Scand J Work Environ Health 1995;21(6):401-403

<https://doi.org/10.5271/sjweh.54>

Issue date: Dec 1995

Hands up or back to work -- future challenges in epidemiologic research on musculoskeletal diseases

by [Riihimäki H](#)

The following article refers to this text: [2002;28\(6\):402-410](#)

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/8824744

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

Hands up or back to work — future challenges in epidemiologic research on musculoskeletal diseases

Musculoskeletal diseases continue to be the nemesis of medicine and the albatross of industry despite research efforts to find the keys to efficient prevention. In my opinion, however, we have reached a point where old paths have been exhausted and new paths are needed to new solutions. During the past 10 years, the interest in both basic and applied research in this area has increased considerably, and our understanding of the pathomechanisms of musculoskeletal diseases and their risk factors has improved. Yet we still have difficulties in determining musculoskeletal diseases, and we do not know which of the risk indicators are causal and which perhaps only aggravate pain or affect pain perception.

There is a stack of reports from cross-sectional studies in various occupational settings that demonstrate associations between musculoskeletal pain and a number of work- and leisure-related factors, as well as many personal factors. In addition to the well-known inherent problems in cross-sectional studies, many investigations suffer from crude exposure assessment and a nonspecific and soft health outcome measure; we do not need more cross-sectional studies with some “new” explanatory variables and nonspecific pain variables as outcome measures. This path has been explored, and there is no longer anything exciting to be expected from studying such associations. Repeated surveys can be justified, however, for hazard and health surveillance purposes to follow the trends in populations. Actually, we know surprisingly little about these trends.

During the past five years attention has increasingly been focused on the accuracy of exposure assessment in epidemiologic studies of musculoskeletal diseases. Instead of collecting crude group-level exposure data, methods to collect individual data have been developed and vigorous attempts to validate the methods have been made. Assessing the exposure of the musculoskeletal system to biomechanical load is a challenging task because we measure something to which everyone is exposed to some extent nearly all the time: the load due to postures and motion, with or without additional external load. With modern technology, continuous monitoring and the recording of postures and motion have become possible through the use of inclinometers, accelerometers, pedometers, electromyography, and the like.

One of the problems is that we often end up with enormous amounts of data, even when the data collection is based on the sampling of worktime. Exposure can be characterized in terms of amplitude (intensity), frequency, and duration, but the problem is how to reduce the data so that we have relevant measures of exposure in relation to the risk of musculoskeletal diseases. Much “exposure” to postures and motion is good for the well-being of the musculoskeletal system and, at its best, it has a training effect. What are the limits for amplitude, frequency and duration beyond which exposure starts having harmful effects? How should the risk factors be defined? Answers to these questions can be sought by trial and error in epidemiologic studies of the acute effects of the biomechanical exposure of the musculoskeletal system. Another approach, and perhaps a preferable one, is to study experimentally physiological responses in different tissues to various levels of exposure. In this area current knowledge is deficient.

Accurate exposure assessment requires many resources, both monetary and human, and thus it may be an unfeasible choice in large epidemiologic studies. In this respect an old proverb may apply: the best is the worst enemy of the good. Lighter exposure assessment methods have been developed, and their validity has been studied, sometimes with disappointing results. Self-reports in questionnaires or in

diaries have been compared with "objective" observations or direct measurements. The question is "what is the best or 'true' measure of the risk?" Perhaps a self-report resembles a psychophysical test that takes into account the capacity of an individual.

Be it difficult to assess current exposure, it is even more difficult to assess cumulative past exposure retrospectively. For chronic health outcomes, such as degenerative back disease or osteoarthritis, cumulative exposure is the relevant form to be assessed. Accurate retrospective data are usually not available, and thus the assessment of exposure is often based on self-reports and therefore incur information bias. Expert panel ratings of exposure have rarely been employed in musculoskeletal disease epidemiology, but it might be the method of choice. Even in large prospective studies exposure assessment based on laborious measurements or observations may prove to be unfeasible because of high costs, and the researchers must satisfy themselves with the use of softer methods. Further development and validation of these methods is an important goal.

Biomechanical modeling provides one way to estimate the load on the musculoskeletal system. Combined with experimental knowledge about tissue endurance, guidelines for lifting have been given. Early biomechanical models were applicable only to two-dimensional static situations, but there has been progress in the development of three-dimensional dynamic models which correspond better to complex human activities.

A crucial factor in safety recommendations based on biomechanical models is the knowledge of the endurance of different tissues. The experimental results regarding, for instance, vertebrae may not be correct because the lack of circulation in the specimens of the spine may change the mechanical properties of the vertebrae considerably. In basic research on the musculoskeletal system there is much to be studied. The degenerative process of the intervertebral disc and cartilage has still to be unraveled, even though much has been learned during the past 10 years. There is also much to be learned about muscles, tendons, and ligaments in health and disease. We need to know the pathomechanisms at the tissue level in order to gain a better understanding of musculoskeletal diseases. It would also be tempting to be able to identify biomarkers for musculoskeletal diseases.

