The analysis of quality of life using SF-36 among patients with myasthenia gravis in South Korea

Juhyeon Kim

Gyeongsang National University Hospital <https://orcid.org/0000-0001-6466-375X>

Jin Myoung Seok

Suncheonhyang Daehakgyo Cheonan Byeongwon: Soonchunhyang University Hospital Cheonan

Misong Choi

Samsung Medical Center Department of Neurology

Byoung Joon Kim

Samsung Medical Center Department of Neurology

Ansuk Jeong

University of Utah

Ju-Hong Min (✉ juhongm@skku.edu)

Samsung Medical Center, Sungkyunkwan university school of medicine <https://orcid.org/0000-0002-7338-9067>

Research

Keywords: myasthenia gravis, quality of life, MG-ADL, SF-36, South Korea

Posted Date: March 2nd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-256967/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Purpose

Patients with Myasthenia gravis (MG) have poor health related quality of life (HRQoL), which negatively affects their activities of daily living. The purpose of this study was to analyze factors affecting HRQoL in patients with MG using the 36-Item Short-Form Health Survey (SF-36).

Methods

We prospectively studied patients with confirmed diagnosis of MG. Patients, who presented to the neuromuscular outpatient clinic, at a Samsung medical center in South Korea in a four-month period. Severity of MG was assessed by the Myasthenia Gravis Composite Scale (MGCS) and HRQoL was assessed by the 36-Item Short-Form Health Survey (SF-36) and activities of daily living was assessed by the Korean version of Myasthenia Gravis-specific Activities of Daily Living scale (K-MG-ADL).

Results

A total of 120 patients with MG were invited to participate in the study.

We analyzed the difference of SF-36 score according to demographic and clinical characteristics in our MG patients. Significant differences were found according to sex, career change, marital status, MG type, and thymoma.

Conclusion
By analyzing the specifics of the HRQoL, the current study demonstrated that this should be reflected in the treatment guidelines for MG patients.

Introduction

Myasthenia gravis (MG) is a chronic autoimmune disease in which antibodies bind to acetylcholine receptors or to functionally related molecules (muscle-specific kinase, low-density lipoprotein receptor-related protein 4, agrin, cortactin) in the postsynaptic membrane at the neuromuscular junction. The antibodies induce weakness of skeletal muscles, which is the only disease manifestation.¹ Fluctuations in severity of muscle weakness are typical, and increased weakness with continued muscle activity represents a diagnostic clue for myasthenia gravis, but these clinical features can vary.² In about two-thirds of the patients, the involvement of extrinsic ocular muscles presents as the initial symptom, usually progressing to involve other bulbar muscles and limb musculature, resulting in generalized myasthenia gravis (GMG). In about 10% of myasthenia gravis patients, symptoms are limited to extrinsic ocular muscles, with the resultant condition called ocular MG (OMG).³ Symptomatic, immunoactive, and supportive approaches to treatment have a very good effect and the prognosis for strength, functional abilities, quality of life, and survival is generally good.^{1,4}

Myasthenia gravis affects patients' quality of life because it is a chronic disease and the duration of treatment is long. Several studies have been published on the relationship between myasthenia gravis and quality of life. There were several studies using Medical Outcome Survey 36-Item Short-Form Health Survey (SF-36) to assess the health-related quality of life (HRQoL). It has been reported that Osserman scale of MG affects Physical

Composite Score (PCS) of SF-36, but does not affect Mental Composite Score (MCS) of SF-36,⁵ and there is also report that severe form of Myasthenia Gravis Foundation of America (MGFA) classification affected both PCS and MCS.^{6–9}

Among Korean patients with MG, the specifics of HRQoL have not been investigated so far, so we analyzed the subscales of SF-36 to identify the factors affecting HRQoL and to help the treatment.¹⁰

Methods

Subjects

We prospectively studied consecutive patients with MG, who visited Samsung Medical Center from April to July, 2017. MG was diagnosed when they had MG-specific symptoms and/or at least one positive result in acetylcholine receptor antibody (Ach receptor Ab) titer, repetitive nerve stimulation (RNS) test or neostigmine test. All the elements of the questionnaire were written by the patients themselves, and MGCS and K-MG-ADL were assessed by the same day neurologist.

