Medical Xpress

Robotic exoskeletons and neurorehabilitation for acquired brain injury: Determining the potential for recovery

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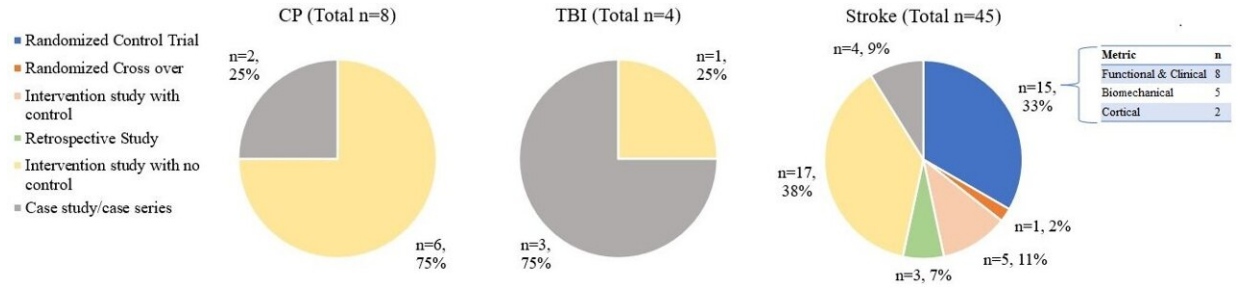

Studies (N=57) divided into three pie charts based on population (cerebral palsy, traumatic brain injury, stroke) and further divided based on study type. Credit: Kessler Foundation

A team of New Jersey researchers reviewed the evidence for the impact of robotic exoskeleton devices on recovery of ambulation among individua5ls with acquired brain injury, laying out a systematic framework for the evaluation of such devices that is needed for rigorous research studies. The open access article, "Lower extremity robotic exoskeleton devices for overground ambulation recovery in acquired brain injury—A review", was published in *Frontiers in Neurorobotics*.

The authors are Kiran Karunakaran, Ph.D., Sai Pamula, Caitlyn Bach, Soha Saleh, Ph.D., and Karen Nolan, Ph.D., from the Center for

Mobility and Rehabilitation Engineering Research at Kessler Foundation, and Eliana Legelen, MA, from Montclair State University.

Acquired brain injury was defined as cerebral palsy, traumatic brain injury or stroke. The review focused on 57 published studies of overground training in wearable robotic exoskeleton devices. The manuscript provides a comprehensive review of clinical and pre-clinical research on the therapeutic effects of various devices.

"Despite rapid progress in robotic exoskeleton design and technology, the efficacy of such devices is not fully understood. This review lays the foundation to understand the knowledge gaps that currently exist in robotic rehabilitation research," said lead and corresponding author Dr. Karunakaran, citing the many variables among the devices and the clinical characteristics of acquired brain injury.

"The control mechanisms vary widely among these devices, for example, which has a major influence on how training is delivered," she added. "There's also wide variability in other factors that affect the trajectory of recovery, including the timing, duration, dosing, and intensity of training in these devices."

Developing a framework for future research requires a comprehensive approach based on diagnosis, stage of recovery, and domain, according to co-author Karen J. Nolan, Ph.D., associate director of the Center for Mobility and Rehabilitation Engineering Research and director of the Acquired Brain Injury Mobility Laboratory. "Through this approach, we will find the optimal ways to use lower extremity robotic exoskeletons to improve mobility in individuals with acquired brain injury," said Dr. Nolan.

"It's important to note that our review is unique in presenting both the downstream (functional, biomechanical, physiological) and upstream

(cortical) evaluations after rehabilitation using various robotic devices for different types of acquired brain injury," Dr. Karunakaran noted. "Each device needs to be evaluated by domain in each population and throughout all stages of recovery. This is the necessary scope for determining the response to treatment."

More information: Kiran K. Karunakaran et al, Lower extremity robotic exoskeleton devices for overground ambulation recovery in acquired brain injury—A review, *Frontiers in Neurorobotics* (2023). DOI: 10.3389/fnbot.2023.1014616

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