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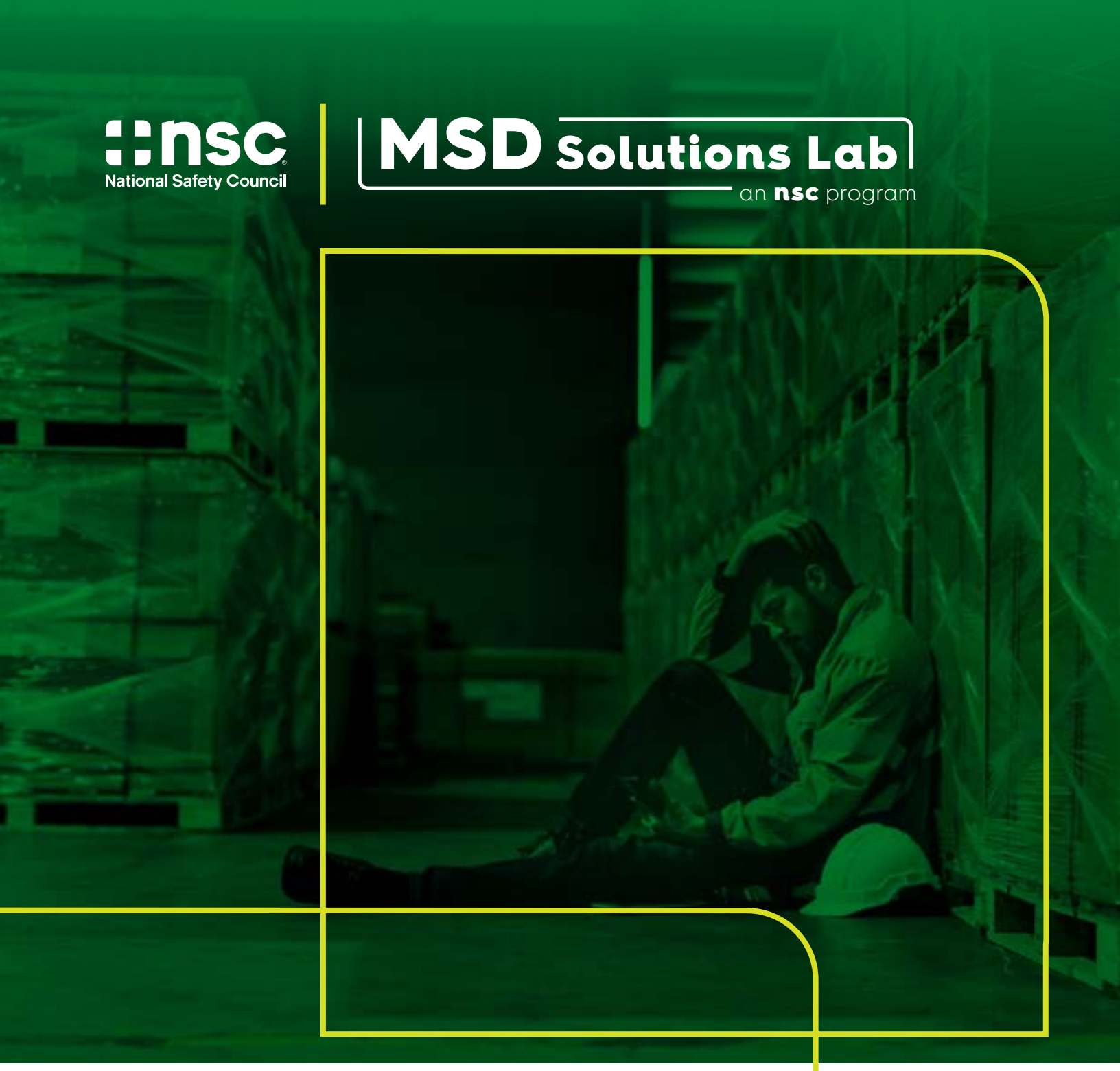

Accounting for Non-Physical Risk Factors in MSD Prevention

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Executive Summary

Work-related physical risk factors, such as force, posture and repetition, are commonly studied, assessed and considered in designing work and preventing musculoskeletal disorder (MSD) risks. While these risk factors are vital to consider when implementing ergonomics programs to mitigate MSDs, other, modifiable non-physical risk factors such as work organization or job stress (as described more fully below) should also be recognized to provide for a more holistic means to assess MSD risks. As we look to the future of MSD prevention and ergonomics, research suggests an emphasis on both physical and non-physical risk factors is needed.

The modifiable, non-physical MSD risk factors discussed in this report are grouped into three categories: organizational, psychosocial and behavioral. These categories were informed by existing literature on MSD risk factors and expert input. However, certain variables or characteristics could be placed into different categories based on individual interpretation and context. For example, a high mental workload could be considered an organizational risk factor or a psychosocial risk factor, depending on the source. For the purpose of this paper, risks are categorized as follows:

Organizational Factors directly influenced or controlled by the employer and related to the way the work is designed, organized and managed.	**Psychosocial** Factors concerning interactions between and among work environment, job content, organization conditions, and workers' capacities, needs and culture, that may influence health and work performance.	**Behavioral** Actions a person engages in that can be modified or impacted by the workplace.
• Work organization • Training • Job control/autonomy • Job security	• Mental workload • Job satisfaction • Job stress • Perceived support	• Amount of sleep • Alcohol/substance use • Tobacco use • Nutrition, physical activity and body mass index

The goal of this report is to discuss the importance of accounting for these non-physical risk factors in MSD prevention programs. Employees who experience these risk factors are at greater risk of injury, less satisfied with their work and more likely to leave their organization. Organizations that have high levels of non-physical risk factors may experience long-term absence of workers, higher workers' compensation costs, poorer safety climates and lower productivity.

To circumvent the negative impacts of non-physical risk factors, organizations are encouraged to address and mitigate their non-physical risk factors. **While the control and mitigation of non-physical risk factors may feel like an issue to be tackled at the organizational level or outside of the environment, health and safety (EHS) purview, safety professionals can have a direct influence on non-physical risk factor management. Specifically, EHS professionals are urged to take a leadership role and champion the assessment and mitigation of non-physical MSD risk factors given the profound effect they have on both safety outcomes and company operations**. Several recommendations for managing and measuring non-physical risk factors are presented at the end of this report.

Introduction

Work-related physical risk factors, such as force, awkward postures and repetitive motions, are commonly studied, assessed and considered in designing work and preventing musculoskeletal disorder (MSD) risks. While such risk factors are vital to consider when implementing ergonomics programs to mitigate MSDs, other, non-physical risk factors should also be recognized to provide for a more holistic representation of assessing MSD risks. Considerable research has increasingly shown that other job-related factors such as high work demands, lack of job control and poor social support at work contribute to MSDs (Lee et al., 2022, European Agency for Safety and Health at Work [EU-OSHA], 2014, Afsharian et al., 2023). For example, one previously developed biopsychosocial model considers MSDs as an interaction of physiological, psychological and social factors (Gatchel, 2004; Schultz et al., 2007). To this effect, work by EU-OSHA (Graveling et al., 2021) as well as Total Worker Health (TWH) models conceptualize that MSDs are comprised of physical, psychosocial, and individual or personal risks.

According to the National Institute of Occupational Safety and Health (NIOSH), psychosocial risk factors are interactive factors between work organization factors and workers' capacities, needs and experiences that can cause stress, strain or interpersonal problems for the worker. Common psychosocial and organizational risk factors are job stress, poor supervisor or coworker support, job dissatisfaction, time pressure, high work pace/workload and lack of job control/degree of flexibility. Behavioral factors are modifiable actions a person engages in (e.g., tobacco use, diet, sleep habits) that can impact MSD propensity. Conversely, individual factors, which are unmodifiable characteristics of a person (e.g., age, genetic predisposition, sex) can also impact the likelihood of suffering an MSD. These may be unmodifiable factors, but they should not be ignored when focusing on reducing injuries. Knowledge of their impact on injury risk can help to select the right type of work for workers. Organizations should focus their efforts on factors that are modifiable and controllable when it comes to MSD risk prevention. Therefore, employers should focus on the mitigation of physical and other modifiable risk factors such as psychosocial, organizational and behavioral risk factors, and not on individual factors.

Looking to the future of MSD prevention and ergonomics, an emphasis on both non-physical and physical risk factors is needed. Jobs will become more mentally demanding in response to automation and other advancements (Gihleb et al., 2023). Further, as organizational culture and wellness continue to be major factors in hiring and retention, it has been suggested that organizations are poised to empower individuals to be involved in decision making (e.g., autonomy over task completion), self-pace their own workloads, develop effective ways to report risks, engage in health promotion programs and implement participatory ergonomics solutions to MSD risks (Mitchell et al., 2016; Rivilis et al., 2008; Sheridan, 1992).

The goal of this report is to discuss the importance of accounting for modifiable non-physical risk factors (i.e., organizational, psychosocial, behavioral) in MSD prevention programs and to provide an overview of common non-physical MSD risk factors that organizations should consider addressing in their risk reduction plans (see Appendix for research methodology). Additionally, after the introduction and explanation of common non-physical risk factors, recommendations for ways to manage and measure such risk factors within the context of MSDs are provided. This white paper is intended to both explain non-physical risk factors and how they affect the workforce, and provide solutions for organizations to implement.

Defining Non-Physical Risk Factors

While some researchers consider non-physical risk factors as one facet, these factors are conceptually different and are better grouped into categories of organizational risk factors and psychosocial risk factors (Canadian Centre for Occupational Health and Safety, 2020; Luckhaupt & Burris, 2013; Sauter & Swanson, 1996; Yang et al., 2016a). **Organizational risk factors are occupational factors such as a lack of personnel or being short-staffed, a lack of worker training, a lack of communication, a lack of job control or autonomy, feelings of job insecurity and poor work organization (e.g., long working hours, inadequate rest breaks or requirements of a rapid pace of work). These factors are generally directly influenced or controlled by an organization and are related to the way the work is designed, organized and managed (Vandekerckhove, 2021).**

Psychosocial risk factors include mental fatigue, high mental workload, workplace stress, job dissatisfaction, and poor support from supervisors or colleagues. In contrast to organizational risk factors, these factors refer to interactions between and among work environment, job content, organization conditions as well as workers' capacities, needs and culture, that may influence health, work performance and job satisfaction (Joint ILO/WHO Committee on Occupational Health, 1984).

