Social determinants of health are associated with delayed diagnosis in myasthenia gravis

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Introduction

- MG is a rare condition with a low incidence rate and individuals can present with common, non-specific symptoms that could be attributable to many other conditions
- Delays in diagnosis are common in MG
- Timely diagnosis of MG may reduce healthcare utilization, facilitate early intervention, improve symptom control, and maintain functional status
- Based upon chart reviews, 10–26% of individuals with MG have MG-related symptoms for more than 2 years before they are formally diagnosed[1–3]
- Neurologists are experts in the diagnosis and management of neuromuscular disease. Delays in referral and poor access to neurologists may contribute to delays in diagnosis and treatment

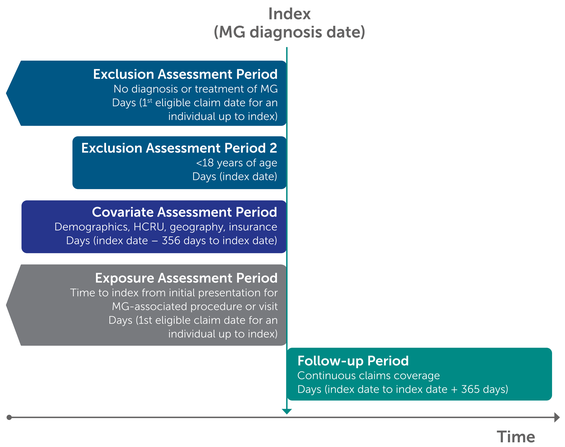
Study objective

- To determine if social determinants of health[4] were associated with delayed diagnosis in MG

Methods

- Total study period: September 1, 2017 to August 31, 2022 (**Figure 1**)
- Patient selection period: September 1, 2018 to August 31, 2022
- Inclusion criteria:
  - ≥2 outpatient claims ≥90 days apart or one inpatient claim with an ICD-10-CM G70.0x
  - ≥18 years of age at index
  - A ≥12-month pre-index baseline period with continuous claims coverage
  - A ≥12-month post-index follow-up period with continuous claims coverage
  - ≥1 pharmacy claim in the study period
  - Assignment to a ZIP5 code (based on PCP ZIP code)

Figure 1 Study design



- Exclusion criteria:
  - History of MG, thymectomy, AChEI, or biologic treatment during the Exclusion and Diagnostic Assessment Period
- Covariate measures:
  - Demographics: age, sex, insurance type
  - Comorbidities: medical and psychiatric
  - Measures assessing social determinants of health included community risk measures of housing, food, economic, transportation, health literacy, social connectedness, and digital landscape. Individuals were assigned to a community (i.e., ZIP5) based on rendering PCP address
    - High-risk community was defined by a score greater than 3.5 on the 5-point scale defined by Socially Determined[4]
- Outcome measures:
  - Delayed diagnosis was defined as >90 days from presentation to index
  - Presentation defined by first claim for an MG-associated symptom or diagnostic procedure
  - Symptoms: diplopia, ptosis, dysphagia, dysarthria, thymic tumor, muscle weakness
  - Procedures: ophthalmology visit, visual field exam, sensorimotor exam, brain MRI, needle electromyography exam, neuromuscular junction test, immunoassay, swallow study
- Analysis:
  - Bivariate comparison of baseline characteristics between individuals with and without a delayed diagnosis
  - Logistic regression of baseline characteristics associated with delayed diagnosis (yes=1, no=0)
  - Chi-squared test for categorical variables and Student's t-test for continuous variables

Results

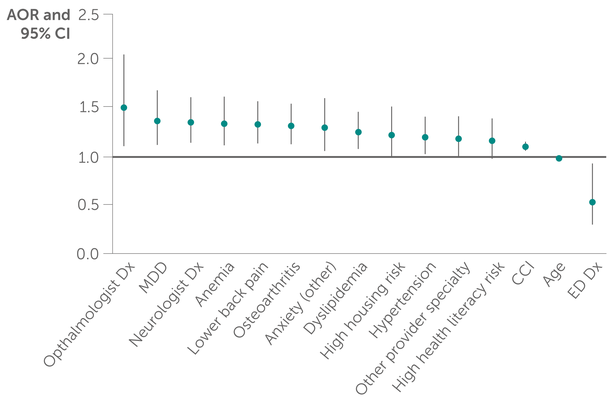
- A total of 3,873 individuals were eligible for inclusion in this study (**Table 1**)
- Of these, 2,613 (67.5%) individuals had one or more qualifying diagnoses or procedure claim(s) before initial MG diagnosis and 1,078 (27.8%) had three or more qualifying claims
- Diagnostic delay was present in 1,837 (47.4%) individuals (**Table 1**)
- Of those with diagnostic delay, 1,042 (56.7%) had a delay of more than 1 year from presentation to diagnosis
- The most common presenting symptom was muscle weakness (27.6%), followed by ptosis (15.8%), dysphagia (15.5%), diplopia (15.4%), dysarthria (8.9%), and thymic tumor (1.2%)
- The most common diagnostic procedure was ophthalmology exam (26.3%), followed by brain MRI (20.7%), immunoassay (10.4%), visual field exam (7.9%), neuromuscular junction test (6.1%), swallow study (4.7%), sensorimotor exam (4.0%), and needle electromyography exam (2.2%)
- Individuals with delayed diagnosis were of older age (65.7 vs. 63.0 years; p<0.001), had higher medical comorbidity burden (CCI: 1.82 vs. 1.04; p<0.001), and had higher psychiatric comorbidity burden (**Table 1**)
- In the unadjusted comparison, individuals with a delayed diagnosis were more likely to reside in high-risk housing communities (24.7% vs. 21.1%; p<0.01) and have high health literacy risk (34.2% vs. 30.0%; p<0.01) (**Table 1**)
- After adjustment, individuals residing in communities with high-risk housing (AOR: 1.26; 95% CI: 1.56–1.02) and those with poor health literacy (AOR: 1.20; 95% CI: 1.43–1.00) had significantly elevated odds of delayed diagnosis (**Figure 2**)
- After adjustment, older adults, individuals diagnosed by an ophthalmologist, neurologist or other specialist, individuals with greater medical comorbidity burden, and individuals with MDD or anxiety had elevated odds of a delay in diagnosis (**Figure 2**)

