OCCUPATIONAL DISEASE IN NEW YORK STATE: AN UPDATE

Michael B. Lax, MD, MPH
Jeanette M. Zoeckler, PhD, MPH

OCCUPATIONAL HEALTH CLINICAL CENTER
Department of Family Medicine
SUNY Upstate Medical University
Syracuse, NY
OCCUPATIONAL DISEASE IN NEW YORK STATE: AN UPDATE

Michael B. Lax, MD, MPH
Jeanette M. Zoeckler, PhD, MPH

OCCUPATIONAL HEALTH CLINICAL CENTER
Department of Family Medicine
SUNY Upstate Medical University
Syracuse, NY

September 2021
# CONTENT

**FORWARD** by Steven Markowitz, MD, DrPH ................................................................. 4  
**EXECUTIVE SUMMARY** .......................................................................................... 6

**Chapter 1: Occupational Disease in New York State** .................................................. 9  
An Update  
The Incidence of Occupational Disease in New York State  
What is an Occupational Disease?  
Assessing the Incidence and Prevalence of Occupational Disease  
Estimating Mortality and Morbidity

**Chapter 2: Estimating the Extent of Hazardous Work** .............................................. 25  
Chemicals  
Lead  
Silica  
Asbestos  
Ergonomic  
Psychosocial  
Infectious Disease/COVID-19

**Chapter 3: Work and Inequalities of Health: Unequal Risk of Occupational Disease** ...... 49  
Low-Wage Work as High Risk for Occupational Disease

**Chapter 4: Expanding the Definition of Occupational Disease** .................................. 61  
Significance of Workplace Stress and Illness  
Substance Use and Work  
Work and the Incidence of Overweight and Obesity

**Chapter 5: Costs of Occupational Disease** .................................................................. 70  
Estimating the Costs  
Distribution of the Costs  
Hidden Costs

**Chapter 6: Clinical Occupational Health Resources** .................................................. 73  
Occupational Health in the Private Health Care Sector  
Occupational Medicine Specialists: Number and Geographic Distribution  
Occupational Health Clinic Network

**Chapter 7: Conclusions and Recommendations** ....................................................... 79

**ACKNOWLEDGEMENTS** .......................................................................................... 84

**LIST OF TABLES AND FIGURES** ............................................................................ 85

**REFERENCES** ............................................................................................................ 87
FORWARD

Its breadth and depth render occupational health endlessly fascinating. No sooner does one get an approximate handle on the great number of activities people do to earn a living then these activities evolve or are supplanted and require new examination. This breadth is matched by the equally challenging depth presented by workplace hazards and their attendant illnesses. I refer to the need to bring enormous areas of human knowledge, i.e., the lens of biomedical sciences, public health sciences, and social sciences, to develop a proper understanding of occupational health problems and their resolution. Consider, for example, what is required simply to identify and recruit an occupational population for a research study: toxicology to identify relevant toxins; medicine to target outcomes; epidemiology to structure and analyze the study population; and industrial relations to get your foot in the door.

It is little wonder then that most occupational health researchers adopt a narrow study approach. They follow the traditional scientific method of posing specific hypotheses, maximizing accuracy of exposure assessment, using accepted methods of characterizing illness or impairment, addressing confounders and interactions to the extent possible, and drawing conclusions that are qualified by caveats about study limitations. Adoption of this approach has been crucial to advancing our knowledge; supporting regulations to limit occupational exposures; and surviving the frequent challenges about the certainty of conclusions permitted by the knowledge gained by such research.

But, to their great credit, Drs. Lax and Zoeckler are after something else in this report: the big picture. They want to capture the breadth and, to the extent possible, the depth of occupational risks and illnesses in a large state with varied industry, New York. They raise important foundational issues, such as the nature of occupational diseases. They identify the hazards that we know most about – lead, silica, and ergonomic conditions, but also include key hazards not usually addressed in such studies, such as psychological stressors, substance abuse, asbestos in place, and COVID-19 infections. They include the problems of low wage workers with their characteristic racial, gender, and ethnic distribution, an issue that was not even on the radar of previous broad surveys of occupational diseases. They document the continued paucity of occupational health resources: just 37 occupational medicine physicians in the Workers’ Compensation system in a state that has 20 million people and over 9 million workers! And they examine the utility of a unique resource – a network of state-supported occupational health clinical centers established over three decades ago in New York State.
Efforts such as this study inevitably have limitations and involve important assumptions. Data of all types – work-related hazards, illnesses, and costs – are of limited availability, quality, detail, and timeliness. The authors are transparent about these limitations, even if readers may not entirely agree on their importance and significance. And the report’s recommendations may not engender consensus. But full agreement is not the point. The point is to provoke a discussion of where we are in occupational health and where we need to go. And, in this goal, Drs. Lax and Zoeckler have succeeded. Read on, and let the discussion begin.

Steven Markowitz MD, DrPH
City University of New York
November 13, 2021
EXECUTIVE SUMMARY

Occupational disease is an epidemic that is largely 'hidden in plain sight.' At the same time, work-related disease is preventable. Since these illnesses arise or are made worse by hazardous workplace conditions, elimination or reduction of those hazards eliminates or reduces disease. More than 30 years ago, a report by Drs. Landrigan and Markowitz found that more than 5,000 NYS workers died from an occupational disease and at least 35,000 more developed a work-related illness each year. This new report shows that occupational disease remains a major public health problem in New York State, with little progress made since 1987.

Annually, over seven thousand New Yorkers lose their lives due to preventable exposure to workplace hazards, and at any given time, over two million New Yorkers suffer from a non-fatal work-related disease. Protecting workers from these hazards requires a multi-faceted approach, addressing disease recognition, treatment and prevention, and must involve both governmental agencies and non-governmental organizations and advocates.

Background

In 1987, Landrigan and Markowitz co-authored a report that showed:

1) At least 5,000-7,000 workers died from an occupational disease, and at least 35,000 workers developed a work-related illness each year

2) Nearly 10% of New York workers were employed in the fifty most hazardous industries and the Industrial use of toxic materials was extensive. Legally permissible levels of exposure were commonly exceeded.

3) The annual costs of occupational disease exceeded $600 million and much of the costs were borne by ill workers, their families, and taxpayers

4) Very few clinical resources existed to diagnose and prevent occupational disease

This new report builds on the framework created by Markowitz and Landrigan, but includes diseases and hazards that have emerged since that report, and takes into consideration additional ways that work plays a role in many chronic diseases, including cardiovascular disease, diabetes, and obesity.

Occupational Disease Mortality and Morbidity – New Findings

Using the same methods as the 1987 study, this new report finds an estimated 3,085 to 4,430 workers die of an occupational disease annually in NYS. Though this number is slightly lower than in 1987, occupational diseases accounts for 3.3-4.7% of total deaths each year which is a higher percent than in 1987.

When ‘emergent’ diseases are taken into account, an estimated 7,016 deaths annually were due to occupational disease, with 5,243 among men and 1,709 among women. Work related cancer and circulatory diseases comprised the majority of deaths for both genders.
We estimated the annual prevalence of non-fatal occupational disease at 13.2% of total disease prevalence in the state, or over two million cases. 86% of the fatal diseases were cancers and circulatory, and 70% of the non-fatal diseases were musculoskeletal and respiratory.

**Estimating the Extent of Hazardous Work**

A very high proportion of workers in New York State continue to work under hazardous conditions that put them at risk of occupational disease. These hazards include:

<table>
<thead>
<tr>
<th>Chemical Exposures</th>
<th>468,509 employees in 30,880 workplaces exposed to at least one of roughly 250 hazardous chemicals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Over 300,000 workers were employed in industries with a risk of high lead exposure. An unknown additional number at risk of lower, yet still health threatening levels.</td>
</tr>
<tr>
<td>Silica</td>
<td>About 100,000 workers are exposed to silica at levels posing a risk of silicosis and other diseases. Over 90% of these exposures are in the construction industries.</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Though asbestos use has declined precipitously since the mid-1970s, workers in the construction trades continue to be at high risk due to handling “asbestos in place.”</td>
</tr>
<tr>
<td>Ergonomic Hazards</td>
<td>Ergonomic hazards are associated with a range of musculoskeletal conditions. Between 1 and 4 million workers reported significant exposure to ergonomic hazards.</td>
</tr>
<tr>
<td>Stressors</td>
<td>Psychosocial stress on the job is widespread, with as many as 6 million workers reporting significant exposure to stressful conditions at work.</td>
</tr>
<tr>
<td>COVID-19</td>
<td>A very high proportion of workers in NYS are employed in health care and other jobs deemed ‘essential’ and at high risk of acquiring COVID-19 infection, with a disproportionate burden of infection and mortality borne by Black and Latinx workers.</td>
</tr>
</tbody>
</table>

**Occupational Health Inequities**

Employer attitudes and practices, declining unionization, discrimination, and government policies all contribute to increasing numbers of ‘vulnerable workers’ at increased risk of occupational disease. ‘Vulnerable workers’ are concentrated in low-wage jobs that make up almost 40% of all jobs in the state. Workers in these jobs are disproportionately Black, Latinx, and women.

**Estimating the Costs of Occupational Disease**

The annual costs of occupational disease in NYS, an estimated $4.077 billion dollars, are tremendous. Employers are able to pass off most of those costs to others with injured workers, their families, and taxpayers paying over 70%.

**Clinical Occupational Health Resources**

Despite the creation of the publicly funded Occupational Health Clinic Network (OHCN), clinical occupational medicine resources remain scarce, particularly upstate. There are only 30 Board Certified Occupational Medicine specialists accepting patients with Workers’ Compensation insurance in the entire state, almost one-third of whom are employed by the OHCN. A large gap remains between the magnitude of the problem of occupational disease and the clinical resources devoted to diagnosis, treatment, and prevention.
**Recommendations**

Recommendations to reduce the toll of occupational disease in New York State include:

1) Adequate Funding
   - Increase funding for governmental and non-governmental occupational health programs commensurate with the need for services
   - Develop mechanisms that make OHCN and OSHTEP funding sustainable and keep pace with increases in the cost of living

2) Building on the existing OSH infrastructure
   - Systematically analyze existing data on occupational disease from the WCB, the OHCN, and state registries to target prevention efforts
   - Develop other data sources to provide more comprehensive information on occupational disease workplace hazards
   - Improve the Workers’ Compensation process to provide an incentive for clinicians to participate
   - Eliminate barriers to care for occupational disease by Workers’ Compensation reforms that curb insurance carrier powers to deny and delay claims

3) Prevention of occupational disease
   - Development of a statewide occupational disease prevention agenda that includes both governmental and non-governmental organizations in its crafting
   - Incentivize employers to engage in occupational disease prevention efforts by reducing their ability to socialize the costs of occupational disease and by more assertive State intervention and regulation of workplace hazards

4) Integration and Collaboration
   - Development of a statewide occupational disease prevention agenda that includes both governmental and non-governmental organizations in its crafting
   - Continue the collaboration between these groups in the implementation of the agenda

5) Building worker capacity and expanding worker participation
   - Build worker based occupational health capacity
   - Include workers and worker advocacy organizations as central participants in collaborative occupational health efforts

**Key words:** occupational disease, occupational disease prevention, occupational disease surveillance, occupational epidemiology, occupational health, occupational medicine, occupational health services, work-related illness

Michael B. Lax, MD, MPH
Jeanette M. Zoeckler, PhD, MPH
OCCUPATIONAL HEALTH CLINICAL CENTER
SUNY Upstate Medical University, Syracuse, NY
September 2021
OCCUPATIONAL DISEASE IN NEW YORK STATE

In 1987, Landrigan and Markowitz co-authored a report on occupational disease in New York State (NYS). This pioneering effort estimated that:

1. At least 5,000-7,000 workers die from an occupational disease, and at least 35,000 workers develop a work-related illness each year.
2. “(N)early 10% of New York workers were employed in the fifty most hazardous industries...Industrial use of toxic materials is extensive. Legally permissible levels of exposure are commonly exceeded.”
3. The annual costs of occupational disease exceeded $600 million and that much of the costs are borne by ill workers, their families, and taxpayers.

The report concluded that: occupational disease was common and often deadly; millions of workers labor under hazardous conditions that put them at risk of an occupational disease; and the costs of occupational disease were enormous. Given the magnitude of the problem, the authors emphasized that resources to diagnose, treat, and prevent occupational disease were wholly inadequate.

The report served to bolster an organizing effort led by the labor union movement, but including a broad range of occupational health professionals and activists, to establish a publicly funded network of occupational health clinical centers. The effort was successful in convincing state legislators and the governor to provide funding for the creation of a network. Funding has been maintained for the more than thirty years since and the Occupational Health Clinic Network (OHCN) consists of eight clinics with a regional responsibility and one with a state wide mandate focused on agricultural safety and health. OHCN clinics were envisioned as community based and advised centers that would employ multidisciplinary teams including an Occupational Medicine physician, an Industrial Hygienist, and a Social Worker to diagnose and prevent occupational disease.

Just prior to the Landrigan/Markowitz report, the Occupational Safety and Health Training and Education Program (OSHTEP) was created to fund organizations to provide training and education to workers, heightening awareness about occupational health hazards and facilitating the development of the knowledge and skills necessary to reduce hazards by changing workplace conditions. OSHTEP funds were crucial to building both Committees on Safety and Health (COSH) and union health and safety staff.

Both OSHTEP and the OHCN were funded through an assessment on Workers’ Compensation Insurance premiums paid by employers. As a result of these pieces of legislation, public funding in New York has been crucial to building a relatively extensive, sustained and unique occupational health infrastructure. That infrastructure includes state-based programs in the Department of Labor (DOL) and the Department of Health (DOH) engaged in regulating,
educating, data collection and analysis, and technical assistance on occupational health issues. In addition, it includes the State’s Workers’ Compensation system that provides access to medical, wage replacement and vocational rehabilitation benefits to workers suffering from work related disease.

Thirty years later, it is time to re-assess the state of occupational disease in NYS. Over that period, aside from the development of the OHCN and OSHTEP, there have been significant economic, political, and scientific changes that have had important implications for occupational disease. Key issues include:

1) A dramatic shift in the economic base of the state away from manufacturing and toward service industries
2) A large growth of low-wage jobs that offer little in the way of security or benefits
3) A major increase in the participation of women and immigrants in the state’s workforce
4) A significant decline in the size and power of the labor union movement
5) A sustained shift away from a liberal ‘welfare state’ to a neoliberal state emphasizing de-regulation, governmental downsizing, and shrinking both taxation (particularly business taxes) and government spending
6) Reform to the Workers’ Compensation system inducing large numbers of physicians to exclude patients with work related injuries or illnesses from their practices.
7) A global viral pandemic (COVID-19) that dramatically reshaped virtually all aspects of life beginning in 2020. Work related infections and deaths brought the issue of occupational disease to widespread attention
8) Recognition of a high incidence musculoskeletal injuries due to long term work in ergonomically poorly designed jobs
9) An evolution in the way occupational disease is defined and conceptualized

As a whole, these changes are likely to substantially impact the results of an inquiry into all the areas covered in the original 1987 Landrigan/Markowitz report. The changing landscape of work alters the profile of hazards workers face on the job. Other political and economic changes combine to make it less likely that occupational disease will be recognized. Conversely, a re-definition of occupational disease that enlarges the concept and will improve the accuracy of what is recognized. The COVID-19 pandemic may generally raise awareness and sensitivity to other work-related diseases. Consequently, the approach to identifying, treating and preventing occupational disease will require modification to be effective under these changed circumstances.

This paper uses the Landrigan/Markowitz report as a model to re-assess occupational disease incidence, the extent of hazardous work that puts workers at risk of occupational disease, the costs of occupational disease, and occupational health resources available to identify and prevent occupational disease in New York State. Though the paper explores the same themes as Landrigan/Markowitz, it does so with a modified definition of occupational disease and the use of some different sources of data and methodology.
The intent of this report is to provide data that can both frame and inform efforts to reduce the toll of occupational disease in New York State.

The Incidence of Occupational Disease in New York State

What is an occupational disease?

The traditional definition of an occupational disease\(^6\) has two key components that distinguish it from an occupational injury:

1. An exposure to a hazard that occurs over a period of time
2. An ill-defined onset that becomes evident over a period of time

In contrast an injury is conceived as a condition that:

1. Results from exposure to a hazard that produces immediate effects
2. Results in symptoms with a well-defined, often abrupt onset

There is a need to critically evaluate the definition of occupational disease in order to better determine what gets counted when assessing incidence, risk and costs, and consequently, the type and amount of resources that need to be devoted to the prevention, treatment, and compensation of these conditions.

Classic examples of occupational disease include asbestosis from years of asbestos exposure, lead poisoning from radiator repair work, and solvent related encephalopathy. “Emergent” occupational diseases that have become evident over the past several decades fall into several categories:

1. Musculoskeletal conditions caused by prolonged exposure to work-related risk factors
2. Airborne infectious disease (e.g. COVID-19)
3. Conditions that are multi-factorial and may include non-work-related causes (e.g. heart disease, chronic lung disease)
4. Conditions that are caused by workplace psycho-social factors (e.g. work-related stress, bullying, violence)
5. Conditions that are caused by organizational factors (e.g. shiftwork, short-staffing, long hours)
6. Mental health conditions that occur as a direct result of workplace conditions or as sequelae of a work-related physical condition
7. Work-related substance abuse
8. Less well-defined health conditions (e.g. loss of well-being) related to work
9. Non-musculoskeletal conditions that do not meet the prolonged exposure time and/or chronic onset aspects of the classic occupational disease definition

The possible pathways along which workplace exposures may interact with each other, and workplace exposures may interact with non-workplace exposures, to impact the expression of disease are many and potentially complex. The classic example is the interaction
between cigarette smoking and asbestos exposure that greatly increases the risk of lung cancer beyond that of either exposure alone.10-12 ‘Work aggravated’ asthma is another example of this interaction.13-15 The COVID-19 pandemic has also dramatically illustrated this interaction. Recognizing that the non-work and work worlds interact greatly complicates the concept of occupational disease. In addition, it may be quite difficult to parse out the contribution of the various exposures, and the occupational component may vary from minimal to predominant.16

One of the insights of this more complex model is that exposure to workplace hazards can interact with non-work exposures to contribute to the production of diseases typically not thought of as ‘occupational’ in origin. Characteristics of workplace stress that put workers at increased risk of cardiovascular disease including hypertension, myocardial infarction, and stroke have been elucidated over the past several decades.17-21 Workplace hazards can play a role in aggravating, or perhaps in causing diabetes through a variety of mechanisms including: direct exposure to endocrine disrupting chemicals; limiting breaks necessary to access insulin and/or food; limited access to healthy food; or high stress levels.22-30 Obesity can be encouraged through some of these same pathways, as well as by sedentary jobs that restrict movement throughout the work shift.31-43

At the time of the Landrigan/Markowitz report musculoskeletal conditions due to workplace conditions such as repetitive motion, forceful movements, and static posture were beginning to be recognized as an important part of the occupational disease landscape, but they were not included in the Landrigan/Markowitz assessment. In the ensuing decades, they have been established as a major source of work-related morbidity and disability and require inclusion in the discussion of occupational disease.44-46

The psycho-social and organizational characteristics of work have received considerable attention and recognition as contributors to illness. The characteristics of modern work have been explored including attributes of the work itself (e.g. high job demands with low control over work, machine paced work, shiftwork), social characteristics of the workplace (e.g. presence or absence of social support, lack of respect, bullying supervisor), and more macro level factors (e.g. lack of job security, unemployment).17,47-55 Cardiovascular and mental health were the main health impacts studied early on, but it has become evident that the potential health impacts of poor psycho-social work conditions are much broader.56 For example, the epidemic of violence in health care workplaces exemplifies how systemic factors such as understaffing and underfunding lead to extreme stressors with complex multifactorial sources of job strain.57-58 As already suggested above, work plays some role as a contributor to most, if not all, contemporary major health challenges including the obesity epidemic, diabetes, and substance abuse (not only opiates, but alcohol, tobacco, and other substances as well).30,34,59-62 Undoubtedly, other health issues will continue to emerge. For example, the importance of sleep is increasingly recognized, and the way work is organized can have major impact on sleep, or lack of it.63-68 Psycho-social and organizational characteristics of work play a major role in the production of these issues.

Mental health and its relationship to work is a specific area requiring attention. As already discussed, aspects of work generically grouped as ‘stressful’ have mental health consequences, commonly including depression and anxiety. Mental health impact is also manifest as a
consequence of suffering from an occupational disease and the resulting trauma of job loss, decline in physical capabilities, loss of friendships and social networks, financial stress, and the indignities of the Workers’ Compensation process. 69-70

Substance abuse is another contemporary public health challenge. While opiates have received most of the attention, tobacco and alcohol are the most commonly abused substances. Work may play a role in these addictions with their use as a way of coping with the various stresses of work. Tobacco may augment workers’ ability to stay alert for long hours, and function as a substitute for food. Alcohol is used to unwind after a shift. And opiates help workers who are in pain to keep working, or to come back to work sooner after an injury.

Even an expanded definition of occupational disease does not adequately capture all aspects of health. Well-being can be stimulated or enhanced by work, but also the lack of well-being can be caused by or contributed to by work. The concept, as advanced by Schulte and colleagues, describes well-being as

“flourishing and aspiring to... a good life that is characterized by happiness, life satisfaction, positive emotion and self-determination. It includes health, but goes beyond that ...and has been linked to individual enterprise, national health care costs, reduced injury and illness and lower rates of absenteeism and presenteeism.” 71

The loss of a sense of “well-being” is important to the individual worker as it can negatively color all aspects of their lives, reducing their ability to engage and be present. Prolonged loss of “well-being” can have an impact on mental health and possibly on physical health as well.71-72

Finally, there are a number of conditions that intuitively seem like diseases that do not meet one or both criteria of prolonged exposure and ill-defined progressive onset. For example, asthma can occur, and become persistent, immediately following an initial heavy exposure to chlorine gas. In fact, asthma is an example of a disease that occurs along a full spectrum of both acute and chronic exposure and acute and chronic onset and progression. Contact dermatitis typically appears rapidly upon re-exposure to a substance to which an individual has been sensitized. It then recurs whenever the person is re-exposed to the allergen, and can become nonspecific, occurring with exposure to other substances as well. An argument that these conditions should be included among diseases and not injuries is based upon the cause: an exposure to an airborne, dermal, or, occasionally, ingested hazard.

An overall assessment of occupational disease requires investigation of both ‘classic’ and ‘emergent’ conditions.

Assessing the Incidence and Prevalence of Occupational Disease

Obtaining accurate and comprehensive data on occupational disease is notoriously difficult, as the United States and New York State have no systematic reporting systems in place that capture deaths and morbidity due to a workplace cause. 73 The NYS Workers’ Compensation Board and Bureau of Labor Statistics are the most obvious potential sources of data, but they suffer from a narrow definition of occupational disease and multiple barriers to
reporting and recognition. Additionally, the NYS Workers’ Compensation Board to date has offered only a superficial analysis of its data, and has not made its occupational disease data available in a meaningful way to allow further analysis.

The NYS Department of Health maintains several registries (i.e. Heavy Metals Registry, Occupational Lung Disease Registry, Pesticide Registry). All suffer from limitations including difficulty accessing the data, and (except for the Heavy Metals Registry) non-comprehensive reporting which makes them of little use in estimating incidence or prevalence. The Occupational Health Clinic Network has amassed considerable data on patients with suspected work-related conditions evaluated over the last 32 years. This is a rich source of information that adds to the picture of occupational disease in the state, but is not comprehensive and also cannot be utilized to estimate incidence/prevalence.

In addition, the cumulative effect of the changes in the landscape of work that have occurred since the Landrigan/Markowitz report has been to reduce the visibility of occupational disease.

As a consequence of the dearth of data, alternative and less direct methods must be utilized to estimate occupational disease mortality and morbidity. The specific methodologies used will be discussed in the sections that follow.

**Occupational Disease: Estimating Mortality and Morbidity**

**Methods for estimating occupational disease mortality and morbidity**

**Mortality**

The Landrigan/Markowitz report used the idea of “attributable fraction” to estimate mortality in New York State. "Attributable fraction" is defined as the portion of overall deaths that can be attributed to occupational causes. For example, cancer can be caused by exposure to inhaled hazards at work or at home/in the community. The work-related attributable fraction, or the percentage caused by work exposures is estimated to be 8.4%. The attributable fractions are derived from review of relevant epidemiologic literature. The totals for specific causes of death in New York State are obtained from death certificates. In Table 1, we replicated the Landrigan/Markowitz mortality assessment using average annual mortality rates for 2010-2016 in New York State, and applying the same attributable fractions used by Landrigan/Markowitz.

In addition, we estimated mortality using a different set of attributable fractions (Table 2 and Table 3). Since the original Mount Sinai Report significant bodies of literature have accumulated that allow for an updating of the attributable fraction of occupational disease for many health conditions. In 2001, Nurminen and Karjalainen estimated the global burden of occupational disease based on significant improvements in the calculation of the attributable fractions. Following on their methods, we have reformulated occupational disease mortality estimates for New York State. Nurminen and Karjalainen’s work also allows for inclusion of
health conditions that may be work-related but were not included in the Mount Sinai calculation. This is consistent with the idea of a broadened conception of occupational disease.\textsuperscript{86-90} Their work also allowed us to demonstrate how occupational disease fatalities vary by gender (Table 4). In addition, to accommodate known latency in chronic disease and the fact that workers are working longer, we specified age ranges to include additional years beyond the conventional time of workforce participation.

<table>
<thead>
<tr>
<th>TABLE 1 Occupational Disease Mortality Estimates in New York State, 2010-2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause of Death a,b</strong></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Cancer (malignant neoplasms)</td>
</tr>
<tr>
<td>Pneumoconioses\textsubscript{e}</td>
</tr>
<tr>
<td>Chronic lower respiratory disease</td>
</tr>
<tr>
<td>Cardiovascular, Renal disease and Neurologic disorders</td>
</tr>
<tr>
<td>Circulatory system</td>
</tr>
<tr>
<td>Renal\textsuperscript{f}</td>
</tr>
<tr>
<td>Neurological</td>
</tr>
<tr>
<td>Other conditions</td>
</tr>
<tr>
<td>Total occupational disease</td>
</tr>
<tr>
<td>Total all cause mortality</td>
</tr>
<tr>
<td>Percent of all deaths attributed to occupational disease</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Cause of Death computed from death certificates as recorded by New York State Vital Statistics.

\textsuperscript{b}Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2015 on CDC WONDER Online Database, released December, 2016. Data are from the Multiple Cause of Death Files, 1999-2015, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10.html April 22, 2019

\textsuperscript{c}Age 15-84 economically active population, older ages accommodate disease latency

\textsuperscript{d}Method derived from Landrigan & Markowitz, Occupational Disease in New York State, Proposal for a Statewide Network of Occupational Disease Diagnosis and Prevention Centers: Report to the New York State Legislature, February, 1987.

