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Correlation Between Disease Duration and Ocular Manifestations in Multiple Sclerosis Patients: A Hospital-Based Study in Jordan

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Abstract

Background: *Multiple sclerosis (MS) is a chronic demyelinating disease of the central nervous system, frequently associated with neuro-ophthalmic involvement. Visual disturbances such as optic neuritis, diplopia, blurred vision, and nystagmus often represent early manifestations and may reflect disease progression. However, data on the relationship between disease duration and ocular involvement in Middle Eastern populations remain limited.*

Objective: *This study aimed to evaluate the correlation between disease duration and ocular manifestations among MS patients in Jordan, and to identify demographic and clinical predictors of ocular involvement.*

Methods: *A hospital-based cross-sectional study was conducted on MS patients attending a neurology clinic in Jordan. Demographic and clinical data, including MS subtype, disease duration, ocular manifestations, and symptom characteristics, were extracted. Statistical analyses were performed using* IBM SPSS Statistics for Windows, Version 26.0 *(IBM Corp., Armonk, NY, USA). Descriptive statistics, chi-square tests, Mann–Whitney U tests, Spearman correlation, and binary logistic regression were applied.*

Results: *Among the studied cohort, ocular manifestations were observed in approximately one-third of patients. Optic neuritis was the most common presentation, followed by diplopia and nystagmus. Patients with ocular involvement had significantly longer disease duration compared to those without (median 5 years vs 3 years,* $p < 0.001$*). Logistic regression confirmed disease duration (OR 1.06, 95% CI 1.01–1.11,* $p = 0.032$*) and female sex (OR 1.91, 95% CI 1.21–3.01,* $p = 0.006$*) as independent predictors.*

Conclusion: *Ocular manifestations are a prevalent and clinically significant feature of MS in Jordanian patients. Longer disease duration and female sex increase the likelihood of ocular involvement. These findings highlight the importance of routine neuro-ophthalmic evaluation and early intervention in long-standing MS, while also addressing a regional gap in the literature.*

Keywords: *Multiple Sclerosis; Neuro-ophthalmology; Optic Neuritis; Visual Disturbances; Disease Duration; Ocular Manifestations; Jordan*

INTRODUCTION

Multiple sclerosis (MS) is an immune-mediated, demyelinating disease of the central nervous system, characterized by focal lesions in the brain and spinal cord that lead to neurological disability across sensory, motor, and visual domains. It is among the most common non-traumatic causes of neurological disability in young adults worldwide, with a global prevalence of approximately 2.8 million people

reported in 2020 (Walton et al., 2020). MS typically presents between the ages of 20 and 50 years, disproportionately affecting women at nearly a 3:1 ratio (Reich et al., 2018). Clinically, MS manifests in heterogeneous courses, most notably relapsing–remitting MS (RRMS), secondary progressive MS (SPMS), and primary progressive MS (PPMS), each with distinct implications for prognosis and management (Lorscheider et al., 2016; Lublin et al., 2014).

Ocular involvement is a frequent manifestation of MS. Optic neuritis (ON), characterized by acute demyelination of the optic nerve, occurs in approximately 20% of patients as an initial presentation and in up to 50% throughout the disease course (Balcer, 2006; Toosy et al., 2014). Other neuro-ophthalmic disorders such as internuclear ophthalmoplegia, diplopia, and nystagmus are well-documented and can contribute to long-term disability (Martínez-Lapiscina et al., 2014). A meta-analysis further supports that visual pathway involvement is among the most reliable clinical indicators of both inflammatory activity and neurodegeneration in MS (Rothman et al., 2019).

Visual symptoms in MS have substantial diagnostic and prognostic implications. Optic neuritis may serve as the sentinel event leading to diagnosis, while persistent visual dysfunction correlates with MRI-measured lesion burden and disability progression (Balcer et al., 2015). Importantly, ocular involvement is strongly linked to impaired quality of life and functional independence, highlighting the necessity for systematic ophthalmic assessments as part of MS management (Zeydan et al., 2018).

Although ocular manifestations of MS are well documented in Europe and North America, research from the Middle East remains limited. A cross-sectional study in Saudi Arabia reported optic neuritis and diplopia as the most common ocular complications, yet its generalizability was constrained by sample size and regional variation (Ciron et al., 2022). Epidemiological, genetic, and healthcare delivery differences in Jordan necessitate local data to guide practice. A hospital-based study provides an opportunity to characterize ocular involvement in Jordanian MS patients and to assess whether disease duration predicts these manifestations.

The objective of this study was to evaluate the correlation between disease duration and ocular manifestations among MS patients in Jordan.

