Poster #: 0396

Effects of Viral Load on Neuroimaging and Neuropsychological Performance

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Background

- Viral load (VL) is often used as a proxy for the efficacy of HIV treatment, and viral suppression is considered a primary goal of treatment.
- Virologic control/suppression is often defined differently across studies. Some research studies combine people living with HIV (PLWH) who have and have not achieved "viral suppression".
- Effects of different levels of virologic control on brain integrity are not well-established.

Aims

- To compare brain volumetrics and cognition between HIV- controls and PLWH at various levels of virologic control (viral suppression (≤ 20 copies/mL), low level viremia (21-200 copies/mL), and virologic failure (> 201 copies/mL)).

Methods

- Participants:
  - 195 HIV- controls and 349 PLWH on antiretroviral therapy (ART)
- Neuroimaging:
  - Magnetic resonance imaging (MRI) completed on 3T Siemens Tim Trio scanner or 3T Siemens Prisma scanner
  - Scans were processed using FreeSurfer v5.3.0
  - Regional brain volumes were generated using Desikan-Killiany atlas
  - Volumes were corrected for age, sex, intracranial volume, and scanner, then transformed into Z-scores
  - Cortical region Z-scores averaged into lobes; subcortical region Z-scores were also examined
- Neuropsychological (NP) testing:
  - 15 test were included in the cognitive battery
  - Raw test scores were transformed into demographically-corrected (age, sex, race, education) Z-scores
  - Z-scores were averaged into 5 domains: Learning (L), Delayed Recall (DL), Executive Functioning (EF), Psychomotor/Processing Speed (PS), and Language
  - Domain Z-scores were averaged into a Global Z-score
- Statistical analyses:
  - PLWH participants were divided into categories based on viral load[1]
  - Group differences in cortical and subcortical brain volume Z-scores, and NP Z-scores, compared using general linear models
  - Post-hoc Tukey's tests were performed to identify group differences (Bonferroni correction)
  - Spearman correlations compared brain volumes and NP scores

Group classifications

	Viral load (VL)
Healthy controls (**HIV-**)	Not applicable (n/a)
Virologic suppression (**VS**)	VL ≤20 copies/mL
Low level viremia (**LL**)	20 copies/mL < VL ≤ 200 copies/mL
Virological failure (**VF**)	VL >200 copies/mL

Results

Table 1: Participant demographic and clinical characteristics

	HIV- (n=195)	VS (n=206)	LL (n=63)	VF (n=80)	P-value
Age in years; mean (SD)	38.1 (17.7)	49.4 (13.9)	47.9 (16.3)	35.8 (15.3)	**<.001**
Sex (% males)	48%	75%	75%	84%	**<.001**
Race (% AA)	57%	66%	63%	79%	.07
Education in years; mean (SD)	13.7 (2.0)	13.2 (3.2)	13.5 (2.7)	13.0 (1.8)	.08
Recent CD4 T-cell count; median (IQR)	-	638 (471,816)	522 (360,685)	297 (172,437)	**<.001**
Nadir CD4 T-cell count; median (IQR)	-	213 (36,343)	111 (55,251)	256 (90,387)	.05

