MULTIPLE SCLEROSIS JOURNAL | MSJ

Short Report

Impact of neurological impairment, depression, cognitive function and coping on quality of life of people with multiple sclerosis: A relative importance analysis

Multiple Sclerosis Journal
1–5
DOI: 10.1177/1352458514562439

Eduardo Fernández-Jiménez and Peter A. Arnett

Correspondence to:
Peter A Arnett
Department of Psychology; Pennsylvania State University, 352 Moore Building, University Park, PA 16802–3106, USA
paa6@psu.edu

E Fernández-Jiménez
Department of Personality, Assessment and Psychological Treatment; University of Seville; Spain

PA Arnett
Department of Psychology; Pennsylvania State University, University Park, PA, USA

Abstract

Background: Determining the relative importance of factors that predict quality of life (QoL) in people with multiple sclerosis (MS) must be addressed through multiple regression metrics, e.g. relative weights, which are designed to solve colinearity problems.

Objective: We aimed to compare disease variables, Expanded Disability Status Scale (EDSS), depressive symptomatology (BDI-FS), cognitive performance and coping in predicting MS patients' QoL, using relative weights.

Methods: We assessed 97 patients with MS, using the Functional Assessment of MS (FAMS) as the criterion.

Results: EDSS predicted global and physical QoL domains, whereas BDI-FS predicted general contentment and global QoL.

Conclusion: EDSS and BDI-FS are relevant determinants of QoL in people with MS.

Keywords: Cognitive function, coping, depression, Expanded Disability Status Scale, multiple sclerosis, predictive model, relative importance, relative weight, quality of life measures

Date received: 16 June 2014; accepted: 9 November 2014

Introduction

A number of studies have aimed to identify the determinants of the quality of life (QoL) of people with multiple sclerosis (MS)[1–3]; however, there are at least two limitations in this literature. First, some studies include overlapping variables (e.g. depression measures confounded with MS-related symptoms), or they do not consider more comprehensive models, where diverse relevant variables are included in the same analysis. Second, the regression metrics that are traditionally used (i.e. beta coefficients) do not adequately address colinearity concerns.

In the current study, a relative weight analysis was used to clarify the differential importance of various factors in QoL. These metrics consider each predictor, both orthogonally and jointly regarding the remaining correlated variables, thereby better partitioning the outcome variance before colinearity.[4]

In brief, we aimed to determine the relative importance of disease variables (disease duration, MS subtype), neurological disability, depressive symptomatology, cognitive performance and coping in predicting QoL in people with MS.

Patients and methods

We enrolled 97 participants (80 were female subjects; mean age (SD) was 47.34 (8.95) yrs), who were recruited in the Northwest USA. Exclusion criteria were: A relapse at the evaluation time, substance abuse history, neurological illness other than MS, or severe physical impairment that might interfere with testing. MS diagnosis was confirmed using the McDonald criteria.[5] All participants gave their written informed consent. This study was approved by our local Institutional Review Board (IRB).

Measures

EDSS. A self-reported version of the Expanded Disability Status Scale (EDSS) was administered, as described elsewhere.[6]

Neuropsychological tests. According to preliminary analyses, the following tests were included: Symbol Digit Modalities Test (SDMT) oral form (total correct in the 90s); Visual Elevator subtest (time per correct switch, with scores reversed such that the higher values reflect better performance); 10/36 Spatial Recall Test (total correct on immediate free recall); the verbal Selective Reminding Test (long-term storage) and the Food Fluency Test (total food items available in a supermarket, generated in 60 seconds). Using these tests, cognitive functioning was dichotomized into 'impaired' and 'not impaired'. Cognitive impairment was considered as a failure on at least two neuropsychological tests, with failure defined as at least 2 SD below the mean of an available healthy control group. This procedure resulted in 18 patients (18.6% of the sample) meeting the criteria for being 'impaired'.

Depression measure. The Beck Depression Inventory - FastScreen (BDI-FS) was used, with a Cronbach's alpha of 0.78.