\textsuperscript{e}data suppressed for ages under 44 for some years due to confidentiality restraints (low numbers)

<table>
<thead>
<tr>
<th>TABLE 2 Attributable Fraction\textsuperscript{a} (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause of Death</strong></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>All causes (all codes)</td>
</tr>
<tr>
<td>Infectious diseases (all A and B)</td>
</tr>
<tr>
<td>Malignant neoplasms (all C)</td>
</tr>
<tr>
<td>Mental disorders (all F)</td>
</tr>
<tr>
<td>Diseases of the nervous system (all G and H)</td>
</tr>
<tr>
<td>Diseases of the circulatory system (all I)</td>
</tr>
<tr>
<td>Diseases of the respiratory system (all J)</td>
</tr>
<tr>
<td>Diseases of the digestive system (all K)</td>
</tr>
<tr>
<td>Diseases of the genitourinary system (all N)</td>
</tr>
<tr>
<td>Intentional self-harm and sequelae (X60 - X84, Y87.0)</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Nurminen and Karjalainen 2001
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious diseases (all A and B)</td>
<td>8.8</td>
<td>52962</td>
<td>4661</td>
<td>3.8</td>
<td>3199</td>
<td>282</td>
<td>4.0</td>
</tr>
<tr>
<td>Malignant neoplasms (all C)</td>
<td>8.4</td>
<td>493324</td>
<td>41439</td>
<td>33.5</td>
<td>28428</td>
<td>2388</td>
<td>34.0</td>
</tr>
<tr>
<td>Mental disorders (all F)</td>
<td>3.5</td>
<td>50741</td>
<td>1776</td>
<td>1.4</td>
<td>2606</td>
<td>91</td>
<td>1.3</td>
</tr>
<tr>
<td>Diseases of the nervous system (all G and H)</td>
<td>3.1</td>
<td>96951</td>
<td>3005</td>
<td>2.4</td>
<td>3350</td>
<td>104</td>
<td>1.5</td>
</tr>
<tr>
<td>Diseases of the circulatory system (all I)</td>
<td>12.4</td>
<td>506027</td>
<td>62747</td>
<td>50.8</td>
<td>29673</td>
<td>3679</td>
<td>52.4</td>
</tr>
<tr>
<td>Diseases of the respiratory system (all J)</td>
<td>4.1</td>
<td>178742</td>
<td>7328</td>
<td>5.9</td>
<td>8758</td>
<td>359</td>
<td>5.1</td>
</tr>
<tr>
<td>Diseases of the digestive system (all K)</td>
<td>2.1</td>
<td>87119</td>
<td>1829</td>
<td>1.5</td>
<td>3815</td>
<td>80</td>
<td>1.1</td>
</tr>
<tr>
<td>Diseases of the genitourinary system (all N)</td>
<td>1.3</td>
<td>44202</td>
<td>575</td>
<td>0.5</td>
<td>2043</td>
<td>27</td>
<td>0.4</td>
</tr>
<tr>
<td>Intentional self-harm and sequelae (X60 - X84, Y87.0)</td>
<td>0.4</td>
<td>43308</td>
<td>173</td>
<td>0.1</td>
<td>1620</td>
<td>6</td>
<td>0.1</td>
</tr>
<tr>
<td>Other causes</td>
<td></td>
<td>303564</td>
<td></td>
<td></td>
<td>14706</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total occupational disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>123534</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total all-cause mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1856940</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of deaths attributable to occupational disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.65%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (age 15-84), economically active population, older ages accommodate latency


* Nurminen and Karjalainen 2001

* some figures suppressed for 15-24 year olds
<table>
<thead>
<tr>
<th>Causes</th>
<th>Infectious diseases (all A and B)</th>
<th>Malignant neoplasms (all C)</th>
<th>Mental disorders (all F)</th>
<th>Diseases of the nervous system (all G and H)</th>
<th>Diseases of the circulatory system (all I)</th>
<th>Diseases of the respiratory system (all J)</th>
<th>Diseases of the digestive system (all K)</th>
<th>Diseases of the genitourinary system (all N)</th>
<th>Self-harm and sequelae (X60-X84, Y87.0)</th>
<th>Other causes</th>
<th>Total occupational disease</th>
<th>Total all-cause mortality</th>
<th>Percent of deaths attributable to occupational disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths Women by Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-24</td>
<td>15</td>
<td>24</td>
<td>supressed</td>
<td>20</td>
<td>24</td>
<td>23</td>
<td>supressed</td>
<td>supressed</td>
<td>52</td>
<td>234</td>
<td>388</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>25</td>
<td>124</td>
<td>27</td>
<td>30</td>
<td>74</td>
<td>26</td>
<td>26</td>
<td>supressed</td>
<td>62</td>
<td>484</td>
<td>878</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>60</td>
<td>384</td>
<td>28</td>
<td>30</td>
<td>184</td>
<td>39</td>
<td>48</td>
<td>18</td>
<td>63</td>
<td>466</td>
<td>1,320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-54</td>
<td>153</td>
<td>1,322</td>
<td>39</td>
<td>80</td>
<td>677</td>
<td>180</td>
<td>189</td>
<td>40</td>
<td>91</td>
<td>714</td>
<td>3,485</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td>286</td>
<td>3,118</td>
<td>75</td>
<td>184</td>
<td>1,662</td>
<td>605</td>
<td>323</td>
<td>127</td>
<td>69</td>
<td>886</td>
<td>7,335</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>390</td>
<td>4,541</td>
<td>188</td>
<td>379</td>
<td>3,234</td>
<td>1,288</td>
<td>441</td>
<td>261</td>
<td>38</td>
<td>1,071</td>
<td>11,831</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75-84</td>
<td>490</td>
<td>4,661</td>
<td>861</td>
<td>953</td>
<td>6,261</td>
<td>2,039</td>
<td>580</td>
<td>507</td>
<td>25</td>
<td>1,438</td>
<td>17,815</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,415</td>
<td>14,174</td>
<td>1,218</td>
<td>1,676</td>
<td>12,116</td>
<td>4,200</td>
<td>1,607</td>
<td>953</td>
<td>400</td>
<td>5,293</td>
<td>43,052</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attributable Fraction Women</td>
<td>32.5</td>
<td>2.2</td>
<td>1.8</td>
<td>1.7</td>
<td>6.7</td>
<td>1.1</td>
<td>1.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths from Occupational Disease Women</td>
<td>460</td>
<td>312</td>
<td>22</td>
<td>28</td>
<td>812</td>
<td>46</td>
<td>24</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1709</td>
<td>43,052</td>
<td>4.00%</td>
</tr>
<tr>
<td>Deaths Men by Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-24</td>
<td>13</td>
<td>58</td>
<td>10</td>
<td>28</td>
<td>24</td>
<td>29</td>
<td>supressed</td>
<td>supressed</td>
<td>151</td>
<td>743</td>
<td>1,056</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>43</td>
<td>105</td>
<td>44</td>
<td>37</td>
<td>166</td>
<td>36</td>
<td>43</td>
<td>10</td>
<td>184</td>
<td>1,337</td>
<td>2,005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>77</td>
<td>295</td>
<td>87</td>
<td>42</td>
<td>447</td>
<td>66</td>
<td>114</td>
<td>15</td>
<td>204</td>
<td>1,033</td>
<td>2,380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-54</td>
<td>201</td>
<td>1,163</td>
<td>166</td>
<td>106</td>
<td>1,582</td>
<td>193</td>
<td>327</td>
<td>63</td>
<td>240</td>
<td>1,384</td>
<td>5,425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td>481</td>
<td>3,456</td>
<td>221</td>
<td>216</td>
<td>3,614</td>
<td>737</td>
<td>585</td>
<td>172</td>
<td>241</td>
<td>1,649</td>
<td>11,372</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>486</td>
<td>5,030</td>
<td>253</td>
<td>430</td>
<td>5,112</td>
<td>1,500</td>
<td>595</td>
<td>315</td>
<td>122</td>
<td>1,379</td>
<td>15,222</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75-84</td>
<td>483</td>
<td>4,711</td>
<td>603</td>
<td>810</td>
<td>6,612</td>
<td>1,997</td>
<td>531</td>
<td>509</td>
<td>78</td>
<td>1,352</td>
<td>17,686</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,784</td>
<td>14,818</td>
<td>1,384</td>
<td>1,669</td>
<td>17,557</td>
<td>4,558</td>
<td>2,195</td>
<td>1,084</td>
<td>1,220</td>
<td>8,877</td>
<td>55,146</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attributable Fraction Men</td>
<td>4.8</td>
<td>13.8</td>
<td>7.3</td>
<td>5.1</td>
<td>13.8</td>
<td>7.3</td>
<td>5.1</td>
<td>13.8</td>
<td>7.3</td>
<td>5.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths from Occupational Disease Men</td>
<td>86</td>
<td>2,045</td>
<td>101</td>
<td>85</td>
<td>2,045</td>
<td>101</td>
<td>85</td>
<td>2,045</td>
<td>101</td>
<td>85</td>
<td>5,243</td>
<td>55,146</td>
<td>9.50%</td>
</tr>
<tr>
<td>Total Work-Related Deaths</td>
<td>546</td>
<td>2,357</td>
<td>101</td>
<td>114</td>
<td>2,357</td>
<td>123</td>
<td>114</td>
<td>2,357</td>
<td>123</td>
<td>114</td>
<td>6,952</td>
<td>98,198</td>
<td>7.10%</td>
</tr>
</tbody>
</table>

*a* economically active population (age 15-64), also accommodates latency (age 65-84)


*c* Nurminen and Karjalainen 2001
Morbidity

The Landrigan/Markowitz used three data sources to estimate occupational disease morbidity:

1) New York State Workers’ Compensation data
2) Bureau of Labor Statistics reports
3) Physicians’ reports of occupational disease in California.

They acknowledged the severe limitations of each of these sources.

Numerous studies have emphasized the small proportion of individuals with an occupational disease who ever actually apply for and receive Workers’ Compensation benefits. These studies have examined well-established work-related conditions such as silicosis and asbestosis. Given the low recognition of even these diseases in Workers’ Compensation, recognition of many of the conditions in the expanded definition of occupational disease would likely not be represented in this data. A further difficulty is that the New York State Workers’ Compensation Board is not currently organizing its case data to even make an analysis of occupational disease possible.

Bureau of Labor Statistics data are based on employer reports of occupational disease. These reports are mandated by the Occupational Safety and Health Administration (OSHA). A major limitation of this data is that it is restricted to a relatively few conditions which are almost entirely easily recognizable and acute.

In California physicians are required to submit reports of occupational disease to the State Department of Labor. Similar to the BLS data, the California Doctors’ reports suffer from restriction to a limited set of primarily acute conditions. Physician and employer recognition and reporting of occupational disease suffer from significant limitations which also contribute to the lack of comprehensiveness of the BLS and California physicians’ data.

Given the limitations of available data we chose to estimate occupational disease morbidity two ways. The first estimate uses BLS data. The second estimates attributable fractions using Nurminen and Karjalainen’s 2001 work as a starting point and modifying their estimates based on newer data. Consequently, our estimates rest on the assumption that attributable fractions for mortality are also valid for estimating morbidity. Since occupationally-related cases for any given diagnosis are likely to have a similar probability of death as non-occupational cases, this assumption seems reasonable. Because most available data estimate prevalence rather than incidence, we chose to use prevalence rather than incidence rates. This was largely based on the practicalities of available data. In order to estimate the attributable fraction, the total number of people with the disease must be ascertained. Consequently, the morbidity estimates provide a useful picture of the overall occupational disease burden, but do not reveal how many cases occur each year, and are not directly comparable with the Landrigan/Markowitz morbidity estimates.
**Results: Mortality and Morbidity**

*Mortality*

The Mount Sinai study estimated between 4,686 and 6,592 New Yorkers died each year from an Occupational Disease. **Table 1** provides our estimate of occupational disease mortality. Using an average annual mortality for 2010-2016 in New York, and applying the same attributable fractions used by Landrigan/Markowitz, current estimates of occupational disease fatalities range from 3,085 to 4,430. Overall number of deaths have decreased in 2010-2016 compared to the 1979-1982 period described in the Mount Sinai report, with 95,824 and 132,139 annually in the respective time periods.88-89 Consequently despite the decline in the number of deaths, occupational disease accounts for an increased proportion of deaths in 2016 compared with 1987, with the estimate ranging from 3.3-4.7% in 2016 and 2.8-3.7% in 1987.

Using Nurminen and Karjalainen's attributable fractions (**Table 2 and Table 3**), a total of 7016 deaths (7.14%) were due to occupational disease in NYS. **Table 4** stratifies mortality by gender and age and relies on gender-based attributable fractions. Deaths attributable to occupational disease in men numbered 5,243 or 9.5% of deaths from all causes among men. Deaths attributable to occupational disease in women numbered 1,709 or 4.0% of deaths from all causes among women. Among the men, cancer and circulatory causes made up 87% of the occupationally related deaths, and among the women 93% were comprised of cancer, circulatory conditions and infectious diseases.

*Morbidity: Non-fatal occupational illnesses*

According to BLS data abstracted for NYS, there are an estimated 9,300 people diagnosed with a non-fatal occupational illness in NYS each year. In 2016, the incidence rate was 13 per 10,000 full time workers (**Table 5**). It should be noted that these are mostly acute or subacute conditions, with chronic conditions largely unrecognized. Two-thirds of the illness are occurring in the private sector with the remaining one-third in state and local government. In the private sector, utilities, manufacturing, health care and social assistance and transportation and warehousing have higher than average incidence rates. Hearing loss drives the figures for utilities and manufacturing while the category named “all other illnesses” drives the figures for health care and social assistance significantly. Among public sector workers, the “all other illnesses” category also drives the reported rates. Examples of “all other illnesses” include: Heatstroke, heat exhaustion, and heat stress; freezing and frostbite; decompression sickness; effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flash, ultra-violet rays, lasers); anthrax; bloodborne pathogenic diseases such as AIDS, HIV, hepatitis B or hepatitis C; brucellosis; malignant or benign tumors; histoplasmosis; coccidioidomycosis.
<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Total cases</th>
<th>Skin disorders</th>
<th>Respiratory conditions</th>
<th>Poisonings</th>
<th>Hearing loss</th>
<th>All other illnesses</th>
<th>Total cases</th>
<th>Skin disorders</th>
<th>Respiratory conditions</th>
<th>Poisonings</th>
<th>Hearing loss</th>
<th>All other illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>All industries including state and local government</td>
<td>13.0</td>
<td>1.3</td>
<td>1.1</td>
<td>0.2</td>
<td>2.0</td>
<td>8.4</td>
<td>9.3</td>
<td>0.9</td>
<td>0.8</td>
<td>0.1</td>
<td>1.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Private industry</td>
<td>9.9</td>
<td>0.8</td>
<td>0.6</td>
<td>0.1</td>
<td>2.1</td>
<td>6.2</td>
<td>6.1</td>
<td>0.5</td>
<td>0.4</td>
<td>0.1</td>
<td>1.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Goods-producing</td>
<td>19.7</td>
<td>1.3</td>
<td>0.6</td>
<td>--</td>
<td>8.9</td>
<td>9.0</td>
<td>1.6</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
</tr>
<tr>
<td>Natural resources and mining</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Agriculture, forestry, fishing and hunting</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Mining, quarrying, and oil and gas extraction</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Construction</td>
<td>2.5</td>
<td>--</td>
<td>0.5</td>
<td>--</td>
<td>--</td>
<td>1.7</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>26.9</td>
<td>1.4</td>
<td>0.7</td>
<td>--</td>
<td>15.7</td>
<td>8.2</td>
<td>1.1</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
</tr>
<tr>
<td>Service-providing</td>
<td>8.4</td>
<td>0.8</td>
<td>0.6</td>
<td>0.1</td>
<td>1.1</td>
<td>5.8</td>
<td>4.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.1</td>
<td>0.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Trade, transportation, and utilities</td>
<td>8.1</td>
<td>0.4</td>
<td>0.6</td>
<td>--</td>
<td>1.7</td>
<td>5.2</td>
<td>1.0</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>1.6</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Retail trade</td>
<td>7.5</td>
<td>0.5</td>
<td>0.6</td>
<td>--</td>
<td>3.4</td>
<td>9.1</td>
<td>0.3</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Utilities</td>
<td>34.7</td>
<td>--</td>
<td>--</td>
<td>32.0</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td>5.2</td>
<td>0.9</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>3.5</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Finance, insurance, and real estate</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Finance and insurance</td>
<td>0.7</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.6</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Real estate and rental and leasing</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Professional and business services</td>
<td>3.3</td>
<td>--</td>
<td>0.3</td>
<td>--</td>
<td>--</td>
<td>2.2</td>
<td>0.4</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Management of companies and enterprises</td>
<td>1.9</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>--</td>
</tr>
<tr>
<td>Administrative and support and waste management and remediation services</td>
<td>6.3</td>
<td>--</td>
<td>0.4</td>
<td>--</td>
<td>--</td>
<td>3.9</td>
<td>0.2</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Educational and health services</td>
<td>15.6</td>
<td>1.1</td>
<td>0.9</td>
<td>0.1</td>
<td>--</td>
<td>13.3</td>
<td>2.0</td>
<td>0.1</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>1.7</td>
</tr>
<tr>
<td>Educational services</td>
<td>9.4</td>
<td>--</td>
<td>0.9</td>
<td>--</td>
<td>--</td>
<td>8.0</td>
<td>0.2</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Health care and social assistance</td>
<td>16.9</td>
<td>1.3</td>
<td>1.0</td>
<td>0.2</td>
<td>--</td>
<td>14.5</td>
<td>1.8</td>
<td>0.1</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>1.6</td>
</tr>
<tr>
<td>Leisure, entertainment, and hospitality</td>
<td>5.8</td>
<td>0.9</td>
<td>0.6</td>
<td>--</td>
<td>--</td>
<td>4.0</td>
<td>0.3</td>
<td>0.1</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Arts, entertainment, and recreation</td>
<td>9.0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>7.0</td>
<td>0.1</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Accommodation and food services</td>
<td>5.3</td>
<td>0.9</td>
<td>0.7</td>
<td>--</td>
<td>--</td>
<td>3.5</td>
<td>0.3</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.2</td>
</tr>
<tr>
<td>Other services (except public administration)</td>
<td>6.1</td>
<td>1.1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>3.1</td>
<td>0.2</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>Other services (except public administration)</td>
<td>6.1</td>
<td>1.1</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>3.1</td>
<td>0.2</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.1</td>
</tr>
<tr>
<td>State and local government</td>
<td>33.3</td>
<td>4.0</td>
<td>4.4</td>
<td>0.5</td>
<td>1.7</td>
<td>22.8</td>
<td>3.2</td>
<td>0.4</td>
<td>0.4</td>
<td>*</td>
<td>0.2</td>
<td>2.2</td>
</tr>
<tr>
<td>State government</td>
<td>25.8</td>
<td>2.2</td>
<td>3.3</td>
<td>1.0</td>
<td>1.2</td>
<td>18.1</td>
<td>0.5</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>0.4</td>
</tr>
<tr>
<td>Local government</td>
<td>35.4</td>
<td>4.5</td>
<td>4.7</td>
<td>0.3</td>
<td>1.9</td>
<td>24.1</td>
<td>2.7</td>
<td>0.3</td>
<td>0.4</td>
<td>*</td>
<td>0.1</td>
<td>1.8</td>
</tr>
</tbody>
</table>

1 Incidence rates represent the number of illnesses per 10,000 full-time workers and were calculated as: (N/EH) x 20,000,000 where: N= number of illnesses; EH= total hours worked by all employees during the calendar year; 20,000,000 = base for 10,000 equivalent full-time workers (working 40 hours per week, 50 weeks per year).
3 Excludes farms with fewer than 11 employees.
4 Data for mining (Sector 21 in the North American Industry Classification System Manual, 2012 edition) include establishments not governed by the Mine Safety and Health Administration (MSHA) rules and reporting, such as those in oil and gas extraction and related support activities. Data for mining operators in coal, metal, and nonmetal mining are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor. Independent mining contractors are excluded from the coal, metal, and nonmetal mining industries. These data do not reflect the changes OSHA made to its recordkeeping requirements effective January 1, 2002; therefore, estimates for these industries are not comparable to estimates in other industries.
5 Data for employers in railroad transportation are provided to BLS by the Federal Railroad Administration, U.S. Department of Transportation.
6 Examples: Heatstroke, sunstroke, heat exhaustion, heat stress and other effects of environmental heat; freezing, frostbite, and other effects of exposure to low temperatures; decompression sickness; effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flash, ultra-violet rays, lasers); anthrax; bloodborne pathogenic diseases such as AIDS, HIV, hepatitis B or hepatitis C; brucellosis; malignant or benign tumors; histoplasmosis; coccidioidomycosis.

NOTE: Because of rounding, components may not add to totals. Dash indicates data do not meet publication guidelines. Asterisk indicates data too small to be displayed.

Nurminen and Karjalainen’s attributable fraction approach estimates that occupational disease comprises 13.2% of total disease prevalence in the state. In contrast to mortality, musculoskeletal, respiratory and nervous disorders make up nearly 80% of the total occupational disease burden. Diseases of the skin, circulatory system and cancer account for an additional 17% of the total. Occupationaly related mental illness is an estimated 4.5%. These results, applying Nurminen and Karjalainen’s attributable fraction values, are shown in Table 6. In total, there were an estimated 2,218,426 cases of occupational disease prevalent in 2016.

Prevalence estimates for several selected diseases and conditions representing current major health and public health challenges are demonstrated in Table 7. The prevalence of all of these conditions (except opioid misuse) is quite high in the general population, and the health consequences of all are serious, and potentially lethal. Through different mechanisms work can contribute to all of these conditions. Attributable fractions demonstrating the occupational contribution to these specific conditions have not been developed. However, even a relatively small attributable fraction would represent thousands of cases and a significant burden of disease contributed to by workplace conditions.

<table>
<thead>
<tr>
<th>Definitions for Analysis of Occupational Disease Burden for Table 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Illnesses</strong></td>
</tr>
<tr>
<td>Infectious diseases (A and B)</td>
</tr>
<tr>
<td>Cancer (C and D 0-99)</td>
</tr>
<tr>
<td>Mental disorders (F, X60-84,Y87)</td>
</tr>
<tr>
<td>Diseases of the nervous system (G and H)</td>
</tr>
<tr>
<td>Diseases of the circulatory system (I)</td>
</tr>
<tr>
<td>Diseases of the respiratory system (J)</td>
</tr>
<tr>
<td>Diseases of the digestive system (K)</td>
</tr>
<tr>
<td>Diseases of the genitourinary system (N)</td>
</tr>
<tr>
<td>Diseases of the skin (L)</td>
</tr>
<tr>
<td>Diseases of the musculoskeletal system (M)</td>
</tr>
</tbody>
</table>
### TABLE 6 Excess Occupational Disease Burden in the United States and in New York State in 2016

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious diseases (A and B)</td>
<td>8.8</td>
<td>0.1</td>
<td>238,918,622</td>
<td>328,119</td>
<td>28,874</td>
<td>0.08</td>
<td>0.01</td>
<td>15,029,160</td>
<td>20,233</td>
<td>1,781</td>
<td>0.08</td>
</tr>
<tr>
<td>Cancer (C and D 0-99)</td>
<td>8.4</td>
<td>4.24</td>
<td>238,918,622</td>
<td>10,130,150</td>
<td>850,933</td>
<td>2.38</td>
<td>7</td>
<td>15,029,160</td>
<td>981,084</td>
<td>82,411</td>
<td>3.71</td>
</tr>
<tr>
<td>Mental disorders (F, X60-84, Y87)</td>
<td>3.5, 0.4</td>
<td>18.9</td>
<td>238,918,622</td>
<td>45,466,214</td>
<td>1,581,689</td>
<td>4.42</td>
<td>18.9</td>
<td>15,029,160</td>
<td>2,860,049</td>
<td>99,496</td>
<td>4.48</td>
</tr>
<tr>
<td>Diseases of the nervous system (G and H)</td>
<td>6.7</td>
<td>0.57, 2.3, 16</td>
<td>238,918,622</td>
<td>45,988,041</td>
<td>3,081,199</td>
<td>8.61</td>
<td>7.4</td>
<td>15,029,160</td>
<td>1,121,158</td>
<td>137,908</td>
<td>6.22</td>
</tr>
<tr>
<td>Diseases of the circulatory system (I)</td>
<td>12.4</td>
<td>9</td>
<td>238,918,622</td>
<td>24,300,000</td>
<td>3,013,200</td>
<td>8.42</td>
<td>7</td>
<td>15,029,160</td>
<td>1,112,158</td>
<td>137,908</td>
<td>6.22</td>
</tr>
<tr>
<td>Diseases of the respiratory system (J)</td>
<td>11.7, 18.2, 100, 15.4</td>
<td>6.2, 8.3, 0.06</td>
<td>238,918,622</td>
<td>168,138,002</td>
<td>5,399,156</td>
<td>15.08</td>
<td>4.0, 9.5, 0.006</td>
<td>15,029,160</td>
<td>2,038,614</td>
<td>335,359</td>
<td>15.12</td>
</tr>
<tr>
<td>Diseases of the digestive system (K)</td>
<td>2.1</td>
<td>5.19</td>
<td>238,918,622</td>
<td>18,157,815</td>
<td>381,314</td>
<td>1.07</td>
<td>5.7</td>
<td>15,029,160</td>
<td>1,142,216</td>
<td>23,987</td>
<td>1.08</td>
</tr>
<tr>
<td>Diseases of the genitourinary system (N)</td>
<td>1.3</td>
<td>2.7</td>
<td>238,918,622</td>
<td>6,450,803</td>
<td>83,860</td>
<td>0.23</td>
<td>2</td>
<td>15,029,160</td>
<td>330,642</td>
<td>4,298</td>
<td>0.19</td>
</tr>
<tr>
<td>Diseases of the skin (L)</td>
<td>10.2</td>
<td>10.1</td>
<td>238,918,622</td>
<td>24,130,731</td>
<td>2,461,340</td>
<td>6.88</td>
<td>5.68</td>
<td>1.68</td>
<td>15,029,160</td>
<td>1,517,945</td>
<td>154,830</td>
</tr>
<tr>
<td>Diseases of the musculoskeletal system (M)</td>
<td>3.68</td>
<td>5.68, 16.8, 15.1</td>
<td>238,918,622</td>
<td>70,003,156</td>
<td>18,912,034</td>
<td>52.84</td>
<td>52.84</td>
<td>15,029,160</td>
<td>4,403,544</td>
<td>1,215,102</td>
<td>54.77</td>
</tr>
</tbody>
</table>

**Total disease and occupational disease**

<table>
<thead>
<tr>
<th></th>
<th>413,093,080</th>
<th>35,793,599</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of illnesses attributable to occupational disease</td>
<td>8.66%</td>
<td>100</td>
</tr>
</tbody>
</table>

---

a Nurminen and Karjalainen 2001, except for MSDs and skin disease, across all occupational diseases 6.7%
b age 18-84, economically active population, older ages accommodate latency, analysis focused on 2016 with some exceptions due to availability of data
c selected illnesses organized by ICD-10 code scheme
d prevalence (period rates expressed as % of population)
e based on 2016 US population age 18-84, US Census
f based on 2016 NYS population age 18-84, US Census
h CDC, SEER, 24-year limited duration prevalence counts for 2016 divided by the population for the US in 2016+ 13,725,579/323,400,000
i (AMI) as recognized by NIMH
m NHIS unadjusted prevalence among all employed adults 2013-2015, not including upper extremity MSDs (complaints of arm, neck and/or shoulder), knees, cumulative trauma disorders, https://wwwn.cdc.gov/Niosh-whc/chart/nhis-sd/illness?OU=ARTH1&T=GE&V=R
### TABLE 7 Adults with health conditions expected to contribute to future occupational disease diagnosis

<table>
<thead>
<tr>
<th>Illnesses</th>
<th>Prevalence Rate, USb</th>
<th>U.S. Population Age 18-84c</th>
<th>Numbers of Illnesses, USd</th>
<th>Prevalence Rate, NYSb</th>
<th>NYS Populatione</th>
<th>Numbers of Illnesses, NYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>10.5</td>
<td>238,918,622</td>
<td>25,086,455</td>
<td>10.5</td>
<td>15,029,160</td>
<td>1,578,062</td>
</tr>
<tr>
<td>Hypertension</td>
<td>31.4</td>
<td>238,918,622</td>
<td>75,020,447</td>
<td>31.7</td>
<td>15,029,160</td>
<td>4,764,244</td>
</tr>
<tr>
<td>Obesity</td>
<td>30.1</td>
<td>238,918,622</td>
<td>71,914,505</td>
<td>25.5</td>
<td>15,029,160</td>
<td>3,832,436</td>
</tr>
<tr>
<td>Binge drinking in the past month</td>
<td>16.9</td>
<td>238,918,622</td>
<td>40,377,247</td>
<td>17.5</td>
<td>15,029,160</td>
<td>2,630,103</td>
</tr>
<tr>
<td>Currently smoking</td>
<td>17</td>
<td>238,918,622</td>
<td>40,616,166</td>
<td>14.2</td>
<td>15,029,160</td>
<td>2,134,141</td>
</tr>
<tr>
<td>Opioid misuse</td>
<td>4.6</td>
<td>238,918,622</td>
<td>10,933,000</td>
<td>3.7</td>
<td>15,029,160</td>
<td>553,073</td>
</tr>
</tbody>
</table>

* BRFSS, Prevalence Rates, 2016 CDC Division of Population Health: Chronic Disease Indicators: Explore by Location: Crude Prevalence (%), Adults greater than or equal to 18
* prevalence (period rates expressed as % of population)
* based on 2016 US population age 18-84, US Census
* based on 2016 NYS population age 18-84, US Census
* SAMSHA, misuse opioids (heroin or prescription pain relievers) in the past year age 18 and over, 2016

### Conclusions

#### Mortality and Morbidity

Occupational disease remains a significant cause of death and illness in NYS. Our estimates demonstrate that the percentage of all death in NYS attributable to occupational illness ranges from 3.3-4.7%, with men experiencing more than twice the deaths as women. Also, over two million working people are experiencing work-related illness (13.2% of the total disease prevalence). Finally, an expanded definition of occupational disease should include highly prevalent conditions that contribute to workers’ lack of health, especially because the connections between work and health for these conditions are well-documented.

