CONFERENCE PROCEEDINGS

Stooped and Squatting Postures in the Workplace

July 29–30, 2004
Oakland, California, USA

Center for Occupational and Environmental Health ▪ University of California: Berkeley ▪ Davis ▪ San Francisco

A Conference Jointly Sponsored by the:

University of California Center for Occupational & Environmental Health

University of California Agricultural Ergonomics Research Center

National Institute for Occupational Safety and Health (NIOSH)

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EXECUTIVE SUMMARY

Stooped postures have probably been with us since the first human ancestors began walking upright. In the modern world, it might appear that stooped postures are confined to work in developing countries or less mechanized workplaces. However, nothing could be further from the truth. Stooped postures are commonly found in agricultural, construction, mining, and other workplaces all around the world. Further, work requiring stooped postures is strongly associated with high incidence of low back disorders (LBDs). Nonetheless, the terms "stooped" or "squatting" postures are not commonly found in ergonomics studies or literature. These facts taken together led to the questions that stimulated this conference: (1) what do we know about the scope of stooped, kneeling and squatting postures in the workplace; (2) what scientific basis is there for understanding the effects of these postures; and (3) what do we know about strategies for controlling stooped postures?

Speakers at this conference made clear that the problem of stooped and squatting postures in the workplace is global in scope and widespread in many industries. Further, evidence presented made clear that stooped postures are commonly associated with work that has a high incidence of LBDs. Nonetheless, stooped postures have been little studied as a primary risk factor for LBDs. Most attention on risk factors for LBDs has been focused on manual materials handling and whole-body vibration. Stoop (sustained bending of the spine) has been largely neglected. In part, this may be due to the lack of an accepted definition of stooped or squatting postures. As this conference ended, we accepted the following as initial working descriptions: a stooped posture can be defined as "bent forward and down from the waist and/or mid-back while maintaining relatively straight legs"; squatting can be described as a "bending of the knees so that the buttocks rest on or near the heels".

The full scope of the problem is not well reflected in occupational injury data because current reporting methods do not examine the relatedness of an injury to stooped and squatting work postures. Workers' compensation programs focus more on delivering benefits than prevention efforts, and claims data collection is driven by injury (an 'event') rather than cumulative trauma. Reducing the incidence of work-related LBDs in these jobs will require a new focus on identifying and describing stooped and squatting postures as specific LBD risk factors in the workplace.

Biomechanical research shows that high spinal compression forces occur in stooped postures, and that sustained or repeated flexion of the spine may disturb the neuromuscular stability of the lower back and increase the risk of fatigue, leaving the back more vulnerable to injury. What is missing (as is the case with many ergonomics risk factors) is definitive etiology demonstrating the causal role and mechanisms linking stooped postures with MSDs.

While there is considerable epidemiological evidence associating working in stooped, kneeling and squatting postures to LBDs, it is mostly focused on those postures in combination with other risk factors such as bending or twisting or heavy loads. The literature combining stooped, squatting or kneeling postures with load handling shows rapid and severe spinal damage. There is much less in the literature regarding the health effects of these postures in an unloaded situation.

Kneeling and squatting are often seen as alternatives to stooping as a way to work at low levels without bending the back as much. In agriculture and construction, workers often resort to stooping because it demands less energy expenditure than the alternatives, and they can exert higher force and

have increased mobility than when kneeling or squatting. There is good biomechanical reason to view these postures as significant contributors to MSDs of the knee and low back. There are generally few studies of knee injuries associated with these postures, and conclusive, causal studies are still lacking. Job improvement efforts should target reduction of existing risk factors, while avoiding increased risk to other regions of the body.

Determining which controls are available as interventions to the problem of stooped work is challenging for the industries of concern, especially agriculture, construction, and mining, because they have tremendous variation in their workplace environments. Four classes of interventions were discussed at the Conference, and successful interventions in all these areas were presented:

1. Reduce or Eliminate the Need to Stoop or Squat
   (e.g., raised planting beds, portable tables or carts, lifting aids and handles)
2. Mechanical Worker Protection or Worker Aids
   (e.g., devices to facilitate kneeling, prone workstations, and load transfer devices)
3. Mechanical Assists to Allow the Employee to Work in a Standing Position
   (e.g., tool extensions, mechanical harvesting, wheeled roofing equipment for tear-off, fastening, and bitumen application.)
4. Administrative Controls
   (e.g., programmed breaks, reducing the number of working hours, or hiring more workers during peak periods to reduce the demands on the individual worker).

However, intervention experts were unanimous in noting that interventions must be task- and situation-specific to be both adoptable and effective. This means that few interventions can be expected to travel un-adapted between jobs or tasks.

In order to improve our understanding of the relationship of stooped, squatting and kneeling postures and MSDs and their prevention we must increase and improve research focused on these risk factors. A necessary first step will require differentiation by the research community between stooped posture and stooped work. This may be achieved by determining at what exposure level assuming a flexed posture becomes 'stooped work', and establishing a consensus definition of stooped work (e.g., work below knees > 40% of time).

Secondly, there is a need to develop practical and objective measures of exposure to stooped work (degree of bending, duration, frequency) and refine the epidemiological case definition of outcome (symptoms, physical findings, diagnoses) for a deeper focus on the effects of stooped work.

