Exploring the outcome of multiple sclerosis among Saudi adult patients

A single-centered cross-sectional study at King Abdulaziz Medical City in Riyadh, Saudi Arabia

Azhar M. Alanazi, MD, *Jinan R. Al-Rashoud,* MD, *Jumanah M. Aljahani,* MD, *Ahlam F. Alotaibi,* MD, *Alaa M. Althubaiti,* MD, *Suleiman M. Kojan,* MD, *Mohammed A. Aljumah,* MD, *Ahmad A. Abulaban,* MBBS, SBN.

ABSTRACT

الأهداف: تقييم نتائج التصلب اللويحي باستخدام نسخة عربية معتمدة من مؤشر بارثل، ومقياس تأثير التصلب اللويحي، ومقياس رانكين المعدل، ومقياس حالة الإعاقة الموسع.

الطريقة: أجريت هذه الدراسة المقطعية في مدينة الملك عبدالعزيز الطبية خلال الفترة من يوليو حتى نوفمبر 2017م. شملت جميع المرضى السعوديين البالغين الذين تم تشخيصهم بمرض التصلب اللويحي في الفترة 2000-2016م (269 مريضا). تم التواصل مع المرضى عبر مكالمات هاتفية لتقييم حالاتهم باستخدام استبيان متعدد المكونات تم تطويره والتحقق من صحته. وقد تضمن البيانات الديموغرافية ومسار المرض والنسخة العربية المعتمدة من المقاييس.

النتائج: من أصل 269 مريض، استجاب 210 (78.2%). كان متوسط عمر المرضى 37.44±10.3 عام. وكانت الأغلبية من الإناث (69.5%). أفاد 51 (24.3%) مريض فقط بتدهور حالاتهم. كان معدل الانتكاس 2.28±1.91 هجمة بالسنة. فيما يتعلق بنتائج المقاييس، 120 (57.1%) أظهروا عدم وجود إعاقة في مقياس رانكين المعدل، و146 (69.5%) كانوا متنقلين دون مساعدة في مقياس حالة الإعاقة الموسع، و185 (89.4%) من المرضى كانوا مستقلين في مؤشر بارثل. بلغ متوسط مقياس التأثير الجسدي للتصلب اللويحي 33.6±27.6 والنفسي 38.2±25.8. ارتبط مقياسي رانكن وحالة الإعاقة بشكل إيجابي مع استخدام الأدوية المعدلة للمرض. بينما ارتبط مقياس رانكن بشكل سلبي مع التشخيص المتأخر. أظهر مؤشر بارثل ارتباط إيجابي مع الانتظام بالدواء وغياب الهجمات.

الخاتمة: كان لدى أغلب المرضى نتائج إيجابية ارتبطت بشكل كبير مع استخدام الأدوية المعدلة للمرض والانتظام المستمر بها والتشخيص المبكر وغياب الهجمات.

Objectives: To assess the outcome and impact of multiple sclerosis (MS) using validated Arabic versions of the Barthel index (BI) multiple sclerosis impact scale (MSIS-29), the modified Rankin scale (mRS), and the expanded disability status scale (EDSS).

Methods: A cross-sectional study conducted at King Abdulaziz Medical City in Riyadh, Kingdom of Saudi Arabia, during July-November 2017. All Saudi adult patients diagnosed with MS between 2000-2016 (269 patients) were included. Patients were contacted via phone calls and were assessed using a newly developed and validated multi-component questionnaire that included demographic data, disease course, and Arabic versions of the scales.

Results: Out of 269 patients, 210 (78.2%) responded. The average patient age was 37.44±10.3 years. The majority were females (69.5%). Only, 51 (24.3%) patients reported worsening conditions. Annually, the average relapse rate was 2.28±1.91. In regard to patient outcomes, 120 (57.1%) showed no significant disability in mRS, 146 (69.5%) were ambulatory without aid in EDSS, and 185 (89.4%) were independent in BI scores. The average MSIS-29-PHYS score was 33.6±27.6 and MSIS-29-PSYCH score was 38.2±25.8. Modified Rankin scale and EDSS were significantly associated with the current use of disease-modifying therapy (DMT). Modified Rankin scale was negatively associated with delayed diagnosis. Barthel index showed significant association with medication compliance and the absence of attacks.

