokers.[41] Worldwide, COPD is an underdiagnosed disease, especially among never smokers, younger individuals, and those with mild symptoms.[42] Occupational COPD is likely to fall into this category also likely underdiagnosed, especially for nonsmokers.[41]

There is longstanding evidence of the relationship between inorganic dust exposure and COPD. The first occupational etiology of COPD was noted with coal mine dust. A clear exposure-response relationship was found between coal dust exposure and decreased lung function, regardless of smoking habits and age. The US Coal Workers' Health Surveillance Program demonstrates the prevalence of airway obstruction as high as 7.7% among never smokers and 16.4% among those with coal worker's pneumoconiosis, highlighting the impact of coal dust on airways.[43] Silica dust can also contribute to chronic airway obstruction even without silicosis.[44,45] These findings have been seen across both mining and non-mining industries,[46] including those exposed to engineered stone products where 23% demonstrate obstruction on pulmonary function testing.[47]

The contribution of occupational exposures to COPD differs across populations. The burden of occupational COPD may be higher among minority populations due to higher exposure while working in hazardous industries than exposure among nonminority workers.[48] Black individuals are more likely to be exposed to indoor air pollution through biomass fuel usage at home and work, which is known to cause airflow obstruction in resource-poor settings. In the BOLD study by Amaral et al., biomass fuels were seen between 47% and 96% of populations in Sub-Saharan Africa and 70% in Lexington, Kentucky, affecting both domestic and occupational sources of indoor air pollution.[49]

A significant proportion of COPD cases can be attributed to inhaled particles at work, including coal dust, silica, organic dusts, fibers, and fumes. Disadvantaged people tend to work in these environments while having limited access to high-quality primary and specialty care, further contributing to their health inequity. In addition to contributing to the development of COPD, occupational exposures in those with established disease, whether occupational or nonoccupational, are associated with shorter walk distance, greater breathlessness, worse quality of life, and increased exacerbation risk.[50] When seeing patients with symptoms such as breathlessness or chronic cough consistent with COPD, clinicians should ask about occupational exposures and consider screening for COPD if applicable. Additionally, a complete history will enable clinicians to counsel patients on avoidance of further exacerbating exposures for patients at risk of COPD or with established disease.

Silicosis

Silicosis, a pneumoconiosis caused by inhalation of respirable crystalline silica, has been recognized as an occupational hazard for many centuries. Industries that involve work with silica-containing materials, such as sand and stone, can place workers at risk of silica exposure and silica-related disease. Once diagnosed, silicosis is progressive and can lead to severe disability and death, with treatment options limited mainly to lung transplantation.[51] Silicosis is, however, preventable with reduction or elimination of silica dust exposures in the workplace, through strategies such as modified work practices, improved ventilation, and appropriate personal protective equipment, many of which are required in the United States under Occupational Safety and Health Administration (OSHA) silica regulations.

Despite this long-recognized hazard and known prevention strategies, large numbers of workers continue to be affected, including in newly identified industries where changes in work practices or the use of new materials have led to increases in worker exposure to silica dust.[51,52] One such example is the emergence of silicosis in the engineered stone countertop industry (also known as artificial stone or quartz). Engineered stone, a material made of crushed quartz bound with resins, first became available in the 1980s and has since increased markedly in popularity. It also contains significantly higher levels of silica – typically upwards of 90% – compared to its natural stone predecessors, such as granite (~40-50%) and marble (<10%).[51,53] Workers who cut, polish, and finish countertops made from engineered stone can therefore be exposed to much higher levels of respirable crystalline silica, increasing their risk of developing silicosis.

Indeed, over the past decade, numerous cases of engineered stone silicosis have been identified among these workers in Israel, Spain, Australia, the United States, and elsewhere.[47,54] These cases have been particularly concerning because many have affected younger workers with shorter durations of exposure, who have presented with accelerated disease leading to more severe, rapidly progressive impairment and death.[47,51,53,54] In the United States, workers in this industry diagnosed with silicosis have been primarily Latinx, some of whom may be undocumented immigrants.[53,55,56]

The heightened risk of this severe, progressive occupational disease among these at-risk worker groups can exacerbate underlying health disparities. For silicosis patients with severe lung impairment, lung transplantation is the only available treatment option, but undocumented individuals may face significant barriers in pursuing this option due to factors such as lack of health insurance, limited financial and social resources, language barriers, and others.[57] Overall, the challenges posed by silicosis among engineered stone countertop workers illustrate how occupational factors can contribute to pulmonary health disparities and the significant effort that remains for the clinical, public health, and regulatory communities to address this preventable cause of illness.

COVID-19

The COVID-19 pandemic has resulted in more than 550 million cases and 6.3 million deaths worldwide and more than 87 million cases and 1 million deaths in the United States as of July 1, 2022.[58] This impact has been experienced disproportionately by low-income communities and communities of color. In the United States, higher rates of COVID-19 cases, hospitalizations, and deaths have been observed in Latino, Black, and American Indian/Alaska Native individuals compared to White, non-Hispanic individuals.[59,60]

The differential effects of COVID-19 on certain communities have, in large part, magnified pre-existing inequities. While the drivers of disparities in COVID-19 morbidity and mortality are multifactorial – reflecting longstanding discrimination and unequal access to healthcare, housing, and other resources – differences in occupational exposures and risks have likely played an important role. Workers who have continued to report to work in person throughout the pandemic (“essential workers”), as well as those who work in public-facing roles or whose work involves close contact with others, have faced higher risks of COVID-19 exposure and infection. The workers who have faced these elevated risks are more likely to be members of minority racial or ethnic groups; Black and Hispanic workers in the U.S., for example, are disproportionately employed in essential industries and occupations with a higher risk of exposure to COVID-19.[61-63]

These statistics have played out in numerous high-profile examples during the COVID-19 pandemic. In the early months of the pandemic, several large COVID-19 outbreaks occurred at meat processing plants around the United States, such as an outbreak at a Smithfield Foods pork processing plant in South Dakota that led to more than 1,300 cases and four worker deaths, and outbreaks at JBS Foods facilities in Colorado and Wisconsin that led to several hundred cases and seven worker deaths.[64,65] Workers in this industry, who hail disproportionately from minority and immigrant communities, have long faced higher risks of work-related injuries from repetitive motion tasks, rapid line speeds, and other hazards.[66] COVID-19 introduced a significant new risk; as these facilities, designated as “critical infrastructure” by federal executive order, largely remained open, the crowded workplaces, lack of personal protective equipment (PPE) access, and shared worker transportation and housing drove rapid transmission among workers and the surrounding communities. In the initial months of the pandemic, these workers and communities were estimated by one study to comprise 6-8% of total COVID-19 cases and 3-4% of total COVID-19 deaths in the United States;[67] counties with meat processing facilities experienced significantly higher rates of COVID-19 than other comparable counties.[67-69] Studies of outbreaks in these facilities confirmed that racial and ethnic minority workers were disproportionately affected; during the early months of the pandemic, over 80% of cases of COVID-19 in agricultural processing and manufacturing industries, including meat processing, were among racial and ethnic minority workers. Latinx workers comprise just over a third of the meat processing workforce but accounted for nearly three-quarters of COVID-19 cases in the industry between March 1 and May 31, 2020.[70]

The skilled nursing facility industry has also been heavily affected by the COVID-19 pandemic. One of the earliest COVID-19 outbreaks in the United States occurred in February-March 2020 at the Life Care Center nursing home in Kirkland, Washington, which was ultimately associated with 129 COVID-19 cases, including 34 staff members, and 23 deaths among residents and visitors.[8] Similar scenes soon unfolded in nursing homes around the country; as of June 2022, more than 1.1 million cases and nearly 2,500 deaths had occurred among skilled nursing facility staff since the pandemic's beginning.[71] Workers in these facilities faced numerous risks, including exposure to patients and other staff members with COVID-19 and PPE shortages. While PPE shortages occurred in many health care settings, skilled nursing facilities typically have more limited occupational health resources and less rigorous infection control and respiratory protection programs, placing these workers at additional risk.[9] Skilled nursing facilities are also primarily staffed by health care workers with lower levels of education and training, such as certified nursing assistants and personal care aides. These jobs are low-wage and high-risk; a study by the U.S. Department of Health and Human Services found that more than 20% of certified nursing assistants relied on some form of public assistance, such as Medicaid or food and nutrition benefits, and many worked multiple jobs to make ends meet. These workers also had higher baseline workplace injury rates and limited access to paid leave.[72] For these workers at increased risk, increased work-associated COVID-19 risk magnified pre-existing disparities.

