RESEARCH ARTICLE

Psychiatric comorbidities in multiple sclerosis patients and their relationship with clinical variables: A university hospital sample

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ABSTRACT

Objective: This study aimed to determine the prevalence of clinically documented psychiatric diagnoses in patients with multiple sclerosis (MS) and to identify demographic and clinical predictors associated with an increased risk of comorbidity.

Method: This study included 382 patients with MS who were followed at a university hospital between January 2022 and June 2025. Medical records were reviewed for demographic characteristics, disease course and duration, disability severity (Expanded Disability Status Scale [EDSS]), comorbid neurological symptoms, disease-modifying therapies, and documented psychiatric diagnoses. Patients were categorized into those with psychiatric comorbidity (PC+) and those without psychiatric comorbidity (PC–). Univariate analyses and binary logistic regression were performed to identify independent predictors.

Results: At least one psychiatric diagnosis was present in 35% of the patients. Depression (20%) and anxiety disorders (10%) were the most common conditions. Overall, 51.8% of patients were using at least one psychotropic medication, prescribed either for psychiatric diagnoses or for MS-related symptoms such as fatigue and neuropathic pain. Comparison of the PC+ and PC- groups revealed significant differences in age, sex, duration of MS, disease severity, presence of urinary incontinence, and fatigue. Logistic regression analysis showed that female sex was independently associated with lower odds of psychiatric comorbidity, whereas fatigue, higher EDSS scores, and longer MS duration were associated with higher odds.

Conclusion: Psychiatric comorbidities are prevalent in MS, affecting more than one-third of patients. This study comprehensively evaluated the risk factors identified in the literature and found that, when assessed together, most did not remain independent predictors. Key independent predictors for psychiatric comorbidity include female sex, disability severity, disease duration, and fatigue.

Keywords: Expanded Disability Status Scale (EDSS), multiple sclerosis, psychiatric comorbidities

INTRODUCTION

Multiple sclerosis (MS) is a chronic autoimmune disease characterized by inflammation, demyelination, and neurodegeneration of the central nervous system. Clinically, the disease progresses in three main forms: relapsing-remitting (RR), primary progressive (PP), and secondary progressive (SP) (1).

Psychiatric comorbidities are common throughout the course of MS. Depression is the most

prevalent psychiatric disorder (30–50%), occurring at rates two to three times higher than in the general population (2). Anxiety disorders are the second most common psychiatric condition, affecting 25–40% of patients with MS (3). Recent studies indicate that this population is also at increased risk for bipolar disorder, psychotic symptoms, obsessive-compulsive symptoms, substance use disorders, and suicide attempts (4). Additionally, many patients with MS experience several cognitive and affective symptoms, such as affective lability, apathy, irritability, fatigue, and impaired executive functioning, that significantly affect daily functioning, even when full diagnostic criteria for a psychiatric disorder are not met. Psychiatric symptoms in MS are thought to have a multifactorial pathophysiology. Direct damage related to demyelinating lesions and atrophy, as well as lesion localization, are among the proposed mechanisms (5). Additionally, sex (6, 7), smoking (8), and disease severity (6, 9, 10) have been reported to be associated with depressive symptoms, while the effects of certain disease-modifying therapies (e.g., interferon-beta [IFN-β]) remain controversial) (11). Furthermore, several studies have evaluated the associations between neurological manifestations of MS, such as seizures (12), neuropathic pain (6, 13), urinary incontinence (14), spasticity, and fatigue (6), and symptoms of anxiety and depression (15). Recent studies have shown that psychiatric comorbidities in patients with MS are often underrecognized in routine clinical practice. Untreated psychiatric conditions may lead to poor adherence to MS treatments, increased healthcare utilization, a higher risk of suicide, and reduced functional capacity (16). Given the high burden of psychiatric comorbidities in MS and their potential impact on clinical outcomes, comprehensive research on these comorbidities is increasingly important.

This study aimed to evaluate the prevalence of psychiatric comorbidities in patients with MS and their associations with demographic, clinical, and treatment-related variables. We hypothesized that psychiatric comorbidities in MS are associated with markers of disease severity and cumulative disease burden. Specifically, higher Expanded Disability Status Scale (EDSS) scores, longer disease duration, a progressive clinical course, and symptoms such as neuropathic pain, urinary incontinence, and fatigue were expected to increase the risk of psychiatric comorbidity.

