Small Changes Make Big Differences

The role of ergonomics in agriculture

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Agriculture is one of the most hazardous occupations, not only in terms of fatalities but also musculoskeletal disorders (MSDs). MSDs are injuries to and compromised function of the body's system of muscles, tendons, ligaments, nerves, and spinal discs. Ergonomics is the term we commonly use in the evaluation and design of tools and workplaces to minimize the risk of MSDs.

Ergonomics is about fitting the job to the worker, by looking at the worker-workplace interface and helping workers avoid awkward postures, excessive forces, and repetitive motions. The term is based on two Greek words: *ergon*, meaning work, and *nomos,* meaning natural laws. Its first use can be traced to 1857, which was around the time when significant strides were being made in the early mechanization of agriculture.

Looking at this topic from the worker's perspective, the area of biomechanics is about understanding the motions, forces, and mechanisms of the body, from overall movements to specific muscles, tendons, and other tissues. Broadening this concept of human capabilities and limitations is the area of human factors, in which cognitive, physiological, psychological, and social elements are considered in the overall worker-workplace interface for improving safety and health.

A collaborative robot that assists workers in transporting strawberries during harvest. *Photo courtesy of Stavros Vougioukas, University of California-Davis.*

In 2001, the National Academies Press published *Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities* (www.nap.edu/catalog/10032/musculoskeletal-disorders-and-the-workplace-low-back-and-upper-extremities). For all industries, it estimated a $45 billion to $55 billion annual cost for MSDs, and one million people taking time from work due to MSDs. For the scope of this issue in agriculture, we can look back to California's AgSafe program, which published a study of fatal and non-fatal injuries in California agriculture in 1991. Non-fatal injuries were primarily sprains and strains (43%) and caused by overexertion (25%). Overexertion was close behind being struck by something (28%) and just ahead of falls (17%). In a later survey in 2004 with a follow up in 2013 by the Western Center for Agricultural Health and Safety, 1,947 California farm operators reported 160 injuries, 29.4% of which were sprains and strains, and 24.2% of which were caused by overexertion and strenuous movements. In general, MSDs predominate among nonfatal injuries in agriculture and often involve extremities or the back.

Interventions in agriculture

Although many intervention efforts have been made over the last couple of decades, permanent solutions are hard to come by, for various reasons. In labor-intensive agriculture, solutions are often crop-specific. When labor shortages exist, more resources are focused on mechanization, which can eliminate existing risks but can also introduce new risks at the same time.

A successful intervention was the introduction of smaller harvest tubs for hand-harvesting of wine grapes. The smaller tubs reduced the average load from 57 to 46 pounds, bringing the weight below the common 50-pound limit used in general industry. Even though the NIOSH lifting equation suggests a much lower recommended weight limit for this job (www.cdc.gov/niosh/docs/94-110/default.html), this relatively small change made a big difference in workers'