Studies in the United States and elsewhere have documented more broadly which groups of workers have been most significantly affected by COVID-19. Analyses of COVID-19-related mortality in California in 2020 found elevated excess morbidity and mortality rates among food and agriculture, transportation, construction, and manufacturing occupations. In addition, Latino and Black working-age Californians faced higher COVID-19 mortality rates than White workers.[10,73] Studies from England have also documented elevated risk of severe disease and mortality among groups such as transportation workers and personal care workers, with the highest risk of severe disease found among non-white essential workers.[74,75]

Studies of COVID-19 outbreaks in the United States have also found high numbers of outbreaks in essential industries, suggesting that such workplaces are an important source of SARS-CoV-2 exposure among their workers. Studies in California and Utah identified the highest numbers of outbreaks in sectors such as healthcare, manufacturing, retail, construction, and transportation and warehousing.[76-78] In Utah, while Hispanic and non-White workers comprised 24% of the workforce in affected sectors, they comprised 73% of workplace outbreak-associated cases.[78]

Though it can be challenging to disentangle the many drivers of COVID-19 disparities, a California study attempted to estimate the contributions of occupation and educational attainment to racial and ethnic disparities in COVID-19 mortality. The authors found that if all working-age Californians had the mortality risk associated with the lowest-risk educational and occupational groups, COVID-19 mortality would have been reduced by 43%, with the largest risk reductions seen for Latinx men and women.[79] Given the contributions of work-related risks to COVID-19 disparities, workplace interventions, including safety measures such as masking and improved ventilation, targeted vaccination, paid sick leave, access to early treatment, and others, may offer a means not only to improve workplace health and safety but also to reduce broader COVID-19 disparities.

Lung Cancer

Lung cancer is the most common cause of death from cancer worldwide, causing nearly 1 in 5 (18.4%) cancer deaths. Tobacco is the dominant cause, but the International Agency for Research on Cancer (IARC) has identified 12 occupational exposure factors as being carcinogenic to the human lung: aluminum production, arsenic, asbestos, bis-chloromethyl ether, beryllium, cadmium, hexavalent chromium, coke and coal gasification fumes, crystalline silica, nickel, radon, and soot.[80,81] Occupational lung cancer is widely under-recognized at less than 3% of the total number of estimated cases.[82-84] Estimates using recognized lung carcinogens have produced a calculated population attributable fraction of occupational lung cancer of 10 to 15% of all lung cancer. Still, occupational exposures are only implicated in 3% of the total number of diagnosed cases.[85-87] For example, in Great Britain, only 22 cases per year were reported in their occupational respiratory disease registry between 1996 – 2014.[83]

Similarly, there are gaps in recommendations for lung cancer screening in occupational populations. Previously, the United States Preventive Services Task Force recognizes occupational exposures as a risk factor in risk assessment for individual patients but does not give discrete guidelines for screening.[88,89] To improve disparities in screening, they updated their guidelines in March 2021 to recommend screening in persons aged 50 to 80 with current or recent smoking and a 20-pack-year history of smoking. Instead, the National Comprehensive Cancer Network (NCCN) and the American Society of Thoracic Surgeons have developed guidelines for including additional risk factors, which include occupational risk factors, recommending screening people [3] greater than 50 years with a 20-pack-year smoking history if they have additional risk factors for lung cancer including occupational exposures.[90] Otherwise, a 30-pack-year history would be required. In the National Lung Screening Trial (NLST), African-Americans had a higher rate of lung cancer and were more likely to report occupational exposure, including 6.5% to silica and 4.7% to asbestos.[91] Lack of clear guidance on lung cancer screening in occupational populations can lead to delayed lung cancer diagnosis especially affecting minority populations, though recent steps have been taken to reduce disparities by lowering the smoking requirement.

STRATEGIES FOR IMPROVING EQUITY

Clinical Strategies

Equity in pulmonary health can be improved by addressing occupational contributors to disparities. Clinicians have a vital role to play in this process. One key step is talking with patients about their work, which does not happen often enough. For instance, multiple studies have documented poor patient-provider communication about work among patients with asthma. In one survey of more than 50,000 ever-employed adults with current asthma, 46% of whom had possible work-related asthma, fewer than 15% of respondents reported ever having any communication with a healthcare provider about asthma and work.[19] Interviews with 142 patients with welding-related asthma reported by physicians and other providers to a state's work-related asthma surveillance system found that fewer than half of the patients knew they had work-related asthma.[92] Both primary care physicians and specialists have been found to have difficulty identifying work-related asthma, taking occupational histories, and educating their patients about the relationship between the workplace and asthma.[93] Similar challenges have been documented for chronic bronchitis.[94]

Closing these communication gaps starts with taking an occupational history (Box 1). Yet many clinicians lack the training or experience to navigate this conversation, or they focus on a narrow set of exposures and workplaces with which they are already familiar.[93,95-97] A targeted occupational health curriculum in medical school could improve the history-taking skills of future clinicians.[95] For clinicians already in practice, many sources of information about occupational exposures and their health effects are available from governmental and non-profit entities, including several searchable online databases (Table 2).[98,99] In addition, manufacturers are required by the Occupational Safety and Health Administration (OSHA) to transmit information about the potential hazards of chemicals to employers and employees using standardized Safety Data Sheets.[100] Although some trade secret chemical information can be withheld, physicians and other health professionals providing services to exposed employees have the right to obtain the trade secret information from the manufacturer. With patient permission, healthcare providers also can contact employers directly for additional information about workplace conditions, processes, and potential exposures.

Beyond knowledge barriers, time constraints in clinical encounters limit the collection of adequately detailed information about work.[97,101] Self-administered questionnaires that assess workplace exposures have been developed for general occupational diseases and for many lung diseases, including asthma, lung cancer, and interstitial lung disease.[102-106] Using such questionnaires in the clinical setting could foster more efficient communication between patients and providers. In addition, the adoption of clinical decision support tools and incorporation of standardized occupational data into health information technology systems show promise for improving the timely recognition of work-related diseases.[107,108]

For occupational lung diseases generally, patient-provider communication gaps can lead to delays in diagnosis, treatment, and cessation of causative workplace exposures, resulting in increased morbidity and healthcare utilization and contributing to health disparities.[93,99,109-111] While respiratory diseases in their later stages present with pronounced lung function impairment, workers typically present with more subtle clinical findings or may be asymptomatic in their early stages. For example, employer-provided clinical screening for silicosis, including chest x-ray and spirometry, is mandated for silica-exposed workers under OSHA regulations. However, analysis of OSHA inspections has indicated that few employers are complying.[112] When workers do develop respiratory symptoms, they may face barriers in seeking medical care, such as limited health care access, language barriers, and hesitation to interface with the medical system. And when they do present to care, accurate diagnosis may be delayed if providers do not ask about or recognize occupational associations. Also, delayed diagnosis can lead to worse outcomes in many respiratory diseases. In COPD, delayed diagnosis is associated with a higher exacerbation rate and increased comorbidities.[113]