Using the Landrigan/Markowitz methodology, the proportion of annual deaths attributable to occupational causes is actually higher than the proportion they found in the 1980’s. Not surprisingly, using an expanded definition of occupational disease based on Nurminen and Karjalainen’s work yields an estimate of occupational disease-related deaths 57% higher than the estimate using Landrigan/Markowitz methods.

Non-fatal occupational diseases are also quite prevalent in New York State. Roughly half of the cases are musculoskeletal conditions due to chronic exposure to work characterized by some combination of repetition, forceful movements, awkward postures, and vibration. Only a relative few of the total types of musculoskeletal diagnoses were included due to limitations in available data. Consequently, despite the high prevalence, the estimate is likely to be a substantial underestimate. This underscores the importance of these types of conditions in the current landscape of work.
More than three quarters of the illnesses originate in the musculoskeletal, respiratory, and nervous systems. Respiratory conditions included asthma, pneumoconiosis, chronic obstructive lung disease (COPD) and interstitial lung disease, all of which have well known connections to various workplace exposures. The prominence of nervous system conditions is driven by the high prevalence of hearing loss.

The actual prevalence of work-related mental health conditions is likely severely underestimated by this data. Clinical experience evaluating individuals with work-related illness over a period of many years demonstrates the widespread occurrence of mental health issues. These can occur as a direct result of the nature of the work itself, or as a consequence of being diagnosed with another occupational disease and all of the implications (social, financial, job and career) that entails. These effects are important in terms of their impact on the individual, but may not conform to the diagnostic criteria of a 'mental illness', or may not be formally recognized and diagnosed by the treating clinician.

A broadened definition of occupational disease allows for an exploration of how work may contribute to the major health challenges faced by modern society. For example, hypertension is a major risk factor for heart attack and stroke and is highly prevalent, especially among men, Black men in particular, with age-adjusted rates for White and Black men reaching 26.5% and 30.3% respectively. Stressful psychosocial conditions of work have been identified as important contributors to the development of high blood pressure. Many causes have been hypothesized for the rapidly increasing prevalence of obesity and diabetes. Working conditions have appeared in the mix of factors considered, operating through several different potential mechanisms. Likewise, multiple mechanisms originating at work contribute to epidemic of substance abuse, including alcohol, tobacco, and opiates.

The extent of the role work plays in these conditions is debated and only relatively recently receiving research attention. Further exploration may reveal a significantly more important role for work in some, or all of these conditions. Tables 6 and 7 illustrate the large numbers of people potentially affected. From a public health perspective, an important conclusion of this report is that the contribution of work should be considered and investigated for all of the major modern health issues.
Chapter 2

ESTIMATING THE EXTENT OF HAZARDOUS WORK

What is an occupational hazard?

The traditional idea of a workplace hazard is closely coupled with the traditional definition of an occupational disease. A straightforward causal relationship between exposure to a hazard and a specific disease is envisioned. Hazardous exposures may include:

- Chemicals
- Metals
- Dusts: inorganic, organic
- Physical: ergonomics, noise, radiation
- Infectious/Biological
- Psychosocial (i.e. stress)

The extent and patterns of various hazardous exposures has changed dramatically in the United States. These changes reflect shifts in the broad outlines of the US economy as sectors traditionally identified as hazardous (e.g. manufacturing, agriculture) have faded in importance or make up a relatively small slice of the workforce (e.g. construction). In contrast, service jobs including education, health care, and food service, have increased. As a result, hazards such as poor ergonomics, indoor air contaminants, infections, and stress have become much more prevalent. Chemical exposures have not disappeared in these settings but are often intermittent and include cleaners, renovation or construction materials, pesticides, and exposures from adjoining offices or external sources.

It should not be inferred, however that ‘traditional’ hazards have ceased to exist. Hazardous sectors have shrunk but have not disappeared. Chemicals continue to be widely used, and new chemicals continue to be introduced into workplaces. For example the reporting of a number of bronchiolitis obliterans (‘popcorn lung’) cases in the mid 1990’s pulled the curtain back on the use of diacetyl and other potentially hazardous chemicals in a wide spectrum of workplaces including flavoring manufacturing, food production, and coffee roasting.

The example of coal dust and a recent resurgence in the occurrence of coal workers’ pneumoconiosis (CWP) is a reminder that ‘traditional’ exposures in ‘traditional’ settings should not be ignored. The incidence of CWP dropped as regulatory pressure reduced exposures and the shrinkage of the industry reduced the workforce. However, the coal seams remaining in unworked mining areas are thinner and require drilling and removal of more silica containing rock to get to. As a result, many are of the opinion that the increased exposure to silica is a key factor responsible for the spike in CWP. The lesson for other settings is that exposure is not necessarily static, and that hazards thought to be controlled in one context can change dramatically if the context changes.
In addition, ‘traditional’ hazards continue to be found in ‘new’ contexts. Silica exposure can be quite significant among workers fabricating and installing natural and artificial stone countertops, an increasingly popular product in both residential and commercial settings. Workers are exposed to isocyanates applying spray foam insulation in homes and other buildings. Many workers are employed in industries that clean up hazards that are no longer used or have been dumped indiscriminately such as asbestos or mercury. As these examples suggest, these exposure contexts are often small employers working in diffuse settings, in contrast to traditional manufacturing in a large centralized work setting.

Over the past 30 years, the psychosocial environment and workplace organization have received increased attention as sources of workplace hazards. In fact, stress and stressors often dominate discussions with workers in the large and fast-growing low-wage service sectors. The concept of ‘stress’ has been increasingly better defined, at least as far as identifying a variety of specific stressors. The imbalance between high psychological demands and low control over the work, and between effort expended on the job and rewards received are two of the dominant models of workplace stress. However, a range of other stressors not captured by these models have been identified including employment quality, discrimination, and degrading and disrespectful behavior by supervisors.

‘Precarity’ has also come to the fore as an important stressor. The idea of a lifelong job with wages and benefits high enough to support a middle-class lifestyle and build a nest egg for retirement has gone by the wayside. Job insecurity is now the norm and a growing portion of the workforce is employed without guarantee or even the likelihood of long term employment, decent or any benefits, full time work, or regular schedules. The growing number of temporary workers, day laborers, and many now included among the ‘self-employed’ are on the extreme end of the precarity spectrum. The heightened and chronic insecurity inherent in these job arrangements is suspected, and increasingly connected as a contributor to a range of health problems.

Connected to the idea that occupational disease is often multifactorial in origin, is the interaction of non-work and work hazards. As noted earlier, work and non-work life are not always neatly separable, and the worker who is stressed at work often takes that stress home, and the worker stressed at home brings that stress to work. The result in either case is stress that is reciprocally amplified. Adding to this complexity is the unknown way mixtures of hazards interact to affect risk and health, and how the accumulation of mixed exposures over a lifetime impact risk.

In this chapter we provide estimates for workers at risk of occupational disease in NYS from selected major hazards. By necessity, the methods used to make the estimates were quite disparate for each category of hazard, reflecting the disparate nature of available data. In addition, the list of hazards considered is partial and should not be construed as composing a comprehensive picture of hazard and risk.
Exposure to Hazardous Materials

Chemicals

A wide array of chemicals are used in New York’s workplaces, some with known toxicity, others benign, and many with incomplete or completely lacking toxicity profiles. Unfortunately, there are no systems in place in New York to track workplace chemical usage. However, Massachusetts has legislated the mandatory reporting of a portion of hazardous chemicals used in workplaces in the state. Their reports were used as a method of estimating usage of similar chemicals in New York State and the number of workers potentially exposed to these hazardous substances.

In 1989, Legislation in Massachusetts was passed “to promote safer and cleaner production that enhances the economic viability of Massachusetts firms”. In practice the Toxic Use Reduction Act (TURA) required employers who manufacture, process, or use hazardous chemicals to report that use to the state. Over 1400 chemicals are subject to reporting. A business is required to report if it manufactures or processes more than 25,000 pounds, or ‘otherwise uses’ 10,000 pounds of a chemical annually. Since reporting began businesses in Massachusetts have reported using roughly 250 chemicals on the list. In May 2020, a list of 1536 chemicals was released.

Methods

Data from the Toxics Use Reduction Institute (TURI) in Massachusetts was obtained for 2013 (the most recent year available) detailing the numbers and types of industries reporting chemical usage. The Standardized Industrial codes for the reporting businesses were re-coded into North American Industrial Classification (NAICS) codes. County Business Pattern (CBP) data was used to estimate the number of workers employed in those businesses in New York State.

Results

In New York, we estimated that 468,509 employees (about 5% of the total NYS workforce), work in 30,880 establishments with potential exposure to one or more of the hazardous chemicals reported to TURI. These results are further detailed in Table 8.

As expected, manufacturing accounts for 44% of potentially exposed workplaces and together with administrative and support and waste management and remediation services comprise over 60%. No other sector contributes more than 7% to the total with information, professional scientific and technical services, and utilities all hovering around that level.

Conclusions

The limitations of the data include factors that can lead to both under and over-estimates of exposure. The data assumes that all workers employed in the reporting industries are potentially exposed to the hazard which is highly unlikely. The proportion of workers exposed will vary from industry to industry and even from individual workplace to individual workplace. While this will result in an over-estimate of exposure there are a number of factors contributing to under-estimation.
<table>
<thead>
<tr>
<th>NAICS Sector</th>
<th>Description</th>
<th>Number of establishments</th>
<th>Number of paid employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Mining, Quarrying, and Oil and Gas Extraction</td>
<td>25</td>
<td>370</td>
</tr>
<tr>
<td>22</td>
<td>Utilities</td>
<td>511</td>
<td>34,231</td>
</tr>
<tr>
<td>31-33</td>
<td>Manufacturing</td>
<td>7,403</td>
<td>206,065</td>
</tr>
<tr>
<td>42</td>
<td>Wholesale Trade</td>
<td>4,356</td>
<td>26,944</td>
</tr>
<tr>
<td>48-49</td>
<td>Transportation and Warehousing</td>
<td>386</td>
<td>9,128</td>
</tr>
<tr>
<td>51</td>
<td>Information</td>
<td>1,260</td>
<td>32,736</td>
</tr>
<tr>
<td>52</td>
<td>Finance and Insurance</td>
<td>493</td>
<td>n/a</td>
</tr>
<tr>
<td>54</td>
<td>Professional, Scientific, and Technical Services</td>
<td>4,870</td>
<td>31,789</td>
</tr>
<tr>
<td>56</td>
<td>Administrative and Support and Waste Management and Remediation Services</td>
<td>6,245</td>
<td>82,634</td>
</tr>
<tr>
<td>71</td>
<td>Arts, Entertainment, and Recreation</td>
<td>1,663</td>
<td>23901</td>
</tr>
<tr>
<td>81</td>
<td>Other Services (except Public Administration)</td>
<td>3,668</td>
<td>20,711</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>30,880</strong></td>
<td><strong>468,509</strong></td>
</tr>
</tbody>
</table>

* As compared with Massachusetts industrial data (Toxics Use Reduction Institute, UMass Lowell)
* County Business Patterns (U.S. Census)

Exemptions for businesses with less than ten employees, trade secrets, and some sectors altogether (i.e. workers employed by the state, in education, and in construction) obscure potential hazards for a significant number of workers. In addition, there are undoubtedly businesses that use hazardous chemicals, but in an amount less than necessary to mandate reporting. This does not lessen the hazard for workers exposed in those industries, but does hide them from being counted. Another factor is that only 250 of 1400 hazardous chemicals on the TURI list were reportedly used in Massachusetts. As a result, there are no data on another 1150 chemicals potentially used in New York State. Finally, there are many more than 1400 chemicals being used in US workplaces, with new ones being introduced continuously. The toxicity data of any kind is lacking for many of these substances, while for others is too scanty to draw conclusions. There is no doubt that some proportion of these substances are hazardous to human health. Until there is laboratory or epidemiologic data, however, these substances will remain off the hazards list, leaving workers exposed to potentially harmful chemicals and uncounted.

The Landrigan/Markowitz report used two hazard index models to estimate the number of workers exposed in the most hazardous industries in the state. Neither of these models could be utilized to estimate current numbers of workers exposed to hazardous conditions as the data serving as the basis for the estimates has not been updated since the Landrigan/Markowitz report. Their estimates were 158,804 and 746,806 workers employed in the 50 most hazardous industries for the respective models. In contrast to our estimate, the Landrigan/Markowitz estimates include hazards of various types while ours includes only chemicals. Consequently, it is not possible to directly compare the numbers.

Despite the limitations of the data, however, the estimates indicate that hazardous exposures to chemicals and risk of occupational disease continues for a large number of workers in New York despite the changing landscape of work.
Lead

Lead has been known for centuries as a threat to human health.1,2 The nature of the threat has been refined over the last several decades with the understanding that adverse health effects are evident at much lower exposure levels than those previously deemed ‘safe’.3,4 The potential health impacts are myriad and include damage to the central and peripheral nervous systems, kidneys, cardiovascular system, reproduction, and increased cancer risk.5,6 Lead continues to be used in a variety of applications.7-15 Direct medical costs for occupational exposure to lead have been estimated to be $141 million annually in the U.S.16

Methods

In NYS, blood lead levels (BLLs) are reported to a central Heavy Metals Registry which in turn, reports to the national Adult Blood Lead Epidemiology and Surveillance (ABLES) program administered by the National Institute for Occupational Safety and Health (NIOSH).17 Elevated BLLs in New York, defined as levels greater than or equal to 10 micrograms per deciliter (µg/dl) were identified from this database, as was a subset of workers with BLLs greater than or equal to 25 µg/dl.18

Historically, adult BLL thresholds requiring a public health response were much higher. Until 2008, an adult BLL wasn’t considered “elevated” unless it was higher than 25 µg/dL. By 2010, it was generally accepted that adult BLLs ≥ 10 µg/dL were hazardous to human health. In 2015, NIOSH designated adult BLLs ≥ 5 µg/dL as the reference point, however NIOSH statistics report only on BLLs ≥ 10 µg/dL and ≥ 25 µg/dL.18

NIOSH also creates a National Occupational Research Agenda (NORA) which has developed a list of industries in which workers are likely to be at high risk of occupational lead exposure.19 Using county business patterns data we estimated the number of workers employed in these industries in NYS.20 The industries were grouped using NIOSH’s National Occupational Research Agenda’s (NORA) categories. County Business Patterns from 2014 were used to determine the number of establishments and their employees for the identified industries.

In addition, the ABLES program collects exposure source information on reported cases. The ABLES and NORA data were combined to estimate the prevalence of workers with BLLs greater than or equal to 25 µg/dl from the high-risk industries.

Results

Prevalence rates express the number of cases with elevated BLLs ≥ 10 µg/dL per 100,000 employed adults. In the United States, prevalence rates for BLLs ≥ 10 µg/dL have declined each year starting at 26.6 in 2010 and declining to 19.1 in 2014. As shown in Table 9, in 2014, the prevalence rate for elevated adult BLLs in NYS was 19.5 per 100,000 employed adults, just above the national average.
In the United States, prevalence rates for BLLs ≥ 25 µg/dL have declined each year starting at 7.0 in 2010 and declining to 4.5 in 2014. As shown in Table 10, in 2014, there were 246 cases of adult BLLs ≥ 25 µg/dL in NYS. The prevalence rate for adult BLLs was 2.5 per 100,000 employed adults, lower than the national average (4.5 per 100,000).

For the U.S., 76.4% of BLLs ≥ 25 µg/dL in adults were cases of occupational exposure, but a lower percentage, 70.3% of occupational cases were reported in NYS. (Table 10)

Individuals with BLLs ≥ 25 µg/dL were employed in a variety of settings as shown in Table 11. The number of workers at risk of lead overexposure in NYS is also illustrated in the table. Just under half of the elevated lead levels occurred in manufacturing industries including battery manufacturing, foundries, and metal products. Another quarter were employed in various construction trades. Services and mining industries were the source of just under another quarter of the reported cases. Over 300,000 workers are employed in these industries in NYS, just under half in construction and only about 7% percent in manufacturing.

### Table 9

<table>
<thead>
<tr>
<th>Division/State</th>
<th>Number of employed state-resident adults</th>
<th>BLL ≥10 µg/dL, all cases, number</th>
<th>BLL ≥10 µg/dL, all cases, rate</th>
<th>BLL ≥25 µg/dL, all cases, number</th>
<th>BLL ≥25 µg/dL, all cases, rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total U.S.†</td>
<td>99,806,197</td>
<td>18,453</td>
<td>19.1</td>
<td>4,461</td>
<td>4.5</td>
</tr>
<tr>
<td>New York</td>
<td>8,989,429</td>
<td>1,754</td>
<td>19.5</td>
<td>246</td>
<td>2.7</td>
</tr>
</tbody>
</table>

* An employed person aged ≥16 years at the time of blood collection. When an adult had multiple blood lead tests in a given year, only the highest blood lead level for that adult in that year was counted. Rate per 100,000 employed adults. Data from the Adult Blood Epidemiology and Surveillance (ABLES) Program, National Institute for Occupational Safety and Health (NIOSH/CDC). Denominators for 2014 extracted from 2015 U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics (LAUS) program (http://www.bls.gov/lau/staadata.txt).

§ The numbers and rates of adults with BLLs ≥25 µg/dL are subsets of the numbers and rates of adults with BLLs ≥10 µg/dL.

¶ All cases reported by a state. These include cases among adult residents in the reporting state plus cases identified by the reporting state but who reside in another state.

** Adults residing in the reporting state.

### Table 10

<table>
<thead>
<tr>
<th>Division/State</th>
<th>Occupational§, number</th>
<th>Occupational, percentage</th>
<th>Nonoccupational, number</th>
<th>Nonoccupational, percentage</th>
<th>Unknown, number</th>
<th>Unknown, percentage</th>
<th>Total, number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total U.S.†</td>
<td>3,408</td>
<td>76.4</td>
<td>207</td>
<td>4.6</td>
<td>846</td>
<td>19.0</td>
<td>4,461</td>
</tr>
<tr>
<td>New York</td>
<td>173</td>
<td>70.3</td>
<td>55</td>
<td>22.4</td>
<td>18</td>
<td>7.3</td>
<td>246</td>
</tr>
</tbody>
</table>

* An employed person aged ≥16 years at the time of blood collection. When an adult had multiple blood lead tests in a given year, only the highest blood lead level for that adult in that year was counted.

§ Includes 26 cases coded with both occupational and nonoccupational exposure source. State Adult Blood Epidemiology and Surveillance (ABLES) programs follow-up with laboratories, health care providers, employers, or workers to ensure completeness of information (e.g., the industry in which the adult is employed and whether the exposure source is occupational, nonoccupational, or both).

¶ Data not available.

<table>
<thead>
<tr>
<th>National Occupational Research Agenda (NORA) Sector</th>
<th>North American Industry Classification System (NAICS) Description</th>
<th>NAICS code</th>
<th>Numbers of Workers with BLL &gt; 25 µg/dL</th>
<th>Percent of workers with BLLs &gt;25 µg/dL in all NORA sectors</th>
<th>New York</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number of workers with BLL &gt; 25 µg/dL</td>
<td></td>
<td>Number of establishments</td>
<td>Paid employees</td>
</tr>
<tr>
<td>All NORA sectors</td>
<td>Grand total</td>
<td>1801</td>
<td>100.0</td>
<td></td>
<td>45,676</td>
<td>308,520</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Storage battery manufacturing</td>
<td>33591</td>
<td>340</td>
<td>38.9</td>
<td>9</td>
<td>1880</td>
</tr>
<tr>
<td></td>
<td>Nonferrous metal (except copper and aluminum) rolling, drawing, extruding, and alloying</td>
<td>33149</td>
<td>196</td>
<td>22.5</td>
<td>39</td>
<td>1861</td>
</tr>
<tr>
<td></td>
<td>Alumina and aluminum production and processing</td>
<td>33131</td>
<td>102</td>
<td>11.7</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonferrous metal foundries</td>
<td>33152</td>
<td>56</td>
<td>6.4</td>
<td>32</td>
<td>925</td>
</tr>
<tr>
<td></td>
<td>Other basic inorganic chemical manufacturing</td>
<td>32518</td>
<td>40</td>
<td>4.6</td>
<td>33</td>
<td>2087</td>
</tr>
<tr>
<td></td>
<td>All other fabricated metal product manufacturing</td>
<td>32999</td>
<td>33</td>
<td>3.8</td>
<td>211</td>
<td>6719</td>
</tr>
<tr>
<td></td>
<td>Other manufacturing industries</td>
<td>33999</td>
<td>106</td>
<td>12.1</td>
<td>328</td>
<td>7428</td>
</tr>
<tr>
<td></td>
<td>Total, manufacturing industries</td>
<td></td>
<td>873</td>
<td>48.5</td>
<td>671</td>
<td>20,900</td>
</tr>
<tr>
<td>Construction</td>
<td>Highway, street, and bridge construction</td>
<td>23731</td>
<td>131</td>
<td>29.1</td>
<td>465</td>
<td>8899</td>
</tr>
<tr>
<td></td>
<td>Painting and wall covering contractors</td>
<td>23832</td>
<td>97</td>
<td>21.6</td>
<td>2393</td>
<td>9937</td>
</tr>
<tr>
<td></td>
<td>Residential building construction</td>
<td>23611</td>
<td>65</td>
<td>14.4</td>
<td>13960</td>
<td>46826</td>
</tr>
<tr>
<td></td>
<td>Plumbing, heating, and air-conditioning contractors</td>
<td>23822</td>
<td>55</td>
<td>12.2</td>
<td>6718</td>
<td>55990</td>
</tr>
<tr>
<td></td>
<td>All other specialty trade contractors</td>
<td>23899</td>
<td>25</td>
<td>5.6</td>
<td>1858</td>
<td>7814</td>
</tr>
<tr>
<td></td>
<td>Site preparation contractors</td>
<td>23891</td>
<td>20</td>
<td>4.4</td>
<td>1638</td>
<td>11746</td>
</tr>
<tr>
<td></td>
<td>Other heavy and civil engineering construction</td>
<td>23899</td>
<td>17</td>
<td>3.8</td>
<td>183</td>
<td>5647</td>
</tr>
<tr>
<td></td>
<td>All other specialty trade contractors</td>
<td>23899</td>
<td>40</td>
<td>8.9</td>
<td>1858</td>
<td>7814</td>
</tr>
<tr>
<td></td>
<td>Total, construction industries</td>
<td></td>
<td>450</td>
<td>25.0</td>
<td>29,073</td>
<td>154,673</td>
</tr>
<tr>
<td>Services (except Public Safety)</td>
<td>All other amusement and recreation industries</td>
<td>71399</td>
<td>61</td>
<td>46.6</td>
<td>1097</td>
<td>7802</td>
</tr>
<tr>
<td></td>
<td>Automotive mechanical and electrical repair and maintenance</td>
<td>81111</td>
<td>14</td>
<td>10.7</td>
<td>5987</td>
<td>20573</td>
</tr>
<tr>
<td></td>
<td>Remediation services</td>
<td>56291</td>
<td>11</td>
<td>8.4</td>
<td>289</td>
<td>5898</td>
</tr>
<tr>
<td></td>
<td>Other services (except public safety industries)</td>
<td>71394</td>
<td>45</td>
<td>34.4</td>
<td>2320</td>
<td>56479</td>
</tr>
<tr>
<td></td>
<td>Total, services (except public safety) industries</td>
<td></td>
<td>131</td>
<td>7.3</td>
<td>9,693</td>
<td>90,752</td>
</tr>
<tr>
<td>Mining (except Oil &amp; Gas Extraction)</td>
<td>Copper, nickel, lead, and zinc mining</td>
<td>21223</td>
<td>61</td>
<td>96.8</td>
<td>1</td>
<td>733</td>
</tr>
<tr>
<td></td>
<td>Support activities for mining</td>
<td>21311</td>
<td>2</td>
<td>3.2</td>
<td>48</td>
<td>733</td>
</tr>
<tr>
<td></td>
<td>Total, mining industries</td>
<td></td>
<td>63</td>
<td>3.5</td>
<td>49</td>
<td>733</td>
</tr>
<tr>
<td></td>
<td>Other/missing</td>
<td></td>
<td>284</td>
<td>15.8</td>
<td>6,239</td>
<td>42,195</td>
</tr>
</tbody>
</table>

a An employed person aged ≥16 years at the time of blood collection. When an adult had multiple blood lead tests in a given year, only the highest blood lead level for that adult in that year was counted.

b Selected industries were the National Occupational Research Agenda (NORA) sectors with high with blood lead levels ≥25 µg/dL coded with North American Industry Classification System (NAICS) industry - State Adult Blood Lead Epidemiology and Surveillance (ABLES) programs, United States, 2014. NORA sectors consist of ten industry sectors based on major areas of the U.S. economy (https://www.cdc.gov/niosh/nora/sectorapproach.html).

c Data not available.
Limitations

In 2014, elevated BLLs were defined as >10 $\mu g$/dL, but NORA was defining high risk industries (and workers) as those with BLLs > 25 $\mu g$/dL, where workers with BLLs between 10 and 25 $\mu g$/dL were employed is unknown. If the distribution of lead overexposure is different than those with BLLs > 25 $\mu g$/dL, then our results would be an underestimate.

Conclusions

A substantial number of workers in NYS continue to be potentially exposed to lead at levels high enough to pose a health risk. The greatest number of the potentially lead exposed employees work in construction, particularly bridge work, and painting. “Traditional” lead exposed occupations in manufacturing industries are relatively lower in number but are disproportionately exposed to higher levels of lead.

Silica

Silica (silicon dioxide) is a mineral widely distributed and found in rocks, soil, and sand. It occurs in crystalline and non-crystalline forms. Quartz is by far the most common crystalline form. Crystalline forms of silica have been known for centuries to cause a scarring lung disease (silicosis).1-3 More recent research has implicated silicosis as a cause of lung cancer, kidney disease, autoimmune diseases like rheumatoid arthritis and scleroderma, and an increased risk of pulmonary tuberculosis.4-13

Historically, exposure to silica at work has been widespread, both as a contaminant and as a material used in production.14 Mining, milling, and construction work are well known sources of silica exposure.15-18 Abrasive blasting with sand on construction sites and in manufacturing is a particularly important exposure source.19-22 Silica exposure can also be found in specialized trades like cutting grave stones,23 jewelry manufacturing,24 and dental laboratories.25 Important sources of emerging exposures include hydraulic fracturing for natural gas,26-27 and the fabrication of artificial stone kitchen and bathroom counter tops.28-30

OSHA recently promulgated a Silica Standard reducing allowable exposure levels as significant numbers of workers continue to be exposed to hazardous levels of silica.31-32 As part of its justification for the Standard OSHA carried out a detailed assessment of the likely exposed workforce on a national level.33-35 Estimates for New York State were obtained utilizing a similar approach.
Methods

In the Preamble to the Silica Standard, OSHA presents silica exposure profiles for at-risk workers by sector and job category. Summary data are also provided for the number of workers in each affected industry who are currently exposed above the proposed silica PEL of 50 $\mu g/m^3$, as well as above an alternative PEL of 100 $\mu g/m^3$ for economic analysis purposes.$^{33-35}$

OSHA's analysis was applied to NYS employment data, from 2014, obtained through County Business Patterns to determine the number of affected employees at silica air levels: $\mu g/m^3 \geq 0, \geq 25, \geq 50, \geq 100, \text{ and } \geq 250$ within each occupation.

