



The economics of worker safety, health, and well-being

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Economic Research and Support Office (ERSO) mandates

- Develop and implement an **economics research agenda**
- Conduct **applied economic research** on economic factors and the value of prevention
- Evaluate the **economic impact of NIOSH programs and recommendations**
- Perform **economic analysis and review of regulations**
- Provide **technical assistance and training**
- Promote the use of **economic metrics**

Economists co-lead the Healthy Work Design and Well-being (HWD) cross-sector

Sector Cross-sector	Agriculture, Forestry and Fishing	Construction	Healthcare and Social Assistance	Manufacturing	Mining	Oil and Gas Extraction	Public Safety	Services	Transportation, Warehousing and Utilities	Wholesale and Retail Trade
Cancer, Reproductive, Cardiovascular and Other Chronic Disease Prevention										
Hearing Loss Prevention										
Immune, Infectious and Dermal Disease Prevention										
Musculoskeletal Health										
Respiratory Health										
Traumatic Injury Prevention										
Healthy Work Design and Well- Being										



Economists co-lead the HWD cross-sector

- <https://www.cdc.gov/niosh/programs/hwd/default.html>
- <https://www.cdc.gov/nora/councils/hwd/default.html>
- Focus on protecting and advancing the safety, health, and well-being of workers by **improving the design of work, management practices, and the physical and psychosocial work environment**
- **Holistic perspective on how work affects** overall safety, health and **well-being**, including physical, psychological, social, and **economic aspects**
- HWD health outcomes of interest
<https://www.cdc.gov/niosh/about/strategicplan/researchgoals.html>

Presentation purpose

- Highlight the need for considering public health and economics together
- Use a few illustrative examples to discuss how we have been addressing our mandates, focusing on applied research
- Briefly discuss next steps
- Get feedback from the Board of Scientific Counselors

Research agenda



Broad research agenda

- We study
 - **economic factors** that affect worker safety, health, and well-being
 - **economic burden** of worker injury and illness
 - **value of prevention**
- Economics-related goals and objectives are respectively included throughout the
 - NIOSH Strategic Plan: <https://www.cdc.gov/niosh/about/strategicplan/default.html>
 - National Occupational Research Agenda: <https://www.cdc.gov/nora/default.html>

HWD research priorities <https://www.cdc.gov/niosh/programs/hwd/default.html>

	Agriculture, Forestry and Fishing	Construction	Healthcare and Social Assistance	Manufacturing	Mining	Oil and Gas Extraction	Public Safety	Services	Transportation, Warehousing and Utilities	Wholesale and Retail Trade
Work arrangements or Contingent workers	x	x						x		x
Mental health	x		x							
Fatigue					x	x			x	
Opioids						x				
Total Worker Health approach		x	x				x	x		

Applied economic research

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Economic factor examples

Employment

Paid sick leave (PSL)

Work arrangements

Precariousness

Employment: Employment status, unemployment duration, and health-related metrics among US adults of prime working age – Behavioral Risk Factor Surveillance System, 2018-2019

- Compared **employed** workers to respondents who were **self-employed, short-term (<12 months) unemployed, long-term unemployed, and unable to work**
- Found:
 - Short-term unemployment and self-employment were associated with poor healthcare access
 - Health behaviors and outcomes declined with increasing duration of unemployment and were worst for those unable to work
- Concluded:
 - Access to affordable healthcare is problematic for the self-employed and short-term unemployed
 - **Short-term unemployment is a particularly important locus for intervention and provision of resources to prevent health declines that may hinder re-employment**

Employment: Visual representation of work as a social determinant of health: augmenting Silver et al. (Jan 2022)

Silver SR; Li J; Quay B. Am J Ind Med 2022 Aug; 65(8):697-698 <https://doi.org/10.1002/ajim.23398>