Once work-related lung disease is identified, clinicians can also impact disparities through appropriate disease management. James et al. provide an excellent summary of resources available to clinicians managing occupational lung disease, including information on workers' compensation, family and medical leave, and reasonable accommodations.[99] Unfortunately, one obstacle that patients with work-related diseases generally face is access to care, as many practices do not accept workers' compensation insurance.[114] Another challenge is that requests for workplace accommodations such as respiratory protection, job restrictions, or job transfer can risk job loss if overly restrictive but lead to ongoing exposure if inadequate.[7] Job loss can leave workers without a source of income. Furthermore, if an individual cannot work due to severe disease, they may have limited access to disability and health benefits, depending on their insurance and immigration status. In challenging or unfamiliar circumstances related to occupational pulmonary disease, referral to an occupational medicine specialist for further evaluation and management is recommended; the Association for Occupational and Environmental Clinics provides a directory of member clinics (http://www.aoec.org/directory.htm).

Other Strategies

Ultimately, improving equity in pulmonary health requires preventing occupational exposures that cause lung disease. The identification of work-related lung disease affords an opportunity to not only care for the patient with disease but potentially to identify and prevent additional cases among co-workers. Although clinicians can advocate with the employer directly for improvements to workplace conditions, involvement of regulatory and public health authorities is often warranted. OSHA (or MSHA, for the mining industry) is the regulatory agency tasked with setting and enforcing regulations for recognized hazards. Clinicians, patients, and others can file a complaint with OSHA, which prompts investigation and, under certain conditions, inspection of the workplace (https://www.osha.gov/workers/file-complaint).

In some situations, standards for exposures do not exist. This may be because a recognized hazard is not regulated, such as indoor dampness and mold exposures that are associated with asthma and hypersensitivity pneumonitis.[115] Under these circumstances, OSHA's regulatory enforcement role is limited to the General Duty Clause, which requires that employers provide a workplace free from recognized hazards. When a problem is just emerging, as was flavoring-related lung disease in the early 2000s[116] and BADE, more recently,[117] there are no applicable regulations. Consultation with state public health authorities or the National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention, can lead to multidisciplinary inquiry and the development of an evidence base for causality and prevention.[118] In particular, NIOSH's Health Hazard Evaluation (HHE) program is a unique resource for site-specific investigation of new and recurring hazards (https://www.cdc.gov/niosh/hhe/default.html).

Public health surveillance for occupational lung disease can contribute to prevention by identifying changes in disease patterns that merit further investigation, such as a cluster of asthma associated with a particular workplace or cases of severe silicosis among young workers across an industry.[53,119] With the exception of several industry-specific programs, including Congressionally-mandated surveillance of coal miners by NIOSH[120] and California's Flavoring Industry Safety and Health Evaluation Program,[121] surveillance for occupational lung disease in the U.S. relies in large part on data derived from medical and vital records. Clinicians can improve the sensitivity of public health surveillance by routinely documenting information on employment and occupational exposures for patients with lung disease.[7] This step is crucial because even if a relationship to work is not evident or established at the individual level, examination of aggregate clinical data may reveal an occupational burden that informs future preventive measures.[41]

Several approaches beyond government merit mention. Labor unions have traditionally played an important role in advocating for workplace health and safety measures and are associated with improved health outcomes for workers.[122] Although union membership among private-sector workers declined to 6% in 2021,[123] recent strikes by teachers, successful union drives at major companies such as Amazon and Starbucks, and increases in petitions for union elections are notable.[124] These developments suggest renewed opportunities to improve equity through the innovative design of employment contracts to address workplace conditions and other social determinants of pulmonary health.[122,125] Furthermore, workers could benefit from legal advocacy to educate them about their legal rights to mitigation of adverse workplace conditions and about available protections from employer retaliation, a need that has been documented for patients with occupational asthma.[126] In addition, beyond its benefits in direct compensation to injured workers, litigation is a potential mechanism to highlight the harm of particular exposures to workers and drive change, as has occurred with asbestos.[64] Lastly, there is need for continued growth in product stewardship programs and laws requiring manufacturers to consider holistic costs to human health and the environment. The push to increase awareness and engagement among consumers has the potential to positively impact workers and improve equity in pulmonary health.[127,128]

SUMMARY

Occupational exposures are important social determinants of health to consider in respiratory health disparities. Occupation and associated exposures must be included in the socioecological models of health since work exposures contribute to health inequities and respiratory health. In this review, we have highlighted some of the most demonstrative examples of respiratory diseases affected by occupational exposures. These include asthma, COPD, silicosis, COVID-19, and lung cancer. While this list is not comprehensive, it illustrates the critical role that occupational exposures play in ongoing respiratory disparities. Future studies to address the inter-relatedness between one's work and environment are necessary to begin the process of improving health equity.

Overall, we recommend that clinicians take a broad approach when considering how occupation interacts with other social factors when caring for patients with lung disease. This approach will provide a framework to identify the full complement of modifiable and preventable risk factors that must be addressed to improve care for patients with high-risk occupational exposures. For example, a clinician who knows that 15-54% of adult asthma is attributed to workplace exposures will understand the importance of interviewing their patients to identify potential workplace exposures and providing them with avoidance counseling.[14,15] Addressing and understanding social determinants of health, including occupational contribution, is a critical step to achieving respiratory health equity.

REFERENCES

1. Gaffney AW, Himmelstein DU, Christiani DC, Woolhandler S. Socioeconomic Inequality in Respiratory Health in the US From 1959 to 2018. JAMA Internal Medicine. 2021;181(7):968–976. doi:10.1001/jamainternmed.2021.2441 [PubMed: 34047754]
2. Gaffney AW, Hawks L, Bor D, et al. National Trends and Disparities in Health Care Access and Coverage Among Adults With Asthma and COPD: 1997-2018. CHEST. 2021;159(6):2173–2182. doi:10.1016/j.chest.2021.01.035 [PubMed: 33497651]
3. Perez MF, Coutinho MT. An Overview of Health Disparities in Asthma. Yale J Biol Med. 2021;94(3):497–507. [PubMed: 34602887]
4. Ahonen EQ, Fujishiro K, Cunningham T, Flynn M. Work as an Inclusive Part of Population Health Inequities Research and Prevention. Am J Public Health. 2018;108(3):306–311. doi:10.2105/AJPH.2017.304214 [PubMed: 29345994]
5. Landsbergis PA, Choi B, Dobson M, et al. The Key Role of Work in Population Health Inequities. Am J Public Health. 2018;108(3):296–297. doi:10.2105/AJPH.2017.304288 [PubMed: 29412716]
6. Brigham E, Allbright K, Harris D. Health Disparities in Environmental and Occupational Lung Disease. Clinics in Chest Medicine. 2020;41(4):623–639. doi:10.1016/j.ccm.2020.08.009 [PubMed: 33153683]
7. Brigham E, Harris D, Carlsten C, Redlich CA. Occupational health disparities: The pandemic as prism and prod. J Allergy Clin Immunol. 2021;148(5):1148–1150. doi:10.1016/j.jaci.2021.09.007 [PubMed: 34534567]
8. McMichael TM, Clark S, Pogosjans S, et al. COVID-19 in a Long-Term Care Facility - King County, Washington, February 27-March 9, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(12):339–342. doi:10.15585/mmwr.mm6912e1 [PubMed: 32214083]
9. Abbasi J. “Abandoned” Nursing Homes Continue to Face Critical Supply and Staff Shortages as COVID-19 Toll Has Mounted. JAMA. 2020;324(2):123–125. doi:10.1001/jama.2020.10419 [PubMed: 32525535]
10. Cummings KJ, Beckman J, Frederick M, et al. Disparities in COVID-19 fatalities among working Californians. PLOS ONE. 2022;17(3):e0266058. doi:10.1371/journal.pone.0266058 [PubMed: 35349589]
11. Centers for Disease Control. Most Recent National Asthma Data | CDC.; 2022. Accessed August 15, 2022. https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm
12. Nurmagambetov T, Kuwahara R, Garbe P. The Economic Burden of Asthma in the United States, 2008–2013. Annals ATS. 2018;15(3):348–356. doi:10.1513/AnnalsATS.201703-259OC