The protocol was approved by Samsung Medical Center Institutional Review Board. Each subject signed a written informed consent.

Measures

The MGCS was used to measure the clinical status and outcome.¹¹ MGCS score ranges from 0 to 50, with higher score suggesting more severe symptoms of MG. And the HRQoL was assessed by the SF-36. The SF-36 includes one multi-item scale measuring each of eight health scales: physical functioning (PF), role functioning physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role functioning emotional (RE) and mental health (MG). Among them, PF, RP, BP and GH are composed of PCS subscale, and VT, SF, RE and MG are composed of MCS subscale. Each subscale ranges from 0 to 100, and the higher the score, the better the QOL.^{12–14} And ADL was assessed by K-MG-ADL validated in Korean.^{15, 16} K-MG-ADL score ranges from 0 to 24, with higher score suggesting more interference in daily living activities due to MG

Demographics include age, sex, height, weight, Body Mass Index (BMI), duration of MG, living arrangement, income, career change due to MG, education level (below elementary, middle, high, above university) and marital status (single, married, divorced, widowed). The clinical types of MG were divided into OMG and GMG, and the thymoma was also divided into no thymoma, thymic hyperplasia, thymoma, and thymic cancer. Positive Ach receptor Ab or RNS were also collected.

Statistical analysis

Descriptive statistics and frequency analysis were used to examine demographic data. Using linear regression analysis, demographics, MGCS and K-MG-ADL variables that have significant effects on PCS and MCS were identified. Student's *t* test, one-way ANOVA, Tukey and Dunnett's T3 *post hoc* tests were used to compare the scores of eight domains and two composite scales from SF-36. The data are presented as the mean plus/minus standard deviation, and $P < 0.05$ was considered significant. All data analyses were performed using IBM SPSS Statistics for Windows (version 24.0; IBM Corp. Armonk, NY, USA).

Results

Demographic data

A total of 120 patients with MG (female, 60%; mean age, 55.65 ± 12.90 years) were enrolled in this study. At inclusion, 68 patients (56.7%) had generalized MG and 52 patients (43.3%) had ocular MG. 93 patients (77.5%) were Ach receptor Ab positive and 84 patients (70%) were RNS positive. 27 patients (22.5%) lived alone, 45 patients (37.5%) changed their occupation due to MG, and 6 (5.0%) had medical subsidies. Thymoma was found in 42 patients (35%), thymic cancer in 2 patients (1.7%), thymic hyperplasia in 18 patients (15%), and a normal thymus in 58 patients (48.3%). At the level of education, there were 10 patients (8.3%) under elementary school graduation, 9 patients (7.5%) middle school graduates, 46 patients (38.3%) high school graduates, and 54 patients (45%) undergraduate students. There were 19 patients (15.8%) unmarried, 86 patients (71.7%) married, 4 patients (3.3%) divorced and 7 patients (5.8%) widowed in the marriage status. Demographic and clinical features are shown in Table 1.

Table 1
Baseline characteristics

Variable		Value
Age (years)		55.65 ± 15.90
Height (cm)		161.66 ± 8.24
Sex	Male	48 (40%)
	Female	72 (60%)
Weight (kg)		65.66 ± 14.80
BMI (kg/m ²)		25.00 ± 4.47
Duration of MG (years)		8.43 ± 7.41
MGCS (0–50)		3.74 ± 3.86
K-MG-ADL (0–24)		3.18 ± 2.63
MG type	Ocular	52 (43.3%)
	Generalized	68 (56.7%)
Positive Ach receptor Ab		93 (77.5%)
Positive RNS		84 (70%)
Living arrangement	Alone	27 (22.5%)
	With spouse	82 (68.3%)
Career change due to MG		45 (37.5%)
Insurance	Medical subsidies	6 (5.0%)
	National health insurance and/or private insurance	104 (86.7%)
Thymoma	No thymoma	58 (48.3%)
	Thymic hyperplasia	18 (15%)
	Thymoma	42 (35%)
	Thymic cancer	2 (1.7%)
Education	Below elementary	10 (8.3%)
	Middle	9 (7.5%)
	High	46 (38.3%)