Work as a Social Determinant of Health (SDOH): Selected Pathways

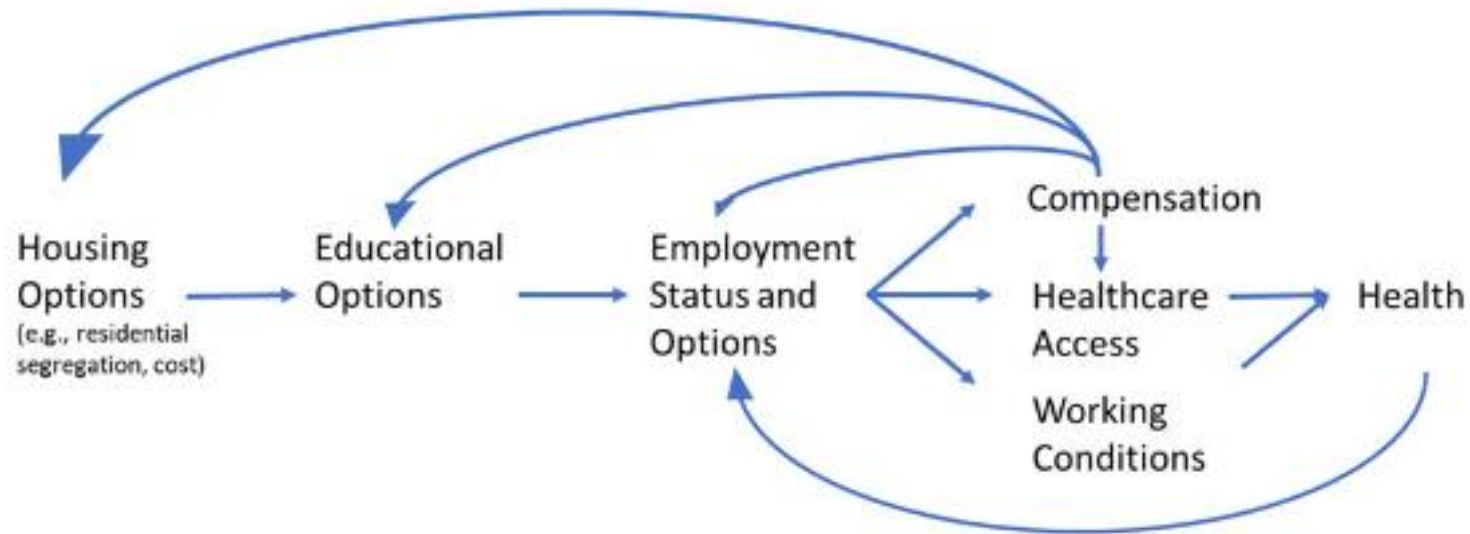


Diagram developed from: Silver, SR, Li, J, Quay, B. *Employment status, unemployment duration, and health-related metrics among US adults of prime working age: Behavioral Risk Factor Surveillance System, 2018–2019*. Am J Ind Med. 2022; 65: 59- 71. [doi:10.1002/ajim.23308](https://doi.org/10.1002/ajim.23308)

PSL: PSL and nonfatal occupational injuries

- Found that during 2005-2008:
 - **Workers with access to PSL were 28% (95% confidence interval = 0.52, 0.99) less likely than workers without PSL to be injured**
 - **The association varied across sectors and occupations, with the greatest differences occurring in sectors and occupations with high risk for injury**
- Used National Health Interview Survey data

Asfaw A; Pana-Cryan R; Rosa R. Am J Public Health 2012 Sep; 102(9):e59-e64 <https://doi.org/10.2105/AJPH.2011.300482>

Work arrangements: Chapter in Handbook of Occupational Health Psychology (3rd edition). Washington, DC: American Psychological Association, Forthcoming

- Reviewed the **definitions, classification, and prevalence** of nonstandard work arrangements and related concepts
- Provided a curated literature review on their **impact on healthy work design and worker well-being**, and their **role in the future of work**

Pana-Cryan R; Howard J; Bushnell T

Work arrangements: Work flexibility and work-related well-being

Found:

- The prevalence of work flexibility remained relatively stable during 2002-2018

Flexibility	Job stress Odds ratio (OR)	Job satisfaction OR	Healthy days Incidence Rate Ratio (IRR)	Days with activity limitations IRR
Work at home	1.22	1.65	0.99	1.09
Time off	0.44	2.15	1.02	0.76
Change schedule	0.80	1.62	1.01	0.88

In bold are statistically significant values at the 0.05 level or lower

- Used General Social Survey – Quality of Worklife (GSS-QWL) data

Precariousness: Precarious work, job stress, and health-related quality of life

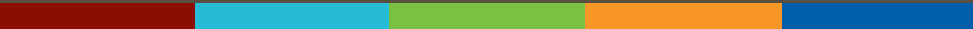
- Constructed a work precariousness scale that included temporariness, disempowerment, vulnerability, and wages; Assessed prevalence and association with well-being outcomes