Table 1 Distribution of characteristics in the populations with and without delayed diagnosis

		No delay n=2,036 (52.6%)	Delay n=1,837 (47.4%)	p-value
Sex, n (%)	Female	**1,028** (50.5)	**981** (53.4)	n.s.
Age, years, mean (SD)		**63.0** (13.2)	**65.7** (12.3)	<0.001
Insurance, n (%)	Commercial	**1,068** (52.5)	**829** (45.1)	<0.001
	Medicaid	**91** (4.5)	**86** (4.7)	–
	Medicare	**876** (43.0)	**921** (50.1)	–
Psychiatric comorbidities, n (%)	CCI*	**1.04** (1.61)	**1.82** (2.21)	<0.001
	Anxiety (other)	**255** (12.5)	**391** (21.3)	<0.001
	MDD	**243** (11.9)	**408** (22.2)	<0.001
	Substance use and addiction disorders	**148** (7.3)	**180** (9.8)	<0.01
	Generalized anxiety disorder	**84** (4.1)	**112** (6.1)	<0.01
Diagnosis specialty (initial MG Dx)	Primary care	**688** (33.8)	**509** (27.7)	<0.001
	Neurology	**600** (29.5)	**631** (34.3)	–
	Ophthalmology	**107** (5.3)	**109** (5.9)	–
	Advanced practitioner (NP, PA)	**67** (3.3)	**49** (2.7)	–
	Other	**574** (28.2)	**539** (29.3)	–
Any neurologist diagnosis (ever)	No	**882** (43.3)	**713** (38.8)	<0.01
Socially Determined measures, n (%)				
Housing risk	High risk	**430** (21.1)	**453** (24.7)	<0.01
Food risk	High risk	**526** (25.8)	**465** (25.3)	–
Economic risk	High risk	**610** (30.0)	**581** (31.6)	–
Transportation risk	High risk	**13** (0.6)	**11** (0.6)	–
Health literacy risk	High risk	**611** (30.0)	**629** (34.2)	<0.01
Digital landscape risk	High risk	**167** (8.2)	**166** (9.0)	–
Social connectedness risk	High risk	**291** (14.3)	**265** (14.4)	–

*Data are presented as mean (SD).

Figure 2 AOR and 95% CI for characteristics associated with a delay in diagnosis



Summary and conclusions

Some social determinants of health measures appear to be associated with elevated odds of delayed diagnosis

47% of patients with newly diagnosed MG met the criteria for a delay in diagnosis

Individuals of older age and with higher rates of medical and psychiatric comorbidities were more likely to meet the criteria for delayed diagnosis, suggesting that individuals with complex clinical presentations may complicate diagnosis of MG

Diagnostic delay was also associated with an index diagnosis by a neurologist, which may reflect delays associated with appropriate specialty referral or inadequate access to neurologists

This claims-based measure of diagnostic delay in MG highlights potential sources of unmet need, including factors associated with patients (demographics, social determinants of health, comorbidities), providers (specialty), health systems (access to care), and the disease itself (symptoms, MG severity)

Social determinants risk contributes to diagnostic delay in MG and should be addressed to optimize care for individuals with potential MG

Abbreviations: AChEI, acetylcholinesterase inhibitor; AOR, adjusted odds ratio; CCI, Charlson Comorbidity Index; CI, confidence interval; Dx, diagnosis; ED, emergency department; HCRU, health care resource utilization; ICD-10-CM, International Classification of Diseases, 10th Revision, Clinical Modification; MDD, major depressive disorder; MG, myasthenia gravis; MRI, magnetic resonance imaging; NP, nurse practitioner; n.s., not significant; PA, physician assistant; PCP, primary care provider; SD, standard deviation; ZIP, Zone Improvement Plan.

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