Conclusion: Majority of patients had a favorable outcome that was linked with the use of DMT, compliance, early diagnosis, and absence of attacks.

Multiple sclerosis (MS) is a neurological disease that is singularly characterized by multifocal areas of demyelination in the central nervous system (CNS). Though its precise etiology is unclear, the pathogenesis of the disease is believed to be immune-mediated myelin destruction and, eventually, axon disruption, which is the main cause behind the progressive disability.[1] Multiple sclerosis is the most common neurological autoimmune disorder in the world, with an estimated number of 2.3 million until 2013. The increase from 2.1 million in 2008 to 2.3 million in 2013 has raised not only epidemiologists' interest and alarm but also neurologists'.[2] As of Kingdom of Saudi Arabia, it was estimated that 40/100,000 is the prevalence of multiple sclerosis in 2008.[3] When it comes to gender, women are generally more affected than men, estimated by a study carried out in Kingdom of Saudi Arabia.[4] Affected person's average age of onset is 30 years.

The outcome and prognosis of MS do not only vary depending on a plethora of factors but are also unpredictable in nature. It is well-recognized in the literature that MS can cause disability with varying degrees, and this can have an impact on patients' quality of life (QoL) and daily activities.[5] However, the outcome is not thoroughly studied, especially in Kingdom of Saudi Arabia. To predict MS patient outcomes, conventional and physician-based validated scales are usually used, one of which is the EDSS. It mainly assesses the degree of disability and monitors the diseases' progression but with several limitations which are documented, such as its insensitivity to change over a spectrum of 2-3 years.[6] Therefore, in this study, we additionally considered other vital scores and scales that not only assess disability via the EDSS, but also the mRS. Moreover, health-related quality of life (HRQoL) is evaluated by the MSIS-29 and the BI. Such measures will help us to have a more objective and reliable endpoint regarding the patients' outcome and survival.

In this study, we hypothesised that the outcome in regard to disability and HRQoL would differ depending on the variables we took into consideration when assessing MS. Thus, the aim was to evaluate the outcome of this neurological disease that we call MS.

Methods. This was a single-centered, cross-sectional study that was conducted in the Adult Neurology

Department at King Abdulaziz Medical City in Riyadh, Kingdom of Saudi Arabia, from July-November 2017. King Abdulaziz Medical City is a tertiary care center in Riyadh, Kingdom of Saudi Arabia. All Saudi adult patients who were diagnosed with MS at King Abdulaziz Medical City between 2000-2016 were included, and there were 269 patients. Excluded individuals were individuals not meeting the criteria in a telephone interview, including non-Saudis, wrong diagnoses, and those who disagreed.

The included variables were age, gender, smoking (type, amount, and duration), age at diagnosis, duration of symptoms before diagnosis, number of attacks/Emergency Department admissions per year, current medications (type, duration, and compliance), previous medication, the disease status during year 2015-2016 (improved, no change, worsen, and dead), BI score, mRS score, EDSS score, MSIS-29 score.

Measures. Firstly, the demographic data including age, gender, and age at diagnosis were collected from patients' charts. Then, the above-mentioned variables were collected after contacting the patients via phone-calls. The duration of symptoms before diagnosis and number of attacks per year were collected, based on the patient's memory. To determine delay in diagnosis, we considered more than 1.5 year between the disease onset and diagnosis as delayed. Patients' outcome including HRQoL and degree of disability were assessed by using validated, Arabic versions of the BI of activities of daily living, mRS, EDSS, and MSIS-29.

We developed our own multi-component questionnaire using the aforementioned variables and scales.

Validation. We conducted the validation through 3 phases. Firstly, we translated the English form into Arabic and simultaneously enquired for a non-medical translator to translate it into Arabic. Then, we compared both copies and asked an expert in the field to check them. Secondly, the form was back-translated by another non-medical translator from Arabic to English without access to the original survey, and was later compared with the original. Both copies showed no major differences. Thirdly, pilot testing survey was carried out on 22 people and the final version was edited until no modifications were needed and the survey was unambiguous and understandable.

The validity of the questionnaire was confirmed using Cronbach's alpha analysis of internal consistency ($\alpha=0.968$).