Additionally, behavioral risk factors include sleeping habits, tobacco use, alcohol or substance use, and diet and nutrition. These are modifiable actions a person engages in that could be modified by their employer through programs and other health initiatives.

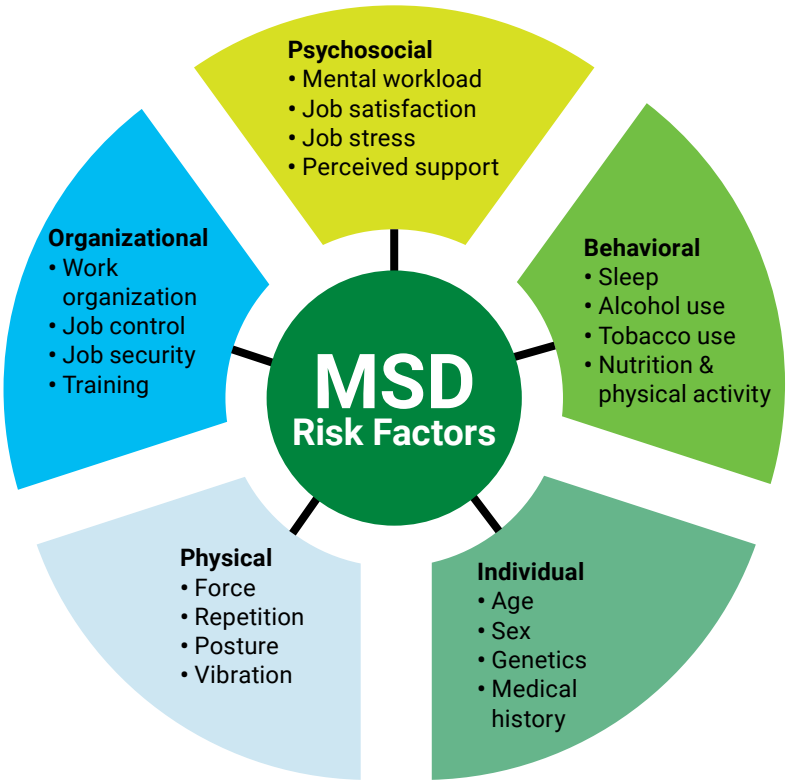
Insights on Behavioral Risk Factors

It is important to note that any person's individual behaviors are in part dependent on their social determinants of health and the ease with which they can choose certain options or behaviors over others (World Health Organization, 1987). Social determinants of health are nonmedical factors, such as the conditions in which people are born, grow, work, live and age, that influence health outcomes (CDC, 2024). Therefore, when framing behavioral risk factors, it is imperative to acknowledge the complex roles social and cultural context have in shaping behavior.

For the purposes of this white paper, organizational, psychosocial and behavioral risk factors are defined as described above. Certain variables or characteristics have been placed into one of the given categories and will be explained throughout this report. However, other literature may view some of these characteristics differently. For example, a high mental workload could for some individuals be considered an organizational risk factor, but by others as a psychosocial factor. Similarly, the perception of job insecurity could be viewed as a psychosocial risk factor instead of an organizational risk factor.

Additionally, it is important to acknowledge individual risk factors as other possible contributors to MSDs. However, employers should focus their efforts on the modifiable risk factors, as opposed to individual factors which are out of their control. While the exact groupings of risks, and the labels given to such risks, may be done differently between publications, this report suggests the risk factor groupings as displayed in Figure 1.

Figure 1. Conceptualization of MSD Risk Factors



For many of these factors, workers may have differing thresholds. This may be best understood using work-related or job stress as an example. Some individuals may be able to handle more frequent or intense stressors before experiencing strain, indicating they might have a higher stress threshold. Thresholds are also applicable to feelings of autonomy, job insecurity, work pace, mental workloads, and many other psychosocial and organizational MSD risk factors. It is important for employers to consider the differing perceptions workers may have when developing risk mitigation plans.

The Impact of Accounting for Non-Physical Risks

There are many reasons to account for non-physical risk factors at work, such as providing the ability to craft a better, more-accurate profile of the job or to help organizations better understand and address the true causes of job risk exposures or injury. Addressing non-physical risk factors has many positive impacts, both on the worker and on the organization. For example, considering and mitigating psychosocial risk factors can lead to a reduction in injuries and injury severity, lower workers' compensation costs, decreased absenteeism and turnover rates, improved job satisfaction and increased work productivity (e.g., Hauke et al. 2011, Dick et al., 2020, Burton, 2010, Tang et al., 2020).

Hauke et al. (2011) reviewed published longitudinal studies and found that factors such as low social support, high job demands, limited job control, reduced decision authority, low skill discretion, low job satisfaction, high job strain and psychological distress influence the risk of developing MSDs. Related, in the 12-year span from 2002 to 2014, findings from the Quality of Work Life survey showed that psychosocial and organizational work factors contributing to the prevalence of back and arm pain included frequent work stress, low job satisfaction,

inadequate supervisor support and a poor safety climate in the workplace (Dick et al., 2020). Lastly, Bernal et al. (2015) showed that high psychosocial demands combined with low job control in health care workers were associated with high prevalence and incidence of low back pain, and high prevalence of shoulder pain and knee pain. Collectively, these studies highlight the impact that accounting for non-physical risk factors can have on the workforce and the propensity to suffer from MSDs.

Marras and colleagues (2000) were the first to demonstrate empirical evidence linking psychosocial stress to biomechanical responses during a lifting task. In this foundational article, subjects were assigned to the unstressed group (consisting of positive interactions with the researcher and encouragement during a lifting task) and the stressed group (consisting of negative interactions with the researcher and scolding during a lifting task). In the stressed condition, subjects experienced greater levels of biomechanical responses in spine compression and lateral shear compared to the unstressed condition. This suggests the effect of psychosocial risk factors, such as the level of support received from management or co-workers, may combine with and exacerbate, or mitigate, the effects of physical risk factors. Punnett and Wegman (2004) also found certain psychosocial stressors, especially high job demands, low decision latitude and few rest breaks, are comparable to physical risk factors in their impact on upper extremity MSDs. Dick and colleagues (2020) found that affording workers a high level of 'work freedom' or decision latitude appears to have a protective effect against MSDs and was correlated with reduced prevalence of arm pain.

Further, addressing both workloads and working contexts is increasingly being recognized to successfully control and prevent musculoskeletal pain (Lindström, 1994). Addressing organizational factors, such as implementing work-rest cycles, has been shown to reduce workplace MSDs (Faucett et al., 2007, Stock et al., 2018). Wergeland and colleagues (2003) also found that shortening the working hours for those doing physically demanding work significantly reduced the occurrence of MSDs. There have also been reports of the successful management of musculoskeletal pain with interventions for psychosocial factors (Baek et al., 2018). Using ergonomic interventions in tandem with psychosocial interventions (e.g., job stress reduction management) for upper extremity musculoskeletal pain were more effective for pain relief than ergonomic interventions alone (Feuerstein et al., 2004). Similarly, an intervention that combined education about ergonomics, job stress and communication was more effective than an intervention using only electromyographic feedback (Faucett et al., 2002).

Organizational Risk Factors

As mentioned above, for the purpose of this paper, organizational risk factors concern the content of work and risks associated with working conditions and work organization. A lack of training, lack of job control, job insecurity and work organization – inclusive of the required working hours, pace of work and opportunities for rest breaks – are all organizational risk factors that have direct or indirect impacts on MSDs.

Work Organization

Work organization is the way work is structured, distributed, processed and supervised (Hagberg et al., 1995). It includes many characteristics of work such as working hours, pace of work, amount of personnel, structure of shifts and the availability of rest breaks. Work organization aspects impact many workplace outcomes, and notably impact employee health inclusive of MSD development.

Research has shown that extended work hours, especially when combined with irregular schedules and high-performance demands, are linked to fatigue, stress, reduced performance, unhealthy behaviors, and both short-term and long-term physical health issues (Alterman et al., 2013; Johnson & Lipscomb, 2006). Specifically, long working hours and inadequate staffing were related to increases in musculoskeletal conditions among nursing staff (Krishnan et al., 2021). Similarly, Kim et al. (2014) found significant associations between perceived inadequate staffing, back pain and pain in other body areas. The association between inadequate staffing and back pain remained significant even after adjusting for physical work factors (such as the use of lifting devices and time spent on physical activities).

Regarding work schedules, shift work (defined as working during non-daytime hours) is associated with increased prevalence of lower back and ankle issues among nursing personnel (Attarchi et al., 2014). While much of the research linking shift work and MSDs comes from the health care sector, a recent study by Sharan and colleagues (2023) of aircraft engineers explored this linkage. They found aircraft engineers experience an increase in fatigue and a decrease in physical activity when working night shifts compared to those working morning shifts. However, despite decreases in physical activity, there were increases in fatigue and consequently more reported MSDs in aircraft engineers working night shift compared to those working morning shift. Other research indicates that shift type significantly impacts injury risk, with night shifts increasing risk by approximately 33% compared to morning shifts (Fischer et al., 2017). Injury risk rises significantly after the 8th hour on duty, when rest breaks are infrequent (<4 hours) or too short (<30 minutes), and when work occurs during the night (particularly when working more than three consecutive night shifts). Similarly, based on a survey of manufacturing workers, Lu et al. (2017) found fixed shift work (morning and night shifts) was positively associated with fatigue when compared with rotated shifts.

Additionally, based on the 2010 National Health Interview Survey, certain workers with nonstandard work arrangements, in this case, working more than 40 hours a week, were more prone to low back pain (Yang et al., 2016b). The authors also demonstrated significant associations between neck pain and non-standard work arrangements, working in multiple jobs and long working hours. Similarly, Mahesa and colleagues (2017) found that shift work influenced musculoskeletal pain among welders in the shoulder and neck regions both weekly and annually and was found to be a cause of disability in the shoulder, wrist/hands, upper back and hip/thigh/buttock regions.