13. Asthma Disparities - Reducing Burden on Racial and Ethnic Minorities | AAFA.org. Accessed August 13, 2022. https://www.aafa.org/asthma-disparities-burden-on-minorities.aspx
14. 2019 Behavioral Risk Factor Surveillance System Asthma Call-back Survey Summary Data Quality Report. Published online 2019:45.
15. Malo JL, Tarlo SM, Sastre J, et al. An Official American Thoracic Society Workshop Report: Presentations and Discussion of the Fifth Jack Pepys Workshop on Asthma in the Workplace. Comparisons between Asthma in the Workplace and Non–Work-related Asthma. Ann Am Thorac Soc. 2015;12(7):S99–S110. doi:10.1513/AnnalsATS.201505-281ST [PubMed: 26203621]
16. White GE, Mazurek JM, Moorman JE. Work-related asthma and employment status--38 states and District of Columbia, 2006–2009. J Asthma. 2013;50(9):954–959. doi:10.3109/02770903.2013.829491 [PubMed: 23889492]
17. Kirkland KH, Rosenman KD. Association of occupational and environmental clinics exposure code system and criteria for substances that cause work-related asthma. Occup Environ Med. 2022;79(4):287–288. doi:10.1136/oemed-2021-108174 [PubMed: 35177429]
18. Rosenman KD, Beckett WS. Web based listing of agents associated with new onset work-related asthma. Respir Med. 2015;109(5):625–631. doi:10.1016/j.rmed.2015.03.004 [PubMed: 25863522]
19. Mazurek JM, White GE, Moorman JE, Storey E. Patient-physician communication about work-related asthma: what we do and do not know. Ann Allergy Asthma Immunol. 2015;114(2):97–102. doi:10.1016/j.anai.2014.10.022 [PubMed: 25492097]
20. Milton DK, Solomon GM, Rosiello RA, Herrick RF. Risk and incidence of asthma attributable to occupational exposure among HMO members. Am J Ind Med. 1998;33(1):1–10. doi:10.1002/(sici)1097-0274(199801)33:1<1::aid-ajim1>3.0.co;2-2 [PubMed: 9408523]
21. Sama SR, Hunt PR, Cirillo CIHP, et al. A longitudinal study of adult-onset asthma incidence among HMO members. Environ Health. 2003;2(1):10. doi:10.1186/1476-069X-2-10 [PubMed: 12952547]
22. Le Moual N, Kauffmann F, Eisen EA, Kennedy SM. The healthy worker effect in asthma: work may cause asthma, but asthma may also influence work. Am J Respir Crit Care Med. 2008;177(1):4–10. doi:10.1164/rccm.200703-415PP [PubMed: 17872490]
23. Wong A, Tavakoli H, Sadatsafavi M, Carlsten C, FitzGerald JM. Asthma control and productivity loss in those with work-related asthma: A population-based study. J Asthma. 2017;54(5):537–542. doi:10.1080/02770903.2016.1220011 [PubMed: 27494107]
24. Santos MS, Jung H, Peyrovi J, Lou W, Liss GM, Tarlo SM. Occupational asthma and work-exacerbated asthma: factors associated with time to diagnostic steps. Chest. 2007;131(6):1768–1775. doi:10.1378/chest.06-2487 [PubMed: 17505048]
25. Walters GI, Soundy A, Robertson AS, Burge PS, Ayres JG. Understanding health beliefs and behaviour in workers with suspected occupational asthma. Respir Med. 2015;109(3):379–388. doi:10.1016/j.rmed.2015.01.003 [PubMed: 25657173]
26. Roberts JL, Janson S, Gillen M, Flattery J, Harrison R. Processes of care for individuals with work related asthma: treatment characteristics and impact of asthma on work. AAOHN J. 2004;52(8):327–337. [PubMed: 15357371]
27. Laditka JN, Laditka SB, Arif AA, Hoyle JN. Work-related asthma in the USA: nationally representative estimates with extended follow-up. Occup Environ Med. 2020;77(9):617–622. doi:10.1136/oemed-2019-106121 [PubMed: 32404531]
28. Rosenman KD, Reilly MJ, Pickelman BG. 2020 Annual Report Tracking Work-Related Asthma in Michigan.; 2021.
29. White GE, Mazurek JM, Storey E. Employed adults with asthma who have frequent workplace exposures. J Asthma. 2015;52(1):46–51. doi:10.3109/02770903.2014.944984 [PubMed: 25029228]
30. Reilly MJ, Wang L, Rosenman KD. The Burden of Work-related Asthma in Michigan, 1988–2018. Ann Am Thorac Soc. 2020;17(3):284–292. doi:10.1513/AnnalsATS.201905-401OC [PubMed: 31682471]
31. Milet M, Lutzker L, Flattery J. Asthma in California: A Surveillance Report. California Department of Public Health, Environmental Health Investigations Branch; 2013:194.

32. LaSee CR, Reeb-Whitaker CK. Work-related asthma surveillance in Washington State: time trends, industry rates, and workers' compensation costs, 2002–2016. J Asthma. 2020;57(4):421–430. doi:10.1080/02770903.2019.1571084 [PubMed: 30701998]

33. Stanbury M, Rosenman KD. Occupational health disparities: a state public health-based approach. Am J Ind Med. 2014;57(5):596–604. doi:10.1002/ajim.22292 [PubMed: 24375809]

34:. U.S. Bureau of Labor Statistics. Labor force characteristics by race and ethnicity, 2020 : BLS Reports. Published November 2021. Accessed August 15, 2022. https://www.bls.gov/opub/reports/race-and-ethnicity/2020/home.htm

35. Knoeller GE, Mazurek JM, Moorman JE. Work-related asthma, financial barriers to asthma care, and adverse asthma outcomes: asthma call-back survey, 37 states and District of Columbia, 2006 to 2008. Med Care. 2011;49(12):1097–1104. doi:10.1097/MLR.0b013e31823639b9 [PubMed: 22002642]

36. Knoeller GE, Mazurek JM, Moorman JE. Health-related quality of life among adults with work-related asthma in the United States. Qual Life Res. 2013;22(4):771–780. doi:10.1007/s11136-012-0206-7 [PubMed: 22661107]

37. Tarlo SM, Balmes J, Balkissoon R, et al. Diagnosis and Management of Work-Related Asthma: American College of Chest Physicians Consensus Statement. CHEST. 2008;134(3):1S–41S. doi:10.1378/chest.08-0201 [PubMed: 18779187]

38. Dodd KE, Mazurek JM. Asthma medication use among adults with current asthma by work-related asthma status, Asthma Call-back Survey, 29 states, 2012-2013. J Asthma. 2018;55(4):364–372. doi:10.1080/02770903.2017.1339245 [PubMed: 28704107]