Expanded disability status scale (EDSS). Expanded disability status scale is a scale used to assess the degree of disability in patients with MS. Additionally, it is used

to monitor the level of changes and the progression over time. It assesses disability through measuring the level of impairment in 7 functional systems (FS) that include cerebral (mental), pyramidal, cerebellar, brainstem, visual, sensory, bowel and bladder functions plus ("other"). The scale ranges from 0-10, and each score represents level of disability. Score 0 indicates perfect health and normal neurological exam, while score 10 indicates death due to MS. Owing to the fact that our study is a phone-call interview and does not include clinical bed-sided exam, patients were assessed using a previously published questionnaire, which is called the nurse-led telephone assessment of EDSS. It is a 12-question form that assesses the disability based on the ability to walk, with or without assistance, for an EDSS of 6 and higher.[7] For the patients who needed examination to determine their EDSS score, they were given the term "less than 6".

At the analysis, the scores of EDSS were grouped into 4 categories: 6 or less implies "Fully ambulatory without aid", 6.5 to 7.5 implies "ambulatory with aid", 8 to 9.5 implies "restricted and severely disabled", and 10 implies "death".

Modified Rankin scale. modified Rankin scale is a scale widely used to assess the level of disability or dependence in patients' daily activities. It is commonly used to measure the functional outcomes for patients who have suffered a stroke or other neurological disability. The scale consists of 6 grades, from 0-6, with 0 corresponding to perfect health without symptoms while 6 corresponding to death.[8] At the end of the interview, the investigator gave a sutible score for the patient.

At the analysis, the scores of mRS were grouped into 4 categories: 0 and 1 indicates "No significant disability despite symptoms", 2 and 3 indicates "mild disability", 4 and 5 indicates "severe disability", and 6 indicates "death".

Multiple sclerosis impact scale. Multiple sclerosis impact scale-29 is a patient-based outcome measurement for clinical trials of MS. It is disease-specific and combines patients' perspective with rigorous psychometric methods. It is made out of 20 physical (MSIS-29-PHYS) items and 9 psychological (MSIS-29-PSYCH) items, measuring the impact of MS. Furthermore, MSIS-29 satisfies all the 5 psychometric criteria (data equality, scaling assumption, acceptability, reliability, and validity), which indicate a significant clinical usefulness and applicability for clinical trials and epidemiological studies. The total score is calculated, and the higher the score reaching 100, the greater the degree of impact on physical and psychological well-being.[9]

Barthel index. Barthel index is another scale used to evaluate the physical assistance required in activities of daily living (ADL) in patients who had stroke and those with neuromuscular or musculoskeletal disorders. It is scored based on the sum of a patient's scores in 10 variables describing ADL and mobility, (namely: feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation, and stair climbing). The items are rated from 0-5, with a lower score suggesting greater impact of the disease on the patient's physical functioning.[10] A cutoff value of 65 was used from a previous study to categorize BI scores into independent (65 or more) and dependent (less than 65).[11]

Analysis. The Statistical Package for the Social Sciences (SPSS), version 23 (IBM Corp., Armonk, NY, USA) was used for data management and analysis.

Categorical values were reported in terms of percentages, and continuous values were expressed as mean, standard deviation (SD). For testing associations, chi-square was used for categorical data. A bivariate analysis was carried out to examine the association of each scale with gender, smoking, number of attacks/year, delayed diagnosis, current use of DMT, type, and compliance. For continuous data, an independent t-test was used to assess the difference between males and females in terms of age at onset. Odds ratios (OR) with 95% confidence intervals (CI) were reported for significant results. All tests were considered statistically significant if the p-value was less than 0.05.

Ethical considerations. Upon assessing patients' outcome via phone-calls, the consent was taken verbally in the presence of a witness. Confidentiality is guaranteed, and the data was secured with the primary investigator and co-investigators. Medical record numbers (MRN) and names were not included in the data; serial numbering was used instead.

Results. In all, between a recruitment period of July-November 2017, 269 MS patients were enrolled in this study, 210 (78.2%) of whom responded and completed the questionnaire (**Figure 1**).

Table 1 presents the demographic characteristics of the study sample in detail. The mean age at diagnosis was 22.89±11.9 years old with no significant difference in terms of gender female [M±SD=22.9±11.98] and male [M±SD=22.8±11.6], conditions; *p*=0.96. Additionally, each scale was analyzed separately (**Table 2**).

