

Interaction between the shoulder and spine using biomechanical and biopsychosocial perspectives

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Background: Worker's Compensation statistics position low back pain and shoulder related musculoskeletal disorders (MSD) as leading causes of recurrent work-related disabilities¹. Despite shared biophysical, psychosocial, and work demand factors of the shoulder and spine during occupational reaching tasks, the complex interaction of these two adjoining areas with respect to injury mechanisms while performing upper extremity motion is poorly understood²⁻⁵. The objectives of this research are to:

1. Capture the function of the shoulder and spine in an asymptomatic young adult population.
2. Investigate the trade-off between between the shoulders and the spine during lifting and reaching tasks with small hand-held loads.

Methodology: In the initial study 150 young adults will be screened for previous shoulder, and low back injuries to allocate three participant groups: asymptomatic, previous shoulder injury, and previous low back injury. Physical activity behaviour, psychosocial measures of pain, fear-avoidance, anthropometrics, range of motion and strength of the shoulders, thoracic, and lumbar spine will be recorded⁶. A sample of the screened participants will return to complete a series of lifting and reaching tasks constrained using current occupational MSD prevention standards. Independent measures will include load, task type (predominantly shoulder versus low back), and injury group (asymptomatic, previous shoulder, previous low back). Dependent measures will include physical activity patterns, pain ratings, pain attitudes, fear-avoidance beliefs, upper body and trunk kinematics, muscle activation (surface/indwelling), relative joint angles, and joint loading (peak, cumulative). Univariate (ANOVA) and multivariate (principal component analyses) will be used to detect group differences, along with shoulder/spine patterns in the data.

Significance: Interpreting psychosocial factors alongside the quantification of biomechanical interactions of the shoulder and spine will address complex injury mechanisms to improve workspace design and create evidence-based MSD prevention guidelines.

- 1 Association of Workers' Compensation Boards of Canada (AWCBC) (2017) National Work Injury, Disease and Fatality Statistics. [Web Pub.]. Retrieved from: <http://awcbc.org/wp-content/uploads/2018/03/National-Work-Injury-Disease-and-Fatality-Statistics-Publication-2015-2017.pdf>
- 2 Belbeck, A., Cudlip, A. C., & Dickerson, C. R. (2014). Assessing the interplay between the shoulders and low back during manual patient handling techniques in a nursing setting. *International Journal of Occupational Safety and Ergonomics*, 20(1), 127-137.
- 3 Siu, A., Schinkel-Ivy, A., & Drake, J. D. (2016). Arm position influences the activation patterns of trunk muscles during trunk range-of-motion movements. *Human movement science*, 49, 267-276.
- 4 Schinkel-Ivy, A., & Drake, J. D. (2015). Sequencing of superficial trunk muscle activation during range-of-motion tasks. *Human movement science*, 43, 67-77.
- 5 Dickerson, C. R., Kim, K. H., Martin, B. J., & Chaffin, D. B. (2004). Evaluating the effect of back injury on shoulder loading and effort perception in hand transfer tasks. *SAE transactions*, 78-81.
- 6 Kerr, M. S., Frank, J. W., Shannon, H. S., Norman, R. W., Wells, R. P., Neumann, W. P., & Bombardier, C. (2001). Biomechanical and psychosocial risk factors for low back pain at work. *American Journal of Public Health*, 91(7), 1069-1075.