Original Article

Reliability and Validity of Turkish Myasthenia Gravis-Activities of Daily Living Scale

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Abstract

Linguistic, reliable, and valid secondary efficacy measures are important in clinical settings and studies. The aim of the study is to report test–retest reliability and construct validity of Turkish version of Myasthenia Gravis-Activities of Daily Living Scale (MG-ADL-T) in Myasthenia Gravis (MG) patients. Fifty-two ocular and generalized individuals with MG, applying to rehabilitation center, were included in the study. MG-ADL-T, MG quality-of-life questionnaire (MG-QoL), MG composite (MGC), quantitative MG score (QMGS), and pulmonary function test were administered. Reliability was assessed with intraclass correlation coefficient (ICC) and Cronbach's alpha. Spearman correlation test and receiver operating characteristic (ROC) analysis were performed for construct validity. MG-ADL-T had fair internal consistency (Cronbach's $\alpha = .67$), excellent test–retest reliability (ICC = 0.96) and moderate construct validity (MG-QoL, $r = 0.59$; QMGS, $r = .58$; MGC, $r = .68$). MG-ADL, a unique scale that evaluates activities of daily living (ADL), has good test–retest reliability and construct validity in Turkish MG patients.

Keywords

outcome measures, activities of daily living, assessment, rehabilitation

Introduction

Myasthenia gravis (MG) is an autoimmune antibody-mediated disorder that targets the neuromuscular junction, leading to muscle weakness and fatigability (Gilhus et al., 2016). The weakness can be ocular or generalized, and bulbar, limb, extraocular, and respiratory muscles are usually affected. Ocular symptoms can occur in the form of double vision and ptosis. Symptoms worsen with activities and recover with rest (Gilhus, 2016).

MG patients may experience a wide variety of activity and participation restrictions. These restrictions are particularly related to self-care and mobility. These factors adversely affect the return to work, maintaining social relationships, the participation in recreational activities, and active social life (Jeong et al., 2018).

Multiple outcome measures have been developed and validated to evaluate the disease status of MG patients (Burns, 2010). As the symptoms fluctuate during the day in MG, a disease state evaluation conducted during the clinical visits is inadequate. Therefore, the activities of daily living (ADL) as measured by the patient play an important role in measuring the disease status (Burns et al., 2008). Patient-reported outcome measures are increasingly used in clinical trials and descriptive studies in order provide data on the health status, health-related quality of life, and the effects of disorders on the daily life of the patient (Raggi et al., 2016). It is very important to know the effect of subjective perception of symptoms on patients' daily life activities. For a chronic and treatable condition such as MG, it is particularly important to measure the effect of the disease on ADL.

The Myasthenia Gravis-Activities of Daily Living Scale (MG-ADL) is a patient-reported scale that evaluates the effects of MG-related disability on ADL. It is a reliable assessment tool that can distinguish between MG groups of different severity with good construct validity (Muppidi et al., 2011). It has also been reported to be highly sensitive for evaluating the response to treatment (Howard et al., 2017).

The MG-ADL has been the most widely used patient-reported scale as there is no other scale for assessing ADL. The scale, originally in English, is available in Polish, Italian, Arabic, and Korean translations (Alanazy et al., 2019; Lee

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et al., 2017; Raggi et al., 2017; Rozmilowska et al., 2018). Although the number of clinical trials is increasing in MG Turkish population (Salci et al., 2018; Tascilar et al., 2017; Yildiz Celik et al., 2019), the Turkish version of MG-ADL has not been yet prepared. Therefore, a Turkish version of the scale is necessary both for international standardization in clinical trials and adequate evaluation of the patients. The aim of the current study is to investigate the reliability and validity of the Turkish version of MG-ADL in Turkish-speaking MG patients.

Method

Participants

This study had a cross-sectional methodological study design. It was conducted in Department of Neurology of Hacettepe University during March 2018–September 2019. The study protocol was approved by the Non-interventional Clinical Research Ethics Board of Hacettepe University (Approval Number: GO 18/208). Written informed consent was obtained from all participants.