METHODS

This medical record-based, descriptive, cross-sectional study was approved by the Ethics Committee of Baskent University (KA25/383, 21/10/2025). All study procedures adhered to the Declaration of Helsinki.

The study sample included all patients diagnosed with MS who were examined at the Neurology Department of Baskent University Ankara Hospital between January 1, 2022 and June 1, 2025. Neurology and, when available, psychiatry consultation notes were retrospectively reviewed to collect data on the following variables: age, sex, age at MS diagnosis, disease duration, disease severity (measured by the Expanded Disability Status Scale), type and duration of disease-modifying therapy (DMT), smoking and alcohol use, documented psychiatric diagnoses, psychotropic medication use, and MS-related clinical features, such as seizure history, neuropathic pain, spasticity, urinary or fecal incontinence, and fatigue. Clinical variables, including EDSS score, fatigue, urinary or fecal incontinence, neuropathic pain, and spasticity, were obtained from the most recent neurology visit. This visit corresponded to the time at which psychiatric status was documented.

Participants

Medical records of 494 patients were screened. After applying the exclusion criteria, 382 patients with complete and reliable longitudinal data were included in the final analysis. Patients were excluded if: (1) the initial MS diagnosis was subsequently revised to an alternative disorder, such as connective tissue disease or vasculitis (n=24); (2) they had an additional genetic or demyelinating neurological disorder (e.g., myelin oligodendrocyte glycoprotein antibody–associated disease [MOGAD], neuromyelitis optica spectrum disorder [NMOSD], hereditary spastic paraplegia) (n=3); (3) they had only one or two recorded visits for preoperative consultation, medical advice, or disability reports (n=50); (4) they had not attended follow-up appointments for more than two to three years (n=12); (5) they were undergoing treatment for an active malignancy (n=7); or (6) early disease-course records were missing or inaccessible (n=16).

The authors verified MS diagnoses by reviewing documented symptoms, examination findings, and radiological imaging data according to the Revised (2024) McDonald Criteria (17). No discrepancies were identified between prior and current assessments. The drugs used in MS treatment were categorized