39. Vandenplas O, Toren K, Blanc PD. Health and socioeconomic impact of work-related asthma. Eur Respir J. 2003;22(4):689–697. doi:10.1183/09031936.03.00053203 [PubMed: 14582924]

40. Global Burden of Disease Study 2019 (GBD 2019) Data Resources | GHDx. Accessed April 2, 2021. http://ghdx.healthdata.org/gbd-2019

41. Blanc PD, Annesi-Maesano I, Balmes JR, et al. The Occupational Burden of Nonmalignant Respiratory Diseases. An Official American Thoracic Society and European Respiratory Society Statement. Am J Respir Crit Care Med. 2019;199(11):1312–1334. doi:10.1164/rccm.201904-0717ST [PubMed: 31149852]

42. Lamprecht B, Soriano JB, Studnicka M, et al. Determinants of Underdiagnosis of COPD in National and International Surveys. CHEST. 2015;148(4):971–985. doi:10.1378/chest.14-2535 [PubMed: 25950276]

43. Kurth L, Laney AS, Blackley DJ, Halldin CN. Prevalence of spirometry-defined airflow obstruction in never-smoking working US coal miners by pneumoconiosis status. Occup Environ Med. 2020;77(4):265–267. doi:10.1136/oemed-2019-106213 [PubMed: 32041810]

44. Oxman AD, Muir DC, Shannon HS, Stock SR, Hnizdo E, Lange HJ. Occupational dust exposure and chronic obstructive pulmonary disease. A systematic overview of the evidence. Am Rev Respir Dis. 1993;148(1):38–48. doi:10.1164/ajrccm/148.1.38 [PubMed: 8317812]

45. Hnizdo E, Vallyathan V. Chronic obstructive pulmonary disease due to occupational exposure to silica dust: a review of epidemiological and pathological evidence. Occupational and Environmental Medicine. 2003;60(4):237–243. doi:10.1136/oem.60.4.237 [PubMed: 12660371]

46. Murgia N, Gambelunghe A. Occupational COPD—The most under-recognized occupational lung disease? Respirology. 2022;27(6):399–410. doi:10.1111/resp.14272 [PubMed: 35513770]

47. Hua JT, Zell-Baran L, Go LHT, et al. Demographic, exposure and clinical characteristics in a multinational registry of engineered stone workers with silicosis. Occup Environ Med. Published online May 3, 2022. doi:10.1136/oemed-2021-108190

48. Ejike CO, Dransfield MT, Hansel NN, et al. Chronic Obstructive Pulmonary Disease in America's Black Population. Am J Respir Crit Care Med. 2019;200(4):423–430. doi:10.1164/rccm.201810-1909PP [PubMed: 30789750]

49. Amaral AFS, Patel J, Kato BS, et al. Airflow Obstruction and Use of Solid Fuels for Cooking or Heating. BOLD (Burden of Obstructive Lung Disease) Results. Am J Respir Crit Care Med. 2018;197(5):595–610. doi:10.1164/rccm.201701-0205OC [PubMed: 28895752]

50. Paulin LM, Diette GB, Blanc PD, et al. Occupational Exposures Are Associated with Worse Morbidity in Patients with Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2015;191(5):557–565. doi:10.1164/rccm.201408-1407OC [PubMed: 25562375]
51. Krefft S, Wolff J, Rose C. Silicosis: An Update and Guide for Clinicians. Clinics in Chest Medicine. 2020;41(4):709–722. doi:10.1016/j.ccm.2020.08.012 [PubMed: 33153689]
52. Hoy RF, Jeebhay MF, Cavalin C, et al. Current global perspectives on silicosis—Convergence of old and newly emergent hazards. Respirology. 2022;27(6):387–398. doi:10.1111/resp.14242 [PubMed: 35302259]
53. Rose C, Heinzerling A, Patel K, et al. Severe Silicosis in Engineered Stone Fabrication Workers - California, Colorado, Texas, and Washington, 2017-2019. MMWR Morb Mortal Wkly Rep. 2019;68(38):813–818. doi:10.15585/mmwr.mm6838a1 [PubMed: 31557149]
54. Leso V, Fontana L, Romano R, Gervetti P, Iavicoli I. Artificial Stone Associated Silicosis: A Systematic Review. International Journal of Environmental Research and Public Health. 2019;16(4):568. doi:10.3390/ijerph16040568 [PubMed: 30781462]
55. Heinzerling A, Cummings KJ, Flattery J, Weinberg JL, Materna B, Harrison R. Radiographic Screening Reveals High Burden of Silicosis among Workers at an Engineered Stone Countertop Fabrication Facility in California. Am J Respir Crit Care Med. 2021;203(6):764–766. doi:10.1164/rccm.202008-3297LE [PubMed: 33207123]
56. Tustin AW, Kundu-Orwa S, Lodwick J, Cannon DL, McCarthy RB. An outbreak of work-related asthma and silicosis at a US countertop manufacturing and fabrication facility. American Journal of Industrial Medicine. 2022;65(1):12–19. doi:10.1002/ajim.23304 [PubMed: 34671999]
57. Rizzolo K, Cervantes L. Barriers and Solutions to Kidney Transplantation for the Undocumented Latinx Community with Kidney Failure. CJASN. 2021;16(10):1587–1589. doi:10.2215/CJN.03900321 [PubMed: 34556499]
58. Kaiser Family Foundation. Global COVID-19 Tracker – Updated as of July 5. KFF. Published July 5, 2022. Accessed July 5, 2022. https://www.kff.org/coronavirus-covid-19/issue-brief/global-covid-19-tracker/
59. CDC. Cases, Data, and Surveillance. Centers for Disease Control and Prevention. Published February 11, 2020. Accessed July 5, 2022. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html
60. Acosta AM, Garg S, Pham H, et al. Racial and Ethnic Disparities in Rates of COVID-19-Associated Hospitalization, Intensive Care Unit Admission, and In-Hospital Death in the United States From March 2020 to February 2021. JAMA Netw Open. 2021;4(10):e2130479. doi:10.1001/jamanetworkopen.2021.30479 [PubMed: 34673962]
61. Asfaw A. Racial Disparity in Potential Occupational Exposure to COVID-19. J Racial Ethn Health Disparities. Published online August 5, 2021:1–14. doi:10.1007/s40615-021-01110-8 [PubMed: 33104967]
62. Hawkins D. Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. American Journal of Industrial Medicine. 2020;63(9):817–820. doi:10.1002/ajim.23145 [PubMed: 32539166]
63. Schnake-Mahl AS, Lazo M, Dureja K, Ehtesham N, Bilal U. Racial and ethnic inequities in occupational exposure across and between US cities. SSM - Population Health. 2021;16:100959. doi:10.1016/j.ssmph.2021.100959 [PubMed: 34805478]
64. Occupational Safety and Health Administration. JBS Foods USA reaches settlement with OSHA to develop, implement infectious disease preparedness plan at seven meat processing plants. Accessed July 20, 2022. https://www.osha.gov/news/newsreleases/national/05272022
65. Groves Stephen. OSHA, South Dakota Pork Plant Settle Coronavirus Complaint. US News & World Report. //www.usnews.com/news/best-states/south-dakota/articles/2021-11-15/osha-south-dakota-pork-plant-settle-coronavirus-complaint. Accessed July 20, 2022.
66. Campbell DS. Health hazards in the meatpacking industry. Occup Med. 1999;14(2):351–372. [PubMed: 10329910]
67. Taylor CA, Boulos C, Almond D. Livestock plants and COVID-19 transmission. Proceedings of the National Academy of Sciences. 2020;117(50):31706–31715. doi:10.1073/pnas.2010115117

