Active Lifestyle is Associated with Better Brain Function in Persons Living with HIV

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Introduction

- ✧Antiretroviral therapy can promote a longer lifespan by preventing further viral DNA integration.
- ✧Viral Reservoirs can persist in virally suppressed HIV+ individuals and act as chronic suppliers of viral antigen for decades.
- ✧On average, PLWH have reduced physical exertion and a reduction in active lifestyles.
- ✧Sedentary individuals typically have increased CVD risk.
- ✧A reduction in physical function may affect both brain function and structure in PLWH.

Aims

- ✧We evaluated whether physical fitness (as measured by vO2 maximum). Relates to metrics of brain structure (diffusion tensor imaging (DTI)) and function arterial transit time (ATT)).

ASL Methods / Statistics

- ✧ In-house scripts were used to process the arterial transit time.
- ✧ Arterial transit time (ATT) was estimated by calculating the ASL signal difference as a function of the post-labeling delay.[1]
- ✧ ATT was estimated for each of the cortical Freesurfer (v5.3) regions.
- ✧ Associations between ATT and Max vO2 were calculated with a significance at p=0.05.

Scan Sequence

- ✧3D Turbo GRASE pCASL and acquired with six post-labeling delays from 1.0s to 2.5s in increments of 300 ms. For the 1.0s PLD sequence, TR=3130 ms, TE=35.94, flip angle=120 deg, A-P phase encoding, FOV=218 mm, Resolution: 3.4 x 3.4 x 4.8 mm.
- ✧Diffusion Imaging sequence contained 23 directions with multiple bval's and one b0.

	HIV
N	41
Gender: %Male	80%
Age M(SD)	56.6 (5.5)
Education M(SD)	13.3 (2.5)
Ethnicity C/AA/A	27/13/1
Viral Load	<200
CD4 Nadir M(IQR)	192.1 (25,313)
Recent CD4 M(IQR)	671.48(492,834)
CVD Risk (10yrs) M(SD)	18.1(10.6)

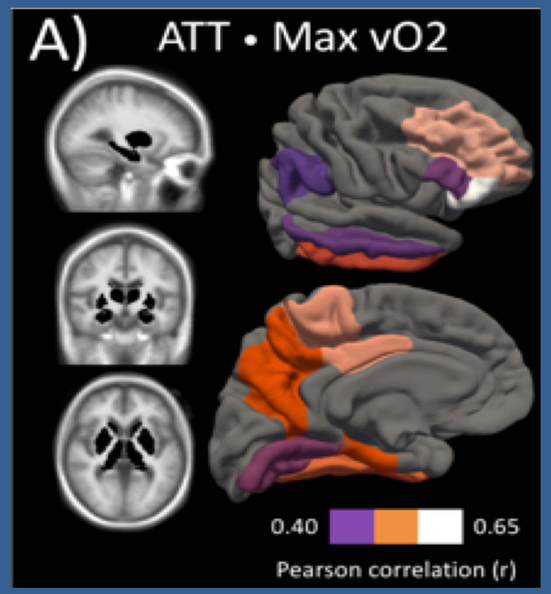


Figure 1: Significant regions are highlighted visualized by the strength of the r-value. This includes motor regions, temporal regions and rostral middle frontal.

Results

- ✧Faster arterial transit time (ATT) associated with worse max v02.
- ✧Decreased structural integrity was seen in individuals with lower vO2 max.
- ✧Diffusion basis spectrum imaging (DBSI) revealed that Increased edema was observed with individuals with lower vO2 max.
- ✧Metrics of inflammation did not associate with the max vO2.
- ✧Clinical HIV variables did not associate max vO2.
- ✧The white matter tracks that associated with decreased vO2 max project to similar regions that had faster ATT.

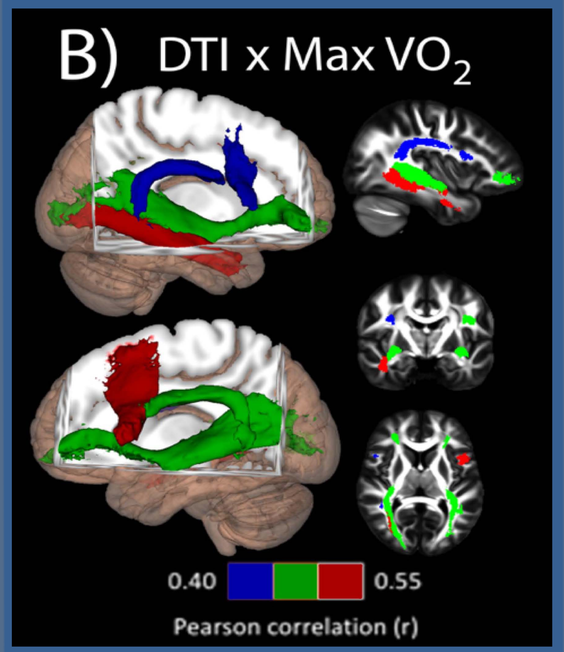


Figure 3: White matter tracts that significantly associated with max vO2.

DTI/DBSI Methods

- ✧Correction for motion and eddy current distortions followed by skull stripping using FSL 5.0.4.
- ✧Fractional Anisotropy (FA) maps were generated with DTIFIT.
- ✧Tract Based Spatial Statistics was performed with a skeleton of 2.5 threshold.
- ✧White matter track ROI's were overlaid onto the skeletal voxels
- ✧All FA values within each of the tracts were averaged together to create a summarized FA for all connections between the structurally connected ASL regions.
- ✧In addition to DTI metrics we estimated metrics of inflammation and edema using Diffusion Basis Spectrum Imaging (DBSI) with in-house processing methods.[2]
- ✧DBSI is a multiple tensor model that provides insight into the underlying mechanisms that can impact white matter integrity.

Summary

- ✧Atherosclerosis is known to occur in both HIV and in sedentary individuals which can lead to increased ATT.
- ✧Atherosclerosis and edema are both pathologically associated with inflammation.
- ✧Subtle inflammation can persist in HIV and maintaining a healthier lifestyle may improve brain integrity.
- ✧Further work is needed to determine if HIV + sedentary lifestyle exacerbate these changes in structure and function.

Funding

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References: 1. Dai W., Robson PM et al. A reduced Resolution Transit Delay Prescan for Quantitative Continuous Arterial Spin Labeling Perfusion Imaging.
2. Strain J., Burdo TH et al., Diffusion Basis Spectrum Imaging Detects Ongoing Brain Inflammation in Virologically Well Controlled HIV+ Patients.

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