Figure 1. Flowchart illustrating participant selection and grouping.
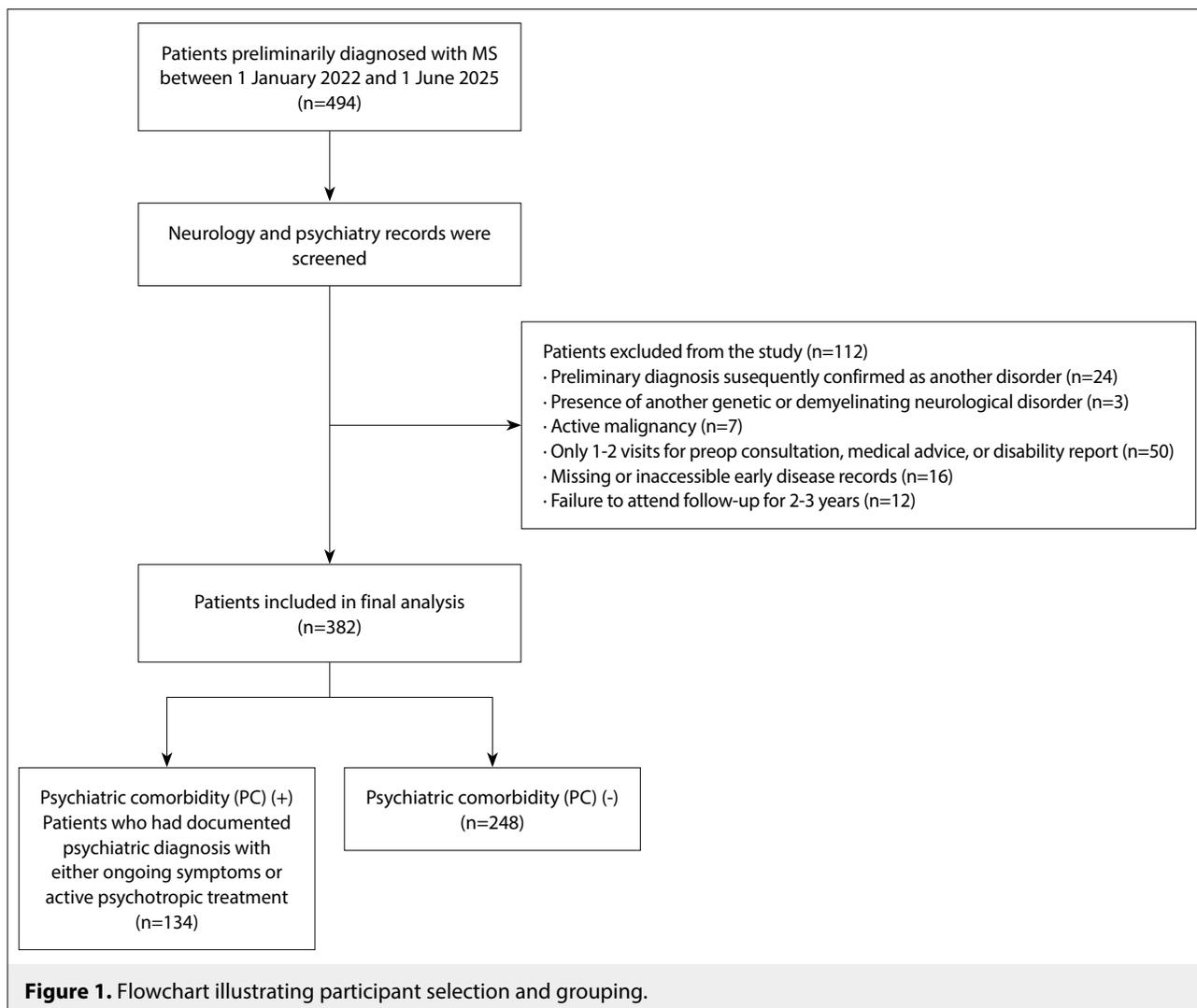
according to the literature as low- to moderate-efficacy agents (dimethyl fumarate, IFN-β and peginterferon, glatiramer acetate, teriflunomide), high-efficacy drugs (fingolimod, natalizumab, alemtuzumab, ocrelizumab, cladribine), and other treatments (fenebrutinib, fentrepid, methotrexate) (18, 19).

Psychiatric comorbidity was determined retrospectively from electronic medical records. Patients with a documented psychiatric diagnosis and either ongoing symptoms or current psychiatric treatment were classified into the psychiatric comorbidity-positive (PC+) group. A psychiatric diagnosis was considered present if it had been established and documented by a psychiatrist or neurologist at the study center, or if neurology records included documentation from external psychiatric evaluations. All other patients were classified into the psychiatric comorbidity–negative (PC-) group.

Figure 1 presents the flowchart detailing the participant selection and data collection process.

Statistical Analysis

All statistical analyses were performed using SPSS 27.0 for Windows (SPSS, Chicago, IL, USA). A descriptive analysis of the sample, including key sociodemographic and clinical variables, was summarized in tables. Dichotomous variables were expressed as numbers and percentages, while continuous variables were presented as medians and interquartile ranges (IQR). The normality of continuous variables was assessed using the Kolmogorov-Smirnov test and visual tests. For univariate comparisons between the two groups (PC+ and PC-), the Mann–Whitney U test was used for non-normally distributed continuous variables (age, age at MS diagnosis, MS duration, and EDSS score), and chi-square tests were applied to categorical variables (e.g., sex, clinical course, DMT category). For multivariate analysis, variables identified as significant in the univariate analysis, along with previously reported risk factors for psychiatric comorbidity in MS,

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were entered into a binary logistic regression model to determine independent predictors. Multicollinearity among independent variables was assessed using the variance inflation factor (VIF). Variables with high correlations (>0.40) in the regression correlation matrix were examined prior to regression model construction. The Hosmer-Lemeshow goodness-of-fit test was used to evaluate model fit. All tests were two-tailed, and a p-value <0.05 was considered statistically significant.

