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Comparison of four peak spinal loading exposure measurement methods and their association with low-back pain

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Objectives This paper examines the performance of 4 different methods of estimating peak spinal loading and their relationship with the reporting of low-back pain.

Methods The data used for this comparison was a subset of subjects from a case-referent study of low-back-pain reporting in the automotive industry, in which 130 random referents and 105 cases (or job-matched proxies) were studied. The peak load on the lumbar spine was determined using a biomechanical model with model inputs coming from a detailed self-report questionnaire, a task-based check list, a video digitization method, and a posture and load sampling technique.

Results The methods were directly comparable through a common metric of newtons or newton meters of spinal loading in compression, shear, or moment modes. All the methods showed significant and substantial associations with low-back pain in all modes (odds ratios 1.6—2.3). The intraclass correlation coefficients (ICC) showed strong similarities between the checklist and video digitized techniques (ICC 0.84—0.91), moderate similarities between these techniques and the work sampling method (ICC 0.49—0.52), and poor correlations (ICC 0.16—0.40) between the self-report questionnaire and the observer recorded measures.

Conclusions While all the methods detected significant odds ratios, they cannot all be used interchangeably for risk assessment at the individual level. Peak spinal compression, moment, and shear are important risk factors for low-back pain reporting, no matter which measurement method is used. Questionnaires can be used for large-scale studies. At the individual level a task-based checklist provides biomechanical model inputs at lower cost and equal performance compared with the criterion video digitization system.

Key terms biomechanical load, epidemiology, exposure measurement, low-back pain.

Recently, several studies using high-quality exposure measures have demonstrated strong associations between physical work exposures and a risk of low-back pain (1—3). These and other studies have identified widely differing exposure variables that include heavy work, forceful movements, awkward postures, and moments of force, all of which have different units of measurement (4). Wells et al (5) have identified these differences between the risk factors as a potential problem when the results of different studies are to be compared in, for example, a meta analysis. The use of a "common metric" approach whereby different measurements strategies yield a consistent and comparable unit of exposure has been proposed (5).

The data presented in this paper were obtained as part of a large epidemiologic study of risk factors for reported low-back pain in the automotive industry. It identified psychosocial, biomechanical, and psychophysical variables all as independent, significant, and substantial risk factors (6). Further analysis of the biomechanical exposure data bases of this study identified the following 4 separate risk factors that are independently associated with the risk of low-back pain: peak spinal load, integrated spinal load, trunk kinematics, and exter-

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