Racial Differences in Visual Outcomes in Patients with NMOSD and MOGAD

Jaklin Gukasyan, BA[1], Kimberly Gokoffski, MD[2], Alexander Brandt, MD[3], Lilyana Amezcua, MD[4]

[1]Keck School of Medicine (KSOM), [2]KSOM Department of Ophthalmology, [3]UC Irvine School of Medicine, Department of Neurology, [4]KSOM Department of Neurology

Background

Neuromyelitis optica spectrum disorder (NMOSD), myelin oligodendrocyte glycoprotein antibody disorder (MOGAD), and multiple sclerosis (MS) are central nervous system demyelinating diseases that commonly cause optic neuritis (ON), resulting in painful loss of central vision, peripheral vision, contrast sensitivity, and color vision (1). Studies show that African Americans with MS have faster retinal damage, accelerated retinal nerve fiber loss and ganglion cell/inner plexiform layer thinning, and have greater impaired vision than Whites at baseline as measured by high contrast visual acuity (2). While Hispanics/Latinx are reported to have a lower risk for MS (3), they develop MS at a younger age (4) and more often present with optic neuritis compared to Whites (5). Whether these health disparities seen in MS by race and ethnicity also exist in NMOSD and MOGAD is unknown and whether these differences stem from social disadvantage is also less clear.

Objective/Hypothesis

- Characterize the impact of race/ethnicity on visual outcomes in NMOSD and MOGAD, while considering social determinants of health.
- We hypothesize that race/ethnicity will independently affect visual outcomes in NMOSD and MOGAD.

Methods

- Retrospective study conducted on patients at Keck Hospital and LAC+USC County hospital who have been diagnosed with NMOSD or MOGAD.
- Demographic information, disease history, and variables describing visual function (e.g., eye exam, color plate testing, and ocular coherence tomography (OCT) results within a 5-year disease history) were collected. Estimated household median income was collected using zip code tabulation areas (ZCTA) from the 2015-2019 American Community Survey (ACS) 5-year estimates and Social Deprivation Index (SDI), developed by the Robert Graham Center, was collected for each patient using ZCTAs.
- We analyzed visual outcomes in three cross-sectional time points:
  1. *Baseline*: Earliest time point, within a 5-year disease history, that is at least 6 months after the onset of an ON attack.
  2. *Most Recent*: Most recent documented timepoint.
  3. *Acute Attack*: Timepoint that is within a month of the first documented attack of ON.
- For "Baseline" and "Most Recent" time points, both eyes were analyzed using mixed-effects models with R package lme4. For the "Acute Attack" time point, only the eye that had a worse presentation as determined by visual acuity (VA) was analyzed.

Results

Table 1: Demographics

Item	Frequency (N=62) Hispanic	Black	Asian	White	Total (N=62)	p-value
Race/Ethnicity	39 (62.9%)	6 (9.7%)	13 (20.9%)	4 (6.5%)	62 (100%)	
Health Insurance						
Private	15 (24.2%)	5 (8.1%)	10 (16.1%)	4 (6.5%)	34 (54.8%)	0.007[1]*
Public	24 (38.7%)	1 (1.6%)	3 (4.8%)	0 (0%)	28 (45.2%)	
Disease Serotype						
AQP4 IgG+	16 (25.8%)	4 (6.5%)	9 (14.5%)	2 (3.2%)	31 (50%)	0.226[1]
MOG IgG+	18 (29%)	1 (1.6%)	1 (1.6%)	2 (3.2%)	22 (35.5%)	
Seronegative	5 (8.1%)	1 (1.6%)	3 (4.8%)	0 (0%)	9 (14.5%)	
Sex						
Female	29 (46.8%)	5 (8.1%)	11 (17.7%)	4 (6.5%)	49 (79%)	0.596[1]
Male	10 (16.1%)	1 (1.6%)	2 (3.2%)	0 (0%)	13 (21%)	
Age at first symptom (years)						
Mean (SD)	36.7 (12.2)	33.2 (12.2)	43.7 (17.3)	38.4 (16.3)	37.9 (13.7)	0.351[2]
Age at diagnosis (years)						
Mean (SD)	39.9 (11.6)	38.8 (10.6)	48.8 (16.6)	41.3 (17.3)	41.8 (13.3)	0.192[2]
Years from onset to diagnosis						
Mean (SD)	3.2 (5.5)	5.6 (4.3)	5.2 (9.5)	3 (3.52)	3.8 (6.3)	0.689[2]
Onset Symptom						
Unilateral ON	31 (50%)	3 (4.8%)	7 (11.3%)	2 (3.2%)	43 (69.4%)	0.167[1]
Bilateral ON	4 (6.5%)	2 (3.2%)	2 (3.2%)	0 (0%)	8 (12.9%)	
Non-visual	4 (6.5%)	1 (1.6%)	4 (6.5%)	2 (3.2%)	11 (17.7%)	
Number of ON episodes						
Mean (SD)	2.2 (1.7)	1.8 (0.8)	1.8 (0.7)	2.5 (1.3)	2.1 (1.4)	0.705[2]
Median Income by ZCTA (USD)						
Mean (SD)	59,704 (21,559)	53,704 (17,461)	81,260 (25,677)	82,591 (19,575)	65,120 (23,878)	0.007[2]*
Social Deprivation Index						
Mean (SD)	81.6 (24.6)	89.2 (16)	54.1 (31.4)	57.8 (30.9)	75 (28.3)	0.004[2]*
Currently on DMTs	32 (51.6%)	5 (8.1%)	12 (19.4%)	3 (4.8%)	52 (83.9%)	0.798[1]