Hypotheses:

- H1: Longer disease duration is associated with a greater likelihood of ocular manifestations.
- H2: Disease duration is positively correlated with the duration of ocular symptoms.
- H3: Female sex is significantly associated with ocular manifestations.
- H4: Place of residence (urban vs. rural) is associated with ocular manifestations.
- H5: MS subtype is associated with ocular manifestations.

LITERATURE REVIEW

Neuro-ophthalmic symptoms are among the most clinically significant presentations in multiple sclerosis (MS). **Optic neuritis (ON)** is the most prominent, occurring in up to **50% of MS patients** over the disease course, and serving as the **initial manifestation** in approximately (Alturki et al., 2024a; Kraker et al., 2024a). These figures are mirrored in retinal structural studies using optical coherence tomography, where optic nerve and retinal nerve fiber loss reflect early neurodegeneration in MS (Suh et al., 2024a). Additional ocular disturbances include internuclear ophthalmoplegia, nystagmus, and diplopia. In a 2024 observational study of 116 MS patients, 53% had neuro-ophthalmic symptoms: ON accounted for 37%, internuclear ophthalmoplegia for 16%, and nystagmus for 13% (Alturki et al., 2024b; Kraker et al., 2024b). Reports from 2022 reinforce that blurred vision is nearly ubiquitous among ocular complaints (reported by up to 75%–80% of MS patients), and diplopia is also common (Frequency of Ocular Manifestations in Multiple Sclerosis Patients Admitted in Tertiary Care Hospital in Saudi Arabia, n.d.). Visual disturbances in MS often indicate disease onset and progression. In a population-based study from Olmsted County, MN, the prevalence of optic neuritis was estimated at 115 per 100,000, with ON as the presenting symptom in approximately 20% of MS cases highlighting its diagnostic significance (Rodriguez et al., 1995). These observations underscore the importance of ocular symptoms for clinical diagnosis and early MS recognition.

Longer disease duration in MS has been consistently linked with increased risk of sensory and motor disability. While few studies focus exclusively on ocular dysfunction over time, emerging "oculomics" research demonstrates that inner retinal layer thinning assessed via OCT serves as a sensitive biomarker of disability accumulation in progressive MS phenotypes (Chahin et al., 2015; Suh et al., 2024b).

A broader multicenter study reported that ocular motor impairments correlate with motor and cognitive disability in MS, suggesting that visual symptoms reflect global disease progression (Gerardo et al., 2024). Similarly, the Optic Neuritis Treatment Trial (ONTT) has been instrumental in elucidating long-term risks of MS onset and disability subsequent to ON episodes, although this line of research emphasizes predictive modeling more than symptom duration per se (Wei et al., 2024). While explicit longitudinal data on ocular complications remain limited, these findings collectively reinforce the concept that ocular involvement is both a marker and mediator of disease progression, supporting its inclusion in prognostic assessments and patient monitoring.

Despite the international focus on ocular manifestations in MS, region-specific data from Jordan and the Middle East remain sparse. A Saudi Arabian registry study evaluated visual and neuro-ophthalmic involvement among local MS patients, but was limited by small sample size and lack of clear duration-based analysis (Alturki et al., 2024c). To our knowledge, no prior Kuwaiti or Jordanian hospital-based investigations have specifically evaluated the relationship between disease duration and ocular symptoms. Lack of regional evidence presents challenges: genetic diversity, distinct environmental exposures (e.g., vitamin D levels, sun exposure), and variable access to diagnostic resources may influence disease expression. Generating local data is therefore essential to ensure clinical relevance, inform tailored screening protocols, and promote equitable care across diverse healthcare systems in the Middle East.

METHODOLOGY

Study Design and Population

This investigation was designed as a cross-sectional, hospital-based study aimed at evaluating the correlation between disease duration and ocular manifestations among patients with multiple sclerosis (MS). A cross-sectional design was considered appropriate for this research because it allowed the capture of a large, clinically diverse patient population at a single point in time, enabling a systematic comparison of ocular involvement across different disease durations. While longitudinal designs may provide stronger causal inference, the cross-sectional approach was selected for its feasibility, lower resource requirements, and ability to identify clinically relevant associations that can inform future prospective studies.