Values are mean plus/minus standard deviation or number (%)

Abbreviations used are as follows: BMI (Body Mass Index), MG (Myasthenia Gravis), MGCS (Myasthenia Gravis Composite Score), K-MG-ADL (Korean version of Myasthenia Gravis-specific Activities of Daily Living scale), Ach receptor Ab (Acetylcholine receptor Antibodies), RNS (Repetitive Nerve Stimulation), SF-36 (36-Item Short-Form Health Survey)

Variable		Value
	Above university	54 (45%)
Marital status	Single	19 (15.8%)
	Married	86 (71.7%)
	Divorced	4 (3.3%)
	Widowed	7 (5.8%)
SF-36	Physical Functioning	68.70 ± 22.76
	Role Physical	66.47 ± 28.47
	Bodily Pain	70.71 ± 26.76
	General Health	48.65 ± 20.56
	Vitality	53.24 ± 25.59
	Social Functioning	72.06 ± 27.98
	Role Emotional	71.19 ± 27.32
	Mental Health	69.71 ± 21.80
	Physical Composite Score	46.13 ± 8.08
	Mental Composite Score	46.85 ± 11.02
Values are mean plus/minus standard deviation or number (%)		
Abbreviations used are as follows: BMI (Body Mass Index), MG (Myasthenia Gravis), MGCS (Myasthenia Gravis Composite Score), K-MG-ADL (Korean version of Myasthenia Gravis-specific Activities of Daily Living scale), Ach receptor Ab (Acetylcholine receptor Antibodies), RNS (Repetitive Nerve Stimulation), SF-36 (36-Item Short-Form Health Survey)		

SF-36 scales

The mean scores and standard deviation of SF-36 scales of our MG patients are shown in Fig. 1. The highest mean score was SF, and the lowest was GH. And the mean score of MCS was higher than that of PCS.

Table 2 and Fig. 2 show the mean scores of the SF-36 according to demographic (sex, education, career change, marital status, living alone) and clinical (MG type, Thymoma) characteristics in our MG patients. Significant differences were found between male and female in PF ($p < 0.001$), RP ($p = 0.017$), BP ($p < 0.001$), GH ($p = 0.044$), SF ($p = 0.008$), PCS ($p < 0.001$). And there were significant differences in all SF-36 dimensions, PCS, and

MCS between the groups with and without occupational changes: PF ($p = 0.005$), RP ($p = 0.003$), BP ($p < 0.001$), GH ($p < 0.001$), VT ($p = 0.001$), SF ($p = 0.009$), RE ($p = 0.015$), MH ($p = 0.028$), PCS ($p < 0.001$), MCS ($p = 0.014$). In the analysis according to marital status, data show a significant difference between single and divorced, married and divorced in MH ($p = 0.023$). But there was no significant difference according to the education level and between living alone and living with a partner. In the analysis according to MG type, there were significant differences in PF ($p = 0.043$), RP ($p = 0.014$), BP ($p = 0.047$) and PCS ($p = 0.018$) between OMG and GMG. And there was a significant difference between no thymoma and thymic hyperplasia in GH ($p = 0.037$).

