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The Clinical Spectrum of Autoimmune-Mediated Neurological Diseases in Patients Presenting to a Tertiary Care Hospital in Rawalpindi

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ABSTRACT

Autoimmune-mediated neurological diseases (AMNDs) affect the central and peripheral nervous systems through inflammation and demyelination, leading to diverse neurological dysfunctions. Their heterogeneous clinical presentations complicate diagnosis, and epidemiological data in adult Pakistani populations remain scarce. **Objectives:** To determine the frequencies of different AMNDs among adult patients presenting to a tertiary care hospital in Rawalpindi. **Methods:** This cross-sectional study was conducted at the Department of Neurology, Pak Emirates Military Hospital, Rawalpindi, from 1st April to 20th September 2025, including 177 adult patients consecutively presenting with neurological symptoms suggestive of autoimmune etiology. The diagnosis was made on the basis of clinical manifestations supported by MRI, cerebrospinal fluid analysis, and autoantibodies. The analysis was performed using SPSS version 27.0. **Results:** The mean age of the patients was 47.9 ± 11.4 years. The majority of patients were female 108 (61%). Multiple Sclerosis was the most frequent diagnosis (27.1%), followed by autoimmune encephalitis (20.3%), Guillain-Barré syndrome (16.4%), myasthenia gravis (13.6%), and neuromyelitis optica spectrum disorder (10.7%). Anti-ganglioside antibodies showed the highest seropositivity (12.4%), while MRI and CSF abnormalities were observed in 33.9% and 38% of patients, respectively. Significant associations were found between disease type and age (p=0.018), gender (p=0.006), residence (p=0.041), family history (p=0.032), and symptom duration (p=0.014). **Conclusions:** Multiple Sclerosis, autoimmune encephalitis, and Guillain-Barré syndrome are the most prevalent AMNDs in this population, with distinct demographic patterns and variable diagnostic findings. Early recognition and integrated diagnostic approaches are essential to improve patient outcomes.

INTRODUCTION

The disorders that attack and disrupt the central and peripheral nervous systems are the autoimmune-mediated neurological diseases (AMNDs) [1, 2]. The primary cause of these conditions is mostly T-cell-mediated reactions that result in inflammation [2]. The neurons in the results, are killed and cause the development of glioma. The CD8 + T cells associated with neuronal destruction have been observed in the case of anti-Yo paraneoplastic degeneration of cells [3]. The T cell-mediated autoimmune pathophysiology is also identical in Multiple Sclerosis (MS) and autoimmune encephalitis (AE) [4]. Other such conditions, such as anti-NMDA receptor encephalitis, make use of antibodies that cause functional damage rather than direct damage to the neurons [5]. Guillain-Barré syndrome (GBS) and chronic inflammatory demyelinating polyradiculoneuropathy (CIDP) involve infection-triggered immune responses, causing macrophage-mediated nerve demyelination. In contrast, MS and NMO are autoimmune disorders of the central nervous system, while paraneoplastic neurological syndromes result from tumor-related autoantibodies that mistakenly attack nervous tissue, leading to similar

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neurological deficits [6-8]. Due to vague presentation of AMNDs, diagnosis becomes an issue and serological tests comes to play in such situations and additional diagnostic support is provided by cerebrospinal fluid analysis typically revealing an inflammatory CSF profile, MRI of the brain and spinal cord, which often shows T2/FLAIR hyperintense or contrast-enhancing lesions consistent with neuroinflammation and electrodiagnostic studies (EMG and nerve conduction studies) shows demyelinating neuropathy [9]. Early treatment with immunotherapy plays a vital role, and according to one study, A significant response rate of 91.4% to immunotherapy was observed [10]. Immunosuppressive medications like corticosteroids, intravenous immunoglobulin (IVIG), and plasmapheresis are vital in the treatment of these conditions [11]. Lubarski et al. examined autoimmune neurological disorders in 508 patients, among which 32.4% were positive for antineuronal antibodies. Specific findings included positivity of serum antineuronal antibodies in 25.4%, associated with Autoimmune Neurologic Diseases, Paraneoplastic Neurologic Syndromes, and Autoimmune Encephalitis. Anti-cell surface antibodies were present in 6.69%, associated with Autoimmune Encephalitis [12]. In a study by Kishk et al. Anti-aquaporin-4 (AQP4) was detected in 37.5% of patients being investigated for possible NMOSD [13]. According to a report by Pascual-Goñi et al, in 50% of patients with acute motor neuropathies, anti-GM1 and anti-GD1a IgG antibodies are detected in Guillain-Barré syndrome (GBS) [14]. A study conducted by Rajput et al. in a tertiary-care centre included 204 patients with suspected demyelination, identifying neuromyelitis optica spectrum disorder (NMOSD) in 36 patients (17.6%), while multiple sclerosis accounted for 49.0% of cases. Among NMOSD patients, 88.9% were AQP4-IgG seropositive and 11.1% seronegative; females predominated (72.2%). The mean age was 31.0 ± 10.1 years in seropositive and 28.0 ± 2.5 years in seronegative patients ($p>0.05$), with relapsing disease observed in 75% and longitudinally extensive transverse myelitis (LETM) on MRI in 72.8% of cases [15].