It is stated that the sample size should be at least 5 times the number of items on the scale (Bryman & Cramer, 2000). Therefore, in the present study, eight items on the scale are multiplied by five. And the minimum number of patients to be included in the study was determined as 40.

Fifty-two ocular and generalized individuals diagnosed MG by a neurologist, applying to rehabilitation center, were included in the study. The inclusion criteria were patients within the age ranged from18 to 65 years, having a diagnosis of MG for at least 1 year, having class between I and IV according to Myasthenia Gravis Foundation of America Clinical Classification (MGFA*)*, having stable medical condition (no myasthenic crisis and no medical treatment change) and having no vision problems that interfered reading. Exclusion criteria were diagnosis with other autoimmune diseases and inflammatory diseases, diagnosis with cardiorespiratory diseases, and mechanical ventilator requirement (MGFA Class V).

Measures

Demographic information (age, sex, and body mass index) and data on the clinical course of the disease (time of last myasthenic crisis, disease duration, comorbid diseases, and the treatments) were recorded.

To demonstrate the construct validity of a scale, it is necessary to show the existence of the correlation between primary and secondary outcome measures specific to the disease. The most commonly used primary outcome measures in clinical trials for MG are The Myasthenia Gravis Composite (MGC), The Quantitative Myasthenia Gravis Score (QMGS) and MGFA (Muppidi, 2017). Also respiratory problems, which is among the primary symptoms in MG patients, should be assessed. Therefore, MGC, QMGS, MGFA, and Pulmonary Function Test (PFT) were selected primary evaluation. In addition, considering the close interaction of quality of life and ADL, Myasthenia Gravis Quality-of-Life Questionnaire (MG-QoL) was preferred as a secondary measurement.

The MGFA. The clinical status of the patients was classified according to the MGFA. MGFA divides MG in to five major classes and several subclasses. It is stated as MGFA Class I (ocular), MGFA Class II (mild generalized), MGFA Class III (moderate generalized), MGFA Class IV (severe generalized), and MGFA Class V (defined by intubation) in the main classification (Jaretzki et al., 2000).

The MG-ADL. MG-ADL is a patient-reported questionnaire consisting of eight items and is designed to evaluate the functional performance of daily activities that are impaired by MG. These items consist of two ocular, three bulbar, one respiratory, and two limb-related symptoms. Each item is rated between 0 and 3, resulting in a total score range of 0 to 24 (Wolfe et al., 1999).

The MGC. The MGC is a quantitative measure used to determine disease status in everyday practice and in clinical trials. The MGC consists of a total of 10 items with six items evaluated by the physician and four items reported by the patient. Items are scored using a four-level severity assessment and a total score is obtained by adding up the weighted scores of each item. The maximum score is 50. Higher scores indicate worsening disease status (Burns et al., 2008). The MGC is easy to administer, taking less than 5 min to complete without the need for any equipment (Burns et al., 2010a).

The QMGS. The QMGS contains 13 physician-rated items, each scored between 0 (no symptoms) and 3 (severe symptoms), with a total score range of 0 to 39. Higher scores indicate more severe disease (Bedlack et al., 2005).

The MG-QoL-15. The MG-QoL-15 is a valid and reliable scale in Turkish for the assessment of the health-related quality of life. The scale consists of 15 items and each item is scored between 0 and 4. The total scores' range is therefore 0 to 60 points with higher scores indicating worse quality of life (Burns et al., 2010b; Taşcilar et al., 2016).

PFT. PFT were evaluated with a portable spirometer (Fitmate MED Spirometer, COSMED, Rome, Italy) according to the guidelines of the American Thoracic Society and the European Thoracic Society. The test was repeated three times for each patient and the best value was recorded. A rest period of 1 min was provided between the tests. The values obtained were FVC, FEV1, FEV1/FVC, and VC (Miller, 2005).