Table 2

Mean scores for the SF-36 factors in MG patients according to demographic and clinical characteristics

Variable	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Sex										
Male	76.97 ± 17.01	73.96 ± 25.92	81.85 ± 19.86	53.26 ± 19.69	58.55 ± 22.30	79.95 ± 23.03	76.56 ± 24.89	73.75 ± 18.20	49.42 ± 6.11	48.71 ± 9.10
Female	63.11 ± 24.51	61.34 ± 29.17	63.18 ± 28.28	45.53 ± 20.68	49.65 ± 27.16	66.73 ± 29.88	67.50 ± 28.45	66.97 ± 23.67	43.88 ± 8.51	45.58 ± 12.06
<i>P</i>	< 0.001	0.017	< 0.001	0.044	0.062	0.008	0.077	0.096	< 0.001	0.111
Education										
Below elementary	64.66 ± 24.30	62.50 ± 33.07	69.00 ± 27.33	52.70 ± 18.67	55.00 ± 29.43	57.50 ± 40.48	65.74 ± 34.72	74.50 ± 21.79	46.57 ± 6.97	47.00 ± 13.57
Middle	56.73 ± 22.31	51.39 ± 30.74	54.89 ± 28.41	52.86 ± 23.56	48.38 ± 24.36	80.56 ± 24.30	59.26 ± 27.15	80.83 ± 19.20	40.22 ± 10.21	50.14 ± 7.67
High	70.12 ± 19.96	71.11 ± 25.26	75.27 ± 25.86	49.89 ± 19.04	58.06 ± 24.84	79.72 ± 19.45	76.67 ± 24.53	71.56 ± 18.37	46.94 ± 7.46	49.10 ± 9.92
Above university	69.78 ± 24.58	65.16 ± 29.48	69.33 ± 26.68	46.10 ± 21.97	50.00 ± 25.87	68.28 ± 29.11	68.98 ± 27.92	65.51 ± 24.41	46.17 ± 8.12	44.59 ± 11.68
<i>P</i>	0.381	0.262	0.201	0.632	0.426	0.090	0.239	0.164	0.149	0.176
Career change										
Change	61.15 ± 24.10	56.25 ± 26.93	59.73 ± 27.46	39.43 ± 19.65	43.56 ± 23.66	63.35 ± 26.47	63.18 ± 27.89	63.98 ± 21.17	42.445 ± 8.31	43.59 ± 9.99
No change	73.13 ± 20.85	72.33 ± 27.82	77.16 ± 24.29	54.06 ± 19.21	58.92 ± 25.11	77.17 ± 27.75	75.78 ± 26.07	73.07 ± 21.61	48.24 ± 7.18	48.72 ± 11.21
<i>P</i>	0.005	0.003	< 0.001	< 0.001	0.001	0.009	0.015	0.028	< 0.001	0.014
Marital status										

Abbreviations used are as follows: SF-36 (36-Item Short-Form Health Survey), MG (Myasthenia gravis), PF (physical functioning), RP (role functioning physical), BP (bodily pain), GH (general health), VT (vitality), SF (social functioning), RE (role functioning emotional), MH (mental health), PCS (physical composite score), MCS (mental composite score), OMG (ocular myasthenia gravis), GMG (generalized myasthenia gravis)