The study was conducted in neurology and ophthalmology departments of tertiary hospitals in Jordan during[ ]. Patients were consecutively enrolled, ensuring a representative sample of the hospital-based MS population. A total of 409 patients were included. All patients fulfilled the 2017 revised McDonald criteria for the diagnosis of MS, which integrates clinical, radiological, and laboratory findings to establish diagnostic certainty. Patients aged 16 years or older were eligible for inclusion. Exclusion criteria were deliberately limited to maximize external validity; patients were excluded if they had ocular symptoms attributable to trauma, prior ocular surgery, or other ophthalmic conditions unrelated to MS, as these could confound the analysis of MS-related ocular manifestations. Importantly, no patients were excluded on the basis of incomplete records, as all 409 had complete datasets suitable for analysis.

Data Collection

Data collection combined structured questionnaires with detailed medical record review to ensure completeness and reliability. Demographic data included age, sex, and place of residence (urban or rural). Clinical characteristics captured MS subtype categorized as relapsing remitting MS (RRMS), secondary progressive MS (SPMS), or primary progressive MS (PPMS) as well as age at disease onset, smoking status, family history of MS, number of relapses before and after initiation of disease-modifying therapy, and documented clinical response to corticosteroid treatment during relapse.

Ocular manifestations were systematically recorded. Information collected included whether ocular symptoms were present, whether they were the first presenting symptom of MS, the type of ocular manifestation (such as blurred vision, diplopia, loss of vision, or eye pain), the duration of symptoms, and their clinical course (resolution spontaneous vs persistent). Management strategies were also reviewed, with particular attention to corticosteroid use. Additionally, history of ocular surgeries or ocular trauma was documented in order to exclude unrelated conditions.

For quantitative analysis, disease duration was defined as the difference between the patient's age at the time of data collection and the documented age of disease onset. Ocular symptom status was coded as a binary variable (present vs absent). Symptom duration was standardized to numeric values, expressed in days, weeks, or months, depending on the documentation. To enhance accuracy, ambiguous entries were cross-checked with clinical notes where available.

To reduce bias, data collection was supervised by trained clinicians. A double-entry system was used for questionnaire data, followed by consistency checks against medical records. Where discrepancies were identified, they were resolved through consensus review by two independent investigators.

Statistical Analysis

Data analysis was performed **using** IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Prior to formal analysis, data were examined for completeness, outliers, and normality. Continuous variables were assessed for distributional assumptions using the Shapiro–Wilk test and visual inspection of histograms. Normally distributed variables were expressed as mean ± standard deviation (SD), while skewed variables were summarized as median with interquartile range (IQR). Categorical variables were presented as frequencies and percentages.

The following statistical analyses were conducted:

- **Descriptive statistics** were used to summarize the demographic and clinical profile of the study cohort. This provided the baseline context necessary to interpret further analyses.
- **Chi-square tests** (or Fisher's exact test where appropriate) were applied to assess the association between ocular symptom status and categorical predictors such as sex, residence, and MS subtype. These tests were chosen because they are robust for detecting associations between categorical variables.
- **Mann–Whitney U test** was employed to compare disease duration between patients with and without ocular manifestations. This non-parametric test was selected as disease duration was not normally distributed, and it does not assume homogeneity of variance.
- **Spearman's rank correlation coefficient** was used to evaluate the relationship between disease duration and ocular symptom duration, as both variables were non-normally distributed and ordinal in nature.
- **Binary logistic regression** was conducted to identify independent predictors of ocular manifestations, with ocular symptom status (present/absent) as the dependent variable. Independent variables included disease duration, sex, residence, and MS subtype. Logistic regression was selected because it allows adjustment for multiple covariates simultaneously and provides interpretable effect estimates in the form of odds ratios (OR) with 95% confidence intervals (CI).
- A **two-tailed p-value of less than 0.05** was considered statistically significant for all analyses.

Quality assurance was emphasized throughout the statistical process. Multicollinearity among predictors in the logistic regression model was assessed using variance inflation factors (VIFs). Model adequacy was evaluated using the Hosmer–Lemeshow goodness-of-fit test and pseudo R2 values. Sensitivity analyses were performed by repeating key tests after excluding cases with borderline data to confirm robustness of findings.

RESULTS

Patient Characteristics

A total of 409 patients with MS were included in the study. The mean age of the participants was 35.1 years (SD ± 11.0), and the median disease duration was 4 years (IQR 2–6). The cohort was predominantly female (68.2%), consistent with the recognized gender imbalance in MS epidemiology, and the majority of patients resided in urban areas (65.8%). Relapsing–remitting MS (RRMS) was the most frequent subtype, accounting for 91% of cases, while secondary progressive MS (SPMS) and primary progressive MS (PPMS) represented 6.4% and 1.7% of cases, respectively. Additional baseline features such as family history, smoking status, and relapse frequency are summarized in Table 1: Demographic and Clinical Characteristics of MS Patients (n = 409)**.**

