

NIOSH research efforts to prevent work-related Musculoskeletal Disorders

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Menekse S. Barim¹ , Ursula (Asha) Brogan¹, Alysha Meyers¹ ,
Tristan Victoroff², Brent A. Baker³, Liying Zheng³,
Mahiyar Nasarwanji⁴ , and Jessica Ramsey¹

Abstract

NIOSH researchers are pioneering the study of musculoskeletal health as professional ergonomists. We examine physical and social components of work environments to mitigate musculoskeletal injury risks. Part of our mission is to reduce the burden of work-related musculoskeletal disorders (MSDs) through a focused program of research and prevention that protects workers from MSDs, helps management mitigate related risks and liabilities, and helps practitioners improve the efficacy of workplace interventions.

The purpose of this discussion panel is to disseminate research findings and recommendations (1) to practitioners to interpret and apply the results of research to real-world problems, and (2) to inspire researchers to continue their efforts to protect the millions of workers at risk.

Keywords

musculoskeletal disorders, injury, ergonomics, aging, mining, exoskeleton, compensation claims

Using Workers' Compensation Systems to Conduct Surveillance and Research on Musculoskeletal Disorders

Alysha R. Meyers, Steven J. Wurzelbacher, Michael P. Lampl, Stephen J. Bertke, Steven J. Naber, Brian Chin, and Marie Hayden
NIOSH, Cincinnati, OH

The NIOSH Center for Workers' Compensation Studies (CWCS) mission is to maximize the use of workers' compensation data and systems to improve workplace safety and health (Utterback et al., 2014). Since its inception, the main research partnership for CWCS has been with the Ohio Bureau of Workers' Compensation (OHBWC), the largest of the US statebased workers' compensation funds.

We will be discussing results from several recent CWCS-OHBWC studies related to reducing the burden of MSDs caused by overexertion:

- Some projects analyzed workers' compensation claims data to describe and quantify trends in MSDs by industry (Meyers et al., 2018; Wurzelbacher et al., 2021), within specific work populations (Alexander et al., 2021), or by diagnosis patterns.
- Machine learning methods used by CWCS quickly and accurately identify incidents caused by overexertion (Bertke et al., 2016).

- Other studies are evaluating the effectiveness of OHBWC programs (such as funded intervention grants) to prevent MSDs and other injuries (Wurzelbacher et al., 2022; Wurzelbacher et al., 2023).
- A study examining factors that may reduce the impact of MSDs by identifying effective secondary and tertiary prevention strategies. This includes an analysis of how access to chiropractic services impacts the severity and cost of workers' compensation claims for common low back injuries.

Addressing Safety and Ergonomic Hazards in the Seafood Industry

Tristan Victoroff
NIOSH, Spokane, WA

The NIOSH Center for Maritime Safety and Health Studies (CMSHS) identifies priorities for safety interventions in

¹Division of Field Studies and Engineering, NIOSH, Cincinnati, OH, USA

²Western State Division, NIOSH, Spokane, WA, USA

³Health Effects Laboratory Division, NIOSH, Morgantown, WV, USA

⁴Pittsburgh Mining Research Division, NIOSH, Pittsburgh, PA, USA

Corresponding Author:

Menekse S. Barim, Division of Field Studies and Engineering, NIOSH, Cincinnati, OH, 45202, USA.
Email: oih9@cdc.gov

maritime industries. This is done using epidemiologic analysis, field observation, qualitative research methods, and industry partner collaborations.

This presentation will discuss several examples of both traumatic and chronic musculoskeletal injuries in maritime workers. Data sources include US Coast Guard reports, workers' compensation claims, and trauma center records. A new analysis of injury claims among commercial fishermen in Alaska over a 20-year period described traumatic injuries from winch entanglements by fishery, vessel gear type, and winch type. The results highlighted the risk from deck winches, mainly on purse seine vessels, and from anchor winches across vessel types, but especially among drift gill-net vessels. Other studies analyzing injury reports have revealed a high burden of musculoskeletal injuries, particularly to the upper limbs and trunk, among offshore and onshore seafood processing workers, as well as commercial fishermen. These results emphasize the need for ergonomic hazard controls in these workforces. Currently, we are evaluating a prototype for a handheld tool to aid in handling packaged frozen seafood. The tool would prevent hand injuries and other ergonomic hazards associated with unloading seafood boxes from motorized conveyors.