Tables 3, 4, & 5 present the bivariate analysis of mRS, EDSS, and BI with several variables.

A statistically significant correlation was found between high scores of mRS and delayed diagnosis
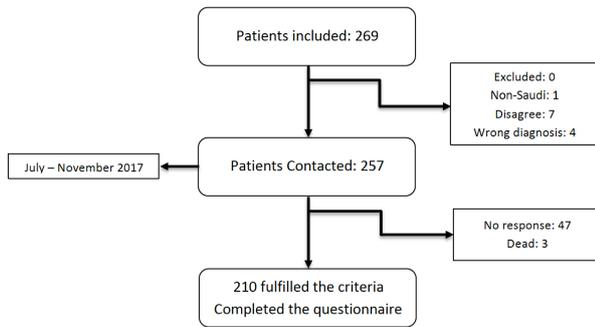
Figure 1 - Data collection flowchart.

Table 1 - Distribution of characteristics of study subject (N=210).*

Demographic characteristics	n (%)
Age (years), (mean±SD)	37.44±10.3
Age at diagnosis (years), (mean±SD)	22.89±11.9
Gender	
Male	64 (30.5)
Female	146 (69.5)
Delayed diagnosis	
Yes	58 (28)
No	149 (72)
Number of attacks per year (mean±SD)	2.28±1.91
Disease status last year	
Improved	76 (36.2)
Same	80 (38.1)
Worsen	51 (24.3)
Dead	3 (1.4)
Previous DMT†	
Yes	132 (63.8)
No	75 (36.2)
Current DMT†	
Yes	159 (76.8)
No	48 (23.2)*
DMT distribution ‡	
Interferon beta-1a (Avonex)	13 (8.2)
Glatiramer acetate	1 (0.6)
Interferon beta-1a (Rebif)	63 (39.6)
Teriflunomide	12 (7.5)
Fingolimod	45 (28.3)
Dimethyl fumarate	5 (3.2)
Alemtuzumab	3 (1.9)
Natalizumab	16 (10.1)
Daclizumab	1 (0.6)
Compliance	
Compliant	127 (79.9)
Moderate	16 (10.1)
Not compliant	16 (10.1)
DMT duration (months), (mean±SD)	49.8±43.5
Smoking	
Yes	38 (18.4)
No	162 (78.3)
Quit	7 (3.4)
Smoking type	
Cigarette	21 (46.7)
Shisha	21 (46.7)
Both	3 (6.7)
Duration of smoking, (years), (mean±SD)	11.54±7.5

*3 dead patients were not included in the analysis, †DMT - disease modifying treatment, ‡ 51 patients were not using medications. SD - standard deviation

(OR=0.395; 95% CI=[0.176-0.885]; *p*=0.025). Scores of BI were significantly low with absence of recurrent attacks of MS (OR=0.47; 95% CI: [0.194-1.2]; *p*=0.054). A statistically significant correlation was found between low scores of EDSS with use of DMT (OR=2.4; 95% CI [1.01-5.83]; *p*=0.042). Similarly, low scores of mRS were positively correlated with use of DMT (OR=3.2; 95%CI [1.4-7.12]; *p*=0.002). There was a significant association between medication compliance and BI (OR=2.9; 95% CI: [0.8-10.4]; *p*=0.044). Regarding gender, smoking, and type of DMT, there was no significant association with any of the scales.

Discussion. In this study, we assessed the disability and HRQoL via 4 major scales. We also examined the variables separately and explored their association with the scales. We compared the demographics of the present study with 2 other works carried out on similar sample sizes of MS patients. Our mean age at diagnosis was 22.89, which is consistent with previous studies. Similarly, two-thirds of the population were females.[12,6] In addition, we found that the most commonly used DMT during follow-up was interferon beta-1a (Rebif ©), one of the earliest treatment used in MS.[13] The average number of attacks/year was lower (0.65) compared to our study (2.29).[12] However, when patients were asked about the yearly number of attacks, it was mainly memory dependent. Sixty one point eight percent had no attacks in the previous year; therefore, it could be vulnerable to recall bias and over-estimation.