Despite AMNDs, comprehensive adult data from Pakistan, particularly on their clinical spectrum and relative frequencies, remain scarce and fragmented. Overlapping presentations and limited access to advanced serological testing further contribute to delayed diagnosis and suboptimal outcomes. This study aimed to determine the clinical spectrum and frequency of AMNDs at a tertiary care center in Rawalpindi, providing region-specific evidence to support earlier diagnosis, appropriate investigations, and improved patient management.

METHODS

This cross-sectional study was conducted at the Department of Neurology, Pak Emirates Military Hospital, Rawalpindi, including 177 patients from April 2025 to September 2025. Patients were included consecutively based on predefined selection criteria. After obtaining ethical approval from Pak Emirates Military Hospital, Rawalpindi, under ref no: A/28/ERC/31/2025, and written informed consent from patients or guardians, data were collected using a structured proforma capturing demographic details, duration of symptoms, comorbidities, past medical history, and family history of autoimmune or neurological diseases. The sample size was calculated through the WHO sample size calculator, keeping a confidence level of 95%, a margin of Error of 4%, and an anticipated frequency of Neuromyelitis Optica Spectrum Disorder (NMOSD) based on a previous study as 8% [16]. Inclusion criteria were patients of either gender aged ≥18 years presenting with clinical features suggestive of autoimmune-mediated neurological disease. Exclusion criteria comprised patients with confirmed infectious or traumatic neurological conditions, known non-autoimmune neurological disorders (such as stroke or Parkinson's disease), and critically ill patients who were unable to safely undergo required diagnostic investigations. These exclusions were applied to ensure patient safety, ethical compliance, and diagnostic accuracy. Electrophysiological studies (EMG/NCS) were performed selectively in patients with clinical suspicion of peripheral nerve or neuromuscular involvement, in accordance with standardized clinical protocols refer to pre-established, evidence-based guidelines used in the evaluation and management of patients with suspected AMNDs, by specifying the indications for each diagnostic test, such as MRI, cerebrospinal fluid analysis (CSF), antibody testing, and EMG/NCS, based on presenting symptoms and clinical suspicion [17-19]. Final diagnoses were made by a senior neurologist integrating clinical assessment with relevant investigative findings, thereby minimizing potential measurement bias. Co-positivity was recorded, but analyses were conducted according to the principal autoimmune neurological disorder to avoid double-counting in frequency tables. The diseases included Multiple Sclerosis (MS), Autoimmune Encephalitis (AE), NMOSD, GBS, Myasthenia Gravis, CIDP, Stiff-Person Syndrome (SPS), and Progressive Encephalomyelitis with Rigidity and Myoclonus (PERM). Neurological symptoms were defined as motor, sensory, or neuro-electrical dysfunction documented during clinical examination, including limb weakness graded below 5/5 on the MRC scale, reduced sensation confirmed through neurological testing, and seizures diagnosed clinically or via EEG. Diagnostic investigations were done according to the clinical requirements. To test the presence of antibodies or their absence, blood samples were tested in relation to