Results

Overall, we estimate that almost 100,000 workers are exposed to silica at work in New York State. Over 90% work in a construction industry, while the rest are in general industry. The distribution of silica exposure among specific industries is illustrated in Tables 12 and 13.

In terms of the number of workers exposed, State and Local government workers were far and away the largest category making up 36% of the total number of construction workers. Building construction including residential, non-residential, finishing, foundation/structure/exterior, and other specialties comprised another 46% of the construction sector.

The General Industry workers were scattered over a much larger list of types of workplaces, though more than half were employed in jewelry and silverware manufacturing, dental laboratories, or ready mixed concrete manufacturing. Foundry work, a well-known source of silica exposure, employs a relatively small number of workers in the state (though numbers were not available for iron and steel foundries).

With regard to severity of exposure, a significant proportion of exposures are above OSHA's Action Level of 25 $\mu g/m^3$ and at high risk of disease. Forty percent of workers in the Construction sectors are exposed above the Action Level with nine percent exposed to levels more than ten times the Action Level. In General Industry half the workers are exposed above the Action Level with 14% exposed at the highest level.

Among the Construction industries, Foundation, Structure and Building Exterior Contractors stood out with 71% of workers exposed above the Action level and 24% exposed at the highest level. Workers in this category made up 17% of the total number of workers in the Construction sector but 31% of workers exposed above the Action Level and 48% of workers exposed at the highest level.
Of the seven industry types with the most silica exposed workers in General Industry, Ready mixed concrete manufacturing employed 11%, but was responsible for 56% of the highest-level exposures. It should be noted that Aluminum and Nonferrous metal foundries employ a relatively few numbers of workers, but the percent exposed above the Action Level (92% and 76% respectively) and at the highest level of exposure (23% and 10%) are disproportionately high. These results indicate that foundry work remains a significant source of exposure for workers employed in these settings.

Conclusions

Almost 100,000 workers in New York continue to be exposed to silica and are at risk of developing silicosis and other silica-related diseases, according to our analyses. As anticipated, construction work of various types is the most important setting for silica exposure. Foundry work, while employing a relatively small number of workers, carries a high risk of disease due to high exposure levels. The emergent artificial stone countertop fabrications and installation industry is a growing source of concern with regard to silica exposure.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Establishments</th>
<th>Number of Employees</th>
<th>Percent of Total Employees Affected</th>
<th>Number of Affected Employees</th>
<th>&gt;=0</th>
<th>&gt;=25</th>
<th>&gt;=50</th>
<th>&gt;=100</th>
<th>&gt;=250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>667,099</td>
<td>20,032,076</td>
<td>0.076</td>
<td>2,827,321</td>
<td>1,526,647</td>
<td>310,201</td>
<td>347,883</td>
<td>312,329</td>
<td>330,261</td>
</tr>
<tr>
<td>General Industry and Maritime</td>
<td>234,467</td>
<td>3,983,834</td>
<td>0.023</td>
<td>214,964</td>
<td>91,394</td>
<td>38,150</td>
<td>29,399</td>
<td>22,632</td>
<td>33,389</td>
</tr>
<tr>
<td>Totals</td>
<td>901,566</td>
<td>24,015,910</td>
<td>0.067</td>
<td>3,042,285</td>
<td>1,618,041</td>
<td>348,351</td>
<td>377,282</td>
<td>334,961</td>
<td>363,650</td>
</tr>
<tr>
<td>Construction</td>
<td>46,446</td>
<td>1,388,571</td>
<td>0.038</td>
<td>88,435</td>
<td>53,427</td>
<td>9,037</td>
<td>10,054</td>
<td>8,184</td>
<td>7,734</td>
</tr>
<tr>
<td>General Industry and Maritime</td>
<td>13,843</td>
<td>133,223</td>
<td>0.032</td>
<td>8,312</td>
<td>4,207</td>
<td>1,216</td>
<td>926</td>
<td>836</td>
<td>1,127</td>
</tr>
<tr>
<td>Totals</td>
<td>60,289</td>
<td>1,521,794</td>
<td>0.038</td>
<td>96,747</td>
<td>57,633</td>
<td>10,252</td>
<td>10,981</td>
<td>9,020</td>
<td>8,861</td>
</tr>
</tbody>
</table>

c Source: Table III–5 and the technological feasibility analysis presented in Chapter IV of the Preliminary Economic Analysis and Initial Regulatory Flexibility Analysis, Supporting document for the Notice of Proposed Rulemaking for Occupational Exposure to Crystalline Silica, 2013
<table>
<thead>
<tr>
<th>NAICS 2012 Industry</th>
<th>Industry</th>
<th>% &gt; 25 within industry</th>
<th># &gt;25</th>
<th>% &gt;25 of total &gt;25</th>
<th>% &gt;250 within industry</th>
<th># &gt;250</th>
<th>% &gt;250 of total &gt;250</th>
<th># of employees</th>
<th>% total affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>999000</td>
<td>State and local governments</td>
<td>71%</td>
<td>10,842</td>
<td>31%</td>
<td>24%</td>
<td>3,707</td>
<td>48%</td>
<td>15,443</td>
<td>17%</td>
</tr>
<tr>
<td>238100</td>
<td>Foundation, Structure and Building Exterior Contractors</td>
<td>32%</td>
<td>3,061</td>
<td>9%</td>
<td>5%</td>
<td>481</td>
<td>6%</td>
<td>9,626</td>
<td>11%</td>
</tr>
<tr>
<td>238900</td>
<td>Other Specialty Trade Contractors</td>
<td>48%</td>
<td>3,831</td>
<td>11%</td>
<td>12%</td>
<td>946</td>
<td>12%</td>
<td>8,029</td>
<td>9%</td>
</tr>
<tr>
<td>236200</td>
<td>Nonresidential Building Construction</td>
<td>35%</td>
<td>2,127</td>
<td>6%</td>
<td>4%</td>
<td>271</td>
<td>4%</td>
<td>6,023</td>
<td>7%</td>
</tr>
<tr>
<td>237100</td>
<td>Utility System Construction</td>
<td>29%</td>
<td>1,600</td>
<td>5%</td>
<td>4%</td>
<td>204</td>
<td>3%</td>
<td>5,607</td>
<td>6%</td>
</tr>
<tr>
<td>237300</td>
<td>Highway, Street, and Bridge Construction</td>
<td>41%</td>
<td>2,141</td>
<td>6%</td>
<td>12%</td>
<td>642</td>
<td>8%</td>
<td>5,223</td>
<td>6%</td>
</tr>
<tr>
<td>238300</td>
<td>Building Finishing Contractors</td>
<td>28%</td>
<td>809</td>
<td>2%</td>
<td>3%</td>
<td>86</td>
<td>1%</td>
<td>2,932</td>
<td>3%</td>
</tr>
<tr>
<td>237900</td>
<td>Other Heavy and Civil Engineering Construction</td>
<td>58%</td>
<td>1,565</td>
<td>4%</td>
<td>14%</td>
<td>364</td>
<td>5%</td>
<td>2,682</td>
<td>3%</td>
</tr>
<tr>
<td>236100</td>
<td>Residential Building Construction</td>
<td>33%</td>
<td>393</td>
<td>1%</td>
<td>6%</td>
<td>71</td>
<td>1%</td>
<td>1,187</td>
<td>1%</td>
</tr>
<tr>
<td>238200</td>
<td>Building Equipment Contractors</td>
<td>27%</td>
<td>22</td>
<td>0%</td>
<td>2%</td>
<td>2</td>
<td>0.03%</td>
<td>82</td>
<td>0%</td>
</tr>
<tr>
<td>237200</td>
<td>Land Subdivision</td>
<td>35,009</td>
<td>100%</td>
<td>7,734</td>
<td>100%</td>
<td>88,435</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Industry and Maritime</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>339910</td>
<td>Jewelry and Silverware Manufacturing</td>
<td>63%</td>
<td>1,073</td>
<td>29%</td>
<td>13%</td>
<td>214</td>
<td>20%</td>
<td>1,712</td>
<td>22%</td>
</tr>
<tr>
<td>339116</td>
<td>Dental Laboratories</td>
<td>16%</td>
<td>270</td>
<td>7%</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>1,674</td>
<td>22%</td>
</tr>
<tr>
<td>327320</td>
<td>Ready mixed Concrete manufacturing</td>
<td>75%</td>
<td>697</td>
<td>19%</td>
<td>67%</td>
<td>629</td>
<td>59%</td>
<td>935</td>
<td>12%</td>
</tr>
<tr>
<td>327390</td>
<td>Other Concrete Product Manufacturing</td>
<td>50%</td>
<td>281</td>
<td>8%</td>
<td>8%</td>
<td>47</td>
<td>4%</td>
<td>560</td>
<td>7%</td>
</tr>
<tr>
<td>327991</td>
<td>Cut stone and stone product manufacturing</td>
<td>85%</td>
<td>413</td>
<td>11%</td>
<td>10%</td>
<td>50</td>
<td>5%</td>
<td>484</td>
<td>6%</td>
</tr>
<tr>
<td>327110</td>
<td>Pottery, ceramics, and plumbing fixture manufacturing</td>
<td>76%</td>
<td>282</td>
<td>8%</td>
<td>8%</td>
<td>30</td>
<td>3%</td>
<td>370</td>
<td>5%</td>
</tr>
<tr>
<td>327120</td>
<td>Clay building material and refractories manufacturing</td>
<td>58%</td>
<td>207</td>
<td>6%</td>
<td>6%</td>
<td>20</td>
<td>2%</td>
<td>356</td>
<td>5%</td>
</tr>
<tr>
<td>Miscellaneous Other General Industry and Maritime</td>
<td>38%</td>
<td>498</td>
<td>13%</td>
<td>6%</td>
<td>69</td>
<td>7%</td>
<td>1,559</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Industry and Maritime</td>
<td>3,721</td>
<td>100%</td>
<td>1,059</td>
<td>100%</td>
<td>7,650</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron foundries</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel foundries</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum foundries</td>
<td>92</td>
<td>67</td>
<td>17%</td>
<td>23%</td>
<td>17</td>
<td>25%</td>
<td>73</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Other nonferrous metal foundries</td>
<td>76</td>
<td>95</td>
<td>25%</td>
<td>10%</td>
<td>14</td>
<td>21%</td>
<td>143</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>All other miscellaneous nonmetallic mineral product mfg</td>
<td>50</td>
<td>97</td>
<td>25%</td>
<td>8%</td>
<td>16</td>
<td>24%</td>
<td>194</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous other foundry</td>
<td>50</td>
<td>125</td>
<td>33%</td>
<td>8%</td>
<td>21</td>
<td>31%</td>
<td>252</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>39,114</td>
<td>100%</td>
<td>8,861</td>
<td>100%</td>
<td>96,747</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Asbestos**

Asbestos is the name given to a group of naturally occurring minerals including chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite. They are valued for their heat and corrosion resistant properties and, since the late 19th century have been used in thousands of products across the globe.\(^1\) \(^2\) Though the health risks of asbestos exposure were known within the industry and scientific community for decades,\(^3\)-\(^9\) the work of Selikoff and associates in the 1960s brought these risks to much wider public attention.\(^10\)-\(^13\) These risks include asbestosis, lung cancer, mesothelioma, and other cancers.\(^14\)-\(^21\)

Asbestos manufacturing and use declined precipitously in the United States beginning in the mid-1970s (Figure 1), though asbestos mining, manufacturing and use continues in many parts of the world, particularly in the Global South. Observers have described waves of asbestos exposure in the United States:\(^22\)

1) Asbestos mining and milling, manufacture into products
2) Use of asbestos containing products (e.g. pipe insulation, gaskets, brake shoes)\(^23\)-\(^24\)
3) Disturbance of asbestos in place\(^25\)-\(^27\)

![Figure 1. Apparent consumption of asbestos in the US from 1991 to 2018, Consumption in metric tons](https://www.usgs.gov/centers/nmic/asbestos-statistics-and-information)
For several decades, the disturbance of asbestos in place has been the primary source of exposure to asbestos for workers in NYS. Asbestos abatement has become an important business where workers engaged in this work are routinely handling asbestos. Others, such as building maintenance workers, HVAC installers and repair people, bridge workers, auto mechanics, and phone company installers, encounter asbestos irregularly. Their job activities require them to work in proximity to asbestos, or to disturb and remove the asbestos in order for them to access their work. The collapse of the World Trade Center in New York City following the terrorist attack of 9/11/2001 is a vivid example of how workers (and nearby residents and bystanders) can be exposed to a release of asbestos in place.

To date in the U.S., asbestos has not been fully banned, but significant regulatory activity has curtailed its manufacture, import, processing and distribution. Consumption has significantly reduced from about 3,500 metric tons per year to about 700 in 2018. Until 2007, Canada provided nearly all imported asbestos, but since then Brazilian imports have replaced Canadian, with Zimbabwe, Russia and other countries supplying small amounts.

Occupations at risk of asbestos exposure were identified by Nicholson, Perkel, and Selikoff (1982). They divided the industries into groups including:

1) Asbestos mining and milling
2) Asbestos primary manufacturing
3) Asbestos secondary manufacturing
4) Shipbuilding and repair
5) Construction
6) Electric, gas and combination utility services
7) Other occupational groups

Nicholson and colleagues’ estimates were based on 1970s exposures, when asbestos was still actively used in large amounts. Since those estimates and their associated jobs are no longer accurate for current exposures, new estimates would be required to pursue a realistic estimate in today’s conditions. The asbestos mining, milling, and manufacturing industries have essentially disappeared, and exposure in shipbuilding and repair would not be expected to be of significance.

As already noted, since the 1980s, exposure to asbestos has shifted to the disturbance of asbestos in place. This includes asbestos abatement workers, as well as a number of occupational groups not considered exposed in 1982 including building maintenance workers in schools and offices, communications workers disturbing asbestos as they install and service lines in buildings, and firefighters. In addition, some workers are exposed to relatively brief, accidental exposures such as those responding in various ways to the collapse of the World Trade Center towers following the attack of 9/11/01 or to various natural disasters. Exposure to asbestos in place continues among the construction trades, but it is quite variable and intermittent, depending on the trade and the specific job.
Other occupational groups with potential exposure to asbestos have been identified more recently including: lab workers, instrument technicians, sound recording technicians, ceramic industry workers, jewelry and silverware manufacturers, and electronic and precision equipment repairers.\textsuperscript{41-42}

\textbf{Conclusions}

Lack of more specific exposure information, and the extreme variability of exposure, both within, and between occupational groups severely constrains any attempt to quantitatively estimate asbestos exposure for workers in NYS. Qualitatively, a substantial number of workers continue to potentially be exposed in NYS. Asbestos was used so widely in a myriad of applications that it remains present in many industrial, commercial, and residential buildings. Construction workers (including asbestos abatement) are the largest group that potentially encounters asbestos on the job. Other workers tasked with installing, repairing, and maintaining boilers, pipes, communications equipment and other building-related materials and machinery are also at risk of exposure. Those responding to disasters like the World Trade Center attack, and workers in several relatively recently identified occupations make up another segment of the working population that should be included as potentially exposed.

\textbf{Ergonomic Hazards}

The incidence of musculoskeletal injuries involving the hands, arms, shoulder, neck, and back related to chronic overuse and other workplace factors increased dramatically in the United States in the 1980s and 1990s. These injuries occurred across a wide spectrum of occupations and injuries in all sectors of the economy. Specific job characteristics including repetitive motion, awkward postures, forceful movements, repetitive lifting, static postures, vibration, and work in cold temperatures have been associated with these types of injuries.\textsuperscript{1-12} Due to the pervasive nature of these hazards and the widespread prevalence of injury, health and safety advocates called for an OSHA ergonomics standard to better control the hazard. Though a standard was promulgated during the last days of the Clinton administration, it was immediately rescinded by Congress after the election of George W. Bush. One of the results was an end to the reporting of musculoskeletal disorders due to chronic use by employers to OSHA, removing one of the only sources reporting and tracking these types of conditions.\textsuperscript{13-14}

Clearly, work-related musculoskeletal conditions due to chronic use remain important causes of disability and estimation of workers at risk is an important piece of the overall hazard picture for the state and compensable claims in the workers’ compensation systems in the country continue to be driven by MSDs.\textsuperscript{15}
Methods

The O*NET Database 24.0 was utilized to estimate ergonomic exposures among NYS workers. This database obtains information from workers in a survey covering a broad range of issues related to working conditions. The questions include seven pertaining to ergonomic conditions. Answers are divided into low, medium, and high exposure categories. Each exposure category is rated on a 0-100 scale and the average for each occupational code is calculated. The data was last updated in August, 2019.

Estimates were produced using only the high hazard exposure category. The total number of workers at risk was calculated by multiplying the percentage of high exposure workers in each occupational category by the total number of workers in that occupation as identified in NYS County Business patterns data. The individual occupation totals were then summed to produce a grand total for each of the seven ergonomics-related survey questions. Definitions are provided for our analysis in Table 14.

Results

Results of our data exploration are detailed in Table 15. More than 40% of survey respondents reported frequent (more than half the time) activities requiring repetitive motion. Static postures were reported frequently with 36% sitting and 25% standing more than half the time. Significant percentages of respondents reported ‘bending or twisting the body’ (21%), and ‘kneeling, crouching, stooping, crawling’ (10%). The numbers of workers reporting at least one of these hazards were large, ranging from just over one million to over four million. Fourteen percent of respondents reported exposure to ‘cramped work space, awkward positions’ at a lower level of exposure (once a week or more).

Limitations

The following limitations in the data should be noted.

1. A limited number of ergonomic factors were investigated.
2. The data was self-reported and not supplemented with any direct observations of the work.
3. Low and medium level hazards were excluded, even though they could pose a health risk.
4. The data did not allow for determinations of patterns of exposure among groups of workers as each risk factor was calculated individually. It is likely that many workers reported exposure to more than one ergonomic hazard.
5. In addition, musculoskeletal injuries related to ergonomic hazards include the hands, arms, shoulders, back, neck, and sometimes the legs. Different risk factors may be operational for different parts of the body, but there is also significant overlap. Most of the risk factors asked by O*NET pertain more to the back and neck than the upper extremities. Sitting, kneeling/crouching/stooping/crawling, and bending/twisting are all more back and possibly neck-related hazards. Standing for prolonged periods may also strain the back, neck and in addition, the legs. Repetitive motion is often associated with hand and arm use, though it may also refer to jobs requiring repetitive lifting. It is also unknown whether respondents distinguished between the repetitive motion question and those asking about bending/twisting, kneeling/crouching/stooping/crawling. Those are repetitive activities as well and those reporting repetitive motion may have been referring once again to the activities asked about in other questions.

6. Missing data is attributed to coding differences (11.6%) and data suppression per regional, state and federal analysts (5.1%).

The impact of individual limitations including the limited number of ergonomic factors investigated, and the exclusion of low and medium level hazards, contributes to an underestimate of incidence. The data should be interpreted as providing a partial picture.

Conclusions

The use of the O*NET data indicates a large number of workers in NYS are exposed to ergonomic hazards and at risk of musculoskeletal injury. A significant proportion are at risk of back and neck injury. Estimating the number of workers at risk of upper extremity injury is hampered by the lack of specific questions in the O*NET survey.
### TABLE 14 Exposure Definitions and Thresholds

<table>
<thead>
<tr>
<th>Category/Hazard</th>
<th>Exposure</th>
<th>Definition</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ergonomic</td>
<td>Spend time bending or twisting the body</td>
<td>Bending or twisting the body</td>
<td>More than half the time</td>
</tr>
<tr>
<td></td>
<td>Cramped work space, awkward positions</td>
<td>Working in cramped spaces that require getting into awkward positions</td>
<td>Once a week or more</td>
</tr>
<tr>
<td></td>
<td>Spend time kneeling, crouching, stooping, or crawling</td>
<td>Kneeling, crouching, stooping, or crawling</td>
<td>More than half the time</td>
</tr>
<tr>
<td></td>
<td>Spend time making repetitive motions</td>
<td>Makes repetitive motions</td>
<td>More than half the time</td>
</tr>
<tr>
<td></td>
<td>Spend time sitting</td>
<td>Time spent sitting</td>
<td>More than half the time</td>
</tr>
<tr>
<td></td>
<td>Spend time standing</td>
<td>Time spent standing</td>
<td>More than half the time</td>
</tr>
<tr>
<td></td>
<td>Exposed to whole body vibration</td>
<td>Exposure to whole body vibration (such as operating a jackhammer)</td>
<td>Once a week or more</td>
</tr>
</tbody>
</table>

### TABLE 15 Number and percent of workforce with ergonomic exposures\(^{a}\) in New York State\(^{b}\), 2016

<table>
<thead>
<tr>
<th>Ergonomic Exposures</th>
<th>Frequency</th>
<th>Total Workforce</th>
<th>Percent Total Workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cramped work space, awkward positions</td>
<td>once a week or more</td>
<td>1,405,694</td>
<td>14</td>
</tr>
<tr>
<td>Exposed to whole body vibration</td>
<td>once a week or more</td>
<td>341,983</td>
<td>3</td>
</tr>
<tr>
<td>Bending or twisting the body</td>
<td>more than half the time</td>
<td>2,118,286</td>
<td>21</td>
</tr>
<tr>
<td>Kneeling, crouching, stooping, crawling</td>
<td>more than half the time</td>
<td>1,004,493</td>
<td>10</td>
</tr>
<tr>
<td>Make repetitive motions</td>
<td>more than half the time</td>
<td>4,199,291</td>
<td>41</td>
</tr>
<tr>
<td>Sitting</td>
<td>more than half the time</td>
<td>3,696,184</td>
<td>36</td>
</tr>
<tr>
<td>Standing</td>
<td>more than half the time</td>
<td>2,582,123</td>
<td>25</td>
</tr>
</tbody>
</table>

\(^{a}\) SOC-O*NET Codes

\(^{b}\) Statewide Long-term Occupational Projections for New York State, number employed reported in thousands, https://www.labor.ny.gov/stats/lsproj.shtm
<table>
<thead>
<tr>
<th>Category/Hazard</th>
<th>Exposure</th>
<th>Definition</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychosocial</td>
<td>Level of competition</td>
<td>Presence of competing on the job or aware of competitive pressures</td>
<td>High (4 or 5 on a 5-point scale)</td>
</tr>
<tr>
<td></td>
<td>Frequency of conflict situations</td>
<td>Frequency of conflict situations worker has to face in the job</td>
<td>Once a week or more</td>
</tr>
<tr>
<td></td>
<td>Frequency of decision making</td>
<td>Frequency of decisions affecting other people, financial resources, and/or reputation of the organization</td>
<td>Once a week or more</td>
</tr>
<tr>
<td></td>
<td>Freedom to make decisions</td>
<td>Degree of decision making freedom in the job</td>
<td>Some freedom</td>
</tr>
<tr>
<td></td>
<td>Deal with physically aggressive people</td>
<td>Deal with physical aggression of violent individuals</td>
<td>Once a week or more</td>
</tr>
<tr>
<td></td>
<td>Highly structured work</td>
<td>Degree to which job is structured for worker versus allowing worker to determine tasks, priorities, goals</td>
<td>Some freedom</td>
</tr>
<tr>
<td></td>
<td>Time pressure</td>
<td>Need to meet strict deadlines</td>
<td>Once a week or more</td>
</tr>
<tr>
<td></td>
<td>Atypical work schedule</td>
<td>Regularity of work schedule for the job</td>
<td>Irregular or seasonal</td>
</tr>
<tr>
<td></td>
<td>Duration of typical work week</td>
<td>Number of hours typically worked in one week</td>
<td>Less than or more than 40 hours</td>
</tr>
</tbody>
</table>

**TABLE 17 Number and percent of workforce with psychosocial exposures in New York State, 2016**

<table>
<thead>
<tr>
<th>Ergonomic Exposures</th>
<th>Frequency</th>
<th>Total Workforce</th>
<th>Percent Total Workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular Work Schedule</td>
<td></td>
<td>1,993,898</td>
<td>20</td>
</tr>
<tr>
<td>Deal with physically aggressive people</td>
<td>once a week or more</td>
<td>893,740</td>
<td>9</td>
</tr>
<tr>
<td>Work more or less than 40 hours/week</td>
<td></td>
<td>5,685,533</td>
<td>56</td>
</tr>
<tr>
<td>Limited freedom to make decisions</td>
<td></td>
<td>2,605,112</td>
<td>26</td>
</tr>
<tr>
<td>Frequent Conflict Situations</td>
<td>once a week or more</td>
<td>3,780,731</td>
<td>37</td>
</tr>
<tr>
<td>Required to make decisions</td>
<td>once a week or more</td>
<td>2,728,777</td>
<td>27</td>
</tr>
<tr>
<td>Highly structured work</td>
<td></td>
<td>2,503,968</td>
<td>25</td>
</tr>
<tr>
<td>Highly competitive workplace</td>
<td></td>
<td>3,350,225</td>
<td>33</td>
</tr>
<tr>
<td>Under time pressure</td>
<td></td>
<td>6,020,802</td>
<td>59</td>
</tr>
</tbody>
</table>

a SOC-O*NET Codes  
b Statewide Long-term Occupational Projections for New York State, number employed reported in thousands, https://www.labor.ny.gov/stats/lsproj.shtm
Psychosocial Hazards: Exposure to Work-related Stress

Over the past several decades psychosocial stressors at work have received increased attention as hazards associated with disease and illness, both physical and mental. During that time the definition of stress has been better delineated, though no single definition has been universally accepted.1-3 However, widespread agreement continues to develop about some of the specific characteristics that make a workplace stressful including:

- Work that is highly psychologically demanding1
- Lack of control over decision-making1
- Inadequate social supports2
- Effort-reward imbalance3
- Hostile environments- bullying, disrespect by supervisors4
- Relations with clients and customers4
- Precarious employment arrangements5
- Discrimination6

There have also been attempts to synthesize these individual elements into a more holistic model that puts the individual worker in their institutional and macro context.7-9

Not surprisingly, there is little data to tap for use in estimating workers laboring under stressful conditions. The O*Net database 24.0, was used to estimate psychosocial stressors.10-11

Methods

The O*NET Database 24.0 obtains information from workers in a survey covering a broad range of issues related to working conditions. The questions include nine pertaining to psychosocial stressors. Answers are divided into low, medium, and high exposure categories. Each exposure category is rated on a 0-100 scale and the average for each occupational code is calculated. The data was last updated in August, 2019.

Our estimates were produced using only the high hazard exposure category. The total number of workers at risk was calculated by multiplying the percentage of high exposure workers in each occupational category by the total number of workers in that occupation as identified in NYS County Business Patterns data.12 The individual occupation totals were then summed to produce a grand total for each of the nine psychosocial-related survey questions.10-11 Definitions are provided in Table 16.

