Prevalence and correlates of white matter hyperintensities in Royal Canadian Airforce pilots and aircrew

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Background

A recent series of studies examining White matter hyperintensities (WMH) of presumed vascular origin in USA Air Force U-2 pilots found higher WMH burden was associated with lower cognitive performance in otherwise healthy, high-functioning individuals [1-3].

Purpose

To present preliminary findings for a study that will examine the prevalence and correlates of WMH in Royal Canadian Airforce (RCAF) Pilots and aircrew.

Image courtesy of the Department of National Defence

Fig. 1 Royal Canadian Airforce CF18M Armed Fighter Jet, service ceiling of 48,000 feet altitude and can reach MACH 1.8 and fight up to 7.5G.

Discussion

These preliminary results suggest that increases in WMH volume, potentially due to occupational exposure to low ambient pressures from high altitude operations, may be associated with subtle cognitive impairment.

In order to further elucidate the potential pathological mechanisms involved, future results will include analyses of the cardiac bubble saline contrast echo, blood proteomics, and relative comparisons with the overall larger NATO working group collaboration.

Methods

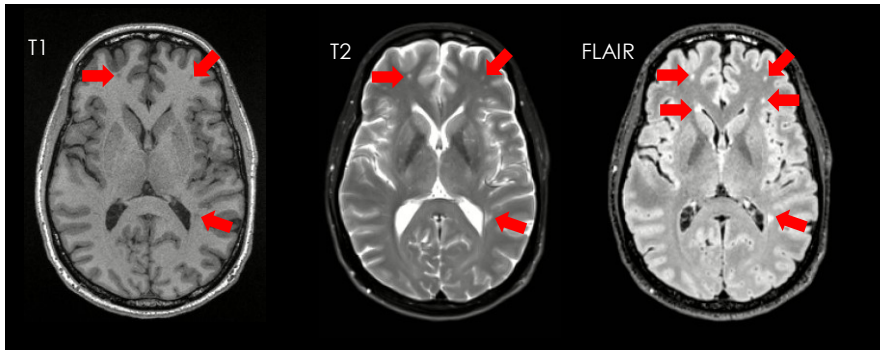

Fig. 2 (Left to right) Co-registered T1, T2, and fluid attenuated inversion recovery (FLAIR) MRI acquired from an RCAF military study participant. Red arrows point to WMH, note the difference in visibility and relative intensity differences between MRI acquisitions: WMH appear iso-intense to gray matter and cerebrospinal fluid (CSF) on T1 (darker), isointense (but bright) to CSF on T2, and hyperintense on FLAIR.

Our goal is to enroll N=50 RCAF study participants with anticipated exposure to low ambient pressures. Test protocol includes: cognitive measures, standard lab tests, cardiac bubble contrast echo, blood proteomic analysis, and MRI. The following preliminary results are based on the currently acquired sub-sample of N=30

Preliminary Results

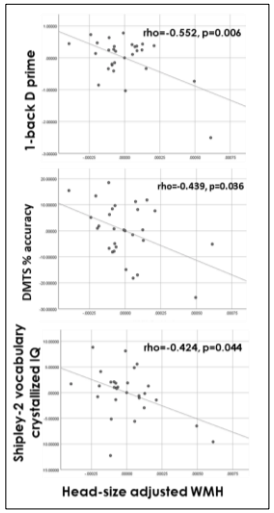

Fig. 3. Plots of the residuals to illustrate the statistically significant Spearman rho partial correlations between cognitive measures and head-size adjusted WMH volumes.

Negative correlations were demonstrated between head-size adjusted WMH volumes and N-back test performance (1-back D prime: rho=-0.552, p=0.006), delayed-matching-to-sample test performance (DMTS % accuracy: rho=-0.439, p=0.036), and the Shipley-2 vocabulary crystallized IQ (standard score: rho=-0.424, p=0.044), after controlling for Framingham risk, depression (~BDI), metabolic syndromes (BP, glucose, HDL, etc.), inflammation (hs-CRP), and mild traumatic brain injury.

References

1. McGuire et al. (2014). *Neurology.*
2. McGuire et al. (2016). *Aerosp Med Hum Perform.*
3. McGuire et al., (2018), *Human Brain Mapping.*

Acknowledgements

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