When comparing the results of each scale separately with other international studies, the average MSIS-29-PHYS score showed better physical outcome of our patients compared to one of the largest cohort studies whose average was 62±20.5. However, our population had a slightly higher average MSIS-29-PSYCH score compared to 23.6±8.7.[6] With that being said, we can infer that our patients had a greater psychological impact compared to international results. Moreover, this can be explained by another local study that had similar findings; the study was carried out to assess the QoL of MS patients in Kingdom of Saudi Arabia and some

Table 2 - Univariate analysis of mRS, EDSS, BI, and MSIS-29 (N=210).

Scales	Scores	Results	
		n (%)	Mean±SD
*mRS**			
No disability	0-1	120 (57.1)	
Mild	2-3	52 (24.8)	
Severe	4-5	35 (16.7)	1.80±1.52
Dead	6	3 (1.4)	
EDSS†			
Fully ambulatory without aid	≤6	146 (69.5)	
Ambulatory with aid	6.5-7.5	32 (15.2)	
Restricted and severely disabled	8-9.5	29 (13.8)	
Dead	10	3 (1.4)	
Barthel index			
Independent	≥65	185 (89.4)	76.16±13.89
Dependent	<65	22 (10.6)	
MSIS-29§	PHYS: 0-100		33.6±27.6
	PSYCH: 0-100		38.2±25.8

*mRS - modified rankin score, † EDSS - expanded disability status scale, MSIS-29§ - multiple sclerosis impact scale, BI - barthel index, SD - standard deviation, PHYS - physical, PSYCH - psychological, ‡3 dead patients were not included in the analysis

Table 3 - Distribution of Saudi MS patients according to mRS (N=207).

Variables	mRS				P-value
	No disability	Mild	Severe	Total	
	n (%)				
Gender					
Male	38 (31.7)	16 (30.8)	10 (28.6)	64 (30.9)	0.94
Female	82 (68.3)	36 (69.2)	25 (71.4)	143 (69.1)	
Smoking					
Yes	26 (21.7)	11 (21.2)	1 (2.9)	38 (18.4)	
No	91 (75.8)	38 (73.1)	33 (94.3)	162 (78.3)	0.34
Quit	3 (2.5)	3 (5.8)	1 (2.9)	7 (3.4)	
Attacks last year					
Yes	42 (35)	23 (44.2)	14 (40.0)	79 (38.2)	0.506
No	78 (65)	29 (55.8)	21 (60.0)	128 (61.8)	
Delayed diagnosis					
Yes	25 (20.8)	19 (36.5)	14 (40.0)	58 (28)	0.021
No	95 (79.2)	33 (63.5)	21 (60.0)	149 (72)	
Medication use					
Yes	95 (79.2)	45 (86.5)	19 (54.3)	159 (76.8)	0.003
No	25 (20.8)	7 (13.5)	16 (45.7)	48 (23.2)	
Compliance					
Compliant	78 (82.1)	33 (73.3)	16 (84.2)	127 (79.9)	
Moderate	8 (8.4)	7 (15.6)	1 (5.3)	16 (10.1)	0.67
Not compliant	9 (9.5)	5 (11.1)	2 (10.5)	16 (10.1)	
Current medication					
Interferon beta-1a (Avonex)	9 (9.5)	4 (8.9)	0 (0)	13 (8.2)	
Glatiramer acetate	1 (1.1)	0 (0)	0 (0)	1 (0.6)	
Interferon beta-1a (Rebif)	41 (43.2)	15 (33.3)	7 (36.8)	63 (39.6)	
Teriflunomide	7 (7.4)	3 (6.7)	2 (10.5)	12 (7.5)	
Fingolimod	28 (29.5)	13 (28.9)	4 (21.1)	45 (28.3)	0.721
Dimethyl fumarate	0 (0)	3 (6.7)	2 (10.5)	5 (3.1)	
Alemtuzumab	1 (1.1)	2 (4.4)	0 (0)	3 (1.9)	
Natalizumab	7 (7.4)	5 (11.1)	4 (21.1)	16 (10.1)	
Daclizumab	1 (1.1)	0 (0)	0 (0)	1 (0.6)	

mRS - modified rankin score

Table 4 - Distribution of Saudi MS patients according to EDSS (N=207).