68. U.S. Department of Agriculture Economic Research Service. The Meatpacking Industry in Rural America During the COVID-19 Pandemic. Published October 28, 2021. Accessed July 18, 2022. https://www.ers.usda.gov/covid-19/rural-america/meatpacking-industry
69. Saitone TL, Aleks Schaefer K, Scheitrum DP. COVID-19 morbidity and mortality in U.S. meatpacking counties. Food Policy. 2021;101:102072. doi:10.1016/j.foodpol.2021.102072 [PubMed: 33846663]
70. Waltenburg MA, Rose CE, Victoroff T, et al. Coronavirus Disease among Workers in Food Processing, Food Manufacturing, and Agriculture Workplaces. Emerg Infect Dis. 2021;27(1):243–249. doi:10.3201/eid2701.203821 [PubMed: 33075274]
71. Centers for Medicare & Medicaid Services Data. COVID-19 Nursing Home Data. Accessed July 7, 2022. https://data.cms.gov/covid-19/covid-19-nursing-home-data
72. Denny-Brown Noelle, Stone Denise, Hays Burke, Gallagher Dayna. COVID-19 Intensifies Nursing Home Workforce Challenges. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation; 2020:2. Accessed July 7, 2022. https://aspe.hhs.gov/reports/covid-19-intensifies-nursing-home-workforce-challenges-0
73. Chen YH, Glymour M, Riley A, et al. Excess mortality associated with the COVID-19 pandemic among Californians 18–65 years of age, by occupational sector and occupation: March through November 2020. PLoS One. 2021;16(6):e0252454. doi:10.1371/journal.pone.0252454 [PubMed: 34086762]
74. Nafilyan V, Pawelek P, Ayoubkhani D, et al. Occupation and COVID-19 mortality in England: a national linked data study of 14.3 million adults. Occup Environ Med. 2022;79(7):433–441. doi:10.1136/oemed-2021-107818 [PubMed: 34965981]
75. Mutambudzi M, Niedwiedz C, Macdonald EB, et al. Occupation and risk of severe COVID-19: prospective cohort study of 120 075 UK Biobank participants. Occup Environ Med. Published online December 9, 2020:oemed-2020-106731. doi:10.1136/oemed-2020-106731
76. Heinzerling A, Nguyen A, Frederick M, et al. Workplaces Most Affected by COVID-19 Outbreaks in California, January 2020-August 2021. Am J Public Health. 2022;112(8):1180–1190. doi:10.2105/AJPH.2022.306862 [PubMed: 35830667]
77. Contreras Z, Ngo V, Pulido M, et al. Industry Sectors Highly Affected by Worksite Outbreaks of Coronavirus Disease, Los Angeles County, California, USA, March 19–September 30, 2020. Emerg Infect Dis. 2021;27(7):1769–1775. doi:10.3201/eid2707.210425 [PubMed: 33979564]
78. Bui DP. Racial and Ethnic Disparities Among COVID-19 Cases in Workplace Outbreaks by Industry Sector — Utah, March 6–June 5, 2020. MMWR Morb Mortal Wkly Rep. 2020;69. doi:10.15585/mmwr.mm6933e3
79. Matthay EC, Duchowny KA, Riley AR, et al. Occupation and Educational Attainment Characteristics Associated With COVID-19 Mortality by Race and Ethnicity in California. JAMA Network Open. 2022;5(4):e228406. doi:10.1001/jamanetworkopen.2022.8406 [PubMed: 35452107]
80. IARC. Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1–42. Accessed August 11, 2022. https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-Supplements/Overall-Evaluations-Of-Carcinogenicity-An-Updating-Of-IARC-Monographs-Volumes-1%E2%80%9342-1987
81. Taylor AN, Cullinan P, Blanc P, Pickering A, eds. Occupational Lung Carcinogens. In: Parkes' Occupational Lung Disorders. 4th ed. CRC Press; 2016.
82. Brown T, Darnton A, Fortunato L, Rushton L, British Occupational Cancer Burden Study Group. Occupational cancer in Britain. Respiratory cancer sites: larynx, lung and mesothelioma. Br J Cancer. 2012;107 Suppl 1:S56–70. doi:10.1038/bjc.2012.119 [PubMed: 22710680]
83. Carder M, Darnton A, Gittins M, et al. Chest physician-reported, work-related, long-latency respiratory disease in Great Britain. European Respiratory Journal. 2017;50(6). doi:10.1183/13993003.00961-2017
84. Labrèche F, Kim J, Song C, et al. The current burden of cancer attributable to occupational exposures in Canada. Prev Med. 2019;122:128–139. doi:10.1016/j.ypmed.2019.03.016 [PubMed: 31078166]

85. Markowitz SB, Dickens B. Screening for Occupational Lung Cancer: An Unprecedented Opportunity. Clinics in Chest Medicine. 2020;41(4):723–737. doi:10.1016/j.ccm.2020.08.016 [PubMed: 33153690]

86. Driscoll T, Nelson DI, Steenland K, et al. The global burden of disease due to occupational carcinogens. Am J Ind Med. 2005;48(6):419–431. doi:10.1002/ajim.20209 [PubMed: 16299703]

87. Boffetta P, Autier P, Boniol M, et al. An estimate of cancers attributable to occupational exposures in France. J Occup Environ Med. 2010;52(4):399–406. doi:10.1097/JOM.0b013e3181d5e355 [PubMed: 20357680]

88. Moyer VA, U.S. Preventive Services Task Force. Screening for lung cancer: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2014;160(5):330–338. doi:10.7326/M13-2771 [PubMed: 24378917]

89. Jonas DE, Reuland DS, Reddy SM, et al. Screening for Lung Cancer With Low-Dose Computed Tomography: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. JAMA. 2021;325(10):971–987. doi:10.1001/jama.2021.0377 [PubMed: 33687468]

90. Wood DE, Kazerooni EA, Baum SL, et al. Lung Cancer Screening, Version 3.2018, NCCN Clinical Practice Guidelines in Oncology. J Natl Compr Canc Netw. 2018;16(4):412–441. doi:10.6004/jnccn.2018.0020 [PubMed: 29632061]

91. Juon HS, Hong A, Pimpinelli M, Rojulpote M, McIntire R, Barta JA. Racial disparities in occupational risks and lung cancer incidence: Analysis of the National Lung Screening Trial. Preventive Medicine. 2021;143:106355. doi:10.1016/j.ypmed.2020.106355 [PubMed: 33301822]

92. Banga A, Reilly MJ, Rosenman KD. A study of characteristics of Michigan workers with work-related asthma exposed to welding. J Occup Environ Med. 2011;53(4):415–419. doi:10.1097/JOM.0b013e31820fd0c3 [PubMed: 21407099]

93. MacKinnon M, To T, Ramsey C, Lemière C, Lougheed MD. Improving detection of work-related asthma: a review of gaps in awareness, reporting and knowledge translation. Allergy, Asthma & Clinical Immunology. 2020;16(1):73. doi:10.1186/s13223-020-00470-w

94. Kuschner WG, Hegde S, Agrawal M. Occupational history quality in patients with newly documented, clinician-diagnosed chronic bronchitis. Chest. 2009;135(2):378–383. doi:10.1378/chest.08-1559 [PubMed: 18719054]

95. Storey E, Thal S, Johnson C, et al. Reinforcement of occupational history taking: a success story. Teach Learn Med. 2001;13(3):176–182. doi:10.1207/S15328015TLM1303_7 [PubMed: 11475661]