Results

Responses to the nine O*NET survey questions we analyzed are shown in Table 17. Work schedules of more or less than the standard 40-hour week considered full time are reported by more than half the workforce (5,685,533 workers). Irregular work schedules (20%), limited freedom to make decisions (26%), highly structured work (25%), highly competitive workplace (33%) and under time pressure (59%) may all reflect a lack of control over workplace activities and conditions, and each was reported by a significant segment of the workforce. A large proportion of workers reported frequent conflict situations (37%), and a smaller proportion
reported having to deal with physically aggressive people (9%). These percentages translate into large numbers of workers (excluding those reporting dealing with physically aggressive people) ranging from over 1.9 million to over 6 million.

Limitations

Some of the same limitations of the O*NET data noted for the ergonomics exposures apply to the psychosocial variables. These include:

1) A limited set of psychosocial stressors
2) An inability to assess how the stressors interact or occur in patterns on specific jobs
3) A limiting of workers at risk to those reporting on the highest exposure frequency.
4) One of the stressors (Deal with physically aggressive people) is limited to only a portion of the spectrum of workplace violence.
5) Missing data is attributed coding differences (11.6%) and data suppression per regional, state and federal analysts (5.1%).

The limitations, overall, suggest that we have underestimated the number of people working under stressful conditions.

Conclusions

Even the partial picture provided by the O*NET data suggests that a large proportion of the workforce labors under stressful working conditions that could have an adverse impact on their physical and mental health. An accurate count might find that well over a majority of New York’s workers are at risk from this category of hazard.

COVID-19 and Infectious Disease in the Workplace

While infectious diseases that are airborne (e.g. tuberculosis), blood borne (e.g. Hepatitis B and C, HIV), and fecal orally transmitted (e.g. Hepatitis A, Clostridium Dificile) have long been recognized as workplace risks, the COVID-19 pandemic has brought the risk of workplace exposure and infection to universal attention.

The major route of exposure to the COVID-19 virus is through inhalation of virus particles, though hand to nose or mouth exposure via direct contact with virus contaminated surfaces may play a relatively minor role. Accumulating evidence points to the role of both large droplet and smaller aerosolized particles in causing infection.

In the workplace there are several pathways for the virus to spread:

1) Workers may be directly infected by patients or clients they serve
2) Workers may spread the infection to each other
3) Workers may spread the infection to the patients or clients they serve.
In addition, the nature of the infection and its transmission blurs the lines between work and community/home environments. Workers may be infected at home and then bring it to work infecting co-workers and patient/clients. Conversely, workers may be infected at work and bring the infection home to their families and community, who may, in turn spread it to their co-workers.\(^7\)\(^-\)\(^\text{12}\)

There are other ways work can contribute to risk of COVID-19 infection. Low wages and lack of paid sick time make it impossible for workers to miss work when sick, or when exposed and needing to quarantine.\(^13\)\(^-\)\(^\text{19}\) Large outbreaks have been documented among migrant farm workers whose working conditions may be less hazardous then their employer provided housing which puts them in very close proximity to each other in cramped quarters.\(^20\)\(^-\)\(^\text{23}\) In this situation, working conditions dictate housing/living conditions that put workers at risk.

Somewhat less directly, a high percentage of workers in NYS are employed in low-wage settings, many with routine direct contact with patients/clients, and often without adequate employer provision of protective measures, but with a mandate to keep working throughout the pandemic because their work has been deemed ‘essential’.\(^13\)\(^-\)\(^\text{18}\) Low wages also contribute to higher density living conditions with less ability to social distance and control the potential of infection being brought in and spread through the household.\(^7\)\(^-\)\(^\text{12}\)

As noted in the following section, low-wage jobs are disproportionately held by people of color and the COVID-19 pandemic has struck these communities disproportionately hard. It is likely that work has contributed to these inequities. There was little or no monitoring of the workplace during the early months of the crisis. Lack of personal protective equipment was a constant issue among lower paid staff, especially in health care settings.\(^24\)\(^-\)\(^\text{36}\)

\textit{Estimating workers at risk of COVID-19 infection at the workplace}

 Attempts to estimate the number of workers at increased risk of COVID-19 suffer from a variety of difficulties, of which two are key. The first is that COVID-19 is a novel infectious agent and a priori assumptions about who is at risk have yet to be extensively tested through experience. A logical and widely used assumption is that the frequency a worker comes into contact with potentially infected people, and the closer the job requires them to work to the potentially infected person is a reasonable indication of risk. Initial studies have suggested the validity of this assumption and its usefulness as a predictor. However, the studies also suggest that there are clearly additional factors at play determining risk.

The second is that information about a COVID-19 patient’s occupation is rarely collected. This is a huge handicap for attempts to assess risk. Researchers are forced to rely on the records from the rare state that does collect occupational information, or to limit themselves to looking at death certificates for individuals who have died of COVID-19, both of which provide only a partial picture. Researchers could attempt to retrospectively obtain occupational information from COVID-19 patients through direct contact but this would require significant funding, personnel, and time.\(^37\)
As a consequence of these difficulties, to date there are only a handful of studies that have attempted to identify and quantify workers at increased risk of occupational COVID-19 infection. Despite non-uniform definitions and study designs, there is significant consistency in the studies’ findings that allows some conclusions to be drawn.

As might be expected, health care workers are at increased risk. The risk is not equal, however for all categories of health care workers. Table 18 predicts prevalence for categories of health care workers at higher risk of COVID-19 infection.

Beyond health care, a wide swath of workers are employed in occupations that put them at increased risk of COVID-19 infection. Table 19 lists the broad categories identified in one study and estimates mortality. This list overlaps with the list of ‘essential’ workers as defined by NYS. Many of these workers continued to work throughout the pandemic at their usual worksites.

Conclusions

At the end of March 2021, NYS had sustained 1.82 million confirmed cases with 49,305 deaths from COVID-19. Even though NYS’s vaccination rate is nearly 70%, by September 1st, the total of confirmed cases was 2.3 million with over 54,300 deaths. The pandemic continues with significant morbidity and mortality, primarily due to the strength of the Delta Variant. Premature returns to social ‘normalcy’ and vaccine hesitancy also factors in the current resurgence of disease. Workers experiencing “long-Covid” are an increasing concern.

A very high proportion of workers in NYS are employed in jobs deemed ‘essential’ and at high risk of COVID-19 infection. In addition, it is important to note the disproportionate burden of COVID-19 infection and mortality borne by Black and Latinx communities, to which work is contributing.

Finally, a unique feature of a highly infectious disease spread primarily through exposure through inhalation of virus, is the risk of carrying a workplace infection home and vice versa. Consequently, the population at risk is comprised not only of workers directly present in the workplace, but also their families, friends and other contacts in the community.
### TABLE 18 Estimated individual health care occupations at highest risk for COVID-19, NYS, 2019

<table>
<thead>
<tr>
<th>SOC Code</th>
<th>Occupation</th>
<th>Predicted Prevalence Ratio</th>
<th>95% Confidence Interval</th>
<th>Employed in NYS</th>
<th>Predicted cases</th>
<th>Low range</th>
<th>High range</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-1292.00</td>
<td>Dental hygienists</td>
<td>2.71</td>
<td>1.28 4.13</td>
<td>11620</td>
<td>315</td>
<td>149</td>
<td>480</td>
</tr>
<tr>
<td>29-1022.00</td>
<td>Oral and maxillofacial surgeons</td>
<td>2.67</td>
<td>1.26 4.07</td>
<td>360</td>
<td>10</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>31-9091.00</td>
<td>Dental assistants</td>
<td>2.64</td>
<td>1.24 4.05</td>
<td>19,520</td>
<td>515</td>
<td>242</td>
<td>791</td>
</tr>
<tr>
<td>29-1021.00</td>
<td>Dentists, general</td>
<td>2.62</td>
<td>1.23 4.02</td>
<td>8,780</td>
<td>230</td>
<td>108</td>
<td>353</td>
</tr>
<tr>
<td>31-1132.00</td>
<td>Orderlies</td>
<td>2.61</td>
<td>1.22 4</td>
<td>3,070</td>
<td>80</td>
<td>37</td>
<td>123</td>
</tr>
<tr>
<td>29-1124.00</td>
<td>Radiation therapists</td>
<td>2.6</td>
<td>1.22 3.98</td>
<td>1,170</td>
<td>30</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>29-1218.00</td>
<td>Obstetricians and gynecologists</td>
<td>2.57</td>
<td>1.19 3.94</td>
<td>1,580</td>
<td>41</td>
<td>19</td>
<td>62</td>
</tr>
<tr>
<td>29-1126.00</td>
<td>Respiratory therapists</td>
<td>2.54</td>
<td>1.16 3.93</td>
<td>5,860</td>
<td>149</td>
<td>68</td>
<td>230</td>
</tr>
<tr>
<td>29-1062.00</td>
<td>Family and general practitioners</td>
<td>2.53</td>
<td>1.13 3.93</td>
<td>17,852</td>
<td>452</td>
<td>202</td>
<td>702</td>
</tr>
<tr>
<td>29-1141.00</td>
<td>Registered nurses</td>
<td>2.61</td>
<td>1.16 4.14</td>
<td>178,320</td>
<td>4,654</td>
<td>2,069</td>
<td>7,382</td>
</tr>
<tr>
<td>29-1024.00</td>
<td>Prosthodontists and other specialists</td>
<td>2.51</td>
<td>1.15 3.88</td>
<td>280</td>
<td>7</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>29-2034.00</td>
<td>Radiologic Technologists</td>
<td>2.52</td>
<td>1.16 3.88</td>
<td>12,620</td>
<td>318</td>
<td>146</td>
<td>490</td>
</tr>
<tr>
<td>29-1161.00</td>
<td>Nurse midwives</td>
<td>2.51</td>
<td>1.15 3.86</td>
<td>480</td>
<td>12</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>29-2040.00</td>
<td>Emergency medical technician and paramedics</td>
<td>2.51</td>
<td>1.15 3.88</td>
<td>18,610</td>
<td>467</td>
<td>214</td>
<td>722</td>
</tr>
<tr>
<td>29-1122.00</td>
<td>Occupational therapists</td>
<td>2.51</td>
<td>1.15 3.87</td>
<td>12,460</td>
<td>313</td>
<td>143</td>
<td>482</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td></td>
<td>292,582</td>
<td>7,593</td>
<td>3,424</td>
<td>11,907</td>
</tr>
</tbody>
</table>

### Estimation of individual nonhealthcare occupations at highest risk for COVID-19, NYS, 2019

<table>
<thead>
<tr>
<th>SOC Code</th>
<th>Occupation</th>
<th>Predicted Prevalence Ratio</th>
<th>95% Confidence Interval</th>
<th>Employed in NYS</th>
<th>Predicted cases</th>
<th>Low range</th>
<th>High range</th>
</tr>
</thead>
<tbody>
<tr>
<td>53-2031.00</td>
<td>Flight attendant</td>
<td>2.34</td>
<td>1.02 3.68</td>
<td>10,820</td>
<td>253</td>
<td>110</td>
<td>398</td>
</tr>
<tr>
<td>33-2011.01</td>
<td>Firefighters</td>
<td>2.21</td>
<td>0.94 3.5</td>
<td>14,050</td>
<td>311</td>
<td>132</td>
<td>492</td>
</tr>
<tr>
<td>53-3011.00</td>
<td>Ambulance drivers, attendants</td>
<td>2.17</td>
<td>0.90 3.6</td>
<td>990</td>
<td>21</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>39-5011.00</td>
<td>Barbers</td>
<td>2.1</td>
<td>0.76 3.7</td>
<td>1,790</td>
<td>30</td>
<td>14</td>
<td>66</td>
</tr>
<tr>
<td>25-2012.00</td>
<td>Kindergarten teachers, except special education</td>
<td>2.04</td>
<td>0.81 3.8</td>
<td>6,450</td>
<td>132</td>
<td>52</td>
<td>245</td>
</tr>
<tr>
<td>33-3012.00</td>
<td>Correctional officers and jailers</td>
<td>2</td>
<td>0.76 3.9</td>
<td>35,420</td>
<td>708</td>
<td>269</td>
<td>1381</td>
</tr>
<tr>
<td>33-1011.00</td>
<td>First-line supervisor of corrections officers</td>
<td>1.96</td>
<td>0.56 3.1</td>
<td>3,890</td>
<td>76</td>
<td>22</td>
<td>121</td>
</tr>
<tr>
<td>39-4031.00</td>
<td>Morticians, undertakers, and funeral directors</td>
<td>1.91</td>
<td>0.57 3.11</td>
<td>1,420</td>
<td>27</td>
<td>8</td>
<td>44</td>
</tr>
<tr>
<td>33-9093.00</td>
<td>Transportation security screeners</td>
<td>1.88</td>
<td>0.66 3.13</td>
<td>3,720</td>
<td>70</td>
<td>25</td>
<td>116</td>
</tr>
<tr>
<td>25-2051.00</td>
<td>Special education teachers, preschool</td>
<td>1.86</td>
<td>0.62 3.14</td>
<td>5,930</td>
<td>110</td>
<td>37</td>
<td>186</td>
</tr>
<tr>
<td>47-4071.00</td>
<td>Septic tank servicers and sewer pipe cleaners</td>
<td>1.83</td>
<td>0.63 3.15</td>
<td>1,570</td>
<td>29</td>
<td>10</td>
<td>49</td>
</tr>
<tr>
<td>39-4011.00</td>
<td>Embalmers</td>
<td>1.8</td>
<td>0.32 3.16</td>
<td>1,450</td>
<td>26</td>
<td>5</td>
<td>46</td>
</tr>
<tr>
<td>25-2053.00</td>
<td>Special education teachers, middle school</td>
<td>1.79</td>
<td>0.60 3.17</td>
<td>10,960</td>
<td>196</td>
<td>66</td>
<td>347</td>
</tr>
<tr>
<td>21-1093.00</td>
<td>Social and human service assistants</td>
<td>1.79</td>
<td>0.60 3.18</td>
<td>39,810</td>
<td>713</td>
<td>239</td>
<td>1266</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td></td>
<td>138,270</td>
<td>2,710</td>
<td>997</td>
<td>4,794</td>
</tr>
</tbody>
</table>

*Sources: Zhang 2021; bNYS Bureau of Labor*
## TABLE 19 Occupational groups at higher risk of COVID-19 infection, New York State, 2019

<table>
<thead>
<tr>
<th>SOC Occupation Group</th>
<th>Number of Workers</th>
<th>Mortality rate, per 100,000</th>
<th>Estimated deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation and materials moving</td>
<td>631,580</td>
<td>61</td>
<td>385</td>
</tr>
<tr>
<td>Food preparation and serving</td>
<td>768,040</td>
<td>30</td>
<td>230</td>
</tr>
<tr>
<td>Building and Grounds cleaning and maintenance</td>
<td>311,150</td>
<td>42</td>
<td>131</td>
</tr>
<tr>
<td>Production</td>
<td>328,630</td>
<td>45</td>
<td>148</td>
</tr>
<tr>
<td>Construction and Extraction</td>
<td>358,350</td>
<td>45</td>
<td>161</td>
</tr>
<tr>
<td>Installation maintenance and repair</td>
<td>318,830</td>
<td>21</td>
<td>67</td>
</tr>
<tr>
<td>Protective services</td>
<td>314,490</td>
<td>14</td>
<td>44</td>
</tr>
<tr>
<td>Personal care and services</td>
<td>262,220</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>Arts, design, entertainment, sports, and media</td>
<td>221,800</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td>Community and social services</td>
<td>198,410</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3,713,500</strong></td>
<td></td>
<td><strong>1,262</strong></td>
</tr>
</tbody>
</table>

Sources: aHawkins, Davis, Kriebel 2020; bNYS Bureau of Labor
Chapter 3

WORK AND INEQUALITIES OF HEALTH: UNEQUAL RISK OF OCCUPATIONAL DISEASE

Not all workers are at equal risk of injury or illness caused or contributed to by exposure to workplace hazards.1-13 As described above, some jobs are more hazardous than others, creating unequal risk of an injury or illness. Risk varies, however; even among jobs with relatively similar hazard profiles. Employers differ in the attention they give to health and safety, the extent to which they provide effective control measures, the rapidity with which they respond to suspected or identified safety and health issues, the training they provide employees on hazards and controls, and the way they deal with workers who are injured or ill.

The flip side of the coin is the influence and knowledge workers are able to marshal on their own behalf. A union provides at least the potential of collective power in the workplace, giving workers the ability to bargain and struggle in other ways for better working conditions.14-18 Even non-union workers who are trained to identify workplace hazards and know their rights and resources, are in a better position to achieve improvements in their working conditions compared to others without a similar level of knowledge.19 The support of worker oriented health and safety organizations in the community including Councils on Occupational Safety and Health (COSHs),20 occupational health clinics,21-22 and Workers’ Centers23-24 also can play an important role strengthening workers’ abilities to pursue health and safety goals.25-27

The larger political economic context plays a key role in determining how employers and workers ‘negotiate’ working conditions. The shift away from manufacturing has cost the country a large number of jobs, a high proportion of which were unionized.28-33 The threat of companies moving off shore or outsourcing work becomes an even more potent means of silencing worker demands in this context. Over the past several decades the balance of power has swung decidedly in employers’ favor.34-36 Low-wage jobs grow while middle income employment has disappeared. Unions have lost thousands of members and their ability to defend workers has weakened considerably.37

The larger context also powerfully structures who is able to access available jobs. Part of the legacy of discrimination of various types, including racial, gender, age, class, and sexual orientation has been to sort people into certain jobs and industries.38-46 Unsurprisingly low-wage, high risk jobs are disproportionately filled by Latinx and African-Americans.39-41 Women have historically been slotted into jobs that involve domestic work, care work, the education of children, customer service, social service or work that requires repetitive and tedious handiwork based on their inappropriately presumed superior abilities to tolerate and perform these types of activities.41-43

Government policy and regulation is another important determinant of actual workplace conditions. Health and safety policy includes research on hazards and controls, funding for training professionals and community members, and setting and enforcing standards.25-27, 47-48 All presidential administrations since the late 1970s have paid homage to the idea of smaller
government, reduced government spending and deregulation. As a result, from a health and safety standpoint, over time the threat of inspection and enforcement has decreased, funding to sustain and continue building the government and non-government safety and health infrastructure has shrunk, standard setting moves at a glacial rate, and Workers’ Compensation is increasingly inadequate as a remedy for workers with occupational disease.49-59

Consequently, another way to look at who is at increased risk of occupational disease in New York State is to identify individuals and groups most impacted by the processes outlined above. Low-wage work provides an accessible vantage point for capturing the bulk of these ‘marginalized’ or ‘vulnerable’ workers.60-89

Low-Wage Work as High Risk for Occupational Disease

Counting low-wage workers is a useful way of getting a picture of the bulk of ‘marginalized’ workers. Low-wage work is overwhelmingly non-union and conforms to the other criteria of work that produces vulnerability. IPUMS data, from the Institute for Social Research and Data Innovation, integrates and harmonizes data across time and location. (Note: IPUMS originally stood for Integrated Public Use Microdata Series, but is currently not used as an acronym). Using IPUMS USA Version 10.0, we stratified the distribution of historically marginalized groups (people of color, women, immigrants) into various low-wage occupations. This allows an estimate of both the size of this population, and the job hazards they are likely to face.93-94

In non-union workplaces, workers are maintained on the job “at will”, meaning the employer can discipline and fire them at any time and without even needing a reason. Likewise, employers in non-union workplaces have undisputed control over which workers are placed in which jobs, how the work is done, hours and shifts worked, safety and health measures and training, and how to respond to hazards. Though nominally protected from discrimination and retaliation for raising health and safety concerns, in practice those rights mean very little to workers in a non-union “at will” workplace.89-92 What has come to be called ‘precarious’ work is increasingly the norm, with such work being characterized by insecurity, which in practice includes: lack of fixed hours, shifts and consequent wages; fear that one can be easily replaced due to the low skills required to do the job and the knowledge that there are many potential replacement workers; fear of retaliation for speaking up or making waves about working conditions.

Policies and Practices

In many low-wage workplaces, where employers spend little on wages, they also spend little on health and safety. Lack of resources, lack of attention, and lack of management commitment all amplify the risk of the actual hazards themselves. Workers in precarious jobs are reluctant to step forward and demand improvements. In an employment “at will” setting, it is relatively easy for the employer to fire any worker perceived as a troublemaker for raising health and safety issues. Since many low-wage occupations involve work that is relatively unskilled, it is not that difficult for an employer to find a replacement for a terminated worker. Government
regulation including workplace inspection by OSHA and whistleblower protection is weak and few low-wage employers seem deterred by the possibility of regulatory sanction.

The impact of racism, sexism and other forms of discrimination must also be considered as a factor impacting low-wage worker health and safety. Discrimination plays a role in how workers are sorted into specific types of work, with people of color often disproportionately represented in dirtier, more hazardous jobs. Aside from selective job placement, racist and sexist attitudes and practices adversely impact how people of color and women are treated on the job by employers and co-workers, by regulatory agencies, and by physicians and other occupational health resources.

Access to Occupational Health Resources

Workers in most low-wage workplaces are not unionized and consequently, have no institutional resource to readily turn to if they want to address workplace hazards or have suffered a possible workplace illness. These workers are typically unaware of their workplace rights or how to effectively exercise those rights. In addition, if they are experiencing symptoms they suspect may be work-related, they may lack access to medical resources to help diagnose the condition and advocate for them in the workplace. Commonly they are unaware of Workers’ Compensation or of the legal and medical resources necessary to help them navigate this very difficult system. Conversely, they may know of others who have filed Workers’ Compensation claims and suffered adverse consequences from the employer and/or experienced the victim blaming, drawn out struggle to obtain any benefits from Workers’ Compensation. Observing the experience of others may act as a deterrent to accessing appropriate care and other benefits.

NYS Occupational Employment Statistics were used to select all low-wage jobs (below $15 per hour/$31,200 per year). Linking these occupations to IPUMS National Data Set, we observed some details about historical trends, race/ethnicity and gender (Tables 21, 22, 23 and 24 and Figure 2). Some related occupational groups were combined.93,94

Low-Wage work in New York State: Total

The top 28 low-wage categories in NYS in 2018 are illustrated in Table 20, with 2,915,172 workers or 31% of the workforce. Of the total number of low-wage workers, the top 10 categories employ 79%. The top three categories alone comprise 42% and include retail salespersons and cashiers; nursing assistants, home health aides and personal care aides; and restaurant workers. The other largest categories of low-wage workers include construction trades; pre-school and kindergarten teachers and assistants; restaurant workers including cooks, servers, and bar staff; truck and delivery drivers; and bookkeeping, accounting, and related clerical jobs.

When considering all low-wage work since 1990 (rather than the top 28 low-wage categories as in the analysis above), low-wage work has increased from 32% to 40% as a proportion of the total employed. Table 21 demonstrates trends from 1950-2019. Nine of the top ten job categories in 1990 were the same as those in 2018, though the order of their ranking after the top three was different. The most striking growth was observed in early education
and childcare occupations with the number of teachers and aides more than quadrupling, and childcare jobs increasing two and a half times. Health and nurses’ aides also jumped significantly, more than doubling in numbers. Construction laborers, masons, tilers and carpet installers likewise more than doubled. Restaurant work including servers, bartenders, and cooks expanded dramatically, with the number of jobs increasing over 80%.

**Low-Wage Work: Women**

Over the last 90 years, the proportion of women who have entered the workforce has increased dramatically, but economic and social equality has been elusive. As Figure 2 and Table 22 show, less than one third of women worked outside of the home in 1930 compared to 71% in 2018. Over three quarters of the increase occurred between 1950 and 1990, with the most dramatic increase (half the total) between 1970 and 1990. As Table 23 details, by 2018 women numbered 5,982,333 and composed 50.8% of the total labor force in NYS.

Early education, childcare and health aide jobs all increased tremendously in the last 30 years and the vast majority of the increase was fueled by women, further contributing to a persistent gender wage gap across the U.S.\(^1\)\(^{-13}\) and in NYS.\(^14\)

Among low-wage workers overall, women are mildly over-represented. However, among certain low-wage jobs women predominate. The occupational categories most dominated by women are illustrated below. Sixty percent of women in low-wage jobs work in one of these six occupational categories.

