

## INTRODUCTION

Executive functioning and the cortical volume of corresponding brain regions have been shown to decline with aging. Although there is an emerging body of evidence suggesting that higher aerobic fitness (VO<sub>2</sub> max, maximal amount of oxygen consumed) may be related to improved executive functioning in older adults, there is a paucity of human-derived data regarding the potential mechanisms linking aerobic fitness to the functional anatomy of the brain. Previous studies suggest that there is an age-related decline in cerebral white matter (WM) integrity; thus, individual differences in aerobic fitness may be associated with differing levels of WM integrity, which may in turn have implications for preserved cognitive function. Diffusion Tensor Imaging (DTI) can provide detailed delineation of WM pathways based on rates of microscopic water diffusion. A higher degree of WM integrity is reflected in a greater degree of fractional anisotropy (FA) of diffusion. Prior research has shown an age-related decline in FA, particularly in the prefrontal regions. **Therefore, the purpose of this study was to determine if individual differences in aerobic fitness would be associated with variation in WM integrity, independently of age and gender, in selected regions of interest (ROIs).**

## METHOD

### Participants

Thirteen younger (20-28 years; 24 ± 3 years) and 15 older (63-78 years; 69.6 ± 4.7 years) neurologically intact (MMSE = 29.6 ± 0.6) adults participated in this study.

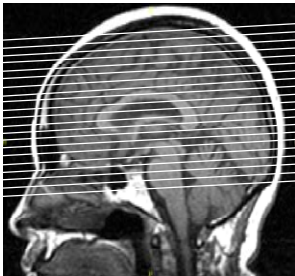
### Diffusion Tensor Imaging:

Magnetic resonance imaging was conducted at 4T. In the diffusion tensor sequence, we acquired 30 contiguous near-axial slices parallel to the AC-PC, 3.8 mm thick; TR = 30000; per slice, diffusion measured in 6 directions (b = 1000 sec/mm<sup>2</sup>) plus one image with no diffusion weighting (b = 0); five signal averages. Diffusion tensor eigenvalues were calculated from custom MATLAB scripts.

### Structural Imaging:

3D fast IRP SPGR sequence, 60 contiguous slices, parallel to AC-PC, 1.9 mm thick.

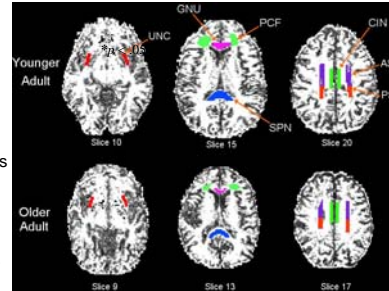
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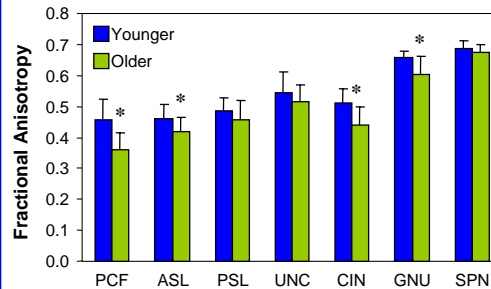
## REGIONS OF INTEREST

ROIs were drawn directly on the diffusion tensor images on a slice-by-slice basis for each participant, using the high-resolution SPGR images as a reference.

ROIs included the genu (GNU) and splenium (SPN) of the corpus callosum, anterior (ASL) and posterior (PSL) regions of the superior longitudinal fasciculus, uncinate fasciculus (UNC), pericallosal frontal (PCF) and the cingulum (CIN).



## Age Differences in Fractional Anisotropy



Significantly lower mean FA for older adults than younger adults in the PCF, ASL, CIN, and GNU.

\* p < .05

## AEROBIC FITNESS

### ESTIMATED AEROBIC FITNESS (VO<sub>2</sub> max)

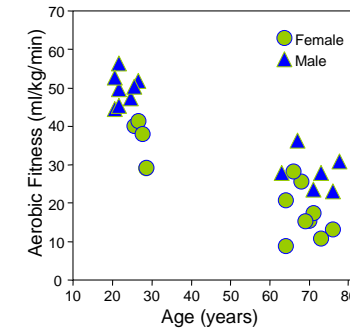
$$VO_{2\max} \approx 56.363 - (0.381 * \text{age}) + (1.951 * \text{PAS}) - (0.754 * \text{BMI}) + (\text{gender} * 10.987)$$

where:

- ❖ Gender: 0 = women; 1 = men
- ❖ BMI = body mass index = weight (kg) / (height in meters)<sup>2</sup>
- ❖ PAS = physical activity scale self-rating from 0 to 7 (mean = 4)
  - ❖ No regular participation in recreational sport or heavy physical activity (0-1)
  - ❖ Regular participation in recreation or work requiring modest physical activity (2-3)
  - ❖ Regular participation in heavy physical exercise (4-7)
- ❖ Equation Validity: n = 2,007; 18 – 70 yrs; R = 0.78; SE = 5.6 ml/kg/min

Reference: Jackson AS, Blair SN, Mahar MT, et al.(1990). Prediction of functional aerobic capacity without exercise testing. *Med. Sci. Sports Exerc.*, 22:863-870.

## Effects of Age and Gender on Aerobic Fitness

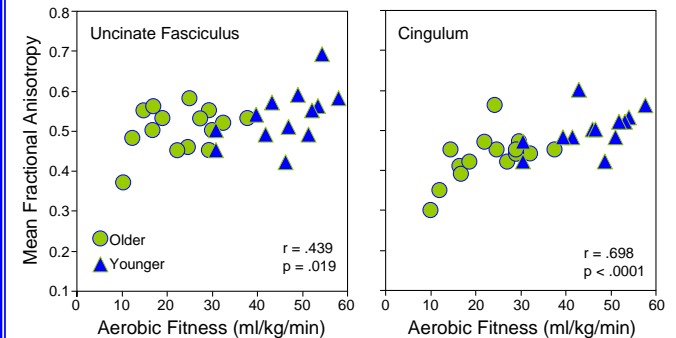


**Regression ANOVA Model 1**  
(Including age group, gender, and their interaction as predictors of aerobic fitness):  
df = 3, 24; F = 51.9, p < .0001

Significant Main Effects:  
Age: t Value: - 9.46, p < .0001  
Gender: t Value: - 5.88, p < .0001

No significant interaction

## Raw Correlation Between Fractional Anisotropy and Aerobic Fitness



## CONCLUSIONS

- Covarying for age and gender, significant (p < .05) positive correlations remained between aerobic fitness and FA in the UNC and CIN.
- Stepwise Linear Regression revealed that the unique contribution of aerobic fitness to the FA in the UNC was 15% and its contribution to the FA in the CIN was 13%.
- Although these preliminary findings suggest that increased VO<sub>2</sub>max is associated with greater WM integrity in select ROIs independently of age and gender, the results should be viewed with caution due to potential influence of outliers in such a small study sample.
- Larger sample sizes and direct VO<sub>2</sub> max measurement are suggested.