Precariousness	2002	2006	2010	2014
Low (%)	32.47	33.23	32.16	35.62
Moderate (%)	35.40	32.40	32.46	33.42
High (%)	32.12	34.37	35.37	30.96

Precariousness	Job stress OR	Unhealthy days Coefficients	Days with activity limitations Coefficients
Moderate	0.95	0.07	-0.24
High	1.57	0.39	1.16

- Used GSS-QWL data

Economic burden



Economic burden definition and levels of analysis

- Defined as the broad economic consequences of injury and illness outcomes
- How big is the problem?
 - Priority setting
 - Tracking changes
- Levels of analysis: who pays?
 - Societal
 - Worker
 - Family
 - Organization or employer
 - Other members of society

Three sets of approaches to estimate economic burden

Approach	Comments	Decision makers
Medical Costs and Productivity Losses	<p>Most common</p> <p>Used by Leigh (2011) for NIOSH-sponsored estimates of the national level societal costs of occupational injuries and illnesses</p> <p>Used for analyses at the organization or employer level</p>	<p>Public health community</p> <p>Employers</p>
Risk-Money Tradeoffs	<p>Include mandated approaches that are used to estimate the impact of regulations by federal agencies (Willingness-to-pay [WTP], Value of a Statistical Life [VSL])</p>	<p>Regulatory community</p>
Reductions in health-related quality of life (HRQL)	<p>Include assessments of the Global Burden of Disease (GBD) that use Disability-adjusted Life Years (DALYs)</p>	<p>Public health community</p>

Examples of burden assessments

At the national level

By health and well-being outcome

Over time

Beyond work

At the national level: Cost of lost work hours associated with the COVID-19 pandemic-United States, March 2020 through February 2021

- Estimated the **cost of lost work hours due to:**
 - **economic** (slack work or business condition and could find only part-time work)
 - **workers' own health** (own illness, injury, medical appointment, health or medical limitation)
 - **other COVID-related reasons**
- Found:
 - **In its first year, the cost** of lost work hours associated with the pandemic **was \$138 billion**
 - economic 33.7%,
 - workers' own health 13.7%
 - other reasons 52.6%
- Used before-and-after analysis of data on full-time workers from the 2017-2021 Current Population Survey

At the national level: Injuries that happen at work lead to more opioid prescriptions and higher opioid costs

- Found:
 - During 2010-2019, compared with other injury-caused conditions, **occupational injury-caused conditions resulted in:**
 - **33% higher odds of opioid prescribing**
 - **32.8 more opioid prescription supply days**
 - **\$134 higher average cost**
- Concluded that we need to focus on making work safer and the role employers may play in supporting worker recovery from injury and opioid use disorders
- Used Medical Expenditure Panel Survey (MEPS) data

By health and well-being outcome: Hearing impairment among noise-exposed workers - United States, 2003-2012

- Estimated the prevalence at six hearing impairment levels, measured in the better ear, and the **impact on quality of life expressed as annual disability-adjusted life years (DALYs)**, as defined by the 2013 Global Burden of Disease (GBD) Study
- Found:
 - Among 9 industry sectors, **mining had the highest prevalence** of workers with any hearing impairment, and with moderate or worse impairment, followed by construction and manufacturing
- Concluded that hearing loss prevention, and early detection and intervention to avoid additional hearing loss, are critical to preserve worker quality of life
- Used 1,413,789 noise-exposed worker audiograms from the NIOSH Occupational Hearing Loss Surveillance Project

Over time: Suicide and drug-related mortality following occupational injury

- Estimated the association between receiving lost-time WC benefits and mortality hazard ratios (HRs) for common causes of death and for drug-related, suicide, and alcohol-related mortality
- Found an almost a **3-fold increase in combined drug-related and suicide mortality hazard among women (HR = 2.63) and a substantial increase among men (HR = 1.42)**
- **Concluded that drug-related deaths and suicides may be important contributors to the long-term excess mortality of injured workers**

- Linked New Mexico workers' compensation (WC) data for 100,806 workers injured during 1994-2000 with Social Security Administration earnings and mortality data through 2013 and National Death Index cause of death data