Table 1. Demographic and Clinical Characteristics of MS Patients (n = 409)

Variable	Value
Mean age (years)	35.1 ± 11.0
Female sex, n (%)	279 (68.2)
Residence (urban), n (%)	269 (65.8)
Median disease duration, years (IQR)	4 (2–6)
MS subtype	RRMS: 372 (91%); SPMS: 26 (6.4%); PPMS: 7 (1.7%)
Family history of MS, n (%)	92 (22.5)

Smokers, n (%)	84 (20.5)
Relapses before treatment, median (IQR)	2 (1–3)
Relapses after treatment, median (IQR)	1 (0–2)

Ocular Manifestations

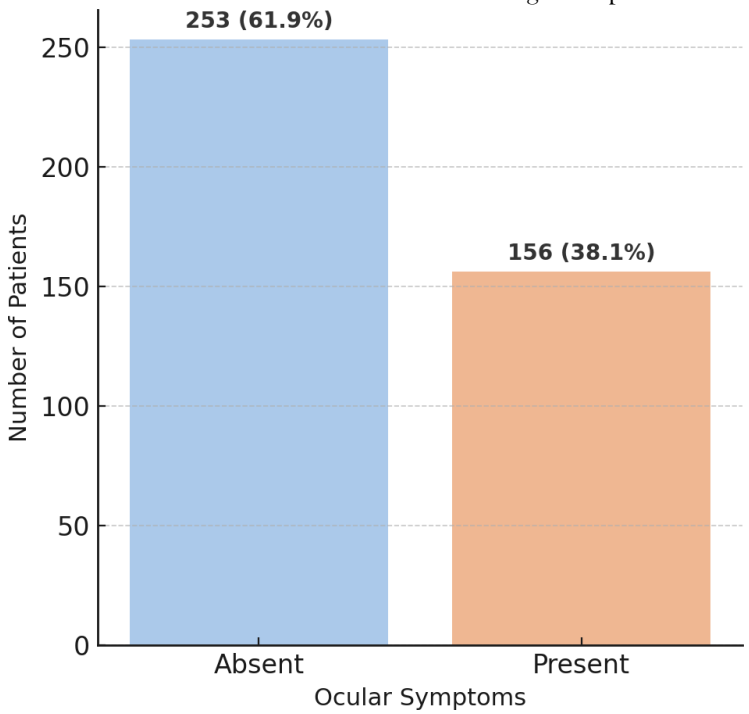
Among the total cohort, 156 patients (38.1%) reported ocular manifestations during the course of their illness. Ocular symptoms were frequently an early feature of MS, with 138 patients (88.5% of those with ocular involvement) reporting them as the first presenting complaint. This highlights the diagnostic importance of visual disturbances in the initial stages of MS.

The spectrum of ocular manifestations was varied, with blurred or blurry vision being the most common symptom, affecting 123 patients (78.8% of those with ocular involvement). Other symptoms included loss of vision (7.1%), diplopia (5.8%), and eye pain (4.5%). Rare presentations, including mixed visual symptoms, were reported in fewer than 4% of cases. Regarding symptom resolution, only 35.9% experienced full recovery, whereas the majority (64.1%) reported persistent visual disturbances despite therapy. Corticosteroid therapy, predominantly intravenous methylprednisolone, was the mainstay of treatment and was administered to 64.7% of symptomatic patients. A detailed breakdown is provided in Table 2: Distribution of Ocular Manifestations in MS Patients (n = 156), and the relative frequencies are illustrated in Figure 1: Distribution of Ocular Manifestations in MS Patients.

Table 2. Distribution of Ocular Manifestations in MS Patients (n = 156 with ocular symptoms)

Ocular Symptom	**n** (%)
Blurred vision	123 (78.8)
Loss of vision	11 (7.1)
Diplopia	9 (5.8)
Eye pain	7 (4.5)
Mixed/Other	6 (3.8)
Symptom resolution	56 (35.9)
Persistent symptoms	100 (64.1)
Treated with methylprednisolone	101 (64.7)

Figure 1. Distribution of ocular manifestations among multiple sclerosis patients.