Finally, Punnett and Wegman (2004) found that a rapid work pace is also a common risk factor for MSDs, and that these risks are even higher when in combination with low job control or high work demands. Moreover, EU-OSHA (2007) states that work pace is becoming fast-paced, leading to an increase in the risk of MSDs for workers. They suggest workers should determine their own pace of work and should have a choice over how and when to complete work tasks. Based on the questionnaire data collected from labor-intensive trades like electrical and mechanical work, Hanna et al. (2005) reported worker productivity decreased as both the number of hours worked per week and the duration of the project increased. There was a 4.5% drop in productivity for every additional five hours worked per week per worker beyond the typical 40-hour schedule. While not assessing the relationship between work hours and MSDs, decreases in productivity is another metric that can be used to understand if workers are becoming overworked.

Job Control

Job control, often called autonomy or decision latitude, is defined as the individual's potential autonomy over their tasks and conduct during the workday (Karasek, 1979).

In his foundational work, Karasek (1979) found that exposure to high job demands combined with low decision-making latitude raises the likelihood of job strain, potentially leading to an increased risk of developing MSDs over time. Using data from the European Social Survey, Gulseren (2022) found that employees with greater control over work decisions and schedules may take breaks from demanding tasks and when experiencing pain, which can partially alleviate the pain. This implies the protective role of job control against various negative outcomes at work (Gulseren, 2022).

Furthermore, Hämmig and colleagues (2011) found MSDs were negatively and significantly correlated with job autonomy. In turn, job autonomy was also correlated with other safety-related factors such as general stress and physical strain. Cantley et al. (2016) found workers in low-control jobs had a higher risk of minor injury and minor MSD compared to those in high-control jobs. These results indicate decision latitude influences the risk of injury and MSDs in blue-collar manufacturing environments. A perceived lack of job control also plays a role in job insecurity.

However, not all research is as clear. In health care workers, Keyaerts et al. (2022) found that higher autonomy contributed to low back pain, implying workers given autonomy may put in extra effort when performing their jobs, which may contribute to pain and injury. Other studies have failed to find a relationship between MSDs and job control or autonomy (Fujii et al., 2013; Sprigg et al., 2007). Yet, beyond MSDs, failing to provide workers with autonomy can also lead to burnout, job dissatisfaction and reduced productivity, all of which can have negative impacts on an organization (Bjelland, 2022). Thus, more work is needed to definitively determine job control's role in MSD development.

Job Security

Job security is the assurance of staying in the same job with the same employer (Zekic, 2016). Conversely, job insecurity is the subjective perception of the likelihood of losing one's job involuntarily (Sverke et al., 2002). Job insecurity threatens the benefits of work (e.g., income, social contacts, status, purpose), can cause stress, burnout and frustration around needs for autonomy and belonging. It can also disrupt workers' expectations and perception of fairness, leading to negative work and health outcomes such as poor work-related wellbeing, reduced work engagement and health issues (De Witte, 2016; Saeed et al., 2023).

Job insecurity was a significant predictor of musculoskeletal complaints in the elbows and wrists in workers (e.g., office workers, toolmakers, welders, nurses, drivers) from a variety of industries (Bugajska et al., 2013). Further, a recent systematic review found 23 studies assessing the relationship between job insecurity and MSDs, with 15 of those finding a significant relationship between job insecurity and the experience of MSDs (Mateos-Gonzalez et al., 2023). Most studies within this systematic review found the relationship with job insecurity specifically with upper limb or back MSDs.

Additionally, Yang et al. (2016a) reported significant association between low back pain and psychosocial factors such as work-family imbalance, exposure to hostile work and job insecurity. In a follow up study, Yang and colleagues (2016b) also found neck pain was associated with job insecurity. Vander Elst et al. (2014) found job insecurity increases feelings of uncontrollability, leading to adverse health and wellbeing consequences for workers. Interestingly, an analysis by Barrech et al. (2016) reported the adverse effects of unstable working conditions created by job insecurity during working life may endure well into retirement, even after employment has ceased. This suggests the lasting impact on quality of life and the seriousness of such conditions on workers.

Training

Goldstein (1993) defines training as the systematic acquisition of attitudes, concepts, knowledge, rules or skills that improve performance at work, implying an expectation for changes in task execution. Awareness, quality of training and hazard reduction practices are considered crucial and effective in preventing MSDs (Van Eerd et al., 2022). Based on a survey of workers, managers, and occupational health and safety practitioners, the authors identified that proactive and customized trainings facilitate MSD prevention efforts.

A lack of proper training in the workplace can lead to job dissatisfaction, high turnover and unsafe working environments (Hendy, 2023). For example, a study investigating musculoskeletal complaints in office workers compared ergonomic training to no training (Mahmud et al., 2011). It was found there were significant reductions in the number of musculoskeletal complaints in the training group at the six-month follow-up.

Safe patient handling and mobility programs, including health care worker training, appear to cultivate a safety-oriented culture, teach proper equipment handling and reduce physical strain on caregivers (Wiggermann et al., 2020). Some programs have demonstrated a 56% reduction in worker injuries, inclusive of MSDs (Teeple et al., 2017). Nussbaum and Torres (2001) assessed the impact of training on behavioral changes related to injury prevention in nurses at high risk for injuries during patient-handling tasks. Compared to a control group, participants adopted a more upright lifting posture, which was maintained in follow-up measures after four to six weeks. Their findings suggest training can effectively modify behaviors.

Interestingly, the systematic review of Hogan et al. (2014) demonstrated the effectiveness of training in reducing MSDs is inconclusive, echoing previous reviews (Clemes et al., 2010; Verbeek et al., 2011) indicating that manual handling training may not effectively reduce MSDs. The review further suggests achieving the desired behavioral change through training alone appears challenging, possibly because training may divert attention from addressing underlying workplace risks. Despite evidence of systematic reviews showing possible ineffectiveness, training programs remain widely used in MSD prevention (Oakman et al., 2024). Yet, receiving training may indicate a level of care and support from management that outweighs the impact of the training itself. More research is needed to accurately determine the impact training has on MSDs.

Organizational Risk Factors Takeaways

Overall, the current review suggests there are aspects of organizational factors that can impact the risk of MSDs. Factors such as work schedules, the opportunity for breaks and the number of staff are all in direct control of the organization and should be considered in MSD prevention initiatives. Also, job security provided to employees, training and equipment availability, and the amount of decision latitude an employee has are within the organization's control and should be considered in MSD prevention initiatives. Without assessing for and mitigating organizational risk factors, employers will miss opportunities to further prevent MSDs.

Psychosocial Risk Factors

Psychosocial risk factors concern hazards related to perceptions of work, the management of work and interpersonal relationships at work. Yet, the origin of workplace psychosocial factors and their causal pathway to MSD development is still under investigation. Some consider psychosocial stress may have impacts on the healing process and thereby perpetuate MSDs (Gallagher & Barbe, 2022) or that stress hormones may influence the body or muscle tension in a way that increases the likelihood an MSD could occur (Melin & Lundberg, 1997). Others suggest changes in required physical work demands may impact the psychosocial environment, or that psychosocial risks may increase injury reporting (Graveling et al., 2021, Kyung et al., 2023, National Research Council, 2001). As such, some of these risk factors may have direct relationships with MSDs, while others may be indirectly related, often through perceptions of stress.

Mental Workload

The concept of mental workload is a multidimensional construct influenced by task characteristics (e.g., demands, performance), operator traits (e.g., skill, attention) and the environmental context (Young et al., 2015). It is defined as the level of attentional resources required to meet performance criteria, which may be mediated by task demands, external support and past experience. Related, according to NIOSH (2023), fatigue can be described as a feeling of weariness, tiredness or a general lack of energy. In relation to work, fatigue is prevalent in jobs that are stressful, have irregular or long work hours, or have physically or mentally demanding tasks. Fatigue is in turn related to several adverse outcomes for employees, such as reduced ability to concentrate, slower reaction times and MSDs.

Studies by Nino et al. (2019) and Nino et al. (2020) investigated how perceived workload affects body postures during manual lifting under varying mental and physical loading levels. The studies manipulated mental workload by increasing the physical demands of the tasks and incorporating an audible alarm as a psychosocial factor. They found that increased mental workload led to riskier and more awkward postures.

Further investigating these concepts, Nino et al. (2023) reported that mental workload perception can be altered solely by psychosocial factors, even when physical task demands remain constant. They found an increase in the perception of mental workload resulted in poorer body postures and influenced how participants performed the task, suggesting psychosocial workplace characteristics, such as job demands and mental workload, can directly impact postures that may lead to MSDs. The level of mental processing during a physical task also influences the biomechanical responses on the spine (Davis et al., 2002). When task complexity and mental processing demands were high, these factors interacted with work pace to increase spinal loads by 25–65%. This increase was attributed to significant increases in muscle activation, suggesting a potential mechanism linking psychosocial stress from modern work demands to an increased risk of low back pain.

Occupational fatigue and high mental workloads are risk factors in many industries. Specifically, for those working in forestry operations, occupational fatigue and high mental workloads were correlated with MSDs over the previous year and within the previous week (Arman et al., 2022). Given the nature of the work in forestry, these higher levels of fatigue and workload are expected, and point to the need to understand how the job tasks and pace of work required may exacerbate such psychosocial risk factors. However, less physically demanding jobs can also yield similar relationships between mental workload, occupational fatigue and MSDs. Among those working in communications, higher levels of mental workload and occupational fatigue were related to higher MSD rates (Haghshenas et al. 2018). Moreover, Heidarimoghadam and team (2019) found mental workload leads to MSDs, with fatigue impacting this relationship (i.e., when fatigue was higher, the link between mental workload and MSDs was stronger). Aluminum manufacturing workers in jobs with high psychological demand (e.g., workload and time pressure) had a 49% higher risk of serious injury and MSDs requiring medical treatment, work restrictions or lost work time compared to those in low psychological demanding jobs (Cantley et al., 2016).

