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Total Worker Health® and Organizational Behavior Management: Emerging Opportunities for Improving Worker Well-being

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ABSTRACT

We draw artificial boundaries between our lives at work, at home, and in the community. Each person is living an integrated life where all of their environments (resources, physical environment, psychosocial environment, responsibilities/demands) interact to impact their safety, health, and well-being. *Total Worker Health*® is an approach developed by the National Institute for Occupational Safety and Health (NIOSH) to address such interactions, and to advance science and practice for protecting workers' safety, health, and well-being. The *Total Worker Health* (TWH) approach represents an expansion of traditional occupational safety and health research and practice, with strong safety protections for workers as its foundation. The current paper provides an introduction to TWH, including: (1) Significance, (2) Historical Background, (3) Hierarchy of Controls, (4) Review of TWH Interventions, and (5) Future Opportunities. The reciprocal and interactive perspective of TWH is consistent with Skinnerian and other approaches to behavioral science, as well as organizational systems analysis approaches. With its behavioral and systems analysis roots, and associated historical emphasis on environmental conditions and interventions, the Organizational Behavior Management community can make great and important contributions in the TWH domain.

KEYWORDS

Total Worker Health; Occupational Safety and Health; Safety; Health; Well-Being

We draw artificial boundaries between our lives at work, at home, and in the community. Each person is living a whole and integrated life where all of their environments, relationships, behaviors, and physiological states interact. The body we take with us to work is the one we had with us at home, and both work and home environments (resources, physical environment, psychosocial environment, responsibilities/task demands) impact our safety, health, and well-being. Our

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private verbal behavior also fluidly migrates between personal- and work-related topics throughout each day. When experiencing a major stressor or demand in one domain, this can cross over to impact other roles. Such intersections between work and life were powerfully experienced by over a billion workers globally in 2020-22 due to governmental and community efforts to control the COVID-19 pandemic (Chappell, 2020; Onyeaka et al., 2021). Those performing essential work outside of the home were exposed to new and substantial work-related stressors (Faghri et al., 2021). For those who transitioned to work from home, work became much more intermingled with personal roles (e.g., isolation for those living alone, limited or no child care, home schooling) (Petts et al., 2020; Shockley et al., 2021).

Stressors, including work-to-family conflict, impact our physiology, thinking, and behavior across work and life boundaries. For example, occupational stress substantially increases insomnia (Kalimo et al., 2000). Insufficient sleep is an established public and occupational safety hazard (Colten et al., 2006; Lockley et al., 2007), but is also associated with long-term risk for chronic disease and early mortality (McHill & Wright, 2017). On a day-to-day basis, sleep deficiency can also lead to worsened mood and the mistreatment of others (Dinges et al., 1997; Rajaratnam et al., 2011), as well as reduced productivity (Barnes & Watson, 2019).

Thinking of workers as whole people, and considering the impact of work on their total physical and behavioral lives, is what the exciting *Total Worker Health®* approach is all about. Behavioral researchers, including those with ties to the Organizational Behavioral Management (OBM) community, have already made contributions in areas relevant to *Total Worker Health* (TWH) such as sleep and fatigue management for safety (Hursh et al., 2004, 2006, 2011; Raslear, 2011), reducing sedentary behavior and increasing physical activity at work (Green & Dallery, 2019), integrated interventions that address safety, health, and/or well-being (Anger et al., 2018; Olson et al., 2018, 2020; Olson, Wipfli, et al., 2016), and leveraging intermediary organizations to advance TWH within small businesses (Cunningham et al., 2021). To further encourage such contributions, the purpose of this paper is to introduce the topic of TWH to members of the OBM community. It is also an invitation for members to jump in, engage, and contribute to this important area of scholarship, research, and practice.

The contemporary TWH approach represents an expansion of traditional occupational safety and health (OSH) research and practice, with strong safety protections for workers as its foundation. The National Institute for Occupational Safety and Health (NIOSH) defines TWH as " ... *policies, programs, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being*" (Tamers et al., 2019, p. 1). TWH approaches are meant to protect and advance the safety, health, and well-being of *all* workers, supervisors, and leaders across industries and occupations. From an even broader public health perspective, TWH approaches also recognize that

work is a social determinant of health, and that there are strong interdependencies between workers' broader physical and social environments (e.g., communities), privileges/barriers (e.g., income, race, ethnicity), personal well-being, and their success at work.

From a behavioral perspective, most people are naturally motivated to behave in ways that lead to success and reinforcement in both their home and work environments (acknowledging that a person's thoughts and behaviors can become maladaptive, dysregulated, or motivated by problematic reinforcers). However, their success in both domains, and in experiencing overall well-being, is dependent upon both environmental conditions and individual factors. The organization of work and working conditions can have tremendous positive or negative impacts on a worker's ability to thrive in both their work and personal lives. Also, each worker brings with them their own unique biology, learning history, and other attributes (i.e., personality, health, physical and social resources) that contribute to their ability to perform and succeed at work and also fully enjoy their life outside of work.

As we consider both the environment and individuals, the TWH approach – like the field of OBM – prioritizes addressing the environment due to its power and influence. Specifically, the TWH approach prioritizes removing and reducing occupational exposures that threaten the safety and well-being of workers (see Part 3 below), and then further prescribes that such hazard reduction is accompanied by efforts to educate and encourage people to engage in safe and health promoting behaviors.

Work-related injuries and illnesses are the traditional focus of OSH research and practice. The TWH approach expands our scope of practice to address worker well-being, which requires defining the concept. In most posited definitions, well-being is a multi-dimensional concept that goes beyond physical health and the absence of illness. Well-being assessments often seek to characterize an individual's quality of life in an integrated fashion across health and work-related environmental, organizational, and psychosocial factors (e.g., economic, mental, social, behavioral, and physical health). The worker well-being framework put forward by NIOSH and the RAND Corporation (Chari et al., 2018; NIOSH, 2021b) identifies the following five domains of worker well-being: work evaluation and experience; workplace physical environment and safety climate; health status; and home, community, and society. In our view, this approach includes worker assessments of the quality of their social and physical environments (e.g., safety climate), as well as the workers' individual objective and subjective well-being (e.g., physical and mental health status).

To accomplish the purposes of this paper, we begin in Part 1 with the social importance of occupational safety, health, and well-being. Part 2 describes the history and evolution of the TWH approach, and discusses the roles of the NIOSH-funded TWH Centers of Excellence, TWH Affiliate

organizations, and professional societies. Part 3 addresses the fundamental importance of environmental conditions – organizational, physical, and psychosocial – for both OBM and TWH research and practice. This includes prioritizing interventions according to the Hierarchy of Controls applied to TWH. Given OBM's primary interests in interventions and experimentally determining environment-behavior relationships, Part 4 summarizes early reviews of TWH intervention research, research gaps, and highlights illustrative intervention studies. And finally, Part 5 will suggest current and future opportunities for OBM researchers and practitioners related to TWH.

This is an exciting time for occupational science and practice. From a TWH perspective, the "action is in the interactions" between safety, health, and well-being. This includes interactions between environmental exposures (work, community, home) and each person's biology, learning history, daily behaviors, and ongoing physical and mental health status. This reciprocal and interactive perspective is highly consistent with Skinnerian and other approaches to behavioral science (Bandura, 1978; Skinner, 1957), as well as organizational systems analysis approaches (Brethower, 1982; Rummler & Brache, 2012). With its behavioral and systems analysis roots, and associated historical emphasis on environmental conditions and interventions (Brethower et al., 2022), the OBM community can make great and important contributions in the TWH domain.

Part 1: Significance

Americans experience a significant burden of illnesses, injuries, and diminished quality of life due to exposures to work-related hazards. In 2018 alone, 2.8 million nonfatal injuries and illnesses were reported in private industry in the U.S., with over 900,000 resulting in missed work (Bureau of Labor Statistics, 2019). While injury rates declined in 2020 (Bureau of Labor Statistics, 2021), the number of illness cases quadrupled to 544,600 compared to 2019, driven by a nearly 4000% increase in occupational respiratory illness cases. Unsurprisingly, the highest days-away-from-work cases were in healthcare, particularly among nursing assistants (Bureau of Labor Statistics, 2021). The annual financial burden of occupational injuries and illnesses in the United States was estimated to be $250 billion ($320 billion in 2022 dollars) (Leigh, 2011). In Europe, a study of five countries found total costs of injuries and illnesses were equal to substantial proportions of national Gross Domestic Products (range: 2.7% to 10.4%) (Tompa et al., 2021). In this study, indirect costs arising from factors such as absenteeism, presenteeism, and reduced workability, represented the largest component of the total financial burdens for countries. In any country, these costs are shared by societies, healthcare systems, employers, and individuals.

To illustrate the burden and need for TWH approaches to address injuries, consider the burden, costs, and associated comorbidities of occupational back injuries. In 2018, there were over 142,000 back injury cases causing days away from work reported in private industry Back injuries have historically been the most prevalent (38.5%) type of work-related musculoskeletal disorder causing days away from work (Bureau of Labor Statistics, 2018, 2022). Overexertion and repetitive motion are typical contributing factors to such disorders. In 2019, overexertion was identified as the most costly cause of workplace injuries, resulting in a burden of over $13 billion (Liberty Mutual Insurance, 2019). In a startling finding, workers who suffered low-back injuries and experienced lost work time had an increased risk for mortality from a variety of causes such as heart disease, cancer, suicide, and opioid overdose (Martin et al., 2020). Both the causes and consequences of back injuries are complex and interacting, and illustrate how injuries experienced at work can have broad and substantial impacts on overall physical, social, and mental well-being.

Chronic pain from any type of injury, and ongoing efforts to manage it, can also have impacts well beyond physical functioning at work. Pain has negative impacts on quality of life and well-being, including sleep deficiency, reduced physical activity, functional limitations in activities of daily living, and increased risk for mood disorders (Turk et al., 2016). Workers in physically demanding jobs with elevated injury rates and pain have also been disproportionately impacted by the opioid crisis (Shaw et al., 2020). To illustrate, in a study of Massachusetts opioid overdose deaths, individuals from construction and extraction occupations experienced a rate of opioid overdoses six times higher than the rate for all occupations (Massachusetts Department of Public Health Occupational Health Surveillance Program, 2018). The economic costs of pain, including both direct medical care (e.g., including medications, physical therapy, and surgeries) and indirect costs (e.g., lost productivity from lost wages and lost work time), range from $560 to $635 billion annually (Gaskin & Richard, 2012). At the time of the study cited, this burden was about 30% higher than the combined costs of cancer and diabetes (Gaskin & Richard, 2012).

Our scientific understanding of the interacting factors that affect employee safety, health, and well-being has broadened over the past several decades, further strengthening the need for expanded TWH approaches to improving occupational health. Occupational Safety and Health Act of 1970 (1970) primarily addressed workers' exposures to physical, biological, and chemical hazards in the workplace, and generated many stronger safety and health protections in workplaces and improved safety outcomes in the U.S. In the 50 years since the act was passed, scientists have produced mounting evidence that additional psychosocial and health hazards at work must also be addressed. For example, work is a commonly reported source of stress

(American Psychological Association, 2017). Stress is associated with increased risk for neck pain (Yang et al., 2016) and injury at work (Nakata et al., 2006), but also with increased risk for poor mental health (Maulik, 2017), sleep deficiency (Kalimo et al., 2000), and cardiovascular disease (Backé et al., 2012; Sara et al., 2018). Annual health care costs generated by work stressors have been estimated for a range of exposures, including high job demands ($48 billion), work-family conflicts ($24 billion), and long work hours ($13 billion) (Goh et al., 2015). Workplace incivility and aggression (including bullying) are additional examples of stressors that contribute to poor mental health and high turnover (Porath & Pearson, 2013).

Research has also increasingly shown that work exposures impact health behaviors and chronic health conditions, and that these factors can interact with safety. For example, obesity appears to be elevated in occupational groups in concert with the degree of workers' exposures to "obesogenic" conditions such as shiftwork, prolonged sitting, long work hours, poor access to healthy food, and limited opportunities for healthy physical activity (Apostolopoulos et al., 2016; Yamada et al., 2001). Commercial driving is an example of an occupation where obesity-related health conditions may interact with safety risks. Among a nationally representative sample of truck drivers, the prevalence of obesity at that time was 69% compared to 31% in the general population (Sieber et al., 2014). Obesity increases risk for obstructive sleep apnea, which if left undetected and untreated, increases risk for serious crashes by five-fold (Burks et al., 2016). Whether or not obesity increases risk for non-vehicular injuries at work is a research question with mixed findings (Gu et al., 2016; Krause et al., 2004; Pollack & Cheskin, 2007). However, independent of any potential direct association between obesity and injuries, the interaction between obesity and *experienced* injuries is quite dramatic. Workers who are injured, and also obese, experience 80% greater lost work time and costs (Young & Swedlow, 2013).

A societal or public health perspective further illustrates the importance of an expanded view of occupational safety, health, and well-being. Work is now recognized as a social determinant of overall well-being (Ahonen et al., 2018; Burgard & Lin, 2013). Socio-economic status and occupation are associated with job security and likelihood of hazardous work exposures (American Psychological Association, 2010; Clougherty et al., 2010). Such factors can have an impact on health behaviors, access to care and support, risk for illness and injury, ability to pursue well-being for oneself and one's family, and one's overall prospects for thriving. As with long-standing health inequities in the U. S. (Bor et al., 2017), such work-related outcomes have the potential to perpetuate across generations and impact the overall health and economy of the nation (Loeppke, 2008). Addressing socially important safety, health, and well-being factors across individual, organizational, and societal levels encourages "systems thinking" (Brethower, 1982) and systemic approaches. Relevant

multi-level public health perspectives are offered by socio-ecological models of health promotion. These approaches posit that multiple levels of factors, and reciprocal interactions, converge to influence individual behavior and health outcomes. These factors include public policy, community, institutional and organizational, interpersonal, and intrapersonal/individual factors (McLeroy et al., 1988; National Cancer Institute, 2005). As noted in the introduction, OBM's interventionist roots that emphasize behavior-environment relationships, reciprocal causation, and organizational systems analysis, are well suited to address socially important and complex multi-level problems.