Applebaum KM; **Asfaw** A; O'Leary PK; Busey A; Tripodis Y; Boden LI. Am J Ind Med 2019 Sep; 62(9):733-741

<https://doi.org/10.1002/ajim.23021>

Beyond work: Do injured workers receive opioid prescriptions outside the workers' compensation system? The case of private group health insurances

- Assessed the impact of workplace injury on receiving opioid prescriptions from employer-sponsored private group health insurance (GHI) and how long injured workers receive opioid prescriptions after injury
- Found:
 - **The odds for injured workers relative to non-injured workers to receive opioid prescriptions from GHI within 60 and 180 days from the index date of injury were 4.9 and 1.5, respectively**
 - **The number of opioid prescriptions received within 60 days of injury was 2.5 times higher**
- Concluded that studies that use only workers' compensation medical claim data likely underestimate the impact of workplace injuries on opioid prescriptions
- Used 2013-2015 MarketScan data

Beyond work: Association of parent workplace injury with emotional and behavioral problems in children

	Worry	Depressed	ECBR difficulties	Good attention span	Well-behaved	Gets along with adult
	OR					
Injured parent	1.51	1.50	1.72	0.60	1.16	0.98

ECBR: emotions, concentration, behavior, or being able to get along with other people

- Used 2012-2016 National Health Interview Survey data

Asfaw A; Sauter SL; Swanson N; Beach CM; Sauter DL. J Occup Environ Med 2021 Sep; 63(9):760-770

<https://doi.org/10.1097/JOM.0000000000002249>

Value of prevention examples
Cost-effective interventions

Cost-effective intervention: Potential economic benefits of paid sick leave (PSL) in reducing absenteeism related to the spread of influenza-like illness (ILI)

- Estimated:
 - **the impact of PSL in reducing overall absence due to illness or injury**
 - potential benefits to employers of PSL in reducing absenteeism related to the spread of ILI
- Used published data to compute the share of ILI from the total days of absence, ILI transmission rates at workplaces, wages, and other parameters
- Found:
 - Workers with PSL spent an average of 4.58 days away from work per year due to illness or injury, while workers without PSL spent 3.48 or 1.10 fewer days away from work
 - **Providing PSL could have saved employers \$0.63-\$1.88 billion in reduced ILI-related absenteeism costs per year during 2007-2014** in 2016 dollars
- Used Medical Expenditure Panel Survey (MEPS) data from 2007-2014

Cost-effective intervention: The effectiveness of insurer-supported safety and health engineering controls in reducing workers' compensation claims and costs

- Evaluated the effectiveness of a program in which a workers' compensation (WC) insurer provided matching funds to insured employers to implement safety/health engineering controls
- Compiled pre- and post-intervention WC metrics for the employees designated as affected by the interventions within 468 employers for interventions occurring from 2003 to 2009
- Found:
 - **Total WC claim frequency rates** (both medical-only and lost-time claims) **decreased 66%**
 - **Lost-time WC claim frequency rates decreased 78%**
 - **WC paid cost per employee decreased 81%**
 - **WC geometric mean paid claim cost decreased 30%** post-intervention
 - **Reductions varied by employer size, specific industry, and intervention type**
- Concluded that the program was effective in reducing WC claims and costs for affected employees

Economic impact of NIOSH programs and recommendations

Economic benefits of NIOSH research and services

- **Two RAND reports with a total of six case studies** – see NIOSH Science blogs that include report links:
 - <https://blogs.cdc.gov/niosh-science-blog/2018/01/03/impact-rand/>
 - <https://blogs.cdc.gov/niosh-science-blog/2020/01/06/rand-2/>
- **Measuring the benefits of occupational safety and health research with economic metrics: insights from the National Institute for Occupational Safety and Health:**
 - **Bushnell PT; Pana-Cryan R; Howard J; Quay B; Ray TK.** Am J Ind Med 2022 May; 65(5):323-342
<https://doi.org/10.1002/ajim.23347>
- We plan smaller, in-house case studies

Economic benefits of NIOSH research: The six case studies

- Development of silica dust controls in asphalt pavement milling (asphalt milling)
- Building and disseminating evidence on firefighters' cancer risk
- Assessing impacts of Ohio safety intervention grants for safety equipment
- Developing continuous personal dust monitors (PDMs) for coal miners
- Re-design of ambulance patient compartments for safety