Mental Health and MSDs

Another important antecedent to MSDs is an employee's mental wellbeing. For example, compared to those with higher levels of mental health as determined by the Short Form-36 Health Survey, health care workers with moderate levels of mental health had increased pain intensity in the low back, upper back and neck (Espin et al., 2023). Similarly, compared to those with high vitality, workers with moderate and low vitality had increased pain intensity in the low back, upper back and neck. These findings highlight the importance of considering mental health and vitality in the prevention of MSDs.

Job Satisfaction

Job satisfaction represents a combination of positive and negative feelings workers have towards their work (Davis & Nestrom, 1985). Workers have high job satisfaction when they have mostly positive feelings and experiences with their work. Conversely, they have low job satisfaction, or job dissatisfaction, when they have mostly negative feelings. Job dissatisfaction can have a slew of adverse outcomes in the workplace including likelihood of an MSD.

Research by Lachowski and colleagues (2017) cited that lower levels of job satisfaction were related to increases in musculoskeletal complaints among their sample of foresters. Relationships have also been reported between low job satisfaction and pain in both blue-collar and white-collar workers (Hoogendoorn et al., 2002; Loghmani et al., 2013). Additionally, job satisfaction emerged as a significant factor related to low back pain outcomes, even after adjusting for job demands and company tenure (Thiese et al., 2020). Poor job satisfaction posed the greatest risk for low back pain among the psychosocial variables assessed in their study. Regarding satisfaction of work environment, Robertson and Huang (2006) found satisfaction with workstation layout was significantly related to individual performance, group collaboration and effectiveness, suggesting the fit between a person and their work environment is also important to job satisfaction. These findings collectively suggest job satisfaction plays a significant role in the prevalence and management of musculoskeletal complaints across various occupational settings.

The relationship between musculoskeletal pain and job satisfaction is bidirectional. For example, musculoskeletal pain among health care workers was linked to their levels of professional satisfaction, job performance satisfaction and relationship satisfaction (Kim, 2018). Workers experiencing pain found it challenging to be satisfied with their jobs, provide quality care or maintain positive relationships. Additionally, Shan et al. (2022) found employees' perception of occupational health risks negatively impacted their job satisfaction. They reported work stress acts as a mediator between occupational health risk perception and job satisfaction, implying a lower perception of health risks leads to lower work stress and, consequently, higher job satisfaction. Reduced perception of health risks was also associated with higher organizational commitment and, subsequently, greater job satisfaction.

These findings are similar to the work of Nielsen et al. (2011) who reported workers who perceived high levels of risk tended to report lower levels of job satisfaction, but the effect mitigated when workers perceived a positive safety climate. Related to safety climate, job satisfaction strongly influences perceived management commitment to safety, perceived accident rate and perceived safety inspection frequency in the workplace (Stoilkovska, 2015). Respondents who were dissatisfied with their jobs tended to perceive a higher incident rate and lower safety inspection frequency. In sum, job dissatisfaction seems to be both an important antecedent to MSDs as well as a possible outcome after suffering from an MSD.

Job Stress

Job stress is defined by NIOSH (2023) as harmful physical and emotional responses occurring when the job's requirements do not match the capabilities, resources or needs of the worker. The job demand-control model explains job stress using two concepts: job demand and job control (Karasek, 1979). Job demand refers to workload and evaluates mental job needs, while job control measures workers' decision-making authority. The model suggests job stress rises when workers face high job demands and low job control, together creating the most stressful situations for employees.

The connection between stress and injury and illness, inclusive of the propensity to suffer from a work-related MSD, has been established. While there are different explanations for the mechanism as to how stress leads to MSDs, the connection is still present. Some have proposed a psycho-biological connection between job stress and MSDs (Smith & Carayon, 1996; Sauter & Swanson, 1996). Physiologically, stress can impact hormonal, circulatory and respiratory responses that can further exacerbate physical MSD risk factors (Carayon et al., 1999). Psychologically, stress can impact employee mood, motivation and behavior which could lead to increased risk taking and MSDs (Smith & Carayon, 1996). Psychosocial stressors may increase risk of an MSD via increased biomechanical load or physical strain. Stress may also lead workers to experience their pain as more significant, which can make them more likely to report pain-related symptoms of MSDs (Carayon et al., 1999).

Work by NIOSH (2023) also exemplifies the connection between stress and MSDs, as stress is found to increase the risk of developing an upper extremity or back MSD. Wixted et al. (2018) applied a transactional approach to link psychosocial stress to MSDs. Stress because of social isolation (e.g., working alone, being removed from work processes due to automation) was linked to neck and lower back symptoms, while stress as a result of high cognitive demands was linked to higher rates of shoulder and lower back symptoms. Stress is an important factor within MSD development, as it may be a direct link to MSDs, or a mediator between other antecedents and MSDs (Tang et al., 2020; Hauke et al., 2011).

Perceived Support

The interplay between individual employee characteristics (psychological factors) and group dynamics (social factors) in the workplace contributes to the overall psychosocial environment (Elliott et al., 2017). Organizational, colleague or supervisor support is a general belief that the organization, colleague or supervisor values a worker's contribution and position on the team and is concerned about the worker's wellbeing (Eisenberger et al., 1986; Worley et al., 2009).

Feeling high levels of support may be evident in tangible resources such as pay, rank, job enrichment, rewards or other forms of compensation and benefits. Low levels of support at work are related to many adverse work outcomes, such as increased turnover and decreased job satisfaction. Evidence also points to an impact of perceived support on MSDs. Bongers and colleagues (1993) found low levels of support from colleagues at work were positively associated with MSDs, while Hoogendoorn et al. (2000) uncovered a relationship between low social support as a risk factor for back pain. Moreover, workers with less social support often display prolonged recovery time after suffering from an MSD (Bailey et al., 2015). Similarly, Thiese et al. (2020) also found supervisor support was related to low back pain outcomes, with a decline in co-worker support linked to lost time due to low back pain.

Further, a review of 52 studies by Woods (2005) overwhelmingly showed there is a relationship between social support at work and musculoskeletal health. Additionally, positive support with colleagues and supervisors often includes transparent and open communication. While open communication may not be a direct risk factor, an environment that encourages open communication enables employees to feel more comfortable reporting risks or injuries (Crawford et al., 2020). As such, feelings of support may buffer the impacts of MSDs. For example, a worker may have extremely physically demanding work, yet transparent communication from colleagues and supervisors could mitigate the impacts of work demands on MSD likelihood (Joling et al., 2008). This can also help lead to early reporting of symptoms and risks and early interventions, which decreases the likelihood that discomfort or pain will progress to an MSD.

Chang et al. (2020) examined how social support dynamics at both the individual and unit levels affect nurses' MSD symptoms through negative emotions. The authors found that nurses who perceived an imbalance between the support they were expected to provide and the support they received reported higher levels of anger, which are positively associated with MSD symptoms. Also, looking at the health care industry, Bernal et al. (2015) showed that low social support in health care workers was associated with incidence of back pain.

Psychosocial Risk Factors Takeaways

Overall, psychosocial risk factors can have a significant impact on the likelihood of suffering from an MSD. Employers are encouraged to cultivate working environments in which job stress and mental workloads are low and support and job satisfaction are high to help mitigate MSD risk. While controlling physical risks is a major concern, collectively, research on psychosocial risk factors suggests organizations should also take an active role in psychosocial risk prevention to provide a holistic approach to MSD prevention.

Behavioral Risk Factors

There are also non-physical risk factors for work-related MSDs that fall outside of the workplace. Despite that these factors occur outside of work, they can be modified or impacted by the workplace, and are referred to in this report as behavioral risk factors. These include sleep habits, alcohol or substance use, tobacco use, nutrition and physical activity. Techniques mitigating impacts from these risks include support for health and wellbeing initiatives, employee assistance programs, health care benefits, or other health management or promotion activities and interventions (Proper & van Oostrom, 2019).

Sleep

One behavioral factor that can influence the occurrence of MSDs is sleep health. According to the National Institute of Health (2022), sleep deprivation or deficiency can lead to trouble focusing or reacting, frustration, worry, and a higher likelihood of injury or serious mistakes. Furthermore, they state that "getting enough quality sleep at the right times is vital for mental health, physical health, quality of life and safety."

These statements are true regarding MSDs and are further supported by research. For example, Putsa and colleagues (2022) looked at sleep and MSDs in office workers. They found getting less than six hours of sleep a day was associated with higher occurrence of MSDs. Additionally, a study on nurses found associations between MSDs and various sleep associated variables, including sleep disturbances, the time it takes to fall asleep and the use of sleep-promoting substances (e.g., prescription drugs, over the counter drugs, herbal supplements, alcohol) (Zhang et al., 2018). Shift workers, particularly those working nights, early mornings and rotating shifts, often experience reduced sleep quality and duration due to disturbance of circadian rhythm which could increase their risk of work-related injuries (Boivin et al., 2022).

Additionally, Lombardi et al. (2010) reported significant increases in work-related injury risk with decreasing daily self-reported sleep hours and increasing weekly work hours, independent of industry, occupation, type of pay, sex, age, education and body mass. Compared to workers who sleep 7-8 hours per day, those who sleep less have significantly higher (1.4 to 2.7 times higher) risk of work-related injury (including MSDs).

Fietze et al. (2022) reported a bidirectional relationship between poor sleep and negative work health perceptions influenced by time pressure, job security and stress. In this study, good sleepers (i.e., little/no sleep problems) exhibited more joy of work and confidence. In contrast, poor sleepers (i.e., moderate/severe sleep problems) reported more physical and mental impairments (that depending on intensity and duration can lead to illness or sick leave), aligning with negative perceptions of work health.

Alcohol and Substance Use

The use of alcohol has many known side effects. In the short-term, it can lead to cognitive effects such as changes in mood, critical thought or coordination (National Institute of Alcohol Abuse and Alcoholism [NIAAA], n.d.). This in turn can lead to injury (CDC, 2024). Furthermore, Ramchand and colleagues (2009) found that substance use, including alcohol and sedatives, can impair reaction time, reasoning, coordination and judgment, increasing the risk of injury during work.

