



## Evaluating the Science of Ergonomics

*A National Academy of Sciences workshop explores what we know – and don't know – about musculoskeletal injuries in the workplace.*

**M**usculoskeletal injuries, disorders and/or symptoms affect virtually everyone at some point in their lives. There are various known and suspected causes of these problems, including trauma, genetics, metabolic disorders, psychogenic factors, lifestyle factors, physical build and occupational and nonoccupational activities. Workers with musculoskeletal disorders (MSDs) and symptoms suffer significant morbidity and generate billions of dollars in costs annually in workers' compensation and lost productivity.

Over the past few decades, increasing interest about the relationship between work and MSDs has generated significant research in biomechanics, ergonomics and the epidemiology of MSDs. Numerous studies have been published examining the potential relationship between work (as well as non-work factors) and MSDs. Several reviews of the epidemiologic data, including at least one employing meta-analytic techniques (evaluating combined studies), have yielded conflicting conclusions about the work-MSD association for specific disorders, such as carpal tunnel syndrome and low back pain.

Recently, the National Academy of Sciences (NAS) held a two-day workshop in Washington, D.C., where 80 to 100 leading scientists and clinicians presented and discussed their views on the state of the research regarding

work and MSDs. Five sessions and a workshop integration panel discussion comprised the two-day effort. The five areas consisted of:

- Tissue response to stressors;
- Biomechanics of work stressors;
- Epidemiology of workplace physical factors;
- Nonbiomechanical factors and MSD relationship; and
- Interventions to control MSDs.

The goal of the workshop was to assess the available scientific information and literature as to

how MSDs arise; the relationship among MSDs, work factors and nonwork factors; and what actions prevent MSD development.

Although the focus of the workshop was science, the discussion did involve the issue of adequacy of the scientific base for regulation, specifically OSHA's efforts to promulgate a standard regulating potential workplace physical factors in an effort to prevent MSDs.

The workshop consensus appeared to be that research had opened the informational doors in each of the five areas to some extent. However, attendees felt that the research methodology employed to date was generally not sufficient to answer a number of basic questions posed to the participants. Many suggestions were offered to focus and direct future research.

### Stressors

In the area of biological response,

there are no well-defined mechanisms of the pathogenesis of various disorders. Such information is needed to determine whether and how work physical factors such as repetition might cause one or more MSDs.

Current intervention studies are not able to define specific changes in physical factors or in "work organization" aspects of psychosocial stressors, and whether they prevent MSDs.

Medical management does appear to have reduced workers' compensation costs associated with MSDs. Additionally, employee satisfaction and physical complaints have been positively affected by applying a combination of various workplace changes and programs. It is unclear whether the positive impact consists of disease prevention or better disease and complaint management.

### Work Physical Factors

The workshop attendees felt that some relationship existed between work and MSDs, but there was a lack of clarity regarding whether this was limited to symptoms, including many ill-defined areas such as low back pain and "tension neck syndrome."

Probably most important, workshop attendees were unable to identify clear quantitative relationships between risk factors and injuries. Thus, it is still unknown which physical factors, in which combinations, and at which levels produce an unacceptable increased risk of developing MSDs.

Certainly, once an MSD is present, any activity, including work, may enhance the symptoms. For example, once a person has repeated low back pain, lifting activities in various settings may bring on pain, although they did not cause it, nor is it clear whether they advance the underlying pain mechanism adding to the disability level.

One of the most important areas of

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discussion concerned nonwork factors, such as personal risk factors including age, weight, and diseases such as diabetes. Such factors appear to play a prominent role in the development of MSDs, but as in proposed workplace risk factors, the manner in which they produce MSDs and the extent to which they are responsible for MSDs has not been ascertained. This knowledge gap means that one may not be able to set the same workplace risk factor triggers for susceptible persons and nonsusceptible persons.

This lack of clarity was discovered throughout the workshop. One hopes that a large array of present and future studies within the government and in academia, labor and industry, funded by NIOSH and other sources, will enhance the current research knowledge base and potentially answer many of the questions discussed at the workshop.

Probably the most successful aspect of the workshop was the identification of the huge number of studies which exist in each of the five areas, but which have not been rigorously assessed. Also important in the discussion were the limitations in published research methodology and the lack of consensus as to specific cause-and-effect relationships, prevention activities, and hazardous exposure levels.

There was agreement that very limited data did exist in many areas. Overall assessment efforts, such as the NIOSH 1997 review of the epidemiological evidence of work physical factors and MSDs, only provide basic epidemiologic associations for a few specific relationships. The NIOSH document, admittedly, did not address fundamental questions about exposure triggers, nonwork factor influence, and proven physical factor intervention strategies. Additionally, various problems with the NIOSH document methodology were presented.

Some researchers at the NAS workshop felt sufficient information was available for action to be taken. The question remains: "What action.?" Without specification for cause-and-effect, intervention, and the like, what action will be effective? Simple questions such as "What is the background level of carpal tunnel syndrome in a population?" cannot be answered with today's scientific data. Given this lack of knowl-

edge, it remains to be seen how regulators could identify when a workplace cause for CTS exists and rule out nonwork causal factors.

Finally, one participant noted that the OSH Act required "the best available evidence" for regulatory action. However, "best available" still means "adequate" science.

### Looking Ahead

In summary, the NAS Workshop on Work-Related Musculoskeletal Disorders: An Examination of the Research Base, was a useful preliminary step in assessing the potential relationship between work and the development of MSDs. The nature and scope of the workshop, however, limited to a significant degree the ability of the participants to arrive at a consensus regarding the causal relationships, dose-response factors, and proven preventive measures upon which to base workplace programmatic actions.

The lack of sufficient time to discuss the entire literature database, especially in areas of nonwork factors, prevention activities, and basic pathophysiology understanding was underscored and, as noted by the participants and presenters, limited time was provided by NAS before the workshop to perform a comprehensive literature evaluation. Importantly, only cursory evaluations of the literature were provided and no weight-of-the-evidence approaches were used.

Considering the large difference of opinion in many areas, perhaps the best approach at this juncture is to construct a rigorous scientific framework to determine appropriate weight-of-the-evidence approaches and apply them in a systematic fashion across key scientific areas so that "best available" means scientifically reliable for regulatory action. **OH**

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