INTRODUCTION

As a sub-discipline of biomechanics, occupational biomechanics has experienced extensive growth over recent decades. Chaffin et al. (2006) have defined the area as “the science concerned with the mechanical behavior and limitations of the musculoskeletal system and component tissues when a person performs an exertion in industry (p. xiii).” As an application-oriented discipline, drawing on a broad range of basic biomechanics theory and technology, occupational biomechanics also serves as one of the major components of the ergonomics discipline, which is concerned with more general goals of improving the design of systems involving humans.

The purpose of this paper is to highlight several major topics within the occupational ergonomics discipline, specifically those that represent important current needs to advance the field, and to which research in basic biomechanics can make important contributions. Throughout, occupational biomechanics and (physical) ergonomics are treated in a broad sense, as encompassing the study of the physical (mechanical, physiological, etc.) interactions of workers with work systems (tools, material, etc.).

A major motivation for research in these fields is the continued personal, economic, and societal burden associated with work-related musculoskeletal disorders (WMSDs). Over 500,000 cases were reported in 2001, with nearly half involving more than 20 days away from work (NIOSH, 2006). While ongoing research has led to a reduction of risk in some areas, prevalence rates overall appear to be fairly constant. As such, a need is apparent for improvement in the theory, technology, and application of occupational ergonomics and biomechanics.

METHODS

In order to gain some understanding of current issues that may be hindering such improvement, a survey was conducted of a number of active researchers. This was in no way meant to be a comprehensive investigation, but rather to learn what these individuals believed were substantial current needs to advance understanding and prevention of WMSDs. Roughly 40 individuals were contacted, nearly half of whom responded. In order to summarize the variety of input received, I used as a framework the National Occupational Research Agenda (NORA) material that has been generated by the National Institute for Occupational Safety and Health (NIOSH). The interested reader can refer to the citations provided for additional detail (NIOSH, 1995; 2001; 2006). In the following, major categories of research priorities are taken from the NORA documents. Specific items are drawn from both the input I received as well as my own opinions and limited to those thought most relevant to the current audience.
RESEARCH NEEDS

Disease and Injury
- Improved understanding of injury mechanisms and subsequent pain generation
- Use of biomechanics to identify stages of injury/illness, recovery, rehabilitation, and ability to return to work
- Addressing lower extremity injuries
- Understanding the nature of WMSDs (e.g. accident vs. systematic overload)

Work Environment and Workforce
- Assessing injury in the modern workforce (e.g. those providing service/information)
- Pathophysiological pathways of psychosocial risk factors
- Risks in ‘special populations’, such as the aged and obese (e.g. developing and adapting biomechanical models)
- Quantification of relative contribution and interactions within and between risk factor ‘domains’ (physical, personal, psychosocial)

Research Tools and Approaches

Control Technology
- Developing ‘safe’ workload limits (e.g. posture, repetition, force),
- Tissue-specific, task-specific, and occupationally-relevant tissue tolerances and workload limits
- Relationships between short-term perceptual responses and long-term risk

Exposure Assessment Methods
- How to quantitatively describe complex tasks (e.g. peak, mean, probability dist.), and data reduction procedures for long-term or continuous exposure measures
- How to accumulate risk for jobs composed of sets of different sub-tasks
- Methods to facilitate detailed field assessment
- Determining necessary levels of accuracy in laboratory- or field-based models (e.g. sensitivity analyses)
- Using virtual reality and motion capture for proactive assessment
- Efficacy of ‘macro’ indicators or metrics of risk (e.g. fatigue, stability, technique)
- Biomarkers for musculoskeletal trauma

I hope that this paper and the symposium stimulate continued development of occupational biomechanics research and application, and also inform investigators in basic biomechanics disciplines to the potential applications of their efforts.

REFERENCES


ACKNOWLEDGEMENTS

Thanks to the following individuals, each of whom provided fruitful ideas, that are contained in one form or other in this paper:

Kari Babski-Reeves, Don Chaffin, Rakié Cham, Kermit Davis, Patrick Dempsey, Jack Dennerlein, Kurt Hegmann, Simon Hsiang, Richard Hughes, Pete Johnson, Karl Kroemer, Paul Kuijer, Jim Potvin, David Rempel, Mark Redfern, Gary Mirka, Jaap van Dieën, Jeff Woldstad