Coping measure. The Coping Orientation to Problems Experienced (COPE) was worded so that participants responded according to what they generally did/felt when they experienced stressors. We excluded 6/15 subscales, because their Cronbach's alpha was below 0.60. Three subscales fell between 0.60 and 0.70, and the rest were above 0.70.

Quality of life measure. The Functional Assessment of Multiple Sclerosis (FAMS), version 4, was administered. It yields seven subscales and two composite scores, the 'total' and the 'Trial Outcome Index' (TOI) scores. The latter index includes only the physical dimensions subscales, as well as an *additional concerns* subscale. All their Cronbach's alphas were above 0.72.

Statistical analyses

All analyses were conducted using the macro 'Fitting and Interpreting multiple Regression' (FIRE)[7] and the Statistical Package for the Social Sciences (SPSS) version 20. FIRE indicates whether a relative weight is statistically different from zero and whether it is statistically different from that of each of the remaining predictors. Every model included the same predictors: time since symptom onset, MS subtype, neurological disability, depressive symptomatology, cognitive performance and coping; however, BDI-FS was not included in the model where 'emotional well-being' was the criterion, given the construct overlap. Also, a corrected 'total score' was computed without including 'emotional well-being', in order to avoid construct overlap with BDI-FS as a predictor. Moreover, beta regression and structure coefficients were reported. Missing data were addressed through mean substitution (COPE and FAMS).

Results

EDSS predicted the FAMS 'mobility' and TOI scores (Table 1) in all models. BDI-FS predicted 'general contentment' in all models, whereas EDSS predicted 'general contentment' in five out of the nine models (one per COPE subscale).

'Additional concerns' was predicted by BDI-FS and EDSS in six and five models, respectively. Time since symptom onset was a statistically significant predictor on 'mobility' (in one model) and on the TOI score (in two models).

EDSS and BDI-FS predicted the 'total score' and its corrected version in all models, except BDI-FS in two models on the corrected 'total score'. Furthermore, both predictors were not statistically different from each other in any model on these total scores.

All the beta and structure coefficients were statistically significant (Table 2) in all the models, indicating that the higher the EDSS and BDI-FS scores, as well as the longer the disease duration, the lower the level in the respective QoL domain.

Discussion

Consistent with prior work, the present study revealed that depressive symptomatology (BDI-FS) and neurological disability (EDSS) were major determinants of global and specific domains of QoL in people with MS.

Comparable to another study,[1] BDI-FS consistently predicted *general contentment.* Moreover, *additional concerns* was related to BDI-FS. Physical QoL dimensions were predicted by neurological disability, as reported elsewhere.[2] Also, EDSS significantly predicted *general contentment* and *additional concerns*, but not *emotional well-being*, in agreement with previous work.[2]

Interestingly, no coping strategy was a relevant predictor of QoL, when major MS-related factors were considered in the same model. This contrasts with

Table 1. Relative weights of the main predictors in each FAMS domain.