RESULTS

Of the 382 patients, 69.6% (n=266) were female. The mean age was 44.2±12.9 years (range: 18–85 years), the mean age at diagnosis was 31.6±10.6 years (range: 10–71 years), the mean disease duration was 12.5±7.8 years (range: 0–47 years), and the mean EDSS score was 3.0±1.7 (range: 0.5–7). Thirty-five percent of patients (n=134) had a history of at least one psychiatric diagnosis. Eleven patients (2.8%) had received a psychiatric diagnosis prior to their MS diagnosis, presenting with symptoms such as numbness, dizziness, and blurred vision. The distribution of sociodemographic characteristics, MS-related variables, and psychiatric diagnoses is presented in Table 1.

A comparison of the PC+ and PC- groups with respect to the study variables revealed significant differences in age (p<0.001), sex (p=0.003), MS duration (p<0.001), disease severity (p<0.001), presence of urinary incontinence (p=0.015), and fatigue (p<0.001). Detailed comparisons between the PC+ and PC- groups are presented in Table 1.

More than half of the patients (51.8%, n=198) were receiving at least one psychotropic medication. These medications were prescribed not only for psychiatric comorbidities but also for MS-related symptoms such as fatigue (n=62), neuropathic pain (n=65), and tremor (n=2). The distribution of psychotropic medications and their indications is presented in Supplementary Digital Appendix 1.

A logistic regression analysis was performed to evaluate the effects of variables identified in the univariate analysis (age, sex, MS duration, EDSS score, urinary incontinence, and fatigue), along with previously reported risk factors for psychiatric comorbidity in MS (smoking status, clinical course, treatment category, and neuropathic pain), on the likelihood of psychiatric comorbidity. Multicollinearity was assessed using the variance inflation factor, and all variables were within acceptable limits. The

logistic regression model was statistically significant ($\chi^2(4)$=43.256, p<0.001). The model explained 15% of the variance in psychiatric comorbidity (Nagelkerke R^2=0.153) and correctly classified 67.6% of cases. In the final model (Hosmer-Lemeshow test, p=0.411), sex, MS duration, EDSS score, and fatigue were significant predictors. Longer MS duration, higher EDSS scores, and the presence of fatigue were associated with an increased risk of psychiatric comorbidity. Female sex was identified as a protective factor (Table 2).

DISCUSSION

This study aimed to investigate the prevalence of documented psychiatric comorbidities in patients with multiple sclerosis and their associations with demographic, clinical, and treatment-related variables. In our sample, more than one-third of patients with MS had a history of at least one psychiatric comorbidity. Approximately 20% were diagnosed with depression, and 10% had an anxiety disorder. Female sex was identified as a protective factor, whereas greater disease severity (as measured by EDSS), longer disease duration, and the presence of fatigue were independent risk factors for psychiatric comorbidity in patients with MS.

The prevalence rates of anxiety and depression diagnoses in patients with MS in this study are generally consistent with previous reports. However, several differences merit consideration. Previous studies have reported depression prevalence rates ranging from 27% to 33% and anxiety prevalence rates ranging from 10% to 35% (6, 20-22). These variations may be attributable to methodological differences across studies, including sample size and assessment methods. In particular, scale-based studies (21, 22) tend to report higher prevalence rates because they assess symptom severity rather than clinically documented diagnoses. Conversely, in the absence of standardized symptom screening instruments, our study may have underestimated subclinical psychiatric symptoms. In our cohort, the longer disease duration, lower representation of progressive MS forms, and reliance on clinically documented diagnoses rather than self-report scales may explain the lower prevalence of anxiety and depression compared to some previous studies (20). Consequently, these findings may not fully capture the overall burden of psychiatric symptoms in MS.

In our sample, approximately 2% of patients had a diagnosis of a sleep disorder, which is substantially lower than prevalence rates reported in the literature,