Variables	EDSS				*P*-value
	Fully ambulatory without aid	Ambulatory with aid	Restricted and severely disabled	Total	
		n (%)			
Gender					
Male	52 (35.6)	3 (9.4)	9 (31)	64 (30.9)	0.007
Female	94 (64.4)	29 (90.6)	20 (69)	143 (69.1)	
Smoking					
Yes	36 (24.7)	2 (6.3)	0 (0)	38 (18.4)	
No	104 (71.2)	30 (93.8)	28 (96.6)	162 (78.3)	<0.001
Quit	6 (4.1)	0 (0)	1 (3.4)	7 (3.4)	
Attacks last year					
Yes	52 (35.6)	14 (43.8)	13 (44.8)	79 (38.2)	0.507
No	94 (64.4)	18 (56.3)	16 (55.2)	128 (61.8)	
Delayed diagnosis					
Yes	36 (24.7)	12 (37.5)	10 (34.5)	58 (28)	0.251
No	110 (75.3)	20 (62.5)	19 (65.5)	149 (72)	
Medication					
Yes	120 (82.2)	20 (62.5)	19 (65.5)	159(76.8)	0.042
No	26 (17.8)	12 (37.5)	10 (34.5)	48(23.2)	
Compliance					
Compliant	95 (79.2)	17 (85)	15 (78.9)	127(79.9)	
Moderate	13 (10.8)	2 (10)	1 (5.3)	16 (10.1)	0.77
Not compliant	12 (10)	1 (5)	3 (15.8)	16 (10.1)	
Current medication					
Interferon beta-1a (Avonex)	12 (10)	0 (0)	1 (5.3)	13 (8.2)	
Glatiramer acetate	1 (0.8)	0 (0)	0 (0)	1 (0.6)	
Interferon beta-1a (Rebif)	47 (39.2)	8 (40)	8 (42.1)	63 (39.6)	
Teriflunomide	9 (7.5)	1 (5)	2 (10.5)	12 (7.5)	
Fingolimod	35 (29.2)	6 (30)	4 (21.1)	45 (28.3)	0.999
Dimethyl fumarate	2 (1.7)	1 (5)	2 (10.5)	5 (3.1)	
Alemtuzumab	1 (0.8)	2 (10)	0 (0)	3 (1.9)	
Natalizumab	12 (10)	2 (10)	2 (10.5)	16 (10.1)	
Daclizumab	1 (0.8)	0 (0)	0 (0)	1 (0.6)	

MS - multiple sclerosis, EDSS - expanded disability status scale

Arab contraries. They concluded that out of 382 MS patients, 32.2% had an impact on their psychological well-being in several aspects, including feeling depressed and nervous, as well as being inattentive.[14]

In regard to the BI results, the majority of our patients were independent with a mean of 76.2±13.9. In comparison, Nicholl et al[15] reported a BI mean of 84.0±17.0 in 90 adult MS patients, which is considered slightly better. Moreover, in CombiRx, a double-blinded, 3-year clinical trial that assesses mRS, the mean score was 1.0±0.7, which corresponds with no significant disability despite symptoms.[16] Likewise, the majority of our patients had no significant disability despite symptoms. While a retrospective study of 76 MS patients had a 67% of severely disabled patients in EDSS, the majority of our patients were fully ambulatory without aids.[17]

In terms of scales, our data showed that the majority of patients had generally good outcomes. This is linked significantly with the use of DMT, medication compliance, early diagnosis, and the absence of attacks. On the other hand, we could not interpret the significant *p*-value when comparing the scales with gender and smoking. This might be due to the small number of males when compared to females as well as smokers to non-smokers.

In total, 72% patients did not have delayed diagnosis. Our data showed that delayed diagnosis is significantly associated with disability. In contrast, no association was found by Marrie et al[18] in this regard. Overall, 61.8% of our patients had no attacks in the previous year. The absence of attacks was significantly associated with BI. There is a theoretical hypothesis which proposes that preventing relapses can prevent disability. In one study, they correlated the frequency of relapses in the early phase of the disease with the degree of disability, in which they found a significant

Table 5 - Distribution of Saudi MS patients according to BI (N=207).