Part 2: Historical Background

To understand and consider opportunities for the field of OBM, it is helpful to understand how the TWH approach emerged (DeJoy & Wilson, 2019) and has evolved (Schill & Chosewood, 2013; Tamers et al., 2019). The conceptual foundation for TWH can be traced back across several decades as pioneering scholars proposed integrative models of worker health and safety (DeJoy & Southern, 1993; Ferguson, 1977) and models of healthy work organizations (Murphy & Cooper, 2000; Sauter & Hurrell, 2017; Wilson et al., 2004) based upon ecological or systems approaches (Sauter, 2013). These models emerged from growing concern about the fragmentation of workplace programs to promote health and safety (as opposed to integration). Together, they purported that work design is a determinant of both safety *and* worker well-being, acknowledged that workers are whole beings whose performance on the job cannot be disentangled from their lives outside of work, and further noted that worker well-being is critical for organizational effectiveness.

Acknowledging the intersection of worker well-being and safety, in 2003 NIOSH introduced the *Steps to a Healthier U.S. Workforce* initiative (Schill & Chosewood, 2013) and commissioned three whitepapers to examine the state of the science, initiate discussion, and improve communication between researchers and practitioners in the fields of worksite health promotion and OSH. These papers were presented at the 2004 *Steps to a Healthier U.S. Workforce* symposium and later updated and published as a research compendium (NIOSH, 2012). Together they put forth an initial foundation and scientific rationales for integrating health protection (i.e., safety) and health promotion. In the first paper, Sorensen and Barbeau reviewed the scientific evidence for integration. Among their key points was that workers' risk factors for chronic disease (e.g., smoking) can be exacerbated by exposure to work-related hazards (e.g., benzene or asbestos exposure), and described how modifying work and supporting workers' safety enhanced participation in workplace health programs and improved health outcomes. They also proposed a framework for future research emphasizing the need for trans disciplinary efforts at multiple levels of analysis, including social epidemiology

and methods research, intervention effectiveness research, process evaluation, and durability and dissemination research. In the second paper, Goetzel focused on the value of and business case for integration. His paper examined how poor worker health affects both medical expenditures and work productivity, established reasoning for integration among diverse organizational functions, and described how a "health, safety and productivity management" (p. 67) strategy can facilitate health and be cost-efficient. In the third paper, Seabury, Ladkawalla, and Reville acknowledged that both occupational and non-occupational factors contribute to costly and consequential chronic health conditions. In their paper they conducted an economic analysis of integrated approaches, and discussed policy implications in light of escalating healthcare costs and the need to determine ideal targets for intervention.

In 2005, reflecting the growing evidence about the powerful ways work and life outside of work intersect, the name of the NIOSH initiative was changed to the *WorkLife Initiative*. The *WorkLife Initiative* supported addressing worker health and well-being in a more comprehensive way, taking into account the physical and organizational work environment while at the same time addressing the personal health-related decisions and behaviors of individuals. The *WorkLife Initiative* continued the emphasis on integrative efforts to improve worker safety, health, and well-being. This included continued encouragement of rigorous evaluation of integrative approaches, promoting adoption of policies and practices proven to protect and improve worker health, motivating transdisciplinary collaboration among investigators, and overcoming the traditional separation of the OSHand health promotion communities. To advance research, policy, and practice in this area, NIOSH initiated funding for extramural Centers of Excellence to Promote a Healthier Workforce during 2005-2011, with four Centers established by 2011 (NIOSH, 2015b; Schill et al., 2019).

As research relevant to the *WorkLife Initiative* advancedand applications in workplaces increased, stakeholders weighed in on the developing field. A number of papers were written by stakeholders in support of and expanding upon the rationale for integrated approaches to workplace health. These papers emphasized the need for implementing evidence-based workplace programs to prevent ill-health, protect workers, and advance their overall well-being (Carnethon et al., 2009; Cherniack et al., 2011; Commission on Health and Safety and Workers Compensation, 2010; Hymel et al., 2011; Institute of Medicine, 2015; Punnett et al., 2009; Sorensen et al., 2011). The NIOSH approach continued to evolve, and in 2011, the program was renamed TWH. Approaches to interventions were encouraged to address the control of physical, biological, and psychosocial hazards and exposures; organization of work; compensation and benefits; built environment supports; and work-life fit. These issues of interest have been expanded and are summarized in a recently updated one page guiding document titled "Issues Relevant to

Advancing Worker Well-Being Using TWH Approaches" (NIOSH, 2020b). The document illustrates the breadth and expansive scope of NIOSH's vision for the future of OSH, and lists over 50 issues that are organized into 10 primary categories: prevention and control of hazards and exposures; built environment supports; community supports; compensation and benefits; healthy leadership; organization of work; policies; technology; work arrangements; and workforce demographics. The current conceptualization of TWH maintains the importance of collaboration among and across disciplines and organizational programs so they can work together to design healthy work that protects workers, supports their performance on the job, allows them to live a fulfilling life outside of work, and optimize their overall well-being (Tamers et al., 2019).

In 2016 NIOSH published a National Agenda to Advance TWH Research, Practice, Policy, and Capacity (NIOSH, 2016). The National Occupational Research Agenda (NORA) resulted from two expert workshops and reflected the input of key stakeholders. The TWH NORA reflects four strategic goals, each accompanied by several intermediate, and activity/output goals:

(1) Research: Advance and conduct etiologic, surveillance, and intervention research that builds the evidence base for effectively integrating protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being.
(2) Practice: Increase the implementation of evidence-based programs and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being.
(3) Policy: Increase adoption of policies that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being.
(4) Capacity Building: Build capacity to strengthen the TWH workforce and TWH field to support the development, growth, and maintenance of policies, programs, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being.

The uptake of TWH by researchers and practitioners has been relatively successful because of productive partnerships for research, training, and communication of workplace-relevant health protective and enhancing recommendations. NIOSH currently funds ten TWH Centers of Excellence for TWH that conduct multi-disciplinary research to advance the evidence-base, disseminate knowledge and interventions, and conduct outreach. Center research projects have addressed topics and populations such as the integration of injury prevention with health promotion, contingent workforces, the

changing nature of work, low wage workers, sedentary work, shift work, fatigue, occupational stress, supportive leadership, work-life fit, workforce diversity, and mental health. The Centers collectively seek to advance TWH approaches, but each through its own unique theme, research projects, and outreach/education efforts (NIOSH, 2021a). In addition to funded Centers, NIOSH created an Affiliate Partnership Program to establish collaborations with organizations that are committed to helping advance practice, awareness, and support of TWH principles. The program currently has 52 Affiliates representing a range of academic institutions, labor organizations, professional societies, not-for-profit associations, workers' compensation insurers, and public sector government agencies, including cities (NIOSH, 2022a).

To support workforce development and continuing education for professionals and students in the emerging discipline, NIOSH established a TWH Workforce Development Program in 2015. The framework includes a standardized core curriculum and an educational approach for traditional OSH professionals, key non-safety and health professionals, and intermediaries. Newman et al. (2020) laid out six core educational competencies, and proposed priorities and strategies for disseminating and implementing training of TWH professionals. Each of the Centers of Excellence sponsors TWH education, training, and outreach for professionals and students. Five Universities affiliated with the Centers offer a range of certificate or degree programs that address TWH through public health, psychology, and occupational and environmental health schools or departments. NIOSH and partners host conferences and webinars (NIOSH, 2022b). NIOSH and stakeholders have also recently established the professional Society for Total Worker Health.

Part 3: Hierarchy of Controls

Controlling exposures to hazards is the fundamental method for protecting workers. This is most effectively accomplished by controlling or changing the work environment. In OSH, the Hierarchy of Controls has been used as a foundational means for prioritizing and selecting feasible and effective control solutions. As a concept dating back to 1950 (National Safety Council, 1955), it has been revised based on consensus and has been in its current 5-level form since 1986 (Barnett & Brickman, 1986). The Hierarchy is typically represented as follows, in order of priority of hazard control tactics: Elimination, Substitution, Engineering Controls, Administrative Controls, and Personal Protective Equipment. The concept is that the higher priority control methods (usually represented at the top of an upside down triangular graphic) are potentially more effective and protective than the lower priority methods. Applying the Hierarchy to hazard control decisions normally leads to the implementation of inherently safer systems, where the

risk of illness or injury has been substantially reduced (NIOSH, 2015a). The key features of these levels of control solutions in terms of cost, effectiveness, and sustainability, are summarized below (NIOSH, 2015a):

Elimination and Substitution

Elimination and substitution, while most effective at reducing hazards, also tend to be the most expensive and difficult to implement in an existing workplace or process. If the workplace condition is still at the design or development stage, elimination and substitution of hazards may be less expensive and more simple to implement. For an existing condition or process, major and expensive changes to buildings, equipment, or workstations may be required to eliminate a hazard or substitute something less hazardous. An example of eliminating a hazard – at least for one particular phase of construction - is to move roof truss assembly to the ground instead of assembling trusses at a height. This eliminates a significant period of time with employees exposed to a fall hazard for that task. An example of substitution related to a serious and sometimes fatal chemical hazard in the bathtub refinishing industry (Occupational Safety and Health Administration, 2016) is replacing methylene chloride-based stripping products with much less dangerous options (California Department of Public Health, 2014).

Engineering Controls

Engineering controls are favored over administrative controls and personal protective equipment (see below) for reducing existing worker exposures to hazards because they are designed to reduce the hazard at the source, before it comes in contact with the worker. Well-designed engineering controls can be highly effective in protecting workers, and will typically be effective independent of worker behavior. The initial cost of engineering controls can be higher than the cost of administrative controls or PPE, but over the longer term, operating costs (including costs associated with worker illnesses and injuries) are frequently lower, and in some instances, can provide a cost savings in other areas of work processes. Examples of engineering controls include local exhaust ventilation systems to capture and remove airborne emissions, or built in machine guards or sensor-based shut-off systems (e.g., light curtains or interlocked guards) to protect a worker from contact with moving objects such as saw blades, grinding wheels, or other types of moving machinery. Infrared light curtains automatically shut off power when the curtain is breached, and power interlocks shut off power when a guard to mobile machinery is lifted or removed.

Administrative Controls and Personal Protective Equipment

Administrative controls and Personal Protective Equipment (PPE) are frequently used to reduce exposures and risks where hazards are not particularly well controlled. Examples of administrative controls include providing training on safe work practices, using safety inspection checklists prior to tasks, lock-out/tag-out procedures to prevent exposures during equipment maintenance, providing performance and safety-related feedback, and posting signage to communicate presence of particular hazards. PPE, which is considered the last line of defense in worker protection, includes equipment such as fall protection equipment, respirators, safety glasses, hard hats, and gloves.

Poorly controlled hazards may be the result of failures by leaders to invest in elimination, substitution, or engineering controls, but may also be due to a true inability to eliminate or reduce hazards through higher priority control methods. Administrative controls and PPE programs may be relatively inexpensive to establish but, over the long term, can be very costly to sustain, both in terms of money and behavioral management. These methods for protecting workers have also proven to be less effective than other measures, requiring significant effort by the affected leaders and workers to sustain.

Many of the types of interventions that are familiar to social and behavioral scientists, including OBM practitioners and scholars, would be considered to be located at lower levels of priority in the Hierarchy. To illustrate, an observation and feedback intervention for increasing safe behaviors and conditions would be considered an administrative control. Given that such processes are often central to so called "behavior-based safety programs," it is valuable that we consider and discuss such programs from the perspective of the Hierarchy of Controls. The administrative nature of behavioral processes has been a criticism of "behavioral" approaches to safety. To illustrate, a labor union report (Howe, 2001) asserted: "These programs force companies to waste precious limited resources on behavior surveys and other low-level controls instead of attacking the root cause of exposures at the source with high-level controls" (p. 24). While this criticism may be valid for many safety services that are broadly described as behavior-based approaches, it fails to account for the underpinnings of behavioral systems approaches which aim to empower employees to take control of their safety, and proactively identify and advocate for the correction of hazardous conditions, as a part of an overall culture of safety (Geller, 2005).

While elimination, substitution, and engineering controls are higher priorities, an important innovation of behavioral safety systems was to push the focus of safety systems upstream from injuries, which are infrequent and a poor source of system-improving feedback. In this context, such processes may be considered a component of overall safety systems or process safety (Ludwig, 2017). Observation and feedback processes are one way to move

from lagging to leading indicators of safety, which has been recommended by safety professionals for decades. A focus on leading indicators has also been promoted in recent Occupational Safety and Health Administration guidance (Occupational Health and Safety Administration, 2019). Frequent organizational measurement and feedback on safety-related conditions and prevention practices is of high value for any organization, especially if such processes are designed to identify poorly controlled hazards in the environment that are then addressed through higher order controls (e.g., elimination). While critics may object to the particular form or style of such feedback processes, the presence of feedback and its behavioral functions, are an important and powerful administrative control. In two literature reviews, behavioral observation and feedback interventions were found to be associated with substantial reductions in incidents and/or injuries (Sulzer-Azaroff & Austin, 2000; Tuncel et al., 2006). In a meta-analysis written by Tuncel et al. (2006), the average reduction in the standardized accident/injury ratio for 13 interventions was 0.60 (representing a 40% reduction from baseline). Another study analyzed incident rates before and after implementation of a behavior-based safety program across 73 companies, and found significant reductions in incidents on average compared to baseline, ranging from 26% in the first year to 69% by the fifth year (Krause et al., 1999).