96. Politi BJ, Arena VC, Schwerha J, Sussman N. Occupational medical history taking: how are today’s physicians doing? A cross-sectional investigation of the frequency of occupational history taking by physicians in a major US teaching center. J Occup Environ Med. 2004;46(6):550–555. doi:10.1097/01.jom.0000128153.79025.e4 [PubMed: 15213517]

97. Holness DL, Tabassum S, Tarlo SM, Liss GM, Silverman F, Manno M. Practice patterns of pulmonologists and family physicians for occupational asthma. Chest. 2007;132(5):1526–1531. doi:10.1378/chest.06-2224 [PubMed: 17890481]

98. Harber P, Leroy G. Informatics Approaches for Recognition, Management, and Prevention of Occupational Respiratory Disease. Clin Chest Med. 2020;41(4):605–621. doi:10.1016/j.ccm.2020.08.008 [PubMed: 33153682]

99. James E, Linde B, Redlich CA. Master Clinician and Public Health Practitioner: Selected Occupational and Environmental Pulmonary Cases. Clin Chest Med. 2020;41(4):567–580. doi:10.1016/j.ccm.2020.08.019 [PubMed: 33153680]

100. Occupational Safety and Health Administration (OSHA). 1910.1200 - Hazard Communication - Toxic and Hazardous Substances.; 2012. Accessed August 15, 2022. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1200

101. Parhar A, Lemiere C, Beach JR. Barriers to the recognition and reporting of occupational asthma by Canadian pulmonologists. Can Respir J. 2011;18(2):90–96. [PubMed: 21499594]

102. Newman LS. Occupational illness. N Engl J Med. 1995;333(17):1128–1134. doi:10.1056/NEJM199510263331707 [PubMed: 7565952]

103. Killorn KR, Dostaler SM, Olajos-Clow J, et al. The development and test re-test reliability of a work-related asthma screening questionnaire. J Asthma. 2015;52(3):279–288. doi:10.3109/02770903.2014.956892 [PubMed: 25180965]
104. Pélissier C, Dutertre V, Fournel P, et al. Design and validation of a self-administered questionnaire as an aid to detection of occupational exposure to lung carcinogens. Public Health. 2017;143:44–51. doi:10.1016/j.puhe.2016.10.026 [PubMed: 28159026]
105. Pérol O, Charbotel B, Perrier L, et al. Systematic Screening for Occupational Exposures in Lung Cancer Patients: A Prospective French Cohort. Int J Environ Res Public Health. 2018;15(1):E65. doi:10.3390/ijerph15010065
106. Lee CT, Strek ME, Adegunsoye A, et al. Inhalational exposures in patients with fibrotic interstitial lung disease: Presentation, pulmonary function and survival in the Canadian Registry for Pulmonary Fibrosis. Respirology. 2022;27(8):635–644. doi:10.1111/resp.14267 [PubMed: 35512793]
107. Baron S, Filios MS, Marovich S, Chase D, Ash JS. Recognition of the Relationship Between Patients' Work and Health: A Qualitative Evaluation of the Need for Clinical Decision Support (CDS) for Worker Health in Five Primary Care Practices. J Occup Environ Med. 2017;59(11):e245–e250. doi:10.1097/JOM.0000000000001183 [PubMed: 29116994]
108. Marovich S, Luensman GB, Wallace B, Storey E. Opportunities at the intersection of work and health: Developing the occupational data for health information model. J Am Med Inform Assoc. 2020;27(7):1072–1083. doi:10.1093/jamia/ocaa070 [PubMed: 32521001]
109. Lefkowitz RY, Mitma AA, Altassan K, Redlich CA. The Limits of Pattern Recognition: Nodular Lung Disease in a Syrian Refugee. Ann Am Thorac Soc. 2017;14(10):1591–1594. doi:10.1513/AnnalsATS.201702-163CC [PubMed: 28961033]
110. Nett RJ, Harvey RR, Cummings KJ. Occupational Bronchiolitis: An Update. Clin Chest Med. 2020;41(4):661–686. doi:10.1016/j.ccm.2020.08.011 [PubMed: 33153686]
111. Moon J, Yoo H. Misdiagnosis in occupational and environmental medicine: a scoping review. J Occup Med Toxicol. 2021;16(1):33. doi:10.1186/s12995-021-00325-z [PubMed: 34429147]
112. Surasi K, Ballen B, Weinberg JL, et al. Elevated exposures to respirable crystalline silica among engineered stone fabrication workers in California, January 2019–February 2020. American Journal of Industrial Medicine. 2022;65(9):701–707. doi:10.1002/ajim.23416 [PubMed: 35899403]
113. Larsson K, Janson C, Ställberg B, et al. Impact of COPD diagnosis timing on clinical and economic outcomes: the ARCTIC observational cohort study. Int J Chron Obstruct Pulmon Dis. 2019;14:995–1008. doi:10.2147/COPD.S195382 [PubMed: 31190785]
114. Hing E, Burt CW. Characteristics of office-based physicians and their practices: United States, 2003-04. Vital Health Stat 13. 2007;(164):1–34.
115. Mendell MJ, Mirer AG, Cheung K, Tong M, Douwes J. Respiratory and allergic health effects of dampness, mold, and dampness-related agents: a review of the epidemiologic evidence. Environ Health Perspect. 2011;119(6):748–756. doi:10.1289/ehp.1002410 [PubMed: 21269928]
116. Kreiss K, Gomaa A, Kullman G, Fedan K, Simoes EJ, Enright PL. Clinical bronchiolitis obliterans in workers at a microwave-popcorn plant. N Engl J Med. 2002;347(5):330–338. doi:10.1056/NEJMoa020300 [PubMed: 12151470]
117. Cummings KJ, Stanton ML, Nett RJ, et al. Severe lung disease characterized by lymphocytic bronchiolitis, alveolar ductitis, and emphysema (BADE) in industrial machine-manufacturing workers. Am J Ind Med. 2019;62(11):927–937. doi:10.1002/ajim.23038 [PubMed: 31461179]
118. Kreiss K. Recognizing occupational effects of diacetyl: What can we learn from this history? Toxicology. 2017;388:48–54. doi:10.1016/j.tox.2016.06.009 [PubMed: 27326900]
119. Casey M, Stanton ML, Cummings KJ, et al. Work-related asthma cluster at a syntactic foam manufacturing facility - Massachusetts 2008-2013. MMWR Morb Mortal Wkly Rep. 2015;64(15):411–414. [PubMed: 25905894]
120. Reynolds LE, Wolfe AL, Clark KA, et al. Strengthening the Coal Workers' Health Surveillance Program. J Occup Environ Med. 2017;59(4):e71. doi:10.1097/JOM.0000000000000993 [PubMed: 28628061]

121. Kim TJ, Materna BL, Prudhomme JC, et al. Industry-wide medical surveillance of California flavor manufacturing workers: Cross-sectional results. Am J Ind Med. 2010;53(9):857–865. doi:10.1002/ajim.20858 [PubMed: 20564514]

122. Leigh JP, Chakalov B. Labor unions and health: A literature review of pathways and outcomes in the workplace. Preventive Medicine Reports. 2021;24:101502. doi:10.1016/j.pmedr.2021.101502 [PubMed: 34471593]

123. Bureau of Labor Statistics - U.S. Department of Labor. Union Members - 2021.; 2022. https://www.bls.gov/news.release/pdf/union2.pdf

124. Philbrick IP. Why Union Drives Are Succeeding. The New York Times. https://www.nytimes.com/2022/07/17/briefing/union-drives-college-graduates.html. Published July 17, 2022. Accessed August 15, 2022.