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anti-AQP4, anti-MOG, anti-NMDAR, anti-ganglioside, paraneoplastic antibodies, and anti-synaptic protein antibodies, with the results registered as positive or negative. Lumbar puncture was done under sterile conditions to test the CSF, cell count, and protein level, and reported normal, high protein, high WBCs, or not done. The MRI of the brain and spine was read in cases of the presence of demyelinating or inflammatory lesion and EMG/NCS were done where necessary to identify patterns of demyelinating, axonal, mixed, or normal neuropathy. A senior neurologist made final diagnoses based on all the clinical findings and the results of the investigations. The analysis of the data was done with IBM SPSS version 27.0. The age and years of the symptoms were tested with the Shapiro-Wilk test to determine normalization and reported as the mean with standard deviation or median (IQR). Frequencies and percentages were used to summarise categorical variables such as gender, antibody positivity, MRI results, EMG/NCS patterns, CSF profiles, as well as the ultimate AMNDs diagnosis. It is stratified by age, gender, residence, family history, MRI, antibody test, CSF test, and electrophysiological patterns with the ultimate clinical spectrum of autoimmune neurological diseases. In cases where it was necessary, chi-square or Fisher's Exact Test was used, and the p-value of 0.05 was regarded as statistically significant.

RESULTS

The study included 177 patients having a mean age of 47.9 ± 11.4 years, ranging from 32 to 87. There were 69 (39%) male and 108 (61%) female. A majority of participants resided in urban areas, 118 (67%), while 59 (33%) were from rural settings. Most were educated, 161 (91%), whereas 16 (9%) were uneducated. A family history of autoimmune or neurological disease was present in 27 (15%) of the participants. The median symptom duration was 5 months (IQR 3–8 months), indicating that most patients presented after a moderate duration of illness (Table 1).

Table 1: Demographic Analysis

Variables	Mean ± SD, n (%)
Age	
32 to 87 Years	47.9 ± 11.4
Gender	
Male	69 (39%)
Female	108 (61%)
Residence	
Urban	118 (67%)
Rural	59 (33%)
Level of Awareness	
Educated	161 (91%)
Uneducated	16 (9%)

Among all these patients, anti-AQP4 antibodies were positive in 17 (9.6%), while anti-MOG antibodies were detected in 11 (6.2%). Anti-NMDAR antibodies were positive in 15 (8.5%), and anti-ganglioside antibodies in 22 (12.4%), which represented the highest seropositivity among the antibody tests. Paraneoplastic antibodies (Hu/Yo) were identified in 8 (4.5%) patients, and anti-synaptic protein antibodies in 6 (3.4%). MRI showed demyelinating lesions in 60 (33.9%) patients, whereas 92 (52%) had no detectable lesions, and MRI was not performed in 25 (14.1%) cases. CSF analysis revealed elevated protein in 50 (28.2%) and elevated WBC in 18 (10.1%), while 84 (47.5%) had normal CSF findings; CSF analysis was not done in 25 (14.1%) patients. EMG/NCS results showed axonal involvement in 36 (20.3%), demyelinating patterns in 26 (14.7%), and mixed changes in 12 (7%), whereas 44 (24.8%) had normal studies; the test was not conducted in 59 (33.3%) patients (Table 2).

Table 2: Diagnostic Findings among Patients (n=177)

Diagnostic Tests	Results	Frequency (%)
Anti-AQP4	Positive	17 (9.6%)
Anti-MOG	Positive	11 (6.2%)
Anti-NMDAR	Positive	15 (8.5%)
Anti-Ganglioside	Positive	22 (12.4%)
Paraneoplastic Antibodies (Hu/Yo)	Positive	8 (4.5%)
Anti-Synaptic Protein Antibodies	Positive	6 (3.4%)
MRI Findings	Demyelinating Lesions	60 (33.9%)
	No Lesions	92 (52%)
	Not Done	25 (14.1%)
CSF Analysis	Elevated Protein	50 (28.2%)
	Elevated WBC	18 (10.1%)
	Normal	84 (47.5%)
	Not Done	25 (14.1%)
EMG/NCS	Axonal	36 (20.3%)
	Demyelinating	26 (14.7%)
	Mixed	12 (7%)
	Normal	44 (24.8%)
	Not Done	59 (33.3%)

MS was the most common autoimmune neurological disorder, diagnosed in 48 (27.1%) individuals. This was followed by AE in 36 (20.3%) and GBS in 29 (16.4%). MG accounted for 24 (13.6%) cases, while NMOSD was observed in 19 (10.7%) patients. Less frequent conditions included CIDP in 14 (7.9%), SPS in 4 (2.3%), and PERM in 3 (1.7%) (Table 3).