Table 1: Comparisons of variables by psychiatric comorbidity status (n=382)*

	Psychiatric comorbidity (+) (n=134)	Psychiatric comorbidity (-) (n=248)	ESM	p
Age (years), median (IQR)	46 (20)	41 (17)	Z: -3.956	r: -0.202[f]	<0.001[b]
Sex, n (%)			χ²: 8.756	φ: -0.151	0.003[a]
Female	106 (27.7)	160 (41.9)			
Male	28 (7.3)	88 (23)			
Age at MS diagnosis (years), median (IQR)	33 (18)	29.5 (13)	Z: -1.86	r: -0.09[f]	0.063[b]
MS duration (years), median (IQR)	12 (12)	11 (9)	Z: -3.748	r: -0.191[f]	<0.001[b]
EDSS score, median (IQR)	3 (3)	2 (2)	Z: -4.178	r: -0.217[f]	<0.001[b]
Clinical course, n (%)			χ²: 5.501	V: 0.12[e]	0.064[a]
PP	11 (2.9)	15 (3.9)			
SP	11 (2.9)	8 (2.1)			
RR	111 (29.2)	224 (58.9)			
Treatment history with IFN, n (%)				φ: -0.1	0.102[c]
No	134 (35.1)	241 (63.1)			
Yes	0	7 (1.8)			
Drug efficacy, n (%)			χ²: 0.750	V: 0.045[e]	0.687[a]
No DMT	5 (1.3)	6 (1.6)			
Low/moderate efficacy DMTs (DMF, IFN, glatiramer acetate, teriflunomide)	45 (11.8)	90 (23.6)			
High-efficacy DMTs (fingolimod, natalizumab, alemtuzumab, ocrelizumab, cladribine)	82 (21.5)	147 (38.5)			
Other (fenebrutinib, fentrepid, MTX)	2 (0.5)	5 (1.3)			
Smoking status, n (%)			χ²: 0.023	V: 0.008[e]	0.998[a]
No	122 (31.9)	226 (59.2)			
Yes	9 (2.4)	17 (4.5)			
Former	3 (0.8)	5 (1.3)			
Seizure, n (%)			χ²: 0.291	φ: 0.028	0.59[a]
No	127 (32.2)	238 (62.3)			
Yes	7 (1.8)	10 (2.6)			
Fecal incontinence, n (%)			χ²: 2.671	φ: 0.104	0.102[d]
No	129 (33.8)	246 (64.4)			
Yes	5 (1.3)	2 (0.5)			
Urinary incontinence, n (%)			χ²: 5.885	φ: 0.124	**0.015[a]**
No	108 (28.3)	222 (58.1)			
Yes	26 (6.8)	26 (6.8)			
Spasticity, n (%)			χ²: 0.529	φ: 0.037	0.467[a]
No	101 (26.4)	195 (51)			
Yes	33 (8.6)	53 (13.9)			
Neuropathic pain, n (%)			χ²: 3.772	φ: 0.099	0.052[a]
No	104 (27.2)	212 (55.5)			
Yes	30 (7.9)	36 (9.4)			
Fatigue, n (%)			χ²: 17.948	φ: 0.217	**<0.001[a]**
No	86 (22.6)	207 (54.5)			
Yes	47 (12.4)	40 (10.5)			
Psychiatric diagnosis, n (%)					
Depressive disorders	85 (22.3)				
Anxiety disorders	38 (9.9)				
Sleep disorders	6 (1.6)				
OCD	2 (0.5)				
SCH	2 (0.5)				
BAD	1 (0.26)				
Psychotropic medication use, n (%)			χ²: 158.79	φ: 0.65	**<0.001[d]**
No	4 (1)	180 (47.1)			
Yes	130 (34)	68 (17.8)			

*Percentages are presented within each subgroup. †n: Number; %: Percentage; IQR: Interquartile range; ESM: Effect size measure; MS: Multiple sclerosis; EDSS: Expanded Disability Status Scale; PP: Primary progressive; SP: Secondary progressive; RR: Relapsing-remitting; DMT: Disease-modifying therapy; DMF: Dimethyl fumarate; MTX: Methotrexate; OCD: Obsessive-compulsive disorder; SCH: Schizophrenia; BAD: Bipolar affective disorder. a: Pearson's chi-square test; b: Mann–Whitney U test; c: Fisher's exact test; d: Corrected chi-square test; e: Cramer's V; f: Rank-biserial correlation.