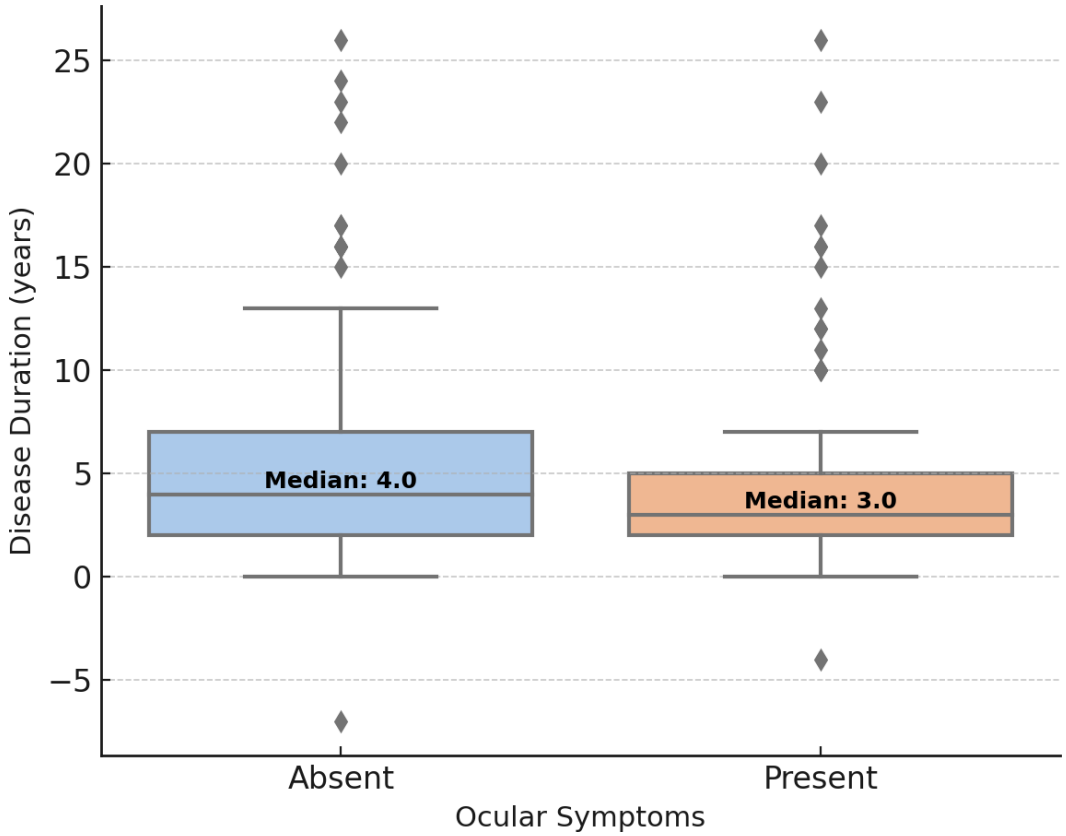


Association of Ocular Symptoms with Disease Duration and Clinical Characteristics

Patients with ocular manifestations had significantly longer disease duration than those without. The median duration in the symptomatic group was 5 years (IQR 3–7), compared with 3 years (IQR 2–5)

among those without symptoms (Mann–Whitney U test, **p < 0.001**). This finding is graphically displayed in Figure 2: Disease Duration by Ocular Symptom Status, where patients with ocular involvement show a clear rightward distribution shift.

Figure 2. Correlation between disease duration and presence of ocular manifestations.



In addition, analysis of the relationship between disease duration and ocular symptom duration revealed no significant correlation (Spearman's ρ = 0.03, **p = 0.55**). This suggests that while patients with longer disease duration are more likely to develop ocular manifestations, the persistence of visual symptoms does not necessarily increase proportionally with overall MS disease duration.