Some studies have found alcohol use is associated with MSDs. Airila and colleagues (2014) found alcohol consumption was associated with higher rates of musculoskeletal pain among Finnish fire fighters. Alcohol use has also been found to be associated with neck/shoulder pain and work-related burnout (Chen et al., 2022).

More indirectly, prolonged alcohol misuse can lead to liver disease, which contributes to musculoskeletal concerns (Ranjan et al., 2021). Specifically, liver disease can cause alterations in bone mineral metabolism and muscle wasting, among other health concerns, which could lead to a higher risk of suffering from an MSD. Certain workplace policies and job characteristics (e.g., flexible sick day use and working alone) may also increase injury risk among people using substances (alcohol or drugs) especially in sectors like transportation (Ramchand et al., 2009).

Opioid Use and MSDs

MSDs can also impact employee behaviors. It is well-documented that some workers face high rates of work-related MSDs, leading to opioid use and opioid use disorder (Shaw et al., 2020). More specifically, opioids prescribed for musculoskeletal pain were strongly linked to long-term opioid use and opioid use disorder among construction workers (Dale et al., 2021). Musculoskeletal pain from demanding work likely contributes to the opioid epidemic among such occupations. The authors also cited studies that found half of those who died from an opioid overdose had previously been treated for a job-related injury. Additional data showed occupational groups with high rates of fatal overdose also had high rates of musculoskeletal injuries. Finally, workers in occupations with lower availability of paid sick leave and job security had higher opioid-related mortality (Shaw et al., 2020). These findings suggest the pressure to return to work quickly after an injury or to work through pain may contribute to high rates of opioid use and overdose deaths among some workers.

Tobacco Use

Tobacco use has been linked to many adverse health outcomes. Additionally, smoking has immediate negative effects on work performance, leading to decreased efficiency, errors and reduced attentiveness, all impacting productivity.

Tobacco use has been linked more directly to musculoskeletal issues, such as bone health, inflammation and rheumatoid arthritis (CDC, 2021). The American Academy of Orthopedic Surgeons (2021) has specifically reported that people who use tobacco face several heightened risks related to injuries and musculoskeletal health. These risks include larger rotator cuff tears in the shoulder compared to nonsmokers, a 1.5 times higher likelihood of overuse injuries such as bursitis or tendonitis, and an increased likelihood of traumatic injuries such as sprains or fractures. Additionally, smoking is associated with a higher risk of experiencing low back pain and developing rheumatoid arthritis. Research has suggested the link between smoking and MSDs may be due to the degeneration of muscles and joints through reduced blood flow (Inoue & Harada, 2002).

Research shows an association exists between smoking and long-term disability from knee and rotator cuff injuries, and disc displacement (Lincoln et al., 2003). This study also found individuals characterized as "heavy smokers" were at a greater risk of disability compared to "light to moderate smokers." Inoue & Harada (2002) found a higher percentage of smokers among employees with musculoskeletal complaints compared to those without symptoms, supporting this finding. Furthermore, Oktaviannoor and colleagues (2015) found a correlation between smoking and complaints of MSDs based on a small sample of farmers.

Jang et al. (2021) reported individuals with higher nicotine dependence had a higher rate of occupational injuries compared to those with lower nicotine dependence. The authors theorized nicotine withdrawal symptoms such as irritability, nervousness, restlessness and difficulty concentrating may contribute to an increased risk of occupational injury among individuals with high nicotine dependence, as the withdrawal symptoms can impact cognitive and motor functions necessary for safe work practices, thus impacting the workers' performance (e.g., decrements in performance, slower reaction time). However, the link between smoking and MSDs is still inconclusive. Thamrin and colleagues (2021) found no association between smoking and MSDs among fishermen, indicating the relationship between smoking and MSDs remains unclear.

Nutrition, Physical Activity and Body Mass Index

Having a high body mass index has been linked to numerous health concerns, such as cardiovascular disease, diabetes, and osteoarthritis and musculoskeletal discomfort. Related, a lack of physical activity and poor nutrition are also related to similar health issues. Such characteristics can also impact workplace safety.

Several studies have been conducted on the relationship between nutrition, physical activity, body weight and MSDs. Darvishi and colleagues (2022) investigated work-related MSDs in office workers. They found those with higher body mass index (BMI) had poorer posture and reported more musculoskeletal complaints. High BMI is also associated with increased MSD symptoms and slower recovery (Viester et al., 2013). The relationship between BMI and MSDs has also been proposed to be a two-way relationship, in that the higher one's BMI, the more likely they are to suffer an MSD, but also, suffering from an MSD may lead to higher BMI.

Moreover, Schulte and colleagues (2007) examined existing literature and proposed that certain work pressures may also contribute to higher BMI. These work pressures include high job demand, low job control, long working hours and shift work, implying high job stress and stress responses correlate with high BMI, particularly in low-control, high-demand work settings, where stress could impact food choices and eating patterns (Hill et al., 2022). Additionally, BMI has been found to be associated with a greater likelihood of disability-related retirement (Roos et al., 2013).

Compared to workers with a lower BMI, Lombardi and colleagues (2012) reported workers with a higher BMI had a 1.34 times higher risk of work-related injury. Similarly, Gu et al. (2016) reported workers whose BMI was considered overweight or obese were more likely to experience work-related injuries compared to workers with lower BMI. These findings support Viester et al. (2013), indicating that high BMI is associated with increased musculoskeletal symptoms over 12 months, affecting people whose BMI is higher. Obesity is also linked to developing musculoskeletal symptoms and inversely related to recovery from symptoms, highlighting the role of biomechanical factors, especially in the lower extremities.

Positive Impacts of Non-Physical Risk Factor Mitigation

Employers can support workers through health promotion, comprehensive health benefits, exercise challenges or frequent movement/stretching breaks. Such physical activity and exercise have been shown to help protect workers from MSDs. For example, Heesch and colleagues (2007) found that amongst women who were active at low, moderate or high levels had significantly lower reports of stiff or painful joints than did women who were not active. Similarly, Pihl et al. (2002) found that individuals who were more physically active had reduced risks of MSDs in comparison to those who were more sedentary. Poplin et al. (2014) reported firefighters of lowest fitness levels were 2.2 times more likely to be injured, including suffering an MSD, than those in the highest fitness category. In a Danish working population, Micheletti et al. (2019), found higher levels of physical activity and fruit and vegetable intake were associated with a lower risk of musculoskeletal pain. Specifically, engaging in physical activity for at least five hours per week was associated with a lower risk of low back pain and neck-shoulder pain.

Collectively, therapeutic exercise and physical fitness may serve as a protective factor against the development of MSDs (Wilson et al., 2011). Another reason to support employees interested in health management is that research has shown decreases in BMI can have a positive effect on MSDs. Kotowski and Davis (2010) found weight loss led to improvements in musculoskeletal pain in several body regions.

Behavioral Risk Factors Takeaways

Underlying behavioral factors undeniably play a crucial role in the development of MSDs. However, addressing these issues can be challenging for employers. Employers are encouraged to implement health-related programs or campaigns and have comprehensive health benefits that promote wellness, as this can help mitigate the risk of MSDs. **Since a significant portion of adult life is spent in the workplace, organizations are uniquely positioned to actively support and promote wellbeing. By doing so, they can provide a holistic approach to MSD prevention, benefiting both employees and the organization. This approach enhances workers' overall health and wellbeing and fosters a positive and productive work environment.**

Workplace Applications

As exemplified in this white paper, non-physical risk factors can profoundly impact employees and employers. While some research has found inconclusive evidence of the linkage between non-physical risks and MSDs (e.g., job control), more evidence points to the connection between non-physical risks and MSDs. Therefore, controlling for and mitigating these non-physical risk factors remains an important aspect of MSD prevention initiatives. Employees who experience these risk factors are at greater risk of injury, are less satisfied with their work and are more likely to leave their organization. Employers who have high levels of non-physical risk factors may experience higher workers' compensation costs, poorer safety climates, less productivity and have more workers out on long-term absence.

To circumvent the negative impacts of non-physical risk factors, organizations are encouraged to address and mitigate non-physical risk factors at their workplace. While interventions targeted at non-physical risk factors are still in their infancy, several recommendations for managing and measuring non-physical risk factors are presented in the following sections.

Non-Physical Risk Management

While the control and mitigation of non-physical risk factors may feel like an issue to be tackled at the organizational level or outside of EHS, safety professionals can have a direct influence on non-physical risk factor management. Based on the information presented throughout this paper and the vast connections found between non-physical risk factors and MSDs, safety professionals are encouraged to convey the importance of addressing non-physical risk factors and to champion non-physical risk management across the organization. As noted by Asuquo and colleagues (2021), having a designated person within an organization who champions MSD prevention and intervention, which should include non-physical risk factor mitigation, could play a significant role in reducing injuries.

At the organizational level, safety professionals can encourage several strategies for reducing psychosocial and organizational stressors at work to lessen MSD risk. Organizations should:

- Engage in risk identification using systems thinking (Sauter et al., 1992; Marras et al., 2000) that addresses the tasks being completed, management styles, interpersonal relationships, work roles, career concerns and environmental conditions. This approach can more broadly help workplaces consider risks outside of more typical physical risks.
- Provide supervisory training aimed at addressing organizational issues, such as justice, safety climate and personal treatment (Greenberg, 2006).
- Incorporate the mitigation of non-physical risk factors into existing MSD prevention and ergonomics programs.
  - For example, incorporate measurement of non-physical risk factors in audits or other assessments (see Non-Physical Risk Measurement section and Appendix).
- Ensure safety and health training is accurate and delivered by qualified instructors. Make training materials available to frontline workers should they need to refer to the content.

Different personnel within the organization can aid in non-physical risk factor management, and partnerships between safety professionals, human resources and health care personnel are crucial. However, it is the responsibility of safety professionals to convey the importance of managing non-physical risk factors and champion this movement to get different levels of the organization involved in non-physical risk management. Below are talking points to get those conversations started with varying employees across organizations.