Resistance-type Exercise for Occupational, Musculoskeletal, and Aging Health

Brent A. Baker
NIOSH, Morgantown, WV

Common musculoskeletal disorders (MSDs) in occupational settings include (1) overexertion and (2) chronic maladaptation resulting from repetitive loading. Both of these MSDs may result in significant weakness and decreased muscle quality. These outcomes may manifest with long-term pain, impaired mobility, and disability. Aging is associated with decreased skeletal muscle function, mass, and quality. While exercise is the most accessible and efficacious intervention available, it is underutilized when prescribed to enhance health span and treat chronic disease. Specifically, resistance-type exercises maximize muscle performance, size, and quality, which are critical for musculoskeletal health and advancing age. Evidence for the diverse effectiveness of exercise led the American College of Sports Medicine and American Medical Association to launch the Exercise is Medicine® initiative in 2007 focusing on translating scientifically proven health benefits of exercise into the healthcare system. However, there is still no consensus as to what an age-specific prescription of resistance-type exercise is, or how it yields an "optimal" systems (molecular to biomechanical) response that will benefit musculoskeletal health. Thus, given the focus of the aging workforce as well as the priority placed upon musculoskeletal health, providing

evidence for resistance-type exercise as a countermeasure, which may serve as an underpinning for worker health and quality of life, is essential.

Exoskeleton Use to Reduce Musculoskeletal Disorders in Healthcare Workers: Perspectives and Challenges

Liyong Zheng
NIOSH, Morgantown, WV

In this panel discussion, perspectives and challenges using exoskeletons in safe patient handling will be presented and discussed. Healthcare workers are at high risk of work-related MSDs mainly caused by overexertion from manually handling patients. The rate of overexertion injuries for hospital workers was twice the average across all industries (BLS, 2017). As current recommendations, Safe Patient Handling and Mobility (SPHM) programs involving the use of mechanical equipment and safety procedures have demonstrated significant reductions in the MSD rate of healthcare workers. However, laws requiring SPHM programs in healthcare exist in only 11 states and no federal legislation has been passed to mandate SPHM programs. In addition, certain specialized healthcare settings—such as home healthcare, operating rooms, and imaging facilities—present unique challenges to adopting the SPHM programs. Emerging technology—exoskeletons—may be a useful intervention tool to help reduce the risk of MSDs during patient handling and complement the existing SPHM programs. We recognized current and potential roles and applications of existing exoskeletons and identified special features and requirements for future exoskeleton products.

The Need for a Systems Approach to Slip, Trip, and Fall Prevention in Mining

Mahiyar F. Nasarwanji
NIOSH, Pittsburgh, PA

Slips, trips, and falls pose a significant burden to the U.S. mining industry (Weston et al., 2021) with nearly half of the non-fatal incidents (46.8%) leading to a musculoskeletal disorder (MSHA 2017-2021). The panelist will provide an overview of recently completed research investigating environmental hazards, ingress and egress from mobile equipment, and footwear as they related to slips, trips, and falls. Research findings identified specific environmental hazards present in the mining environment. This includes material contaminates and liquids on the floor surface, and damage to stairs and ladders (Nasarwanji et al. 2019). Research also highlighted that egress from mobile equipment was more hazardous as

compared to ingress. Equipment design, specific tasks, and ground conditions contributed to the slips, trips, and falls from mobile equipment ((Nasarwanji et al. 2018, Pollard et al. 2019). Findings indicate that some occupations may need boots replaced more often than others, however, boot construction may be the limiting factor as compared to increased slip risk (Whitson & Kocher 2019). Finally, no significant differences were found between metatarsal boots with safety toes as compared to safety toe boots when considering gait and walking up and down stairs (Kocher et al. 2020). When investigating individual elements of the work system; including the person, task, environment, tools and equipment, and the organization; there were explicit interactions between the work system elements that affect the slip, trip, or fall outcome. Although prevention efforts for each element of the work system are useful considering the entire work system elements together is likely to increase the impact of slip, trip, and fall prevention. Future research for slip, trip, and fall prevention in mining should adopt a macroergonomic or work systems approach.