An OBM-oriented researcher or practitioner might view adding observations and feedback as part of changing the environment, and not as just an administrative control. The psychosocial environment can be characterized as a system for controlling hazards, exposures, and behaviors, just as the physical and engineered environment can. However, there are important differences and interactions between psychosocial and physical environments, and these factors are particularly relevant for behavioral scientists and practitioners who contribute social and behavioral solutions to workplace problems. Safety leadership and behavior must be addressed, and are part of the total environment. This includes management of all varieties of safety processes (including but not limited to observations) that identify hazards and generate methods to eliminate or reduce them (Ludwig, 2017). Even though such leader and management driven processes are critical, it would be better (if possible) not to have to rely on supervisor or worker behavior at all to maintain or improve safety. For example, if hazardous airborne chemical exposures can be removed with a new ventilation system, such a new system would reduce injury and illness risk for all workers without any special effort on the part of leaders or workers. However, relying on the behavior of supervisors to encourage and facilitate PPE use, and workers to wear PPE properly, is effortful and has potential for inconsistent application and failures. Thus, the behavior-based processes described above (and other psychosocial dimensions of work environments), are best viewed as complementary to higher order controls rather than equivalent. Such behavioral processes have great potential for identifying

hazards and advocating for and monitoring their correction, *if observations are directed at workplace conditions and not only worker behavior*. With this function in mind, involving leaders in safety audits and observations of working conditions may lead to more effective control methods to correct hazards, as well as alleviate labor concerns related to such observational processes. In fact, auditing and feedback processes focused exclusively on conditions show promising levels of efficacy (Sparer et al., 2016).

TWH Hierarchy of Controls

To address the burden and impacts of psychosocial and other hazards to well-being in workplaces, the Hierarchy of Controls has been applied to TWH with slightly modified labels and descriptions (NIOSH, 2020a). NIOSH recommends that efforts to advance OSH *plus* well-being employ the five levels of the Hierarchy in the following order of priority:

- *Eliminate* negative working conditions and barriers to safety, health, and well-being
- *Substitute* safer and healthier workplace policies, work processes, and practices
- *Redesign* the work environment to enhance working conditions and improve safety, health and well-being
- *Educate* all employees and provide resources for improved knowledge
- *Encourage* or reinforce adoption of safe and healthy practices

As the field progresses and applies the Hierarchy of Controls to TWH approaches, there may be some points of departure from the direct corresponding levels of the traditional Hierarchy of Controls. For example, redesign of a work environment may be more costly, and yet more effective over the long term compared to substitution of a workplace policy, process, or practice.

A potentially useful way for organizational and behavioral scientists to approach the Hierarchy in both traditional OSH and TWH, is to view it as a *Hierarchy of Decisions* for safety and health. OBM expertise and opportunities for applications are inherent in the Hierarchy of Controls, even if the originators of the Hierarchy did not see it or explicitly acknowledge it. All the decisions in the Hierarchy (and especially in the TWH version) are organizational decisions made by people or groups of people, or are results accomplished through such organizational decisions. Decisions about actions and investments to take at each level involve behaviors of decision makers, which correspond to levels of leadership within an organization and their respective spans of control. That is, the more preferable, higher levels of control are the result of decisions of top organizational leaders, and not under the control of front line workers and supervisors. Organizational, social, and behavioral

influence tactics can be directed toward changing decision behaviors at higher levels within the organization, as well as at the broader industry and societal levels. Trying to influence the right top leaders to do the right things may feel too aspirational, but organizations big and small, as well as individuals (including researchers and practitioners designing occupational health interventions), can make a difference within their spans of control. Examples of relevant movements or efforts include environment, social, and governance (ESG) investing and/or socially responsible investing, which may motivate company leaders to make decisions that lead to achieving particular third party ESG scores (e.g., Napoletano & Curry, 2022), and professional societies that recognize organizations for creating healthy work environments (e.g., American Psychological Association, 2019). Thus, although efforts to educate and/or motivate are given the lowest priority in the Hierarchy of Controls, if directed toward leaders who control budgets and can invest in the elimination of hazards, educational and motivational efforts could be considered the highest priority. In other words, it is through the behaviors and decisions of leaders that most major hazards get eliminated or reduced, although influencing leaders may not often be viewed or studied as a hazard control intervention.

The concept of designing interventions to target safety leadership is not new. Measures of organizational safety climate are one of the most powerful leading indicators of future injury rates (Beus et al., 2010; Christian et al., 2009; Nahrgang et al., 2011). Safety climate is defined as workers' shared perceptions about the priority of safety in an organization. Dov Zohar, who is broadly considered the father of safety climate research, has demonstrated that safety practices and safety climate can be improved by targeting supervisor safety leadership and communication behaviors, in addition to changing contingencies for front-line workers (Zohar & Fussfeld, 1981). Specifically, one of his interventions involved multiple levels of leadership in weekly feedback on the frequency of subordinates' reports of safety-related conversations with supervisors over eight weeks, as well as communications of the priority put on safety by superiors. This process increased the frequency of safety-related conversations reported by subordinates and improved workplace safety, including increased frequency of ear plug use, improved safety climate scores, and lower minor injury rates compared to a randomized control group (Zohar, 2002). Although there is not clear evidence in the peer-reviewed literature for leadership interventions directly resulting in elimination of hazards, the approach described by Zohar does lend itself to further shift the focus upstream from worker behavior to leader behavior, which can enable greater potential for leader decisions that result in hazard reduction.

Researchers and practitioners in public health have wrestled with similar challenges in prioritizing interventions. This includes criticisms of health promotion efforts that focus on individual behavior change strategies rather

than higher-order policies, systems, processes, and resources. Socio-ecological models of public health (McLeroy et al., 1988), which were addressed briefly in Part 2, may parallel the Hierarchy of Controls to a degree. This model recognizes the importance of multiple layers of influence for health behavior, with the higher priority levels of social-environmental change (e.g., public policy, organizational) being more broadly effective or powerful than individual-level interventions. These layers of influence or change can also be viewed as layers of decision-making, which extend even further upward beyond the organizational level to the community and society levels.

Part 4: Review of TWH Interventions

From the outset, the field of Applied Behavior Analysis has largely focused on intervention research – to change the environment to make desired behaviors easier or more probable, as well as to prompt, shape, teach, and motivate changes to behaviors useful to one's health or safety (Azrin & Lindsley, 1956; Ferster & DeMyer, 1961; Skinner, 1955; Ulrich et al., 1966; Wolf et al., 1963). As noted in Part 1, early OSH policies, regulations, and research were focused on the identification and characterization of health risks from chemical and physical agents, and establishing safe workplace processes, conditions, and behaviors to prevent or reduce exposures to those conditions (NIOSH, 1987). However, even though that early focus was on chemical and physical exposures, "psychologic disorders" were included in the top 10 occupational problems in the 1980s (NIOSH, 1987). Prevention was focused on exposure reduction, but safety intervention studies with some focus on behavior, led by seminal OBM investigators, began to appear in the research literature in the late 1970s and 80s (Hopkins et al., 1986; Komaki et al., 1978; Sulzer-Azaroff, 1978). Such organizational and behavioral interventions became more common by 2000 as more active forms of prevention became a greater focus of OSH (for reviews of behavior-based safety interventions see Sulzer-Azaroff & Austin, 2000; Tuncel et al., 2006). Despite its foundational importance, exposure/hazard reduction interventions remain relatively uncommon (Ohlander et al., 2020), and their methods and analyses have been criticized as lacking randomized controlled trials, limited description of processes, lack of power analyses, and a lack of theoretical rationale (Anger et al., 2015, 2019; Feltner et al., 2016; Goldenhar et al., 2001; Kristensen, 2005; Ohlander et al., 2020). Thus, there remains a need, and many opportunities, for investigators to develop interventions that address both exposures, and the behaviors of leaders and workers, to advance safe working conditions, prevent injuries, and promote worker well-being.

NIOSH and the then-emerging field of Occupational Health Psychology had begun to broaden the scope of OSH in the late 1990s in additional ways to

encompass factors that contributed to overall worker well-being, which marked a move from a focus on the physical work environment and safety to include worker-centered factors such as stress and health behaviors; this change began even earlier in Europe (Quick & Tetrick, 2011; Sauter & Hurrell, 1999). Since its founding, publications in the *Journal of Organizational Behavior Management* also intermittently addressed health and well-being factors, including the health consequences of stress, smoking cessation interventions, and work-based promotion of healthy physical activity (Fanslow et al., 1988; Green & Dallery, 2019; Hantula et al., 1992; Quick et al., 1987).

Interventions that could be defined as TWH interventions, which means they addressed traditional safety targets but also *integrated* issues relevant to worker health or well-being, began to appear in the 1990s. Bertera (1990), Dalton and Harris (1991), and Peters and Carlson (1999) developed broad company-wide programs that addressed safety, health and well-being. However, groundbreaking intervention research in the area that has come to be known as TWH was conducted by Sorensen et al. (1996) followed by Sorensen et al. (2002). The latter publication addressed the reduction of line workers' smoking *in combination* with reducing exposure to chemical hazards that synergized with the chemicals in tobacco smoke. The hypothesis was that if the company (with the implementation guided by the research team) reduced workplace chemicals that would interact with the carcinogenic chemicals in cigarette smoke (e.g., invested in protecting workers from a work hazard), then a higher percentage of workers would initiate a smoking cessation program and stop smoking. The hypothesis was supported, and the study provided useful evidence with its quasi-experimental design, although the causal link between company safety protections leading to a higher prevalence of smoking cessation was not firmly established due to a lack of a "safety protections only" group in the experiment. The breakthrough in approach was the integration of a more traditional safety intervention with a logically associated health behavior intervention. Workers were more likely to engage in workplace health programs and quit smoking in the integrated intervention than in a stand alone smoking cessation intervention.

Published Systematic Reviews of TWH Interventions

In a systematic review of peer reviewed research, Anger et al. (2015) identified the workplace interventions through November 2013 that had attempted to change both traditional OSH and wellness/well-being endpoints and measured both. To illustrate, the Sorensen et al. (1996); Sorensen et al. (2002) studies reviewed above addressed chemical exposure reduction (an OSH endpoint) and smoking reduction (a "wellness" endpoint). The authors qualified 17 studies out of almost 3700 considered in the search. Feltner et al. (2016) reviewed the TWH literature between 1990 and (September) 2015 and

identified 15 interventions in 23 articles. Several years later, Anger et al. (2019) updated their earlier 2015 review using their same selection criteria, and identified 38 TWH intervention studies. This updated review also assessed levels of the Hierarchy of Controls addressed by TWH interventions. The three systematic reviews identified largely overlapping intervention studies with differences driven by the inclusion time frames and some analysis decisions. For example, the Anger et al. reviews did not set an early time bound, and the Feltner review lumped multiple reports of the same sample as a single study whereas Anger and colleagues did not for reasons of clarity. By comparison, Ohlander et al. (2020) conducted a review of more traditional OSH interventions to reduce exposures and identified 146 intervention studies published between 1960 and 2019.

Bringing together the two systematic reviews by Anger and colleagues (Anger et al., 2015, 2019), the mean sample size was just over 2000, although the smallest study had only 16 participants. Well over half the studies (21 of 36) involved randomized controlled designs, with the remainder using quasi experimental designs. The most frequent goals reported by study authors were reduced sitting/increased activity, stress reduction, and open goals identified through participatory processes involving employees and management. Five interventions based their selection of intervention methods on a theoretical framework of some type. The socio-ecological model was the basis for the interventions developed by one research group (Sorensen et al., 2002, 1996).

Most interventions were implemented in services, public administration, and manufacturing. By far most TWH interventions were implemented in the U.S., which is not surprising given that the definition was promulgated by the U.S. NIOSH. Investigators in other countries certainly are conducting OSH and wellness/well-being interventions, and did so earlier than investigators in the US, but without the emphasis on *integration* of domains that has been a key concept of the NIOSH TWH approach (Anger et al., 2019).

The Hierarchy of Controls, as discussed in Part 3, was rarely mentioned specifically in intervention publications (with Sorensen et al., 2002, 1996 as exceptions that did employ the Hierarchy). Based on the Hierarchy applied to TWH, most of the 36 TWH interventions summarized in Anger et al. (2019), were categorized as using education (92%, n=34) and encouragement (81%, n=30) as their primary tactics, although a substantial number (n=20) used the technique of redesigning the work environment. Four interventions implemented some form of the highest priority strategy – elimination. Most interventions used two to three types of controls from the Hierarchy, and the authors noted that a combination of controls may be a preferable approach (e.g., providing education and encouragement in combination with higher order controls may enhance overall success). This systematic assessment of intervention tactics employed in TWH interventions thus far suggests there are great opportunities to evaluate more higher priority controls (e.g.,

elimination, substitution) in our efforts to improve worker safety, health, and well-being.

The intervention methods used were further descriptively categorized as antecedents, behavioral processes, or consequences. Subcategories of methods within each category that were identified included: (a) *antecedents*: organizational structure, environmental modifications, assessments (e.g., health risk), training and education (e.g., scripted training, classes by professional trainers, health fairs, newsletters); (b) *behavioral processes*: self-monitoring, motivational interviewing/counseling, or group or team change strategies, and (c) *consequences*: feedback and incentives. Management or employee participation in intervention development occurred in several programs, and was the focus of five interventions.

The intervention dose, or how much time was devoted to the intervention, ranged from 1 to 120 hours. Most interventions were conducted in person and targeted employees and supervisors/managers. True to an underlying principle of the NIOSH vision of TWH, most interventions were integrated in the sense that the various components – those targeting safety, health, and well-being – were conducted or presented together in parallel rather than, for example, a safety committee conducting the safety component and Human Resources department managing a wellness or well-being component (Anger et al., 2015).