FAMS[a] subscales	Predictor	Lowest ε (95% CI)[j,k,l]	Highest ε (95% CI)[j,k,l]
Mobility	EDSS[b,i]	0.352 (0.242 / 0.434), $F = 27.01$ $p = 0.000$, $R^2 = 0.643$	0.375 (0.259 / 0.459), $F = 26.46$ $p = 0.000$, $R^2 = 0.638$
Symptoms[h]	MS subtype[c]	0.065 (0.007 / 0.113), $F = 3.44$ $p = 0.004$, $R^2 = 0.186$	0.073 (0.008 / 0.118), $F = 3.33$ $p = 0.005$, $R^2 = 0.182$
Emotional well-being[h]	EDSS	0.093 (0.024 / 0.153), $F = 5.92$ $p = 0.000$, $R^2 = 0.245$	0.110 (0.036 / 0.164), $F = 5.56$ $p = 0.000$, $R^2 = 0.234$
General contentment	BDI-FS[d,i]	0.282 (0.164 / 0.365), $F = 18.84$ $p = 0.000$, $R^2 = 0.557$	0.314 (0.196 / 0.388), $F = 18.10$ $p = 0.000$, $R^2 = 0.547$
	EDSS	0.115 (0.053 / 0.189), $F = 18.39$ $p = 0.000$, $R^2 = 0.551$	0.130 (0.063 / 0.204), $F = 18.84$ $p = 0.000$, $R^2 = 0.557$
Thinking/ fatigue[h]	Symptom onset	0.095 (0.017 / 0.167), $F = 5.15$ $p = 0.000$, $R^2 = 0.255$	0.105 (0.021 / 0.169), $F = 4.78$ $p = 0.000$, $R^2 = 0.241$
Family/social well-being[h]	SSER[e]	0.077 (0.014 / 0.111), $F = 2.73$ $p = 0.017$, $R^2 = 0.154$	–
Additional concerns	BDI-FS	0.175 (0.074 / 0.254), $F = 12.77$ $p = 0.000$, $R^2 = 0.460$	0.193 (0.086 / 0.265), $F = 12.44$ $p = 0.000$, $R^2 = 0.453$
	EDSS	0.121 (0.055 / 0.196), $F = 11.61$ $p = 0.000$, $R^2 = 0.436$	0.138 (0.064 / 0.216), $F = 12.77$ $p = 0.000$, $R^2 = 0.460$
TOI[f] score	EDSS[i]	0.226 (0.138 / 0.314), $F = 18.73$ $p = 0.000$, $R^2 = 0.555$	0.241 (0.148 / 0.329), $F = 19.14$ $p = 0.000$, $R^2 = 0.561$
	Symptom onset	0.129 (0.049 / 0.226), $F = 19.14$ $p = 0.000$, $R^2 = 0.561$	0.134 (0.050 / 0.232), $F = 18.85$ $p = 0.000$, $R^2 = 0.557$
Total score	BDI-FS[i]	0.211 (0.120 / 0.283), $F = 21.79$ $p = 0.000$, $R^2 = 0.592$	0.228 (0.129 / 0.301), $F = 21.93$ $p = 0.000$, $R^2 = 0.594$
	EDSS[i]	0.181 (0.107 / 0.255), $F = 22.33$ $p = 0.000$, $R^2 = 0.598$	0.195 (0.117 / 0.274), $F = 21.79$ $p = 0.000$, $R^2 = 0.592$
Total score corrected[g]	EDSS[i]	0.201 (0.118 / 0.283), $F = 16.80$ $p = 0.000$, $R^2 = 0.528$	0.215 (0.129 / 0.295), $F = 16.88$ $p = 0.000$, $R^2 = 0.529$
	BDI-FS	0.134 (0.059 / 0.202), $F = 16.88$ $p = 0.000$, $R^2 = 0.529$	0.147 (0.070 / 0.214), $F = 16.66$ $p = 0.000$, $R^2 = 0.526$

[a]FAMS: Higher scores indicate better status in each domain.
[b]EDSS: Higher scores indicate higher disability.
[c]MS subtype (dummy variable: relapsing-remitting or progressive types).
[d]BDI-FS: Higher scores reflect more depressive symptomatology.
[e]SSER: COPE subscale, higher scores indicate greater endorsement.
[f]TOI: Trial Outcome Index. It includes only the FAMS physical dimensions subscales, as well as the *additional concerns* subscale.
[g]Total score corrected: Without the *emotional well-being* subscale included in the computation.
[h]No predictor was statistically significant for this criterion variable.
[i]This predictor was statistically significant in the nine models where the respective COPE subscale was entered as a predictor (positive reinterpretation and growth, planning, social support for emotional reasons, social support for instrumental reasons, religion, venting emotions, behavioral disengagement, substance use, or humor).
[j]ε = relative weight. 95% CIs were computed across 10,000 bootstrapped samples. Relative weights range from 0 to 1; and their sum equals R^2.
[k]Final analyses were run with a sample size of 94 participants, due to missing data.
[l]F, p and R^2 values refer to the entire model, where the indicated predictor achieved the lowest or the highest relative weight, respectively.
BDI-FS: Beck Depression Inventory - FastScreen; COPE: Coping Orientation to Problems Experienced; EDSS: Expanded Disability Status Scale; FAMS: Functional Assessment of MS; MS: multiple sclerosis; SSER: Social Support for Emotional Reasons; TOI: Trial Outcome Index.

