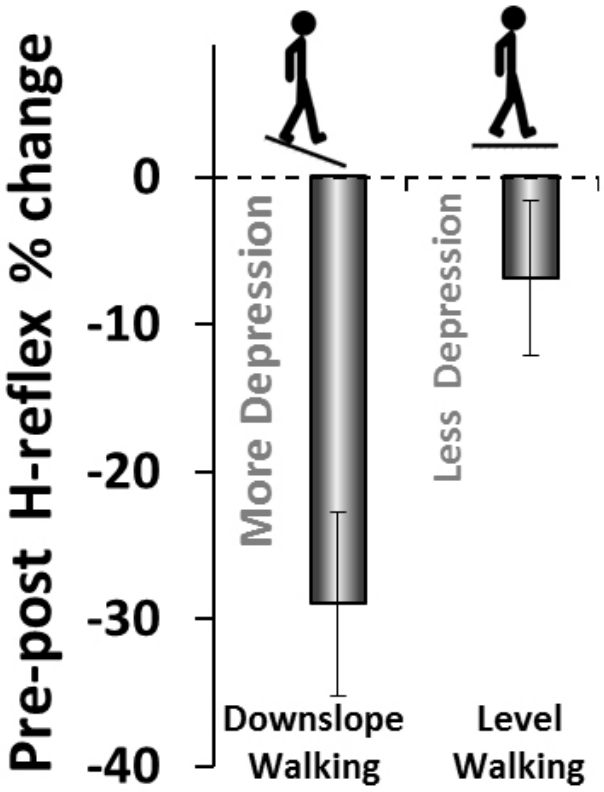
A new take on walking exercise to stimulate adaptations in the nervous system

Exercise causes adaptations that ultimately make performance of physical activity easier. One way the body adapts to exercise is by re-organization of the central nervous system (CNS). Some neural connections may be strengthened, while others may be weakened, depending on the unique demands of the particular exercise. The spinal cord is now recognized more than ever as a critical source of adaptive potential in the CNS.



Effect of downslope and level walking on the H-reflex

The overarching goal of our lab is to better understand how exercise can be tailored to encourage spinal adaptations that result in better functional ability. Walking is a fundamental rhythmic activity that supports independence and quality of life. In this study we sought to determine if walking on a negative incline, or downslope walking, could encourage a change in spinal reflexes. One reason to expect downslope walking could evoke such a change is that communication between the active muscles and the CNS is different during downslope walking compared to other types of walking. For example, because the body is lowered with each step during downslope walking, muscles are

stretched more during downslope walking than during other types of walking. Thus, the CNS receives more stretch-related feedback from the muscles involved in walking if the slope is negative. Moreover, the brain plays a larger role in activity involving muscle contractions with stretch, sending signals that might induce a change in the spinal cord. Lastly, a change in spinal function is found after stretch-sensitive sense organs in the muscle, muscle spindles, are activated artificially for a short period of time via vibration. Therefore, downslope walking might represent a natural way to activate those muscle sense organs to cause re-wiring in the spinal cord.

In this study healthy participants walked on a treadmill for 20 minutes at an easy pace (2.5 mph) on three separate days; one day at 15% decline (downslope), another at 0% incline, and another at 15% incline (upslope). We measured the Hoffman (or H-) reflex to evaluate the state of spinal neural signaling while participants were at rest. Both downslope and level walking caused H-reflex depression, but depression was small for level walking (6.8±5.2%), and more than 4 times larger for downslope walking (29.3±6.2%), Figure 1. H-reflex depression did not occur after upslope walking. Therefore, changes in the spinal neural signaling resulting from walking are dependent on treadmill slope. Moreover, participants who were more physically active had significantly more H-reflex depression with downslope walking, suggesting regular physical activity increases adaptability of the CNS.

The results of this study advance our knowledge of how to tailor exercise to induce neural adaptations. Although previous studies have found that H-reflexes are depressed after running downslope, the current study is the first to report a similar effect for walking. Because walking is accessible to a much larger portion of the population than running, the potential applications of the current results are much more far-reaching. Furthermore, downslope walking evoked only a minor cardiovascular response and perception of effort, increasing the likelihood of good compliance with downslope walking exercise prescription. We are especially intrigued that downslope walking caused H-reflex depression because people with neural dysfunction generally have elevated H-reflexes. For these people, the new knowledge from this study could help advance efforts to develop therapeutic exercise to restore or maintain proper neural function. Future studies will be needed to help explain the biological mechanisms for H-reflex depression after downslope walking, and how best to dose downslope walking to get the best effect.

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Publication

Slope walking causes short-term changes in soleus H-reflex excitability.
Sabatier MJ, Wedewer W, Barton B, Henderson E, Murphy JT, Ou K

Physiol Rep. 2015 Mar