

How Do We Measure Neuromuscular Fatigue at the Workplace? The Toronto CRE-MSD Workshop

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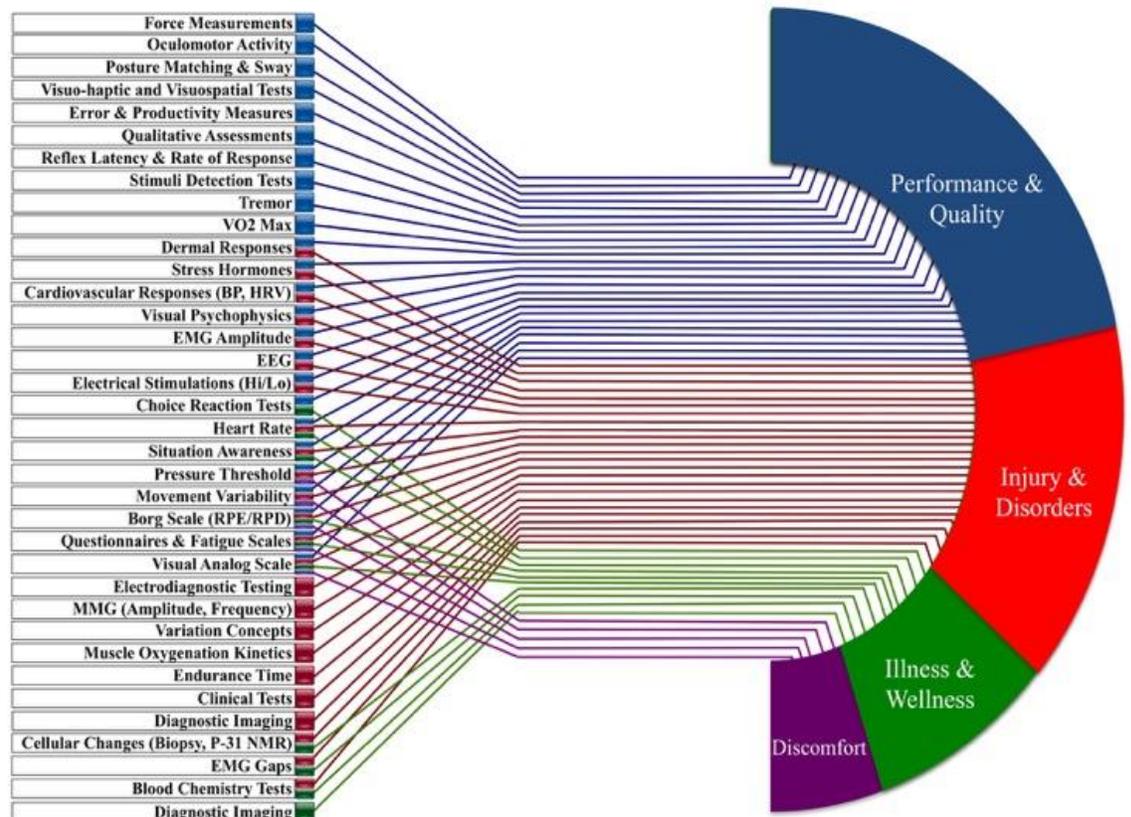
Fatigue can be defined in multiple ways, but it is a phenomenon that is generally associated with terms such as weariness, exhaustion, tiredness, sleepiness, and weakness. In occupation settings, fatigue has been used to describe both work and the human body, where energy was seen as the limiting factor in production¹. As new forms of work emerged, so has increased levels of physical and mental fatigue^{2,3}.

In the short term, fatigue is linked to increased risk of accidents, which might result in fatal and non-fatal injury. In the longer-term, fatigue may be a precursor to the development of work-related musculoskeletal disorders⁵, and may lead to compromised immune function and other adverse health outcomes, including myalgia, chronic fatigue syndrome, and burnout². Fatigue has also been cited as an important intermediary in the relationship between ergonomic risk factor and work performance deficits, i.e., quality and productivity⁴. In Canada, abnormal levels of self-perceived fatigue is found in up to 20% of the working population⁵.

Fatigue manifests itself in various forms, so a single test to measure fatigue is not reasonable. Because different measures provide information on different fatigue processes, fatigue should be evaluated by a multidisciplinary approach³ with a complementary set of measures⁶. However,

Key Messages

- Fatigue is linked to both short and longer-term health outcomes.
- A workshop was convened to identify fatigue measures which are feasible for workplace use.
- Fatigue was defined as: a process that results in the impairment of wellbeing, capacity, and/or performance as a result of [work] activity.
- Fifty-seven unique measures were identified from four fatigue outcome domains: work performance and quality; injury and disorders; illnesses and discomfort.
- Measures linked to all four domains were questionnaires & fatigue scales, Borg's RPE/RPD scales, visual analog scales.



given the large number of measures and detection methods, this begs the question, which measures are most efficacious to detect fatigue in the workplace?

A workshop, consisting of 14 researchers, was convened to critically evaluate fatigue measures from different research disciplines and perspectives. At the beginning of the workshop the group operationally defined fatigue. The definition considered potential effects of fatigue in occupational tasks, its potential impact on the health and wellbeing of the individual, but did not confine fatigue to a single mechanism or impairment of a specific system.

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The workshop was then segmented based on four areas of discussion. First, researchers were asked to identify general outcome domains potentially affected by fatigue. Second, discussion centered on potential sub-outcomes and effects within each outcome domain. Third, potential causes and physiological mechanisms for these sub-outcomes and/or effects were identified. And lastly, fatigue measurement and detection methods were reviewed to best address the quantification of the proposed causes and mechanisms. This workshop structure shifted the focus onto the outcomes and/or effects of fatigue to help identify measures that could be meaningful for workplace evaluation.

Participants identified 57 unique measures based on 4 outcome domains: work performance and quality, injury and disorders, illnesses, and discomfort. Common measures were grouped together and directly linked to outcome domains. By doing so, measures that would be useful as indices for multiple workplace fatigue outcomes were documented. Three measures were linked to all four main outcome domains: questionnaires and fatigue scales; Borg's rating of perceived exertion/discomfort scales, and visual analog scales.

Conclusion

By assembling expert opinion from multiple research perspectives and disciplines, fatigue measures and detection methods were identified for workplace investigations. Fatigue researchers arrived to 57 unique measures, three were linked to all four outcome domains (work performance & quality, injury & disorders, illness & wellness, and discomfort). These measures should be considered for inclusion into a larger test battery of fatigue measures. However, the results of this workshop serve as a guide and it is the researcher or practitioner's discretion to select appropriate detection methods.

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Implications for the Prevention of MSD

Fatigue may be a precursor or potential biomarker for long-term outcomes, including MSD. Therefore, fatigue may be a useful risk indicator and a design and evaluation tool.

However, a single test to measure a single function is not reasonable. We confirm that fatigue is complex, involving multiple mechanisms, and can be measured by multiple measurements and detection methods.

Three measures were linked to multiple fatigue outcomes and should be considered for inclusion, as part of a larger test battery of fatigue measures, to detect fatigue at the workplace.

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