Most interventions studied had multiple targets, which is a key feature of TWH interventions. While all but one of the 36 intervention studies reported statistically significant findings, only a few reports from randomized controlled trials also included standardized effect sizes. Among these reports, notable significant safety effects with moderate effect sizes were reported by Olson et al. (2016), and included increased interactions with supervisors about unsafe work conditions, use of safer tools (for moving clients and housecleaning in home care), correction of slip, trip, fall hazards (Olson, Thompson, et al., 2016). Important health-related changes observed included medically meaningful weight loss of −3.31 kg (−7.29 lb) among commercial truck drivers (Olson, Wipfli, et al., 2016) and reduced blood pressure among construction workers (Hammer et al., 2015), although standardized effect sizes only approached Cohen's definition of small (d=0.20). In the Olson et al. (2016) intervention, fruit and vegetable intake and physical activity increases approached or exceeded the moderate (d=0.50) effect size range (unadjusted standardized effect sizes). Among young employees in a public parks system, Rohlman et al. (2016) produced self-reported improvements in safety attitudes and behaviors, and health attitudes, that had effect sizes of 0.36 or 0.37. More recently, Anger et al. (2018), in a quasiexperimental study of primarily supervisors (N=36), found reduced systolic blood pressure (d=0.27) and self-reported increases with small to moderate effect sizes (0.38-0.72) in family-supportive supervisor behaviors, exercise and sleep duration, reduced sugary

snacks, and reduced sugary drinks. In sum, while there are relatively few published TWH intervention studies, there are a number of studies with significant findings and some reporting small to moderate effect sizes. A general conclusion drawn was that integrated TWH interventions can *efficiently* produce simultaneous and important impacts on safety, health, and well-being in a variety of working populations (Anger et al., 2019).

A Recent TWH Approach to Interventions and Future Directions

Looking to the future, it is important that TWH intervention researchers strive to improve working conditions that threaten safety, health, and well-being, and then supplement such approaches with state-of-the art behavioral tactics. Olson et al. (2020) explicitly employed the Hierarchy of Controls (and further distinguished between NIOSH's pre-TWH version and it's modified TWH version of the Hierarchy) as the rationale for TWH interventions evaluated with truck driving teams. They distinguished between engineering-type controls (redesign in the language of the modified Hierarchy) and behavioral controls (education, encouragement in the modified Hierarchy) in interventions designed to improve sleep, reduce fatigue, and advance the well-being of truck driver teams (pairs) who work together (one sleeps while the other drives). The project includes a published pilot study (Olson et al., 2020) and a randomized controlled trial (Olson et al., 2017) to evaluate (1) truck cab enhancements including a vibration-dampening active suspension seat and a therapeutic mattress; and (2) a behavioral sleep-health program involving an inter-team walking competition supported with training on physical activity and sleep, goal setting and self-monitoring of physical activity and sleep hygiene practices, and optional goal-setting and training addressing body weight management and diet.

The published pilot study (Olson et al., 2020) involved a within subjects design where team drivers (n=16) spent one month using a new coil spring mattress and one month using the therapeutic mattress (the order of mattress evaluation was counterbalanced). The second half of the sample (n=8) also completed a three month phase involving their preferred mattress (all preferred the therapeutic mattress), an active suspension seat, and the behavioral sleep-health program. At baseline and after each phase, drivers completed surveys about sleep, fatigue, and well-being. During each phase drivers wore actigraphs to measure daily sleep and physical activity via movement, and whole body vibration measurements were collected from seat and mattress tops relative to the truck floor and mattress frame. Both the new coil spring mattress and the therapeutic mattress led to self-reports of improved sleep and reduced fatigue compared to drivers' original mattresses, with the therapeutic mattress producing the larger effects (e.g., new coil spring mattress vs. original mattress absolute d range for sleep and fatigue measures =.05 to .63;

therapeutic mattress vs. original mattress absolute *d* range for sleep and fatigue measures =.19 to .82). Actigraphic measures of average daily sleep duration were better during the therapeutic mattress condition compared to the coil spring condition (M=8.25 hrs vs. M=7.89 hrs). The final multi-component phase led to even larger effect sizes for physical activity, sleep, and fatigue outcomes (*d* range = 0.37 to 1.83) (Olson et al., 2020). Vibration analyses confirmed that the seat reduced total worker exposure to whole body vibration from an average 8 hour exposure level of 0.28 m/s^2 (SD=0.03) to 0.20 m/s^2 (SD=0.04) (*d*=−2.43), and revealed some differences between the two mattresses in the most prevalent frequencies of vibrations transmitted to drivers.

This more recent intervention example represents an important emerging theme for future TWH approaches, which is prioritizing changes to working conditions whenever possible. We believe the Tech4Rest effects observed thus far (pilot study) also illustrate that there is room for strong behavioral interventions after working conditions are changed, as the very best safety and health programs also have strong safety cultures that include processes that establish and maintain leadership safety-oriented priorities and decision making, as well as employee prevention behaviors. Additional future intervention priorities include involving higher level decision makers in interventions, and influencing their strategic and budgetary decisions (or studying what influences their decisions). Changing working conditions and influencing top leaders are high bars for intervention researchers to aim for, but they are worthy aspirational aims. As evidence builds that certain working conditions are bad for workers, leaders may be more inclined to partner with researchers to eliminate or reduce them and evaluate impacts.

Part 5: Future Opportunites

As we hope to have made the case, TWH is not just a vision for a niche subarea of organizational research and practice, but *the* expanded future vision for OSH from NIOSH (Schill et al., 2019). Thus, TWH's foundation is strong traditional safety and health protections, policies, and programs. This future vision has evolved in response to evidence that we (scientists and practitioners) *must* expand, as working conditions not only impact our risk for physical harm and work related physical diseases, but also our health behaviors, physical and mental well-being (at work and at home), and risk for chronic diseases. In the other direction, our home and community conditions, and lifestyle behaviors outside of employment, come with us to the workplace. Furthermore, these work and community exposures, as well as their consequences, often powerfully interact. A goal of this paper is to invite OBM researchers and practitioners to join in and help shape the future of occupational safety, health, and well-being. In the following paragraphs we provide some thoughts on alignment between OBM and TWH research and practice,

strategies for getting involved, and some ideas for broadening and building upon the intervention science strengths within the OBM community.

As a specialty with roots in the field of Applied Behavior Analysis (Brethower et al., 2022), OBM has a strong traditional focus on identifying relationships between environments and behaviors, and leveraging the environment to create both organizational and behavior change. This emphasis on the environment (including the social environment) has made OBM researchers very effective intervention scientists and practitioners. As OBM researchers and practitioners plan and begin new work in the area of TWH, it is critical that they embrace the environmental foundations of the OBM discipline. As described in Part 3, while line workers' exposures and behaviors related to safety, health, and well-being are often the ultimate targets of workplace interventions, impacting these outcomes should prioritize changing upstream working conditions with guidance from both the traditional and the newer TWH Hierarchy of Controls. This environmentally-oriented focus is highly aligned with OBM's historical DNA. However, OBM research traditionally has focused a fair amount of attention on front line supervisors' and workers' behaviors or results, and on the use of techniques like goal setting, measurement, social accountability, and feedback to change such outcomes. These intervention tactics are included in the TWH Hierarchy of Controls as education and encouragement, but they are "icing on the cake" tactics relative to other more powerful and higher priorities. TWH prioritizes how working conditions impact workers, and emphasizes changing physical, structural, and design aspects of working conditions in order to remove or eliminate hazards first. Such interventions may focus exclusively on organizational assessments of hazards and leadership decisions to invest in their remediation. This environmental orientation is also an emphasis on changing working conditions so that at-risk behaviors are not possible or very high effort, and/or that preventive behaviors are less effortful and easier.

OBM also brings methodological traditions and strengths to the table that will advance TWH approaches, intervention quality, and effect sizes. These strengths include the general environmental and intervention-forward orientations of OBM. In addition, OBM researchers often include measures of performance results (Brethower et al., 2022), and/or direct observations of conditions and behavior in their studies, and also assess the reliability of such measures (e.g., inter-rater agreement assessment). These are important "boots-on-the-ground" compliments to survey measures commonly used in large organizational studies. In fact, without an assessment of performance or business results, or direct observations or qualitative interviews, surveys are likely inadequate for describing intervention impacts or what actually happened "on the ground" to achieve them. Another methodological strength is the tradition in OBM of measuring intervention fidelity or exposure. Although not formally assessed in the initial literature reviews of TWH approaches to

interventions, direct observational measures and intervention fidelity measures in those studies appeared to be relatively rare. And finally, most TWH intervention studies have used between- or within-group designs with pre and post program measures. While randomized controlled between-group designs are the gold standard in intervention effectiveness research, there is tremendous value in repeated measures and single-case style experimental designs that are common in OBM. Such designs place an emphasis on visually obvious (large) effect sizes, and also reveal important variability (and stability) within and across conditions, participants, or work groups. These methodological traditions also place value on reversals and replications (e.g., ABAB designs, multiple baseline designs) which boosts confidence that an effect is not due to chance variability or special circumstances at one particular time point, worksite, or within one participant or group.

Integrating Health and Well-being into more Traditional Safety and Performance Research and Interventions

In addition to prioritizing opportunities to address and change working conditions, and leveraging OBM's methodological strengths, a straightforward way for OBM practitioners and researchers to further advance TWH is to integrate health and well-being measures or targets into their projects. In this area, it may be fruitful to consider the work of colleagues who are applying Acceptance and Commitment Therapy principles and methods in the workplace, as they target and measure factors such as values, psychological flexibility, and well-being (Moran, 2015; Veage et al., 2014). For example, one could add measures of stress, psychosocial health, or well-being to a project focused primarily on safety or performance. A more advanced step would be to integrate an intervention approach so that it simultaneously addressed safety plus other interacting factors, but this requires that the integration makes sense to individuals in the level of the organization being targeted. For example, the first author found that commercial truck drivers did not understand why driving safety was integrated into a weight loss and health promotion program, even though obesity and associated health conditions increase crash risk in the literature (Olson et al., 2009). However, in subsequent iterations of the intervention, drivers did understand and better accept the integration of sleep education and targets into that weight loss and health promotion program (Olson, Wipfli, et al., 2016). Sleep was the cross cutting factor that both related to successful weight loss (and health and well-being) and driving safety. While safety is the foundation of TWH, it should be noted that many scholars view changes to working conditions to eliminate or reduce psychosocial stressors as TWH approaches (Hammer & Sauter, 2013). In this regard, another TWH approach is to apply the traditional Hierarchy of Controls prioritization process and interventions to eliminate or reduce *psychosocial hazards* (e.g., workplace bullying). In such

interventions, expanded measurement approaches would also be encouraged in the other direction, such as including safety-related measures in a study focused primarily on stress reduction.

Systems, Process, and Job Design Interventions to Advance TWH

The OBM community, given their work in complex organizations and historical roots, has an affinity for systems analysis approaches to understanding and changing organizational outcomes for both internal and external stakeholders (Brethower, 1982; Brethower et al., 2022; Dickinson, 2001). Systems approaches to interventions fall well in line with the top priority levels of the Hierarchy of Controls as they focus an analyst on organizational structures, processes, and job design. To illustrate organizational features considered in systems models, we can consider Brewthower's Total Performance System. This approach defines a "Total" living system as including a mission or niche, inputs, processing systems (administrative, management, production), outputs, receivers, and internal and external feedback loops. The top TWH priority from a systems perspective, would be designing organizational processing systems that regularly assess, identify, and remove or eliminate hazards from work environments. For example, workers have no control over air quality in a work facility. Thus, an employer whose processes produce physical or chemical airborne exposures that are dangerous to workers must have systems and processes in place to assess exposure levels regularly, internal feedback processes, and the budgetary resources and decision-making processes to prioritize and invest in solutions to eliminate or reduce airborne hazards for workers. OBM is also informed by the discipline of Industrial-Organizational Psychology, which offers evidence-based approaches and interventions for personnel selection and placement, and job design. There is much work to do in these areas to address worker safety, health, and well-being in both types of processes: a) recruitment, selection, placement, and new employee onboarding processes; and b) job design processes. In our view, there is a fundamental need for TWH-informed approaches in the areas of process, schedule, and job design, where the natural tendency is for organizations to design such systems to maximize productivity, but often at the expense of employees' safety, health, and well-being.

Opportunities for TWH Research and Practice in Clinical Behavior Analysis Organizations

We believe additional opportunities for OBM researchers and practitioners involve the operation and leadership of behavior analysis clinics, and protecting the safety, health, and well-being of clinical behavior analysts. Given its shared ties with the behavior analysis community, OBM trained researchers and practitioners are uniquely positioned to be natural and trusted sources for

potential TWH solutions. The growth of Board Certified Behavior Analysts has been tremendous over the past two decades with more than 50,000 behavior analysts and behavior technicians in more than 70 countries credentialed by the Behavior Analyst Certification Board® (Carr & Nosik, 2017). This work, which involves providing care and training for individuals with intellectual and developmental disabilities, can be uniquely rewarding and meaningful, especially when the caregiver or instructor plays a key role in helping their service recipient accomplish learning goals and live a full and rich life. However, providing such services for these special populations also means that workers must anticipate, plan for, and manage challenging behaviors. Such behaviors can be emotionally draining to cope with, and sometimes physically harm workers. While specific surveillance data are lacking, clinical behavior analysts are likely to be at elevated risk for a range of problems experienced by direct service providers in general, including physical injury, occupational stress, and burnout (Barling et al., 2001; Denton et al., 2002; Hanson et al., 2015). To illustrate, Womack et al. (2020) found that 31.3% of personal support workers who assist individuals with disabilities reported experiencing certain types of physical aggression (e.g., being slapped, pushed, grabbed, shoved, bitten, kicked, or hit with a fist) in the past 12 months. Levels observed were more than double the aggression experienced by home care workers who primarily assist older adults (Womack et al., 2020). All this being considered, leaders of behavior analysis clinics and service organizations are overseeing a workforce in great need of occupational safety, health, and well-being protections and supports. These leaders could benefit from learning about a range of OBM interventions and best practices, but have particular needs to learn about implementing strong OSH programs, as well as occupational stress prevention and support.