Translation

Permission was obtained from the developer of the original scale (Wolfe et al., 1999) for the translation of MG-ADL into Turkish. The scale was translated into Turkish according to the current guidelines (Beaton et al., 2000). The standard multistep forward–backward method was used for the translation. Expert committee consisted of a physiotherapist (E.K.), two neurologists (C.E.B.K, and S.E.Ö) who are native Turkish speakers and know English. The scale was first translated into Turkish by two neurologists. The physiotherapist reviewed these versions and revised them to a single version. Then it was translated back into English by other physiotherapist (A.F.B). The new translation was then back-translated into English blindly and independently by a native English speaker linguist. This translation was jointly reviewed and discussed by the expert committee. A single final version of the Turkish version of the scale (MG-ADL-T) was produced as a result.

Procedure

The MG patients were asked to complete the MG-ADL-T scale while the MG-QoL-15-T, PFT, MGC, MGFA, and QMGS data were collected during the physician–patient encounter. The patients were asked to complete the MG-ADL-T scale again 3 to 7 days later to test the repeatability, using an electronic link to the questionnaire.

Data Analysis

Collected data were analyzed using Shapiro–Wilk for normality test according to MG-ADL. Non-parametric tests were used in the analyses as the data were not normally distributed. Data were expressed as the means ± *SD* (standard deviation), range (minimum, maximum), or medians (interquartile ranges) for numerical variables and as numbers and frequencies for categorical variables.

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 20.0 (SPSS Inc., Chicago, Illinois). The statistical significance level was set at .05. Reliability and validity analyses were carried out using the guideline of Consensus Based Standards for the Selection of Health Status Measurement Instruments (COSMİN) (Mokkink et al., 2010).

Test–retest reliability. The intraclass correlation coefficient (ICC) values were used to evaluate test–retest reliability and were calculated for the data from Time 1 (T1) and Time 2 (T2). The item–total score correlation values and Cronbach alpha values were calculated to evaluate internal consistency.

The standard error of measurement (SEM) and the minimum detectable change (MDC) were computed. The value of ICC was then employed to estimate SEM and thereafter, to estimate the MDC (95% level of confidence). The MDC is calculated by multiplying the SEM by 1.96 to correspond to the 95% confidence interval (CI) and the square root of two to adjust for sampling from two different measurements. *SD* is the pooled standard deviation (King, 2011). The formulas:

$$SEM = SD\sqrt{1 - ICC}$$

$$MDC = SEM \times 1.96 \times \sqrt{2}$$

Table 1. Patient Demographic Characteristics.

Variables	*M* ± *SD* (min–max), *n* = 52
Age	46.75 ± 17.85 (18–65)
BMI	25.61 ± 4.67 (16.07–37.25)
Disease duration	6.75 ± 6.55 (1–29)
Gender (male/female, %)	40.4/59.6
QMGS	9.94 ± 6.02
MG-QoL-T	14.65 ± 6.90
MGC	9.94 ± 6.31
MGFA (%)	
Class I	11.5
Class II	44.3
Class III	28.8
Class IV	15.4

Note. M ± SD = Mean ± Standard Deviation; BMI = body mass index; QMGS = quantitative myasthenia gravis score; MG-QoL-T = Turkish version of myasthenia gravis quality-of-life; MGC = myasthenia gravis composite score; MGFA = Myasthenia Gravis Foundation America Classification System; min–max = minimum to maximum.

Construct validity. Hypothesis testing and predictive validity were performed for construct validity.

Hypothesis testing. Hypothesis tests were analyzed as convergent validity by using Spearman's correlation coefficients (rho) and *p* values for the relationships between the MG-ADL-T score and the MG-QoL15-T, MGC, QMGS, and PFT values. A correlation coefficient of rho $<.4$ was considered weak, .4 to .7 moderate, and $>.7$ strong (Schober et al., 2018).

Predictive validity. The receiver operating characteristic (ROC) curves and area under the curve (AUC) analyses were used to assess predictive validity. Patients were divided into two groups according to the MGFA status as minimal disability (I, II) and moderate disability (III, IV; Rozmilowska et al., 2018). The sensitivity and specificity of MG-ADL-T as regards disease severity was determined by setting the optimal threshold value through the Youden index method (Kumar & Indrayan, 2011).