During recent years, it has become apparent that we even have gaps in our knowledge about the basic anatomy of the musculoskeletal system. Thus far, modern imaging methods, such as magnetic resonance imaging and ultrasonography, have not been utilized to a great extent in research on musculoskeletal diseases. Imaging findings can be used as an outcome measure in traditional epidemiologic research, but these methods might be useful also in diagnostic research on, for instance, hand-wrist or shoulder tendon syndromes, the carpal tunnel syndrome or epicondylitis.

The most common outcome measure in epidemiologic studies of musculoskeletal diseases has been the occurrence of pain. To some extent this is natural because pain, along with the restriction of movement (often due to pain), are the major manifestations of these diseases. Pain can also be a prodromal symptom of a more severe disease. In many cases of musculoskeletal pain a specific diagnosis cannot be made. One of the major drawbacks in using pain as the measure of outcome is its nonspecificity. For instance, acute minor muscular sprains are in no way distinguished from more chronic and severe conditions, although this differentiation is essential in both etiologic and prognostic studies.

With respect to symptoms related to the musculoskeletal system, one of the most frequently employed questionnaires is the Nordic questionnaire. In this questionnaire the number of days with pain during the past 12 months is inquired about, as well as the occurrence of pain during 7 days for different anatomic regions. Furthermore, the number of days on sick leave during the past 12 months and any change in daily activities due to the pain is inquired about. But the symptoms are not characterized any further. The wide use of this questionnaire has provided comparable data across studies, but, due to their nonspecificity, these data are not very useful. Today it can be argued that the wide use of this

standardized questionnaire has perhaps prohibited progress in this field of research rather than enhanced it. The comparability of results is beneficial, but only if the data are relevant.

The Nordic questionnaire is too simple; it does not allow the proper differentiation of symptoms according to severity, type, localization, duration, or frequency. For instance, a simple division of low-back symptoms into local low back-pain and radiating low-back pain (sciatic pain) has proved useful; the former seems to be less strongly associated with work-related loading factors and also with disc degeneration of the lumbar spine than the latter. Adding duration (less than two weeks/more than two weeks) as a further classification criterion has revealed that short spells of local low-back pain occur characteristically in younger age groups, whereas long spells of sciatic pain occur more frequently in older age groups of people of working age. Research groups are urged to use their creativity and prior knowledge about the characteristic symptoms of musculoskeletal diseases to develop symptom questionnaires further. One way to learn more about possible symptom-based syndromes would be to apply qualitative research methods among musculoskeletal patients.

Longitudinal studies are becoming more and more common in epidemiologic research on musculoskeletal diseases. In cohort studies the objective of the study should be made clear: is it a causal study or is it a prognostic study. In many cases this distinction has not been made. Symptoms are treated the same irrespective of prior history or the type of symptoms that occur during the follow-up; for some disorders, such as osteoarthritis, it is obvious that intermittent episodes of pain and the swelling of joints are manifestations of the same disease. For hand-wrist tendon syndromes, consecutive spells are probably independent diseases, but this is not known for sure. Muscle, tendon, and ligament sprains, unless they are very severe and lead to extreme scar formation, heal perfectly, and thus the next sprain is distinctly an independent injury.

These distinctions have a bearing on study design. These facts or assumptions determine the manner in which contrasts between cases and noncases are designed in a causal study and the relevant observation time needed to assess exposure. The relevant exposure precedes the inception of the disease and may vary from lifetime cumulative exposure until the inception of the disease to a couple of days or hours preceding the occurrence of the disorder. If the latency time for the health outcome is not known it can be hypothesized, perhaps in several ways, and then tested in the study. This procedure requires time windows to be used in exposure assessment.

Prospective studies provide a good opportunity to study the natural course of musculoskeletal symptoms and diseases. This is an area in which we need to improve our knowledge.

The incidence of severe musculoskeletal disorders is rather low, even in high-risk groups. Thus, when strict diagnostic criteria are used in prospective studies, large study groups are required. When chronic diseases are studied, also long follow-up times are needed. Actually, in such studies, a preferable approach would be the case-referent design. Only a few case-referent studies of musculoskeletal diseases have appeared in the literature. Potential bias in case ascertainment is a problem that can be minimized if only severe cases are used. Examples are arthroplasties, operated disc herniations or carpal tunnel syndromes with palmar muscle wasting. In case-referent studies retrospective exposure assessment is often the only possibility.

Epidemiologic research on musculoskeletal diseases is a challenging field. Many experts in this field have shared a feeling of desperation at times, but the progress in recent years is promising, and, indeed, now is not the time to throw up our hands but rather go back to work!

Hilkka Riihimäki, MD
Department of Epidemiology and Biostatistics
Finnish Institute of Occupational Health
Topeliuksenkatu 41 a A
FIN-00250 Helsinki Finland