Embracing Topics Outside the Typical OBM Comfort Zone: Sleep, Stress, and Health Behaviors

TWH approaches encourage an expansion of research and practice topics beyond traditional occupational safety, and this challenge (and opportunity) applies to the field of OBM. In our view, the most compelling topics for expanded attention from OBM include sleep, stress, and health behaviors. The OBM Network website currently lists three primary areas of application: performance management, behavior-based safety, and behavioral systems analysis. To further assess the current foci of the field of OBM we reviewed 10 years of content (2011-2021) from the *Journal of Organizational Behavior Management*. In that review we found 60 of 103 papers focused on interventions. Of the interventions, 51 focused on performance or productivity (mostly performance), 8 focused on safety, 1 focused on physical activity/health (we counted ergonomics as safety-related), and none focused on well-being.

Sleep is perhaps an exemplar topic to address through TWH approaches, as it deeply cuts across occupational safety, day-to-day employee performance and well-being, and the prevention of chronic diseases. Sleep has been studied by behavior analysts to some degree (Blampied & Bootzin, 2013), and with notable achievements such as the Steven Hursh's models of human fatigue and circadian variation (Hursh et al., 2004, 2006, 2011; Raslear, 2011). Over 43% of workers are sleep-deprived (those at the highest risk work nights, long, or irregular shifts) (National Safety Council, 2017). Further, workers in rotating shift work (especially women, who report greater levels of time spent on household activities) report the most difficulties in managing work-home conflict (Gignac et al., 2012). Sleep deficiency is associated with obesity and chronic diseases (Buxton & Marcelli, 2010; Cappuccio et al., 2010; McAllister et al., 2009), and early death (Grandner et al., 2010; Wingard & Berkman, 1983), with some probable mechanisms including impacts on hormones, metabolism, food cravings, and calorie consumption (Brondel et al., 2010; Buxton et al., 2012; Greer et al., 2013; McAllister et al., 2009; Spiegel et al., 2004). Interestingly, there is increasing evidence that the timing of what we eat matters, especially relative to our biological clock time, which is largely driven by light exposure. McHill and colleagues found that individuals who consumed a higher percentage of daily calories closer to and after dim light melatonin onset (a biomarker of biological clock time) had a higher percentage of body fat relative to those who consumed a lower percentage of daily calories closer to and after melatonin onset (McHill et al., 2017). Getting sufficient sleep is influenced by job design and work schedules, but also by life at home, the sleep environment, a range of health-related and sleep hygiene behaviors, and individual health conditions. The OBM community is well suited to join in and make further contributions in this area.

Workplace stressors, including physiological stress responses and behavioral coping, are other domains of research encouraged in TWH approaches that have received limited consideration by OBM researchers (Beehr & Franz, 1987). Not surprisingly, stress and sleep are interconnected, with over a third of workers in high strain jobs (jobs with low control, high demands) experiencing insomnia (Kalimo et al., 2000). As reviewed earlier, the body of evidence that high job strain was related to heart disease (Backé et al., 2012; Sara et al., 2018) was a call to action for NIOSH to form first the *WorkLife Initiative*, and then its evolution into the TWH program.

Health behaviors are another broad category that is prime for more study by the OBM community (Green & Dallery, 2019). Individual behaviors that promote sufficient sleep, as well as healthy stress coping behaviors, are important health behavior targets that have been discussed at length in this paper. Other physical health domains include eating and exercise behaviors, including limiting sedentary time. Excess body weight increases the risk for a range of conditions, including type II diabetes, heart disease, and some cancers

(Centers for Disease Control and Prevention, 2021), and approximately 40% of adults in the U.S. are obese (Hales et al., 2020). Only 1 in 10 U.S. adults eat the recommended daily servings of vegetables, and only 1 in 4 meet recommended guidelines for regular physical activity (Centers for Disease Control and Prevention, 2021). Dietary behaviors are fundamental for achieving and maintaining a healthy body weight. Diets that are rich in fruits and vegetables are also essential for reducing the risk of cardiovascular disease and prolonging life expectancy (Wallace et al., 2020; Wang et al., 2021). Regular aerobic exercise (30 minutes on five days each week) has broad benefits for preventing or reversing chronic health conditions (Blair, 2009). In addition, regular exercise substantially reduces the risk for sleep problems (Sherrill et al., 1998), and is also equal or superior in effectiveness to medications for managing and reducing moderate depression and anxiety (Rethorst et al., 2009; Wipfli et al., 2008).

As members of the field of OBM, as well as its current leaders, consider joining in with TWH research and expanding their science and practice, it is also worth considering available resources. It has been noted that adopting a TWH approach will likely will come with challenges related to relatively limited overall investments by society via federal and state governments in OSH research and resources. This broader view of OSH, which integrates worker health and wellbeing, may be viewed by some stakeholders as potentially diluting those limited resources. Thus, it remains critical to demonstrate how TWH approaches will benefit society by not only improving workers' safety health, and well-being, but also that such efforts may generate financial returns on organizational investments (at national, business, and worker levels).

Conclusion

OSH has evolved toward more expansive and holistic approaches in response to the changing nature of work and research that challenges traditional thinking about work and job-related hazards (Schulte et al., 2019). The TWH approach advanced by NIOSH provides an expanded vision for the future of OSH, and the emerging field presents exciting opportunities and creative challenges. Scientists and practitioners are needed from diverse backgrounds to create and study integrated interventions that strongly impact occupational safety, health, and well-being. There is ample room for members of the OBM to community to get involved. OBM has made important contributions to occupational safety and performance management, and the strengths of OBM applied in those domains stand to produce similar successes when focused on health and well-being outcomes. Some of these strengths include a long-established focus on interventions that produce clearly observable and meaningful changes, a strong environmental orientation, and

employment of interactionist and systems models for diagnosing problems and creating solutions. These factors, as well as OBM's methodological traditions and strengths, predict that members will address TWH-related topics from unique and value-added perspectives.

As both the fields of OBM and TWH continue to evolve, future research and practice should be guided by the Hierarchy of Controls. From a behavioral perspective, it may be useful to view this model as a Hierarchy of leader decisions. Aspirational goals for people from all backgrounds should be to intervene at higher leadership levels, and to discover effective methods for influencing leaders' decisions that most powerfully impact working conditions and work design. Perhaps the ultimate stretch goal is to alter society-level economic incentives for corporate leaders in ways that prioritize and reward workforce well-being. A range of particular opportunities for the OBM community were reviewed, including integrating health and well-being targets or measures into projects focused on safety and performance; applying systems, process, and job design interventions to improve TWH related outcomes; providing guidance for leaders and evaluating interventions in clinics that provide behavior analysis services; and tackling topics outside of traditional OBM comfort zones, such as sleep, stress, and health behaviors. We believe these opportunities highlight the need for interdisciplinary collaboration, focusing on crosscutting and interacting intervention targets, and keeping the "whole person" in mind in occupational research and practice. Considering and addressing the safety, health, and well-being of workers should, in parallel, advance the long-term sustainability and effectiveness of organizations. In this area, it important for researchers to study and quantify the value or return on investment of TWH approaches and interventions. Finally, for the growth of TWH approaches and OBM to continue, there is a need for supportive and enabling state and national policies. For those of us among the OBM and TWH communities that have found ourselves in these overlapping pools of research and practice, we want to extend this last request: come along and jump in! The water is great!

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References

Ahonen, E. Q., Fujishiro, K., Cunningham, T., & Flynn, M. (2018, March). Work as an inclusive part of population health inequities research and prevention. *American Journal of Public Health*, *108* (3), 306–311. https://doi.org/10.2105/AJPH.2017.304214

American Psychological Association. (2010). *Work, stress, and health & socioeconomic status*. Retrieved August 10, 2020, from https://www.apa.org/pi/ses/resources/publications/work-stress-health

American Psychological Association. (2017). *Stress in America: The state of our nation*. Retrieved September 2, 2022, from https://www.apa.org/news/press/releases/stress/2017/state-nation.pdf

American Psychological Association. (2019). *Psychologically Healthy Workplace Awards*. Retrieved September 2, 2022, from https://www.apa.org/applied-psychology/phwa-2019-winners

Anger, W. K., Elliot, D. L., Bodner, T., Olson, R., Rohlman, D. S., Truxillo, D. M., Kuehl, K. S., Hammer, L. B., & Montgomery, D. (2015, April). Effectiveness of total worker health interventions. *Journal of occupational health psychology*, *20*(2), 226–247. AHRQ Comparative Effectiveness Reviews. https://doi.org/10.7326/M16-0626

Anger, W. K., Kyler-Yano, J., Vaughn, K., Wipfli, B., Olson, R., & Blanco, M. (2018). Total worker health® intervention for construction workers alters safety, health, well-being measures. *Journal of Occupational and Environmental Medicine*, *60*(8), 700–709. https://doi.org/10.1097/jom.0000000000001290

Anger, W. K., Rameshbabu, A., Olson, R., Bodner, T., Hurtado, D. A., Parker, K., Wan, W., Wipfli, B., & Rohlman, D. S. (2019). Effectiveness of Total Worker Health® interventions. In H. L. Hudson, J. A. S. Nigam, S. L. Sauter, L. C. Chosewood, A. L. Schill, & J. Howard (Eds.), *Total Worker Health* (pp. 61–89). American Psychological Association.

Apostolopoulos, Y., Lemke, M., Sönmez, S., & Hege, A. (2016). The obesogenic environment of commercial trucking: A worksite environmental audit and implications for systems-based interventions. *American Journal of Health Education*, *47*(2), 85–93. https://doi.org/10.1080/19325037.2015.1133339

Azrin, N. H., & Lindsley, O. R. (1956). The reinforcement of cooperation between children. *The Journal of Abnormal and Social Psychology*, *52*(1), 100–102. https://doi.org/10.1037/h0042490

Backé, E.-M., Seidler, A., Latza, U., Rossnagel, K., & Schumann, B. (2012). The role of psychosocial stress at work for the development of cardiovascular diseases: A systematic review. *International Archives of Occupational and Environmental Health*, *85*(1), 67–79. https://doi.org/10.1007/s00420-011-0643-6

Bandura, A. (1978). The self system in reciprocal determinism. *American Psychologist*, *33*(4), 344. https://doi.org/10.1037/0003-066X.33.4.344

Barling, J., Rogers, A. G., & Kelloway, E. K. (2001). Behind Closed Doors: In-Home Workers' Experience of Sexual Harassment and Workplace Violence. *Journal of occupational health psychology*, *6*(3), 255–269. https://doi.org/10.1037/1076-8998.6.3.255

Barnes, C. M., & Watson, N. F. (2019). Why healthy sleep is good for business. *Sleep Medicine Reviews*, *47*, 112–118. https://doi.org/10.1016/j.smrv.2019.07.005

Barnett, R. L., & Brickman, D. B. (1986, June 1). Safety hierarchy. *Journal of Safety Research*, *17* (2), 49–55. https://doi.org/10.1016/0022-4375(86)90093-9

Beehr, T. A., & Franz, T. M. (1987). The current debate about the meaning of job stress. *Journal of Organizational Behavior Management*, *8*(2), 5–18. https://doi.org/10.1300/J075v08n02_02

Bertera, R. L. (1990, September). The effects of workplace health promotion on absenteeism and employment costs in a large industrial population. *American Journal of Public Health*, *80* (9), 1101–1105. https://doi.org/10.2105/ajph.80.9.1101

Beus, J. M., Payne, S. C., Bergman, M. E., & Arthur, W., Jr. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. *Journal of Applied Psychology*, *95* (4), 713. https://doi.org/10.1037/a0019164

Blair, S. N. (2009). Physical inactivity: the biggest public health problem of the 21st century. *British Journal of Sports Medicine*, *43*(1). https://pubmed.ncbi.nlm.nih.gov/19136507/

Blampied, N. M., & Bootzin, R. R. (2013). Sleep: A behavioral account. In G. J. Madden, W. V. Dube, T. D. Hackenberg, G. P. Hanley, & K. A. Lattal (Eds.), *APA handbook of behavior analysis, vol. 2: Translating principles into practice* (pp. 425–453). American Psychological Association. https://doi.org/10.1037/13938-017

Bor, J., Cohen, G. H., & Galea, S. (2017). Population health in an era of rising income inequality: USA, 1980–2015. *The Lancet*, *389*(10077), 1475–1490. https://doi.org/10.1016/s0140-6736(17)30571-8

Brethower, D. M. (1982). The total performance system. *Industrial Behavior Modification: A Management Handbook*, 350–369.