To seriously begin to improve our understanding of the etiology and causal relationship between stooped and squatting postures and MSDs we need to increase our understanding of the biomechanics of the spine and the lower extremities in these positions. There is a need for research studies designed to evaluate the effects of these postures on tissue responses under various conditions and loading patterns. Research is required to understand how the intervertebral disc, the meniscus of the knee, and other passive tissues respond to repetitive versus static loading. Such research may point the way to understanding the relationship of degrees of postural stress and disease and, similarly, how much postural relief is needed or useful in preventing disease. Epidemiology and biomechanics provide much of the basis for understanding the effects of working in stooped and squatting postures, and the knowledge gained from such study needs to be incorporated into the case definition of stooped work, and in job design criteria that take into account the tissue fatigue generated by static postures.

Finally, there is need for an improved system of intervention research that both disseminates the evaluation of alternative strategic approaches in different workplaces and supports the development of workplace specific adaptations of known approaches. Interventions that are not both acceptable to workers and employers and that fit the work system without serious detriment to productivity will not be widely adopted. Development of such interventions is neither an automatic nor guaranteed result of publication of research results or successful demonstrations in other industries.

SUGGESTIONS FOR IMPROVING PREVENTION OF MUSCULOSKELETAL DISORDERS CAUSED BY STOOPING, SQUATTING OR KNEELING POSTURES

SUGGESTIONS FOR ASSESSING HIGH RISK JOBS

1. Evaluate the effectiveness of different methods of risk assessment with attention to predictive ability and field utility.

SUGGESTIONS FOR SURVEILLANCE RESEARCH

1. Develop a national registry of musculoskeletal hazards and health outcomes.
2. Add supplements to existing surveillance systems for stooped, squatting, and kneeling postures.
3. Conduct surveys in high risk industries (agriculture, construction, mining).
4. Determine the number of workers exposed and what jobs they are doing.
5. Record the exposure in identified jobs: time in stooped and squatting, by 'zones' of mild, moderate, and severe positions.
6. Identify the specific job or task elements requiring stooped postures, and why.
7. Conduct cross-sectional and longitudinal studies to develop and validate a list of high risk jobs and significant health outcomes.

SUGGESTIONS FOR INTERVENTION RESEARCH

1. Develop new partnerships with agencies, academia and industry to support intervention research focused on stooped, squatting, and kneeling work, including national and regional partnerships focused on industry- or task-specific applications.
2. Increase the number and range of intervention research underway.
3. Encourage higher-quality intervention evaluations using randomized trials, quasi-experimental designs and blended evaluations.
4. Document and broaden the dissemination of successful/proven interventions.

SUGGESTIONS FOR ETIOLOGICAL RESEARCH

1. Conduct studies to improve understanding of specific biomechanical stresses and MSD development during stooped, squatting and kneeling postures.
2. Develop and evaluate improved standards and methods for assessing exposure, health outcomes and other etiological factors for stooped, squatting and kneeling work.
3. Conduct population, clinical and laboratory studies to evaluate the short-term impacts of different types of exposure to working in stooped, squatting or kneeling postures on MSD development and early indicators of such disorders.
4. Conduct population, clinical and laboratory studies to evaluate the long-term impacts of different types of exposure to working in stooped, squatting or kneeling postures on MSD development and early indicators of such disorders.

PRESENTATIONS

Thomas Waters – Stooping at Work: A Risk Factor for Low Back Pain? (U.S. Perspective)

Adarsh Kumar – Stooped and Squatting Posture Problems in Agriculture: International Perspective (India)

Peter Lundqvist – The Scope of the Problem of Stooped and Squatting Postures in the Workplace, International Perspectives: (Sweden)

R.J. Banks – Related Injury Incidence in California

John Rosecrance – What Can Epidemiology Tell Us?

William Marras – Biomechanics of Low Back Disorders

Sean Gallagher – Capabilities and Costs of Working in the Stooping Posture

Willette "Billy" Gibbons – Interventions for Stooping/Bending Postures in Construction

Laura Welch – Bend Your Knees, Not Your Back: Work Accommodation for Stooped Postures among Construction Workers

Suzanne Rodgers – What Should We Consider in Evaluating Workplace Interventions?

Julia Faucett – Rest and Recovery Breaks as Interventions

John Miles – Agricultural Interventions in the U.S.

Peter Lundqvist – Agricultural Interventions in Sweden

Fadi Fathallah – Risk Factor Control for Stooped Postures in Agriculture

Robert Meyer – Research and Recent Ergonomic Developments in Prone Posture Workstations for Agriculture

Ira Janowitz – Conference Summation

CONFERENCE FORMAT

Conference Organization:

The conference was organized into three sessions, each consisting of presentations and discussions focused on one of three main areas of interest:

1. The Scope of the Problem of Stooped and Squatting Postures in the Workplace

2. Scientific Basis for Understanding the Effects of Stooped and Squatting Postures in the Workplace

3. Controlling Stooped and Squatting Postures in the Workplace

Each session consisted of a minimum of three presentations focused on the categorical topic. After each presentation, a brief period was allowed for questions from the audience. Upon the conclusion of all presentations for the session, a panel discussion was conducted to clarify and expand upon concepts that emerged during the course of the session. Owing to the nature of interdisciplinary research, many presenters provided content within their scheduled session that pertained to one or both of the other sessions. In order to maximize the breadth and depth of the knowledge provided by this conference, the authors of these proceedings have chosen to organize this document based on how the content of the presented material addresses the three main categories of interest, rather than by the specific session in which it was presented.

4. Suggestions for Improving Prevention of Musculoskeletal Disorders Caused by Stooping Squatting or Kneeling Postures

At the end of the conference, participants were asked to suggest where this dialogue and the effort to define, better understand and prevent work-related exposures to stooped, squatting and kneeling postures should go next.

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