Results

Fifty-two patients (31 women and 21 men) were included in the study. Patients' demographic data and clinical characteristics are presented in Table 1. The MG-ADL-T has good

Table 2. Reliability and Stability of the MG-ADL-T.

MG-ADL-T items	*M* ± *SD*	Item-total correlation	Alpha if item deleted	Test–retest correlation
Talking	0.59 ± 0.69	.28	.66	.95
Chewing	0.69 ± 0.70	.58	.59	.97
Swallowing	0.61 ± 0.84	.45	.61	.94
Breathing	0.59 ± 0.60	.56	.60	.90
Impairment in the ability to brush teeth or comb hair	0.57 ± 0.82	.19	.68	.93
Impairment in the ability to arise from a chair	0.26 ± 0.52	.18	.67	.89
Double vision	0.73 ± 0.81	.33	.65	.95
Eyelid drop	0.80 ± 0.76	.37	.64	.97

Note. M ± SD = Mean ± Standad Deviation; MG-ADL-T = Turkish version of the myasthenia gravis-activities of daily living scale.

Table 3. Relationship of MG-ADL-T to Quality of Life, Disease Status, and PFT.

Scale		MG-QoL-T	QMGS	MGC	VC%	FVC%	FEV1%
MG-ADL-T	*Rho*	.59	.58	.68	−.37	−.31	−.33
	p	<.001*	<.001*	<.001*	.017**	.048**	.033**

Note. MG-ADL-T = Turkish version of the myasthenia gravis-activities of daily living scale; PFT = pulmonary function test; MG-QoL-T = Turkish version of the myasthenia gravis quality-of-life; QMGS = quantitative myasthenia gravis score; MGC = myasthenia gravis composite; VC = vital capacity; FVC = forced vital capacity; FEV1 = forced expiratory volume in 1 second.
*$p < .001$. **$p < .05$.

reproducibility with similar T1 and T2 scores 4.88 ± 3.05, 4.88 ± 3.22, respectively.

Test–Retest Reliability

The internal consistency of the MG-ADL-T was fair, with a Cronbach alpha value of .67, a mean inter-item correlation of .21, and an item-total correlation for all items ranging from .18 to .58. Test–retest was carried out on all patients: the analysis showed correlation coefficients varying between .89 and .97 at the item level, and a value of .96 for the MG-ADL total score (all with $p < .001$); the ICC was .96 (95% CI = [0.93–0.98]; Table 2). And MDC value was 1.63 for MG-ADL.

Construct Validity

Spearman's correlation coefficients between the MG-ADL-T score and the MG-QoL-T, QMG, MGC, VC, FVC, FEV1 results were .59, .58, .68, .37, .31, and .33, respectively (Table 3). When the MG-ADL-T score distribution was analyzed according to the severity of MG, there was a significant difference between the MGFA ($p = .002$) and MGC severity groups ($p < .001$; Table 4).

Predictive Validity: ROC Analysis Results

The AUC value was 0.795, indicating a high degree of accuracy for MG-ADL-T. The optimal cutoff point for MG-ADL-T was set at 5.5 with 79.3% sensitivity and 61.9% specificity (Figure 1). The results demonstrated that MG-ADL-T had good performance in differentiating disease severity.

Table 4. MG-ADL-T Scores Categorized According to Disease Status.

	MG-ADL-T			
		Range		Median
Scale	*M* ± *SD*	Min	Max	(interquartile range)
MGC				
<4	1.57 ± 0.61	0	4	2 (0–3)
5–11	4.10 ± 0.51	0	9	4 (2–5.75)
>12	7.52 ± 0.61	3	11	8 (5.5–9.5)
MGFA				
Class I	2.16 ± 0.65	0	4	2 (0.75–4)
Class II	3.73 ± 0.58	0	9	4 (2–6)
Class III	6.33 ± 0.76	2	11	6 (3–9)
Class IV	7.50 ± 1.05	2	11	8 (5.5–10.25)

Note. M ± SD = Mean ± Standard Deviation; MG-ADL-T = Turkish version of the myasthenia gravis-activities of daily living scale; MGC = myasthenia gravis composite; MGFA = Myasthenia Gravis Foundation America Classification System; Min = minimum; Max = maximum.