previous, less comprehensive studies, where depression or neurological disability were not included along with coping, as predictors.

Cognitive performance did not predict any QoL domain, which converges with several investigations that show no relationship between cognitive dysfunction and QoL,[1,8] or small effect sizes.[9] Furthermore, the absence of relationship with *thinking/fatigue* in this study was not unexpected, as the divergence between self-reported and performance-based measures of cognitive function is widely reported.[10]

Table 2. Beta and structure coefficients associated with the highest and lowest relative weights of the main predictors in each FAMS domain.

FAMS[a] subscales	Predictor	β[h] of the lowest ε (95% CI)[g,i]	β[h] of the highest ε (95% CI)[g,i]	r_s of the lowest ε (95% CI)[g,i]	r_s of the highest ε (95% CI)[g,i]
Mobility	EDSS[b]	−0.585 (–0.726/–0.422)	−0.607 (–0.737/–0.448)	−0.950 (–0.976/–0.879)	−0.953 (–0.978/–0.883)
Symptoms	MS subtype[c]	−0.215 (–0.406/–0.006)	−0.247 (–0.437/–0.039)	−0.732 (–0.889/–0.292)	−0.741 (–0.889/–0.278)
Emotional well-being	EDSS	−0.243 (–0.440/–0.034)	−0.311 (–0.491/–0.110)	−0.823 (–0.942/–0.499)	−0.843 (–0.947/–0.543)
General contentment	BDI-FS[d]	−0.483 (–0.633/–0.308)	−0.541 (–0.679/–0.374)	−0.841 (–0.909/–0.706)	−0.848 (–0.913/–0.720)
	EDSS	−0.194 (–0.358/–0.020)	−0.251 (–0.417/–0.079)	−0.697 (–0.821/–0.515)	−0.693 (–0.815/–0.517)
Thinking/fatigue	Symptom onset	−0.264 (–0.488/–0.048)	−0.305 (–0.519/−0.086)	−0.755 (–0.921/–0.352)	−0.776 (–0.928/–0.372)
Family/social well-being	SSER[e]	0.301 (0.080/0.480)	–	0.729 (0.302/0.885)	–
Additional concerns	BDI-FS	−0.354 (–0.511/–0.176)	−0.400 (–0.545/–0.222)	−0.751 (–0.877/–0.521)	−0.756 (–0.876/–0.523)
	EDSS	−0.233 (–0.426/–0.044)	−0.299 (–0.484/–0.104)	−0.784 (–0.889/–0.604)	−0.763 (–0.868/–0.581)
TOI score	EDSS	−0.404 (–0.572/–0.232)	−0.433 (–0.598/–0.255)	−0.882 (–0.943/–0.762)	−0.878 (–0.941/–0.759)
	Symptom onset	−0.255 (–0.437/–0.082)	−0.270 (–0.445/–0.092)	−0.647 (–0.801/–0.431)	−0.649 (–0.802/–0.432)
Total score	BDI-FS	−0.391 (–0.526/–0.243)	−0.420 (–0.552/–0.270)	−0.737 (–0.828/–0.583)	−0.736 (–0.826/–0.579)
	EDSS	−0.297 (–0.447/–0.130)	−0.337 (–0.495/–0.170)	−0.805 (–0.885/–0.677)	−0.809 (–0.890/–0.681)
Total score corrected[f]	EDSS	−0.357 (–0.514/–0.179)	−0.397 (–0.565/–0.221)	−0.863 (–0.929/–0.742)	−0.862 (–0.928/–0.739)
	BDI-FS	−0.276 (–0.419/–0.124)	−0.310 (–0.449/–0.167)	−0.653 (–0.772/–0.463)	−0.655 (–0.771/–0.467)