125. Hagedorn J, Paras CA, Greenwich H, Hagopian A. The Role of Labor Unions in Creating Working Conditions That Promote Public Health. Am J Public Health. 2016;106(6):989–995. doi:10.2105/AJPH.2016.303138 [PubMed: 27077343]

126. Harris DA, Mainardi A, Iyamu O, et al. Improving the asthma disparity gap with legal advocacy? A qualitative study of patient-identified challenges to improve social and environmental factors that contribute to poorly controlled asthma. Journal of Asthma. 2018;55(8):924–932. doi:10.1080/02770903.2017.1373393

127. Product Stewardship Institute (PSI). Published 2020. Accessed August 15, 2022. https://www.productstewardship.us/

128. Weiss MD. Leveraging best practices to promote health, safety, sustainability, and stewardship. Workplace Health Saf. 2013;61(8):365–370; quiz 371. doi:10.1177/216507991306100807 [PubMed: 23930660]

Key Points

- Occupation is an important contributor to disparities in respiratory disease, affecting financial status, health care access, and exposure to hazardous substances.
- Occupational exposures contribute to disparities across a spectrum of respiratory diseases; this article focuses on asthma, chronic obstructive pulmonary disease, COVID-19, silicosis, and lung cancer.
- Because occupational exposures are largely preventable through proper workplace safety controls, recognition of occupational etiologies of disease can provide an opportunity for interventions that can bring about health equity.
- Clinicians, employers, regulatory agencies, policymakers, workers, and unions play essential roles in improving workplace conditions and decreasing disparities in respiratory health.

Synopsis

Occupation is an important contributor to disparities in respiratory disease, affecting financial status, health care access, and exposure to hazardous substances. While occupation and associated exposures are included in the socioecological models, work exposures remain persistently absent from research on health inequities and their contribution to health. This article focuses on the occupational contribution to disparities in asthma, chronic obstructive pulmonary disease, silicosis, COVID-19, and lung cancer. Because occupational exposures are largely preventable through proper workplace safety controls, recognition of occupational etiologies of disease can provide an opportunity for interventions to bring about health equity.

CLINICS CARE POINTS –

Bulleted list of evidence-based pearls and pitfalls relevant to the point of care

- Integrate an occupational history as part of patient care
- Consider how respiratory diseases are affected by both structural and individual-level factors in occupational exposures
- Develop a treatment approach to integrate workplace exposures into disease interventions.

BOX 1.

Components of an occupational history for respiratory disease

- Screening questions
  - What kind of work do you do?
  - Do you think your breathing problems are related to your work?
  - Are your symptoms better away from work?
  - Have you ever been exposed to dusts, fumes, or chemicals at work?
- Detailed inquiry (prompted by responses to screening)
  - Chronological job history: employers, industries, job titles, duties and tasks, years of employment
  - Inhalational exposures and controls (ventilation, personal protective equipment)
  - Onset, duration, and frequency of symptoms in relation to work tasks
  - Co-workers with similar symptoms or respiratory diagnoses
  - Review of safety data sheets for identified exposures

References: Newman 1995; Lefkowitz 2017; James 2020

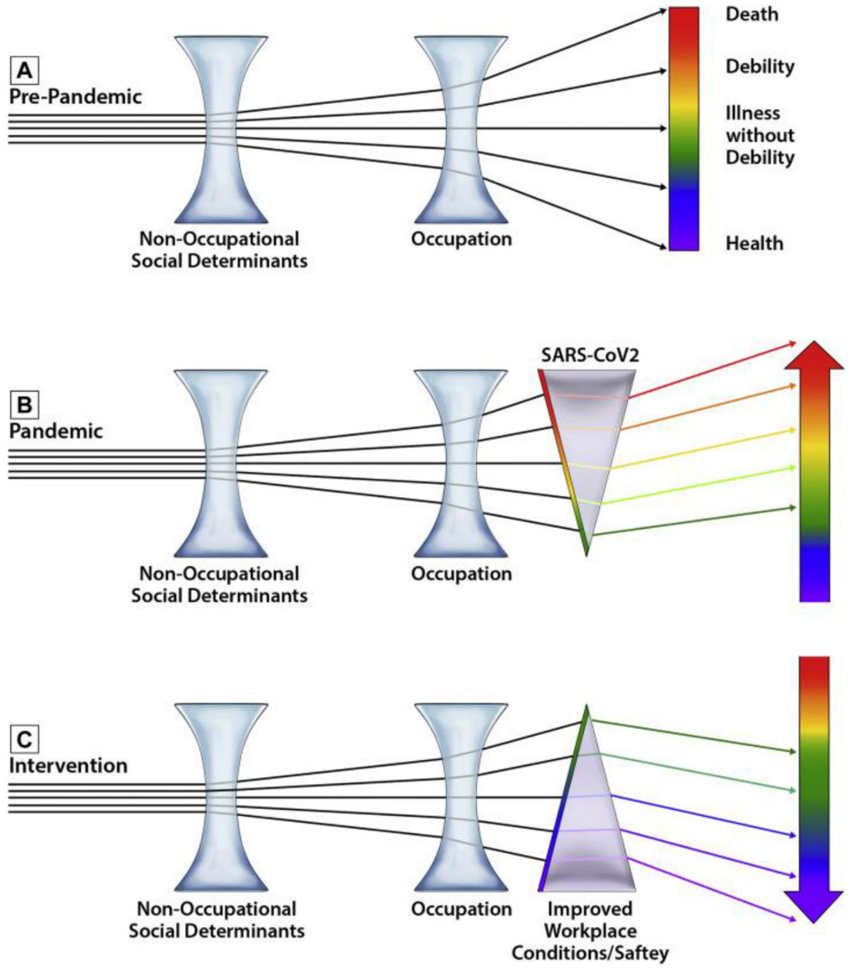

FIGURE 1. Occupational factors as a magnifier of underlying disparities.
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Table 1.

Examples of respiratory diseases with occupational contributions

Disease	Examples of contributory exposures
Asthma	Isocyanates, cleaning products
Chronic Obstructive Pulmonary Disease	Coal dust, silica, secondhand smoke
Idiopathic pulmonary fibrosis	Metal dust, wood dust, silica
Hypersensitivity pneumonitis	Bacteria, fungi, animal proteins
Pneumoconiosis	Coal mine dust, silica, beryllium, asbestos, cobalt
Obliterative Bronchiolitis	Flavoring chemicals (diacetyl, 2,3-pentanedione), military deployment, styrene
Pulmonary alveolar proteinosis	Inorganic and organic dusts, metals
Infections	SARS-CoV-2, *M. tuberculosis*, bacterial pneumonia
Lung cancer	Asbestos, hexavalent chromium, silica

TABLE 2.

Sources of information about occupational exposures and health effects

Source	Details
Occupational Safety and Health Administration (OSHA)	Safety and health topics: https://www.osha.gov/topics Establishment search: https://www.osha.gov/pls/imis/establishment.html
National Institute for Occupational Safety and Health (NIOSH)	Safety and health topics: https://www.cdc.gov/niosh/topics/default.html
Association for Occupational and Environmental Clinics	Exposure code system (includes asthmagens): http://www.aoecdata.org/Default.aspx
Hazard Evaluation System and Information Service (HESIS), California Department of Public Health	Chemical and other workplace hazards: https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/HESIS/Pages/HESIS.aspx
Haz-Map	Hazardous chemicals and occupational diseases database: https://haz-map.com/
National Library of Medicine, PubChem	Hazardous Substances Data Bank: https://pubchem.ncbi.nlm.nih.gov/source/11933
Safety Data Sheets	Required by OSHA's Hazard Communication Standard: https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf
Employers	Health and Safety official or other manager, with patient's permission