Economic benefits of NIOSH research: Findings from asphalt milling

Illness and injury cases averted (annual average)	Monetary results (annualized)	Time horizon	Examples of omitted benefits
<ul style="list-style-type: none"> • 17—22 fatalities due to lung cancer, nonmalignant respiratory disease, and end-stage renal disease • 71—77 nonfatal cases 	<ul style="list-style-type: none"> • Averted medical costs and productivity losses due to fatal lung cancer only (21% of total fatalities): \$4.9 million/year • WTP value of deaths and nonfatal cases averted: \$304 million—\$1.1 billion/year • Benefits would be about half of above if achieved without NIOSH, but with 15-year delay 	<ul style="list-style-type: none"> • 60 years • Projected in future, following implementation in 2017 	<ul style="list-style-type: none"> • Averted medical costs and productivity losses due to <ul style="list-style-type: none"> (1) fatalities from nonmalignant respiratory disease and end-stage renal disease (2) nonfatal cases

Annualized figures represent conversion of a varying stream of estimated dollar values over the time horizon of the analysis into an equivalent, constant stream of unchanging annual values with the same total present value, using a discount rate to represent the lower value of benefits received further in the future. Ranges for estimated benefits are based on alternative assumptions and discount rates (3% and 7%). Dollar figures are expressed in 2016 values.

Economic analysis and review of regulations

Technical assistance and training



Economic analysis and review of regulations

- All regulations include economic analyses
- We have been assisting with
 - NIOSH regulations (e.g. World Trade Center Health Program <https://www.cdc.gov/wtc/regulations2.html>)
 - other regulations

Technical assistance: resource intensive partnerships

- Social Security Administration
 - Long-term consequences of occupational injury on earnings, disability insurance, and mortality
- Center for Workers' Compensation Studies
- Healthy Work Design and Well-being
- COVID-19 deployments and details
- Disaster science response research on COVID-19 and beyond

Technical assistance: other recent examples

- Actively participating in
 - Steering committees and councils, including the Future of Work <https://www.cdc.gov/niosh/topics/future-of-work/default.html>
 - For example, see December 2022 webinar on Economic security (Science blog forthcoming) <https://www.cdc.gov/niosh/topics/future-of-work/webinar.html>
 - NIOSH's Mental Health Initiative for Health Workers <https://www.cdc.gov/niosh/newsroom/feature/health-worker-mental-health.html>
- Currently, several efforts are undertaken to understand and improve the quality of jobs
 - Recent related activities include ERSO feedback for the:
 - National Longitudinal Survey of Youth 2026 <https://www.bls.gov/nls/>
 - Upcoming Government Accountability Office report on work arrangements
- Participated in the first Conference on Working Environment Economics by the Danish National Research Centre for the Working Environment, December 2022

Training

- Provide annual internal NIOSH training
 - Example series from 2021 with focus on disparities included:
 - NIOSH research findings on the **economic determinants of worker well-being by demographic and employment characteristics**
 - Using **mediation analysis to measure racial disparities in teleworking**
 - **Data sources for estimating rates of injury and illness by age, gender, race, ethnicity, and other demographic variables**
 - Exploring the **complexities of measuring health disparities**: a brief overview of concepts, methods, and economic insights
 - **Disparities in teleworking and unemployment**
- Conducting workshops during conferences
 - Recent example: pre-conference workshop on disparities, 3rd International Total Worker Health Symposium

Upcoming activities

Continuing and expanded priority focus areas

- Work arrangements
 - Paid sick leave
 - Flexibility
- Opioids
- Burden
 - Updated overall burden and more comprehensive estimates of specific conditions, including some that are not usually included in burden studies such as stress and overall mental health
 - Includes the cost-shifting from state to federal systems
- Disparities
- Articulating the value of surveillance, including databases economists find useful
- Economics of emergencies and crises

Expanding our reach and capacity

- Starter ideas:
 - More proactively collaborate with others within NIOSH through all the programs and groups we all participate in
 - Convene a workshop with select economists from NIOSH-supported Centers to identify potential synergies
 - Build on the Danish efforts to build and sustain an international applied research community focusing on the economics of worker safety, health, and well-being

Discussion questions

- Within the priority areas mentioned, are there others who are doing valuable work?
- Are we missing any priority areas?
- What type of information would you want from economists?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