Variable	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Single	75.67 ± 18.98	65.94 ± 31.18	71.2 ± 28.20	44.89 ± 22.44	54.06 ± 27.68	73.75 ± 26.87	71.25 ± 28.42	70.50 ± 23.05	46.60 ± 8.53	46.70 ± 11.50
Married	69.17 ± 22.55	68.97 ± 26.40	72.04 ± 26.09	49.44 ± 20.35	54.75 ± 24.43	75.88 ± 24.30	74.31 ± 24.65	71.74 ± 19.62	46.36 ± 8.00	48.34 ± 9.70
Divorced	57.19 ± 19.74	62.5 ± 32.27	50.25 ± 26.06	49.75 ± 31.95	34.38 ± 38.70	50.00 ± 45.64	64.58 ± 31.46	38.75 ± 41.51	45.07 ± 6.94	35.23 ± 21.08
Widowed	53.43 ± 28.61	51.79 ± 30.13	62.14 ± 27.79	52.29 ± 11.66	53.57 ± 23.62	57.14 ± 37.40	46.43 ± 36.91	63.57 ± 21.35	43.75 ± 8.08	41.48 ± 13.28
<i>P</i>	0.103	0.448	0.350	0.802	0.487	0.094	0.061	0.023	0.848	0.051
Living alone										
Living alone	69.39 ± 23.59	68.06 ± 27.26	67.63 ± 28.09	43.66 ± 20.39	56.71 ± 24.33	70.37 ± 26.89	69.75 ± 23.70	67.04 ± 22.20	45.81 ± 7.22	46.09 ± 9.76
Living together	68.50 ± 22.64	66.00 ± 28.95	71.62 ± 26.45	50.11 ± 20.48	52.22 ± 25.99	72.55 ± 28.42	71.61 ± 28.41	70.49 ± 21.75	46.23 ± 8.35	47.08 ± 11.41
<i>P</i>	0.859	0.744	0.498	0.152	0.425	0.723	0.758	0.472	0.815	0.685
MG type										
OMG	73.47 ± 20.59	73.68 ± 28.12	76.10 ± 23.11	51.40 ± 20.06	58.29 ± 23.41	76.20 ± 26.92	74.52 ± 27.98	73.56 ± 17.61	48.05 ± 7.07	48.42 ± 9.91
GMG	65.00 ± 23.81	60.80 ± 27.64	66.54 ± 28.76	46.51 ± 20.83	49.32 ± 26.68	68.84 ± 28.57	68.56 ± 26.71	66.72 ± 24.28	44.62 ± 8.54	45.62 ± 11.75
<i>P</i>	0.043	0.014	0.047	0.199	0.057	0.156	0.241	0.078	0.018	0.171
Thymoma										
No thymoma	73.98 ± 19.31	69.94 ± 26.50	75.83 ± 24.25	53.65 ± 20.34	56.43 ± 25.87	78.88 ± 23.32	73.71 ± 25.16	71.03 ± 20.41	48.22 ± 7.13	47.82 ± 10.51
Thymic hyperplasia	64.88 ± 26.61	69.85 ± 31.11	61.61 ± 28.97	39.14 ± 21.73	43.75 ± 27.87	68.75 ± 31.87	70.59 ± 30.06	65.14 ± 27.18	44.68 ± 8.48	45.01 ± 12.79

Abbreviations used are as follows: SF-36 (36-Item Short-Form Health Survey), MG (Myasthenia gravis), PF (physical functioning), RP (role functioning physical), BP (bodily pain), GH (general health), VT (vitality), SF (social functioning), RE (role functioning emotional), MH (mental health), PCS (physical composite score), MCS (mental composite score), OMG (ocular myasthenia gravis), GMG (generalized myasthenia gravis)

Variable	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Thymoma	63.21 ± 24.82	60.67 ± 30.31	67.22 ± 28.28	45.51 ± 19.10	53.05 ± 23.97	64.02 ± 30.26	67.68 ± 29.42	69.33 ± 21.40	43.91 ± 8.77	46.08 ± 10.93
Thymic cancer	62.51 ± 3.54	56.25 ± 8.84	76.00 ± 33.94	53.50 ± 12.02	50.00 ± 26.52	68.75 ± 44.19	75.00 ± 35.36	80.00 ± 28.28	43.44 ± 1.59	50.14 ± 19.21
<i>P</i>	0.051	0.387	0.173	0.037	0.336	0.067	0.754	0.696	0.053	0.733
Abbreviations used are as follows: SF-36 (36-Item Short-Form Health Survey), MG (Myasthenia gravis), PF (physical functioning), RP (role functioning physical), BP (bodily pain), GH (general health), VT (vitality), SF (social functioning), RE (role functioning emotional), MH (mental health), PCS (physical composite score), MCS (mental composite score), OMG (ocular myasthenia gravis), GMG (generalized myasthenia gravis)										

Predictors of QOL in MG patients

Older age, women, generalized MG type and career change were significant predictors of low PCS, while career change, shorter duration of MG, non-married (single, divorced, separated, widowed), medical subsidies and lower K-MG-ADL were significant predictors of low MCS (Table 3).