Variables	BI			*P*-value
	Independent	Dependent	Total	
		n (%)		
Gender				
Male	55 (29.9)	9 (40.9)	64 (30.9)	0.366
Female	130 (70.3)	13 (59.1)	143 (69.1)	
Smoking				
Yes	36 (19.5)	2 (9.1)	38 (18.4)	0.385
No	143 (77.3)	19 (86.4)	162 (78.3)	
Quit	6 (3.2)	1 (4.5)	7 (3.4)	
Attacks last year				
Yes	67 (36.2)	12 (54.5)	79 (38.2)	0.054
No	118 (63.8)	10 (45.5)	128 (61.8)	
Delayed diagnosis				
Yes	51 (27.6)	7 (31.8)	58 (28)	0.444
No	134 (72.4)	15 (68.2)	149 (72)	
Medication use				
Yes	142 (76.8)	17 (77.3)	159 (76.8)	1.000
No	43 (23.2)	5 (22.7)	48 (23.2)	
Compliance				
Compliant	114 (80.3)	13 (76.5)	127 (79.9)	0.044
Moderate	16 (11.3)	0 (0)	16 (10.1)	
Not compliant	12 (8.5)	4 (23.5)	16 (10.1)	
Current medication				
Interferon beta-1a (Avonex)	13 (9.2)	0 (0)	13 (8.2)	0.324
Glatiramer acetate	1 (0.7)	0 (0)	1 (0.6)	
Interferon beta-1a (Rebif)	55 (38.7)	8 (47.1)	63 (39.6)	
Teriflunomide	9 (6.3)	3 (17.6)	12 (7.5)	
Fingolimod	43 (30.3)	2 (11.8)	45 (28.3)	
Dimethyl fumarate	3 (2.1)	2 (11.8)	5 (3.1)	
Alemtuzumab	3 (2.1)	0 (0)	3 (1.9)	
Natalizumab	14 (9.9)	2 (11.8)	16 (10.1)	
Daclizumab	1 (0.7)	0 (0)	1 (0.6)	
MS - multiple sclerosis, BI - Barthel index				

association. Moreover, upon interpreting the current use of DMT, the majority (77.8%) of the patients were on DMT with a significant association between DMT use and better outcomes with regard to some scales. On the other hand, in a previous study of 367 adult MS patients, no significant association was reported. They found that both treated and untreated patients had a similar average of EDSS scores.[19] Moreover, 79.9% of our patients were compliant to their medications, which positively impacted their activities of daily living as it was significantly associated with BI, meaning 89.8% of independent patients were compliant.

In summary, we observed that our patients had good physical and psychological QoL with no significant disability or major impact of the disease on their activities of daily living. In contrast to another study conducted in Kingdom of Saudi Arabia, HRQoL and disability were assessed in 598 MS patients, in which they reported low score in HRQoL measures and a considerable disease impact that was correlated with significant disability.[20]

The present study has a number of limitations. Firstly, it was carried out with a small sample size; therefore, some of the variables were not interpreted sufficiently. Hence, further studies with a larger sample size are recommended to examine the association of outcome with other factors and variables like gender and smoking. Secondly, the data was collected through interviewing patients via phone-call, so disability and health status were self-reported. Lastly, our study could be vulnerable to recall bias during phone calls mainly for the memory-dependent questions (For example, average numbers of attacks).

In conclusion, the majority of our patients had a favorable outcome, which was significantly linked with the use of DMT, compliance, early diagnosis, and

the absence of attacks. Moreover, our data showed a slightly higher impact of the diseases on psychological well-being compared to international literature. Therefore, attention and care should be directed towards patients chronically suffering from a disease like MS. Furthermore, as a future implication in research and clinical settings, this multi-component questionnaire can be used as an integrated system to monitor disease progression for early intervention and better outcome.

References

1. Goldman L, editor. Cecil Medicine. 24th ed. Philadelphia (PA): Elsevier; 2012.

2. Thompson A. Atlas of MS 2013. Multiple Sclerosis International Federation. London: WHO; 2013: 60.

3. Bohlega S, Inshasi J, Al Tahan AR, Madani AB, Qahtani H, Rieckmann P. Multiple sclerosis in the Arabian Gulf countries: a consensus statement. *J Neurol* 2013; 260: 2959-2963.

