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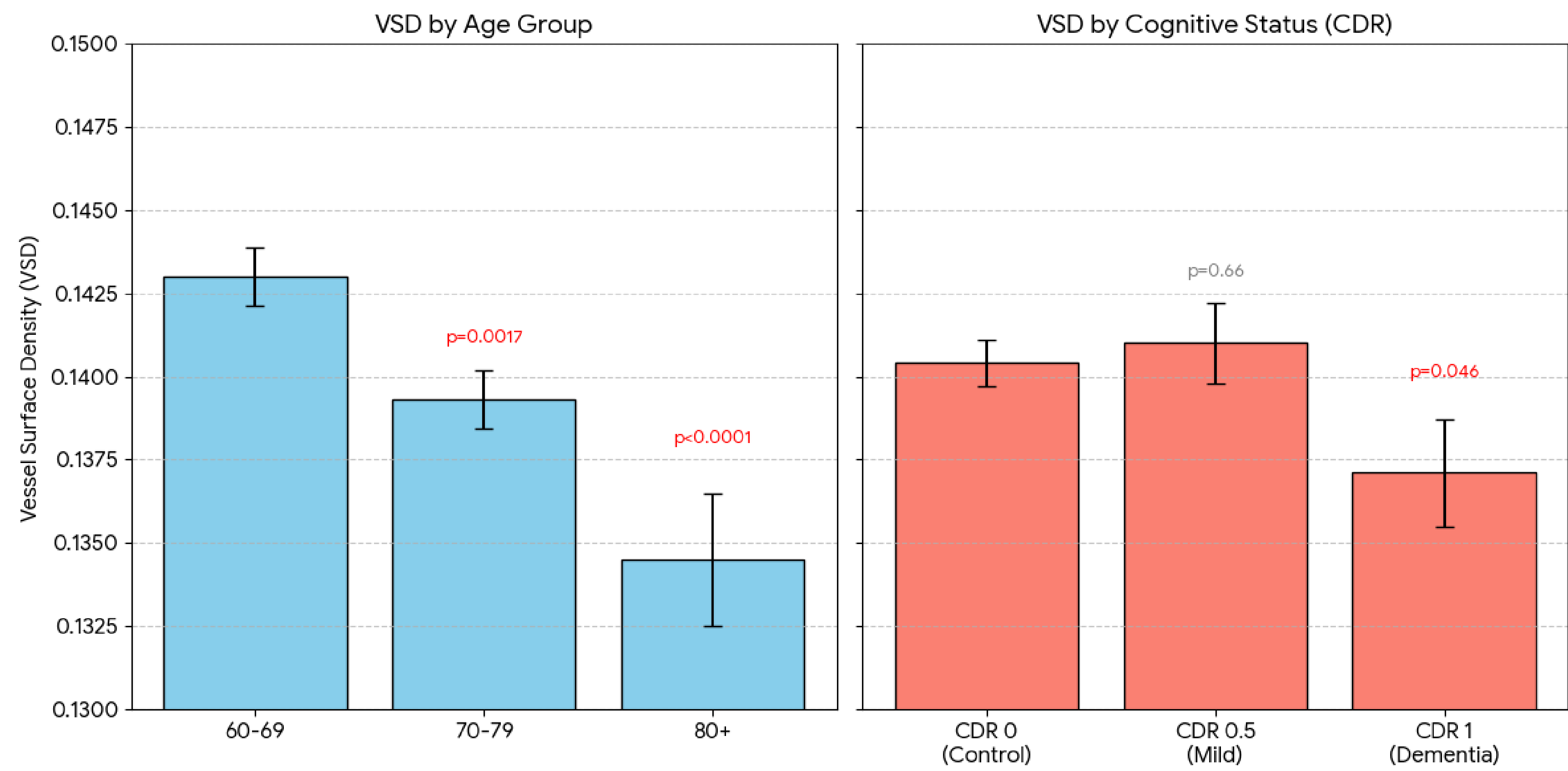
BACKGROUND

- Vascular cognitive impairment and dementia (VCID) is characterized by regionally patterned microvascular injury rather than uniform global dysfunction.
- Optical coherence tomography angiography (OCTA) has shown that reduced retinal capillary perfusion correlates with decline in processing speed and fluid cognition and MRI markers of neurodegeneration.
- This study investigated whether retinal capillary perfusion (µm resolution) is associated with a novel measure of cerebral small blood vessel density derived from high-resolution black-blood MRI (iso-0.5 mm spatial resolution).

METHODS

- We enrolled 115 multiethnic participants (mean age 71 ± 5.9 years; 61% female; 40% had diabetes).
- Fovea-centered 3×3 mm² OCTA images were obtained (218 eyes) using a swept-source OCTA device to quantify retinal vessel skeleton density (VSD) using a semi-automated MATLAB pipeline.
- Cerebral vessel density images (VDIs) were derived from 3T black-blood MRI using a T1-weighted turbo spin-echo sequence with variable flip angles.
- An automated pipeline incorporating nnU-Net based vessel segmentation quantified VDI globally and across cortical lobes.
- Generalized estimating equations assessed associations between superficial retinal VSD and regional VDIs normalized by their global mean values.

Figure 1. Least-square means of retinal VSD by participants’ age and global CDR score adjusted for age and gender.

