Examining how 'micro-breaks' could break workplace cycle of fatigue and injury

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It may seem like common sense, but there is now hard evidence that short rest breaks prevent muscle fatigue and possible injury—without sacrificing productivity—for people engaged in repetitive manual labor.

While working on her master's thesis in mechanical engineering, Karla Beltran measured the fatigue of study participants in a laboratory—having them move boxes as she tracked their muscle activity and movement with body sensors.

In one scenario the participants worked without breaks, and in two others took short "micro-breaks" of no more than a minute every 10 minutes to either rest or stretch.

"We observed a significant reduction in muscle fatigue between the different work-rest schedules," says Beltran. "Taking small breaks during a work shift can significantly reduce muscle fatigue and potentially reduce its consequent risk of work-related musculoskeletal disorders without negatively affecting productivity."

Regarding the effectiveness of recovery, however, the results showed no difference between stretching or simply resting.

Beltran's study, "Breaking the Fatigue Cycle," was published recently in the journal *Sensors*, with co-authors and faculty mentors Milad Nazarahari and Hossein Rouhani.

Improper lifting or overexertion while doing jobs such as materials handling is one of the main causes of musculoskeletal disorders says Beltran, which can affect muscles, nerves, tendons, joints, cartilage, and spinal disks. About 20 percent of people around the world suffer from some type of musculoskeletal disorder.

"Because taking breaks is so intuitive, people haven't really done the full analysis to objectively see what would happen when they actually make that change," she says.

"Most of the studies we looked at just asked people how they feel, which

sometimes isn't taken as seriously."

As her study participants lifted and moved boxes from one table to another, the onset of fatigue was obvious, she said.

"It's something you can even see with your own eyes. Maybe for the first 10 minutes, you bend your knees and do the recommended squat. But eventually, when you get tired, you compensate by slouching or maybe not doing a full squat."

Beltran used electromyography (EMG) sensors to measure the electrical signals generated by muscles and inertial measurement unit (IMU) sensors to track body movement, devising what she calls a "K-score" to measure changes in posture over time.

Her findings support other similar studies measuring fatigue, but most are done using EMG sensors alone, she says, which are difficult to attach, uncomfortable to wear, and provide a limited signal. IMU sensors can be easily attached to clothing and provide important additional data.

Her results show that "body posture characterization based on the K-score is an accurate, sensitive and practical measurement tool for muscle fatigue" and demonstrate "the potential of IMUs in substituting EMG sensors toward providing a reliable tool for long-term use in industrial environments," she writes.

The study suggests slight modifications to a shift in the workplace—whether on a construction site, in a factory, or in a warehouse—can be easily implemented without cost to the employer.

"It's just about talking to your employer and making a small change to your company culture," says Beltran. "The more they start doing it, the more everyone will eventually see the results."

More information: Karla Beltran Martinez et al, Breaking the Fatigue Cycle: Investigating the Effect of Work-Rest Schedules on Muscle Fatigue in Material Handling Jobs, *Sensors* (2023). DOI: 10.3390/s23249670