



Interpretation of Neuro-QoL Domains Across a Spectrum of Patients Living with Multiple Sclerosis

Deborah M Miller¹, Yadi Li², Scott Husak², Dan Ontaneda¹, Robert Bermel¹, Brittany Lapin²

¹Cleveland Clinic Mellen Center, ²Cleveland Clinic Quantitative Health Sciences Submission ID #18

Background

- Neuro-QoL™ is a prominent PROM for MS clinical monitoring and clinical trials
- Multiple Sclerosis (MS) is a neurological condition characterized by distinct progression patterns and increasing disability over time.
- An important question is “Should Neuro-QoL score interpretation be adjusted for disease and demographic characteristics?”

Objectives

- Determine if Neuro-QoL scores vary by MS disease duration, age, and symptom severity as measured by the Patient Determined Disease Steps (PDDS)
- Provide group level interpretation guideline for patients and providers when interpreting Neuro-QoL results

Methods

- Retrospective cohort study conducted at a single academic MS-specialty center in the US between 1/2017-1/2025

Methods

- Neuro-QoL scales included

Lower Extremity Function	Stima
Upper Extremity Function	Depression
Cognitive Function	Anxiety
Participate in Social Roles	Fatigue
Satisfaction w/ Social Role	Sleep Disturbance

- Neuro-QoL scores were stratified by categories of
 - Disease duration
 - Age
 - PDDS
- Comparisons between groups were made with ANOVA
- Adjusted means were calculated and compared across strata after adjusting for demographics and clinical characteristics
- Symptoms/functional deficits were defined as 1/2 standard deviation (SD) worse than population mean score of 50

Results

Table 1. Demographics and Clinical Characteristics for Participants (n=7,798)

	Statistics		Statistics
Age, mean (SD)	48.7 (13.1)	MS Type, n (%)	
Female, n (%)	5,695 (73.0)	RRMS, Relapse-Remitting MS	3,967 (55.6)
Race, n (%)		Progressive MS	2,703 (37.8)
White	6,222 (79.8)	Clinically isolated syndrome	469 (6.6)
Black	1,017 (13.0)	PDDS, median [Q1, Q3]	1.0 [0.0, 4.0]
Other/Unknown	559 (7.2)	ADI National Rank, mean (SD)	56.7 (23.8)
Marital Status, n (%)		Quartile 1 (1-25)	874 (11.2)
Married	4,529 (58.1)	Quartiles 2(26-75)	2,356 (30.3)
Single	1,971 (25.3)	Quartile 3 (51-75)	2,629 (33.8)
Divorced	789 (10.1)	Quartile 4 (76-100)	1,926 (24.7)
Widowed	292 (3.7)		
Other/Unknown	217 (2.8)		

Results

Table 2. Neuro-QoL outcomes, Stratified by MS duration

Neuro-QoL T-scores, mean (SD)	Overall	0-4 years (N=2,147)	5-9 years (N=1,233)	10-14 years (N=1,138)	15-19 years (N=1,034)	20+ years (N=2,246)	p-value
Lower extremity	44.9 (11.3)	49.4 (10.5)	47.1 (11.1)	45.1 (11.2)	43.3 (10.4)	39.7 (10.4)	<0.001
Upper extremity	44.0 (9.7)	47.0 (9.5)	45.5 (9.4)	44.1 (9.8)	42.9 (9.4)	40.6 (9.1)	<0.001
Cognitive function	46.5 (9.6)	47.5 (10.2)	46.9 (9.8)	46.3 (9.5)	46.0 (9.5)	45.7 (8.7)	<0.001
Ability to participate social roles	46.5 (8.1)	47.9 (8.7)	47.1 (8.3)	46.4 (8.3)	45.7 (8.1)	45.1 (7.1)	<0.001
Satisfaction with social roles	46.3 (7.8)	47.5 (8.4)	46.7 (7.8)	46.1 (7.9)	45.9 (7.7)	45.1 (7.0)	<0.001
Stigma†	48.9 (8.7)	47.5 (8.6)	48.4 (8.8)	49.0 (9.1)	49.5 (8.6)	50.2 (8.4)	<0.001
Depression†	47.4 (8.0)	47.2 (8.3)	47.0 (8.1)	47.5 (8.3)	47.7 (7.9)	47.5 (7.7)	0.27
Anxiety†	50.7 (9.5)	50.8 (9.9)	50.6 (9.8)	50.9 (9.6)	50.8 (9.5)	50.4 (8.8)	0.68
Fatigue†	50.5 (10.1)	49.8 (10.7)	50.9 (10.2)	50.7 (10.1)	50.8 (10.2)	50.6 (9.2)	0.029
Sleep disturbance†	52.8 (10.3)	52.4 (10.9)	53.4 (10.4)	53.0 (10.4)	53.0 (10.4)	52.8 (9.4)	0.21