<table>
<thead>
<tr>
<th>Low-wage occupational categories with the highest percentage of women</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational Category</strong></td>
</tr>
<tr>
<td>Hairdressers and Cosmetologists</td>
</tr>
<tr>
<td>Childcare</td>
</tr>
<tr>
<td>Health Aides, Nursing Aides, Personal Services</td>
</tr>
<tr>
<td>Housekeepers, Maids, Butlers, Stewards</td>
</tr>
<tr>
<td>Secretaries, Customer Service Representatives</td>
</tr>
<tr>
<td>Kindergarten and Earlier Teachers</td>
</tr>
</tbody>
</table>

Gender-related occupational health disparities have multiple mechanisms, both direct and indirect.\(^15\)\(^{-22}\) Occupational segregation, wage gaps, role strain, unfair time use patterns and limited opportunity for advancement persist and contribute to workplace inequity.\(^23\)\(^{-27}\)
### TABLE 20 Low-Wage Occupations (collapsed into 28 occupational groups), New York State, 2018

<table>
<thead>
<tr>
<th>SOC Codes</th>
<th>Occupational Titles*</th>
<th>Number of Workers below $31,200</th>
<th>Percent low-wage workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>41-2031, 41-2021, 41-2011</td>
<td>Retail Salespersons, Counter and Rental Clerks, Cashiers</td>
<td>519,660</td>
<td>17.8%</td>
</tr>
<tr>
<td>39-9021, 39-9099, 31-1014, 31-1011</td>
<td>Personal Care Aides, Home Health Aides, Nursing Assistants*</td>
<td>422,984</td>
<td>14.5%</td>
</tr>
<tr>
<td>35-3031, 35-9011, 35-3011, 35-9031</td>
<td>Waiters and Waitresses, Bartenders, Helpers, Hosts and Hostesses,</td>
<td>267,870</td>
<td>9.2%</td>
</tr>
<tr>
<td>35-3021, 35-3022, 35-3041, 35-9099, 35-1012</td>
<td>Combined Food Preparation and Serving Workers, Including Fast Food, Counter Attendants, Cafeteria, Food Concession, and Coffee Shop, First-Line Supervisors of Food Preparation and Serving Workers*</td>
<td>242,427</td>
<td>8.3%</td>
</tr>
<tr>
<td>43-5081, 43-9061, 43-3031</td>
<td>Stock Clerks and Order Fillers, Office Clerks, General*,Bookkeeping, Accounting, and Auditing Clerks*</td>
<td>208,847</td>
<td>7.2%</td>
</tr>
<tr>
<td>53-7062, 53-7064</td>
<td>Laborers and Freight, Stock, and Material Movers, Hand, Packers and Packers, Hand</td>
<td>154,070</td>
<td>5.3%</td>
</tr>
<tr>
<td>25-9041, 25-3098, 25-2011</td>
<td>Teacher Assistants, Substitute teachers*, Preschool Teachers, Except Special Education*</td>
<td>146,454</td>
<td>5.0%</td>
</tr>
<tr>
<td>43-6014, 43-4051, 43-4171</td>
<td>Secretaries and Administrative Assistants, Except Legal, Medical, and Executive*, Customer Service Representatives*, Receptionists and Information Clerks*</td>
<td>144,409</td>
<td>5.0%</td>
</tr>
<tr>
<td>35-1011, 35-2011, 35-2012, 35-2014, 35-2015</td>
<td>Chefs and Head Cooks,* and all cooks (restaurants, fast food, institutions, cafeteria and short order)</td>
<td>102,729</td>
<td>3.5%</td>
</tr>
<tr>
<td>35-2021, 35-9021</td>
<td>Food Preparation Workers, Dishwashers</td>
<td>94,540</td>
<td>3.2%</td>
</tr>
<tr>
<td>39-9032, 39-3091, 39-3031, 39-2021</td>
<td>Recreation Workers, Amusement and Recreation Attendants, Ushers, Lobby Attendants, and Ticket Takers, Nonfarm Animal Caretakers</td>
<td>71,080</td>
<td>2.4%</td>
</tr>
<tr>
<td>37-2011</td>
<td>Janitors and Cleaners, Except Maids and Housekeeping Cleaners*</td>
<td>63,527</td>
<td>2.2%</td>
</tr>
<tr>
<td>33-9032, 33-9099</td>
<td>Security Guards* and Protective Service Workers</td>
<td>63,283</td>
<td>2.2%</td>
</tr>
<tr>
<td>51-2098, 51-9111</td>
<td>Assemblers and fabricators, all other, Packaging and Filling Machine Operators and Tenders</td>
<td>55,880</td>
<td>1.9%</td>
</tr>
<tr>
<td>37-2012</td>
<td>Maids and Housekeeping Cleaners</td>
<td>48,460</td>
<td>1.7%</td>
</tr>
<tr>
<td>39-9011</td>
<td>Childcare Workers</td>
<td>47,260</td>
<td>1.6%</td>
</tr>
<tr>
<td>53-3031, 53-3033</td>
<td>Driver/Sales Workers, Light Truck or Delivery Services Drivers*</td>
<td>36,762</td>
<td>1.3%</td>
</tr>
<tr>
<td>49-9071</td>
<td>Maintenance and Repair Workers, General*</td>
<td>36,013</td>
<td>1.2%</td>
</tr>
<tr>
<td>47-2061, 47-2141, 47-3012, 47-3013, 47-3014, 47-2015, 47-3019, 47-2081, 47-4090, 47-2131, 47-4031, 47-4071</td>
<td>Construction Laborers*, Painters, Construction and Maintenance*, Helpers-Carpenters, Electricians, Painters, Paperhangers, Plasterers, Stucco Masons, Pipelayers, Plumbers, Pipefitters, Steamfitters, Construction Trades, Drywall and Ceiling Tile Installers<em>Miscellaneous Construction and Related Workers</em></td>
<td>33,407</td>
<td>1.1%</td>
</tr>
<tr>
<td>39-5092</td>
<td>Manicurists and Pedicurists</td>
<td>24,190</td>
<td>0.8%</td>
</tr>
<tr>
<td>39-5012</td>
<td>Hairdressers, Hairstylists, and Cosmetologists</td>
<td>23,650</td>
<td>0.8%</td>
</tr>
<tr>
<td>53-7061</td>
<td>Cleaners of Vehicles and Equipment</td>
<td>19,520</td>
<td>0.7%</td>
</tr>
<tr>
<td>53-3041</td>
<td>Taxi Drivers and Chauffeurs</td>
<td>16,650</td>
<td>0.6%</td>
</tr>
<tr>
<td>53-6021</td>
<td>Parking Lot Attendants</td>
<td>16,220</td>
<td>0.6%</td>
</tr>
<tr>
<td>51-6011</td>
<td>Laundry and Dry-Cleaning Workers</td>
<td>15,980</td>
<td>0.5%</td>
</tr>
<tr>
<td>37-3011</td>
<td>Landscaping and Groundskeeping Workers*</td>
<td>14,855</td>
<td>0.5%</td>
</tr>
<tr>
<td>21-1093</td>
<td>Social and Human Service Assistants*</td>
<td>12,445</td>
<td>0.4%</td>
</tr>
<tr>
<td>51-3011</td>
<td>Bakers</td>
<td>12,000</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

| Total, Low-Wage Occupations | 2,915,172 |
| Total, All Occupations      | 9,385,620 |

*Occupations making low wages only at the “entry wage” or the mean of the bottom third of wages in the occupation.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>274, 275*, 276</td>
<td>Cashiers, salespersons, retail sales</td>
<td>426971</td>
<td>441929</td>
<td>470700</td>
<td>441900</td>
<td>398840</td>
<td>497593</td>
<td>536001</td>
<td>503956</td>
</tr>
<tr>
<td>446, 447, 469</td>
<td>Health aides, Nursing aides, personal service</td>
<td>164083</td>
<td>193380</td>
<td>169000</td>
<td>166500</td>
<td>228074</td>
<td>256159</td>
<td>356610</td>
<td>433845</td>
</tr>
<tr>
<td>435, 443*, 434</td>
<td>Waiters/waitresses, waiters’ assistants, bartenders</td>
<td>101477</td>
<td>88657</td>
<td>93300</td>
<td>137600</td>
<td>124264</td>
<td>154593</td>
<td>185120</td>
<td>178832</td>
</tr>
<tr>
<td>439</td>
<td>Kitchen workers</td>
<td>68555</td>
<td>29193</td>
<td>42000</td>
<td>6800</td>
<td>12908</td>
<td>16056</td>
<td>23553</td>
<td>36308</td>
</tr>
<tr>
<td>365*, 337</td>
<td>Stock and inventory clerks, bookkeeping, accounting and auditing clerks</td>
<td>89970</td>
<td>133690</td>
<td>185300</td>
<td>178000</td>
<td>168812</td>
<td>149512</td>
<td>113125</td>
<td></td>
</tr>
<tr>
<td>883*, 888*, 876</td>
<td>Freight, stock, and materials handlers, packers and packagers by hand</td>
<td>18158</td>
<td>20537</td>
<td>46200</td>
<td>77500</td>
<td>47222</td>
<td>19793</td>
<td>23667</td>
<td>27659</td>
</tr>
<tr>
<td>155, 159</td>
<td>Kindergarten and earlier teachers, teachers n.e.c.</td>
<td>.</td>
<td>25400</td>
<td>36700</td>
<td>51884</td>
<td>153191</td>
<td>195363</td>
<td>236327</td>
<td></td>
</tr>
<tr>
<td>313, 376*, 319*, 389*, 379</td>
<td>Secretaries, Customer service reps, investigators and adjusters, except insurance, receptionists, administrative support jobs, general office clerks</td>
<td>695501</td>
<td>581156</td>
<td>579300</td>
<td>563000</td>
<td>580188</td>
<td>613055</td>
<td>568035</td>
<td>525343</td>
</tr>
<tr>
<td>436</td>
<td>Cooks</td>
<td>47088</td>
<td>46521</td>
<td>51000</td>
<td>92300</td>
<td>123088</td>
<td>144179</td>
<td>167095</td>
<td>180433</td>
</tr>
<tr>
<td>444, 439</td>
<td>Food prep workers</td>
<td>68555</td>
<td>29193</td>
<td>42000</td>
<td>47900</td>
<td>60256</td>
<td>60503</td>
<td>88721</td>
<td>117283</td>
</tr>
<tr>
<td>175,462, 487, 459</td>
<td>Recreation, ushers, animal caretakers not on farms, recreation facility attendants</td>
<td>9350</td>
<td>8166</td>
<td>13100</td>
<td>14100</td>
<td>15862</td>
<td>38872</td>
<td>44333</td>
<td>7369</td>
</tr>
<tr>
<td>453</td>
<td>Janitors</td>
<td>25138</td>
<td>30282</td>
<td>83300</td>
<td>132500</td>
<td>159264</td>
<td>133640</td>
<td>189289</td>
<td>180016</td>
</tr>
<tr>
<td>426,427</td>
<td>Guards, watchmen, doorkeepers</td>
<td>27805</td>
<td>29687</td>
<td>32600</td>
<td>53300</td>
<td>73318</td>
<td>72576</td>
<td>96270</td>
<td>101311</td>
</tr>
<tr>
<td>874</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>8400</td>
<td>3262</td>
<td>3827</td>
<td>4773</td>
<td>4772</td>
<td></td>
</tr>
<tr>
<td>405</td>
<td>Housekeepers, maids, butlers, stewards, and lodging quarters cleaners</td>
<td>48255</td>
<td>64738</td>
<td>73900</td>
<td>63500</td>
<td>47936</td>
<td>73755</td>
<td>100663</td>
<td>84141</td>
</tr>
<tr>
<td>468</td>
<td>childcare</td>
<td>8273</td>
<td>18900</td>
<td>42800</td>
<td>42182</td>
<td>86083</td>
<td>119906</td>
<td>107097</td>
<td></td>
</tr>
<tr>
<td>804</td>
<td>Truck, delivery, and tractor drivers</td>
<td>161690</td>
<td>139200</td>
<td>142800</td>
<td>142800</td>
<td>159866</td>
<td>160712</td>
<td>139133</td>
<td>155603</td>
</tr>
<tr>
<td>549</td>
<td>Mechanics and repairers, n.e.c.</td>
<td>104038</td>
<td>113680</td>
<td>87500</td>
<td>31800</td>
<td>37072</td>
<td>38532</td>
<td>35505</td>
<td>33688</td>
</tr>
<tr>
<td>869, 563, 865, 889</td>
<td>Construction laborers, masons, tile setters, carpet installers, construction workers,</td>
<td>233814</td>
<td>203591</td>
<td>101000</td>
<td>100700</td>
<td>138194</td>
<td>162899</td>
<td>228999</td>
<td>231592</td>
</tr>
<tr>
<td>458</td>
<td>Hairdressers and cosmetologists</td>
<td>44702</td>
<td>28569</td>
<td>28800</td>
<td>35100</td>
<td>43050</td>
<td>45569</td>
<td>68404</td>
<td>75440</td>
</tr>
<tr>
<td>887</td>
<td>Vehicle washers and equipment cleaners</td>
<td>6101</td>
<td>4383</td>
<td>7900</td>
<td>6200</td>
<td>9058</td>
<td>16642</td>
<td>13581</td>
<td>14511</td>
</tr>
<tr>
<td>809</td>
<td>Taxi cab drivers and chauffeurs</td>
<td>46056</td>
<td>38152</td>
<td>32900</td>
<td>32100</td>
<td>45528</td>
<td>51655</td>
<td>65944</td>
<td>93226</td>
</tr>
<tr>
<td>813</td>
<td>Parking lot attendants</td>
<td>2700</td>
<td>3300</td>
<td>3514</td>
<td>4670</td>
<td>10060</td>
<td>9084</td>
<td></td>
<td></td>
</tr>
<tr>
<td>748</td>
<td>Laundry workers</td>
<td>41893</td>
<td>36359</td>
<td>34600</td>
<td>11600</td>
<td>9296</td>
<td>13872</td>
<td>12660</td>
<td>11009</td>
</tr>
<tr>
<td>486,</td>
<td>Gardeners and groundskeeper</td>
<td>15665</td>
<td>12256</td>
<td>18300</td>
<td>20400</td>
<td>28210</td>
<td>36340</td>
<td>51216</td>
<td>50662</td>
</tr>
<tr>
<td>465</td>
<td>Welfare service aides</td>
<td>.</td>
<td>1600</td>
<td>14600</td>
<td>6034</td>
<td>21666</td>
<td>23614</td>
<td>31463</td>
<td></td>
</tr>
<tr>
<td>687, 688</td>
<td>bakers and batch food makers</td>
<td>18526</td>
<td>17922</td>
<td>13000</td>
<td>12400</td>
<td>15946</td>
<td>17361</td>
<td>16235</td>
<td>16722</td>
</tr>
<tr>
<td><strong>TOTAL Low-Wage Occupations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2470514</td>
<td>2650750</td>
</tr>
</tbody>
</table>

| | **Total All Occupations** | 5901204 | 6256205 | 6358400 | 7122700 | 8052982 | 8109921 | 8525453 | 9042783 |

* Totals include additional “experienced workers” (as noted with asterisks) who may make slightly higher wages. IPUMS data does not refine by wage rates. Occupations were selected first using OES data defining low-wages as less than $15 per hour or less than $31,200 per year.

**SOURCE IPUMS, National Data Set**
TABLE 22 Labor Force Participation Rate, New York State, by Gender, 1930-2018

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All workers</td>
<td>61.2</td>
<td>60.8</td>
<td>60.9</td>
<td>64.3</td>
<td>64.1</td>
<td>68.2</td>
<td>73.6</td>
<td>70.7</td>
<td>72.9</td>
<td>74.1</td>
</tr>
<tr>
<td>Men</td>
<td>90.6</td>
<td>87.3</td>
<td>86.6</td>
<td>88.0</td>
<td>82.9</td>
<td>80.7</td>
<td>81.1</td>
<td>75.9</td>
<td>76.9</td>
<td>77.2</td>
</tr>
<tr>
<td>Women</td>
<td>31.5</td>
<td>34.7</td>
<td>36.8</td>
<td>42.7</td>
<td>47.3</td>
<td>56.7</td>
<td>66.5</td>
<td>65.7</td>
<td>69.0</td>
<td>71.0</td>
</tr>
</tbody>
</table>

Figure 2. Labor Force Participation Rate, New York State, by Gender, 1930-2018

Source: IPUMS data, National Data Set in same font as other charts

TABLE 23 Workforce Engagement in the United States and in New York State, 2018

<table>
<thead>
<tr>
<th></th>
<th>Labor Force Total</th>
<th>Labor Force Participation Rate</th>
<th>Employment / Population Ratio</th>
<th>Unemployment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENDER/SEXa</td>
<td>192,453,695</td>
<td>11,754,335</td>
<td>77.8</td>
<td>77.8</td>
</tr>
<tr>
<td>Male</td>
<td>95,709,923</td>
<td>5,772,002</td>
<td>82.4</td>
<td>81.6</td>
</tr>
<tr>
<td>Female</td>
<td>96,743,772</td>
<td>5,982,333</td>
<td>73.2</td>
<td>74</td>
</tr>
</tbody>
</table>

a ACDSWY2018.S2301 data with overlays
b Population 20 to 64 years
<table>
<thead>
<tr>
<th>IPUMS CODE(S)</th>
<th>IPUMS CODE TITLES</th>
<th>White (non hispanic)</th>
<th>African American or Black</th>
<th>Latino</th>
<th>Asian, Pacific Islander</th>
<th>Native American</th>
<th>Mixed / Other</th>
<th>Total Valid Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>274, 275, 276</td>
<td>Cashiers, salespersons, retail sales</td>
<td>340,927</td>
<td>53</td>
<td>94,847</td>
<td>15</td>
<td>131,731</td>
<td>20</td>
<td>63,208</td>
</tr>
<tr>
<td>446, 447, 469</td>
<td>Health aides, Nursing aides, personal service</td>
<td>144,874</td>
<td>31</td>
<td>145,072</td>
<td>31</td>
<td>117,314</td>
<td>25</td>
<td>50,675</td>
</tr>
<tr>
<td>435, 443, 434</td>
<td>Waiters/waitresses, waiters' assistants, bartenders</td>
<td>126,827</td>
<td>54</td>
<td>19,538</td>
<td>8</td>
<td>54,419</td>
<td>23</td>
<td>27,164</td>
</tr>
<tr>
<td>439</td>
<td>Kitchen workers</td>
<td>27,718</td>
<td>54</td>
<td>4,749</td>
<td>9</td>
<td>13,067</td>
<td>25</td>
<td>4,547</td>
</tr>
<tr>
<td>365, 337</td>
<td>Stock and inventory clerks, bookkeeping, accounting and auditing clerks</td>
<td>92,414</td>
<td>55</td>
<td>26,504</td>
<td>16</td>
<td>31,064</td>
<td>19</td>
<td>12,398</td>
</tr>
<tr>
<td>883, 888,</td>
<td>Freight, stock, and materials handlers, packers and packagers by hand</td>
<td>9,306</td>
<td>28</td>
<td>8,605</td>
<td>26</td>
<td>10,996</td>
<td>33</td>
<td>3,666</td>
</tr>
<tr>
<td>155, 159</td>
<td>Kindergarten and earlier teachers, teachers n.e.c.</td>
<td>154,872</td>
<td>58</td>
<td>39,607</td>
<td>15</td>
<td>43,852</td>
<td>16</td>
<td>20,883</td>
</tr>
<tr>
<td>313, 376, 319, 379</td>
<td>Secretaries, Customer service reps, investigators and adjusters, etc.</td>
<td>384,238</td>
<td>58</td>
<td>98,692</td>
<td>15</td>
<td>117,569</td>
<td>18</td>
<td>47,487</td>
</tr>
<tr>
<td>436</td>
<td>Cooks</td>
<td>89,624</td>
<td>40</td>
<td>31,161</td>
<td>14</td>
<td>70,147</td>
<td>31</td>
<td>25,877</td>
</tr>
<tr>
<td>444</td>
<td>Food prep workers</td>
<td>47,309</td>
<td>42</td>
<td>12,714</td>
<td>11</td>
<td>37,460</td>
<td>34</td>
<td>11,300</td>
</tr>
<tr>
<td>175,462, 487, 459,</td>
<td>Recreation, ushers, animal caretakers not on farms, recreation facility attendants</td>
<td>71,489</td>
<td>68</td>
<td>8,761</td>
<td>8</td>
<td>16,148</td>
<td>15</td>
<td>4,676</td>
</tr>
<tr>
<td>453</td>
<td>Janitors</td>
<td>92,073</td>
<td>37</td>
<td>53,236</td>
<td>21</td>
<td>88,639</td>
<td>36</td>
<td>9,290</td>
</tr>
<tr>
<td>426,427</td>
<td>Guards, watchmen, doorkeepers</td>
<td>53,050</td>
<td>40</td>
<td>43,681</td>
<td>33</td>
<td>25,653</td>
<td>20</td>
<td>5,518</td>
</tr>
<tr>
<td>874</td>
<td>Production helpers</td>
<td>1,518</td>
<td>47</td>
<td>738</td>
<td>23</td>
<td>717</td>
<td>22</td>
<td>246</td>
</tr>
<tr>
<td>405</td>
<td>Housekeepers, maids, butlers, stewards, and lodging quarters cleaners</td>
<td>26,176</td>
<td>22</td>
<td>22,306</td>
<td>19</td>
<td>56,972</td>
<td>48</td>
<td>8,934</td>
</tr>
<tr>
<td>468</td>
<td>Childcare</td>
<td>62,192</td>
<td>41</td>
<td>27,351</td>
<td>18</td>
<td>50,665</td>
<td>33</td>
<td>8,470</td>
</tr>
<tr>
<td>804</td>
<td>Truck, delivery, and tractor drivers</td>
<td>103,146</td>
<td>52</td>
<td>27,763</td>
<td>14</td>
<td>50,666</td>
<td>25</td>
<td>12,902</td>
</tr>
<tr>
<td>549</td>
<td>Mechanics and repairers, n.e.c.</td>
<td>27,289</td>
<td>63</td>
<td>5,829</td>
<td>13</td>
<td>7,825</td>
<td>18</td>
<td>1,451</td>
</tr>
<tr>
<td>869, 563, 865, 889</td>
<td>Construction laborers, masons, tilers, carpet installers, construction workers</td>
<td>144,324</td>
<td>48</td>
<td>41,625</td>
<td>14</td>
<td>93,566</td>
<td>31</td>
<td>16,438</td>
</tr>
<tr>
<td>458</td>
<td>Hairdressers and cosmetologists</td>
<td>36,235</td>
<td>44</td>
<td>9,225</td>
<td>11</td>
<td>18,846</td>
<td>23</td>
<td>17,264</td>
</tr>
<tr>
<td>887</td>
<td>Vehicle washers and equipment cleaners</td>
<td>8,753</td>
<td>42</td>
<td>5,356</td>
<td>26</td>
<td>5,222</td>
<td>25</td>
<td>226</td>
</tr>
<tr>
<td>809</td>
<td>Taxi cab drivers and chauffeurs</td>
<td>16,639</td>
<td>15</td>
<td>23,951</td>
<td>21</td>
<td>31,339</td>
<td>28</td>
<td>38,266</td>
</tr>
<tr>
<td>813</td>
<td>Parking lot attendants</td>
<td>2,853</td>
<td>35</td>
<td>1,688</td>
<td>21</td>
<td>3,268</td>
<td>40</td>
<td>236</td>
</tr>
<tr>
<td>748</td>
<td>Laundry workers</td>
<td>3,558</td>
<td>27</td>
<td>1,091</td>
<td>8</td>
<td>5,366</td>
<td>41</td>
<td>2,896</td>
</tr>
<tr>
<td>466,</td>
<td>Gardeners and groundskeeper</td>
<td>36,833</td>
<td>58</td>
<td>5,173</td>
<td>8</td>
<td>19,761</td>
<td>31</td>
<td>350</td>
</tr>
<tr>
<td>465</td>
<td>Welfare service aides</td>
<td>15,367</td>
<td>50</td>
<td>8,053</td>
<td>29</td>
<td>5,136</td>
<td>17</td>
<td>1,124</td>
</tr>
<tr>
<td>687, 688</td>
<td>Bakers and batch food makers</td>
<td>10,183</td>
<td>52</td>
<td>1,859</td>
<td>10</td>
<td>5,929</td>
<td>30</td>
<td>1,352</td>
</tr>
</tbody>
</table>

**Table 24** Low-Wage Occupations (collapsed into 28 occupational groups) by Race, New York State, 2018

Source: aIPUMS, National Data Set, 2018
Low-Wage Work in NYS: Race/Ethnicity

Race/ethnicity is a well-recognized and fundamental determinant of health disparity. Work is an important contributor to the unequal distribution of disease among different racial/ethnic groups. Estimates of select low-wage occupations by race/ethnicity are shown in Table 24.

As illustrated in the table below the total working population of NYS in 2018 was 57% White, 14% Black, 18% Latinx, and 9% Asian/Pacific Islander. In the low-wage population both Blacks and Latinx workers were disproportionately over-represented by 21% and 44% respectively. Whites were disproportionately under-represented by 18%. Asian/pacific islanders in the low-wage workforce were proportionate to their number in the overall working population.

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Percent total workforce</th>
<th>Percent low-wage workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>57</td>
<td>46.9</td>
</tr>
<tr>
<td>Black</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Latinx</td>
<td>18</td>
<td>24.9</td>
</tr>
<tr>
<td>Asian/PI</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

The top three low-wage categories (secretaries/customer service, cashiers/sales/retail, health aides/nurses' aides/personal care) were in the top 5 categories for all ethnic groups. The following table illustrates differences in the other job categories rounding out the top five for each ethnic group. Among each group between 50-58% of low-wage workers worked in one of these job categories.

<table>
<thead>
<tr>
<th>Race / Ethnicity</th>
<th>Other job categories in the top five</th>
<th>Overall category rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Kindergarten and earlier teachers/aides</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Construction laborers, masons, tilers</td>
<td>4</td>
</tr>
<tr>
<td>Black</td>
<td>Janitors</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Guards, watchmen, doorkeepers</td>
<td>12</td>
</tr>
<tr>
<td>Latinx</td>
<td>Construction laborers, masons, tilers</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Janitors</td>
<td>6</td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Taxi cab drivers, chauffeurs</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Restaurant servers, assistants, bartenders</td>
<td>7</td>
</tr>
</tbody>
</table>

Another way to look at where different ethnic groups cluster in low-wage jobs is by each group's percentage in a category. The table below demonstrates the top five job categories for each group in this way.

The distinctness of each ethnic group’s top five categories demonstrates the sorting or segregation of specific groups into specific job categories.
<table>
<thead>
<tr>
<th>Race / Ethnicity</th>
<th>Occupation</th>
<th>Total Low-Wage</th>
<th>Percent</th>
<th>Number of Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Recreation, ushers, animal care</td>
<td>2,129,787</td>
<td>32</td>
<td>674,721</td>
</tr>
<tr>
<td>White</td>
<td>Mechanics and repairers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Gardeners, groundskeepers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Kindergarten, pre-school and childcare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Customer Service, investigators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Guards, watchmen, doorkeeper</td>
<td>769,975</td>
<td>27</td>
<td>211,567</td>
</tr>
<tr>
<td>Black</td>
<td>Health aides, nurse aides, personal service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Welfare service aides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Freight, stock, material handling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Vehicle wash, equipment cleaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latinx</td>
<td>Housekeeping, maid, butler</td>
<td>1,113,337</td>
<td>17</td>
<td>191,705</td>
</tr>
<tr>
<td>Latinx</td>
<td>Laundry worker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latinx</td>
<td>Parking lot attendant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latinx</td>
<td>Janitors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latinx</td>
<td>Food preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Taxi driver, chauffer</td>
<td>396,884</td>
<td>28</td>
<td>111,467</td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Laundry worker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Hairdresser, cosmetologist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Cook</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian/PI</td>
<td>Waiters/waitress, bartender</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: IPUMS, National Data Set, 2018
Health Risks of Low-Wage Work

As noted above, the health risks of low-wage work result from the interplay of several factors including:

1) The nature of the hazards encountered at the workplace
2) The ways in which social, political, and workplace policies and practices amplify or mitigate hazards
3) Access to occupational health resources once a hazard is encountered or an illness is incurred

Consequently, the hazard profile for specific jobs will vary. However, there are some hazards that are widespread and common to many low-wage jobs, and these are described below.

**Major Hazards of low-wage work**

**Ergonomics and musculoskeletal injuries**

Ergonomic hazards including repetitive work, awkward postures, forceful movements, lifting and moving heavy weights are widespread in many categories of low-wage work. For women in aide roles in hospitals, nursing homes, and home care, musculoskeletal injuries from lifting and transferring patients are epidemic. Office and clerical jobs dominated by women are also sources of ergonomic hazards, often as a consequence of highly repetitive work in poorly designed work spaces. Hairdressers, 90% of whom are women suffer the consequences of working long hours in constrained postures with repetitive hand and arm tasks. Construction work, restaurant occupations (both serving and cooking), and materials lifting and moving in stock and driving/delivery jobs are other examples of categories of low-wage work where workers are at increased risk of musculoskeletal disorders. Overall, workers in low-wage jobs with ergonomics hazards number in the millions.

**Chemical, metal, dust exposures**

Exposure to hazardous materials is an important issue on many low-wage jobs. Over 300,000 people work in low-wage construction jobs where an array of hazards is potentially present ranging from asbestos, lead, and silica, to solvents and other chemicals. Hairdressing and cosmetology jobs employ almost 200,000 people with potential exposure to a variety of chemicals including formaldehyde containing hair straighteners, hair dyes, and skin and respiratory sensitizing chemicals used in hair and nail care. Cleaners and disinfectants are major exposures for workers using them directly (e.g. janitors, restaurant workers) and those exposed as bystanders. During the COVID-19 pandemic, this has taken on increased importance as the indiscriminate use of cleaning and disinfecting products containing quaternary ammonium salt and other chemicals has become rampant.
**Stress**

Stress is ubiquitous in low-wage work across virtually all occupations. Typical low-wage work offers very little control to the individual worker over their working conditions. Employers often treat workers as if they are interchangeable parts, able to fill any employment hole at any time and are expendable. As a consequence, work schedules are frequently variable and not easily predictable and employment is “at will” and insecure. The threat of violence, as defined by a spectrum from verbal abuse to bullying to outright physical violence is another common source of stress in low-wage jobs. Reports of workplace violence in healthcare especially has been increasing and some states have passed legislation to require workplace violence prevention programs. This violence may originate with supervisors and employers, or from clients. Workplace stress is often linked with home stress in a relationship where either can amplify the other.

**Infectious Disease**

The COVID-19 pandemic has proven the importance of infectious disease as a workplace hazard. Throughout the pandemic many low-wage workers continued to work in jobs deemed ‘essential’ or in industries that were closed down for a period and then reopened, remaining open as the pandemic surged again in the fall and winter of 2020-21. For health care, nursing home, and home health workers, the risk comes through the job itself which requires them to directly take care of individuals infected with COVID-19 or at risk of infection. Many other jobs carry an increased risk because of contact with the general public in settings that vary widely in terms of ventilation and other factors that impact the level of exposure. Even in jobs without much contact with the public there may still be an increased risk of COVID-19 infection depending on how many co-workers are present and the kind of space they are configured into while working. Exposure on the job also carries the risk of conveying the infection into the home environment.