Brethower, D. M., Dickinson, A. M., Johnson, D. A., & Johnson, C. M. (2022). A history of organizational behavior management. *Journal of Organizational Behavior Management*, *42* (1), 3–35. https://doi.org/10.1080/01608061.2021.1924340

Brondel, L., Romer, M. A., Nougues, P. M., Touyarou, P., & Davenne, D. (2010). Acute partial sleep deprivation increases food intake in healthy men. *The American Journal of Clinical Nutrition*, *91*(6), 1550–1559. https://doi.org/10.3945/ajcn.2009.28523

Bureau of Labor Statistics. (2018). Back injuries prominent in work-related musculoskeletal disorder cases in 2016. Retrieved November 21, 2022, from https://www.bls.gov/opub/ted/2018/back-injuries-prominent-in-work-related-musculoskeletal-disorder-cases-in-2016.htm

Bureau of Labor Statistics. (2019). *Employer-reported workplace injuries and illnesses – 2018*. Retrieved September 2, 2022, from https://www.bls.gov/news.release/archives/osh_11072019.pdf

Bureau of Labor Statistics. (2021). *Employer-Reported Workplace Injuries and Illnesses - 2020*. Retrieved September 2, 2022, from https://www.bls.gov/news.release/archives/osh_11032021.htm

Bureau of Labor Statistics. (2022). Nonfatal cases involving days away from work: Selected characteristics (2011 forward). Retrieved November 21, 2022, from https://data.bls.gov/timeseries/CSU00X32XXXX6P100

Burgard, S. A., & Lin, K. Y. (2013). Bad jobs, bad health? How work and working conditions contribute to health disparities. *American Behavioral Scientist*, *57*(8), 1105–1127. https://doi.org/10.1177/0002764213487347

Burks, S. V., Anderson, J. E., Bombyk, M., Haider, R., Ganzhorn, D., Jiao, X., Lewis, C., Lexvold, A., Liu, H., Ning, J., Toll, A., Hickman, J. S., Mabry, E., Berger, M., Malhotra, A., Czeisler, C. A., & Kales, S. N. (2016). Nonadherence with employer-mandated sleep apnea treatment and increased risk of serious truck crashes. *Sleep*, *39*(5), 967–975. https://doi.org/10.5665/sleep.5734

Buxton, O. M., Cain, S. W., O'Connor, S. P., Porter, J. H., Duffy, J. F., Wang, W., Czeisler, C. A., & Shea, S. A. (2012). Adverse metabolic consequences in humans of prolonged sleep restriction combined with circadian disruption. *Science Translational Medicine*, *4*(129), 129ra143. https://doi.org/10.1126/scitranslmed.3003200

Buxton, O. M., & Marcelli, E. (2010). Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Social Science and Medicine*, *71*(5), 1027–1036. https://doi.org/10.1016/j.socscimed.2010.05.041

California Department of Public Health. (2014). *Guide to Choosing Paint Stripping Products: Safety Considerations*. California Department of Public Health. Retrieved September 2, 2022, from https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/HESIS/CDPH%20Document%20Library/Paint-Removal-Methods.pdf

Cappuccio, F. P., D'Elia, L., Strazzullo, P., & Miller, M. A. (2010). Quantity and quality of sleep and incidence of type 2 diabetes: A systematic review and meta-analysis. *Diabetes Care*, *33*(2), 414–420. https://doi.org/10.2337/dc09-1124

Carnethon, M., Whitsel, L. P., Franklin, B. A., Kris-Etherton, P., Milani, R., Pratt, C. A., & Wagner, G. R. (2009). Worksite wellness programs for cardiovascular disease prevention. *Circulation*, *120*(17), 1725–1741. https://doi.org/10.1161/CIRCULATIONAHA.109.192653

Carr, J. E., & Nosik, M. R. (2017). Professional credentialing of practicing behavior analysts. *Policy Insights from the Behavioral and Brain Sciences*, *4*(1), 3–8. https://doi.org/10.1177/2372732216685861

Centers for Disease Control and Prevention. (2021). Obesity-Fact-Sheet-508. Retrieved September 6, 2022, from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cdc.gov/nccdphp/dnpao/docs/Obesity-Fact-Sheet-508.pdf

Chappell, B. (2020). 4 of 5 workers are affected by COVID-19 worldwide, U.N. agency says. NPR. Retrieved April 27, 2020, from https://www.npr.org/sections/coronavirus-live-updates/2020/04/07/828778490/4-of-5-workers-are-affected-by-covid-19-worldwide-u-n-agency-says

Chari, R., Chang, C. C., Sauter, S. L., Petrun Sayers, E. L., Cerully, J. L., Schulte, P., Schill, A. L., & Uscher-Pines, L. (2018, July). Expanding the paradigm of occupational safety and health: A new framework for worker well-being. *Journal of Occupational and Environmental Medicine*, *60*(7), 589–593. https://doi.org/10.1097/JOM.0000000000001330

Cherniack, M., Henning, R., Merchant, J. A., Punnett, L., Sorensen, G. R., & Wagner, G. (2011, January). Statement on national worklife priorities. *American Journal of Industrial Medicine*, *54* (1), 10–20. https://doi.org/10.1002/ajim.20900

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology*, *94* (5), 1103. https://doi.org/10.1037/a0016172

Clougherty, J. E., Souza, K., & Cullen, M. R. (2010, February). Work and its role in shaping the social gradient in health. *Annals of the New York Academy of Sciences*, *1186* (1), 102–124. https://doi.org/10.1111/j.1749-6632.2009.05338.x

Colten, H. R., & Altevogt, B. M., Institute of Medicine (US). (2006). *Sleep disorders and sleep deprivation: an unmet public health problem*. C. O. S. M. A. Research, Ed. National Academies Press (US).

Commission on Health and Safety and Workers Compensation. (2010). *The Whole Worker: Guidelines for Integrating Occupational Health and Safety with Workplace Wellness Programs*. Commission on Health and Safety and Workers Compensation. Retrieved September 2, 2022, from https://www.dir.ca.gov/chswc/WOSHTEP/Publications/WOSHTEP_TheWholeWorker.pdf

Cunningham, T., Jacklistch, B., & Richards, R. (2021). Intermediary perspectives on total worker health in small businesses. *International Journal of Environmental Research and Public Health*, *18*(19), 1–15. https://doi.org/10.3390/ijerph181910398

Dalton, B. A., & Harris, J. S. (1991, March). A comprehensive approach to corporate health management. *Journal of Occupational Medicine*, *33*(3), 338–347. https://pubmed.ncbi.nlm.nih.gov/1903156/

DeJoy, D. M., & Southern, D. J. (1993, December). An integrative perspective on work-site health promotion. *Journal of Occupational Medicine*, *35*(12), 1221–1230. https://pubmed.ncbi.nlm.nih.gov/8113926/

DeJoy, D. M., & Wilson, M. L. (2019). Total worker health®: Evolution of the concept. In H. L. Hudson, J. A. S. Nigam, S. L. Sauter, L. C. Chosewood, A. L. Schill, & J. Howard (Eds.), *Total worker health* (pp. 11–28). American Psychological Association. https://doi.org/10.1037/0000149-002

Denton, M., Zeytinoglu, I. U., Davies, S., & Lian, J. (2002). Job stress and job dissatisfaction of home care workers in the context of health care restructuring. *International Journal of Health Services*, *32*(2), 327–357. https://doi.org/10.2190/VYN8-6NKY-RKUM-L0XW

Dickinson, A. M. (2001, January 29). The historical roots of organizational behavior management in the private sector. *Journal of Organizational Behavior Management*, *20*(3–4), 9–58. https://doi.org/10.1300/J075v20n03_02

Dinges, D. F., Pack, F., Williams, K., Gillen, K. A., Powell, J. W., Ott, G. E., Aptowicz, C., & Pack, A. I. (1997). Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. *Sleep*, *20*(4), 267–277. https://doi.org/10.1093/sleep/20.4.267

Faghri, P. D., Dobson, M., Landsbergis, P., & Schnall, P. L. (2021). COVID-19 pandemic: What has work got to do with it?. *Journal of Occupational and Environmental Medicine*, *63*(4), e245–e249. https://doi.org/10.1097/JOM.0000000000002154

Fanslow, J. L., Leland, L. S., Craig, T., Hahn, H., Polonowita, R., & Teavae, S. (1988). Reducing passive smoking by promoting self segregation of smokers using signs and thematic prompts. *Journal of Organizational Behavior Management*, *9*(2), 23–34. https://doi.org/10.1300/J075v09n02_03

Feltner, C., Peterson, K., Weber, R. P., Cluff, L., Coker-Schwimmer, E., Viswanathan, M., & Lohr, K. N. (2016). The effectiveness of total worker health interventions: A systematic review for a national institutes of health pathways to prevention workshop. *Annals of Internal Medicine*, *1654*, 262–269. AHRQ Comparative Effectiveness Reviews. https://doi.org/10.7326/M16-0626

Ferguson, D (1977). The psychologist and occupational health. In J. Brebner (Ed.), *Proceedings of the Annual conference, Ergonomics Society of Australia and New Zealand* (pp. 41–50). Adelaide, Australia: Department of Psychology, University of Adelaide.

Ferster, C., & DeMyer, M. K. (1961). The development of performances in autistic children in an automatically controlled environment. *Journal of Chronic Diseases*, *13*(4), 312–345. https://doi.org/10.1016/0021-9681(61)90059-5

Gaskin, D. J., & Richard, P. (2012). The economic costs of pain in the United States. *The Journal of Pain*, *13*(8), 715–724.

Geller, E. S. (2005). Behavior-based safety and occupational risk management. *Behavior Modification*, *29*(3), 539–561. https://doi.org/10.1177/0145445504273287

Gignac, M. A. M., Backman, C. L., Kaptein, S., Lacaille, D., Beaton, D. E., Hofstetter, C., & Badley, E. M. (2012). Tension at the borders: Perceptions of role overload, conflict, strain and facilitation in work, family and health roles among employed individuals with arthritis. *Rheumatology (Oxford, England)*, *51*(2), 324–332. https://doi.org/10.1093/rheumatology/ker317

Goh, J., Pfeffer, J., & Zenios, S. A. (2015). The Relationship between workplace stressors and mortality and health costs in the United States. *Management Science*, *62*(2), 608–628. https://doi.org/10.1002/ajim.20094

Goldenhar, L. M., LaMontagne, A. D., Katz, T., Heaney, C., & Landsbergis, P. (2001, July). The intervention research process in occupational safety and health: An overview from the national occupational research agenda intervention effectiveness research team. *Journal of Occupational and Environmental Medicine*, *43* (7), 616–622. https://doi.org/10.1097/00043764-200107000-00008

Grandner, M. A., Hale, L., Moore, M., & Patel, N. P. (2010). Mortality Associated With Short Sleep Duration: The Evidence, the Possible Mechanisms, and the Future. *Sleep Medicine Reviews*, *14*(3), 191–203. https://doi.org/10.1016/j.smrv.2009.07.006

Green, N., & Dallery, J. (2019). Evaluating the effectiveness of education, feedback, & task clarification to increase workplace physical activity. *Journal of Organizational Behavior Management*, *39*(3–4), 237–246. https://doi.org/10.1080/01608061.2019.1632239

Greer, S. M., Goldstein, A. N., & Walker, M. P. (2013). The impact of sleep deprivation on food desire in the human brain. *Nature Communications*, *4*(2259). https://doi.org/10.1038/ncomms3259

Gu, J. K., Charles, L. E., Andrew, M. E., Ma, C. C., Hartley, T. A., Violanti, J. M., & Burchfiel, C. M. (2016). Prevalence of work-site injuries and relationship between obesity and injury among US workers: NHIS 2004–2012. *Journal of Safety Research*, *58*, 21–30. https://doi.org/10.1016/j.jsr.2016.06.001

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L (2020). *Prevalence of Obesity and Severe Obesity Among Adults: United States, 2017-2018*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/nchs/products/databriefs/db360.htm

Hammer, L. B., & Sauter, S. (2013, December). Total worker health and work-life stress. *Journal of Occupational Environment Medicine*, *55* (12 Suppl), S25–29. https://doi.org/10.1097/JOM.0000000000000043

Hammer, L. B., Truxillo, D. M., Bodner, T., Rineer, J., Pytlovany, A. C., & Richman, A. (2015). Effects of a workplace intervention targeting psychosocial risk factors on safety and health outcomes. *BioMed Research International. 2015* 10 1–12. https://doi.org/10.1155/2015/836967

Hanson, G. C., Perrin, N. A., Moss, H., Laharnar, N., & Glass, N. (2015). Workplace violence against homecare workers and its relationship with workers health outcomes: A cross-sectional study. *BMC Public Health*, *15*(1), 11. https://doi.org/10.1186/s12889-014-1340-7

Hantula, D. A., Stillman, F. A., & Waranch, H. R. (1992). Can a mass-media campaign modify tobacco smoking in a large organization? Evaluation of the great American smokeout in an urban hospital. *Journal of Organizational Behavior Management*, *13*(1), 33–47. https://doi.org/10.1300/J075v13n01_04

Hopkins, B. L., Conard, R. J., Dangel, R. F., Fitch, H. G., Smith, M. J., & Anger, W. K. (1986). Behavioral technology for reducing occupational exposures to styrene. *Journal of Applied Behavior Analysis*, *19*(1), 3–11. https://doi.org/10.1901/jaba.1986.19-3

Howe, J. (2001). *A union critique of behavior-based safety*. UAW, Health and Safety Department. Retrieved September 2, 2022, from http://www.uawlocal974.org/BSSafety/Warning!_Behavior-Based_Safety_Can_Be_Hazardous_To_Your_Health_and_Safety_Program!.pdf

Hursh, S. R., Balkin, T. J., Miller, J. C., & Eddy, D. R (2004). The fatigue avoidance scheduling tool: Modeling to minimize the effects of fatigue on cognitive performance. *SAE Technical Paper*, 2004-01-215. SAE International. https://doi.org/10.4271/2004-01-2151

Hursh, S. R., Fanzone, J. F., Jr., & Raslear, T. G. (2011). *Analysis of the relationship between operator effectiveness measures and economic impacts of rail accidents*. Office of Railroad Policy and Development. Retrieved September 2, 2022, from https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/99/TR_Economic_Analysis_of_Rail_Accidents_and_Effectiveness_final.pdf

Hursh, S. R., Raslear, T. G., Kaye, A. S., & Fanzone, J. F., Jr. (2006). Validation and calibration of a fatigue assessment tool for railroad work schedules - summary report. *Office of Research and Development*, Retrieved September 2, 2022 from https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/17499/ord0621.pdf

