Exercise May Provide 'Motor Reserve' in Older Age

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March 12, 2015

Just as higher education and social connections seem to provide a cognitive reserve as people age, physical activity may build a motor reserve that protects against the harmful effects of white matter hyperintensities (WMHs) in the brain on motor function, new research suggests.

The results point to a potential biological mechanism that may at least partly explain the well-established association between physical activity and motor function in healthy older adults, said lead author Debra Fleischman, PhD, professor, neurological sciences and behavioral sciences, Rush University Medical Center and Rush Alzheimer's Disease Center, Chicago, Illinois.

"The data suggest that physical activity may protect motor function from the untoward effects of small vessel disease," seen on MRI as WMHs.

The new findings emphasize the importance of an active lifestyle in protecting motor function from the adverse neurobiological effects of aging, Dr Fleischman said.

The study used data from 167 community-dwelling adults without dementia who were participants in the Rush Memory and Aging Project, an ongoing longitudinal clinical pathologic study of aging and dementia. Their mean age was 80 years and about 30% were male.

Researchers used a composite measure of global cognition from 19 individual computer-scored cognitive tests. To assess motor function, they created a composite measure from 11 individual motor tests that included both upper- and lower-extremity motor performance.

Using actigraphs, the investigators measured total daily activity, including all exercise and nonexercise physical activity. Participants wore a watch-like monitor on the nondominant wrist for 24 hours a day for up to 11 days. The data were then downloaded to a computer for analysis. Researchers also calculated intensity of activity.

To assess WMH burden, they used a well-established, automated computer program that measures the total volume of brain tissue affected by WMH as shown on fluid-attenuated inversion recovery MRI. Dr Fleischman noted that although studies suggest that WMHs on MRI reflect small vessel disease, more studies are needed to characterize the pathologic bases of WMH.

After adjustment for age, sex, and education, total daily activity was not associated with WMH burden ($P = .169$).

As did previous research, this study showed that a higher level of WMH burden was associated with poorer motor function, but it also found that the harmful effects of WMHs disappeared in active people.

Comparing participants in different percentiles of total daily activity, they showed that in those with the highest activity (90th percentile) WMH burden did not affect motor function. In contrast, those at the 50th percentile of physical activity showed a negative effect of WMH burden on motor function, and this effect was even stronger for those in the 10th percentile of activity.

The difference between the 90th and 50th percentiles is about an additional hour and a half of walking per day at 2.5 miles per hour, Dr Fleischman noted. And the difference between the 50th and 10th percentiles translates to just under an hour of additional walking per day.

This interaction persisted after controlling for various potential confounding variables, including depressive symptoms, body mass index, vascular diseases, functional status, and interactions with WMH burden.

"Together these findings suggest that higher levels of physical activity may provide reserve against the effects of brain pathology on motor function in older age," the authors conclude.

Dr Fleischman stressed that the association was significant when two different actigraphic measures were used: total daily activity and intensity of daily activity. There was no association when physical activity was measured by self-report.

Neural Reserve

That physical activity was not associated with WMH burden suggests that the benefit on motor function is through a neural reserve mechanism rather than through a direct association with WMH. Dr Fleischman suggested possible candidate mechanisms, including increases in various trophic factors that promote tissue survivability and genesis. However, she said, more work needs to be done to examine the potential mechanisms underlying motor reserve.

The concept of reserve has been frequently used in relation to cognition. Studies show that older patients with higher levels of education, social networks, and purpose in life have better cognitive function despite significant Alzheimer's disease pathology burden.

The same concept may be at play here; physically active people may have the same amount of brain damage as physically inactive people but this damage doesn't seem to affect their motor function. Unlike education, however, physical activity is a modifiable behavior at any age.

The motor reserve provided by physical activity may have an influence at multiple sites along motor pathways. While in the current study, the brain proxy measure was limited to WMH burden, further studies that examine a wider array of central nervous system abnormalities and other components of the motor pathways "will be crucial for defining the neurobiological basis of reserve provided by physical activity," said the authors.