Table 3
Multiple linear regression between two composite scores (PCS, MCS) and several variables.

	PCS			MCS		
	R	<i>P</i>	95% CI	R	<i>P</i>	95% CI
Age	-0.115	0.019	(-0.221 - -0.019)			
Gender	-3.962	0.007	(-6.837 - -1.088)			
MG type	-3.165	0.029	(-5.990 - -0.339)			
Career change	-5.105	0.001	(-8.021 - -2.190)	-6.174	0.002	(-10.047 - -2.300)
Duration of MG				0.448	0.001	(0.178 - 0.718)
Marital status				-5.946	0.020	(-10.941 - -0.952)
Insurance				-10.698	0.009	(-18.683 - -2.714)
K-MG-ADL				-1.778	0.037	(-3.450 - -0.105)
R, regression coefficient; <i>P</i> , p value; CI, confidence interval						

Discussion

It is well known that MG is a chronic disease that causes physical symptoms such as weakness of various muscles, and the quality of life is deteriorated because of the long and varied course of the disease.^{5-7,17,18} The quality of life should be considered both physical and mental factors. In our study, the mean score of MCS was higher than that of PCS, but other studies showed that PCS was high,^{6,8,9,17} while MCS was higher.^{19,20} The recent increase in interest in mental health and the increased use of psychiatric medication is explained by

the reason that MCS scores are higher than PCS.⁹ And our MG patients showed the lowest score in GH, which may be attributed to the characteristics of Koreans that MG patients are generally distrusted about their health. But the mean score of SF was the highest on the SF-36 scale, which may be related to the atmosphere of family and social relations in Korean society.

First, we analyzed the HRQoL of patients with MG according to demographics. Women had lower mean scores on all scales than men, with statistically significant differences in PF, RP, BP, GH, SF, and PCS. Although mean score of PCS is higher in women than in men,⁸ it is generally similar to our study in other papers.^{9,19} This suggests that women are more affected physically than men in terms of the HRQoL, which can be thought of as the difference in physical ability of men and women.

There was no statistically significant difference in all domains of SF-36 between the levels of below elementary school graduation, middle school graduation, high school graduation, above university graduation, when the difference in HRQoL according to educational level difference was examined. In other papers, the higher the academic level, the higher the mean score of BP or PCS.^{8,9} but the Korean patients do not seem to have a difference in educational level or HRQoL according to MG.

In the case of 'career change' or 'change to another career' as 'career change', mean scores of all domains of SF-36, PCS and MCS were statistically significantly lower in 'career change'. This suggests that both physical and mental aspects of severity of myasthenia gravis impact on job cuts or job changes. There was a study on the SF-36 scale according to occupation,⁹ but no analysis of the SF-36 scale according to the job change was found in the previous study.

And we analyzed the difference of HRQoL according to marital status. In the majority of the domains, there was no difference. But in the MH domain, the divorced patients showed lower mean scores than the other marriage types. There was a similar tendency in mental domains of SF-36, and the mean score of MCS was similar ($p = 0.051$), although it was not statistically significant. This can be interpreted as a result of divorce, in which there is a greater sense of loss with no spouse to depend mentally. In other articles, the divorced group was statistically significantly lower in all domains except MH than the married group.⁸ However, there was no significant difference in all domains of SF-36 when compared with the case of living alone and the other living together.

Next, we analyzed the HRQoL of MG patients with MG according to clinical features including MG type and thymoma. The mean scores of PF, RP, BP and PCS in GMG were lower than those of OMG, when comparing two composite scores and domains of SF-36 according to OMG and GMG. In contrast, MCS and its four domains did not differ. This suggests that muscle weakness and bulbar symptoms of GMG have a negative impact on mental aspects of quality of life rather than physical aspects. In other articles, the mean scores of PF, RP, and BP in GMG were significantly lower than those in OMG, and the mean scores of VT, SF, and MCS were also significantly lower in GMG.⁹ However, overall trends were similar.