Hymel, P. A., Loeppke, R. R., Baase, C. M., Burton, W. N., Hartenbaum, N. P., Hudson, T. W., McLellan, R. K., Mueller, K. L., Roberts, M. A., Yarborough, C. M., Konicki, D. L., & Larson, P. W. (2011, June). Workplace health protection and promotion: A new pathway for a healthier–and safer–workforce. *Journal of Occupational and Environmental Medicine*, *53* (6), 695–702. https://doi.org/10.1097/JOM.0b013e31822005d0

Institute of Medicine. (2015). Integrating employee health: A model program for NASA. https://doi.org/10.17226/11290

Kalimo, R., Tenkanen, L., Härmä, M., Poppius, E., & Heinsalmi, P. (2000). Job stress and sleep disorders: Findings from the Helsinki heart study. *Stress Medicine*, *16*(2), 65–75. https://doi.org/10.1002/(sici)1099-1700(200003)16:2<65::Aid-smi834>3.0.Co;2-8

Komaki, J., Barwick, K. D., & Scott, L. R. (1978). A behavioral approach to occupational safety: Pinpointing and reinforcing safe performance in a food manufacturing plant. *Journal of Applied Psychology*, *63*(4), 434–445. https://doi.org/10.1037/0021-9010.63.4.434

Krause, N., Rugulies, R., Ragland, D. R., & Syme, S. L. (2004). Physical workload, ergonomic problems, and incidence of low back injury: A 7.5-year prospective study of San Francisco transit operators. *American Journal of Industrial Medicine*, *46*(6), 570–585. https://doi.org/10.1002/ajim.20094

Krause, T. R., Seymour, K. J., & Sloat, K. C. M. (1999). Long-term evaluation of a behavior-based method for improving safety performance: A meta-analysis of 73 interrupted time-series replications. *Safety Science*, *32*(1), 1–18. https://doi.org/10.1016/S0925-7535(99)00007-7

Kristensen, T. S. (2005). Intervention studies in occupational epidemiology. *Occupational and Environmental Medicine*, *62*(3), 205–210. https://doi.org/10.1136/oem.2004.016097

Leigh, J. P. (2011). Economic burden of occupational injury and illness in the United States. *The Milbank Quarterly*, *89*(4), 728–772. https://doi.org/10.1111/j.1468-0009.2011.00648.x

Liberty Mutual Insurance. (2019). *Workplace safety indices by industry: Insights and methodology*. Retrieved September 2, 2022, from https://www.libertymutualgroup.com/about-lm/news/documents/2019-workplace-safety-index.pdf

Lockley, S. W., Barger, L. K., Ayas, N. T., Rothschild, J. M., Czeisler, C. A., & Landrigan, C. P., Harvard Work Hours, & Health and Safety Group. (2007). Effects of health care provider work hours and sleep deprivation on safety and performance. *The Joint Commission Journal on Quality and Patient Safety*, *33* 7–18. https://doi.org/10.1016/s1553-7250(07)33109-7

Loeppke, R. (2008). The value of health and the power of prevention. *International Journal of Workplace Health Management*, *1*(2), 95–108. https://doi.org/10.1108/17538350810893892

Ludwig, T. D. (2017). Process Safety: Another Opportunity to Translate Behavior Analysis into Evidence-Based Practices of Grave Societal Value. *Journal of Organizational Behavior Management*, *37*(3–4), 221–223. https://doi.org/10.1080/01608061.2017.1343702

Martin, C. J., Jin, C., Bertke, S. J., Yiin, J. H., & Pinkerton, L. E. (2020, March). Increased overall and cause-specific mortality associated with disability among workers' compensation claimants with low back injuries. *American Journal of Industrial Medicine*, *63* (3), 209–217. https://doi.org/10.1002/ajim.23083

Massachusetts Department of Public Health Occupational Health Surveillance Program. (2018). *Opioid-related Overdose Deaths in Massachusetts by Industry and Occupation, 2011-2015*. Retrieved September 2, 2022, from https://www.mass.gov/doc/opioid-related-overdose-deaths-in-massachusetts-by-industry-and-occupation-2011-2015/download

Maulik, P. K. (2017). Workplace stress: A neglected aspect of mental health wellbeing. *The Indian Journal of Medical Research*, *146*(4), 441–444. https://doi.org/10.4103/ijmr.IJMR_1298_17

McAllister, E. J., Dhurandhar, N. V., Keith, S. W., Aronne, L. J., Barger, J., Baskin, M., Benca, R. M., Biggio, J., Boggiano, M. M., Eisenmann, J. C., Elobeid, M., Fontaine, K. R., Gluckman, P., Hanlon, E. C., Katzmarzuk, P., Pietrobelli, A., Redden, D. T., Ruden, D. M., Wang, C., … Allison, D. B. (2009). Ten putative contributors to the obesity epidemic. *Critical Review in Food Science and Nutrition*, *49*(10), 868–913. https://doi.org/10.1080/10408390903372599

McHill, A. W., Phillips, A. J., Czeisler, C. A., Keating, L., Yee, K., Barger, L. K., Garaulet, M., Scheer, F. A., & Klerman, E. B. (2017). Later circadian timing of food intake is associated with increased body fat. *The American Journal of Clinical Nutrition*, *106*(5), 1213–1219. https://doi.org/10.3945/ajcn.117.161588

McHill, A. W., & Wright, K. P., Jr. (2017, February). Role of sleep and circadian disruption on energy expenditure and in metabolic predisposition to human obesity and metabolic disease. *Obesity Reviews*, *Suppl 18*, 15–24. https://doi.org/10.1111/obr.12503

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, *15*(4), 351–377. https://doi.org/10.1177/109019818801500401

Moran, D. J. (2015). Acceptance and commitment training in the workplace. *Current Opinion in Psychology*, *2*, 26–31. https://doi.org/10.1016/j.copsyc.2014.12.031

Murphy, L. R., & Cooper, C. L. (2000). Models of healthy work organizations. In L. R. Murphy & C. L. Cooper (Eds.), *Healthy and productive work* (pp. 1–11). Taylor & Francis.

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology*, *96*(1), 71. https://doi.org/10.1037/a0021484

Nakata, A., Ikeda, T., Takahashi, M., Haratani, T., Hojou, M., Fujioka, Y., Swanson, N. G., & Araki, S. (2006, August). Impact of psychosocial job stress on non-fatal occupational injuries in small and medium-sized manufacturing enterprises. *American Journal of Industrial Medicine*, *49* (8), 658–669. https://doi.org/10.1002/ajim.20338

Napoletano, E., & Curry, B (2022). *Environmental, Social And Governance: What Is ESG Investing?* Forbes. Retrieved September 2, 2022, from https://www.forbes.com/advisor/investing/esg-investing/

National Cancer Institute. (2005). *Theory at a Glance: A Guide for Health Promotion Practice*. Retrieved September 2, 2022, from http://www.sbccimplementationkits.org/demandrmnch/wp-content/uploads/2014/02/Theory-at-a-Glance-A-Guide-For-Health-Promotion-Practice.pdf

National Institute for Occupational Safety and Health. (1987). *Prevention of leading work-related diseases and injuries*. Center for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/mmwr/preview/index87.html

National Institute for Occupational Safety and Health. (2012). *Research compendium: The NIOSH total worker healthTM program: Seminal research papers 2012*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and

Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2012-146, May 2012. 1–214. https://www.cdc.gov/niosh/docs/2012-146/pdfs/2012-146.pdf?id=10.26616/NIOSHPUB2012146

National Institute for Occupational Safety and Health. (2015a). *Hierarchy of Controls*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/topics/hierarchy/default.html

National Institute for Occupational Safety and Health. (2015b). *History*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/twh/history.html

National Institute for Occupational Safety and Health. (2016). *National Occupational Research Agenda (NORA)/national total worker health research, practice, policy, and capacity*. Centers for Disease Control and Prevention.

National Institute for Occupational Safety and Health. (2020a). *Hierarchy of Controls Applied to NIOSH Total Worker Health*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/twh/guidelines.html

National Institute for Occupational Safety and Health. (2020b). *Issues Relevant to Advancing Worker Well-Being Using Total Worker Health® Approaches*. Center for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/twh/pdfs/Issues-Graphic-2020_508.pdf

National Institute for Occupational Safety and Health. (2021a). *NIOSH Centers of Excellence for Total Worker Health®*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/twh/centers.html

National Institute for Occupational Safety and Health. (2021b). *NIOSH worker well-being questionnaire (WellBQ)*. By Chari R, Chang CC, Sauter SL, Petrun Sayers EL, Huang W, Fisher GG. Publication No. 2021-110 Retrieved 5, 2021, from https://doi.org/10.26616/NIOSHPUB2021110revised52021

National Institute for Occupational Safety and Health. (2022a). *NIOSH Total Worker Health® Affiliate Program*. Centers for Disease Control and Prevention. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/twh/affiliate.html

National Institute for Occupational Safety and Health. (2022b). *Conferences, Meetings, Webinars, and Events*. National Institute for Occupational Safety and Health. Retrieved September 2, 2022, from https://www.cdc.gov/niosh/conferences/default.html

National Safety Council. (1955). Removing the hazard from the job. In *Accident prevention manual for industrial operations*. National Safety Council. (3rd ed., pp. 4–11).

National Safety Council. (2017). *Fatigue in the workplace: Causes and consequences of employee fatigue*. Retrieved February 10, 2021, from https://www.nsc.org/getmedia/5a0a7e87-9170-41a0-b28c-ce7b6ef3fc7e/fatigue-survey-report.pdf.aspx

Newman, L. S., Scott, J. G., Childress, A., Linnan, L., Newhall, W. J., McLellan, D. L., Campo, S., Freewynn, S., Hammer, L. B., Leff, M., Macy, G., Maples, E. H., Rogers, B., Rohlman, D. S., Tenney, L., & Watkins, C. (2020). Education and training to build capacity in Total Worker Health®: Proposed competencies for an emerging field. *Journal of Occupational and Environmental Medicine*, *62*(8), e384. https://doi.org/10.1097/JOM.0000000000000196

Occupational Health and Safety Administration. (2019). *Using leading indicators to improve safety and health outcomes*. Retrieved September 2, 2022, from https://www.osha.gov/leadingindicators/docs/OSHA_Leading_Indicators.pdf

Occupational Safety and Health Act of 1970, § 651 et seq. (1970). https://www.osha.gov/laws-regs/oshact/completeoshact

Occupational Safety and Health Administration. (2016). *Lethal Exposure to Methylene Chloride during Bathtub Refinishing*. Retrieved September 2, 2022, from https://www.osha.gov/sites/default/files/publications/OSHA3883.pdf

Ohlander, J., Kromhout, H., & van Tongeren, M. (2020). Interventions to reduce exposures in the workplace: A systematic review of intervention studies over six decades, 1960–2019 [Systematic Review]. *Frontiers In Public Health*, *8*(67). https://doi.org/10.3389/fpubh.2020.00067

Olson, R., Anger, W. K., Elliot, D., Wipfli, B., & Gray, M. (2009). A new health promotion model for lone workers: Results of the SHIFT pilot study (Safety & Health Involvement For Truckers). *Journal of Occupational and Environmental Medicine*, *51*(11), 1233–1246. https://doi.org/10.1097/JOM.0b013e3181c1dc7a

Olson, R., Hess, J. A., Parker, K. N., Thompson, S. V., Rameshbabu, A., Rhoten, K. L., & Marino, M. (2018). From research-to-practice: An adaptation and dissemination of the COMPASS program for home care workers. *International Journal of Environmental Research and Public Health*, *15*(12), 377–392. https://doi.org/10.3390/ijerph15122777

Olson, R., Johnson, P., Shea, S., & Marino, M (2017). *Tech4Rest Trial With Team Truck Drivers* (Tech4Rest). ClinicalTrials.gov Identifier NCT03108599. https://ClinicalTrials.gov/show/NCT03108599

Olson, R., Johnson, P., Shea, S. A., Marino, M., Rimby, J., Womak, K., Wang, F., Springer, R., Donovan, C., & Rice, S. P. M. (2020). Advancing the safety, health, and well-being of commercial driving teams who sleep in moving semi-trucks: The tech4rest pilot study. *Journal of Occupational and Environmental Medicine*, *62*(12), 1082–1096. https://doi.org/10.1097/jom.0000000000002063

Olson, R., Thompson, S. V., Elliot, D. L., Hess, J. A., Rhoten, K. L., Parker, K. N., Wright, R. R., Wipfli, B., Bettencourt, K. M., Buckmaster, A., & Marino, M. (2016). Safety and health support for home care workers: The COMPASS randomized controlled trial. *American Journal of Public Health*, *106*(10), 1823–1832. https://doi.org/10.2105/AJPH.2016.303327

Olson, R., Wipfli, B., Thompson, S. V., Elliot, D. L., Anger, W. K., Bodner, T., Hammer, L. B., & Perrin, N. A. (2016). Weight control intervention for truck drivers: The SHIFT randomized controlled trial, United States. *American Journal of Public Health*, *106*(9), 1698–1706. https://doi.org/10.2105/AJPH.2016.303262

Onyeaka, H., Anumudu, C. K., Al-Sharify, Z. T., Egele-Godswill, E., & Mbaegbu, P. (2021). COVID-19 pandemic: A review of the global lockdown and its far-reaching effects. *Science Progress*, *104*(2), 1–18. https://doi.org/10.1177/00368504211019854

Peters, K. K., & Carlson, J. G. (1999). Worksite stress management with high-risk maintenance workers: A controlled study [Peer Reviewed]. *International Journal of Stress Management*, *6*(1), 21–44. https://doi.org/10.1023/A:1021958219737

Petts, R. J., Carlson, D. L., & Pepin, J. R. (2020). A gendered pandemic: Childcare, homeschooling, and parents' employment during COVID-19. *Gender, Work & Organization*, *28*(S2), 515–534. https://doi.org/10.1111/gwao.12614

Pollack, K. M., & Cheskin, L. J. (2007). Obesity and workplace traumatic injury: Does the science support the link?. *Injury Prevention*, *13*(5), 297. https://doi.org/10.1136/ip.2006.014787

Porath, C., & Pearson, C (2013). *The price of incivility*. Harvard Business Review. Retrieved September 2, 2022, from https://hbr.org/2013/01/the-price-of-incivility

Punnett, L., Cherniack, M., Henning, R., Morse, T., Faghri, P., & Team, C.-N. R. (2009, July-August). A conceptual framework for integrating workplace health promotion and occupational ergonomics programs. *Public Health Reports*, *124 Suppl 1* (4_suppl1), 16–25. https://doi.org/10.1177/00333549091244S103

Quick, J. D., Horn, R. S., & Quick, J. C. (1987). Health consequences of stress. *Journal of Organizational Behavior Management*, *8*(2), 19–36. https://doi.org/10.1300/J075v08n02_03

Quick, J. C., & Tetrick, L. E. (2011). *Handbook of occupational health psychology, 2nd ed.* American Psychological Association.