**Summary**

Low-wage work carries a high risk of occupational disease. This increased risk results from the nature of the hazards faced on the job, the way work is organized, managed and regulated, discriminatory treatment, and lack of access to occupational health resources. According to NYS government data, over 2.5M jobs in NYS (27%) pay less than $15 per hour. We’ve estimated 2.9M workers, or 31% of New York’s workers occupy 28 low-wage occupations, constituting an immense at-risk group.
Chapter 4

EXPANDING THE DEFINITION OF OCCUPATIONAL DISEASE

The ways in which work impacts health are further illustrated in this chapter with the examples of stress, substance use and obesity, all important contemporary health problems. While often conceived as problems caused by individual choices, and remedied through personal responsibility and behavior modification, the recognition of the contribution of work requires a different solution. As with more ‘traditional’ workplace hazards, the prevention of work-related illness depends upon changing workplace conditions to reduce or eliminate the hazard. A similar approach could be used for other major health and public health challenges.

Significance of Workplace Stress and Illness

Job stress is a central preoccupation of workers across the spectrum of industries and occupations. There is a sense that work has become increasingly stressful in the last few decades. A variety of maladies have been linked to stress, some with more evidence than others. Impacts on mental health encompassing both specific diagnostic conditions such as depression and anxiety, and conditions like ‘distress’ and ‘burnout’ that are not easily placed in a formal diagnostic category are widely described. Cardiovascular disease including hypertension, heart attack, and stroke has also been given significant attention. Researchers connect musculoskeletal problems to stressful work. The gastrointestinal system may also be a target for stress related conditions including gastritis, gastroesophageal reflux, ulcers, irritable bowel syndrome, and symptoms such as abdominal pain and bloating. Other symptoms caused or exacerbated by stress include headaches, disrupted sleep, and fatigue. Some evidence points to stress having detrimental effects on the immune system, and there is speculation that stress might increase the risk of certain cancers. Stress may also contribute to behaviors such as tobacco smoking, substance use, and dietary intake that increase the risk for other diseases.

Work over the last several decades has done much to move stress from a vague to a relatively well-defined concept. In general, stress can be seen as a “form of stimulus that causes bodily or psychological reaction.” This definition doesn’t specify whether the reactions are positive or negative. But most work on stress is focused on how it produces distress and illness. The workplace has long been recognized as a source of stress, and researchers have done much to illuminate the specific characteristics of a job that generate stress. Work produced by Karasek, and others following his lead, has emerged as the dominant paradigm describing stress as a work hazard. His demand-control model suggests that jobs that subject workers to high psychological demands and deny them the ability to exert significant control over their work carry the highest risk for mental health, cardiovascular, and other conditions.
Critique of the Karasek model has included the argument that it is incomplete and fails to capture other aspects of work that play a significant role in producing stress. Chief among these is the idea that job-related support can buffer the negative impact of high demands or low control. In this augmentation of Karasek’s model, support is specifically defined as a helping function, occurring in the form of either material provision of information or emotional support from colleagues or managers. Higher levels of support can mitigate some of the impact of stress and workers lacking social support suffer more of the adverse impacts. 28-32

While Karasek’s model has dominated the literature, others have advanced significant models. Siegrist, for example, asserts that an imbalance between effort on the job and reward leads to poor health outcomes.33-34 Various sociological paradigms describe stress processes wherein stressors either produce poor outcomes, or the lack of stressors leads to the accumulation of advantages including better health.35-40 Occupational health psychology research often emphasizes psychosomatic connections between factors based on individual experiences and health, such as stress perception or coping mechanisms.41-43 Others assert that contributing stressors include: workplace violence, bullying, harassment, perceived job insecurity, and times when work interferes with life outside of work and/or the reverse.44-48

Still others have recognized the value of Karasek’s model, but have posited that it describes just one link in a causal chain between work, stress, and disease. Tausig and Fenwick, for example, argue that it is important to understand the forces that encourage the creation of high demand-low control work which are to be found in the larger context within which an individual workplace resides. They argue that macro level economic and political policies ultimately shape conditions at the workplace, or micro level.49-51 These policies are mediated by work organizations and the labor market (the meso level). They describe a process beginning in the mid-1970’s where the political economy has shifted from a ‘Fordist’ economy premised on the idea that workers should be paid enough to be able to afford the products being manufactured. That demand would keep the economy stimulated. Accordingly, the characteristics of Fordism included relatively decent wages and benefits, a strong union presence, job security and a substantial safety net.

With ‘post-Fordism’ (what others would call neoliberalism) came a re-shaping of the American political economy with the disappearance of manufacturing jobs and their relatively high wages and benefits.52 The labor market increasingly split into higher wage (professionals, managers) and lower wage segments, with the middle ‘hollowed out’. Along with this split came lower wages, reduced benefits, and much decreased job security.53 Companies strove for maximum ‘flexibility’ to meet the demands of global competition, and a key feature of that flexibility is the ability to hire, fire, and move workers around as the employer deems necessary. In their view, impediments to this mobility in the form of regulations and law must be removed. In this context, there is minimal state oversight, so employers control the work environment. Working conditions often deteriorate as employers pay less attention to matters like health and safety that get in the way of production, and workers are much more reluctant to speak out about conditions, being concerned mainly with just holding onto their jobs.54-62
The importance of understanding the larger context within which stressful working conditions are produced is twofold. It suggests that interventions limited to job re-design to increase worker control and reduce demands at the individual workplace are unlikely to be effective as they do not address the underlying pressures to create these types of jobs. It follows that effective interventions to reduce workplace stress must address it on multiple levels.

The work cited in the preceding paragraphs strongly suggests the importance of stress related conditions in the consideration of occupational illness. This has been underscored by work the OHCC has undertaken over the last several years with low-wage workers in the Syracuse area. In discussions with 1,924 low-wage workers, workplace stress and related symptoms were a central feature of every discussion.63 Our consideration of the extent of occupational illness requires inclusion of stress related illnesses since these are quite widespread and linked to work conditions. We expect further expansion of traditional models to recognize closely-related phenomenon such as resilience, overwork, work-non-work interference, job insecurity/precarity/low-wages, workplace incivility, workplace harassment as part of the workplace stress picture. Given the inherent complexity, currently existing data is frequently inadequate to allow for a full and accurate assessment of the incidence and prevalence of work-related stress and the disorders/diseases associated with it.

Substance Use and Work

As the deaths from opioid overdose become epidemic, 47,600 in 2017 alone, the issue has forced itself beyond the medical and public health spheres into the public and political eye.1 Prevalence of drug use in adults is high, indicating pervasive substance use and misuse (Table 25). Occupational health professionals and advocates have begun exploring the relationship between opioid use and work.2-3 A recent study from Massachusetts found opioid overdoses were associated more commonly with certain kinds of work and also varied by gender, with 77.3% (3,324) among men and 22.7% (978) among women.4 The data and findings from other research suggest some underlying reasons for this disproportionate use.4-12

The scenario described in the Massachusetts report, however, is just one of the ways that work and opioid use are related, and opioids are just one of the addictive/psychoactive substances that should be considered in trying to draw a more comprehensive picture of the role of work in substance use.13-18 Other major substances to consider are tobacco,19-22,28 alcohol,23-26,28 stimulants 13-18,27 and perhaps marijuana.13-18,28
<table>
<thead>
<tr>
<th>Substance</th>
<th>US Estimate</th>
<th>US Confidence Interval</th>
<th>NYS Estimate</th>
<th>NYS Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illicit Drug Use in the Past Month</td>
<td>12.73</td>
<td>12.42 - 13.05</td>
<td>12.81</td>
<td>11.74 - 13.97</td>
</tr>
<tr>
<td>Marijuana Use in the Past Year</td>
<td>17.1</td>
<td>16.72 - 17.47</td>
<td>17.7</td>
<td>16.50 - 18.98</td>
</tr>
<tr>
<td>Marijuana Use in the Past Month</td>
<td>11.17</td>
<td>10.88 - 11.47</td>
<td>11.36</td>
<td>10.37 - 12.44</td>
</tr>
<tr>
<td>Cocaine Use in the Past Year</td>
<td>2.16</td>
<td>2.05 - 2.28</td>
<td>2.71</td>
<td>2.26 - 3.26</td>
</tr>
<tr>
<td>Heroin Use in the Past Year</td>
<td>0.31</td>
<td>0.26 - 0.37</td>
<td>0.32</td>
<td>0.17 - 0.60</td>
</tr>
<tr>
<td>Methamphetamine Use in the Past Year</td>
<td>0.76</td>
<td>0.69 - 0.83</td>
<td>0.25</td>
<td>0.13 - 0.48</td>
</tr>
<tr>
<td>Pain Reliever Misuse in the Past Year</td>
<td>3.69</td>
<td>3.53 - 3.85</td>
<td>3.05</td>
<td>2.59 - 3.59</td>
</tr>
<tr>
<td>Alcohol Use in the Past Month</td>
<td>55.09</td>
<td>54.53 - 55.64</td>
<td>54.57</td>
<td>52.70 - 56.42</td>
</tr>
<tr>
<td>Binge Alcohol Use in the Past Month</td>
<td>26.15</td>
<td>25.75 - 26.55</td>
<td>24.88</td>
<td>23.41 - 26.40</td>
</tr>
<tr>
<td>Tobacco Product Use in the Past Month</td>
<td>23.01</td>
<td>22.61 - 23.41</td>
<td>19.25</td>
<td>17.95 - 20.61</td>
</tr>
<tr>
<td>Cigarette Use in the Past Month</td>
<td>18.35</td>
<td>17.98 - 18.72</td>
<td>15.63</td>
<td>14.47 - 16.87</td>
</tr>
<tr>
<td>Illicit Drug Use Disorder in the Past Year</td>
<td>2.97</td>
<td>2.83 - 3.11</td>
<td>3.01</td>
<td>2.56 - 3.55</td>
</tr>
<tr>
<td>Pain Reliever Use Disorder in the Past Year</td>
<td>0.57</td>
<td>0.51 - 0.64</td>
<td>0.42</td>
<td>0.27 - 0.64</td>
</tr>
<tr>
<td>Alcohol Use Disorder in the Past Year</td>
<td>5.71</td>
<td>5.53 - 5.90</td>
<td>5.48</td>
<td>4.81 - 6.23</td>
</tr>
<tr>
<td>Substance Use Disorder in the Past Year</td>
<td>7.74</td>
<td>7.52 - 7.96</td>
<td>7.43</td>
<td>6.65 - 8.30</td>
</tr>
</tbody>
</table>

*adults over 18; percentages based on annual averages National Survey of Drug Use and Health; SAMHSA definitions and statistical method

Source: https://www.samhsa.gov/data/sites/default/files/reports/

A useful framework for exploring the relationship between substances and work contains several elements, with an understanding that each element may not be equally relevant for each substance.

1) Substances as workplace hazards

In the past few years, heroin has been increasingly cut with fentanyl. This increases the potency and also reduces the volume of product smugglers have to transport across borders. Since fentanyl can be absorbed through the skin, this raises the possibility of medical responders and law enforcement being exposed. In fact, NIOSH has already investigated a number of these types of exposures.29-30 Second hand smoke is another example of how workers may be exposed directly to a substance at work.

2) Use of substances to perform the job

Some jobs require long hours, night shifts, and the maintenance of vigilance. Examples include long distance truckers, and military personnel. To keep awake and alert stimulants like amphetamines may be used. Tobacco may serve a similar function.31-36
3) Use of substances to cope with the job

For many, substance use is a way of coping with difficult life circumstances. Job ‘stress,’ as described elsewhere in this report, is an important source of difficulty for many workers. Precarious insecure work, an unfair boss, demanding work with no ability to exert control, irritated clients, unsafe conditions, poor wages and benefits, no opportunities for advancement or change, and discrimination are among the factors that can make work life extremely hard to tolerate.37-43 Under these circumstances, it is not surprising that some workers turn to substances to make it through the shift and the day.44-49 Few programs or supports are in place to prevent or reduce stress on the job.

The line between job stress and life stress is often not clear, with interaction between the two working in both directions to exacerbate both.

For example, the single parent making low-wages struggles to manage all aspects of family life under conditions of rotating schedules and fluctuating hours. Juggling to keep quality childcare consistent, accomplish all of the household chores and errands, and manage finances often presents mounting unsolvable predicaments. When asked to work more, the network of support so carefully constructed can be strained to the breaking point. If informed that hours are reduced, paying rent and/or putting food on the table may create an immediate crisis. Often finding themselves “putting out fires,” it should not be surprising that some turn to stimulants to give energy, or alcohol/drugs for relief from the unrelenting demands of life.28,50-56

4) Use of substances after a work injury

This aspect of the substance issue has received the most attention to date, specifically in relation to opioid use. Workers injured on the job may be prescribed opioids for pain control and then become addicted. With physicians over prescribing and providing easy access, workers in industries and occupations with higher injury rates (e.g. construction) are consequently, at higher risk of opioid use and abuse. But in addition to the inherent riskiness of the job, other factors come into play exacerbating the problem. If the workplace has no light duty policy, workers may feel pressured to take pain relievers to enable them to return to full duty prematurely and to keep working despite pain and a less than fully healed injury.57-59 In jobs with little or no sick leave, and precarious jobs generally, a similar dynamic is at play, with injured workers using opioids to get them back on the job quicker and keep them on the job to avoid losing pay they cannot afford to go without.37-43 In seasonal jobs like construction or agriculture the pressure to return to work and stay at work injured is heightened by the compressed time period workers have to earn the income necessary for the off season as well.60-62
5) Impact of substance use on work

In many instances work may not be a cause or contributor to substance use, but may be adversely impacted by such use. Intoxicated workers can pose a safety risk to themselves and others. Pilots, bus drivers, and firefighters are examples of workers among whom on the job impairment by substances could be disastrous for themselves, their co-workers, and those to whom they are providing a service. On a more mundane, day to day level, substance use can affect any user's ability to be productive at work.

6) Accessibility and use of medical treatment resources

In 2018, 18.9 million people in the U.S. (7.18%) needed specialty substance use treatment, but did not receive it. In New York State, in 2018, among adults over 18 who needed, but did not receive treatment numbered 1,073,903 (6.94%) for substance use, 795,369 (5.14%) for alcohol use, and 442,559 (2.86%) for illicit drug use. Common reasons given in NYS for not receiving substance use treatment were:

- not being ready to stop using (38.4 %)
- having no health care coverage, not able to afford the cost of treatment (32.5%)
- not knowing where to go to get treatment (21%)
- felt that getting treatment would have a negative effect on their job (17%)
- felt that getting treatment would cause their neighbors or community to have a negative opinion of them (15%).

Once a worker develops an addiction to a substance, work can play an important role in determining the outcome of the addiction. Ideally employers would treat substance abuse as a health, rather than a moral or criminal problem. This would mean encouraging workers with substance abuse issues to seek treatment without punitive consequences (e.g. termination), and facilitating access to treatment resources. Under these circumstances workers will be more likely to come forward and take advantage of the opportunity. With a punitive policy and no easy access to effective treatment, workers will be apt to do the opposite: keep using and hide the problem.

Attempting to quantify the impact of work on substance use in terms of disease incidence is impossible, yet we know that drug use is highly prevalent, and that work deserves attention as a contributor to substance use and abuse, and as a contributor to the immense overall disease burden, resource use, and costs imposed by this problem.
Work and the Incidence of Overweight and Obesity

Many discussions of obesity conceptualize it simply as a technical issue: too many calories ingested and not enough used up. Causes and solutions are primarily seen as individual: eat less and increase activity. Individuals who are obese are frequently viewed in judgmental or moralistic terms as weak, lacking self-control, and lazy. Obesity in this framework is a personal failing.

This is not to say that obesity has not been analyzed in its economic, political, and social context, just to note that this is not the mainstream approach. The dominant paradigm from this perspective sees the increasing incidence of obesity as a result of a shift in the type of foods eaten to more calorie dense offerings, increased caloric intake, and an increasingly sedentary lifestyle.

The American diet has changed dramatically since the Second World War. Corporations marketed processed foods to an increasingly urbanized population. Those foods became relatively cheap to produce and buy and were typically laden with sugars. They are also convenient, requiring little or no preparation. Some commentators have dubbed this the ‘neoliberal’ diet as a result of its connection to the production and marketing practices of large corporations in a setting of decreased government regulation.

Obesity- why is it a health problem?

Americans also have found convenience buying and eating prepared food in places other than the home. Over time restaurants increased the size of the portions served, as a lure to diners seeking increased value for their dollars. This has translated into larger portions at home also, as a new norm for the size of meals has been established. As a result, each American adult ingests on average 800 more calories per day than they did just 50 years ago.

Changes in levels of daily physical activities have also shifted dramatically among Americans. Jobs have become more sedentary, with more people spending time at work sitting or moving minimally, often in front of a computer screen. Urban sprawl and suburbianization, along with notoriously lacking public transportation systems have made car use practically mandatory for most Americans. There is very little walking to get to the grocery store, the pharmacy or the bar. Screens of various types (computer, television, phone) dominate leisure time, starting at a very young age.

As some critics have pointed out, the ‘dominant paradigm’ is limited and does not describe all of the causes of the obesity increase. It is acknowledged that the causes of obesity are complex and multifactorial and the description above is simplified. However, even a schematic outline describes some of the major underlying developments, and is useful for turning our gaze from the individual to the social when trying to explain and understand the explosion of obesity.
The risk of obesity is not shared equally by all Americans, in much the same way as most other health problems. There is a social gradient for obesity which has been noted for both income and race. Simply put, the lower the income the higher the risk of obesity. Likewise, non-whites have a higher incidence than whites.¹⁸

**Work and Obesity**

At first glance work may not seem to have obvious connection to the increased incidence of obesity. An emerging literature, however, particularly the work of Schulte and collaborators from NIOSH has illuminated a number of potential pathways, albeit some better established than others. Obesity can be both an outcome of working under conditions that promote obesity, and a risk factor for the development of disease through an interaction with other workplace and health conditions.¹⁹-²⁴

Examples of ways in which workplace conditions may contribute to the development of obesity include:

1) **Sitting/sedentary work**

As noted in the description of the ‘dominant paradigm’ to explain the increase in obesity, the increase in sedentary lifestyles is seen as an important development. Presumably, the reduction in physical activity results in less calorie expenditure. If the dietary caloric intake does not change then the imbalance between intake and expenditure is augmented, and if sustained, will result in ongoing weight gain.

Work has not been immune to the increase in sedentary activity. More and more jobs require less physical exertion and more sitting.²⁵-²⁹ In this way work is contributing to the generalized reduction in physical activity, and clearly should be considered a contributor to the obesity epidemic through this mechanism.

2) **Job stress**

Various health outcomes, most prominently cardiovascular and mental health issues, have been clearly linked to stressful working conditions.³⁰-³⁸

Workplace stress may increase the risk of obesity in several ways. In response to stress, workers may seek more ‘comfort foods’, typically high calorie and energy dense. After a long stressful shift, workers may be too tired to cook and will look for processed foods that are easy to prepare or can be conveniently purchased. Likewise, there may not be time or energy before a shift to prepare a healthy meal or snacks to be taken to work. On demanding jobs, workers may have very little time to sit for a regular meal, and instead may rely on quickly ingested, high calorie snack foods or caffeinated drinks as an alternative. Stress can also reduce a worker’s ability to exercise, reducing calorie use. Daily hassles related to work can interfere with home life and generate role strain, especially for parents or caregivers.
3) Shift work

Shift work has also been associated with the increased risk of obesity. Presumably some of the same mechanisms as described for work stress generally would be operative with shift work. In addition, shift work disrupts normal circadian and hormonal cycles potentially altering metabolism and how the body utilizes calories.

4) Chemical exposure

Obesity can be a direct result of chemical exposure. Substances with endocrine or lipid metabolism disrupting properties, such as Bisphenol A and phthalates, cause weight gain through a variety of mechanisms. Some of these occur in utero, but others alter hormones that regulate appetite and satiety, alter basic metabolic rate, insulin sensitivity and lipid metabolism. Exposures to obesogenic endocrine disruptors over the life span, for some, may have appetite altering qualities in terms of both quantity and types of food eaten. Exposure to these chemicals can be widespread. For example, phthalates are found in many consumer products including adhesives, paints, packaging, children’s toys, electronics, flooring, medical equipment, personal care products, air fresheners, food products, pharmaceuticals and textiles.

Obesity can also be a risk factor contributing to the development or increased seriousness of other health conditions. Examples include:

1) Musculoskeletal disorders
2) Osteoarthritis
3) Asthma
4) Mental health/substance abuse
5) Diabetes

Quantifying the Work/Obesity Connection

The development of obesity reflects a complex multifactorial process. Work clearly has the potential to contribute to the development of obesity, and to interact with obesity to produce ill health. The full extent of these interactions is unknown as research into these issues remains relatively undeveloped. In the current context there is no way to accurately quantify how much obesity can be attributed to workplace conditions. The precise role obesity plays interacting with other workplace and health conditions to produce ill health is even more difficult to ascertain. However, as the examples described above indicate, the connection between work and obesity has already been shown to be substantial, and is very likely to grow stronger as our knowledge base develops.
Chapter 5

COSTS OF OCCUPATIONAL DISEASE

Estimating Overall Costs

The Landrigan/Markowitz report estimated the costs of occupational disease in New York State. They used a variety of data sources to produce an estimate for occupational cancer, heart disease and stroke, end stage renal disease, chronic respiratory disease and pneumoconiosis. As they note, this is only a partial list of occupational diseases, and the costs they were able to estimate for these diseases were not comprehensive, resulting in an underestimate of overall costs. Despite these limitations the economic burden of occupational disease was striking, $685 million per year, equivalent to about $1.4 billion in 2019 dollars.

Since Landrigan/Markowitz, J. Paul Leigh has produced a body of work that can be used to update occupational disease estimates. \(^1\)\(^-\)\(^{16}\) Leigh’s work utilizes an increased number and types of data sources, and has produced a uniform approach for all diseases and injuries. The basic approach he uses is similar to Landrigan/Markowitz:

1) Determine the incidence of various injuries and illnesses
2) Determine the proportion of overall incidence that is occupational in origin
3) Estimate the costs for a case of each type of injury and illness with costs divided into:
   a. Direct costs defined as “spending on hospitals, physicians, pharmaceuticals, and nursing homes”
   b. Indirect costs defined as “current and future lost earnings, fringe benefits, and home production (e.g. making home repairs, cooking, cleaning, and rearing children)”

Leigh estimated the costs of occupational disease in the US, both fatal and non-fatal cases, to be $57.81 billion based on 2007 figures for both fatal and non-fatal disease rates and currency value. \(^1\) Table 26 updates figures for New York State. Waehrer provided state-by-state figures. The total costs of $57.81 billion were multiplied by Waehrer’s NYS factor (5.69%), resulting in an estimate for NYS costs at $3.289 billion. \(^6\)\(^-\)\(^8\) Adjusting cumulative inflation rates from 2007 to 2016 for both medical inflation (32.118%) and wage inflation (15.734%) brought the figure up to $4.077 billion. \(^17\)

The Distribution of the Costs of Occupational Disease

The overall economic costs of occupational diseases and injuries were estimated by Leigh to be $249.6 billion. Workers’ Compensation, the state-based system established to pay for the direct and indirect costs of work-related injuries and diseases covered only $55.4 billion (22%) of the total. As Leigh notes, Workers’ Compensation payments for restitution of lost wages “rarely, if ever” exceed 70% of the actual wages lost. Most of the time they cover far less. In addition, Workers’ Compensation benefits do not cover lost fringe benefits or home production.
As many as 95% of those with an occupational disease receive no payment at all from Workers’ Compensation. Consequently, Leigh’s estimate that Workers’ Compensation pays for 22% of the costs of occupational diseases and injuries combined, is certainly substantially lower for occupational diseases.²

| TABLE 26 Estimated Occupational Disease Costs in NYS (based on contribution to US costs) |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| US costs for fatal and non-fatal occupational disease cases¹ | NYS costs for fatal and non-fatal occupational disease cases² | NYS costs for fatal and non-fatal occupational disease cases adjusted for medical and wage inflation, 2007-2016³,⁴ |
| $57,810,000,000 | $3,289,938,085 | $4,077,088,158 |

¹ Leigh 2011
² Waehrer et al.2004 (5.69%)
³ Leigh, conversation 2016, [formula: 1/2 x (medical inflation + wage inflation)]
⁴ Halfhill 2018

<table>
<thead>
<tr>
<th>TABLE 27 Distribution of Costs of Occupational Disease in NYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total estimated costs</td>
</tr>
<tr>
<td>Employers</td>
</tr>
<tr>
<td>Sick workers and their families; taxpayers</td>
</tr>
<tr>
<td>Total estimated costs</td>
</tr>
</tbody>
</table>

Source: Leigh 2011, 2012

Costs are distributed among employers, ill workers and their families, and taxpayers. Employers pay for Workers’ Compensation insurance. Some employers also contribute to payment for employees’ health insurance which is utilized when occupational disease is not paid for by Workers’ Compensation. Table 27 estimates the proportion of the costs of occupational disease borne by employers. Leigh estimated the total cost of occupational disease to be $57.8 billion with $20.83 billion (36%) in direct costs and $36.97 billion (64%) in indirect costs. If it is assumed that employers pay for 22% of the direct costs and the lost earnings portion of the indirect costs through Workers’ Compensation and 50% of other direct costs (i.e. medical costs paid for by private health insurance), their share of the total costs would be $16.90 billion or 29% of the total. In New York employers would pay about $1.18 billion a year. The employer share is actually likely to be significantly less for occupational disease as the assumptions used for the estimates are generous.

The other 71% of the costs are paid by ill workers and their families, and taxpayers. In New York this amounts to about $2.89 billion annually. These costs include co-pays, deductibles, contributions to insurance premiums and other out-of-pocket medical expenses. Sick workers pay for a portion of these costs and taxpayers contribute to publicly funded health care under Medicare and Medicaid. Indirect costs are likewise covered by publicly funded benefits including Social Security Disability Insurance.
**Hidden Costs**

Costs not captured by the methods employed by Leigh are important additions to the overall burden of occupational disease.¹⁸-²⁰ ‘Pain and suffering’ is a shorthand way of describing some of these costs, which encompass a variety of impacts. For an injured worker it may literally describe the day to day reality of living with a chronic illness that may be progressive or even eventually fatal. ‘Pain and suffering’ also describes the anguish of lost abilities and the frustration of not being able to participate in social and recreational activities that were once sources of pleasure. It describes the impact of losing a job that was a major source of identity, pride, and social standing as well as social contact. ‘Pain and suffering’ extends to partners, children and close family members of ill workers. Taking care of an ill or disabled partner exacts a tremendous toll over time. As Leigh comments: “pain and suffering can be terrible for a child” when a parent dies from an occupational disease. These effects are extremely difficult to quantify, but are no doubt substantial. Some estimate these costs to be greater than those of occupational disease and injury combined. They are borne entirely by ill workers and their families.

Also uncounted are costs to employers for absences, decreased productivity, and recruiting and training replacement workers. When workers miss work due to illness their absence clearly decreases productivity. ‘Presenteeism’, when ill workers come to work, but are unable to perform at a high level, also reduces productivity, but may be less obvious.²¹-²⁵ When ill workers can no longer work, employers are faced with the task of finding and training replacements. The difficulty of this task depends on a number of factors and costs increase along with the difficulty.²⁶

**Conclusions**

Using updated methods, we estimated the costs of occupational disease in New York State to be over $4 billion a year, about 3.25 times greater than those estimated by Landrigan/Markowitz. The cost burden is tremendous. Injured workers and their families bear the major brunt of the costs. Taxpayers also contribute a substantial amount to the costs of occupational disease. Given that, under the Occupational Safety and Health Act, employers have the responsibility of creating and maintaining a safe and healthy workplace, their contribution of less than 30% to the costs of occupational disease is strikingly low.
Chapter 6
CLINICAL OCCUPATIONAL HEALTH RESOURCES

The Landrigan/Markowitz report identified a serious lack of occupational health clinical resources focused on the identification and prevention of occupational disease in New York State.¹ The deficiencies they recognized are largely still in place in the private health care sector, and have actually worsened since their report came out in 1987. However, as the report recommended, a publicly funded Occupational Health Clinic Network (OHCN) was established in 1987 and has contributed to addressing these needs.²-⁶

Occupational Health in the Private Health Care Sector

While there is no central database to identify or quantify private sector doctors and clinics that provide occupational medicine services, experience suggests the number of providers has increased since Landrigan/Markowitz. With the decline in manufacturing and the loss of large plants, there are fewer employers that maintain an on-site occupational medicine service or an occupational medicine specialist. The trend has been for employers to contract out these services to providers in the community. These industrial clinics may be free standing or a service of a parent institution, usually a hospital.