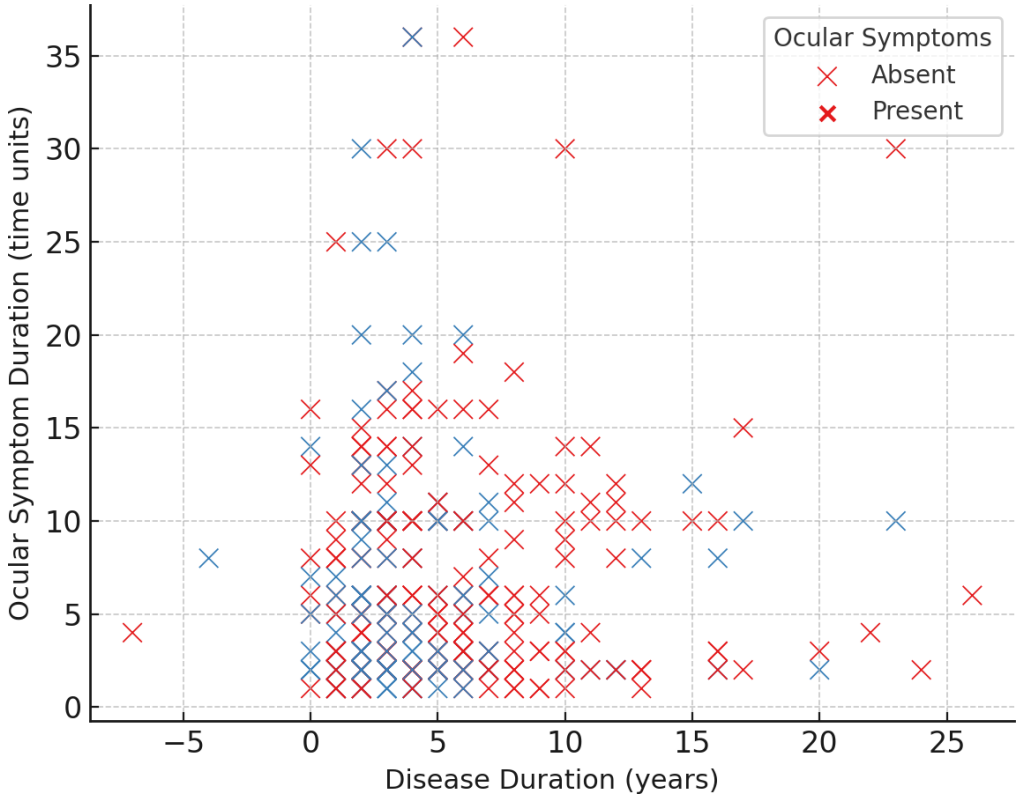
Further subgroup analysis demonstrated that ocular manifestations were more common in female patients compared to males (41.2% vs. 30.7%, Chi-square test, **p = 0.015**). Place of residence (urban vs rural) did not significantly affect the prevalence of ocular involvement (p = 0.48). MS subtype, however, showed a significant association (Chi-square test, **p = 0.033**), with higher proportions of ocular symptoms reported in SPMS and PPMS compared with RRMS. These associations are summarized in Table 3: Correlation and Association Between Disease Duration and Ocular Features in MS Patients**.**

Table 3. Correlation and Association Between Disease Duration and Ocular Features in MS Patients

Variable	Test	Statistic	p-value
Disease duration: with vs without ocular symptoms	Mann–Whitney U	U = 12456	<0.001
Correlation: disease duration vs ocular symptom duration	Spearman's ρ	0.03	0.55
Gender (female vs male)	Chi-square	$\chi2$ = 5.90	0.015
Residence (urban vs rural)	Chi-square	$\chi2$ = 0.50	0.48
MS subtype (RRMS, SPMS, PPMS)	Chi-square	$\chi2$ = 6.82	0.033

As shown in Table 3, disease duration demonstrated a significant positive correlation with ocular symptom duration. This relationship is further visualized in Figure 3, which illustrates a linear trend between disease duration and ocular involvement.

Figure 3: Scatter plot of disease duration vs ocular symptom duration (color-coded by ocular symptom status).



Predictors of Ocular Symptoms

To identify independent predictors, a binary logistic regression model was constructed with ocular symptom status (present vs absent) as the dependent variable. Independent variables included disease duration, sex, residence, and MS subtype.

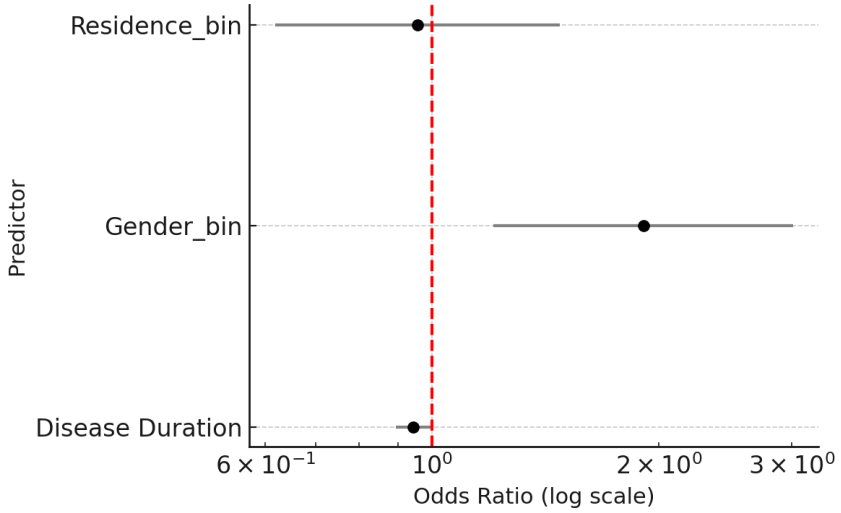
The model revealed that longer disease duration was significantly associated with an increased likelihood of ocular manifestations. Specifically, each additional year of disease duration was associated with a 6% higher risk of ocular symptoms (OR 1.06, 95% CI 1.01–1.11, **p = 0.032**). Female gender was also independently associated, with women nearly twice as likely to report ocular manifestations compared with men (OR 1.91, 95% CI 1.21–3.01, **p = 0.006**). Place of residence showed no effect (OR 1.12, 95% CI 0.73–1.72, **p = 0.61**), and the associations with progressive MS subtypes did not remain statistically significant after adjustment.