Frontline workers

Risk management systems are not sufficient without the buy-in and involvement of frontline workers. If frontline workers are not empowered to voice concerns, feel unsupported by management, or are experiencing job dissatisfaction or fatigue, it may be harder to create a safe working environment. As a safety professional, you can get frontline workers involved in the following ways:

- **Education:** Engage frontline workers in learning about the connection between non-physical risk factors and workplace safety. If workers are unaware of this connection, they may not feel supported in speaking up regarding their working conditions, psychosocial concerns or correlated behavioral factors.
- **Communication:** Empower frontline workers to voice their safety concerns and be prepared to act on those concerns. Make needed improvements wherever able.
  - Frontline workers may be used to speaking up only regarding physical risk factors. Safety professionals should request feedback on possible non-physical risk factors as well, such as the ease of equipment use, levels of job satisfaction and perceived levels of support.
- **Decision making:** Take a participative approach by involving frontline workers in decision making about their working conditions. Employees are more likely to adhere to protocols if they have a hand in determining them and perceive they have control over aspects of their work.

Supervisors/mid-management

Supervisors play an important role in enacting safety across teams and employees. Ensuring adequate training, equipment, policies and working environments often falls on mid-management. As a safety professional, you can get supervisors involved in the following ways:

- **Transparency:** Supporting communication and knowledge sharing between supervisors and workers makes it possible to get a better understanding of where the greatest risks are. Enact a communication system for frontline workers to clearly and safely communicate non-physical risk factors. This could be a ticketing system, or simply ensuring supervisors include non-physical risk factor discussions in their safety talks or one-on-one meetings.
- **Observation:** Encourage supervisors to support their direct reports. Just as frontline workers can see the risks in their day-to-day jobs, supervisors should be able to identify risks, including non-physical risks, across their teams. Train managers in how to identify non-physical risk factors. These risks can then be reported to safety professionals and senior leadership to enact change.
- **Facilitation:** Be a champion for proper MSD intervention implementation at your site or on your team. Work with leadership, safety professionals and direct reports to encourage the incorporation of non-physical risk factor mitigation into existing MSD prevention efforts.

Upper management/senior leadership

Many non-physical risks occur due to systems beyond the control of a safety professional. For these risks to be addressed at an organizational level, leadership buy-in is needed. Safety professionals need to be able to make a case for why non-physical risk management is in the best interest of the company so leadership will be open to enacting larger, policy-level changes.

- **Return on investment:** The greatest investment a company can make is in its workers. Workers who are safe, from both physical and non-physical risk, show increases in productivity, morale and attendance. Non-physical risk management is good for both individuals and the bottom line.
- **Workplace culture:** Leadership can help to set the tone for a workplace's culture, inclusive of safety culture and psychological safety. Fostering a culture of support, transparent communication and listening to employees is beneficial for many reasons, including lessening the chances of MSDs.
- **Non-biased feedback:** At an organizational level, make it a priority to gather feedback from employees. Enact validated measurement tools designed to measure non-physical risk factors. Risks cannot be mitigated and addressed if their presence and severity is unknown.

Non-Physical Risk Measurement

Once your organization is prepared to implement non-physical risk factor mitigation, the first step is to understand which factors are impacting the workforce. To do this, organizations need to be measuring the presence and severity of non-physical risk factors within their organizations. As exemplified through findings on the 2022-2023 MSD Solutions Index, most (84%) of participating organizations reported non-physical risk factors contribute to MSDs in their workplace. However, of those respondents who believe non-physical risk factors contribute to MSDs, 50% could not quantify the impact of these factors, meaning such factors were not measured. This highlights the need for increased measurement of these factors. One of the main ways to measure the impact of non-physical risk factors, such as fatigue or workplace stress, is to conduct perception surveys including all levels of employees.

Surveys have been developed and validated regarding many psychosocial and organizational risks. Some surveys take a collective approach to measuring such risks and may include a variety of variables and factors, while other surveys narrow in on a particular risk factor. Some surveys also have taken an even broader approach and measure both physical risk and non-physical risks.

A survey developed through the, "A Participative Hazard Identification and Risk Management Toolkit" (APHIRM toolkit; Oakman & Macdonald, 2019) has the potential to be a singular way to measure both physical and non-physical risk presence in the workplace. The survey measures physical demands, emotional demands, job satisfaction and support from colleagues, all of which have been mentioned throughout this paper as important factors related to MSD development. A full list of items from this survey is available in the Appendix.

Also, the Quality of Worklife Questionnaire measures organizational risk factors such as work hours, work-life balance, culture and climate. While longer in length, this survey can provide a comprehensive overview of the state of organizational and psychosocial risk factors present in an organization. The survey also measures behavioral risk factors, such as sleep quality. The items from this survey are available in the Appendix.

Lastly, the NIOSH Worker Well-Being Questionnaire (WellBQ) assesses worker wellbeing across multiple domains, such as an individual's work life, life outside of work, and physical and mental health. This 68-item survey may be of use when trying to better understand work experience, workplace policies and culture, workplace physical environment and safety climate, employee health status and the employee's experiences with their home, community and society.

We encourage workplaces to begin not only acknowledging and better understanding non-physical risk factors in their workplace, but also measuring the presence and severity of these factors. This will allow organizations to more fully account for non-physical risks and provide for a more holistic approach to MSD mitigation.

Assessments to Measure Psychosocial Risks

There are several validated and popular measurement tools designed to assess psychosocial risks in the workplace. When possible, the items on the measurement tools mentioned below are listed in the Appendix.

- **Effort-Reward Imbalance (ERI) Measure** (Siegrist et al., 1996): Assesses psychosocial risks by focusing on the possible mismatch between effort or motivation on job tasks and rewards for such tasks. Items relate to extrinsic efforts, occupational rewards and security, and intrinsic attributes and overcommitment.
- **Copenhagen Psychosocial Questionnaire** (COPSOQ) (Burr et al., 2019): Covers a broad range of domains including demands at work, work organization and job contents, interpersonal relations and leadership, the work-individual interface, social capital, offensive behaviors, and health and wellbeing to provide a holistic view on psychosocial workplace factors.
- **Job Content Questionnaire** (JCQ) (Karasek, 1985, 1998): Assesses job demands, decision latitude and social support.
- **Occupational Health Clinics for Ontario Workers** (OHCOW) **StressAssess online survey tool**: Based on the COPSOQ but designed to be more easily used by workplaces, provides action steps and resources to help understand results and implement needed change.

Specific measurement tools that align more closely with a certain industry or a specific psychosocial stressor may also be warranted.

- **Job Descriptive Index** (JDI; Smith et al., 1969) **and the Minnesota Satisfaction Questionnaire** (MSQ; Weiss et al., 1967): The JDI assesses satisfaction in the areas of pay, promotion, co-workers, supervision and the work itself while the MSQ measures satisfaction through 20 different facets and comes in a short (20 item) and long (100 item) form.
- **Work Stress Survey** (Cavanaugh et al., 2000): Assesses stressors in two categories of challenge stressors (positive stressors, or eustress) and hindrance stressors (negative stressors, or distress).
- **Survey of Perceived Organizational Support** (SPOS; Eisenberger et al., 1986, 1990; Shore & Tetrick, 1991; Shore & Wayne, 1993): Measures supervisor, colleague or organizational support.
- **Swedish Occupational Fatigue Inventory** (SOFI; Åhsberg et al., 1997; Åhsberg, 2000): Measures work or occupational fatigue through five dimensions – lack of energy, physical discomfort, physical effort, lack of motivation and sleepiness.

Employing a psychosocial risk survey to measure and assess the state of psychosocial risks is an important first step to mitigating non-physical risk factors. Safety professionals are encouraged to review the measures mentioned here and select a tool best suited for their workforces.

Assessments to Measure Organizational Risks

Organizational risks are most often measured through employee perception surveys. These surveys are usually tailored to the organization and contain items related to an employee's satisfaction with many work aspects. Such surveys typically ask questions about culture, communication, satisfaction with pay, equipment, safety, schedules, flexibility, training opportunities, growth opportunities and other topics that may be specifically of interest to an employer. In some cases, employee perception surveys assess both organizational risks and psychosocial risks, which may make them an even more powerful measurement tool.

While there are many surveys to choose from, selecting one that emphasizes safety and is validated is important to link organizational risks and safety outcomes, such as MSDs.

- **NSC Safety Barometer:** Measures safety culture and organizational risks. The survey contains 50 items across the following six categories: 1) management commitment 2) supervisor engagement 3) employee involvement 4) safety support activities 5) safety support climate and 6) organizational climate. Respondents are benchmarked against an NSC database of more than 1,400 other organizations to determine how organizations score compared to others.
- **PSC-12 Scale** (Hall et al., 2010): Assesses employees' perceptions toward their organizations' policies and regulations regarding employee psychological health (Loh et al., 2020). This validated scale measures psychosocial safety climate and only uses 12 items categorized into four domains: management support and commitment, management priority, organizational communication and organizational participation. A full list of items for this scale is provided in the Appendix.

While organizations may opt to run employee perception surveys themselves through in-house survey systems, there is utility in using a measurement tool from a third party. Employees may be more likely to answer honestly on surveys if they do not feel their responses will be going directly to their employer. Therefore, properly selecting an employee perception survey to assess organizational risk factors is important.

Conclusion

Non-physical risk factors for MSDs have an effect on workplace safety that cannot be ignored. While MSD prevention traditionally focuses on mitigating physical risk factors, the shift toward taking a more holistic approach to MSD prevention incorporating strategies to reduce non-physical MSD risks is imperative. Ergonomics research will need to increasingly focus more on non-physical risks and mental stress from work.