Finally, we compared the difference in quality of life between the presence and absence of thymoma and diagnosis. Thymoma was divided into thymic hyperplasia, thymoma, and thymic cancer. In another article they did an analysis according to whether they were thymectomy. However, we classified only by diagnosis and did not show statistically significant difference in other domains except GH. In GH, there is a significant difference

between no-thymoma group and thymic hyperplasia group, so it is not clinically meaningful. Other previous studies have shown no significant difference between the groups with and without thymoma, and no difference between the groups with and without thymectomy.^{6, 8, 9}

In Our study, older age, women, GMG and career change were significant predictors of low PCS. Other studies have also reported that older age is a predictor of low HRQoL, particularly PCS.^{8, 9, 18, 21} And career change, shorter duration of MG, non-married (single, divorced, separated, widowed), medical subsidies and lower K-MG-ADL were significant predictors of low MCS. (Table 3). Career changes that have not been covered in other studies have been predictors of low MCS and PCS. As explained earlier in the paragraph, both physical pain and mental factors influence career change. In another study, longer duration of MG was predictive of low PCS,¹⁸ but in our study shorter duration of MG was predictive of low MCS, which may be associated with psychological anxiety at the initial stage of diagnosis. In other studies, the higher the severity of MG, the more likely a predictor of lower HRQoL,^{5, 6, 8, 9, 17, 18, 21} In our study, severity of MG was not a predictor of low HRQoL. Rather, low ADL has been shown to affect low MCS. ADL may be thought to be associated with PCS, but if the ADL falls, then the HRQoL of the mental side appears to be falling, which is hard to find in other studies.

Our study has the advantage of uncovering what has not been revealed in other studies, but it also has limitations. It is a cross-sectional study that recruited patients from one institution. Therefore, there are limitations in representing all patient groups in Korea, and there are also limitations because they are selectively collected at a specific time.

Conclusion

We investigated and analyzed demographics, severity of MG, ADL and HRQoL of patients with MG that had never been studied in Korea. And identified factors affecting HRQoL such as age, sex, career change, duration of MG and ADL. We found that career change is a predictor of HRQoL in terms of physical and mental aspects and that ADL affects the HRQoL on the mental side. Therefore, it should be reflected in the treatment guidelines to improve the quality of life in physical and mental aspects, and neurologists should pay attention not only to the clinical treatment but also to the quality of life of patients.

Declarations

Acknowledgements

Not applicable.

Authors' contributions

JK, JA and JHM conceived the study; JK, JMS, MC and BJK planned and conducted data analysis; the manuscript was drafted by JK and JMS, and MC, BJK, JA and JHM revised it. All authors read and approved the final manuscript.

Funding

This study was not funded.

Availability of data and materials

Data is available on reasonable request.

Ethical approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional/National research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interests.