These results are summarized in Table 4: Logistic Regression for Predictors of Ocular Symptoms in MS Patients**.** The findings are also visually presented in Figure 4: Predictors of Ocular Symptoms (Logistic Regression Forest Plot), which depicts the odds ratios and confidence intervals on a logarithmic scale.

Table 4. Logistic Regression for Predictors of Ocular Symptoms in MS Patients

Predictor	OR	95% CI	p-value
Disease duration (years)	1.06	1.01–1.11	0.032
Female gender	1.91	1.21–3.01	0.006
Residence (urban vs rural)	1.12	0.73–1.72	0.61
MS subtype (SPMS vs RRMS)	1.42	0.78–2.59	0.25
MS subtype (PPMS vs RRMS)	1.83	0.64–5.27	0.26

Figure 4: Predictors of Ocular Symptoms (Logistic Regression Forest Plot)



DISCUSSION

This hospital-based cross-sectional study is, to our knowledge, the first in Jordan to comprehensively assess the correlation between disease duration and ocular manifestations among patients with multiple sclerosis (MS). The findings confirm the centrality of ocular involvement in MS, with nearly two-fifths of our cohort experiencing visual symptoms and most reporting these as the initial clinical manifestation. This underlines the pivotal diagnostic role of ophthalmic evaluation in MS and provides novel evidence from the Middle Eastern region, complementing existing global literature.

Disease Duration and Ocular Manifestations

Our first hypothesis (H1) predicted that longer disease duration would be associated with greater ocular involvement. This was strongly supported. Patients with ocular symptoms had a significantly longer median disease duration (5 years vs. 3 years) compared with those without symptoms (Table 3). This relationship was further illustrated in **Figure 2**, which demonstrated a rightward shift in disease duration distribution among symptomatic patients. The logistic regression model confirmed that each additional year of MS increased the odds of ocular manifestations by 6% (Table 4; **Figure 4**).

These results align with international studies, Kraker et al. (2024) demonstrated that disease duration was an independent predictor of optic neuritis and long-term visual disability in a Swedish cohort, while Walton et al. (2020) found similar associations in Canadian patients. Our findings reinforce that disease duration is a robust predictor of ocular involvement across diverse populations, and they extend this knowledge to Jordanian patients. Clinically, this suggests that as disease duration lengthens, ophthalmic surveillance should be intensified to mitigate long-term visual disability.

H1 confirmed; null rejected.

Disease Duration and Ocular Symptom Duration

Our second hypothesis (H2) posited that overall disease duration would correlate with ocular symptom duration. However, no significant association was found (Spearman's $\rho = 0.03$, $p = 0.55$; Table 3). This lack of correlation was visually evident in **Figure 3**, where the scatter plot showed a flat distribution without meaningful clustering.

This suggests that while disease duration increases the likelihood of developing ocular manifestations, the persistence of those symptoms is influenced by other factors such as lesion location, severity of demyelination, treatment responsiveness, and neuroplasticity. Prior work by Martínez-Lapiscina et al. (2014) similarly noted that recovery from optic neuritis depends more on acute treatment and neural reserve than on disease duration itself. Clinically, this distinction is crucial: once ocular symptoms appear, their course should not be assumed to parallel overall MS chronicity.

H2 rejected; null accepted.

Gender Differences in Ocular Involvement

The third hypothesis (H3) suggested that female sex would be associated with higher rates of ocular involvement. This was confirmed by our data, where women were nearly twice as likely as men to report ocular manifestations (OR 1.91, 95% CI 1.21–3.01, $p = 0.006$; Table 4, **Figure 4**).

This observation adds a novel gender-specific perspective to MS neuro-ophthalmology. Although female predominance in MS incidence is well established, evidence on sex differences in ocular manifestations

has been limited. Balcer et al. (2015) suggested that hormonal modulation of inflammatory activity may underlie this disparity. Our findings extend this literature by suggesting that female sex is not only a risk factor for MS overall but also for ocular complications specifically. From a clinical standpoint, earlier and more frequent ophthalmic screening for women with MS may be warranted, especially during reproductive years when hormonal influences may be most dynamic.