The research presented above categorizes non-physical factors into organizational, psychosocial and behavioral categories. As exemplified, these non-physical risk factors can impact many aspects of work and safety, including MSD likelihood, worker wellbeing, workplace productivity and the organization's bottom line. Ignoring the need to control and mitigate non-physical risk factors within MSD prevention efforts can be a common reason MSDs are not decreasing in an organization. Therefore, non-physical MSD risk can and should be addressed and managed by employers. Many non-physical risk factors, such as work organization, job stress and health promotion, are modifiable by employers. It is the responsibility of safety professionals to convey the threat of these factors to all levels of their organization to ensure modifications are made to mitigate organizational, psychosocial and behavioral risk factors. Safety professionals should promote a holistic approach to MSD prevention, address non-physical risk factors and champion solutions reducing risks of injuries. Only with everyone involved can these complex risk factors be properly addressed.

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Appendix

Methodology

The methodology for this paper consisted of: 1) establishing research questions and objectives 2) creating a search strategy with search terms 3) searching for relevant studies 4) selecting studies meeting pre-defined inclusion criteria 5) full text reviews of selected studies and 6) organizing and reporting results.

The literature review was conducted by sourcing articles from Google Scholar, WorldCat and other databases (i.e., MEDLINE, the Cochrane library, PsycINFO, Web of Science, Scopus). The authors used a combination of many search terms to arrive at the articles included in this narrative review, including: "work-related musculoskeletal disorder" or "work-related MSD" with a variety of outcome variables:

- "work organization"
- "work schedules"
- "shift work"
- "job control"
- "job security"
- "training"
- "equipment", "tools", "PPE"
- "rest breaks"
- "occupational fatigue"
- "mental workload"
- "job satisfaction"
- "job stress"
- "psychosocial"
- "organizational"
- "personal", "individual", "lifestyle" "behavioral"
- "job demands"
- "perceived support", "co-worker support", "leadership support", "social support"
- "mental wellbeing", "wellbeing"
- "sleep"
- "alcohol use", "alcohol"
- "opioid use", "opioids"
- "smoking", "smoking cessation"
- "weight management", "health management", "physical activity", "exercise"

To identify articles pertaining to non-physical risk factors of work-related MSDs, inclusion criteria were that articles needed to: 1) relate to occupational health and safety 2) measure work-related MSDs, risks, pain, discomfort or symptoms 3) be written in the English language 4) be available as a full-length article (i.e., not a published abstract) 5) be published prior to March 2024 and 6) be published in a peer-reviewed journal. Titles and abstracts were reviewed by the authors to verify these criteria. If all inclusion requirements were present or if this remained unclear, articles were fully read. In the event the full text revealed not all requirements were present, the paper was excluded. Additional literature was obtained through searching references listed in the manuscripts.

A framework or outline for the literature review was predefined, and studies fit into either the organizational risk factors, psychosocial risk factors or behavioral risk factors categorization. Categorization of the variables of interest as specified in the search terms above was determined through feedback from MSD experts before writing the report.

Assessments

Effort Reward Imbalance Survey Items - Long Version (Siegrist, 1996)

This survey can be used to measure the demanding aspects of the work environment. These items are designed to be asked along a four-point Likert scale, ranging from strongly disagree to strongly agree. The first 16 items concern efforts and rewards, while the last six items concern overcommitment.

- I have constant time pressure due to a heavy workload
- I have many interruptions and disturbances while performing my job
- I have a lot of responsibility in my job
- I am often pressured to work overtime
- My job is physically demanding
- Over the past few years, my job has become more and more demanding
- I receive the respect I deserve from my superior or a respective relevant person
- I experience adequate support in difficult situations
- I am treated unfairly at work (Reverse coding)
- My job promotion prospects are poor (Reverse coding)
- I have experienced or I expect to experience an undesirable change in my work situation (Reverse coding)
- My employment security is poor (Reverse coding)
- My current occupational position adequately reflects my education and training
- Considering all my efforts and achievements, I receive the respect and prestige I deserve at work
- Considering all my efforts and achievements, my job promotion prospects are adequate
- Considering all my efforts and achievements, my salary / income is adequate

Workplace Stressors Survey Items (Cavanaugh et al., 2000)

This survey can be used to measure the perceptions of workplace stress experienced by employees. These items are designed to be asked along a five-point Likert scale, ranging from one (produces no stress) to five (produces a great deal of stress). Respondents are asked to report how much stress each of the items causes them. The first six items are considered "challenge" stressors, while the last five items are considered "hindrance" stressors.

- The number of projects and/or assignments I have
- The amount of time I spend at work
- The volume of work that must be accomplished in the allotted time
- Time pressures I experience
- The amount of responsibility I have
- The scope of responsibility my position entails
- The degree to which politics rather than performance affects organizational decisions
- The inability to clearly understand what is expected of me on the job
- The amount of red tape I need to go through to get my job done
- The lack of job security I have
- The degree to which my career seems "stalled"

Survey of Perceived Organizational Support

This survey can be used to measure employees' beliefs about the extent to which their organization values their contributions, cares about their wellbeing and is committed to them. These items were designed to be answered along a seven-point Likert scale ranging from one (strongly disagree) to seven (strongly agree). Items denoted with an (R) are reverse coded when scoring, and items with an asterisk indicate the item is retained for the short version of the survey.

- The organization values my contribution to its wellbeing
- If the organization could hire someone to replace me at a lower salary it would do so (R)*
- The organization fails to appreciate any extra effort from me (R)
- The organization strongly considers my goals and values
- The organization would understand a long absence due to my illness
- The organization would ignore any complaint from me (R)
- The organization disregards my best interests when it makes decisions that affect me. (R)*
- Help is available from the organization when I have a problem
- The organization really cares about my wellbeing*
- The organization is willing to extend itself in order to help me perform my job to the best of my ability
- The organization would fail to understand my absence due to a personal problem (R)
- If the organization found a more efficient way to get my job done, they would replace me (R)
- The organization would forgive an honest mistake on my part
- It would take only a small decrease in my performance for the organization to want to replace me (R)
- The organization feels there is little to be gained by employing me for the rest of my career (R)
- The organization provides me little opportunity to move up the ranks (R)
- Even if I did the best job possible, the organization would fail to notice (R)
- The organization would grant a reasonable request for a change in my working conditions
- If I were laid off, the organization would prefer to hire someone new rather than take me back (R)
- The organization is willing to help me when I need a special favor
- The organization cares about my general satisfaction at work
- If given the opportunity, the organization would take advantage of me (R)
- The organization shows very little concern for me (R)
- If I decided to quit, the organization would try to persuade me to stay
- The organization cares about my opinions
- The organization feels that hiring me was a definite mistake (R)
- The organization takes pride in my accomplishments at work*
- The organization cares more about making a profit than about me (R)
- The organization would understand if I were unable to finish a task on time
- If the organization earned a greater profit, it would consider increasing my salary
- The organization feels that anyone could perform my job as well as I do (R)
- The organization is unconcerned about paying me what I deserve (R)
- The organization wishes to give me the best possible job for which I am qualified
- If my job were eliminated, the organization would prefer to lay me off rather than transfer me to a new job (R)
- The organization tries to make my job as interesting as possible*
- My supervisors are proud that I am a part of this organization

Swedish Occupational Fatigue Inventory (SOFI; Åhsberg et al., 1997)

This survey can be used to measure subjective dimensions of work-related fatigue. The instrument consists of 20 items, in which different feelings of being tired are rated from zero (not had such feelings at all) to six (had such feelings to a very high degree). Feelings of being tired are clustered into five categories: lack of energy, physical exertion, physical discomfort, lack of motivation and sleepiness.

Lack of energy

- Worn out
- Spent
- Drained
- Overworked

Physical exertion

- Palpitations
- Sweaty
- Out of breath
- Breathing heavily

Physical discomfort

- Tense muscles
- Numbness
- Stiff joints
- Aching

Lack of motivation

- Lack of concern
- Passive
- Indifferent
- Uninterested

Sleepiness

- Falling asleep
- Drowsy
- Yawning
- Sleepy

Psychosocial Safety Climate Scale (PSC-12; Hall et al., 2010)

- In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health
- Senior management acts decisively when a concern of an employees' psychological status is raised
- Senior management shows support for stress prevention through involvement and commitment
- Psychological wellbeing of staff is a priority for this organization
- Senior management clearly considers the psychological health of employees to be of great importance
- Senior management considers employee psychological health to be as important as productivity
- There is good communication here about psychological safety issues which affect me
- Information about workplace psychological wellbeing is always brought to my attention by my manager/supervisor
- My contributions to resolving occupational health and safety concerns in the organization are listened to
- Participation and consultation in psychological health and safety occur with employees' unions and health and safety representatives in my workplace
- Employees are encouraged to become involved in psychological safety and health matters
- In my organization, the prevention of stress involves all levels of the organization

APHIRM Measurement Tool

This survey can be used to measure both physical and non-physical MSD risk factors. The instrument consists of 58 items, in which different demands are rated from one to five on one of five Likert scales, as denoted below:

1. Very small extent … Small extent … Somewhat … Large extent … Very large extent
2. Almost never … Seldom … Sometimes … Often … Almost always
3. Major problem … Slight problem … Not a problem … Good … Very good
4. Very dissatisfied … Dissatisfied … Neutral … Satisfied … Very satisfied
5. Never … A few times … Monthly … Weekly … Daily

Physical task demands (12 items – Scale Two)

- Keep repeating the same movements, every minute or so?
- Lift or carry things that are moderately (or very) heavy?
- Push or pull things, using some force?
- Work in twisted or awkward postures?
- Squat or kneel while you work?
- Work standing in one position, without moving around?
- Work sitting still, without moving around?
- Work with your body bent forward?
- Work with your arms raised above shoulder level?
- Work so hard or fast that you get a little bit out of breath?
- Use your hands or fingers to hold or grip things?
- Have to make very precise movements to place things accurately?
- Work with vibrating tools/equipment OR in a vehicle that vibrates?