[a]FAMS: Higher scores indicate better status in each domain.
[b]EDSS: Higher scores indicate higher disability.
[c]MS subtype (dummy variable: relapsing-remitting or progressive types).
[d]BDI-FS: Higher scores reflect more depressive symptomatology.
[e]SSER: COPE subscale, higher scores indicate greater endorsement.
[f]Total score corrected: Without the *emotional well-being* subscale included in the computation.
[g]Final analyses were run with a sample size of 94 participants, due to missing data.
[h]β: beta coefficient.
[i]ε: relative weight.
BDI-FS: Beck Depression Inventory - FastScreen; COPE: Coping Orientation to Problems Experienced; EDSS: Expanded Disability Status Scale; FAMS: Functional Assessment of MS; MS: multiple sclerosis; r_s: structure coefficient; SSER: Social Support for Emotional Reasons; TOI: Trial Outcome Index.

Finally, the present study had the following limitations. First, the cross-sectional study design does not allow for causal inferences. Second, our study relied on many self-reported measures, increasing the chances of confounding mood-driven self-reporting bias with QoL outcomes. However, if common method bias had been the main explanation for these results, then BDI-FS would presumably have been a key predictor in subjective dimensions, such as *family/social well-being* or *thinking/fatigue*. Finally, our sample size was relatively small, so further studies with larger samples are required to confirm our findings.

Conflict of interest

The authors declare that there are no conflicts of interest.

Funding

This work was supported by the Program of Formation for University Professors (FPU) of the Ministry of

Education, Culture and Sport of Spain (for Eduardo Fernández-Jiménez).

References

1. Benedict RHB, Wahlig E, Bakshi R, et al. Predicting quality of life in multiple sclerosis: Accounting for physical disability, fatigue, cognition, mood disorder, personality and behavior change. *J Neurol Sci* 2005; 231: 29–34.
2. Spain LA, Tubridy N, Kilpatrick TJ, et al. Illness perception and health-related quality of life in multiple sclerosis. *Acta Neurol Scand* 2007; 116: 293–299.
3. Fruehwald S, Loeffler-Stastka H, Eher R, et al. Depression and quality of life in multiple sclerosis. *Acta Neurol Scand* 2001; 104: 257–261.
4. Tonidandel S and LeBreton JM. Relative importance analysis: A useful supplement to regression analysis. *J Bus Psychol* 2011; 26: 1–9.
5. McDonald WI, Compston A, Edan G, et al. Recommended diagnostic criteria for multiple sclerosis: Guidelines from the international panel on the diagnosis of multiple sclerosis. *Ann Neurol* 2001; 50: 121–127.
6. Arnett PA, Higginson CI and Randolph JJ. Depression in multiple sclerosis: Relationship to planning ability. *J Int Neuropsychol Soc* 2001; 7: 665–674.
7. Lorenzo-Seva U and Ferrando PJ. FIRE: An SPSS program for variable selection in multiple linear regression analysis via the relative importance of predictors. *Behav Res Methods* 2011; 43: 1–7.
8. Baumstarck K, Simeoni MC, Reuter F, et al. Cognitive function and quality of life in multiple sclerosis patients: A cross-sectional study. *BMC Neurol* 2011; 11: 17.
9. Rosti E, Mantynen A, Koivisto K, et al. Neuropsychological rehabilitation has beneficial effects on perceived cognitive deficits in multiple sclerosis during nine-month follow-up. *J Neurol Sci* 2013; 334: 154–160.
10. Higginson CI, Arnett PA and Voss WD. The ecological validity of clinical tests of memory and attention in multiple sclerosis. *Arch Clin Neuropsychol* 2000; 15: 185–204.