Discussion

The aim of our study was to demonstrate the validity and reliability of the Turkish version of the MG-ADL scale in individuals with MG. MG-ADL-T enables the evaluation of

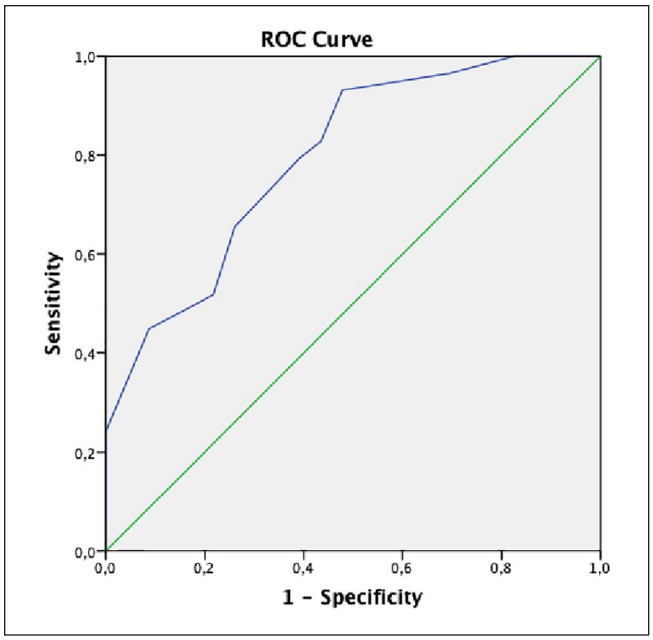

Figure 1. ROC for predicting mild versus moderate disability level.
Note. The optimum cutoff point was 5.5 point for MG-ADL-T with 79.3% sensitivity and 61.9% specificity. MG-ADL-T = Turkish version of Myasthenia Gravis-Activities of Daily Living Scale; ROC = receiver operating characteristic.

the symptom status and functional performance of the ADL and was found to be a valid and reliable scale in Turkish MG patients. The results of this study are important because MG-ADL-T is the only self-report scale that allows easy clinical evaluation of the ADL in these patients.

Internal consistency refers to the degree of interrelatedness among the scale items. The internal consistency should be low if the scale is multidimensional (Streiner et al., 2015). It has even been suggested not to use Cronbach's alpha if the scale is suspected of being multifaceted (Streiner, 2003). However, Cronbach's alpha has previously been used in the validity and reliability studies of MG-ADL in different languages and the value was .77 in Italian and Arabic versions (Alanazy et al., 2019; Raggi et al., 2017). In our study, we found Cronbach's alpha, which is the criterion used for internal consistency, to be .67. It is known that MG-ADL evaluates various aspects of the impairment caused by MG. This result was expected due to the multifaceted nature of the scale.

Test–retest reliability was excellent with an ICC of .96, indicating the reproducibility of MG-ADL-T. Test–retest results have also been found to be excellent in other languages (Alanazy et al., 2019; Lee et al., 2017; Raggi et al., 2017; Rozmilowska et al., 2018). The test–retest correlation of the MG-ADL-T was very high for all the items, similar to the original article, which reported a test–retest reliability of about 93.7% (Mukaka, 2012; Muppidi et al., 2011). Item-total correlations are the correlations between each item and the total score in the survey. All items should be correlated with the total score in a reliable scale. We found that all scale items except Items 5 and 6, related to brushing the teeth and combing hair, showed good correlation with the total score. These activities are more significantly affected later in the disease. We believe that this result may be due to the exclusion of MGFA Class V patients in the study.

The moderate correlation of the MG-ADL-T self-reported scale with MGC, QMGS, and MG-QoL15, indicating disease status, shows that it is a valid tool that can be used more frequently in clinical practice. Living with this chronic disease causes loss of functionality as well as decreases well-being, life satisfaction, and quality of life. In the previous study by Muppidi, a high degree of correlation was found between MG-ADL and MGC (r = 0.84; Muppidi et al., 2011). Raggi et al. (2017) also reported that MG-ADL and MGC results were well correlated. Alanazy et al. (2019) found a similar result as well. These results were expected, as MGC and MG-ADL share common evaluation parameters.

