



Race/ethnicity and socioeconomic-based analysis of vascular alterations on optical coherence tomography angiography (OCTA) in patients with diabetes

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Objective

To investigate microvascular differences between racial and ethnic groups in patients with and without diabetes using optical coherence tomography angiography (OCTA)

Introduction

- Racial and ethnic minorities have a higher prevalence of diabetic retinopathy (DR) and present at advanced stages.¹⁻³
- Previous studies have measured DR in racial/ethnic groups using OCTA. However, neither included adjustments for socioeconomic (SES) factors.^{4,5}
- Our study intended to quantify any microvascular variations between racial/ethnic groups in the context of their socioeconomic status.

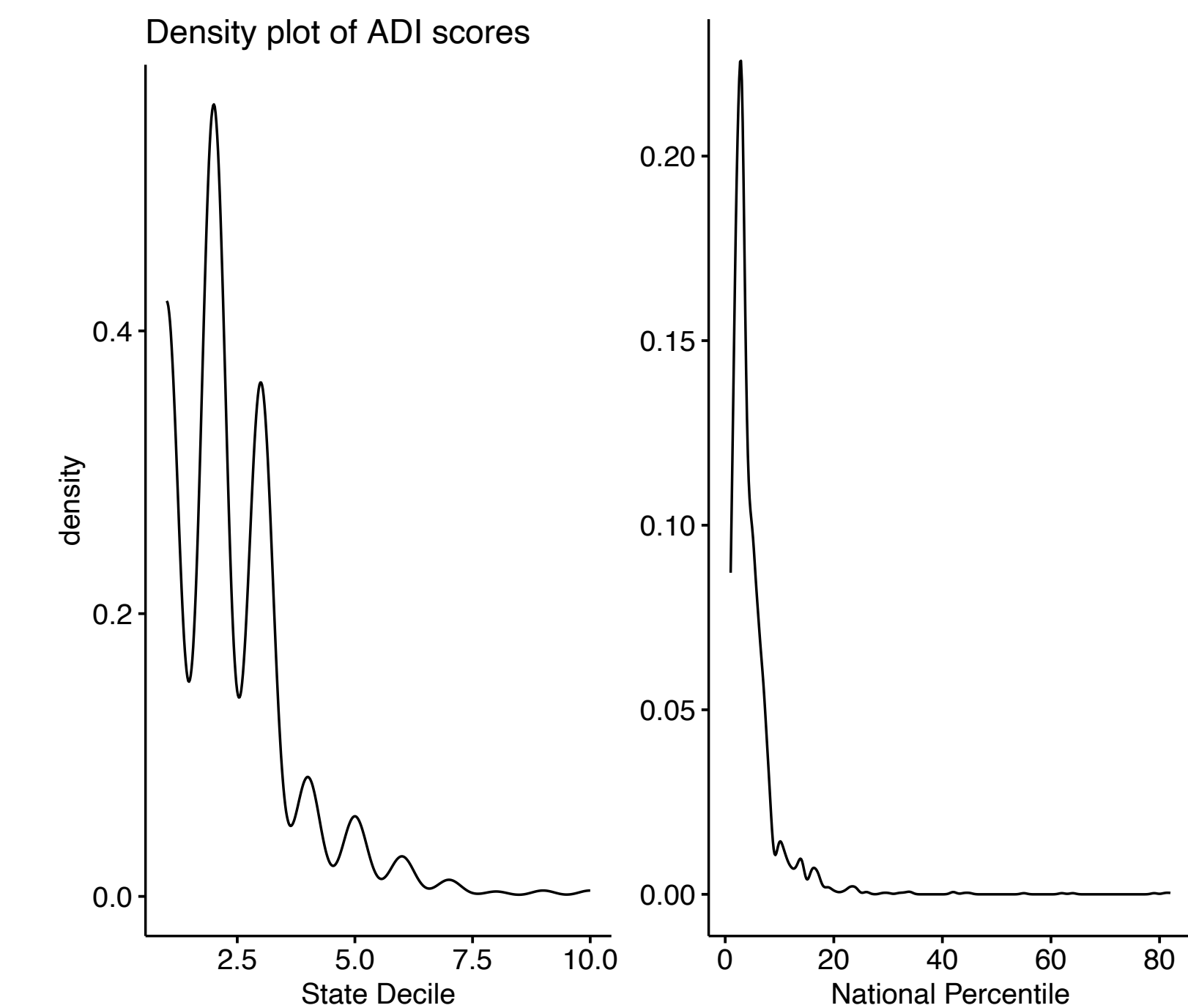
Methods

- Study design:** Cross-sectional.
- Participant selection:** Urban underserved patient population with diabetes of all severity levels.
- Imaging:** 3x3mm OCTA macula scans without significant motion or shadow artifact, with signal strength index (SSI) of >7.
- Image analysis:** Conducted on the superficial capillary plexus, deep capillary plexus, and foveal avascular zone either by proprietary machine software or by ImageJ.
- Outcomes:**
 - Foveal avascular zone (FAZ) area, perimetry
 - Parafoveal vessel density (VD) and vessel length density (VLD)
 - Flow index (FI)
- Data analysis:** Multivariable linear regression was used to adjust estimates for potential confounders of age, sex, SSI, hypertension, duration of disease, and HbgA1c (when available).
- Race/ethnicity term and ADI scores were added to the regression models only if the ANOVAs comparing two models were significantly different P <0.001.
- “Hispanic” was used as reference group.
- P <0.001 was designated statistically significant.