Health Hazard Evaluation Program – How NIOSH Can Help You!

Jessica Ramsey
NIOSH, Cincinnati, OH

During this panel, NIOSH Health Hazard Evaluation (HHE) Program staff will provide background information on the NIOSH HHE Program, including who we are and what we do. We will also discuss recent ergonomics-related HHEs. The HHE Program was created by the Occupational Safety and Health Act of 1970 and was granted authority to investigate possible health hazards in the workplace under the act. The HHE Program goals are to (1) provide assistance in evaluating new and recurring workplace health hazards, and (2) raise awareness of new and recurring workplace health hazards and preventive measures based on health hazard evaluation findings. Since its creation, the HHE Program has responded to almost 17,000 requests from employers, unions, and employees, and has completed almost 3,500 numbered final reports.

The HHE Program has expertise in many areas, including health hazard identification, exposure assessment, symptom surveys, medical testing, and engineering controls. Our staff has experience with many types of hazards including chemicals, particulates, noise, biological agents, ergonomics, heat, and stress.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention

ORCID iDs

Menekse S. Barim  <https://orcid.org/0000-0001-5148-6512>
Alysha Meyers  <https://orcid.org/0000-0002-6402-0145>
Mahiyar Nasarwanji  <https://orcid.org/0000-0002-3961-3432>

References

Alexander, B. M., Wurzelbacher, S. J., Zeiler, R. J., & Naber, S. J. (2021). Lessons learned from Ohio workers' compensation claims to mitigate hazards in the landscaping services industry [Article]. *American Journal of Industrial Medicine*, 64(8), 699-713. <https://doi.org/10.1002/ajim.23261>

Bertke, S. J., Meyers, A. R., Wurzelbacher, S. J., Measure, A., Lampl, M. P., & Robins, D. (2016). Comparison of methods for auto-coding causation of injury narratives. *Accident Analysis and Prevention*, 88, 117-123. <https://doi.org/10.1016/j.aap.2015.12.006>

Kocher, L. M., Pollard, J. P., Whitson, A. E., & Nasarwanji, M. F. (2020). Effects of Metatarsal Work Boots on Gait During Level and Inclined Walking. *Journal of Applied Biomechanics*, 36(5), 284-291. doi:10.1123/jab.2019-0338

Meyers, A. R., Al-Tarawneh, I. S., Wurzelbacher, S. J., Bushnell, P. T., Lampl, M. P., Bell, J. L., Bertke, S. J., Robins, D. C., Tseng, C.-Y., Wei, C., Raudabaugh, J. A., & Schnorr, T. M. (2018). Applying Machine Learning to Workers' Compensation Data to Identify Industry-Specific Ergonomic and Safety Prevention Priorities: Ohio, 2001 to 2011. *Journal of Occupational and Environmental Medicine*, 60(1), 55-73. <https://doi.org/10.1097/jom.0000000000001162>

MSHA (1995-2015). Mining Industry Accident, Injuries, Employment, and Production Statistics and Reports. Retrieved from <https://www.cdc.gov/niosh/mining/data/default.html>

Naimo, MA, Ensey, E, Rader, EP, & Baker, BA. (2019). Reduced Frequency of Resistance-Type Exercise Training Promotes Adaptation of the Aged Skeletal Muscle Microenvironment. *J Appl Physiol (1985)*. 2019 Apr 1;126(4):1074-1087.

Naimo, MA, Gu, JK, Lilly, C, Kelley, GA, & Baker, BA. (2018). Resistance training frequency confers greater muscle quality in aged individuals: A brief NHANES report. *J Cachexia Sarcopenia Muscle*, 2018, 3(2).

Nasarwanji, M. F., Mayton, A. G., & Pollard, J. (2019). Why slips, trips, and falls are still a problem: a hazard assessment at surface mines. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 63, No. 1, pp. 1856-1860). Sage CA: Los Angeles, CA: SAGE Publications.