We found that MG-ADL-T was able to discriminate patients with various types and severity of disease as defined by MGC and MGFA. Raggi et al. (2017) also reported that MG-ADL was successful in distinguishing different disease severities according to MGC.

ROC effectively evaluates the performance of a diagnostic test (Kumar & Indrayan, 2011). It can be used to determine a suitable cutoff that affects the sensitivity and specificity of the test. The performance of the test increases as the curve approaches the upper left corner. According to our result, a score of 5.5 is critical in distinguishing patients with minimal and moderate disease severity. As far as we know, no set point has been identified in the other studies. In Muppidi's (2012) validation study, a 2-point change in the MG-ADL score was found to have the best balance between sensitivity and specificity. AUC is a global measure of the ability of a test to distinguish whether a particular condition exists. The ability of a diagnostic test to make this differentiation increases as the area becomes larger. The AUC value was 0.779 in our study but 0.90 in the original MG-ADL article (Muppidi, 2012).

In addition to all its positive properties, the MG-ADL has two important disadvantages. The first is that there is no item to assess effect of axial weakness (such as neck extension). Although neck extension weakness leads to head drop, the MG-ADL will not reflect this limitation at the activity level. Second, items in the MG-ADL test are scored linearly. Linear scoring may not reflect the different effect of dissimilar symptoms on ADL, as no weighting is made (Muppidi, 2012).

Our study had several limitations. The distribution of the patients to the groups was not balanced according to the MGFA classification. Patients were mostly in MGFA Class II or III. We could not include MGFA Class V patients as they

were intubated. Anxiety levels and fatigue conditions of the patients could be taken into consideration during patient selection. There may be patient selection bias due to conducting the study from a single center, exclusion of patient with MGFA Class V, and exclusion of coexisting medical conditions. In addition, lack of cultural adaptation can be considered as a limitation. However, cultural adaptation may not be needed as the scale does not contain any items that may cause cross-cultural differences such as habits, religion, or social work. Inclusion of patients was based on the wide range of disease duration. Patients with different disease durations from 1 to 29 years were included in the study. Many studies have shown that disease status is independent of the duration of the disease. While some patients may have severe MG symptoms in the early stages of the disease, some patients with long disease duration may show mild symptoms (Cejvanovic & Vissing, 2013).

Conclusion

MG-ADL is a primary and secondary outcome measure that is commonly used in both observational and clinical studies. The present study has demonstrated that the Turkish version of MG-ADL has fair internal consistency, excellent test–retest reliability, and moderate construct validity in ocular and generalized MG patients. Our results support its use both in daily practice and clinical trials to measure the limitations of the ADL due to MG. Determining the impairment in daily life activities is also very important for establishing occupational therapy and rehabilitation programs and evaluating the effectiveness of interventions.

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Conflict of Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Non-Interventional Clinical Research Ethics Committee of the Hacettepe University (Approval Number: GO 18/208)

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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References

Alanazy, M. H., Abuzinadah, A. R., & Muayqil, T. (2019). Translation and validation of the Arabic version of the myasthenia gravis activities of daily living scale. *Muscle & Nerve*, *59*(5), 583–586. https://doi.org/10.1002/mus.26435

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, *25*(24), 3186–3191. https://doi.org/10.1097/00007632-200012150-00014

Bedlack, R. S., Simel, D. L., Bosworth, H., Samsa, G., Tucker-Lipscomb, B., & Sanders, D. B. (2005). Quantitative myasthenia gravis score: Assessment of responsiveness and longitudinal validity. *Neurology*, *64*(11), 1968–1970. https://doi.org/10.1212/01.WNL.0000163988.28892.79

Bryman, A., & Cramer, D. (2000). *Quantitative data analysis with SPSS release 8 for Windows : A guide for social scientists*. Routledge.