Table 2: Final logistic regression model predicting psychiatric diagnoses in patients with multiple sclerosis (MS)

	Odds Ratio (95% CI)	p
Sex (female)	0.419 (0.245-0.715)	**0.001**
MS duration	1.037 (1.003-1.073)	**0.032**
EDSS score	1.194 (1.024-1.393)	**0.023**
Fatigue (yes)	2.447 (1.45-4.13)	**0.001**

CI: Confidence interval; MS: Multiple sclerosis; EDSS: Expanded Disability Status Scale. † Nagelkerke R^2=0.153.

where up to 55% of patients with MS are affected (23). Other studies have indicated that nearly one-fifth of MS patients experience sleep disturbances, with female sex, anxiety, and bladder dysfunction identified as independent predictors (24). The discrepancy between our findings and prior research may reflect methodological differences. Higher prevalence rates in some studies were frequently based on symptom rating scales rather than clinical diagnoses. Moreover, potential contributors to sleep disturbances, such as restless legs syndrome, neuropathic pain, bladder dysfunction, or comorbid depression, were not systematically evaluated in our study. Additionally, many patients in our cohort were using medications with sedative properties, including pregabalin, gabapentin, pramipexole, and benzodiazepines, which may have mitigated observable sleep-related complaints. These findings suggest that future research on sleep disorders in MS should incorporate comprehensive clinical assessments and account for both pharmacological and non-pharmacological factors. Studies should also systematically evaluate neurological and psychiatric factors to obtain more accurate prevalence estimates.

We found that most patients were female, consistent with the well-established higher prevalence of MS among women (25). When psychiatric comorbidities were analyzed according to disease course, no statistically significant differences were observed among relapsing-remitting, primary progressive, and secondary progressive forms, in line with previous reports (26). However, one study identified relapsing–remitting MS (RRMS) as a risk factor for anxiety (7).

Consistent with earlier findings, higher EDSS scores (6, 7, 9, 10), longer disease duration, and fatigue (6) were identified as significant risk factors for psychiatric comorbidity in our cohort. Several studies have demonstrated that greater neurological disability is associated with increased rates of depression and anxiety. This association may reflect the long-term psychological burden of functional impairment,

loss of independence, and restriction of social roles (27). Similarly, longer disease duration may indicate prolonged exposure to disease-related uncertainty, treatment burden, and progressive limitations, each of which can increase vulnerability to psychiatric morbidity (4). However, some studies have reported higher rates of anxiety and depression at lower EDSS levels (21, 28), while others have found no association between psychopathology and EDSS (20) or disease duration (10, 20).

In contrast to previous studies identifying female sex as a risk factor (3, 7), our findings suggest that female sex is a protective factor. Additionally, some reports indicate that anxiety and depression are more prevalent among male patients with MS (29), whereas others have found no significant sex differences (20). These discrepancies may reflect differences in help-seeking behavior, healthcare utilization, clinician recognition, and symptom presentation between sexes, which may influence the documentation of psychiatric comorbidities in retrospective medical records. Furthermore, biological differences in disease expression, coping strategies, and social roles may contribute to distinct psychiatric profiles in male and female patients with MS. Longitudinal studies incorporating systematic symptom screening are needed to clarify sex-specific patterns of psychiatric morbidity in MS.

In this study, approximately one-third of patients reported fatigue, which is consistent with previous studies indicating that fatigue affects up to 80% of patients with MS (22). Although several pharmacological interventions, including selective serotonin reuptake inhibitors (SSRIs) (1), monoamine oxidase A (MAO-A) inhibitors (30), amantadine, and stimulants, have been evaluated for fatigue management, current evidence does not support the clear superiority of any specific agent (22, 31). In our cohort, modafinil, methylphenidate, and amantadine were the most commonly prescribed treatments, reflecting a pragmatic approach to symptom management rather than a strategy specifically targeting psychiatric comorbidity. Importantly, fatigue emerged as an independent risk factor for psychiatric comorbidity in this study. This finding underscores its impact not only on physical functioning and quality of life but also on psychological well-being. The relationship between fatigue and psychiatric symptoms appears to be bidirectional. Large cohort analyses have demonstrated that fatigue is independently associated with depression and

anxiety, even after adjusting for demographic factors and disease severity. Conversely, depression has been shown both to co-occur with fatigue and to increase the risk of persisting or worsening fatigue over time (32). Shared neurobiological mechanisms, including cytokine-mediated inflammation, monoaminergic dysregulation, and hypothalamic-pituitary-adrenal axis hyperactivity, may contribute to both fatigue and mood dysregulation in MS (33). Moreover, the subjective experience of profound fatigue may exacerbate psychological distress by reducing functional capacity, limiting social engagement, and diminishing perceived control, thereby increasing vulnerability to depression and anxiety. Regardless of the direction of causality, the co-occurrence of fatigue and psychiatric symptoms highlights the need for comprehensive clinical assessment in clinical practice.