Nasarwanji, M. F., Pollard, J., & Porter, W. (2018). An analysis of injuries to front-end loader operators during ingress and egress. *International journal of industrial ergonomics*, 65, 84-92.

NIOSH [2022]. Whole-body vibration analysis of golf course maintenance tasks. By Ramsey, JG, & Brueck, SE. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Health Hazard Evaluation Report 2018-0137-3385, <https://www.cdc.gov/niosh/hhe/reports/pdfs/2018-0137-3385.pdf>.

NIOSH [2020]. Evaluation of employee noise exposures and ergonomic risks during dental procedures at a veterinary hospital. By Li, JF, Grimes, GR, Brueck, SE, & Ramsey, J. Cincinnati, OH: U.S. Department of Health and Human Services, Centers

for Disease Control and Prevention, National Institute for Occupational Safety and Health, Health Hazard Evaluation Report 2018-1065-3374, <https://www.cdc.gov/niosh/hhe/reports/pdfs/2018-0165-3374.pdf>.

Pollard, J., Kosmoski, C., Porter, W. L., Kocher, L., Whitson, A., & Nasarwanji, M. (2019). Operators' views of mobile equipment ingress and egress safety. *International journal of industrial ergonomics*, 72, 272-280.

Rader, EP, Naimo, MA, Ensey, J, & Baker, BA. (2018) High-intensity stretchshortening contraction training modifies responsivity of skeletal muscle in old male rats. *Exp Gerontol.* 2018 Apr; 104:118-126.

Rader, EP, Naimo, MA, Layner, KN, Triscuit, AM, Chetlin, RD, Ensey, J, & Baker, BA. (2017) Enhancement of Skeletal Muscle in Aged Rats Following High-Intensity Stretch-Shortening Contraction Training. *Rejuvenation Research.* 2017 Apr; 20(2):93-102. doi:10.1089/rej.2016.1816.

Victoroff, T.M., Case, S.L., Robertson, L.D., & Syron, L.N. (2023). Workplace injuries caused by Commercial Fishing, Winches – Alaska, 2000-2020, Journal of Agromedicine, DOI: 10.1080/1059924X.2023.2171524

Weston, E., Nasarwanji, M. F., & Pollard, J. P. (2016). Identification of WorkRelated Musculoskeletal Disorders in Mining. *J Saf Health Environ Res*, 12 (1): 274–83

Whitson, A.E., & Kocher, L.M. (2019) When Work Boots Wear Out, Pit & Quarry, Feb 2019, 138-143.

Wurzelbacher, S., Meyers, A. R., Lampl, M. P., Bushnell, P. T., Bertke, S. J., Robins, D. C., Tseng, C., & Naber, S. J. (2021). Workers' compensation claim counts and rates by injury event/exposure among state-insured private employers in Ohio, 2007-2017. *Journal of Safety Research*, 79, 148-167. <https://doi.org/https://doi.org/10.1016/j.jsr.2021.08.015>

Wurzelbacher, S. J., Bertke, S. J., Lampl, M. P., Bushnell, P. T., Robins, D. C., Naber, S. J., & Moore, L. L. (2022). The Impact of a State-Based Workers' Compensation Insurer's Risk Control Services on Employer Claim Frequency and Cost Rates [Article]. *Journal of Occupational and Environmental Medicine*, 64(7), 562-572. <https://doi.org/10.1097/JOM.00000000002508>

Wurzelbacher, S. J., Bertke, S. J., Lampl, M. P., Bushnell, P. T., Meyers, A. R., Lowe, B. D., Robins, D. C., Naber, S. J., Hayden, M., & Moore, L. L. (2023). Safety intervention grant programs can be effective in preventing workplace injuries. NIOSH Science Blog. <https://blogs.cdc.gov/niosh-science-blog/2023/01/10/safety-grants/>

Utterback, D. F., Meyers, A. R., & Wurzelbacher, S. J. (2014). Workers'compensation insurance: A primer for public health (Workers' Compensation Insurance: A Primer, Issue.

Zheng, L., Hawke, A.L., & Evans, K. (2022). Critical review on applications and roles of exoskeletons in patient handling, *International Journal of Industrial Ergonomics*, 89:103290.