†higher scores indicate greater symptoms; bolded and italicized values are meaningfully worse than population average

Table 3. Neuro-QoL Outcomes, Stratified by Age

Neuro-QoL T-scores, mean (SD)	Overall	18-34 (N=1,267)	35-49 (N=2,388)	50-64 (N=2,734)	65+ (N=909)	p-value
Lower extremity	44.9 (11.3)	51.0 (10.2)	47.2 (10.9)	41.7 (10.5)	37.7 (9.4)	<0.001
Upper extremity	44.0 (9.7)	47.9 (9.2)	45.2 (9.7)	41.9 (9.5)	40.6 (8.4)	<0.001
Cognitive function	46.5 (9.6)	47.4 (10.4)	45.9 (9.9)	46.4 (9.2)	47.5 (8.0)	<0.001
Ability to participate social roles	46.5 (8.1)	48.2 (8.9)	46.6 (8.3)	45.7 (7.7)	45.7 (7.0)	<0.001
Satisfaction with social roles	46.3 (7.8)	48.2 (8.7)	46.2 (8.0)	45.7 (7.4)	45.6 (6.7)	<0.001
Stigma†	48.9 (8.7)	47.9 (9.0)	48.7 (8.8)	49.4 (8.7)	49.3 (7.8)	<0.001
Depression†	47.4 (8.0)	47.5 (8.6)	47.5 (8.1)	47.3 (7.9)	46.8 (7.3)	0.24
Anxiety†	50.7 (9.5)	51.2 (10.2)	51.3 (9.6)	50.1 (9.2)	49.7 (8.4)	<0.001
Fatigue†	50.5 (10.1)	50.6 (10.8)	51.4 (10.2)	50.0 (10.0)	48.8 (8.4)	<0.001
Sleep disturbance†	52.8 (10.3)	53.3 (11.5)	53.7 (10.6)	52.4 (9.7)	50.9 (8.4)	<0.001

†higher scores indicate greater symptoms; bolded and italicized values are meaningfully worse than population average

Results

Table 4. Neuro-QoL outcomes, stratified by MS severity (PDDS)

Neuro-QoL T-scores, mean (SD)	Overall	0-2 (N=4,652)	3-4 (N=1,696)	5+ (N=1,376)	p-value
Lower extremity	44.9 (11.3)	51.2 (8.6)	38.7 (5.0)	30.4 (6.6)	<0.001
Upper extremity	44.0 (9.7)	48.5 (8.3)	38.9 (6.8)	34.7 (7.1)	<0.001
Cognitive function	46.5 (9.6)	48.4 (9.3)	42.6 (8.8)	44.8 (9.4)	<0.001
Ability to participate social roles	46.4 (8.1)	49.3 (8.2)	42.4 (5.2)	41.4 (5.9)	<0.001
Satisfaction with social roles	46.3 (7.8)	49.1 (7.9)	42.5 (5.2)	41.2 (5.5)	<0.001
Stigma†	48.9 (8.7)	45.6 (8.0)	53.6 (7.1)	54.6 (7.3)	<0.001
Depression†	47.4 (8.0)	45.8 (7.8)	50.1 (7.6)	49.7 (7.9)	<0.001
Anxiety†	50.7 (9.5)	49.1 (9.5)	54.1 (8.5)	52.1 (9.0)	<0.001
Fatigue†	50.5 (10.1)	48.3 (10.1)	54.7 (8.7)	53.1 (9.5)	<0.001
Sleep disturbance†	52.9 (10.3)	51.0 (10.0)	56.9 (9.8)	54.4 (9.9)	<0.001

†higher scores indicate greater symptoms; bolded and italicized values are meaningfully worse than population average

- After adjustment, there were minimal differences across MS duration, age, or PDDS

Discussion & Conclusion

- When assessing differences in Neuro-QoL scores by increasing **disease duration** only two measures were clinically significant
 - Lower Extremity Function at ≥15years duration
 - Upper Extremity Function at ≥10 years duration
- When assessing differences in Neuro-QoL scores by increasing **Age** the same measures were clinically significant at 50+ years of age
- When assessing differences in Neuro-QoL scores by increasing **disability**, 5 measures were clinically significant
 - Lower Extremity, Upper Extremity, Cognition, Ability to Participated in Social Roles, and Satisfaction with Social Roles for PDDS 3+
- Level of Disease Severity is more strongly associated with measures of Neuro-QoL scores than are time related measures
- Neuro-QoL scores are highly correlated with clinical measures of lower extremity function and upper extremity function (data not shown)
- Neuro-QoL scores of cognition, stigma, depression, anxiety, fatigue, and sleep disturbance indicate normal functioning which is inconsistent with the general MS literature
 - A possible explanation is that more recent disease modifying therapies impact affective as well as physical symptoms