

Quantitative MG Score (QMG)

Focus	Evaluation of Strength and Fatigable weakness geared towards MG (including ocular muscles)
Patient or clinician centric	Clinician ¹
Administration	Clinician/Evaluator Administered ¹
# items	13 ²
Equipment needed	Spirometer (with Mouth Pieces), Stopwatch, Cups and water, Dynamometer, Goniometer
Item scoring	None (0), Mild (1), Moderate (2), Severe (3) Severity is graded by time (for positional tests), percentage (FVC), Kg (hand grip), subjective strength (eyelid closure)
Domains evaluated	<ul style="list-style-type: none"> • Ocular (ocular movements, ptosis, eyelid closure) • Bulbar (swallowing, dysarthria) • Limb/axial (arm strength, leg strength, grip, neck flexion) • Respiratory (FVC)
Time to complete	~20-30 minutes
Clinically meaningful change	<p>≥2 points for QMG 0-16, and ≥3 points for QMG >16 per Katzberg et al³</p> <p>≥2.3 per Bedlack et al.^{4,5}</p> <p>2.6 per Barohn et al.²</p> <p>Note that per Barnett et al⁶, at an individual level, minimum detectable change (4.3) may be higher than minimum clinically meaningful change, suggesting that minor changes at an individual level may be due to measurement error.</p>
Psychometric properties	<ul style="list-style-type: none"> • Test-retest reliability: Adequate⁶ • Inter-rater reliability: High^{7,2} • Responsiveness: Excellent⁴ • Content validity: Relevant – measures frequently affected domains in MG • Construct validity, correlation with other MG outcome measures: Good, correlates well with MG-QOL15, MGFA Class, MG-MMT, MG-ADL, MG impairment index^{8,9,7,10-13} • Limitations: <ul style="list-style-type: none"> - Criticized for its items not being weighted for clinical relevance.^{9,1} - In the MMF study (muscle study group), QMG was less sensitive to changes than MMT and ADL at weeks 12 and 36¹⁰ - By contrast, correlation analysis of MG-ADL and QMG in the MGTX study demonstrated that MG-ADL was more susceptible to floor effect than QMG¹⁴ - Unclear if the scoring of the timed items in the test were determined arbitrarily - Analysis of prospective study of IVIG in MG suggested a significant floor effect in swallowing, speech, vital capacity and grip strength (and, therefore, did not differentiate well between subjects)⁸
Virtual visit use	Not possible unless modified
Translations/validations	<ul style="list-style-type: none"> • Portugese¹⁵ • Translation is less relevant than other outcome measures since items are administered by clinicians. MAPI Research trust makes the instructions available in Czech, Dutch (Holland), German, Hungarian, Italian, Japanese, Portuguese, Russian, Serbian, Spanish (Spain and US versions), Turkish, Korean, Polish
Key test instructions	<ul style="list-style-type: none"> • Available by MAPI in writing. A video version is also available but difficult to access. Latest written version of the instructions are dated August 6, 2017

Other information	<ul style="list-style-type: none"> • The need for equipment, need for proper training and duration of the evaluation makes QMG less desirable for day-to-day clinic use. (Note: a Thai group published a modified QMG Score, removing speech, vital capacity (replaced by peak flow) and dynamometry, demonstrating a correlation coefficient of 0.96, N=45)¹⁶ • Very commonly used in clinical trials. Was recommended to be included in ALL clinical trials by original MGFA task force but not in the updated version in 2012.¹ Tested in most clinical trials. • A pediatric version does not exist
Areas contributing to lack of standardization	<ul style="list-style-type: none"> • Difficult to access instructions (especially video) • Should the scoring of the right vs. left hand be modified as “dominant vs. non-dominant hand”? (the test may differentially score a right vs. left-handed individual with equal strength) • Glasses are removed in ocular tests but not contact lenses (what if a participant reports blurry vision without glasses)? • Per instructions, ptosis is considered present only when the eyelid is at the mid-pupil level. How is milder ptosis vs. no ptosis are differentiated? • Difficult to assess eye closure strength (mild vs. moderate) • What is incomplete eye closure? Should the sclera be visible or incomplete burial of eyelids is considered incomplete closure? • Should we be still using the Knudson 83 as the normative data? • A mask is listed as an option in the scoring sheet of the VC but not mentioned in the instructions. Relevant given the possible poor seal of the mouthpiece in patients with oral weakness. • Should the patients with baseline NON-MG related limitations be scored “as is”? e.g. if a patient has difficulty with shoulder abduction due to rotator cuff tear, is that item ignored or should we score the shoulder abduction as whatever we time, regardless of the etiology?