Results

All Diabetics			
Term	Estimate	CI_95	P.value
FAZ area			
NH Asian	-0.013	(-0.026, 0)	0.048
NH Black	0.007	(-0.013, 0.028)	0.485
NH White	-0.100	(-0.119, -0.081)	0.000
Other	-0.028	(-0.043, -0.014)	0.000
FAZ perimeter			
NH Asian	-0.061	(-0.12, -0.003)	0.041
NH Black	0.065	(-0.028, 0.159)	0.169
NH White	-0.406	(-0.495, -0.318)	0.000
Other	-0.135	(-0.201, -0.069)	0.000
SUP AFI			
NH Asian	-0.013	(-0.017, -0.009)	0.000
NH Black	-0.004	(-0.011, 0.002)	0.155
NH White	0.000	(-0.006, 0.006)	0.919
Other	-0.003	(-0.007, 0.001)	0.181
DEEP VD			
NH Asian	0.566	(0.288, 0.843)	0.000
NH Black	0.727	(0.286, 1.167)	0.001
NH White	1.227	(0.811, 1.643)	0.000
Other	0.392	(0.081, 0.703)	0.014
DEEP VLD			
NH Asian	0.089	(0.004, 0.174)	0.041
NH Black	0.204	(0.069, 0.339)	0.003
NH White	0.362	(0.234, 0.489)	0.000
Other	0.132	(0.037, 0.228)	0.006

Non-diabetics			
Term	Estimate	CI_95	P.value
FAZ area			
NH Asian	-0.002	(-0.041, 0.037)	0.930
NH Black	0.044	(-0.018, 0.106)	0.163
NH White	-0.089	(-0.128, -0.05)	0.000
Other	-0.001	(-0.049, 0.047)	0.958
FAZ perimeter			
NH Asian	0.004	(-0.159, 0.167)	0.961
NH Black	0.194	(-0.064, 0.451)	0.140
NH White	-0.325	(-0.486, -0.164)	0.000
Other	-0.025	(-0.225, 0.175)	0.808
Summary Characteristics		Diabetics	Non-diabetics
Severity, n			
No DR		1496	
Mild NPDR		311	
Moderate NPDR		141	
Severe NPDR/PDR		52	
Age, mean years (std)		55.3 (11.1)	53.2 (14.4)
Sex, male n (%)		1005 (50.4%)	105 (46.3%)
HTN, %		59.5	36.6
Male		59.5	39.6
Female		59	34.1
HbgA1c, %(std)			
Male		8.42 (4.09)	
Female		7.85 (1.87)	
Duration of disease, years (std)			
Male		7.07 (6.71)	
Female		7.76 (6.80)	
Race/ethnicity, N(%)			
Hispanic		871 (43.7%)	82 (36.1%)
NH Asian		487 (24.4%)	55 (24.2%)
NH Black		137 (6.9%)	14 (6.2%)
NH Caucasian		163 (8.2%)	50 (22.0%)
Other		335 (16.8%)	26 (11.5%)



Conclusions and Future Directions

- In diabetic and non-diabetic patients, there exist microvasculature differences between racial / ethnic groups as measured by OCTA.
- These differences are more prominent between self-identifying Hispanic and NH White patients.
- In our urban population, SES scores did not affect any of the racial differences that existed.
- Further studies should investigate whether these differences are also present when “NH White” group is used as a comparator.
- Albeit statistically significant, further investigation is needed to determine whether these differences are meaningful enough to change clinical DR practices

Takeaway...

Overall, non-Hispanic White patients had smaller FAZ metrics and greater vessel densities in the deep choroid plexus.

References

- Coney JM, Scott AW. Racial disparities in the screening and treatment of diabetic retinopathy. *J Natl Med Assoc.* 2022;114(2):171-181. doi:10.1016/j.jnma.2021.12.011
- Alvarez-Ramos P, Jimenez-Carmona S, Alemany-Marquez P, Cordoba-Doña JA, Aguilar-Diosdado M. Socioeconomic deprivation and development of diabetic retinopathy in patients with type 1 diabetes mellitus. *BMJ Open Diabetes Res Care.* 2020;8(2):e001387. doi:10.1136/bmjdr-2020-001387
- Low JR, Gan ATL, Fenwick EK, et al. Role of socio-economic factors in visual impairment and progression of diabetic retinopathy. *Br J Ophthalmol.* 2021;105(3):420-425. doi:10.1136/bjophthalmol-2020-316430
- Laotaweerungsawat P, Psaras C, Haq Z, Liu X, Stewart JM. Racial and ethnic differences in foveal avascular zone in diabetic and nondiabetic eyes revealed by optical coherence tomography angiography. Vavvas DG, ed. *PLOS ONE.* 2021;16(10):e0258848. doi:10.1371/journal.pone.0258848
- Chun LY, Silas MR, Dimitroyannis RC, Ho K, Skondra D. Differences in macular capillary parameters between healthy black and white subjects with Optical Coherence Tomography Angiography (OCTA). Vavvas DG, ed. *PLOS ONE.* 2019;14(10):e0223142. doi:10.1371/journal.pone.0223142

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