

## Exercise and Brain Volume

Cardiovascular exercise has been associated with improved cognitive functioning in the human brain. (1) One particular study showed that older adults with a lifelong history of cardiovascular exercise had better preserved brains than did age matched sedentary counterparts. (1)

Unfortunately, it may be conceivable that a number of factors influence both brain volume and aerobic fitness. It could even be plausible that older adults who have relatively well preserved brains may be differentially able to maintain participation in a physically active lifestyle, through better preserved cognitive abilities or some other set of genetic or environmental variables that affect both somatic and brain health. (1) The study I reviewed tried to determine if this was the case.

Fifty-nine older (60-79 years old) and twenty younger patients (18-30) who were all right handed and neurologically intact, took part in a 6 month study using aerobic exercise as the intervention. The average age was 66.5 years and 55 % of subjects were female. All tended to be well educated with an average of 13.8 years of education. The aerobic exercise intervention was designed to improve cardiovascular fitness with an exercise intensity prescription derived from peak heart rate (HR) responses to baseline graded exercise testing. Two groups were formed from the older adults (aerobic fitness group and control exercise group) and each group met for 3, 1-hour exercise sessions each week for 6 months. Each group met in different locations to reduce cross over effects. The control group did no aerobic activity, however instead performed whole body stretching exercises.

VO<sub>2</sub> peak was measured via air samples while the subject performed a graded exercise test on a motor driven treadmill. For the 6 months the aerobic group showed an increase of 16.1% in VO<sub>2</sub> peak, whereas the control group only saw a 5.3% change in VO<sub>2</sub> peak and was statistically insignificant.

Also of note was that each subject, including the younger subjects, was examined with a T1 weighted high resolution MRI to acquire a structural image. Two different scanners were used to determine if the machine itself would have any variance in findings. Voxel based morphometry was then used and skull stripping and segmentation into 3D maps of gray matter, white matter, and cerebrospinal fluid occurred. These maps were able to determine the percentage volume change in gray and white matter and the cerebrospinal fluid.

The results from this study showed that previously sedentary older adults in the aerobic exercising group showed a benefit in brain volume in several regions (primarily prefrontal and temporal cortices) after their 6 month participation. The authors concluded that these findings compliment other research on the benefits of exercise on cognition and brain structure such as neuron proliferation and survival, growth of capillary beds, and increased dendritic spines. (1)

Limitations to this study include: small sample size, the exclusionary criteria which limit extrapolation to other populations, and the fact that there are no other studies to compare the relationship between the voxel-based morphology and underlying cellular changes that might occur to determine if the changes in brain volume are indeed due to synaptic interconnections, axonal integrity, and capillary bed growth. (1)

Reference:

1) Colcombe SJ, Erickson KI, Scalf PE, et al. Aerobic Exercise Training Increases Brain Volume in Aging Human. *Journal of Gerontology*. 2006; 61A (11): 1166-1170.