Abbreviations: FVC: forced vital capacity; MG-ADL: myasthenia gravis activities of daily living scale MG-C: myasthenia gravis composite scale, MG-QOL15: myasthenia gravis Quality of Life-15 score, MG-MMT: myasthenia gravis manual muscle test; QMG: quantitative myasthenia gravis score

References:

1. Kaminski HJ, Kusner LL. Myasthenia Gravis and Related Disorders: Springer International Publishing; 2018.
2. Barohn RJ, McIntire D, Herbelin L, Wolfe GI, Nations S, Bryan WW. Reliability testing of the quantitative myasthenia gravis score. *Annals of the New York Academy of Sciences* 1998;841:769-772.
3. Katzberg HD, Barnett C, Merkies IS, Bril V. Minimal clinically important difference in myasthenia gravis: outcomes from a randomized trial. *Muscle & nerve* 2014;49(5):661-665.
4. Bedlack RS, Simel DL, Bosworth H, Samsa G, Tucker-Lipscomb B, Sanders DB. Quantitative myasthenia gravis score: assessment of responsiveness and longitudinal validity. *Neurology* 2005;64(11):1968-1970.
5. Wolfe GI, Kaminski HJ, Aban IB, Minisman G, Kuo HC, Marx A, et al. Randomized Trial of Thymectomy in Myasthenia Gravis. *The New England journal of medicine* 2016;375(6):511-522.
6. Barnett C, Merkies IS, Katzberg H, Bril V. Psychometric Properties of the Quantitative Myasthenia Gravis Score and the Myasthenia Gravis Composite Scale. *J Neuromuscul Dis* 2015;2(3):301-311.
7. Sharshar T, Chevret S, Mazighi M, Chillet P, Huberfeld G, Berreotta C, et al. Validity and reliability of two muscle strength scores commonly used as endpoints in assessing treatment of myasthenia gravis. *Journal of neurology* 2000;247(4):286-290.
8. Barnett TC, Bril V, Davis AM. Performance of individual items of the quantitative myasthenia gravis score. *Neuromuscular disorders : NMD* 2013;23(5):413-417.
9. Barnett C, Katzberg H, Nabavi M, Bril V. The quantitative myasthenia gravis score: comparison with clinical, electrophysiological, and laboratory markers. *Journal of clinical neuromuscular disease* 2012;13(4):201-205.

10. Wolfe GI, Barohn RJ, Sanders DB, McDermott MP, Muscle Study G. Comparison of outcome measures from a trial of mycophenolate mofetil in myasthenia gravis. *Muscle Nerve* 2008;38(5):1429-1433.
11. Howard JF, Jr., Freimer M, O'Brien F, Wang JJ, Collins SR, Kissel JT, et al. QMG and MG-ADL correlations: Study of eculizumab treatment of myasthenia gravis. *Muscle Nerve* 2017;56(2):328-330.
12. Vissing J, O'Brien F, Wang JJ, Howard JF, Jr. Correlation between myasthenia gravis-activities of daily living (MG-ADL) and quantitative myasthenia gravis (QMG) assessments of anti-acetylcholine receptor antibody-positive refractory generalized myasthenia gravis in the phase 3 regain study. *Muscle & nerve* 2018;58(2):E21-E22.
13. de Meel RHP, Barnett C, Bril V, Tannemaat MR, Verschuuren J. Myasthenia Gravis Impairment Index: Sensitivity for Change in Generalized Muscle Weakness. *J Neuromuscul Dis* 2020;7(3):297-300.
14. McPherson T, Aban I, Duda PW, Farzaneh-Far R, Wolfe GI, Kaminski HJ, et al. Correlation of Quantitative Myasthenia Gravis and Myasthenia Gravis Activities of Daily Living scales in the MGTX study. *Muscle Nerve* 2020;62(2):261-266.
15. Oliveira EF, Valerio BCO, Cavalcante V, Urbano JJ, Silva AS, Polaro MN, et al. Quantitative Myasthenia Gravis Score: a Brazilian multicenter study for translation, cultural adaptation and validation. *Arquivos de neuro-psiquiatria* 2017;75(7):457-463.
16. Sathirapanya P, Wiputhanuphongs K, Liabsuetrakul T, Khanittanuphong P, Keeratichananont W. A new and easily used modified myasthenia gravis score. *Neuromuscular disorders : NMD* 2020;30(8):656-660.