Abbreviations: AQP4 IgG+: Aquaporin 4 antibody positive, MOG IgG+: Myelin oligodendrocyte glycoprotein antibody positive, Seronegative: Antibody negative neuromyelitis optica spectrum disorder, ON: Optic neuritis, ZCTA: Zip code tabulation area, USD: United States dollars, SD: Standard Deviation, DMTs: Disease Modifying Therapies
[1]p-value calculated using chi-square test
[2]p-value calculated using one-way analysis of variance (ANOVA) test
*p-value is significant

Table 1: Demographic information and disease history summarized by race and ethnicity. P-values assessed using chi-squared tests and one-way ANOVAs.

- Race/ethnicity was significantly associated with hospital affiliation (p =0.007), median income measured by ZCTA (p=0.007), and SDI (p=0.004).
- In "Baseline" and "Most Recent" timepoint analyses, disease serotype was significantly associated with logMAR VA (p=0.012, p =0.014, respectively).
- In "Acute Attack" timepoint analysis, eye pain was significantly associated with race (p=0.005).
- Visual acuity was not significantly associated with race, SDI score, or median income (p-values>0.05).

Figure 1: Box plots depicting logMAR VA by race for **a)** "Baseline" timepoint, **b)** "Most Recent" timepoint, and **c)** "Acute Attack" timepoint. P-values show no significance (p>0.05).

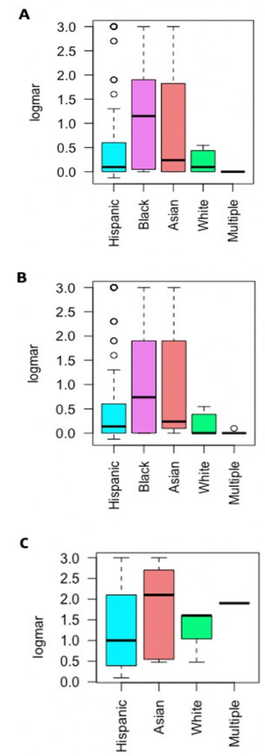


Figure 2: Box plots depicting logMAR VA by disease serotype for **a)** "Baseline" timepoint, **b)** "Most Recent" timepoint, and **c)** "Acute Attack" timepoint. P-values show significance at "Baseline" (p=0.012) and "Most Recent" (p=0.014). AQP4+ is associated with worse visual acuity compared to MOG+ at baseline, and both MOG+ and Seronegative at "Most Recent".

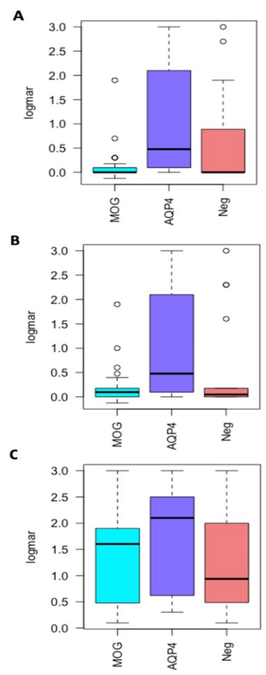
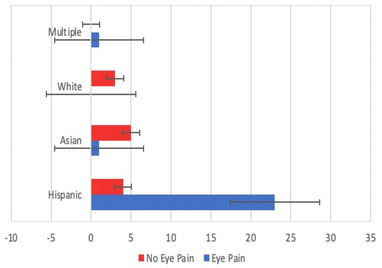


Figure 3: Incidence of eye pain among race/ethnicity in "Acute Attack" analysis are depicted in the bar graph. Hispanics reported greater eye pain than any other racial group ($\chi^2(3)=17.65$, p=0.005).



Analyses for Figures 1-3 were conducted using a variety of statistical tests. These include: Chi-Squared Tests, ANOVAs, Linear Regressions, Logistic Regressions, and Mixed Effects Modeling (for "Baseline" and "Most Recent" time points only).

Discussion

- **Among our patient population, Black and Hispanic patients experience more disadvantage, based on social determinants of health.**
  - However, neither group demonstrates significantly worse visual outcomes compared to other races.
- **Disease serotype was significantly associated with visual acuity.**
  - Patients that were AQP4 IgG+ had a worse visual acuity at "Baseline" and "Most Recent" timepoints. Past literature shows patients who are AQP4 IgG+ have a worse visual prognosis. This data reaffirms that diagnosis is a better predictor of visual outcome and functioning than race/ethnicity.
- **The main racial difference found concerned Hispanics reporting more eye pain than other races during acute attack.**
  - Hispanic patients were more likely to experience eye pain during an acute optic neuritis attack than White or Asian patients. Findings suggest eye pain may be a potential clinical indicator of optic neuritis relapse among Hispanic patients.

Future Directions

- Increase sample size for more reliable within-subject and between-subject analyses.
- With increased sample size, conduct longitudinal analyses to assess disease progression and visual outcomes across racial groups.
- Further explore how disease symptomology may vary during an acute attack across racial groups.

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