4. Al Wutayd O, Mohamed AG, Saeedi J, Al Otaibi H, Al Jumah M. Environmental exposures and the risk of multiple sclerosis in Saudi Arabia. *BMC Neurol* 2018; 18: 86.

5. Salehpoor G, Kafi S, Rezaei S, Hosseininezhad M, Salehi I. The relation between fatigue severity with psychological symptoms and quality of life in patients Multiple Sclerosis. *Zahedan J Res Med Sci* 2012; 14: 80-86.

6. Raffel J, Wallace A, Gveric D, Reynolds R, Friede T, Nicholas R. Patient-reported outcomes and survival in multiple sclerosis: A 10-year retrospective cohort study using the Multiple Sclerosis Impact Scale-29. *PLoS Med* 2017; 14: e1002346.

7. Huda S, Cavey A, Izat A, Mattison P, Boggild M, Palace J. Nurse led telephone assessment of expanded disability status scale assessment in MS patients at high levels of disability. *J Neurol Sci* 2016; 362: 66-68.

8. Wilson JT, Hareendran A, Hendry A, Potter J, Bone I, Muir KW. Reliability of the modified Rankin Scale across multiple raters: benefits of a structured interview. *Stroke* 2005; 36: 777-781.

9. Hobart J, Lamping D, Fitzpatrick R, Riazi A, Thompson A. The Multiple Sclerosis Impact Scale (MSIS-29): a new patient-based outcome measure. *Brain* 2001; 124: 962-973.

10. Collin C, Wade DT, Davies S, Horne V. The Barthel ADL Index: a reliability study. *Int Disabil Stud* 1988; 10: 61-63.

11. Sulter G, Steen C, De Keyser J. Use of the Barthel index and modified Rankin scale in acute stroke trials. *Stroke* 1999; 30: 1538-1541.

12. Kerbrat A, Hamonic S, Leray E, Tron I, Edan G, Yaouanq J. Ten-year prognosis in multiple sclerosis: a better outcome in relapsing-remitting patients but not in primary progressive patients. *Eur J Neurol* 2015; 22: 507-e535.

13. Scalfari A, Neuhaus A, Degenhardt A, Rice GP, Muraro PA, Daumer M, et al. The natural history of multiple sclerosis: a geographically based study 10: relapses and long-term disability. *Brain* 2010; 133: 1914-1929.

14. Abulaban A, Altowairqi A, Altowairqi H, Almutairi A, Altalhi S, Alotaibi F, et al. Quality of life in multiple sclerosis patients in Saudi Arabia and some Arab countries. *American Academy of Neurology* 2017; 88: 3.330.

15. Nicholl L, Hobart J, Dunwoody L, Cramp F, Lowe-Strong A. Measuring disability in multiple sclerosis: is the Community Dependency Index an improvement on the Barthel Index? *Mult Scler* 2004; 10: 447-450.

16. Conwit R, Cofield S, Cutter G, Wolinsky J, Lublin F. The Modified Rankin Score Compared to EDSS and MRI Measures Using CombiRx Baseline Assessments [Internet]. CombiRx; 2018 [Accessed 28 Mar 2018]. Available from: http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=D728CC187D97F8ED78582DCC2996F75E?doi=10.1.1.606.9153&rep=rep1&type=pdf

17. Rabadi MH, Vincent AS. Comparison of the Kurtkze expanded disability status scale and the functional independence measure: measures of multiple sclerosis-related disability. *Disabil Rehabil* 2013; 35: 1877-1884.

18. Marrie RA, Horwitz R, Cutter G, Tyry T, Campagnolo D, Vollmer T. Comorbidity delays diagnosis and increases disability at diagnosis in MS. *Neurology* 2009; 72: 117-124.

19. Shirani A, Zhao Y, Petkau J, Gustafson P, Karim ME, Evans C, et al. Multiple sclerosis in older adults: the clinical profile and impact of interferon Beta treatment. *Biomed Res Int* 2015; 2015: 451912.

20. Alhazzani A, Alqahtani M, Alahmari M, Asiri M, Alamri N, Sarhan L, et al. Quality of life assessment among multiple sclerosis patients, cross sectional study, Saudi Arabia. *Journal of the Neurological Sciences* 2017; 381: 237.