Although urinary incontinence differed significantly between groups in the univariate analyses, it was not identified as an independent predictor in the regression model. Previous studies have reported associations between lower urinary tract symptoms, including storage and voiding disturbances, and elevated anxiety and depression scores in male patients with MS (14).

Similarly, neuropathic pain did not differ between groups in the univariate analyses and was not identified as a risk factor in the logistic regression model. This finding contrasts with a systematic review and meta-analysis reporting that neuropathic pain affects approximately one-quarter of patients with MS and is associated with higher levels of anxiety and depression (13). The discrepancy may be attributable to methodological differences, such as the evaluation of individual symptoms rather than a comprehensive assessment of psychiatric comorbidity, as well as potential correlations with other variables, including EDSS scores and fatigue. These findings suggest that although neuropathic pain contributes to overall symptom burden, it may not function as an independent predictor of psychiatric comorbidity when considered alongside other disease- and symptom-related factors.

In a large cohort study including 5,633 participants assessed using the Hospital Anxiety and Depression Scale (HADS), higher self-efficacy, greater confidence, and being married were identified as protective factors against anxiety and depression (34). Our regression model explained only 15% of the variance in psychiatric comorbidity, indicating that social and demographic factors may play a more significant role than isolated disease-related symptoms such as urinary incontinence or neuropathic pain. These findings underscore the importance of considering both social and clinical dimensions when evaluating psychiatric risk in MS populations and highlight the need for comprehensive, multidimensional assessments.

This study has several limitations. First, its cross-sectional and retrospective design precludes causal inferences regarding the relationship between MS-related variables and psychiatric comorbidity. Second, reliance on medical records and clinically documented diagnoses, without the use of standardized symptom screening instruments, may have led to an underestimation of subclinical psychiatric symptoms. This approach may have misclassified symptomatic but undiagnosed individuals as negative for psychiatric comorbidity. Such misclassification may have attenuated the observed effects in the regression analyses. Therefore, the results should be interpreted as reflecting correlations with clinically recognized psychiatric morbidity rather than the full spectrum of psychiatric symptom burden in MS. Additionally, patients with irregular follow-up, missing early-stage clinical records, or prolonged absence from care were excluded to ensure the reliability of longitudinal and diagnostic data. However, these exclusions may have introduced selection bias, as psychiatric comorbidity can influence healthcare utilization and clinic attendance. Consequently, individuals with a greater psychiatric burden may have been underrepresented in the study sample. Third, although the sample size was relatively large, the single-center design may limit the generalizability of the findings. Finally, several potential confounders, including social support, psychological resilience, and detailed cognitive functioning, were not assessed. These factors may influence the risk of psychiatric comorbidity, symptom reporting, healthcare utilization, and clinical outcomes. The omission of these variables may have contributed to residual confounding in the observed associations. Despite these limitations, this study provides a comprehensive evaluation of both neurological and psychiatric variables in a well-characterized MS cohort. It relies on clinically documented diagnoses rather than symptom-based scales and integrates both disease-related and symptom-specific risk factors into multivariate analyses. These strengths enhance the clinical relevance and interpretability of our findings.

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CONCLUSION

In conclusion, more than one-third of patients with MS had a history of at least one psychiatric comorbidity. Higher EDSS scores, longer disease duration, and fatigue were identified as independent risk factors, whereas female sex emerged as a protective factor. These findings underscore the importance of systematic screening and management of psychiatric conditions in MS, particularly among patients with significant fatigue or disability. Future longitudinal and multicenter studies incorporating social, psychological, and cognitive variables are needed to better understand the determinants of psychiatric comorbidity in MS.

Online Supplementary Digital Appendix File:

https://dusunenadamdergisi.org/storage/upload/files/1774420246-appendix-en.pdf

Ethical Approval: The Baskent University Medical and Health Sciences Research Board granted approval for this study (No: KA25/383, Date: 21/10/2025).

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Contribution Categories		Author Initials
Category 1	Concept/Design	G.A., I.I.
	Data acquisition	G.A., I.I.
	Data analysis/Interpretation	G.A., I.I.
Category 2	Drafting manuscript	G.A.
	Critical revision of manuscript	I.I.
Category 3	Final approval and accountability	G.A., I.I.
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