Table 3: Distribution of Autoimmune Neurological Diseases (n=177)

Disease	Frequency (%)
Multiple Sclerosis (MS)	48 (27.1%)
Autoimmune Encephalitis (AE)	36 (20.3%)
Guillain-Barré Syndrome (GBS)	29 (16.4%)
Myasthenia Gravis (MG)	24 (13.6%)
Neuromyelitis Optica Spectrum Disorder (NMOSD)	19 (10.7%)

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Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)	14 (7.9%)
Stiff Person Syndrome (SPS)	4 (2.3%)
Progressive Encephalomyelitis with Rigidity and Myoclonus (PERM)	3 (1.7%)

Significant demographic differences were observed across autoimmune neurological diseases. Age distribution differed markedly (p=0.018), with MS and NMOSD patients predominantly younger (20–40 years), while GBS, MG, and CIDP were more common in older age groups. Gender also showed a significant association (p=0.006): MS and NMOSD occurred mostly in females, whereas AE, GBS, and CIDP showed a higher proportion of males. Residence was significant (p=0.041), with urban predominance seen especially in MS and MG. Family history showed a meaningful association (p=0.032), with MS and NMOSD having higher frequencies of positive family history than other diseases. Symptom duration varied significantly between disease groups (p=0.014): GBS patients mostly presented within <3 months, whereas MS, NMOSD, and CIDP tended to have symptoms lasting >6 months. Education status did not show a statistically significant association (p=0.221) (Table 4).

Table 4: Autoimmune Neurological Diseases vs Demographics

Baseline Characteristics	MS (n=48)	AE (n=36)	GBS (n=29)	MG (n=24)	NMOSD (n=19)	CIDP (n=14)	SPS (n=4)	PERM (n=3)	p-value
Age									
20–40 Years	26 (54%)	10 (27.8%)	5 (17.2%)	3 (12.5%)	12 (63.2%)	1 (7.1%)	0 (0%)	0 (0%)	0.018
41–60 Years	18 (37.5%)	20 (55.6%)	15 (51.7%)	12 (50%)	6 (31.6%)	7 (50%)	2 (50%)	2 (66.7%)	
>60 Years	4 (8.3%)	6 (16.7%)	9 (31.1%)	9 (37.5%)	1 (5.3%)	6 (42.9%)	2 (50%)	1 (33.3%)	
Gender									
Male	14 (29.2%)	22 (61.1%)	18 (62.1%)	6 (25%)	4 (21.1%)	9 (64.3%)	2 (50%)	1 (33.3%)	0.006
Female	34 (70.8%)	14 (38.9%)	11 (37.9%)	18 (75%)	15 (78.9%)	5 (35.7%)	2 (50%)	2 (66.7%)	
Residence									
Urban	34 (70.8%)	20 (55.6%)	17 (58.6%)	18 (75%)	13 (68.4%)	9 (64.3%)	3 (75%)	2 (66.7%)	0.041
Rural	14 (29.2%)	16 (44.4%)	12 (41.4%)	6 (25%)	6 (31.6%)	5 (35.7%)	1 (25%)	1 (33.3%)	
Education									
Status	46 (95.8%)	30 (83.3%)	23 (79.3%)	23 (95.8%)	18 (94.7%)	11 (78.6%)	4 (100%)	3 (100%)	0.221
Literate	2 (4.2%)	6 (16.7%)	6 (20.7%)	1 (4.2%)	1 (5.3%)	3 (21.4%)	0 (0%)	0 (0%)	
Family History									
Present	12 (25%)	4 (11.1%)	3 (10.3%)	2 (8.3%)	4 (21.1%)	1 (7.1%)	1 (25%)	0 (0%)	0.032
Absent	36 (75%)	32 (88.9%)	26 (89.7%)	22 (91.7%)	15 (78.9%)	13 (92.9%)	3 (75%)	3 (100%)	
Symptom Duration									
<3 Months	6 (12.5%)	8 (22.2%)	21 (72.4%)	3 (12.5%)	2 (10.5%)	1 (7.1%)	0 (0%)	0 (0%)	0.014
3–6 Months	18 (37.5%)	17 (47.2%)	6 (20.7%)	10 (41.7%)	6 (31.6%)	3 (21.4%)	1 (25%)	1 (33.3%)	
>6 Months	24 (50%)	11 (30.6%)	2 (6.9%)	11 (45.8%)	11 (57.9%)	10 (71.4%)	3 (75%)	2 (66.7%)	

