Center for Work and Fatigue Research

BSC Workplace Fatigue Mini-symposium
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The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.
Defining Fatigue

Oliver (1914) – Occupational Fatigue

Lerman (2012); Akerstedt (2009) - Sleepiness is the tendency to fall asleep; fatigue is the body's response to sleep loss or to prolonged physical or mental exertion. Fatigue may be reduced by sedentary activity or rest without sleeping, whereas subjective sleepiness and the propensity for sleep are often exacerbated by sedentary activity or rest.

Frone and Tidwell's (2015) three-factor conceptualization of fatigue:

1. Fatigue involves equal parts of both “extreme tiredness” and “reduced functional capacity;”
2. Fatigue can manifest physically, mentally, and/or emotionally;
3. Fatigue is “temporally tied to the workday”

MedLinePlus: a feeling of weariness, tiredness or lack of energy

DOT Operational definition (1999)

- Symptoms: Fatigue is a complex state characterized by a lack of alertness and reduced mental and physical performance, often accompanied by drowsiness.
- Causes: Fatigue may be caused or exacerbated by any or all of the following: lack of sleep, disruptive work/rest cycles, neurological conditions, excess mental or physical workload, exposure to extreme physical conditions, emotional stress, the use of drugs or alcohol, illness, and/or monotony.

Oxford Dictionary: extreme tiredness resulting from mental or physical exertion or illness
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Workplace fatigue in the US

“Fatigue is a debilitating and potentially deadly problem affecting most Americans”

– National Safety Council

20% (~21 million) Americans work nonstandard hours

37% of workers get < 7 hrs of sleep/day

90% of employers have been negatively impacted by tired employees

• 50% will adjust employee’s schedule or task
• 70% will issue a warning or disciplinary action

68% of workers experience workplace fatigue that requires additional effort to perform tasks at desired level
Effects of fatigue

Cognitive impairment
• May accelerate cognitive aging with long term effects

Work injuries
• Increased risk related to:
  ▪ Nonstandard shifts (2 x times compared to daytime workers)
  ▪ Time on task
    • ≤ 20 hours/wk: 2.03 injuries/100 workers
    • ≥ 60 hrs/wk: 4.34 injuries/100 workers
    • Dose-response effect

Illness
• Gastrointestinal, reproductive, metabolic health effects
• Cardiovascular disease, cancer
• Mental health
Workplace fatigue can have spillover effects to coworkers, family life, and public health and safety
Annual cost of workplace fatigue in the US*

- Workers compensation
  (Liberty Mutual 2019 Workplace Safety Index) $1.2 bn
- Health related productivity
  (National Safety Council 2016) $151.0 bn
- Drowsy driving crashes
  (National Highway Traffic Safety Admin 2017) $72.4 bn
- Societal harm of drowsy driving
  (National Highway Traffic Safety Admin 2017) $157.0 bn
- Shortened mortality rates, absenteeism, presenteeism, future losses on skill development among adolescents
  (RAND 2016) $434.0 bn

“Total” $815.6 bn

*Estimates converted to 2021 equivalent $
Fatigue: A unique workplace hazard

- No standard definition of workplace fatigue
- No standard measure
- No threshold / exposure limit

Endogenous and Exogenous Factors

Adapted from Di Milia (2011)
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Adapted from Di Milia (2011)
Launched May 2020
• Over 50 NIOSH members from different Divisions, Sectors and Cross-sectors

Vision
• Safe and healthy workplaces, free from the effects and consequences of fatigue

Mission
• Raising awareness of different sources of worker fatigue
• Identifying effective methods of assessing fatigue-risk in workplaces
• Developing and communicating strategies to reduce health and safety risks associated with workplace fatigue

Values
• Service, Collaboration, Practicality, Integrity
Center for Work and Fatigue Research Activities

**Fatigue Biomonitoring (FaB)**
- **Partners:**
  - Health Effects Laboratory Division
- **Activities:**
  - Literature review
  - Method development

**Innovations in Fatigue Detection (IFaD)**
- **Partners:**
  - Center Motor Vehicle Safety
  - Center for Direct Reading and Sensor Technologies
- **Activities:**
  - Literature review
  - Survey and Focus Group Studies
  - Outreach

**Knowledge Translation**
- NIOSH Director’s Seminar Series: Work and Fatigue
- Special issue of AJIM: Work and Fatigue
- Toolbox kits
- Online course and modules / podcasts
- Article series: Synergist

**Automation and Situation Awareness (ASAP)**
- **Partners:**
  - Center Motor Vehicle Safety
  - Center for Occupational Robotics Research
  - US DOT Volpe Center
- **Activities:**
  - Outreach
# Workplace fatigue activities at NIOSH

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Future Directions

Other fatigue factors and interactions between factors

Fatigue “thresholds”

Fatigue Risk Management Systems
  • Holistic approach to fatigue management
  • Training for NIOSH researchers

Further partnerships
  • AIHA, ACGIH, NSC
Questions for the Board

How should we measure success of the Center?

What other gaps in the knowledge base should be addressed?
Thank you!

Center for Work and Fatigue Research

cdc.gov/niosh/topics/fatigue(center.html

cwfr@cdc.gov
NIOSH numbered publications


**Plain Language about Shiftwork.** Rosa RR, Colligan MJ. US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Biomedical and Behavioral Science, Education and Information Division. DHHS (NIOSH) Publication No. 1997-145.


**Selected Scientific Manuscripts**


Abstracts from NIOSH Working Hours, Sleep and Fatigue Forum: Meeting the Needs of American Workers and Employers.
September 13-14, 2019. Coeur d'Alene

**Working hours, sleep, and fatigue in the Agriculture, Forestry, and Fishing Sector.** Lincoln JM; Elliott KC; Syron LN; Flynn M; Levin JL; Smidt M; Dzugan J

**Work hours and fatigue in the Healthcare and Social Assistance Sector.** Caruso CC; Arbour MW; Barger L; Berger AM; Chasens ER; Dawson J; Edmonson JC; Hittle B; Landrigan C; Patrician PA; Redeker NS; Rogers AE; Trinkoff A; Tucker S

**The human factors of mineworker fatigue: unique properties of fatigue in the mining environment.** Martell MJ; Bauerle TJ; Willmer DR; Sammarco JJ

**U.S. oil and gas extraction workers: fatigue, sleep, and working hours.** Retzer KD; Lerman SE; Pratt SG

**Working hours and fatigue in the public safety sector.** Allison P; Tiesman HM; Bernzweig D; Butler CR; James L; James S; Kumagai J; Patterson PD

**Research gaps and needs for work hours and fatigue in the transportation, warehousing, and utilities sector.** Sieber WK; Iker K; Lincoln JE; Menendez CC; O'Connor MB; Krueger GP

**Work-related fatigue: a hazard for vulnerable workers.** Cunningham TR; Guerin RJ
Selected publications

Infographics / Fact Sheets