Rajaratnam, S. M., Barger, L. K., Lockley, S. W., Shea, S. A., Wang, W., Landrigan, C. P., O'Brien, C. S., Qadri, S., Sullivan, J. P., Cade, B. E., Epstein, L. J., White, D. P., &

Czeisler, C. A.(2011, December 21). Sleep disorders, health, and safety in police officers. *JAMA*, *306*(23), 2567–2578. https://doi.org/10.1001/jama.2011.1851

Raslear, T. G. (2011). *Measurement and Estimation of Sleep in Railroad Worker Employees*. Federal Railroad Administration. U.S. Department of Transportation. Retrieved September 2, 2022, from https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/135/RR_Measurement_and_estimation_of_Sleep_final_1102.pdf

Rethorst, C. D., Wipfli, B., & Landers, D. M. (2009). The antidepressive effects of exercise. *Sports Medicine*, *39*(6), 491–511. https://doi.org/10.2165/00007256-200939060-00004

Rohlman, D. S., Parish, M., Elliot, D. L., Hanson, G., & Perrin, N. (2016). Addressing younger workers' needs: The Promoting U through Safety and Health (PUSH) trial outcomes. *Healthcare (Basel)*, *4*(3). https://doi.org/10.3390/healthcare4030055

Rummler, G. A., & Brache, A. P. (2012). *Improving performance: How to manage the white space on the organization chart*. John Wiley & Sons.

Sara, J. D., Prasad, M., Eleid, M. F., Zhang, M., Widmer, R. J., & Lerman, A. (2018, April 27). Association between work-related stress and coronary heart disease: A review of prospective studies through the job strain, effort-reward balance, and organizational justice models. *Journal of the American Heart Association*, *7*(9). https://doi.org/10.1161/JAHA.117.008073

Sauter, S. L. (2013). Integrative approaches to safeguarding the health and safety of workers. *Industrial Health*, *51*(6), 559–561. https://doi.org/10.2486/indhealth.ms5106ed

Sauter, S. L., & Hurrell, J. J., Jr. (1999). Occupational health psychology: Origins, content, and direction. *Professional Psychology: Research and Practice*, *30*(2), 117–122. https://doi.org/10.1037/0735-7028.30.2.117

Sauter, S. L., & Hurrell, J. J., Jr. (2017). Occupational health contributions to the development and promise of occupational health psychology. *Journal of Occupational Health Psychology*, *22*(3), 251. https://doi.org/10.1037/ocp0000088

Schill, A. L., & Chosewood, L. C. (2013, December). The NIOSH total worker health program: An overview. *Journal of Occupational and Environmental Medicine*, *55* (12 Suppl), S8–11. https://doi.org/10.1097/JOM.0000000000000037

Schill, A. L., Chosewood, L. C., & Howard, J. (2019). The NIOSH total worker health® vision. In H. L. Hudson, J. A. S. Nigam, S. L. Sauter, L. C. Chosewood, A. L. Schill, & J. Howard (Eds.), *Total worker health* (pp. 29–45). American Psychological Association. https://doi.org/10.1037/0000149-003

Schulte, P. A., Delclos, G., Felknor, S. A., & Chosewood, L. C. (2019). Toward an expanded focus for occupational safety and health: A commentary. *International Journal of Environmental Research and Public Health*, *16*(24), 4946. https://doi.org/10.3390/ijerph16244946

Shaw, W. S., Roelofs, C., & Punnett, L. (2020). Work environment factors and prevention of opioid-related deaths. *American Journal of Public Health*, *110*(8), 1235–1241. https://doi.org/10.2105/ajph.2020.305716

Sherrill, D. L., Kotchou, K., & Quan, S. F. (1998). Association of physical activity and human sleep disorders. *Archives of Internal Medicine*, 158. https://doi.org/10.1001/archinte.158.17.1894

Shockley, K. M., Clark, M. A., Dodd, H., & King, E. B. (2021). Work-family strategies during COVID-19: Examining gender dynamics among dual-earner couples with young children. *Journal of Applied Psychology*, *106*(1), 15–28. https://doi.org/10.1037/apl0000857

Sieber, W. K., Robinson, C. F., Birdsey, J., Chen, G. X., Hitchcock, E. M., Lincoln, J. E., Nakata, A., & Sweeney, M. H. (2014, June). Obesity and other risk factors: The national survey of U.S. long-haul truck driver health and injury. *American Journal of Industrial Medicine*, *57* (6), 615–626. https://doi.org/10.1002/ajim.22293

Skinner, B. F. (1955). The control of human behavior. *Transactions of the New York Academy of Sciences Series*, *2*(17), 547–551. https://doi.org/10.1111/j.2164-0947.1955.tb02820.x

Skinner, B. F. (1957). The experimental analysis of behavior. *American Scientist*, *45*(1), 343–371. https://www.americanscientist.org/article/the-experimental-analysis-of-behavior

Sorensen, G., Landsbergis, P., Hammer, L., Amick, B. C., 3rd, Linnan, L., Yancey, A., Welch, L. S., Goetzel, R. Z., Flannery, K. M., & Pratt, C., & Workshop Working Group on Worksite Chronic Disease, P. (2011). Preventing chronic disease in the workplace: A workshop report and recommendations. *American Journal of Public Health*, *101* (S1), S196–S207. https://doi.org/10.2105/AJPH.2010.300075

Sorensen, G., Stoddard, A. M., LaMontagne, A. D., Emmons, K., Hunt, M. K., Youngstrom, R., McLellan, D., & Christiani, D. C. (2002). A comprehensive worksite cancer prevention intervention: Behavior change results from a randomized controlled trial (United States). *Cancer Causes & Control*, *13*(6), 493–502. https://doi.org/10.1023/a:1016385001695

Sorensen, G., Stoddard, A., Ockene, J. K., Hunt, M. K., & Youngstrom, R. (1996, May). Worker participation in an integrated health promotion/health protection program: Results from the WellWorks project. *Health Education Quarterly*, *23* (2), 191–203. https://doi.org/10.1177/109019819602300205

Sparer, E. H., Catalano, P. J., Herrick, R. F., & Dennerlein, J. T. (2016, July 1). Improving safety climate through a communication and recognition program for construction: A mixed methods study. *Scand J Work Environ Health*, *42*(4), 329–337. https://doi.org/10.5271/sjweh.3569

Spiegel, K., Tasali, E., Penev, P., & Van Cauter, E. (2004). Brief communication: Sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. *Annals of Internal Medicine*, *141*(11), 846–850. https://doi.org/10.7326/0003–4819-141-11-200412070-00008

Sulzer-Azaroff, B. (1978). Behavioral ecology and accident prevention. *Journal of Organizational Behavior Management*, *2*(1), 11–44. https://doi.org/10.1300/J075v02n01_02

Sulzer-Azaroff, B., & Austin, J. (2000). Behavior-based safety and injury reduction: A survey of evidence. *Professional Safety*, 19–24.

Tamers, S. L., Chosewood, L. C., Childress, A., Hudson, H., Nigam, J., & Chang, C. C. (2019, January 24). Total worker health® 2014-2018: The novel approach to worker safety, health, and well-being evolves. *International Journal of Environmental Research and Public Health*, *16*(3), 321. https://doi.org/10.3390/ijerph16030321

Tompa, E., Mofidi, A., Heuvel, S. V. D., Bree, T. V., Michaelsen, F., Jung, Y., Porsch, L., & Emmerik, M. V. (2021). Economic burden of work injuries and diseases: A framework and application in five European Union countries. *BMC Public Health*, *21*(49). https://doi.org/10.1186/s12889-020-10050-7

Tuncel, S., Harshad, L., Salem, S., & Daraiseh, N. (2006). Effectiveness of behaviour based safety interventions to reduce accidents and injuries in workplaces: Critical appraisal and meta-analysis. *Theoretical Issues in Ergonomics Science*, *7*(3), 191–209. https://doi.org/10.1080/14639220500090273

Turk, D. C., Fillingim, R. B., Ohrbach, R., & Patel, K. V. (2016). Assessment of psychosocial and functional impact of chronic pain. *The Journal of Pain*, *17*(9), T21–T49. https://doi.org/10.1016/j.jpain.2016.02.006

Ulrich, R., Stachnik, T., & Mabry, J. (1966). *Control of human behavior: Expanding the behavioral laboratory*. Glenview, IL: Scott, Foresman and Company.

Veage, S., Ciarrochi, J., Deane, F. P., Andresen, R., Oades, L. G., & Crowe, T. P. (2014). Value congruence, importance and success and in the workplace: Links with well-being and burnout amongst mental health practitioners. *Journal of Contextual Behavioral Science*, *3* (4), 258–264. https://doi.org/10.1016/j.jcbs.2014.06.004

Wallace, T. C., Bailey, R. L., Blumberg, J. B., Burton-Freeman, B., Chen, C.-Y. O., Crowe-White, K. M., Drewnowski, A., Hooshmand, S., Johnson, E., Lewis, R., Murray, R., Shapses, S. A., & Wang, D. D. (2020). Fruits, vegetables, and health: A comprehensive

narrative, umbrella review of the science and recommendations for enhanced public policy to improve intake. *Critical Review in Food Science and Nutrition*, *60*(13), 2174–2211. https://doi.org/10.1080/10408398.2019.1632258

Wang, D. D., Yanping, L., Bhupathiraju, S. N., Rosner, B. A., Sun, Q., Giovannucci, E. L., Rimm, E. B., Manson, J. E., Willett, W. C., Stampfer, M. J., & Hu, F. B. (2021). Fruit and vegetable intake and mortality: Results from 2 prospective cohort studies of US men and women and a meta-analysis of 26 cohort studies. *Circulation*, *143*(7), 1642–1654. https://doi.org/10.1161/CIRCULATIONAHA.120.048996

Wilson, M. G., Dejoy, D. M., Vandenberg, R. J., Richardson, H. A., & Mcgrath, A. L. (2004). Work characteristics and employee health and well-being: Test of a model of healthy work organization. *Journal of Occupational and Organizational Psychology*, *77*(4), 565–588. https://doi.org/10.1348/0963179042596522

Wingard, D. L., & Berkman, L. F. (1983). Mortality risk associated with sleeping patterns among adults. *Sleep*, *6*(2), 102–107. https://doi.org/10.1093/sleep/6.2.102

Wipfli, B., Rethorst, C. D., & Landers, D. M. (2008). The anxiolytic effects of exercise: A meta-analysis of randomized trials and dose–response analysis. *Journal of Sport and Exercise Psychology*, *30*(4), 392–410. https://doi.org/10.1123/jsep.30.4.392

Wolf, M., Risley, T., & Mees, H. (1963). Application of operant conditioning procedures to the behaviour problems of an autistic child. *Behaviour Research And Therapy*, *1*(2–4), 305–312. https://doi.org/10.1016/0005-7967(67)90004-6

Womack, K. N., Alvord, T. W., Trullinger-Dwyer, C. F., Rice, S. P. M., & Olson, R. (2020, July 29). Challenging aggressive behaviors experienced by personal support workers in comparison to home care workers: Relationships between caregiver experiences and psychological health. *International Journal of Environmental Research and Public Health*, *17*(15), 5486. https://doi.org/10.3390/ijerph17155486

Yamada, Y., Kameda, M., Noborisaka, Y., Suzuki, H., Honda, M., & Yamada, S. (2001). Excessive fatigue and weight gain among cleanroom workers after changing from an 8-hour to a 12-hour shift. *Scandinavian journal of work, environment & health*, *27*(5), 318–326. https://doi.org/10.5271/sjweh.620

Yang, H., Hitchcock, E., Haldeman, S., Swanson, N., Lu, M. L., Choi, B., Nakata, A., & Baker, D. (2016, July). Workplace psychosocial and organizational factors for neck pain in workers in the United States. *American Journal of Industrial Medicine*, *59*(7), 549–560. https://doi.org/10.1002/ajim.22602

Young, B., & Swedlow, A (2013). *Obesity as a medical disease: Potential implications for workers' compensation*. California Workers Compensation Institute. Retrieved September 2, 2022, from https://www.cwci.org/document.php?file=2008.pdf

Zohar, D. (2002, February). Modifying supervisory practices to improve subunit safety: A leadership-based intervention model. *Journal of Applied Psychology*, *87* (1), 156–163. https://doi.org/10.1037/0021-9010.87.1.156

Zohar, D., & Fussfeld, N. (1981). Modifying earplug wearing behavior by behavior modification techniques. *Journal of Organizational Behavior Management*, *3*(2), 41–52. https://doi.org/10.1300/J075v03n02_05