Physical environment, equipment, OHS overall (Six items – Scale Three)

- Facilities for taking breaks (places for breaks, meals)
- Work surroundings (noise, light, temperature, etc.)
- Exposure to physical danger
- Equipment, tools, IT or software that you use
- Workstations and workspace
- Health and safety at work

Quantitative demands (Three items – Scale Two)

- You get behind with your work
- There is too much work to do in the available time
- You have enough time to complete all your work well

Work pace (Three items)

- You have to work very fast (Scale Two)
- You have to go faster to meet deadlines or target quotas (Scale Two)
- You have to work at a fast pace for the whole shift (Scale One)

Emotional demands (Three items – Scale Two)

- As part of your work, you have to help people who are upset or unhappy
- Your work puts you in emotionally disturbing or upsetting situations
- There are unpleasant arguments or conflicts at your workplace

Influence at work (One item – Scale Two)

- You have a lot of influence on decisions about your work (e.g., what you do, how you do it, how much of if)

Possibilities for development (Four items – Scale Three)

- Sufficient training for this job
- Opportunities for learning new skills
- Opportunities to use your skills
- Opportunities for promotion

Variation of work (One item – Scale Three)

- Amount of variety in the work you do (Also: 1st item of physical task demands)

Control over working time (One item – Scale Three)

- Flexibility of working hours

Meaning of work (Two items – Scale One)

- Your work is meaningful … doing it well makes a difference to people
- The work you do is important

Predictability (One item – Scale Three)

- Consultation about changes in your job

Recognition (One item – Scale One)

- Your work is noticed and appreciated by your supervisor or manager

Role clarity (Two items – Scale One)

- Your work goals and responsibilities are clear
- You know exactly what work you are expected to do and how to do it

Role conflicts (Two items)

- People take short cuts to get things done, rather than use correct procedures (Scale Two)
- People disagree about the correct way to do some things (Scale One)

Illegitimate tasks (One item – Scale Two)

- Some parts of your job seem unnecessary, or a waste of time

Quality of leadership (Two items)

- Senior management attitudes (Scale Three)
- Employees can trust information that comes from management (Scale One)

Support from supervisor (Three items – Scale Three)

- Support from supervisor
- Communication with supervisor
- Feedback on your performance

Social support from colleagues, sense of community at work (Two items – Scale Three)

- How you get on with your co-workers (personally/ socially)
- How well you work with your co-workers (as a team)

Organizational justice (Three items – Scale One)

- People here are treated fairly
- Arguments and problems are sorted out in a fair way
- Work is shared out fairly between people

Job Satisfaction, work-life balance (Two items – Scale Four)

- How satisfied are you with your job here, as a whole … taking everything into account?
- How satisfied are you with the balance between your home life and work – considering how much time and energy you have?

Occupational violence and aggression (Three items – Scale Five)

- During the last six months, have you OR someone else at your workplace experienced workplace aggression or violence by a co-worker, manager or member of the public?
- During the last six months have you OR someone else at your workplace been bullied by a co-worker, manager or member of the public?
- During the last six months have you OR someone else at your workplace been sexually harassed by a co-worker, manager or member of the public?

Quality of Worklife Questionnaire (NIOSH and Institute for Social Research at the University of Michigan)
This survey can be used to measure both physical and non-physical risk factors, specifically as they relate to job-related stress, satisfaction, health outcomes, work hours, work-life balance and culture/climate**.** The 76 items employ a variety of scales and response options, so deployment may be a bit more complicated**.**

How would you describe your work arrangement in your main job?

A. I work as an independent contractor, independent consultant or freelance worker
B. I am on-call, and work only when called to work
C. I am paid by a temporary agency
D. I work for a contractor who provides workers and services to others under contract
E. I am a regular, permanent employee (standard work arrangement)

How long have you worked in your present job for your current employer?

A. Less than 6 months
B. 6-12 months
C. Enter years: _____

In your main job, are you salaried, paid by the hour or what?

A. Salaried
B. Paid by the hour
C. Other (SPECIFY): _____

Which of the following best describes your usual work schedule?

A. Day shift
B. Afternoon shift
C. Night shift
D. Split shift
E. Irregular shift/on-call
F. Rotating shifts

How many days per month do you work extra hours beyond your usual schedule?

A. Enter days _____

When you work extra hours on your main job, is it mandatory (required by your employer)?

A. Yes
B. No

How often are you allowed to change your starting and quitting times on a daily basis?

A. Often
B. Sometimes
C. Rarely
D. Never

How often do you work at home as part of your job?

A. Never
B. A few times a year
C. About once a month
D. About once a week
E. More than once a week
F. Worker works mainly at home

(This question applies only to people who indicate they work at home as part of their job.)

When you work at home, is it part of your primary job at another location, are you taking work home to catch up or do you have a home-based business?

A. Worker is working at home as part of his/her primary job at another location
B. Worker is taking work home to catch up
C. Worker is operating a home-based business
D. Other reasons or combination of these reasons

How hard is it to take time off during your work to take care of personal or family matters?

A. Not at all hard
B. Not too hard
C. Somewhat hard
D. Very hard

How often do the demands of your job interfere with your family life?

A. Often
B. Sometimes
C. Rarely
D. Never

How often do the demands of your family interfere with your work on the job?

A. Often
B. Sometimes
C. Rarely
D. Never

After an average workday, about how many hours do you have to relax or pursue activities that you enjoy?

A. Number of hours: _____

Do you have any jobs besides your main job or do any other work for pay?

A. Yes
B. No

Do you supervise others at work as a part of your job?

A. Yes
B. No

The following items are completed on a four-point Likert scale (strongly agree, agree, disagree and strongly disagree).

- My job requires that I keep learning new things
- My job requires that I work very fast
- I get to do a number of different things on my job
- I have too much work to do everything well
- On my job, I know exactly what is expected of me
- My job lets me use my skills and abilities
- At the place where I work, I am treated with respect
- I trust the management at the place where I work
- The safety of workers is a high priority with management where I work
- There are no significant compromises or shortcuts taken when worker safety is at stake
- Where I work, employees and management work together to ensure the safest possible working conditions
- The safety and health conditions where I work are good
- I am proud to be working for my employer
- Conditions on my job allow me to be about as productive as I could be
- The place where I work is run in a smooth and effective manner
- Workers need strong trade unions to protect their interests

In your job, do you normally work as part of a team, or do you work mostly on your own?

A. Yes, I work as part of a team
B. No, I work mostly on my own

In your job, how often do you take part with others in making decisions that affect you?

A. Often
B. Sometimes
C. Rarely
D. Never

How often are there not enough people or staff to get all the work done?

A. Often
B. Sometimes
C. Rarely
D. Never

The following items are completed on a four-point Likert scale (very true, somewhat true, not too true or not at all true) **with respect to the work you do.**

- The chances for promotion are good
- I have an opportunity to develop my own special abilities
- I receive enough help and equipment to get the job done
- I have enough information to get the job done
- I am given a lot of freedom to decide how to do my own work
- My fringe benefits are good
- My supervisor is concerned about the welfare of those under him or her
- I am free from the conflicting demands that other people make of me
- Promotions are handled fairly
- The people I work with take a personal interest in me
- My supervisor treats me fairly
- The job security is good
- My supervisor is helpful to me in getting the job done
- I have enough time to get the job done
- The people I work with can be relied on when I need help

Do you have access to stress management or stress reduction programs at your current workplace?

A. Yes
B. No

In general, how would you describe relations in your workplace between management and employees?

A. Very good
B. Quite good
C. Neither good nor bad
D. Quite bad
E. Very bad

Does your job require you to do repeated lifting, pushing, pulling or bending?

A. Yes
B. No

Does your job regularly require you to perform repetitive or forceful hand movements or involve awkward postures?

A. Yes
B. No

Please rate the overall physical effort at the job you normally do.

A. Very hard
B. Hard
C. Somewhat hard
D. Fairly light
E. Very light

When you do your job well, are you likely to be praised by your supervisor or employer?

A. Yes
B. Maybe
C. No

How fair is what you earn on your job in comparison to others doing the same type of work you do?

A. Much less than you deserve
B. Somewhat less than you deserve
C. About as much as you deserve
D. Somewhat more than you deserve
E. Much more than you deserve

Do you feel that the income from your job alone is enough to meet your family's usual monthly expenses and bills?

A. Yes
B. No

Were you laid off your main job at any time in the last year?

A. Yes
B. No

How easy would it be for you to find a job with another employer with approximately the same income and fringe benefits as you have now?

A. Very easy to find similar job
B. Somewhat easy to find similar job
C. Not easy at all to find similar job

Taking everything into consideration, how likely is it you will make a genuine effort to find a new job with another employer within the next year?

A. Very likely
B. Somewhat likely
C. Not at all likely

Do you feel in any way discriminated against on your job because of your age?

A. Yes
B. No

Do you feel in any way discriminated against on your job because of your race or ethnic origin?

A. Yes
B. No

Do you feel in any way discriminated against on your job because of your gender?

A. Yes
B. No

In the last 12 months, were you sexually harassed by anyone while you were on the job?

A. Yes
B. No

In the last 12 months, were you threatened or harassed in any other way by anyone while you were on the job?

A. Yes
B. No

Would you say that in general your health is Excellent, Very good, Good, Fair or Poor?

A. Excellent
B. Very good
C. Good
D. Fair
E. Poor

During the past 12 months, how often have you had trouble going to sleep or staying asleep?

A. Often
B. Sometimes
C. Rarely
D. Never

Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?

A. Number of days: _____

Now thinking about your mental health, which includes stress, depression and problems with emotions, for how many days during the past 30 days was your mental health not good?

A. Number of days: _____

During the past 30 days, for about how many days did your poor physical or mental health keep you from doing your usual activities, such as self-care, work or recreation?

A. Number of days: _____

How often do you find your work stressful?

A. Always
B. Often
C. Sometimes
D. Hardly ever
E. Never

How often during the past month have you felt used up at the end of the day?

A. Very often
B. Often
C. Sometimes
D. Rarely
E. Never

In the past 12 months, have you had back pain every day for a week or more?

A. Yes
B. No

In the past 12 months, have you had pain in the hands, wrists, arms or shoulders every day for a week or more?

A. Yes
B. No

In the past 12 months, how many times have you been injured on the job?

A. Number of times: _____

All in all, how satisfied would you say you are with your job?

A. Very satisfied
B. Somewhat satisfied
C. Not too satisfied
D. Not at all satisfied