References

1. Gilhus NE. Myasthenia Gravis. *N Engl J Med*. 2017;376(13):e25. doi:10.1056/NEJMc1701027.
2. Gilhus NE, Verschuuren JJ. Myasthenia gravis: subgroup classification and therapeutic strategies. *Lancet Neurol*. 2015;14(10):1023–36. doi:10.1016/s1474-4422(15)00145-3.
3. Jayam Trough A, Dabi A, Solieman N, Kurukumbi M, Kalyanam J. (2012). Myasthenia gravis: a review. *Autoimmune Dis*, 2012, 874680. doi:10.1155/2012/874680.
4. Sanders DB, Wolfe GI, Benatar M, et al. International consensus guidance for management of myasthenia gravis: Executive summary. *Neurology*. 2016;87(4):419–25. doi:10.1212/wnl.0000000000002790.
5. Paul RH, Nash JM, Cohen RA, Gilchrist JM, Goldstein JM. Quality of life and well-being of patients with myasthenia gravis. *Muscle Nerve*. 2001;24(4):512–6.
6. Padua L, Evoli A, Aprile I, Caliandro P, Mazza S, Padua R, Tonali P. Health-related quality of life in patients with myasthenia gravis and the relationship between patient-oriented assessment and conventional measurements. *Neurol Sci*. 2001;22(5):363–9. doi:10.1007/s100720100066.
7. Kulkantrakorn K, Sawanyawisuth K, Tiamkao S. Factors correlating quality of life in patients with myasthenia gravis. *Neurol Sci*. 2010;31(5):571–3. doi:10.1007/s10072-010-0285-6.
8. Basta IZ, Pekmezovic TD, Peric SZ, Kistic-Tepavcevic DB, Rakocevic-Stojanovic VM, Stevic ZD, Lavrnjic DV. Assessment of health-related quality of life in patients with myasthenia gravis in Belgrade (Serbia). *Neurol Sci*. 2012;33(6):1375–81. doi:10.1007/s10072-012-1170-2.
9. Yang Y, Zhang M, Guo J, et al. Quality of life in 188 patients with myasthenia gravis in China. *Int J Neurosci*. 2016;126(5):455–62. doi:10.3109/00207454.2015.1038712.
10. Jeong A, Min JH, Kang YK, Kim J, Choi M, Seok JM, Kim BJ. Factors associated with quality of life of people with Myasthenia Gravis. *PLoS One*. 2018;13(11):e0206754. doi:10.1371/journal.pone.0206754.

11. Burns TM, Conaway M, Sanders DB. The MG Composite: A valid and reliable outcome measure for myasthenia gravis. *Neurology*. 2010;74(18):1434–40. doi:10.1212/WNL.0b013e3181dc1b1e.
12. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30(6):473–83.
13. Nam BH, Lee SU. Testing the Validity of the Korean SF-36 Health Survey. *J Health Info Stat*. 2003;28(2):3–24.
14. Han CW, Lee EJ, Iwaya T, Kataoka H, Kohzuki M. Development of the Korean version of Short-Form 36-Item Health Survey: health related QOL of healthy elderly people and elderly patients in Korea. *Tohoku J Exp Med*. 2004;203(3):189–94.
15. Muppidi S. The myasthenia gravis–specific activities of daily living profile. *Ann N Y Acad Sci*. 2012;1274:114–9. doi:10.1111/j.1749-6632.2012.06817.x.
16. Lee HL, Min JH, Seok JM, Cho EB, Cho HJ, Kim YD, Kim BJ. Physician- and self-assessed myasthenia gravis activities of daily living score. *Muscle Nerve*. 2017. doi:10.1002/mus.25764.
17. Leonardi M, Raggi A, Antozzi C, Confalonieri P, Maggi L, Cornelio F, Mantegazza R. The relationship between health, disability and quality of life in myasthenia gravis: results from an Italian study. *J Neurol*. 2010;257(1):98–102. doi:10.1007/s00415-009-5279-z.
18. Twork S, Wiesmeth S, Klewer J, Pohlau D, Kugler J. Quality of life and life circumstances in German myasthenia gravis patients. *Health Qual Life Outcomes*. 2010;8:129. doi:10.1186/1477-7525-8-129.
19. Boldingh MI, Dekker L, Maniaol AH, et al. An up-date on health-related quality of life in myasthenia gravis - results from population based cohorts. *Health Qual Life Outcomes*. 2015;13:115. doi:10.1186/s12955-015-0298-1.
20. Koopman WJ, LeBlanc N, Fowler S, Nicolle MW, Hulley D. Hope, Coping, and Quality of Life in Adults with Myasthenia Gravis. *Can J Neurosci Nurs*. 2016;38(1):56–64.
21. Mullins LL, Carpentier MY, Paul RH, Sanders DB. Disease-specific measure of quality of life for myasthenia gravis. *Muscle Nerve*. 2008;38(2):947–56. doi:10.1002/mus.21016.

Figures

Figure 1

The mean scores and standard deviation of SF-36 scales of MG patients

Figure 2

The mean scores of the SF-36 according to demographic (sex, education, career change, marital status, living alone) and clinical (MG type, Thymoma) characteristics in MG patients