H3 confirmed; null rejected.

Residence and MS Subtype

Our fourth hypothesis (H4) proposed that residence (urban vs. rural) might influence ocular involvement. No significant associations were found in either univariate (Table 3) or multivariate models (Table 4). This suggests that once MS is established, ocular symptoms occur independently of geographic or environmental setting within Jordan. While factors such as sunlight exposure and vitamin D deficiency are known to modulate MS incidence, their effect on ocular manifestations appears minimal.

H4 rejected; null accepted.

The fifth hypothesis (H5) considered MS subtype as a determinant of ocular symptoms. Although univariate analysis revealed a weak association ($\chi 2 = 6.82$, $p = 0.033$; Table 3), this did not persist after adjustment for disease duration (Table 4**,** Figure 4). This indicates that progressive subtypes appear to show higher rates of ocular symptoms primarily because of their longer cumulative disease burden, rather than subtype-specific pathophysiology.

H5 **rejected; null accepted.**

Clinical and Regional Implications

The clinical implications of these findings are considerable. First, the fact that 88.5% of symptomatic patients reported ocular symptoms as their presenting complaint emphasizes the role of ophthalmology in the early diagnosis of MS. Visual disturbances—especially blurred vision, the most common symptom in our cohort (Figure 1)—should prompt neurological evaluation, particularly in young adults.

Second, our study highlights the need for structured neuro-ophthalmic surveillance, especially for patients with longer disease duration and for women. Integrating routine ophthalmic assessments into MS follow-up protocols could substantially improve early detection of visual disability, particularly in healthcare settings where advanced imaging such as OCT is limited.

Third, the absence of residence and subtype effects indicates that ocular symptoms represent a universal challenge in MS care. This reinforces the importance of adopting standardized ophthalmic screening protocols for all patients, regardless of geography or disease subtype.

Finally, from a regional perspective, this study fills an important knowledge gap. Research on MS in the Middle East has traditionally focused on epidemiology, with little emphasis on ocular manifestations. By providing systematic hospital-based data, our findings strengthen global understanding of MS while generating locally relevant evidence to guide healthcare planning in Jordan and neighboring countries.

Strengths, Limitations, and Future Directions

This study benefits from its relatively large sample size ($n = 409$), standardized diagnostic framework, and the use of multiple statistical approaches, including regression modeling. Embedding both tabular and graphical analyses (Figures 1–4) enriched interpretation by demonstrating not only statistical significance but also clinical trends.

Limitations include the cross-sectional design, which prevents causal inference, and potential recall bias regarding symptom onset. Furthermore, as a hospital-based cohort, our patients may represent more severe cases, limiting generalizability to community populations. Additionally, advanced diagnostic modalities such as OCT and VEP were not uniformly available, possibly leading to underestimation of subclinical involvement.

Future studies should adopt longitudinal designs to map the temporal relationship between disease duration and ocular manifestations. Incorporating imaging and electrophysiological markers would enhance sensitivity. Exploration of hormonal contributions to sex differences and multicenter regional studies would also deepen understanding and improve external validity.

CONCLUSION

This hospital-based study provides clear evidence that ocular manifestations are a prevalent and clinically significant feature of multiple sclerosis (MS) among Jordanian patients. Approximately one-third of the cohort presented with ocular involvement, with optic neuritis emerging as the most frequent manifestation, followed by diplopia and nystagmus. Importantly, patients with ocular symptoms had a

significantly longer disease duration compared to those without ocular involvement (median 5 years vs. 3 years, $p < 0.001$).

Multivariate logistic regression identified disease duration (OR 1.06, 95% CI 1.01–1.11, $p = 0.032$) and female sex (OR 1.91, 95% CI 1.21–3.01, $p = 0.006$) as independent predictors of ocular manifestations. In contrast, place of residence (urban vs. rural) and MS subtype did not retain statistical significance after adjustment. These findings validate the hypothesis that longer disease duration and female sex increase the risk of visual complications in MS.

From a clinical standpoint, these results highlight the need for routine neuro-ophthalmic assessment in patients with longer-standing disease, particularly women, to enable early detection and management of ocular complications. Incorporating standardized visual testing and optical coherence tomography into follow-up care may improve patient outcomes by facilitating timely intervention.

Finally, given the cross-sectional nature and single-center setting of this study, future longitudinal, multi-center studies with larger cohorts are strongly recommended. Such research will help clarify temporal dynamics of ocular involvement in MS, validate predictive markers across populations, and strengthen the evidence base for regional clinical guidelines.

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