The new findings underscore the importance of facilitating a more active lifestyle to prevent late-life motor impairment, improve survivability, and maintain independence and well-being, said the authors.

For people older than age 65 years, the Centers for Disease Control and Prevention recommends that older adults get at least:

- 2 hours and 30 minutes of moderate-intensity aerobic activity (eg, brisk walking) every week plus muscle strengthening activities on 2 or more days a week that work all major muscle groups; or
- 1 hour and 15 minutes of vigorous-intensity aerobic activity (eg, jogging or running) every week and muscle strengthening activities on 2 or more days a week that work all major muscle groups; or

- An equivalent mix of moderate- and vigorous-intensity aerobic activity and muscle strengthening activities on 2 or more days a week that work all major muscle groups.

As for the type of exercise, that's an individual choice that considers existing medical conditions and leisure-time preferences, said Dr Fleischman. "I think that the important message, and the one that I give to my patients, is that they do not have to be marathon runners to maintain cognitive and motor function through physical activity as they age."

Other studies by Dr Fleischman and her research group showed that participants with the highest level of total daily activity, no matter how this is accumulated, are at the lowest risk for cognitive and motor impairment and decline as they age. "So the message is to just keep moving in any way that is safe and enjoyable."

This is particularly important because, unlike many age-related conditions that impair motor function, such as Parkinson's disease and arthritis, age-related motor impairment is usually left untreated, said Dr Fleischman.

"Until we have a more complete understanding of the biological mechanisms underlying chronic late-life motor impairment, and have developed effective pharmacological treatments to lessen the effects of brain pathology on motor function, efforts to encourage and facilitate an active lifestyle in older adults will be a critical element in meeting this public health challenge."

The research group is acquiring longitudinal scans that will allow them to measure changes in all the primary variables and compare them to baseline, said Dr Fleischman.

Physical Activity a "Panacea"?

The study is yet another example of how physical activity is a kind of "panacea" in medicine, commented Glen Finney, MD, assistant professor, neurology, University of Florida College of Medicine, Gainesville, and a member of the American Academy of Neurology (AAN).

"We have seen similar effects for cognitive function and now they have found it in the motor domain. This supports the idea that physical activity is good for everything."

He noted that the motor function in this case is determined by the brain. "The research clearly shows that lower levels of physical activity are correlating with brain disease burden, so clearly this is brain-driven motor function. But once you get to a high level of physical activity, it actually helps to overcome and sort of negate that white matter burden."

While the authors speculate that this is due to a motor reserve, Dr Finney said he'd like to see a prospective study look at whether it's really a reserve or an actual treatment effect. "At this point, it's correlation; it's not causation. It's a definite possible way this works," he said.

According to an accompanying editorial, the "pooled approach" of using a composite motor score and a range of cognitive tests is statistically powerful but needs further development to be accessible in routine clinical practice.

The editorial writers, Richard Camicioli, MD, Department of Medicine, Division of Neurology, University of Alberta, Edmonton, Canada, and Joe Verghese, MBBS, MS, Departments of Neurology and Medicine, Albert Einstein College of Medicine, Bronx, New York, noted that the 167 participants were

more educated and cognitively healthy although slightly older than the overall sample of 1545 persons originally recruited for the study.

They also commented that because the study was cross-sectional, it can't determine causality. In addition, they note, actigraphy measures total activity, so it's difficult to know which aspects of the activities were protective.

"The nature (aerobic or resistance), complexity (dancing) or frequency of the physical activity may all have a role," they said.

Measuring WMH by fluid-attenuated inversion recovery imaging may not completely reflect white matter damage, they said. Diffusion tensor imaging or magnetization transfer imaging may better depict white matter damage, might provide complementary measures, and may be related to physical activity.

The study was supported by the National Institute on Aging, National Institute of Minority Health and Health Disparities, Illinois Department of Public Health, and Rush Translational Science Consortium. The study authors and editorial writers have disclosed no relevant financial relationships.

Neurology. Published online March 11, 2015. Abstract Editorial