Note: Here, Multiple Sclerosis (MS), Autoimmune Encephalitis (AE), Guillain-Barré Syndrome (GBS), and Myasthenia Gravis (MG). p-value was calculated through Fisher's Exact Test

DISCUSSION

In this study, MS (27.1%), AE (20.3%), and peripheral demyelinating disorders, including GBS/CIDP (24.3%) were the most common diagnoses, with a notable female predominance in MS and NMOSD. Younger patients (20–40 years) more frequently had MS and NMOSD, while GBS, MG, and CIDP were more common in older age groups. Autoantibody positivity varied by disease, and characteristic MRI, CSF, and EMG/NCS abnormalities were observed. Symptom duration differed significantly across disorders, with acute presentation in GBS and delayed onset in MS, NMOSD, and CIDP. The frequency of MS in this study is consistent with global epidemiological data, where MS affects approximately 2.3 million individuals worldwide [20]. The female predominance in MS and NMOSD aligns with reports showing women are 2–3 times more likely to develop these disorders [21]. NMOSD anti-AQP4 seropositivity in our cohort (9.6%) is lower than previously reported rates (30–40%), reflecting regional variability and diagnostic limitations [13]. The proportion of AE (20.3%) in our study corresponds with prior reports, and the 8.5% anti-NMDAR positivity aligns with literature indicating that approximately two-thirds of AE patients have detectable antibodies [22]. Our findings of GBS and CIDP are comparable with global observations on peripheral demyelinating disorders and anti-ganglioside antibody prevalence, although the antibody rate in our cohort was lower than the ~50% reported in some studies [14]. Rare conditions such as Stiff-Person Syndrome and PERM were

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observed at frequencies consistent with international data [23]. Age-related trends observed in our study mirror global patterns: MS and NMOSD predominance in younger populations and GBS/CIDP in older patients [24, 25]. The urban predominance of MS and MG may reflect better healthcare access, increased disease awareness, and environmental exposures, similar to geographic disease burden variations reported in Germany [21]. Family history associations in MS and NMOSD support literature on autoimmune co-aggregation, including thyroiditis and inflammatory bowel disease [26, 27]. Current study highlights the diagnostic utility of multimodal assessment. Autoantibody testing, MRI, CSF analysis, and electrophysiology all contributed to the diagnosis, supporting the precision-medicine approach emphasized in recent studies. MRI and CSF findings were consistent with known limitations in sensitivity and specificity, and EMG/NCS patterns in peripheral demyelinating disorders reflected expected global trends [28, 29]. Diagnostic delays were evident, particularly for AE, MG, and MS. This aligns with prior literature documenting late or misdiagnoses due to diverse symptom presentations [30, 31]. Chronicity and delayed diagnosis, as observed in our cohort, likely contribute to long-term physical, psychological, and socioeconomic impacts, echoing findings from international studies on MS and other autoimmune neurological disorders [20].

Limited generalization is due to single-centre design, small sample (n=177), incomplete diagnostics (14-33% Missing tests), limited antibody testing, no follow-up, and referral bias. Multicentre registries with standardized protocols, enrich access to multicentre diagnostics, formulate national guidelines, longitudinal outcome investigations, and better training of neurologists and community education on the importance of timely detection of the disease.

CONCLUSIONS

This study provides a detailed account of AMNDs in adults with MS, AE, and GBS, with AMNDs being the most prevalent. Significant associations were observed between disease type and demographic factors such as age, gender, residence, family history, and symptom duration, including female predominance in MS and NMOSD and older age distribution in GBS, MG, and CIDP.

Authors' Contribution

Conceptualization: WWM
Methodology: WWM, FW
Formal analysis: WWM, AR
Writing and Drafting: MM, WWM, HUR, FK
Review and Editing: MM, WWM, HUR, AR, FW, FK

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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