Burns, T. M. (2010). History of outcome measures for myasthenia gravis. *Muscle & Nerve*, *42*(1), 5–13. https://doi.org/10.1002/mus.21713

Burns, T. M., Conaway, M., & Sanders, D. B. (2010a). The MG composite: A valid and reliable outcome measure for myasthenia gravis. *Neurology*, *74*(18), 1434–1440. https://doi.org/10.1212/wnl.0b013e3181dc1b1e

Burns, T. M., Conaway, M. R., Cutter, G. R., & Sanders, D. B. (2008). Construction of an efficient evaluative instrument for myasthenia gravis: The MG composite. *Muscle & Nerve*, *38*(6), 1553–1562. https://doi.org/10.1002/mus.21185

Burns, T. M., Grouse, C., Wolfe, G. I., Conaway, M. R., & Sanders, D. B. (2010b). The MG-QOL15 for following the health-related quality of life of patients with myasthenia gravis. *Muscle & Nerve*, *43*(1), 14–18. https://doi.org/10.1002/mus.21883

Cejvanovic, S., & Vissing, J. (2013). Muscle strength in myasthenia gravis. *Acta Neurologica Scandinavica*, *129*(6), 367–373. https://doi.org/10.1111/ane.12193

Gilhus, N. E. (2016). Myasthenia gravis. *New England Journal of Medicine*, *375*(26), 2570–2581. https://doi.org/10.1056/nejmra1602678

Gilhus, N. E., Skeie, G. O., Romi, F., Lazaridis, K., Zisimopoulou, P., & Tzartos, S. (2016). Myasthenia gravis-autoantibody characteristics and their implications for therapy. *Nature Reviews Neurology*, *12*(5), 259–268. https://doi.org/10.1038/nrneurol.2016.44

Howard, J. F., Freimer, M., Obrien, F., Wang, J. J., Collins, S. R., & Kissel, J. T. (2017). QMG and MG-ADL correlations: Study of eculizumab treatment of myasthenia gravis. *Muscle & Nerve*, *56*(2), 328–330. https://doi.org/10.1002/mus.25529

Jaretzki, A., Barohn, R. J., Ernstoff, R. M., Kaminski, H. J., Keesey, J. C., Penn, A. S., & Sanders, D. B. (2000). Myasthenia gravis: Recommendations for clinical research standards. *Neurology*, *55*(1), 16–23. https://doi.org/10.1212/wnl.55.1.16

Jeong, A., Min, J.-H., Kang, Y. K., Kim, J., Choi, M., Seok, J. M., & Kim, B. J. (2018). Factors associated with quality of life of people with myasthenia gravis. *PLOS ONE*, *13*(11), Article e0206754. https://doi.org/10.1371/journal.pone.0206754

King, M. T. (2011). A point of minimal important difference (MID): A critique of terminology and methods. *Expert Review*

of Pharmacoeconomics & Outcomes Research, *11*(2), 171–184. https://doi.org/10.1586/erp.11.9

Kumar, R., & Indrayan, A. (2011). Receiver operating characteristic (ROC) curve for medical researchers. *Indian Pediatrics*, *48*(4), 277–287. https://doi.org/10.1007/s13312-011-0055-4

Lee, H. L., Min, J.-H., Seok, J. M., Cho, E. B., Cho, H. J., Kim, Y.-D., & Kim, B. J. (2017). Physician- and self-assessed myasthenia gravis activities of daily living score. *Muscle & Nerve*, *57*(3), 419–422. https://doi.org/10.1002/mus.25764

Miller, M. R. (2005). Standardisation of spirometry. *European Respiratory Journal*, *26*(2), 319–338. https://doi.org/10.1183/09031936.05.00034805

Mokkink, L. B., Terwee, C. B., Patrick, D. L., Alonso, J., Stratford, P. W., Knol, D. L., . . . Vet, H. C. W. D. (2010). The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Quality of Life Research*, *19*(4), 539–549. https://doi.org/10.1007/s11136-010-9606-8

Mukaka, M. (2012). Statistics Corner: A guide to appropriate use of Correlation coefficient in medical research. *Malawi Medical Journal*, *24*(3), 69–71. https://doi.org/10.4314/mmj.v24i3

