Oman Medical Journal [2018], Vol. 33, No. 1:

Which Exercise Performance is More Important for Cognition? Incremental or Protective Effects

Hakimeh Saadati

Faculty of Medicine, Ardabil University of Medical Sciences, Ardabil, Iran

ARTICLE INFO

Article history:

Received: 3 August 2017

Accepted: 10 September 2017

ONLINE:

DOI 10.5001/omj.2018.

Dear Editor,

Studies have shown that exercise has important implications for learning, cognitive performance, and general health. It has been broadly indicated that running improves various neurological diseases, promotes functional improvement, and enhances resistance to brain insult and stroke. Physical activity can also improve mood disorders, such as anxiety-like behavior.[1–3] However, the underlying mechanisms by which it does this are poorly understood. One probable reason is that exercise augments cell proliferation, long-term potentiation,[4] and synaptic plasticity[5] in animal brains. These beneficial effects of exercise on the brain and synaptic plasticity have been mediated to increase messenger RNA (mRNA) and protein levels of brain-derived neurotrophic factor (BDNF) and other neurotrophins.[4,6] Some evidence indicates the significant promotion of cognitive performance, learning and memory, long-term potentiation and signaling molecules by physical activities.[1,6,7] Other studies have revealed a lack of increments of cognition in normal or control animals.[8–14]

In addition, investigators have observed that regular physical activities prevent cognitive impairments in sleep-deprived male[14] and female rats.[8–12] Previously, it has been revealed that voluntary exercise can increase the cell proliferation in the hippocampus under estrogen-deprived conditions in female mice.[15] Another study reported that treadmill exercise prevented spatial navigation and aversive memory impairments in ovariectomized rats.[16] It has been revealed that regular physical activity has neuroprotective effects on cognitive deterioration correlated with elderly,[17] neurodegenerative diseases such as Alzheimer's[18] and ischemia.[2] Although physical exercise seems to improve cognitive and brain insult, these studies did not show any effect of exercise on spatial learning and memory, synaptic plasticity, and BDNF mRNA and protein levels in the hippocampus of normal animals.[8–11,13] These findings confirm the notion that maybe different exercise regimens have positive effects on patients with brain insults or disorders (i.e., sleep loss, brain injury, stroke, neuropsychiatric disorders, and neurodegenerative diseases). Some studies have indicated that both voluntary and forced exercises can augment acquisition and preservation in a variety of hippocampus-dependent tasks, and also can increase the trophic factors and other signaling molecules in the hippocampus in otherwise healthy subjects.[6] Therefore, these controversial outcomes may be due to the differences in the length, type, and intensity of the performed exercise paradigms. In addition, the differences in findings may be due to the differences in the sex and species of experimental animals. Also, due to the effects of the sexual cycle and ovarian hormones on structure and functions of the brain, fewer studies have been done in female animals. Therefore, more behavioral, electrophysiological, and molecular studies are necessary in this field with various exercise regimens in both sexes of humans and animals.

REFERENCES

1. Ang ET, Gomez-Pinilla F. Potential therapeutic effects of exercise to the brain. Curr Med Chem 2007;14(24):2564-2571.
2. Ding YH, Luan XD, Li J, Rafols JA, Guthinkonda M, Diaz FG, et al. Exercise-induced overexpression of angiogenic

*Corresponding author: ✉h.saadati@arums.ac.ir

factors and reduction of ischemia/reperfusion injury in stroke. Curr Neurovasc Res 2004 Dec;1(5):411-420.

3. Hakimeh S, Vahid S. Effects of exercise and/or sleep deprivation on anxiety-Like behavior and body weight of female rats. Asian J Psychiatr 2017 Aug;28:26-27.
4. van Praag H, Christie BR, Sejnowski TJ, Gage FH. Running enhances neurogenesis, learning, and long-term potentiation in mice. Proc Natl Acad Sci U S A 1999 Nov;96(23):13427-13431.
5. Aguiar AS Jr, Castro AA, Moreira EL, Glaser V, Santos AR, Tasca CI, et al. Short bouts of mild-intensity physical exercise improve spatial learning and memory in aging rats: involvement of hippocampal plasticity via AKT, CREB and BDNF signaling. Mech Ageing Dev 2011 Nov-Dec;132(11-12):560-567.
6. Cotman CW, Berchtold NC. Exercise: a behavioral intervention to enhance brain health and plasticity. Trends Neurosci 2002 Jun;25(6):295-301.
7. Saadati H, Babri S, Ahmadiasl N, Mashhadi M. Effects of exercise on memory consolidation and retrieval of passive avoidance learning in young male rats. Asian J Sports Med 2010 Sep;1(3):137-142.
8. Saadati H. A Review of protective effects of exercise on cognitive impairments induced by sleep deprivation in female rats. Archives of Neuroscience 2017;4(3):e13250.
9. Saadati H, Esmaeili-Mahani S, Esmaeilpour K, Nazeri M, Mazhari S, Sheibani V. Exercise improves learning and memory impairments in sleep deprived female rats. Physiol Behav 2015 Jan;138:285-291.
10. Saadati H, Sheibani V, Esmaeili-Mahani S, Darvishzadeh-Mahani F, Mazhari S. Prior regular exercise reverses the decreased effects of sleep deprivation on brain-derived neurotrophic factor levels in the hippocampus of ovariectomized female rats. Regul Pept 2014 Nov;194-195:11-15.
11. Saadati H, Sheibani V, Esmaeili-Mahani S, Hajali V, Mazhari S. Prior regular exercise prevents synaptic plasticity impairment in sleep deprived female rats. Brain Res Bull 2014 Sep;108:100-105.
12. Salari M, Sheibani V, Saadati H, Pourrahimi A, khaksarihadad M, Esmaeelpour K, et al. The compensatory effect of regular exercise on long-term memory impairment in sleep deprived female rats. Behav Processes 2015 Oct;119:50-57.
13. Titterness AK, Wiebe E, Kwasnica A, Keyes G, Christie BR. Voluntary exercise does not enhance long-term potentiation in the adolescent female dentate gyrus. Neuroscience 2011 Jun;183:25-31.
14. Zagaar M, Dao A, Alhaider I, Alkadhi K. Regular treadmill exercise prevents sleep deprivation-induced disruption of synaptic plasticity and associated signaling cascade in the dentate gyrus. Mol Cell Neurosci 2013 Sep;56:375-383.
15. Jin J, Jing H, Choi G, Oh MS, Ryu JH, Jeong J-W, et al. Voluntary exercise increases the new cell formation in the hippocampus of ovariectomized mice. Neurosci Lett 2008 Jul;439(3):260-263.
16. Ben J, Soares FM, Scherer EB, Cechetti F, Netto CA, Wyse AT. Running exercise effects on spatial and avoidance tasks in ovariectomized rats. Neurobiol Learn Mem 2010 Oct;94(3):312-317.
17. Pietrelli A, Lopez-Costa J, Goñi R, Brusco A, Basso N. Aerobic exercise prevents age-dependent cognitive decline and reduces anxiety-related behaviors in middle-aged and old rats. Neuroscience 2012 Jan;202:252-266.
18. Radak Z, Hart N, Sarga L, Koltai E, Atalay M, Ohno H, et al. Exercise plays a preventive role against Alzheimer's disease. J Alzheimers Dis 2010;20(3):777-783.