SPECIAL SECTION: Impact of Thomas Waters on the Field of Ergonomics

Preface to the Special Section on the Impact of Thomas Waters on the Field of Ergonomics

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Thomas R. Waters had a distinguished career in the field of occupational ergonomics for 24 years while working at the National Institute for Occupational Safety and Health (NIOSH). Although his work focused on musculoskeletal disorders (MSDs) across many industries, including manufacturing, retail trade, warehousing, agriculture, and health care, he is most known for leading the development and validation of the Revised NIOSH Lifting Equation (RNLE) starting in 1993. The RNLE has become the most widely used ergonomic assessment tool in the world. Researchers across the world are now revising and expanding this equation to ensure wide applicability of the RNLE. Waters published 27 articles on the RNLE, with one of the last articles being awarded the 2000 Alice Hamilton Award for Excellence in the Human Studies (Waters et al., 1999) and another expanding the RNLE to be used by pregnant workers lifting at work (MacDonald et al., 2013). The reach of this tool has been phenomenal, with almost 65,000 downloads of the RNLE documentation from the NIOSH Web page between 2007 and 2012, more than 72,000 page views from 2009 to 2012, and more than 25,000 copies of the RNLE distributed by NIOSH. More than 130 articles have been published that employ the RNLE as an assessment tool, providing one indication of the impact that this tool has had on the field.

Lu, Putz-Anderson, Garg, and Davis (2016) have reviewed the literature to assess the impact and application of the RNLE. Three other articles in this special issue provide insight into modifications to the RNLE, including the cumulative RNLE (Garg & Kapellusch, 2016) and the variable-task RNLE (Battevi, Pandolfi, & Cortinovis, 2016; Waters, Occhipinti, Colombini, Alvarez-Casado, & Fox, 2016). In all, the articles continue the legacy of the RNLE as it can be more applicable to a wider number of jobs.

Waters was a major advocate for safe patient handling. He published 27 publications that focused on safe patient handling. He also assisted in the development of guidelines for safe patient handling for the Veterans Health Administration, the American Nursing Association, the Association of periOperative Registered Nurses, the National Association of Orthopaedic Nurses, the Critical Care Nursing Task Force, and the Indian Health Service. His passion to protect nurses from patient-handling injuries culminated with the development of recommendations for schools of nursing (Waters, Nelson, Hughes, & Menzel, 2009). Two articles are included in this special issue that represent the research that Waters fostered in safe patient handling. First, a review by Wilson and Davis (2016) provides a summary of his work in safe patient handling, identifying his contribution to the health care field and beyond. Second, a study by Wiggermann (2016) investigates how a novel feature of a bed can assist the turning and lateral transferring of patients, thus reducing the stress on the caregiver. This research fits well with many of the research priorities that Waters championed in the health care ergonomics field.

Waters also had an impact in youth agriculture ergonomics, where he developed a two-dimensional biomechanical model for adolescents, developed instrumentation to look at bone density and quality, and evaluated interventions for common tasks performed by farm youth. The later focus resulted in three separate studies that were funded by NIOSH and overseen by Waters. In one study, the authors investigated the impact of wheelbarrow design and add-on handles for scoop shovels on trunk kinematics for farm youth (Kotowski, Davis, & Waters, 2009a,

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2009b). In a second study, the authors (Allread & Waters, 2007) investigated whether low-back risk can be reduced with interventions for feed handling and scooping tasks. In the final study (Fathallah, Tang, & Waters, 2016), being published as part of this special issue, the authors evaluate interventions for bucket handling for farm youth. With the complexity of risk factors in agriculture, such as physical, chemical, and heat exposure, the final review paper (Ross, Shipp, Trueblood, & Bhattacharya, 2016) puts into context the synergistic role of multiple stressors with respect to musculoskeletal health.

Waters had a very productive and impactful 24 years in the field of occupational ergonomics and MSDs. He was a true advocate for underrepresentative workers with respect to health and safety, whether in agriculture, health care, or manufacturing. NIOSH recently named Thomas R. Waters the 2016 recipient of the James P. Keogh Award for Outstanding Service in Occupational Safety and Health, which honors contributions by public health workers in achieving safer and healthier workplaces. This special issue is another tribute to his legacy.

REFERENCES

Allread, X., & Waters. (2007). Interventions to reduce low-back injury risk among youth who perform feed handling and scooping tasks on farms. *Journal of Agricultural Safety and Health*, *13*, 375–393.

Battevi, N., Pandolfi, M., & Cortinovis, I. (2016). Variable Lifting Index for manual-lifting risk assessment: A preliminary validation study. *Human Factors*, *58*, 712–725.

Fathallah, F. A., Tang, S. C. H., & Waters, T. (2016). Development and evaluation of ergonomic interventions for bucket handling on farms. *Human Factors*, *58*, 758–776.

Garg, A., & Kapellusch, J. M. (2016). The Cumulative Lifting Index (CULI) for the Revised NIOSH Lifting Equation: Quantifying risk for workers with job rotation. *Human Factors*, *58*, 683–694.

Kotowski, S. E., Davis, K. G., & Waters, T. R. (2009a). Investigation of select ergonomic interventions for farm youth: Part 1. Shovels. *Journal of Agromedicine*, *14*, 33–43.

Kotowski, S. E., Davis, K. G., & Waters, T. R. (2009b). Investigation of select ergonomic interventions for farm youth: Part 2. Wheelbarrows. *Journal of Agromedicine*, *14*, 44–57.

Lu, M.-L., Putz-Anderson, V., Garg, A., & Davis, K. G. (2016). Evaluation of the impact of the Revised National Institute for Occupational Safety and Health Lifting Equation. *Human Factors*, *58*, 667–682.

MacDonald, L. A., Waters, T. R., Napolitano, P. G., Goddard, D. E., Ryan, M. A., Nielsen, P., & Hudock, S. D. (2013). Clinical guidelines for occupational lifting in pregnancy: Evidence summary and provisional recommendations. *American Journal of Obstetrics and Gynecology*, *209*, 80–88.

Ross, J. A., Shipp, E. M., Trueblood, A. B., & Bhattacharya, A. (2016). Ergonomics and beyond: Understanding how chemical and heat exposures and physical exertions at work affect functional ability, injury, and long-term health. *Human Factors*, *58*, 777–795.

Waters, T. R., Baron, S. L., Piacitelli, L. A., Anderson, V. P., Skov, T., Haring-Sweeney, M., Wall, D., & Fine, L. (1999). Evaluation of the Revised NIOSH Lifting Equation: A cross-sectional epidemiological study. *Spine*, *24*, 386–394.

Waters, T. R., Nelson, A., Hughes, N., & Menzel, N. (2009). *Safe patient handling training for schools of nursing* (NIOSH Pub. No. 2009-127). Retrieved from http://www.cdc.gov/niosh/docs/2009-127/pdfs/2009-127.pdf

Waters, T., Occhipinti, E., Colombini, D., Alvarez-Casado, E., & Fox, R. (2016). Variable Lifting Index (VLI): A new method for evaluating variable lifting tasks. *Human Factors*, *58*, 695–711.

Wiggermann, N. (2016). Biomechanical evaluation of a bed feature to assist in turning and laterally repositioning patients. *Human Factors*, *58*, 748–757.

Wilson, T. P., & Davis, K. G. (2016). Health care ergonomics: Contributions of Thomas Waters. *Human Factors*, *58*, 726–747.