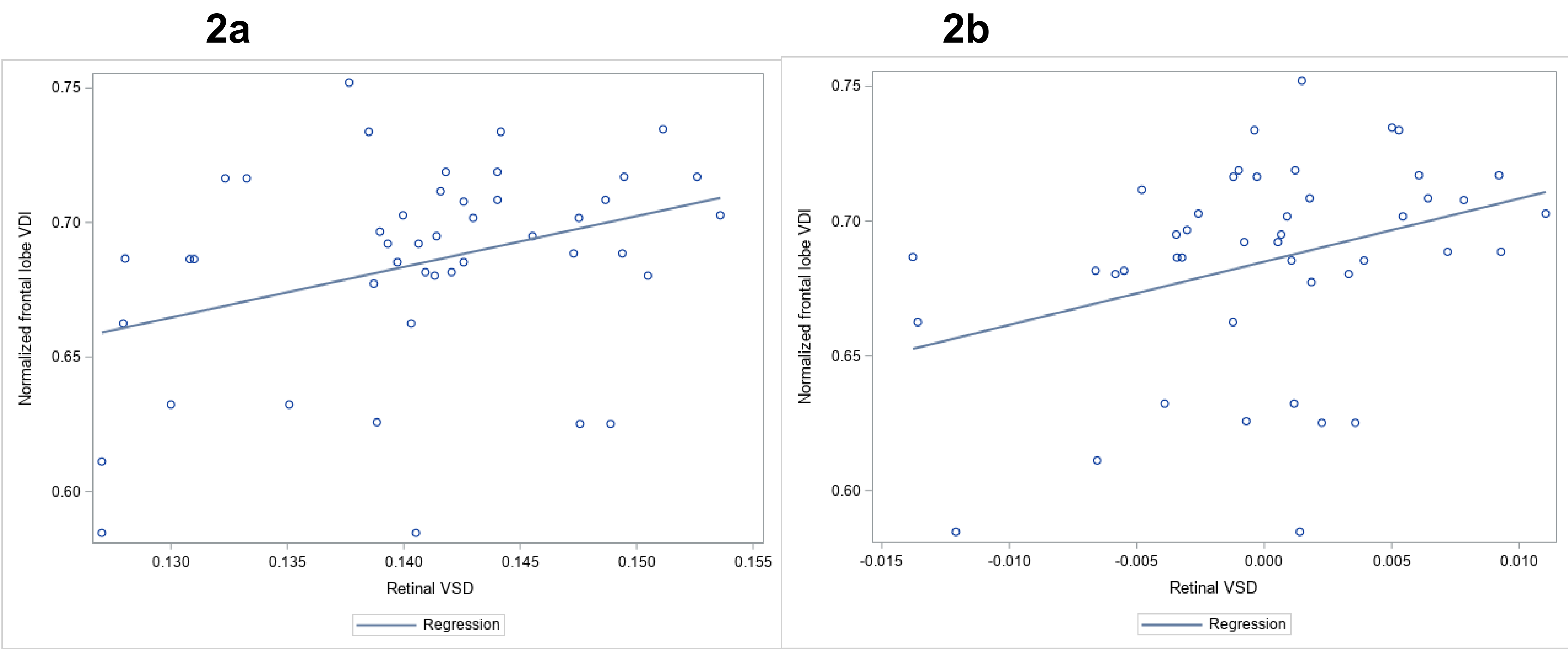


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RESULTS

- The cohort included 30 African Americans, 29 Asians, 11 non-Hispanic White, and 45 Latinx.
- Retinal VSD was significantly lower in older participants and those with higher global Clinical Dementia Rating (CDR) scores.
- Normalized regional VDIs were highest in the occipital lobe (1.114 ± 0.063) and lowest in the frontal lobe (0.686 ± 0.035).
- While retinal VSD did not correlate with global cerebral VDI, it was positively associated with normalized parietal lobe VDI ($\beta = 0.019$, $P = 0.015$); however, this association was attenuated after adjusting for age.
- Notably, among participants with global CDR >0, retinal VSD was positively associated with normalized frontal lobe VDI ($\beta = 0.067$, $P = 0.026$). This relationship remained after adjusting for age ($\beta = 0.048$, $P = 0.067$) and further adjustment for diabetes and blood pressure ($\beta = 0.063$, $P = 0.0027$).

Figure 2. Scatter plots of normalized frontal-lobe VDI by retinal VSD among subjects with global CDR >0 (2a) with and (2b) without adjusting for age, diabetes, and blood pressure.



CONCLUSIONS

Retinal capillary density measured by OCTA reflects regional cerebral microvascular integrity, specifically in the frontal lobe, independent of global vascular burden.

These findings support retinal perfusion as a promising noninvasive biomarker for region-specific cerebral microvascular dysfunction in early VCID.

FINANCIAL DISCLOSURES Ruikang Wang: Commercial relationships: Patent—Kowa Inc, consultant/contractor—Insight Photonic Solutions, Patent—Carl Zeiss Meditec, consultant/contractor—Carl Zeiss Meditec. Amir H. Kashani: Consultant/contractor—Carl Zeiss Meditec, recipient—Carl Zeiss Meditec. The other authors have no proprietary or commercial interest in any materials discussed in this poster.