Figure 1. Cortical brain volumes by group

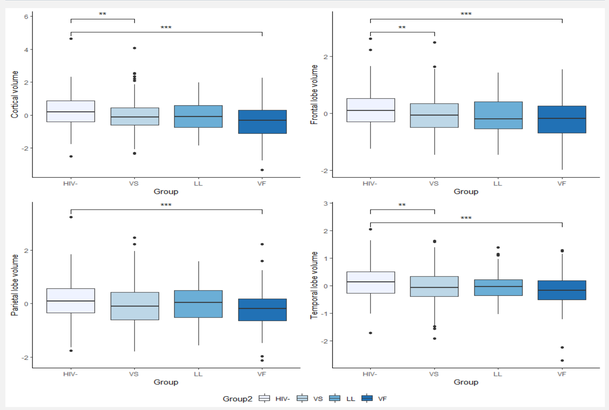
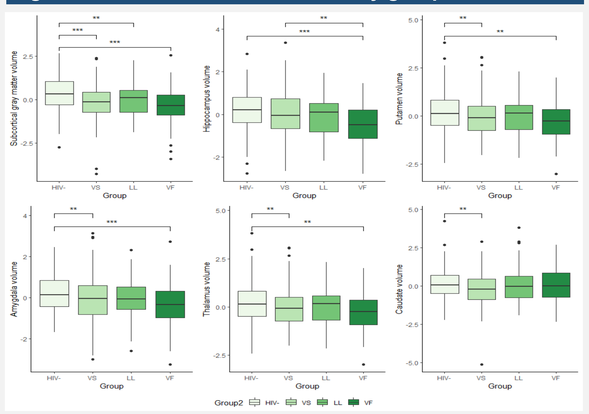
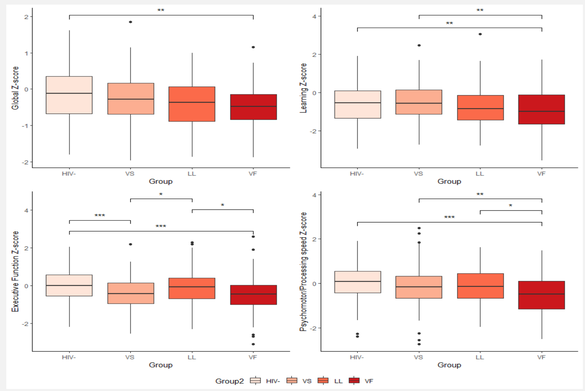


Figure 2. Subcortical brain volumes by group



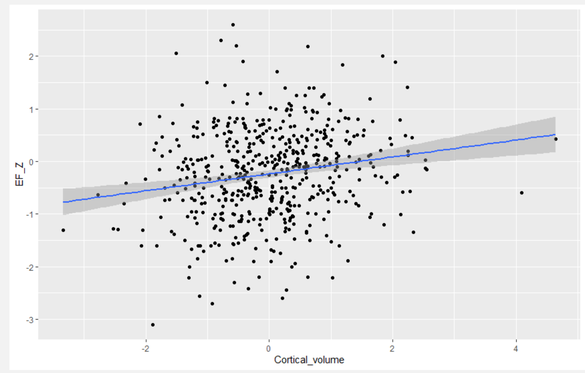
- **Cortical volumes**: The omnibus tests for cortical, frontal lobe, parietal lobe, and temporal lobe volumes were significant (p-values<.01) (**Figure 1**).
  - HIV- group had significantly larger cortical volumes compared to the VS and VF groups
  - No significant differences were observed between PLWH groups.
- **Subcortical volumes**: Omnibus tests for total subcortical gray matter hippocampus, putamen, amygdala, thalamus and caudate volumes were significant (p-values<.01) (**Figure 2**).
  - The IV- group had significantly larger volumes compared to the VF group
  - Only one significant difference was observed between VS and VF groups (hippocampus)
- **Neuropsychological testing:** Omnibus tests for learning, executive functioning, psychomotor/processing speed, language, and global Z-scores were significant (p-values<.01) (**Figure 3**).
  - HIV- controls exhibited significantly better cognitive performance compared to VF
  - VS exhibited significantly better performance on tests of Learning and Psychomotor Speed compared to VF
  - LL exhibited significantly better performance on tests of Executive Function and Psychomotor Speed compared to VF

Figure 3. Global and domain NP by group



- Larger volumes of both total cortical and total subcortical gray matter significantly correlated with better Executive Function, Psychomotor Speed, and global cognition Z-scores (p-values<.01) across all groups. (**Figure 4**).

Figure 4. Relationship between cortical volume and executive functioning



Conclusions

- Results suggest an effect of HIV on cognition and brain volumes, both cortical and subcortical, but little evidence of a significant effect of viral load
  - Differences were observed primarily between HIV-controls and VF group, with few differences between viral load groups of PLWH
  - Brain volumes and cognition were significantly associated, suggesting that lower cognitive performance in PLWH compared to HIV- controls may relate to loss of brain volume
- A lack of significant VL effect may signify that other factors are more critical in HIV, including initiation soon after seroconversion and continuation of cART, cardiovascular health, management of comorbidities, etc.
- Longitudinal studies are needed to assess these factors compared to changes and "blips" in viral load in determining brain integrity in PLWH

References

1. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in adults and adolescents living with HIV. Department of Health and Human Services.

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