The characteristics of these services are similar to those described by Landrigan/Markowitz:

1) A focus on the treatment of acute injuries, pre-employment examinations, examinations to comply with specific regulations (e.g. Department of Transportation requirements for truck drivers), and periodic examinations not specific for occupational hazards
2) Financial dependency on employers creating a potential conflict of interest
3) Lack of involvement in occupational disease prevention without integration with industrial hygiene and training and education staff or resources

In addition, these services:

1) Are often not staffed by Board-Certified Occupational Medicine specialists despite being advertised as ‘Occupational Medicine’ services.
2) Even when staffed by a Board-Certified Occupational Medicine specialist, they are not accessible to the individual injured or ill worker unless referred by an employer with a contract with that provider/clinic.
3) Often include ‘Independent Medical Examinations’, (i.e. examinations provided to Workers’ Compensation insurance carriers and/or employers), usually in cases where the insurer and/or employer is disputing or denying a claim.
The Landrigan/Markowitz report envisioned community-based physicians as continuing to take the leading role in the diagnosis and treatment of occupational injuries and the ongoing treatment of occupational disease after it had been diagnosed by an OHCN clinician. Physicians in the community have traditionally provided care to patients injured or made ill on the job. For the most part, this has meant care for patients with acute musculoskeletal injuries. Much occupational disease went undetected by evaluations in the community due to lack of physician training in occupational which has not improved in the intervening years since Landrigan/Markowitz\textsuperscript{7-8}.

In addition, OHCN clinicians discovered immediately that physicians in the community were not generally interested in taking patients back for treatment after being diagnosed with an occupational disease at an OHCN center. Consequently, the OHCN clinics took on this task, which required the patient be seen at least once every 3 months. Because many patients had complicated Workers’ Compensation trajectories, it often takes years for the issues of the case to be settled. Even then, the OHCN clinics are often called on to continue care indefinitely as no physician in the community (including the patient’s own primary care provider) is willing to take on that role.

This problem has been dramatically compounded in the years since the 1987 report as increasing numbers of physicians in the community have declined to see patients with Workers’ Compensation insurance. This trend has accelerated since the last major round of legislated Workers’ Compensation reform in 2007 and, according to our most recent survey, of 310 medical practices conducted in eight counties, has included virtually every medical specialty except orthopedics, neurosurgery and pain management. Only 20\% of dermatologists, 17\% of ENTs, about 40\% of psychiatrists/psychologists and 50\% of pulmonologists were accepting new Workers’ Compensation patients as listed in Table 28.\textsuperscript{9-12} Since then, the number have gotten worse. Physicians already feeling burdened by increased demands by health insurers, have found the Workers’ Compensation paper work and process to be simply intolerable. In many parts of the state this lack of providers has reached crisis proportions with patients forced to travel long distances to seek care.

It should also be noted that some of the practitioners that continue to accept Workers’ Compensation are unable and/or unwilling to fill out the necessary paper work and to meet the other needs of the Workers’ Compensation process. Their patients suffer as the Workers’ Compensation benefits they receive are below what they are entitled to, and are sometimes cut altogether.\textsuperscript{9,10} This is another reason that some patients might seek care from other resources.
### Table 28: Medical Practices Accepting New Patients compared with New Workers’ Compensation Patients in Cayuga, Cortland, Fulton, Hamilton, Herkimer, Madison, Oneida, and Onondaga Counties, 2013 (n=310)

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Number of Practices</th>
<th>Accepting New Patients</th>
<th>Accepting New Workers’ Compensation Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergy</td>
<td>5</td>
<td>100%</td>
<td>20%</td>
</tr>
<tr>
<td>Dermatology</td>
<td>5</td>
<td>100%</td>
<td>20%</td>
</tr>
<tr>
<td>ENT</td>
<td>6</td>
<td>100%</td>
<td>17%</td>
</tr>
<tr>
<td>Family</td>
<td>104</td>
<td>59%</td>
<td>37%</td>
</tr>
<tr>
<td>Internal</td>
<td>68</td>
<td>72%</td>
<td>23%</td>
</tr>
<tr>
<td>Neuro Surgery</td>
<td>6</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Neurology</td>
<td>18</td>
<td>100%</td>
<td>61%</td>
</tr>
<tr>
<td>Ortho Surgery</td>
<td>26</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>Physical Medicine/Pain Management</td>
<td>12</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>13</td>
<td>69%</td>
<td>38%</td>
</tr>
<tr>
<td>Psychology</td>
<td>34</td>
<td>58%</td>
<td>41%</td>
</tr>
<tr>
<td>Pulmonology</td>
<td>8</td>
<td>88%</td>
<td>50%</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>5</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>76%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Source: Occupational Health Clinical Center, SUNY Upstate Medical University internal data

### Occupational Medicine Specialists: Number and Geographic Distribution

Physicians trained in occupational medicine are key to the diagnosis and prevention of occupational disease. Board Certification is an important indicator of training and suggests a certain level of competency. The Landrigan/Markowitz report demonstrated a shortage of Board-Certified Occupational Medicine specialists in the state. For our report, the current number of Occupational Medicine specialists in the state was assessed.

**Methods**

Occupational Medicine specialists are residency trained and must pass an exam to become Board Certified. Their training focuses on the identification, treatment and prevention of work-related diseases and injuries. However, residencies in the specialty are few in number and small in size, limiting the number of practitioners with this training and expertise. All Board-Certified Occupational Medicine specialists in New York were identified at the American Board of Preventive Medicine (ABPM) website. The ABPM is the organization responsible for certifying Occupational Medicine specialists and maintains a list of all current Board-Certified physicians.

Beyond enumerating the number of occupational medicine specialists, it is important to determine if they practice clinically and if their services are realistically available to individual worker/patients. In order to treat patients with work related illnesses and injuries and to bill
Workers’ Compensation in New York state, physicians must apply for a rating from the Workers’ Compensation Board (WCB). Physicians coded by the WCB are able to evaluate patients with possible work-related conditions and bill Workers’ Compensation insurance. All physicians coded as Occupational Medicine specialists by the New York State Workers’ Compensation Board were identified from the New York State Workers’ Compensation Board’s website. The practice location and whether the practitioner is accepting new patients was ascertained. Each practitioner was then searched via Google to attempt to determine the setting within which they practice.

Results

Landrigan/Markowitz identified 73 occupational medicine specialists in the state out of a total of about 26,000 physicians. According to the ABPM there are currently 153 Board Certified occupational medicine specialists out of a total of 73,299 physicians in New York State. The number of occupational medicine specialists per 1000 physicians was 2.8/1000 and 2.08/1000 in 1987 and 2020 respectively. While the absolute number of occupational medicine specialists has increased, their presence as a proportion of all physicians has diminished by almost a quarter.

According to the New York State WCB there are 44 Occupational Medicine specialists who have been coded, 7 of whom are not listed as Board Certified by the ABPM. Of the 37 Board Certified Occupational Medicine specialists coded to accept Workers’ Compensation as payment only 30 are accepting new patients.

The 30 Board Certified Occupational Medicine specialists are distributed around the state as follows:

<table>
<thead>
<tr>
<th>City/Region</th>
<th>Number of Occupational Medicine Physicians on Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York City</td>
<td>6</td>
</tr>
<tr>
<td>Long Island</td>
<td>5</td>
</tr>
<tr>
<td>Lower Hudson Valley</td>
<td>1</td>
</tr>
<tr>
<td>Albany</td>
<td>6</td>
</tr>
<tr>
<td>Eastern New York</td>
<td>2</td>
</tr>
<tr>
<td>Syracuse</td>
<td>1</td>
</tr>
<tr>
<td>Central New York/Southern Tier</td>
<td>3</td>
</tr>
<tr>
<td>Rochester</td>
<td>4</td>
</tr>
<tr>
<td>Finger Lakes</td>
<td>0</td>
</tr>
<tr>
<td>Buffalo</td>
<td>1</td>
</tr>
<tr>
<td>Western New York</td>
<td>1</td>
</tr>
</tbody>
</table>
Forty percent of the occupational medicine specialists accepting new patients are located in the New York City/Long Island/Lower Hudson valley area. Another 27% are located in the Albany and Eastern New York area. Despite the similarity in size to Albany and heavier concentration of industry, Syracuse and Rochester have only 3% and 13% of the total respectively. Buffalo, a larger city with an historically heavier concentration of industry only has 1 Occupational Medicine specialist. In contrast, the Southern tier, which is relatively sparsely populated has 3 specialists.

Nine of the 30 specialists (30%) practice in the OHCN. Of the remaining 21, twelve practice as part of a hospital based ambulatory care system, 8 in private practices, and 1 as part of a large multi-specialty group. Just under half (10) practice in settings advertising services primarily to employers. The practices of the remaining 11 could not be further characterized from their internet presence.

**Occupational Health Clinic Network**

To address the scarcity of occupational health services focused on occupational disease, the Landrigan/Markowitz report recommended the establishment of a publicly funded Occupational Health Clinic Network (OHCN). The envisioned network, which came to fruition in 1987, was to be regionally based and focused on the diagnosis and prevention of occupational disease. The unique features of the OHCN included:

- Public funding to promote independence from employers
- A multidisciplinary team to provide services including an Occupational Medicine Specialist, Industrial Hygienist, Social Worker, and Outreach/Education specialist 17-19
- Universal accessibility for patients desiring evaluation
- A community based Advisory Board, the majority of whom are, or represent workers directly affected by unhealthy working conditions. A key function of the Advisory Board was to help guide the centers in targeting services to high risk workers and workplaces.

The central activity of the OHCN clinics has been the clinical evaluation of individual patients with suspected work-related health conditions. Since its inception over 30 years ago, OHCN clinics have evaluated 105,664 patients in 324,397 visits or group screenings (Table 29), advocated for workplace changes to allow for safe stay or return to work, and have helped patients obtain benefits from the state’s very difficult Workers’ Compensation system.20-22 Currently funded at about $9.6 million dollars, the OHCN is comprised of eight regional centers and an additional center with an agricultural health focus and a statewide mandate. 23
**TABLE 29** New York State Department of Health, Occupational Health Clinical Network
Individual and Group Patients Seen 01/01/1987 through 03/23/2021

<table>
<thead>
<tr>
<th></th>
<th>Individual Patients</th>
<th>Group Patients</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits</td>
<td>211,769</td>
<td>112,628</td>
<td>324,397</td>
</tr>
<tr>
<td>New Patients</td>
<td>47,023</td>
<td>58,641</td>
<td>105,664</td>
</tr>
</tbody>
</table>

**Limitations**

The number of Board-Certified Occupational Medicine physicians able to evaluate patients in New York state would seem to be relatively accurately ascertainable from the sources accessed, however, the WCB list suffers from shortcomings that could impact the results. The WCB list of specialists accepting new patients has been notoriously inaccurate, with many doctors listed not actually accepting new patients, or even actively practicing. Consequently, the number of Occupational Medicine specialists accepting new patients and accessible to workers may be over-estimated.

**Conclusions**

The number of Board-Certified Occupational Medicine specialists in New York state remains minuscule. While the number of specialists in the state has more than doubled since the Landrigan/Markowitz report, the number actually available to evaluate workers with injuries or illnesses is only 30 for the entire state. Wide swaths of the state are without any specialists and the historically industrial population centers of Syracuse and Buffalo have only one per city. While a plurality of specialists practice in the NYC/Long Island area, given the very large population to be served, the specialty remains under-represented. The development of the OHCN has made a significant contribution to the number of practicing specialists, making up almost a third of the total and being the only specialist in the population centers of Syracuse and Buffalo.

In addition, physicians who are employed either directly by corporations, or under contract in a hospital-based or free-standing clinic generally see patients referred by employers and are not necessarily accessible to individual patients. Even if they nominally accept self-referred individuals, many patients might be reluctant to seek care from facilities they know depend on contracts with employers. Nearly half of the non-OHCN specialists’ practice in settings explicitly offering these kinds of services. The remaining 11 work in settings that are typically employer oriented, but their internet descriptions did not offer enough information to make a certain determination.

In summary, despite the creation of the OHCN, workers in New York State seeking an employer-independent Occupational Medicine specialist to evaluate a potential occupational disease remain grossly under-served.
Chapter 7
CONCLUSIONS AND RECOMMENDATIONS

Despite a significant governmental and non-governmental occupational health infrastructure, and innovations including the OHCN and OSHTEP, occupational disease remains a major public health problem in New York State.

- Over 7 thousand workers die from an occupational disease each year, and at any given time over 2 million workers are suffering from an occupational disease
- Work related musculoskeletal disorders, stress related illness, and infectious diseases (COVID-19) are increasingly recognized
- Millions of workers in NYS are exposed to a wide array of hazards and working conditions that put them at risk of occupational disease.
- The costs of occupational disease are tremendous, estimated to be over $4 billion a year, of which injured workers, their families, and taxpayers pay the vast majority
- Despite the creation of the OHCN clinical occupational health resources remain scarce and inadequate

Effectively recognizing, treating, compensating and preventing occupational disease will require a broad-based effort involving both governmental and non-governmental safety and health organizations working in collaboration with labor unions, Worker Centers’ and other advocacy groups to stimulate development of both a road map for change and action to effectuate it. In the final section of this report we offer some recommendations that flow from our findings to frame this effort.

Recommendations

Adequate Funding

- Increase funding for governmental and non-governmental occupational health programs commensurate with the need for services
- Develop mechanisms that make OHCN and OSHTEP funding sustainable and keep pace with increases in the cost of living

New York State funds both state government and non-state organizations to carry out specific occupational disease related functions. These include programs in the Department of Labor, Department of Health, the Occupational Health Clinic Network (OHCN), and the Occupational Safety and Health Training and Education Program (OSHTEP). The State also provides funding for academic occupational health programs at Hunter and Queens College.

While the State agencies have suffered from general austerity and low prioritization, the OHCN and OSHTEP have additionally faced insecure funding and flat allocations that endure for many years, in effect resulting in yearly budget cuts and program reductions.
To fund some of these programs the State instituted a funding mechanism that requires
employers to pay a small surcharge on their annual Workers’ Compensation premiums. While
the amount the State collects through this mechanism is shrouded in mystery, the scant
information available suggests that considerably more is collected than what is used to fund the
programs for which it was intended.

Consequently, the State could increase funding for occupational disease related activities
by simply using more of what is already collected for that purpose, for that purpose, instead
of diverting the funds to other use. If increased revenue is necessary, however, the surcharge
could be increased. Businesses who are legally responsible for creating and sustaining a healthy
workplace are in actuality socializing much of the costs of their failure to do so. Paying their fair
share either through this or other mechanisms would be a morally just way of increasing funding
for programs aimed at reducing the burden of occupational disease.

In addition, mechanisms that would keep the OHCN and the OSHTEP on more secure
footing should also be developed. An indexing mechanism would help these programs at least
keep pace with inflation without the need for an annual legislative lobbying campaign that,
more often than not, proves fruitless. Currently the OHCN has been flat funded for 13 years and
counting, with OSHTEP faring even worse.

Building on the existing OSH infrastructure

- Systematically analyze existing data on occupational disease from the WCB, the
  OHCN, and state registries to target prevention efforts
- Develop other data sources to provide more comprehensive information on
  occupational disease workplace hazards
- Improve the Workers’ Compensation process to provide an incentive for clinicians
to participate
- Eliminate barriers to care for occupational disease by Workers’ Compensation
  reforms that curb insurance carrier powers to deny and delay claims

The already existing OSH infrastructure in New York State includes both governmental
and non-governmental agencies and organizations and provides a strong basis on which to build
augmented efforts on occupational disease.

The identification of occupational disease suffers from a lack of data. Existing data
sources including Workers’ Compensation (WC), the OHCN patient database, Occupational lung,
pesticide, and heavy metals registries, and Bureau of Labor statistics should all be systematically
and regularly analyzed and reported in a form that is accessible to all who are interested. Efforts
to include occupation in medical records would also increase identification of occupational
disease.
As detailed in this report, all of these data sources suffer from serious shortcomings and will need to be complemented by developing new sources of relevant data. The experiences of workplace and community-based organizations involved in occupational safety and health including unions, COSH groups, and Workers’ Centers should be included as potentially rich sources of data on occupational disease.

The clinical diagnosis and treatment of occupational disease could be strengthened by supporting the OHCN, which remains the only statewide clinical resource focused on occupational disease and staffed with a multidisciplinary team experienced in addressing all facets of patients’ clinical needs.

Community based resources including specialist and primary care clinicians (MDs, NPs, and PAs) are an essential component of the health care system providing care to workers with occupational disease. Their participation in this endeavor, however, has been declining. To encourage more clinicians to participate, the Workers’ Compensation Board needs to more decisively act to make navigating the WC system at least as easy as the private health insurance system. In addition, the OHCN could be used as a resource for other clinicians offering training and consultation without necessarily taking over the care of the patients.

A key reform in attempting to improve the clinical care of patients with occupational disease would be the elimination of barriers to care and to disability benefits imposed by the current way work related illnesses are handled. Disease claims are routinely challenged by WC insurance carriers resulting in patients losing access to diagnostic and treatment resources, often for long periods of time. This can have detrimental effects on the patient’s course, delaying or blocking recovery, or worse, leading to irreversible consequences. Fundamental reform is necessary to end the problem of patients suffering as insurance carriers fight liability.

**Prevention of occupational disease**

- **Development of a statewide occupational disease prevention agenda that includes both governmental and non-governmental organizations in its crafting**
- **Incentivize employers to engage in occupational disease prevention efforts by reducing their ability to socialize the costs of occupational disease and by more assertive State intervention and regulation of workplace hazards**

The prevention of occupational disease depends on data that identifies workers at high risk, and strategies that translate the data into effective action. New York State has largely accepted the idea that prevention, in the private sector at least, is a federal responsibility and consists mainly of OSHA standards and inspections. The State has, however, on occasion stepped in to address problems where OSHA has proven lacking. Recent examples include hazards in nail salons, safe patient handling, and airborne infectious disease in the workplace. A shift from a reluctant, only in dire circumstances stance to a more active and assertive approach is a necessary first step toward more effective prevention.
The State could develop a Statewide prevention agenda which could unify the efforts of the disparate participants in the OSH infrastructure, and could amplify the impact of limited resources. It would be crucial to tap the expertise and experience of non-governmental organizations including unions, the OHCN, COSHs, and Worker Centers in the construction and implementation of this agenda. These organizations often have more direct and intimate relations with workers at high risk. They also have experience with varying approaches to outreach, training, and education that can be profitably utilized.

Along with the carrot of increased resources for training and education, the State could also wield the stick of increased costs to incentivize employer prevention efforts. Those costs could originate in enforcement efforts with teeth as part of legislation like Safe Patient Handling and the new Airborne Infectious disease regulation. Existing regulations that require employers with poor safety records to obtain safety consultations could be broadened and strengthened to include occupational disease more effectively. As noted above, the WC insurance surcharge could be increased to fund preventive activities. And employers could be required to pay for workers to be trained to become safety and health advocates in their own workplaces. Elimination of barriers to participation on workplace health and safety committees, including paid time off for training and participation could also be mandated.

Integration and Collaboration

- **Development of a statewide occupational disease prevention agenda that includes both governmental and non-governmental organizations in its crafting**
- **Continue the collaboration between these groups in the implementation of the agenda**

One of the major characteristics and failings of the State’s current prevention efforts is the lack of communication and collaboration between OSH related agencies and between State and non-State based OSH resources. Each agency and organization focuses on its specific aspect, with some collecting data, others engaged in clinical work, still others doing training and education, all rarely, if ever, coming together to discuss how the various pieces of their work fit together.

The result is a piecemeal approach that minimizes potential effectiveness. With collaboration the identification, treatment, and prevention of occupational disease could be planned, coordinated, implemented and evaluated. For example, Workers’ Compensation data could be shared, analyzed and used for targeting high risk occupations and workers. Workers’ Compensation, DOL, and OHCN data could be used to aid and focus enforcement efforts. Agencies and organizations could freely consult each other when their additional expertise and skills are needed in a specific situation.
Toward this end the State could convene a group focused on occupational disease that brings all of the relevant agencies and organizations together to implement a joint statewide occupational disease agenda.

**Building worker capacity and expanding worker participation**

- **Build worker based occupational health capacity**
- **Include workers and worker advocacy organizations as central participants in collaborative occupational health efforts**

There are at least three major reasons why workers and organizations that advocate for workers should be included as a central participant in prevention efforts. First, from a justice standpoint, since workers are the ones taking the risk and paying the price with their health, they should have a say in what the prevention of occupational disease should consist of. Second, workers have valuable experience and expertise about their jobs and workplaces that should be tapped in developing and implementing preventive efforts. And third, even with expanded resources there is no way for the State to be able to address the problems of every workplace in the state. Trained workers who know their rights and are empowered to participate would be an invaluable resource in efforts to bring effective prevention of occupational disease to every workplace.

For these reasons the building of worker OSH capacity should be a major focus of the State’s efforts, and adequate resources should be devoted toward this end.

In 1987 the Landrigan/Markowitz report documented the massive toll occupational disease took on ill workers, their families, and society as whole. More than thirty years later thousands of workers die and many thousands more fall ill as a consequence of exposure to hazardous working conditions. Millions continue to work under conditions that put them at risk of occupational disease. The resources available to identify, treat and prevent occupational disease remain appallingly limited in the face of such a large-scale problem. Landrigan/Markowitz helped pave the way for the creation of a publicly funded occupational health clinic network. What is needed now is a comprehensive approach that builds on New York State’s safety and health infrastructure and addresses the changed landscape of work.
ACKNOWLEDGEMENTS

The authors are grateful for: assistance from Antoinette Longo over many years, ever-present help from Ana Manning, research assistance from Menas Hadi and Haley MacDougall, the graphic artistry/printing expertise of Denise Lowery, Paul Mangianello, and Billee Wilbur at KinaneCo, provision of TURI data from Heather Tenney, guidance from Jack Kevin at the Division of Research & Statistics New York Data Center, NYS DOL, provision of NYS DOH OHNIS data from Alicia Fletcher and Nehel Verma, guidance from Cara Halldin at NIOSH, guidance of and provision of data from J. Paul Leigh, advice from Federica Manetti and encouragement from Joseph Zanoni. We thank our reviewers for their time and attention on our draft: Joel Shufro, Matt London, Kevin Riley, Nancy Simcox, Jim Brophy, Lin Nelson, Michael Silverstein and Steven Markowitz. Their comments, suggestions, and critique improved the report considerably. Of course, we remain responsible for any mistakes and shortcomings. We acknowledge that the reviewers may not necessarily be in complete agreement with all of our inclusions and omissions, nor our conclusions and recommendations. Hopefully, the report is the start of a conversation, not an end.
LIST OF TABLES AND FIGURES

Table 1 Occupational Disease Mortality Estimates in New York State, 2010-2017
Table 2 Attributable Fraction (%)
Table 3 Estimated Work-Related Mortality in the United States and in New York State in 2016, by causes of death, age 15-84
Table 4 Occupational Disease Mortality in New York State in 2016 by Gender, Age and Cause Estimated by Attributable Fraction
Table 5 Incidence Rates and Numbers of Nonfatal Occupational Illnesses by Industry Sector and Category of Illness, New York, 2016
Table 6 Excess Occupational Disease Burden in the United States and in New York State in 2016
Table 7 Adults with Health Conditions Expected to Contribute to Future Occupational Disease Diagnosis
Table 8 Numbers of Establishments, Number of Paid Employees and Payroll in Industries using Toxic Chemicals, 2013, NYS
Table 9 Reported Numbers of Cases and Prevalence Rates of Adults with Blood Lead Levels (BLL) ≥10 µg/dL and Blood Lead Levels ≥25 µg/dL§, in New York State (State Adult Blood Lead Epidemiology and Surveillance (ABLES) Programs), 2014
Table 10 Reported Numbers of Adults with Blood Lead Levels ≥25 µg/dL, by Exposure, in New York State (State Adult Blood Lead Epidemiology and Surveillance (ABLES) Programs), 2014
Table 11 Estimated Number of Lead Exposed Adults Workers in NY and US from County Business Patterns, by Selected Industries, 2014
Table 12 Estimated Numbers of Workers Exposed to Silica in the United States and in New York State, by Affected Industry and Exposure Level, (µg/m3), 2014
Table 13 Estimated Numbers of Workers Exposed to Silica in New York State (by Affected Industry and Exposure Level (µg/m3)), 2014
Figure 1 Apparent Consumption of Asbestos in the U.S. from 1991 to 2017, Consumption in Metric Tons
Table 14 Exposure Definitions and Thresholds: Ergonomic
Table 15 Number and Percent of Workforce with Ergonomic Exposures in New York State, 2016
Table 16 Exposure Definitions and Thresholds: Psychosocial
Table 17 Number and Percent of Workforce with Psychosocial Exposures in New York State, 2016
Table 18 Estimated Individual Health Care Occupations at Highest Risk for COVID-19, NYS, 2019 and Estimated Individual Non-Healthcare Occupations at Highest Risk for COVID-19, NYS, 2019
Table 19 Occupational Groups at Higher Risk of COVID-19 Infection, New York State, 2019
Table 20 Low-Wage Occupations (collapsed into 28 occupational groups), New York State, 2018
Table 21 Workers Employed in Low-Wage Jobs, 1950 - 2019, NYS, Age 16-64
Table 22 Labor Force Participation Rate, New York State, by Gender, 1930-2018
Figure 2 Labor Force Participation Rate, New York State, by Gender, 1930-2018
Table 23 Workforce Engagement in the United States and in New York State, 2018
Table 24 Low-Wage Occupations (collapsed into 28 occupational groups) by Race, New York State, 2018
Table 25 Prevalence of Drug Use in Adults, United States and New York State, 2018 and 2019
Table 26 Estimated Occupational Disease Costs in NYS (based on contribution to US costs)
Table 27 Distribution of Costs of Occupational Disease in NYS
Table 28 Medical Practices Accepting New Patients compared with New Workers’ Compensation Patients in Cayuga, Cortland, Fulton, Hamilton, Herkimer, Madison, Oneida, and Onondaga Counties, 2013 (n=310)
Table 29 New York State Department of Health, Occupational Health Clinical Network, Individual and Group Patients Seen 01/01/1987 through 03/23/2021

*Technical Notes giving details, methods, and additional sources are available upon request.*
REFERENCES

Chapter 1

Occupational Disease in New York State


**Occupational Disease: Estimating Mortality and Morbidity**


**Chapter 2**

**ESTIMATING THE EXTENT OF HAZARDOUS WORK**


**Exposure to Hazardous Materials**

**Chemicals**


**Lead**


Silica


Asbestos


Ergonomic Exposure


62. E-mail correspondence Jack Kevin, Deputy Director, Division of Research & Statistics New York Data Center, NYS DOL, 7/19/2019 12:59:36 PM.

Psychosocial Exposure


COVID-19 and Infectious Disease in the Workplace


Chapter 3

**Work and Inequities of Health: Unequal Risk of Occupational Disease**


**Women**


**Race/Ethnicity**


Chapter 4

Expanding the Definition of Occupational Disease

Defining Workplace Stress and Stress-Related Illness


### Substance Use and Work


40. Weil D. The Fissured Workplace: Why work became so bad for so many and what can be done to improve it. Cambridge, MA Harvard University Press. 2014.


Work and the Incidence of Overweight and Obesity


Chapter 5

COSTS OF OCCUPATIONAL DISEASE


Chapter 6

CLINICAL OCCUPATIONAL HEALTH RESOURCES


12. Occupational Health Clinical Center, survey (n=310), unpublished data.