Muppidi, S. (2012). The myasthenia gravis-specific activities of daily living profile. *Annals of the New York Academy of Sciences*, *1274*(1), 114–119. https://doi.org/10.1111/j.1749-6632.2012.06817.x

Muppidi, S. (2017). Outcome measures in myasthenia gravis. *Journal of Clinical Neuromuscular Disease*, *18*(3), 135–146. https://doi.org/10.1097/cnd.0000000000000156

Muppidi, S., Wolfe, G. I., Conaway, M., & Burns, T. M. (2011). MG-ADL: Still a relevant outcome measure. *Muscle & Nerve*, *44*(5), 727–731. https://doi.org/10.1002/mus.22140

Raggi, A., Antozzi, C., Baggi, F., Leonardi, M., Maggi, L., & Mantegazza, R. (2017). Validity, reliability, and sensitivity to change of the myasthenia gravis activities of daily living profile in a sample of Italian myasthenic patients. *Neurological Sciences*, *38*(11), 1927–1931. https://doi.org/10.1007/s10072-017-3083-6

Raggi, A., Leonardi, M., Schiavolin, S., Antozzi, C., Brenna, G., Maggi, L., & Mantegazza, R. (2016). Validation of the MG-DIS: A disability assessment for myasthenia gravis. *Journal of Neurology*, *263*(5), 871–882. https://doi.org/10.1007/s00415-016-8072-9

Rozmilowska, I. M., Adamczyk-Sowa, M. H., & Czyzewski, D. (2018). The myasthenia gravis-specific activities of daily living scale as a useful outcome measure and in routine clinical management in Polish patients. *Neurologia i Neurochirurgia Polska*, *52*(3), 368–373. https://doi.org/10.1016/j.pjnns.2017.12.012

Salci, Y., Karanfil, E., Balkan, A. F., Kütükçü, E. Ç., Ceren, A. N., Ayvat, F., Bekircan-Kurt, C. E., & Armutlu, K. (2018). Functional exercise capacity evaluated by timed walk tests in myasthenia gravis. *Muscle & Nerve*, *59*(2), 208–212. https://doi.org/10.1002/mus.26345

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients. *Anesthesia & Analgesia*, *126*(5), 1763–1768. https://doi.org/10.1213/ane.0000000000002864

Streiner, D. L. (2003). Starting at the beginning: An introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment*, *80*(1), 99–103. https://doi.org/10.1207/s15327752jpa8001_18

Streiner, D. L., Cairney, J., & Norman, G. R. (2015). *Health measurement scales: A practical guide to their development and use*. Oxford University Press.

Taşcilar, N. F., Saraçli, Ö., Kurçer, M. A., Ankarali, H., & Emre, U. (2016). Reliability and validity of the Turkish version of myasthenia gravis-quality of life questionnaire-15 item. *Turkish Journal of Medical Sciences*, *46*, 1107–1113. https://doi.org/10.3906/sag-1504-97

Tascilar, N. F., Saracli, O., Kurcer, M. A., Ankarali, H., & Emre, U. (2017). Is there any relationship between quality of life and polysomnographically detected sleep parameters/disorders in stable myasthenia gravis? *Acta Neurologica Belgica*, *118*(1), 29–37. https://doi.org/10.1007/s13760-017-0787-6

Wolfe, G. I., Herbelin, L., Nations, S. P., Foster, B., Bryan, W. W., & Barohn, R. J. (1999). Myasthenia gravis activities of daily living profile. *Neurology*, *52*(7), 1487–1487. https://doi.org/10.1212/wnl.52.7.1487

Yildiz Celik, S., Durmus, H., Yilmaz, V., Saruhan Direskeneli, G., Gulsen Parman, Y., Serdaroglu Oflazer, P., & Deymeer, F. (2019). Late-onset generalized myasthenia gravis: Clinical features, treatment, and outcome. *Acta Neurologica Belgica*, *120*(1), 133–140. https://doi.org/10.1007/s13760-019-01252-x